Project Application

Volume 9

Inner West Marina
Parramatta River, Sydney

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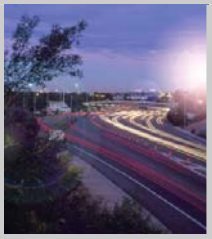
AECOM

Prepared for:

Breakfast Point Pty Ltd

51 Riley Street
Woolloomooloo, NSW, 2011


Sediment Management Report

Proposed inner West Marina

Final

AECOM
16 October 2009
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Environment

AECOM

Distribution

Sediment Management Report
Proposed inner West Marina

16 October 2009

Copies	Recipient
1 electronic copy	**Mr Ray Kearns** **Development Manager** Rose Group 51 Riley Street Woolloomooloo NSW 2011

By
AECOM
ABN: 20 093 846 925
Level 5, 828 Pacific Highway Gordon NSW 2072
PO Box 726 Pymble NSW 2073
Ph: +61 2 8484 8999 Fax: +61 2 8484 8989

Sedat Tasdemir
Associate Director/Team Leader

Technical Peer Reviewer: **Date:** 16/10/09

for **Rui Henriques**
Associate Director/Workgroup Leader

Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by Breakfast Point Pty Ltd to prepare this Summary Contamination Report for the proposed Inner West Marina (the Marina), Kendall Bay, NSW (the Site).

1.1 Objectives

The objectives if the Summary Contamination Report is to address the Director General's requirements for Contamination.

1.2 Background

1.2.1 Brief Site History

The proposed marina is located adjacent to the northern portion of the western shoreline of Kendall Bay, approximately 10 km west of Sydney CBD. Breakfast Point to the west of the proposed marina was historically occupied by Mortlake gasworks and the associated infrastructure, including a former coal loading wharf and oil/gas pipeline, were located within Kendall Bay.

Operation of the gasworks resulted in contamination of the surrounding area, including sediments within Kendall Bay. The contaminated sediments within Kendall Bay are the subject of a Remediation Order by NSW EPA, discussed in **Section 1.1.2** below.

1.2.2 Remediation Order

NSW EPA issued a Remediation Order (RO) for the contaminated sediments within Kendall Bay in 2004 (Order Number 23022; Declaration number 21055; Area 3335) to NSW Maritime (as land owners of the bed sediments). The RO is applicable to *"sediments of the bed of Kendall Bay and the Parramatta River which fall within 200 metres of the land based boundary of the former Mortlake gasworks site"*, referred to as the Remediation Site. The proposed marina falls entirely within the Remediation Site.

The RO states that the Remediation Site poses a significant risk of harm (SRoH) to human health and the environment, due to PAH and TPH contamination detected within sediments. It further states that further development of the area and/or disturbance of the sediments would likely increase the risk of harm. Consequently, NSW Maritime must *"refrain from carrying out or causing, or permitting or allowing any other person to carry out any works or activities at the site that would result in the disturbance, or further disturbance, of the bed sediment of Kendall Bay"* within the Remediation Site, without prior approval of NSW EPA. Therefore, prior to any works being undertaken within the Remediation Site *"a written plan with specific measures directed at minimising the disturbance and migration of the contaminants on the bed sediments"* must be prepared and submitted to NSW EPA.

It is understood that URS Australia Pty Ltd (URS), on behalf of Jemena (owners of the former Mortlake gasworks site) are preparing to undertake remediation works in parts of the area subject to the Remediation Order, close to the shoreline where the highest concentrations of contaminants have been detected. The locations of the URS remediation works were determined based on results of a human health risk assessment and are generally outside of the proposed marina site, with the exception of in the vicinity of the former coal loading wharf. While the full scope of these works is not known and has not therefore been considered in the preparation of the sediment contamination management strategy for the proposed marina development, it is the intention of the proponent that the URS remediation works within the proposed marina site be undertaken prior to commencement of the sediment contamination management strategy within the proposed marina site, which is discussed in more detail in the following sections.

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2.0 Current Condition

Investigations undertaken by AECOM (2009) reported that sediments within the proposed marina site generally comprised sandy silty clay, which was considered typical of an estuarine environment. It was noted that sediments became coarser towards the north within the proposed marina site, likely due to increasing wave (including boat generated waves) and tidal influence associated with proximity to the Parramatta River.

The studies found that the sediment within Kendall Bay were generally dominated (> 75% of the total) by fine material with a particle size of less than 75 µm.

The AECOM (2009a) investigation indicated that PAHs were present at concentrations greater than the interim sediment quality guidelines (ISQG) published in ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* PAHs were found to exceed the ISQG High levels in approximately 35% of samples analysed, and PAHs concentrations were greater than the ISQG Low guidelines in approximately 60% of sample analysed. Elevated concentrations of TPH were also detected in the sediment samples, however, there are currently no available guideline levels for TPH to be assessed against.

The AECOM (2009a) investigation identified that the highest concentrations of PAHs were in the sub surface sediments (greater than 100 mm depth). Lower concentrations were detected in the surficial sediments (i.e. between 0.0-100 mm below the bed surface). The 95% upper confidence limit (UCL) on the mean for PAH concentrations the driving contaminant within the top 100 mm of the sediment profile across the footprint of the marina was 22.3 mg/kg.

Concentrations of heavy metals, including Mercury, Nickel and Zinc were generally greater than their respective ISQG High guidelines, in the majority of surface grab samples analysed. Arsenic, Chromium and Copper concentrations were greater than the ISQG Low guidelines in the majority of surface grab samples analysed, but did not exceed the ISQG High guidelines.

Hydrocarbon odours and an oily sheen were observed within the sediments at a number of sampling locations, however, the AECOM (2009a) investigation did not identify any free product (oil) in sediments within the proposed marina site.

Water depth within Kendall Bay was described as up to 5 m in the central area, and less than 2 m in the southern portion of the bay and along a narrow fringe adjacent to the seawall to the north of the former coal loading wharf.

gbaCoastal Pty Ltd (GBAC) (2009) conducted studies of estuary hydrodynamics and physical sedimentary environment. Based on the study findings, GBAC (2009) reported that under existing conditions, sediment within the proposed marina site is subject to disturbance mainly due to currents induced by wind waves, boat generated waves, boat propeller action and stormwater flows from outlets discharging into Kendall Bay.

GBAC (2009) reported that it would seem reasonable to adopt a disturbance (erosion) threshold velocity of 0.3 m/s for bed sediments at the marina site. While lower velocities could disturb unconsolidated muddy sediments, it is conservative to nominate this 0.3 m/s as a reasonable upper bound threshold.

The nearby passing of Rivercat and Harbourcat ferries alone were found to generate the greatest wave heights and wave velocities within Kendall Bay, with wave heights up to 0.5 m and velocities exceeding 1 m/s for water depth of 1 m, dropping to 0.4 m/s in 2 m of water and 0.3 m/s in 3 m of water (GBAC, 2009). GBAC has estimated that everytime a fast ferry passes at water level of RL 0 m AHD, the median expected tidal level in Kendall Bay, approximately 8,300 m^2 of the footprint of the proposed marina would be stirred by wave induced currents (velocities at or greater than 0.3 m/s).

Currently some 25,000 fast ferries pass the site each year. Passings of recreational power craft are almost three times that of the fast ferries. Combined boat and wind wave action is assessed to disturb the bed in a water depth of 3 m some 70 times per day, controlled by the passing of fast ferries. Wind waves in 50 year average recurrence interval (ARI) storms would only disturb bed sediment in water depths up to 2 m (GBAC, 2009).

Based on the data provided in GBAC (2009), the following estimates have been made:

- Assuming a conservative lower bound thickness of 0.075 mm (equivalent to the dominant grainsize of 75 µm) is disturbed by every ferry crossing the total volume of sediment disturbed within the area of disturbance (8,300 m^2) is 0.62 m^3 for each fast ferry pass;
- If 25,000 fast ferries pass every year, this equates to approximately 15,500 m^3 of sediment being disturbed per year (or 42.6 m^3 per day). This equates to approximately 18,600 tonnes of sediment per year (if a sediment density of 1.2 tonnes/m^3 is applied);
- Based on the AECOM (2009) investigation, the 95% UCL on the mean for PAH (the driving contaminant) concentrations within the top 100 mm of sediment in the area of ferry disturbance (at RL 0 AHD) is 120.5 mg/kg; and
- Therefore, conservatively the weight of PAH presently disturbed by fast ferry alone on a yearly basis would be about 2,200 kg (for a 95% UCL concentration of 120.5 mg/kg).

DEC's requirement for the proposed is that the proposed marina must not cause any additional resuspension of contaminated sediments over and above that attributed to background processes (DEC letter to TLB, 7/8/07). GBAC (2009) provided findings of previous studies, these were presented in terms of propeller wash impacts at the unprotected bed (no SPS) for varying water depths:

- **Two metres** water depth was considered unlikely to satisfy DEC's requirements for any of the test vessels.
- **Three metres** water depth was unacceptable for the large (24m) vessel, with mixed compliance exhibited for the small (11 m) and medium length (14 m) vessels.
- In **four metres** of water, the small (11 m) and medium (14 m) vessels essentially met DEC's requirement, but the large (24 m) vessel did not.
- The small (11 m) and medium (14 m) vessels clearly satisfied DEC for all manoeuvring in **five metres**, but the large (24 m) vessel caused significant turbidity impacts for the case of full thrust starting astern.

GBAC (2009) also applied the available background and vessel test turbidity data to develop an analytical procedure to estimate the level of turbidity impact from proposed marina operations. This assessment indicated that, even without the proposed SPS, the daily average turbidity within the proposed marina area within Kendall Bay would be elevated by less than 1 NTU over and above an assessment of daily average turbidity equal to 10.2 NTU. The overall turbidity impact of the proposed marina in relation to propeller wash was thus predicted to be small.

However, GBAC (2009) concluded that based on the current local conditions, without the implementation of appropriate sediment protection and/or management measures, the proposed marina development would be likely to cause additional disturbance of the bed sediments.

The aquatic biota environment is described in detail in the Environmental Assessment (EA) prepared by TLB Engineers (TLB, 2009). In summary, Cardno Ecology Lab Pty Ltd (Cardno) (2009) report provided the following study findings:

- The proposed Marina location supports a diverse range of infauna, but generally not typical of that region of the estuary. Additionally, the infauna was less abundant generally than observed in a 1996 study;
- There are no wetlands along the western foreshore of Kendall Bay within the proposed Marina location;
- No protected or threatened fauna was found; and
- No sea grasses were found within the proposed marina footprint.

Given that the organisms found by Cardno (2009) were generally not typical of the area and that there are extensive areas of these habitats elsewhere in the estuary, these were not considered of significant ecological value. This is discussed in more detail in the EA (TLB, 2009).

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3.0 Proposed Management

While, GBAC (2009) reported that the turbidity impacts of the proposed marina due to propeller wash were found to be small, it is proposed to install a Sediment Protection System (SPS) over the full area of the marina, extending beyond the edges of the floating facility by a minimum distance equal to an acceptable navigable fairway width of 1.5 times the maximum length of passing vessels.

At the ingress and egress points of the proposed marina, the SPS would be extended to the boundary of the RO specified remediation area, to provide 50 m wide protected navigation conditions. Refer to figures in the EA (TLB, 2009).

The SPS will comprise a geotextile blanket, which will be laid in overlapping strips across the contaminated sediments within the footprint of the marina and to the boundary of the remediation site to allow for vessel access, turning, etc. The geotextile blanket would then be stabilised with a layer of basalt rock armour, approximately 300 – 400 mm in thickness. GBAC (2009) has indicated that the SPS would reduce sediment disturbance caused by the factors discussed above (wave, tide and propeller action), and mitigate against sediment disturbance caused by the development of the marina, as is required by NSW EPA.

The installation and ongoing management of the SPS would be controlled by a construction environmental management plan (CEMP) and an operational environmental management plan (OEMP), respectively. A more detailed discussion of the SPS is provided in the following sections.

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4.0 Adequacy of SPS Design

4.1 SPS Design Specifications

Design development of the SPS has considered the following:

(i) Boat movement zones and controlling bed levels;

(ii) Design water level in Kendall Bay;

(iii) Screw race modelling and design bed velocities;

(iv) Protective rock requirements: rock size, blanket thickness and footprint;

(v) Geotextile filter; and

(vi) Construction aspects.

GBAC (2009) reported that the level of confidence attached to the design would be equivalent to that which generally applies in engineering practice.

The proposed SPS comprises a geotextile blanket overlain by rock armour to minimise scour and hence disturbance of the bed sediments. The SPS is to be installed across the entire development footprint of the proposed marina, including the floating structures, berths and access fairways and areas of potential bed disturbance in shallow water between the floating structure and the mean high water mark. The SPS will cover an area of approximately 56,000 m^2.

The first element of the SPS is the geotextile blanket, Elcomax1200R, a non-woven, needle punched polyester geotextile. The geotextile blanket is proposed to be 5.7 mm thick with a pore size (equivalent opening size – EOS) of < 75 micron, which is the smallest EOS available. The GBAC (2009) study considered that this type of geotextile would meet the impact and tear strength requirements for the Kendall Bay environment and prevent turbulence of the sediment. The geotextile will also serve as a foundation or load distributor for the rock armour when placed over poorly consolidated material, typical of contaminated sediments within the Marina footprint.

The geotextile is supplied in rolls of approximately 40 m width and will be laid in panels of up to 150 m length. Each panel will overlap by approximately 2 m. The overlap is designed to be sufficient to withstand the load of rock armour and edge displacement during construction without exposing the underlying sediment.

The overlying rock armour has been designed to be of between 300 mm and 400 mm thickness, depending on anticipated water velocities at the bed (0.7 – 2.0 m/s), without the SPS, calculated based on a range of propeller sizes, boat lengths, water depths, etc. When applying the water depth, the proposed thickness of rock armour of the SPS was taken into account. Overall, the SPS design requires the placement of approximately 29 000 tonnes of igneous rocks (basalt) in 2 – 5 layers where an end thickness of 300 mm is required (rock size between 70 – 160 mm) and in 2 – 3 layers where an end thickness of 400 mm is required (rock size between 140 – 235 mm), for areas with current water depth and used by boats of 16 to 25 m in length would result in bed velocities greater than 0.3 m/s if 300 mm of rock of 70 – 160 mm were to be used.

The table below provides a summary of the concept design:

Table 1: Concept Design for SPS

Item	300 mm Thick SPS	400 mm Thick SPS
Design axial velocity at top of SPS (m/s)	1.6 m/s	2.2 m/s
Location	Under full marina footprint extending an additional minimum fairway width and extending inshore nominally RL -1.9 bed contour, extending area where 400 mm thick SPS is provided	Protecting bed areas where design velocities assessed to exceed 1.6 m/s, located primarily between Arms 3 and 4, but also at the inshore end between Arms 1 and 2 extending north of Arm 1 and S of Arm 2 immediately under the main inshore walkway
Surface Area	47,000 m^2	9,000 m^2
Median rock diameter range	100 – 120 mm	190 – 220 mm

The ballast along the edge of the geotextile will consist of a thicker layer (about 500 mm thick) of ballast to minimise lifting by wave, propeller and current action. The edge design will comprise ballast placed on the edge and a 1:2 slope (away from the edge) to the desired 500 mm thickness. The ballast thickness will continue at 500 mm for 3000 mm from the edge, at which point the thickness will revert back to 300 mm to 400 mm thickness.

All rock in the SPS will comprise basalt, due to its durability and chemical stability is an ideal material for use as a scour reduction measure. Basalt's (igneous rock) use as rip-rap is a standard practice worldwide. No studies have been identified that indicate impact to marine water quality from the numerous projects where it has been used.

Based on the GBAC (2009) report downslope migration of the geotextile blanket is not considered relevant at the proposed marina site due to the relatively flat bed gradients.

Based on a literature review conducted by GBAC, this type of design has been used previously in similar applications and environments as follows:

- An in-situ cap with armouring layer was used at a Super-fund site in Sheboygan Falls, Wisconsin, USA. This project involved covering areas of PCB-contaminated sediments in river and floodways with a composite cap, comprising layers of gravel and geotextile. A total area of 4,000 m^2 was capped in water depths of 1.5 metres (Eleder, 1992).
- At Eitrheirn Bay in Norway, a composite cap of geotextile and gablions was used over heavy metal contaminated sediments. A total area of 100,000 m2 was capped in water depths of up to 10 metres (Instanes, 1994).

4.2 Geotextile Degradation, Durability and Chemical Impact

The information from Geofabrics Australia Pty Ltd (Geofabrics), the manufacturers of the Elcomax 1200R geotextile (refer to the EA) have indicated that the Elcomax R range of polyester staple fibre geotextiles have a design life of greater than 100 years when submerged in saline water below a rock cover and is resistant to biological and hydrocarbon attack (Geofabrics). Mathur *et al* (1994) noted that polyester geotexiles underwent degradation only at elevated temperatures (70 – 95 degrees Celsius) and relatively high and low pH (pH 3 and 13). These conditions are unlikely to be encountered at the proposed marina site.

Based on the chemical and physical properties of polyester geotextiles assessed in Davis (1986) (*Aging and Durability of Polyester Geotextiles*, Garald W. Davis, 2nd GRI Seminar of Durability and Ageing of Geosynthetics, 1986), the geotexile blanket has excellent strength, toughness and durability. Furthermore, Davis (1986) notes that polyester geotextiles, such as Elcomax R range have good resistance to permanent deformation under long-term loading and excellent chemical resistance to water, salts, organic acids, organic solvents and petroleum based chemicals such as those present in the bed sediments of Kendall Bay.

4.3 Permeability and Sediment Retention

As discussed above, the geotextile has an EOS of <75 micron, which indicates that finer grained sediments may be able to migrate through the geotextile blanket. Geosynthetic Testing Services conducted static and hydrodynamic testing of the Elcomax 1200R geotextile to assess the retention of sediments beneath the SPS. The tests comprised a hydrodynamic sieve test, in which a sample of sediments from north of the former coal loading wharf in a 100 mm piece of geotextile was subjected to a cycle of emersion and drainage over a 24 hour period to simulate intertidal conditions, and a static test, which involved emersion of a sample of the same sediment over a 48 hour period.

Hydrodynamic testing by GTS (presented in GBAC, 2009) involving repeated submersion of the geotextile through a water column resulted in an average of 19% of a 20 mm thick sediment sample passing through the geotextile. Static testing resulted in an average of 0.7% of sediment passing through. GBAC (2009) considered that given the extreme agitation used in the hydronynamic test, during the construction stage (including placement of the geotextile) the static submersion test (i.e. 0.7% pass through) provides a representative measure of the hydraulic loading environment.

GBAC (2009) reported that the application of the rock armour is expected to reduce current velocities at the surface of the geotextile blanket by approximately 80% (equivalent to 0.2 – 0.4 m/s) compared with current velocities at the surface of the rock armour (300 mm to 400 mm thickness). Beneath the geotextile blanket, a further reduction in current velocities of between 25 – 50% is considered likely, therefore resulting in an effective maximum current velocity beneath the geotextile blanket no more than 5 – 10% (equivalent to 0.1 – 0.2 m/s) of current velocities at the surface of the SPS. Given that these predicted velocities of 0.1 to 0.2 m/s are less than the nominal threshold velocity of 0.3 m/s adopted for the marina area, GBAC (2009) concluded that the filtration design would be expected to account for the hydraulic gradients attributed to the propeller wash and thereby contain the underlying sediments.

In considering hydraulic permeability during the SPS design, GBAC (2009) criteria was that the geotextile filter must maintain a higher permeability than the underlying sediments and head loss through the geotextile must not be excessive.

Based on published studies and expected permeability of the Kendall Bay sediments, GBAC (2009) concluded that a permeability of 0.0005 m/s is required for the geotextile. This is easily satisfied by the 0.0016 m/s permeability of the Elcomax 1200R geotextile. Also, given the high permeability of the geotextile it can be concluded that gas retention under the SPS is effectively mitigated.

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5.0 Bed Disturbance during Construction

To minimise disturbance, the SPS construction works will be carried out in small areas that are moved progressively. It is proposed to install a silt curtain and floating boom at the limit of the SPS to trap disturbed sediment. In addition, a second, inner silt curtain will be employed around working areas and moved as construction works progress. The inner silt curtain and floating boom will be removed upon completion of SPS installation and the outer curtain and boom will remain during construction of marina infrastructure. The installation and operation of the silt curtain and floating boom is described in the AECOM (2009b) Construction Environmental Management Plan (CEMP).

Notwithstanding the above, construction of the SPS is likely to result in localised temporary disturbance of the bed sediments during the period of installation. Douglas Partners (DP) (2009) estimated that the upper 100 mm of sediments are likely to be affected during the installation of the SPS, which was considered a reasonable upper bound average over the 56,000 m^2 area of the SPS by GBAC (2009). As discussed above, the AECOM (2009a) investigation found the upper 100 mm of sediments contained elevated concentrations of PAH, the driving contaminant at Kendall Bay. The 95% UCL on the mean was 22.3 mg/kg for PAH within the top 100 mm of the sediment profile across the footprint of the marina.

Based on GBAC (2009), the following estimates have been made:

- Placement of the SPS will affect the top 100 mm of the bed sediment;
- The placement of the SPS is expected to approximately feed between 1 and 20 mm of surface sediment up through the geotextile, with the sediment delivery being much closer to 1 mm (equating to the average of 0.7%) than 20 mm, of the top 100 mm passing through;
- However, a conservative value of 10 mm has been considered for the sediment that will re-settle within spaces in the basalt rock armour and generally at the top of the geotextile. This equates to approximately 560 m^3 of sediment.

GBAC (2009) has also reported that the disturbance of the sediment under the SPS during construction (expected to be a couple of minutes) would equate to same disturbance as fast ferry movements over a period of no more than one month. The above estimates support GBAC when compared to the volume of sediment disturbed during fast ferry, which was estimated to be approximately 42.6 m^3 per day (**Section 2.0**). Therefore, during construction, the volume of sediment disturbed would equate to only, about 13 fast ferry passess. This sediment would not be mobilised into the water column during construction (boating activity not sufficient), therefore impact on water quality from these sediments would be negligible in the context of present conditions. However, these sediments would remain within the rock armour.

Based on the data available from various studies sediment disturbance during construction would be negligible However, to minimise disturbance of sediment, the following approach will be used during the installation of the SPS:

- The works will commence from the northern portion of the proposed Marina area. The sheets will be laid continuously from west to east (perpendicular to the shore) by barge using a guide frame and nose board system to minimise sediment disturbance. The works on the western side will commence on the rising tide when the tidal level is at or above mid tide;
- A dive team would be utilised during construction of the SPS, to ensure positioning of the edges and sufficient overlap (2 m) of the geotextile blanket is achieved;

- The geotextile will be secured by placing ballast on top. This process will involve the use of an excavator (fitted with a GPS controlled bucket guidance system), situated at the stern, which will carefully unload ballast directly onto the newly laid geotextile as the barge passes over the geotextile;
- The barge will be slowly moved from west to east as the geotextile is fed from the roll over the bow and beneath the hull;
- Adjacent sheets will be overlapped and secured in a similar way ensuring that no areas of the bed within the footprint of the marina remain exposed;
- As discussed above, an inner boom/silt curtain will be progressively moved south over the SPS, as the SPS is laid; and
- The edges of the SPS will be sunk into the bed sediments and covered with a thicker layer of rock armour.

Given the size of basalt rock proposed, only a small amount of turbidity is expected from the fines of the associated material. However, settlement of these particles is expected within a short period of time and within the silt curtain, mitigating impact to the water quality.

Piles will be required to support the floating marina infrastructure. It is proposed that piles be driven following installation of the SPS. Areas for the piles will be cleared of ballast and the holes cut by divers to minimise sediment release. Once piles are driven to the appropriate depth a geotextile collar would be attached to each pile overlying the geotextile blanket. The ballast will then be replaced by divers and each pile penetration inspected.

Monitoring of water quality is proposed to be carried out prior to construction works commencing (to obtain baseline conditions), on a daily basis (for the first 2 weeks) and on a weekly basis there on (with the monitoring requirements re-assessed on a monthly basis) throughout the construction works, and at the completion of construction but prior to removal of the silt curtains and floating boom. This monitoring program will be re-assessed regularly and modified as required with consultation with DECC. Furthermore, the silt curtains and floating boom will be inspected visually on a fortnightly basis during the construction works.

Factors relating to local ecology during the construction of the proposed marina are discussed in detail in EA (TLB, 2009).

6.0 Bed Disturbance During Marina Operation

6.1 Immediately Post Construction

As discussed in **Section 5.0**, a quantity of sediment equivalent to up to 10 mm across the marina footprint would settle within the spaces in the rock armour. These sediments would not be mobilised into the water column to any significant extent during the construction period. However given the current velocities (≥ 3m/s) estimated by GBAC(2009) in the rock armour during operation, a significant proportion is expect to be displaced into the water column over the initial 12 months of operation of the marina.

It should be noted that due to the calming effect of the marina infrastructure and the SPS, the effect of fast ferries would be eliminated during operation of the marina.

During the first 12 months of operation of the marina:

- As noted in Section 5 the total volume of sediment from construction expected to be held within the rock armour and available for displacement would be 560 m^3;
- Applying a sediment density of 1.200 Tonnes/m^3, this equates to 672 Tonnes of sediment; and
- Applying the 95% UCL on the mean concentration of 22.3 mg/kg the weight of PAH within the rock armour available for mobilisation into the water column would equate to about 15 kg.

Therefore, during the first 12 months of operation up to 15 kg of PAH within sediment may be mobilised into the water column compared to the present yearly mobilisation conservatively estimated at 2,200 kg per year.

On this basis it is considered that the impact of marina on water quality and local environment in general will be negligible and will in fact effect a significant contribution to its improvement.

6.2 Ongoing Operation

Based on the GBAC (2009) report, the primary causes of potential bed sediment disturbance would be currents induced by wind waves, boat waves and propeller action.

As described previously, disturbance via these mechanisms is currently taking place across the Kendall Bay. GBAC (2009) has also noted that waves generated by vessels navigating within, to and from the marina would be no more energetic than boat waves currently experienced in Kendall Bay due to ambient boat traffic, and would have small wash generating capacity compared to ambient wash in the bay, attributable to the passing of ferries during marina operation, as discussed previously. However, based on the GBAC (2009) report, following placement of the proposed SPS an improvement of conditions will be achieved as:

- The bed will be protected from disturbance by ferry wave action at water depths of between 2 m and 3 m; and
- The calming effect of the floating marina infrastructure and moored boats will reduce wind and boat wave disturbance of the bed sediments at shallow water depths (1 m or less) to the west and south of the proposed marina.

The greatest potential to generate turbidity and disturb bed sediments would therefore be caused from increased propeller action.

For the proposed marina berthing configuration, GBAC (2009) reported that depending on boat size and water depth, current velocities at the sediment bed between 0.7 and 2 m/s would be expected during marina operation without implementation of the SPS. However, the implementation of the SPS, as discussed would reduce these current velocities at the bed to 0.1 to 0.2 m/s, which is below the adopted nominal threshold value of 0.3 m/s. Therefore, the SPS design would account for the hydraulic gradients attributed to the propeller wash, thereby mitigating the disturbance of the underlying sediments. The predicted velocities at the bed with the SPS in place is comparable if not slightly lower than the existing tidal and wind induced water velocities at the bed of Kendall Bay and are significantly lower than present conditions where ferry wave action is considered.

GBAC (2009) reported that once the blanket is in place and the marina operational, it is assessed that currents due to all boat waves including ferry waves, tidal flows, wind action, freshwater flows, stormwater outlet flows, and propeller wash, would be insufficient to mobilise the bed under the SPS.

One of the other factors that requires consideration during operation is the movement of piles and subsequent creation of migration pathways for contaminants through the annulus created around the pile. Given that the piles will be protected by the geotextile collars, migration of contaminants associated with particulates is unlikely. However, contaminants as free phase from the underlying sediments need to be considered. Based on observations of the AECOM (2009a) report, and during pile removal works at the time of the former wharf removal, no free phase contamination has been identified in the sediments down to the underlying clays, consequently this type of contaminant migration is not considered an issue of significance during operation of the marina.

Therefore, based on the available data, when compared with present situation the environmental condition of the area of the proposed marina will be significantly improved. Also, requirements of the RO would be met as marina operations would not result in “further disturbance of the bed sediments” and any disturbance of the bed sediments would be negligible when compared to present levels.

To provide greater assurance of the durability of the SPS and minimisation of disturbance of bed sediment within and outside the marina/SPS footprint, an operational environmental management plan (OEMP) has been prepared, that documents a number of measures that need to be implemented during marina operation. These are discussed in more detail in the following Section.

Factors relating to local ecology during the operation of the proposed marina are discussed in detail in the EA (TLB, 2009).

7.0 Management Controls During Operation

The AECOM (2009c) Operational Environmental Management Plan (OEMP) has been prepared to mitigate potential impacts on the environment from the proposed marina, with respect to water pollution, air pollution, land pollution, hazardous materials and waste, offensive noise and waste.

To protect the SPS and mitigate sediment disturbance, the OEMP (AECOM, 2009c) included the following key management procedures:

- The use of anchors, or other bottom anchoring devices, within the proposed marina is prohibited;
- All marina users would use the designated access and egress routes to and from the marina that would be evident through the use of appropriate navigational measures. The access route would be covered by the SPS, while the egress route would be covered by the SPS and is to be in water sufficiently deep so that disturbance of the bed sediment outside the remediation area is minimised;
- Marina operations staff will be trained in the location and purpose of the SPS and instructed that disturbance of the SPS is not permitted without prior consent from NSW EPA;
- Deep hulled vessels will have restricted access to the marina and will not be permitted in shallow water;
- Yearly inspections of the SPS will be undertaken by divers for at least the first five years of marina operation (frequency to be re-assessed after this period) to assess the conditions of the SPS, including, but not limited to, condition of the rock armour, condition of the geotextile including around piles, presence of any foreign objects that may damage the integrity of the SPS and evidence of potential contamination such as areas of reduced visibility;
- In the event that the integrity of the SPS is compromised a diver will be engaged to repair the subject area. Geotextile material will be available to use, as required; and
- Emergency procedures to address accidents that may impact the integrity of the SPS, including accidental loss overboard of large objects.

The OEMP (AECOM, 2009c) would be implemented by the marina owner / operator.

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8.0 Future Remediation

The type of construction of the proposed marina and the SPS, which have been designed so that the marina infrastructure and the SPS can easily be removed, in sections if required would facilitate future remediation.

Therefore, any future requirement for active remediation of sediments at the proposed marina site would be easily addressed by a simple process. This will include the removal of the marina and associated SPS, as required. Further, to mitigate environmental impact the OEMP (AECOM, 2009c) requires an environmental management plan (EMP) to be prepared prior to the removal of the marina infrastructure and the SPS.

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9.0 Conclusions

Based on the data obtained from the various studies undertaken and referenced in this document, current Site conditions, the proposed design of the SPS and the proposed marina construction and operation management measures, the following conclusions can be made:

During marina construction there will be negligible sediment disturbance into the water column, with disturbed sediment likely to be held within the rock armour. Therefore, any impact on the environmental condition is also likely to be negligible.

During marina operation, limited disturbance of sediment will occur in the first year, as the sediment disturbed during construction will be held within the spaces within the rock armour and is likely to be dispersed into the water column. However, this impact is expected to be orders of magnitude lower than current conditions, and therefore will effect on improvement in the environmental condition of the area within the first twelve months of operation, as current sources of disturbance will have been eliminated due to the presence of the marina and the SPS.

Following the first twelve months of operation, there will be no disturbance of the sediments from the marina operations or the current sources, as these will be eliminated due to the presence of the marina and SPS. Consequently, the operation of the marina will effect on environmental improvement on the area.

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Worldwide Locations

Australia	+61-2-8484-8999
Azerbaijan	+994 12 4975881
Belgium	+32-3-540-95-86
Bolivia	+591-3-354-8564
Brazil	+55-21-3526-8160
China	+86-20-8130-3737
England	+44 1928-726006
France	+33(0)1 48 42 59 53
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Japan	+813-3541 5926
Malaysia	+603-7725-0380
Netherlands	+31 10 2120 744
Philippines	+632 910 6226
Scotland	+44 (0) 1224-624624
Singapore	+65 6295 5752
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AECOM

Prepared for:

Breakfast Point Pty Ltd

51 Riley Street
Woolloomooloo NSW 2011



Sediment Investigation Report

Proposed Inner West Marina
Kendall Bay, Parramatta River, NSW

Final

AECOM

1 October 2009

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Environment

Distribution

Sediment Investigation Report
Proposed Inner West Marina
Kendall Bay, Parramatta River, NSW

1 October 2009

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By
ENSR Australia Pty Ltd (trading as AECOM)
ABN: 34 060 204 702
Level 5, 828 Pacific Highway Gordon NSW 2072
PO Box 726 Pymble NSW 2073
Ph: +61 2 8484 8999 Fax: +61 2 8484 8989

Christiaan Donnetti
Associate Environmental Scientist

Sedat Tasdemir
Principal Environmental Scientist

Technical Peer Reviewer:	**Date:**
	1/10/2009
Rui Henriques Principal Remediation	

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Glossary of Terms

General Terms	
ANZECC	Australian and New Zealand Environment and Conservation Council
BTEX	Benzene, Toluene, Ethyl benzene and Xylene
DECC	NSW Department of Environment Conservation and Climate Change
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
HASP	Health and Safety Plan
ISQG	Interim Sediment Quality Guidelines
LOR	Limit of Reporting
NEHF	National Environmental Health Forum
NEPC	National Environment Protect Council
NEPM	National Environmental Protection Measure
NSW EPA	New South Wales Environment Protection Authority
OH&S	Occupational Health & Safety
POEO	Protection of the Environment Operations Act
SAC	Site Assessment Criteria
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulfate
PAH	Polycyclic Aromatic Hydrocarbons
TPH	Total petroleum hydrocarbons
TOC	Total Organic Carbon

Units			
km	kilometre	µg/kg	micrograms/kilogram
m	metre	µg/L	micrograms/litre
mg/kg	milligrams/kilogram	ppm	parts per million
mg/L	milligrams/litre	^{o}c	Degree Celsius
mV	milli volts	L	Litre
µS/cm	micro Siemens per centimetre	pH	Potential hydrogen

Executive Summary

Introduction

ENSR Australia Pty Ltd (trading as AECOM, hereafter referred to as AECOM) was commissioned by Breakfast Point Pty Ltd to undertake a Sediment Investigation at Kendall Bay, NSW in support of the proposed Inner West Marina Development at Kendall Bay (hereafter referred to as the Site).

This Sediment Investigation Report aims to assist in addressing the Director General's requirements for contamination under Section 75F of the Environmental Planning and Assessment Act as stated in correspondence from the Department of Planning dated 31 May 2007.

Objectives

The objectives of the Sediment Investigation were to:

- Assess sediment contamination levels within the footprint of the Site; and
- Inform construction and operational Marina environmental management plans and environmental management control design.

Scope of Works

The scope of work for the investigation comprised:

- Preparation of a Sampling Analysis Quality Plan;
- The collection and analysis of sediment samples from the footprint of the Site; and
- Preparation of this report.

Summary of Findings

A summary of the findings is provided below:

- Sediments comprised fine to medium grained sandy silty clay and are representative of typical estuarine sediments;
- Total organic carbon (TOC) content was generally highest in the upper 20 cm of the bed profile and decreased with depth;
- The sediments at the Site contain elevated concentrations of total petroleum hydrocarbons (TPH) and polynuclear aromatic hydrocarbons (PAH);
- Approximately 35% the samples collected at the Site had reported PAH concentrations that were greater than the ANZECC (2000) interim sediment quality guidelines (ISQG)-High and approximately 65% of the samples had reported PAH concentrations that were greater than the ISQG-Low;
- The highest concentrations of PAHs were in the sub-surface sediments (between 0.02 – 0.1 m and increasing between 0.2-0.4 m) with lower concentrations detected in the surficial sediments (between 0.0 - 0.02m); and
- Potential acid sulphate soils are present at depths between 0.2 and 0.4 m below bed level.

Recommendations

Based on the above, AECOM considers that a Marina can be constructed over the sediments provided the following should are prepared and implemented:

- Construction Environmental Management Plan; and
- Operational Environmental Management Plan.

These documents should address the following:

- Appropriate environmental controls;
- Contaminated sediment management procedures;
- Monitoring procedures; and
- Vessel access and navigation.

1.0 Introduction

ENSR Australia Pty Ltd (trading as AECOM, hereafter referred to as AECOM) was commissioned by Breakfast Point Pty Ltd to undertake a Sediment Investigation at Kendall Bay, NSW in support of the proposed Inner West Marina Development at Kendall Bay (hereafter referred to as the Site).

This Sediment Investigation Report aims to assist in addressing the Director General's requirements for contamination under Section 75F of the Environmental Planning and Assessment Act as stated in correspondence from the Department of Planning dated 31 May 2007.

The Site comprises the area of the proposed Inner West Marina within Kendall Bay. The location of the Site is illustrated on **Figure F1**, whilst the sediment sampling locations and the proposed Marina layout are shown on **Figure F2**.

A Sampling Analysis Quality Plan (SAQP) was prepared for the sediment investigation. The SAQP was reviewed and agreed to by a Site Auditor accredited by the NSW EPA under the *Contaminated Land management Act 1997.* The sediment investigation was subsequently given approval to proceed by the Department of Environment and Climate Change (DECC).

1.1 Objectives

The objectives of the Sediment Investigation were to:

- Assess sediment contamination levels within the footprint of the Site; and
- Inform construction and operational Marina environmental management plans and environmental management control design.

1.2 Scope of Work

The scope of work for the investigation comprised:

- Preparation of a Sampling Analysis Quality Plan;
- The collection and analysis of sediment samples from the footprint of the Site; and
- Preparation of this report.

1.3 Data Quality Objectives

AECOM has adopted the USEPA published validation guidelines (USEPA SW-846) for setting the project data quality objectives (DQOs) and guidance for the review of analytical data produced from the laboratories. These guidelines along with the DQOs have been used to evaluate the data for this report. The DQOs for the project are provided in **Appendix A**.

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2.0 Site Identification and Surrounding Environment

2.1 Site Description

The Site is located in Kendall Bay which extends from the eastern shoreline to the Breakfast Point residential area.

The Site covers an irregular shaped development footprint of approximately 20 000 m^2 extending from the top of the seawall into the Parramatta River (refer to **Figure F2**).

2.2 Surrounding Land Use

The Site is surrounded by the suburb of Cabarita including Cabarita Park and the Cabarita Rivercat Ferry Wharf to the east of the Site, whilst Breakfast Point residential development area is located to the south west of the Site. The Putney vehicular ferry operates on the Parramatta River approximately 250 m (west) upstream of the Site.

2.3 Sediment Stratigraphy

Based on previous studies, Kendall Bay is characterised by fine grained bottom sediments comprising mostly silty sandy sediments (>95%), which overlies terrestrial clays. Intertidal mud flats are present in the head waters of Kendall Bay and small areas of sand are exposed in the bay at low tide.

Close to the foreshore of Kendall Bay, the sediments comprise sand or sandy mud and the proportion of fine fraction material increases with distance from the shore. Dark to grey black shales of the Ashfield shale overlie Hawkesbury Sandstone. The Ashfield shale crops out on ridge tops away from the coast and dips gently westward reaching sea level near Parramatta.

The sediment profile identified during previous studies by (URS, 2006) is summarised below:

0.00 m – 0.02 m	Surficial sediment of hydrous brown/green muds with broken shell material.
0.02 m – 0.1 m	Green/grey estuarine sediments.
0.1 m – 1.5 m	Sediment – black to olive grey marine sediment, very soft, with trace of fine-grained sand and discrete pockets of bivalve shells.
>1.5 m	Grey to orange sandy clay, firm, with fine sand and dispersed bivalve shells.

Hawkesbury Sandstone outcrops are present on the north eastern tip of the Breakfast Point property and western shoreline of Cabarita Park, located to the south east of the investigation area (refer to **Figure F2**). However, during the previous studies conducted by URS bedrock was not encountered to the maximum depth of investigation.

2.4 Bed Characteristics

Along the northern foreshore of the Breakfast Point development area, adjoining Kendall Bay, the shape of the bed is characterised by a gradient towards the main channel, which varies between 10 and 19.8 m. The sediment to the east of Breakfast Point is characterised by a shallow gradient and plateau varying from 2 to 5 m, typical of a bay. The depth to sediment (bathymetry) identified during the URS (2006) investigation is provided on Figure 2 Presented in **Appendix B** of this report.

2.5 Acid Sulfate Soils

A review for the potential for the presence of acid sulfate soils (ASS) was undertaken with reference to the NSW Acid Sulfate Soil Management Advisory Committee's "*The Acid Sulfate Soil Manual*"

(ASSMAC, 1998) and the Acid Sulfate Soil Risk Map (Edition 2) for Prospect/Parramatta River, published by the Department of Land and Water Conservation (1997). The plan indicates that there is a 'High Probability' of occurrence of ASS within the 'Bottom Sediments', and that there is a potential for severe environmental risk if bottom sediments are disturbed by activities such as dredging.

3.0 Background

3.1 Summary of History

A coal loading wharf and an oil/tar pipeline previously traversed the central section of the Site from west to east. These wharves have since been removed. The western boundary of the Site was bound by the former Mortlake gas works at Breakfast Point which has since been remediated and redeveloped for residential purposes.

3.2 Previous Investigations

Previous studies in Kendall Bay found that sediment was impacted by contaminants associated with gasworks with the main contaminants being polycyclic aromatic hydrocarbons (PAHs), phenols, cyanide and zinc.

A summary of the previous studies conducted is summarised in the sections following.

3.2.1 Intrusive Investigations

The previous testing of the sediment in Kendall Bay (URS, 2002 & 2005), encountered heavy oils and elevated levels of PAHs above the Interim Sediment Quality Guidelines (ISQG's) (ANZECC & ARMCANZ, 2000).

The previous investigations comprised collection of sediment samples from thirty five locations at the following depths:

- 0.00 m - 0.02 m depth;
- 0.02 m – 0.1 m depth; and
- 0.1 m – 0.5 m depth.

A total of 102 sediment samples were analysed, of which 42 were reported to contain PAH concentrations exceeding the ISQG-L (lower limit), but less than the ISQG-H (higher limit) value for at least one analyte. A total of sixty samples exceeded the ISQG-H for at least one analyte.

Concentrations of Total Petroleum Hydrocarbons (TPH) were detected in 76 of the 102 samples, with concentrations of TPH (C_6-C_9) ranging between less than the laboratory Limit of Reporting (LOR) to 210 milligrams per kilogram (mg/kg) and TPH (C_{10}-C_{36}) ranging between less than LOR to 51 210 mg/kg. Concentrations of Benzene, Toluene, Ethylbenzene and Xylene (BTEX) were detected in six samples.

Figures showing the sample locations and distribution of contaminant concentrations are provided in **Appendix B**

3.2.2 Risk Assessment

A human health risk assessment (HHRA) and an environmental risk assessment (ERA) on the impacted sediments were undertaken by URS in 2006 as listed below:

- Human Health Risk Assessment of Estuarine Sediments Adjacent to the Former AGL Mortlake Site. Draft (URS, 2006a); and
- Environmental Risk Assessment for Sediments Adjacent to the Former AGL Mortlake Site. Draft (URS, 2006b).

URS reported that the risk assessment used worst case scenarios for adults and children for a wide range of exposure scenarios and assumptions, and models that were agreed with the DECC.

Based on the results of the HHRA, URS concluded the following with reference to the bed sediments:

- The potential risks to human health associated with the ingestion and inhalation of surface water were considered to be negligible;
- Calculated risk to human health associated with exposure by older and younger children to Contaminants of Potential Concern (CoPC) identified in sediments within the investigation area were below the target risk values and were considered to be negligible for both average and Risk Management Exposure (RME) input parameters;
- Calculated risks to human health (adults, older and younger children) associated with the consumption of recreationally caught biota, comprising fish, shellfish and oysters indicated the potential for exposure to exceed target risk values for the CoPC identified. This assumed a high level of consumption of fish caught exclusively from the remediation area; and
- Calculated risk to human health associated with exposure by older and young children to the CoPC identified in the mangrove areas by the incidental ingestion of sediment while wading exceeded the target risk levels assuming DECC and Health Parameters. The risk assessment for this area was based on the maximum concentrations occurring at either 0.00 m - 0.1 m depth or 0.1 m - 0.2 m depth.

Overall, the risks to human health for all exposure scenarios were considered to be low.

The environmental risk assessment conducted by URS on the sediments adjacent to the former AGL Mortlake Site concluded the following:

- Sediments comprised mainly fine grained material with coarser sands and gravels encountered with in the near shore sediments;
- Concentrations of PAH in the intertidal sediments were generally low with PAH concentrations in the shallow sub tidal sediments being high. Concentrations were noted to decrease significantly with distance from the shore line and correlate inversely with water depth;
- Although spatial trends were similar for the 0.00 m - 0.02 m depth and the 0.02 m - 0.10 m depth intervals, the contaminants trends in deeper sediments were reported to be less apparent. At several locations, relatively clean material overlays contaminated sediments, however at other areas at the Site contaminated sediment overlays clean sediments;
- Concentrations of CoPC in the water column near the estuary bed were all less than the relevant ANZECC/ARMCANZ (2000) 95% Marine Trigger Values;
- Settling rates for particulate materials were similar to and correlated with those of the reference areas indicating that re-suspension processes were not specific to the Site. PAH concentrations in Suspended Particulate Matter (SPM) exceeded ISQG-Low values at the Site but were only slightly higher than SPM values at reference areas. It was concluded that SPM transported from the Site contained marginally higher PAH concentrations than ambient values indicating that there are multiple sources of PAH contamination;
- Shallow sub tidal areas in Kendall Bay and west of Breakfast Point that contain concentrations of PAH in surficial sediment exceeding ISQG-High values would be unlikely to represent accumulation zones for sediment. However deeper areas

elsewhere in the Site (which exclude the main channel of the Parramatta River) are considered to be depositional areas where sediments are accumulating and concentrations of PAH in surficial sediments are expected to decrease;

- Sediment in intertidal and shallow sub-tidal area at the Site were subject to re-suspension by wind waves. Sediment re-suspension was recorded in South Kendall Bay during north easterly winds notably at low tide;
- Vessel wakes were concluded to be capable of re-suspending sediments in large areas of the Site, particularly in intertidal and shallow sub-tidal areas where concentrations of PAH exceeded ISQG High levels;
- PAH concentrations detected in Kendall Bay that were greater than the ISQG-L have the potential to cause adverse effects to benthic organisms and other ecological receptors; and
- PAH concentrations detected in Kendall Bay that were greater than the ISQG-H are likely to cause adverse effects to benthic organisms and other ecological receptors

3.3 NSW DECC Notifications

3.3.1 Significant Risk of Harm

The Environmental Protection Agency (EPA) [now a part of the Department of Environment and Climate Change (DECC)] has determined that the near shore sediments adjoining the former Mortlake Gasworks site pose a significant risk of harm (SRoH) for a number of reasons, as summarised below:

- Lack of benthic biota in the area suggests that Environmental Harm has occurred in the area. Although "cause and effect" has not been established, it is reasonable to assume that the nature and degree of the contaminants results in the "lack of benthic biota";
- Concentrations of total PAH are significantly elevated above ANZECC 2000 sediment quality guideline levels. Although there are no criteria for TPHs these are also present in the sediment in significant concentrations and separate phase product has been observed;
- Some of the PAHs are classifiable as human carcinogens;
- PAHs have the potential to biomagnify through the food chain;
- Benthic Biota and humans could be exposed to the contaminants;
- It is likely that further development of the area would increase the risk of harm; and
- Disturbance of the contaminants would mobilise contaminants and hence increase the risk of harm.

3.3.2 Remediation Order

On 25 May 2004, the EPA declared (remediation order number 23022) the sediments of Kendall Bay, which fall within 200 meters of the land based boundary of the former Mortlake gasworks site as a remediation site under section 21 of the Contaminated Land Management Act 1997.

A number of actions under the order are directly applicable to the proposed Marina development are summarised below:

- The NSW Maritime Authority (being the landowner) must refrain from carrying out, causing, permitting, or allowing another person to carry out works or activities at the site which would result in the disturbance or further disturbance of the bed sediment of Kendall Bay and the Parramatta River in the area adjacent to the Former Mortlake

Gasworks site which fall within 200 m of the land based boundary of the former works. Specific reference is made to excavation activities and Marina developments;

- Prior to commencing works which have the potential to disturb bed sediments the order requires that the person proposing to conduct the works must prepare and submit for the EPA's approval a written plan with specific measures directed at minimising the disturbance and migration of contaminants in the bed sediments of the site;
- Prior to being provided to the EPA the report must be reviewed by an EPA accredited Site Auditor, in relation to the suitability of the plans;
- Plans must be prepared in accordance with the EPA publication titled "Guidelines for Consultants reporting on Contaminated Sites" 1997 as it relates to investigation and/or remedial action;
- Works or activities must be undertaken in accordance with the management plan approved by the EPA; and
- On completion of the works or activities the proponent must prepare and furnish the EPA with a report addressing the manner in which the works were implemented and how the plan was complied with.

3.3.3 Director Generals Requirements

AECOM understands that Breakfast Point Pty Ltd has lodged a Project Application (07_0006) with the NSW Department of Planning (DOP). DOP have determined that an Environmental Assessment is required for the project under section 75F of the Environmental Planning and Assessment Act 1979. The Director General has provided "General Requirements" for the project (in correspondence dated 14 January 2008), which includes the following requirements specific to 'Contamination':

- A detailed assessment of the potential impacts on the disturbance of contaminated marine sediments which shall take into account information from previous investigations as well as any additional investigations as necessary and will need to include a thorough description of the methodology used in the assessment and justification for the methodology used and predictions made;
- Details of proposed remediation works required and justification for why the proposed remediation measures will succeed:
- A site audit statement and a Site audit report by an auditor accredited under the Contaminated Land Management Act 1997; and
- sideration of the impact of the Site operations on possible future remediation actions and details of compliance with any orders issued.

4.0 Screening Levels

The current assessment criteria used in NSW to assess sediment analytical results are based on the *Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).*

The current assessment criteria used in NSW to assess acid sulphate analytical results are based on the *New South Wales Acid Sulphate Management Advisory Committee (ASSMAC) Acid Sulphate Soil Manual (August 1998).*

Application of these guidelines to this investigation is described below.

4.1 Sediment Investigation Screening Levels

For the purpose of screening sediment quality, ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Quality* provide interim sediment quality guidelines (ISQG) values for affects range-low and – high. Low (or 'trigger' value) concentrations are threshold concentrations, and below this concentration the frequency of adverse biological effects is expected to be low. It is noted that the ANZECC (2000) criteria for sediments are interim, and aim at protecting sediment ecological health and remobilisation of contaminants into the water column and/or food chains.

AECOM notes that the ANZECC (2000) sediment guidelines had been developed to serve three principal purposes:

- To identify sediments where contaminant concentrations are likely to result in adverse effects on sediment ecological health;
- To facilitate decisions about the potential remobilisation of contaminants into the water column and/or into aquatic food chains; and
- To identify and enable protection of uncontaminated sediments.

In addition, the guideline numbers are trigger values that, if exceeded, prompt further action. The first-level screening compares the trigger value with the measured value for the total contaminant concentration in the sediment. If the trigger value is exceeded, then this triggers either management/remedial action or further investigation to consider the fraction of the contaminant that is bio-available or can be transformed and mobilised in a bio-available form.

ISQG Values are available for the sums of low molecular weight PAH, sum of high molecular weight PAH and total PAH, however there are no current ISQG values for TPH and BTEX. As per the requirements of ANZECC (2000), in the absence of the guideline values, background concentrations will be used to assess the contaminant concentrations in the sediments.

PAHs fall into two groups, depending on their molecular weight. They can be high or low molecular weight. ANZECC/ARMCANZ (2000) provides a summary of Low and High Molecular Weight PAHs as shown in **Table 1**.

Table 1: Summary of Low and High Molecular Weight PAH's

Low Molecular weight PAH	High Molecular weight PAH
Acenaphthene	Benzo(k)fluoranthene
Acenaphthylene	Benz(a)anthracene
Anthracene	Benzo(a)pyrene
Fluorene	Benzo(b)fluoranthene
Naphthalene	Benzo(g.h.i)perylene
Phenanthrene	Dibenz(a.h)anthracene
	Fluoranthene
	Indeno(1.2.3-cd)pyrene
	Pyrene
	Chrysene

All PAH concentrations presented in Table T1 have been normalised to 1% TOC. 51 of the 103 samples submitted for analysis were analysed for Total Organic Carbon (TOC). Additionally, for the results that do not have TOC values an average TOC % (7.14%) was calculated from the data set.

The adopted sediment screening levels are summarised in **Table 1**

Table 2: Adopted Sediment Screening Levels

Analyte	Units	ANZECC Sediment Quality - Low	ANZECC Sediment Quality - High
Free Cyanide	mg/kg	nc	nc
Total Cyanide	mg/kg	nc	nc
Total Cyanide – (Normalised to 1% TOC)	mg/kg	25*	
PAHs (Normalised to 1% TOC)			
Acenaphthene	mg/kg	0.016	0.5
Acenaphthylene	mg/kg	0.044	0.64
Anthracene	mg/kg	0.085	1.1
Benz(a)anthracene	mg/kg	0.261	1.6
Benzo(a)pyrene	mg/kg	0.43	1.6
Benzo(b)fluoranthene	mg/kg	nc	nc
Benzo(g.h.i)perylene	mg/kg	nc	nc
Benzo(k)fluoranthene	mg/kg	nc	nc
Chrysene	mg/kg	0.384	2.8
Dibenz(a.h)anthracene	mg/kg	0.063	0.26
Fluoranthene	mg/kg	0.6	5.1
Fluorene	mg/kg	0.019	0.54
Indeno(1.2.3-cd)pyrene	mg/kg	nc	nc

Analyte	Units	ANZECC Sediment Quality - Low	ANZECC Sediment Quality - High
Naphthalene	mg/kg	0.16	2.1
Phenanthrene	mg/kg	0.24	1.5
Pyrene	mg/kg	0.665	2.6
Low molecular weight PAHs	mg/kg	0.552	3.16
High molecular weight PAHs	mg/kg	1.7	9.6
Total PAHs	mg/kg	4	45

Notes:
* Bolton et al 1985 and cited in Macdonald et al 1999
nc No ISQG values are available

4.2 Acid Sulphate Soils

The Acid Sulphate Soils Assessment Guidelines presented in the New South Wales Acid Sulphate Management Advisory Committee (ASSMAC) Acid Sulphate Soil Manual (August 1998) provide details on how to undertake a preliminary assessment to confirm if acid sulphate soils are present and if present how to assess and manage the potential impacts of works which may disturb and expose them.

The results of the SPOCAS analysis have been assessed against the “Action Criteria triggering the requirement for an Acid Sulphate Management Plan” presented in Table 4.4 (ASSMAC Assessment Guidelines 1998). The table presents action criteria based on ASS soil analysis for different texture categories.

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5.0 Methodology

The Sediment Investigation program was developed based on the definitions and limitations on the type, quantity and quality of data needed to satisfy the project objectives and conducted in accordance with the NSW EPA accredited Site Auditor approved Sampling, Analytical and Quality Plan (SAQP) prepared by AECOM in April 2009 (AECOM, 2009).

5.1 Health and Safety

Prior to the commencement of the sampling works, a site specific health and safety plan was developed. This plan was prepared to protect the health and safety of the AECOM field staff involved with the sample collection.

5.2 Rationale

The approach involved investigation of the footprint of the proposed Marina at approximately 30 m intervals to identify hotspots. Sampling was conducted by the use of a push core and surface grab sample techniques as summarised below:

- 70 push cores samples at approximately 30 m intervals to identify hotspots;
- 16 surface sediment grab samples targeting near shore sediments and areas between the arms of the proposed Marina;
- Two push core locations which targeted the proximity of the URS proposed remediation area (in the vicinity of the former coal loading wharf). AECOM notes that, initially four locations were proposed, but only two could be sampled due to shallow bedrock;
- Two locations which targeted stormwater discharge from the former gas works site along the foreshore area; and
- Three push core background locations away from the Site within Kendall Bay. The background locations targeted areas away from the Marina footprint.

The surface grab samples comprised the following:

- Composite of surface sediment (0.0 – 0.1 m).

The core sampling comprised the following:

- Surface sediment (0.0 – 0.02 m);
- Sub-surface sediment (0.02 – 0.1 m); and
- Subsurface sediment samples at 5 cm to 20 cm intervals at depths between 0.1 m and 0.5 m (e.g 0.2 m to 0.4 m; 0.4 m to 0.5 m).

The above sampling intervals were consistent with the sampling conducted by URS.

5.3 Summary of Field Activities

The field activities undertaken are summarised in **Table 3**. Sampling was undertaken by suitably qualified and trained AECOM environmental scientists.

Table 3: Summary of Field Activities

Date	Activity	Sample Locations
29 April 2009	Collection of core samples	PC1 – PC12.
1 May 2009	Collection of core samples	PC15 – PC17 and PC20 – PC27.
	Collection of samples from the URS proposed remediation area.	PC14 and PC19
	Collection of background samples	PC28, PC29 and PC30.
	Collection of samples from the stormwater discharge points	SW1 and SW2.
8 May 2009	Collection of surface grab sediment samples	SG1 – SG16.

Sample locations are presented on **Figure F2**.

5.4 Sediment Sampling Methodology

5.4.1 Fieldwork

Fieldworks were undertaken between 29 April 2009 and 8 May 2009, by a suitably qualified and experienced AECOM Environmental Scientist in accordance with the SAQP (AECOM, 2009).

The sediment sampling methodology undertaken on the Site is summarised on **Table 4**, below:

Table 4: Sediment Sampling Methodology

Activity	Details
Collection of sediment samples	All core locations were checked for services prior to the commencement of the sampling works by contacting the Dial-Before-You-Dig service, to ensure that the sample locations were free from submerged utilities. Sampling points were located using a differential GPS system.A small boat with shallow draft was utilised to navigate to each sampling location in order to mitigate disturbance of the bed sediments. At each location designated for grab sample, samples retrieved comprised sediments within the upper 10 cm of the surface sediments. The Van Veen grab was deployed from the boat with a davit to lower it to the desired depth. The jaws of the grab were kept open by a fastened hook until the jaws came into contact with the surface sediment. Upon contact with the surface sediments the jaws were shut tight grabbing the sediment sample before the grab was hoisted to the surface. The jaws were then re-opened at the surface to retrieve the sediment sample. Sediment samples were retrieved from the sampler using disposable nitrile gloves and placed into laboratory prepared glass jars with Teflon-lined lids, which were filled to minimise headspace. Sub-surface sediment samples were collected using push coring techniques using a polycarbonate push core lowered from the side of the boat and pushed into the sediment using the handles on the head. A valve on the core was then closed to retain the sediment sample before the core was brought to the surface.

Activity	Details
	Samples from the core sampler were placed into laboratory supplied sampling containers using a stainless steel spatula and nitrile gloves.
Sediment logging	Sediment logging was conducted in general accordance with the Unified Soil Classification System (USCS) and the AECOM documented standard field procedures. Samples were logged and the following information was recorded in the field: soil/rock type, colour, grain size, sorting, angularity, inclusions, moisture conditions, staining and odour. Core logs are provided in **Appendix C**. Photographs of the cores (with scale) were taken at each location.
Field Screening	Sub-samples were placed in snap-locked plastic bags, and the headspace screened in the field for volatile organic compounds (VOCs) using a calibrated Photo ionisation Detector (PID) with a 10.6 eV lamp. Calibration details are provided in **Appendix D**.
Decontamination	Decontamination of all sampling equipment (Push Core and Van Veen Grab samplers) was undertaken using a phosphate free detergent (Decon Solution) followed by a double rinse with deionised water.
Surplus Sediment	Surplus bed sediment was transferred to sealable drums for off site disposal.
QC samples	QC samples comprised collection of intra-laboratory and inter-laboratory duplicates, and Rinsate Blanks. QC samples comprised split samples from a single core and duplicate samples collected within 0.5 m radius of the primary sample location. Tabulated QC results are presented in **Tables T4**

5.5 Analytical Plan

Primary samples were submitted to the ALS Laboratory Group located in Smithfield NSW and samples for inter-laboratory duplicate analysis were submitted to the Labmark Environmental Laboratories located in Asquith NSW. The selected laboratories are National Association of Testing Authorities (NATA) certified for the analysis required.

The ALS NATA accreditation number is 825, and its analytical procedures are based on established internationally-recognised procedures such as those published by the US EPA, APHA, AS and NEPM (1999). In house procedures are employed by ALS in the absence of documented standards.

The Labmark NATA accreditation number is 13542, and its analytical procedures are based on methods referenced from NEPC, ASTM, modified USEPA / APHA.

The selection of samples for analysis was based on field observations, was conducted in accordance with the analytical program presented in the SAQP (AECOM, 2009) and is summarised in **Table 5.**

Table 5: Summary of Analytical Plan

Sample Collection Method	No. of Sampling Locations	No. of Primary Samples to be Analysed	Analytical Program
Push Core	23 locations along the arms of the proposed Marina to approximate depth of 0.5 m	70 primary sediment samples Three sub samples per location. QA/QC samples consisting of field duplicates (3) intra laboratory duplicates, inter-laboratory duplicates (1 in 10 samples) and rinsate blank (1 per day)	**70 primary sediment samples** (plus 23 duplicate QA/QC samples) for: pH Cyanide (Free and Total) PAH TPH BTEX **30 samples for:** Total Organic carbon (TOC). **5 samples from 0.1 to 0.5 m (Anoxic Layer) interval for:** Acid Sulphate Soil
Push Core	Two locations targeting the proximity of the URS proposed remediation areas.	Three sub samples per location.	**6 primary sediment samples** (plus 1 duplicate QA/QC Sample) for: pH Cyanide (Free and Total) PAH TPH BTEX
Push Core	Three background Sample Locations.	Three sub samples per location.	**9 primary sediment samples** (plus 2 duplicate QA/QC samples) for: pH Cyanide (Free and Total) PAH TPH BTEX **6 samples for:** Total Organic carbon (TOC).

Sample Collection Method	No. of Sampling Locations	No. of Primary Samples to be Analysed	Analytical Program
Van Veen Grab	16 Sample Locations	One sample per location	**18 primary sediment samples** (plus 2 duplicate QA/QC samples) for: pH Cyanide (Free and Total) PAH TPH BTEX **16 samples for:** Total Organic carbon (TOC).

Samples were initially analysed for standard level PAH's and any samples with concentrations of Benzo (a) pyrene below the laboratory LOR were then analysed for Ultra trace PAH. All PAH results were normalized to 1% TOC in accordance with ANZECC/ARMCANZ (2000).

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6.0 Quality Assurance and Control

The overall assessment of AECOM's field and laboratory QA/QC data is provided in **Appendix A**.

All samples collected and analysed complied with the predetermined Data Quality Indicators (DQIs), with the exception of the few (justified) deviations from the predetermined DQIs discussed in **Appendix A**.

Based on the assessment, AECOM considers that the data obtained is greater than 95% quantitative and complete, and meets the project goal for completeness. Therefore the reported analytical results are considered useable in general and representative of concentrations of the compounds analysed at the locations sampled

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7.0 Discussion of Results

7.1 Bed Conditions

A very soft black surficial silt layer was observed at PC14, PC15 located in the near shore area of the former coal loading wharf. Hydrocarbon odour and sheen was noted in this surficial layer at PC14 and PC15, nearest the shoreline. This layer ranged from 0.0 - 0.5 m in depth at PC14 and PC15.

A surficial layer of very soft and loose light to dark grey silt was observed at 0- 0.02m depth along the former coal loading wharf and along arm 8 of the proposed Marina. This surficial layer of silt was also noted at grab locations SW1 and SW2 (targeting stormwater outlets) between 0.0 – 0.10 m depth. No hydrocarbon odours or sheen were noted in surficial sediments at these locations, all of which were distant from the shore line except for PC19, which was located in the proposed URS remediation area where hydrocarbon odours and sheen were noted in a subsurface soft dark gravelly silty layer containing crushed shells between 0.02 and 0.5 m depth.

A layer of loose very soft brown grey silt with sand and shell fragments with occasional pockets of darker sediment with an organic odour was observed along the line of arms 1, 2 and 3 of the proposed Marina which extended from 0.0 – 0.62 m depth, to the full sampled extent of sampling.

At the end of arms 2 and 3, nearest the shoreline, this layer was underlain by loose dark brown black fine to coarse grained sand and angular gravel sized shell fragments. Sheen and strong hydrocarbon odours were noted in this sub-surface layer.

Dark brown and black sediment which exhibited hydrocarbon odour and sheen was also noted at the end of the arms 1 and 2, furthest from the shoreline, and from midway to the end of arm 3, at between 0.1 and 0.4 m depth. Darker sediment and odours were noted along arm 3 of the proposed Marina between 0.2 and 0.35 m depth. AECOM notes that the former oil/tar pipeline wharf was previously located between arms 3 and 5 of the proposed Marina (Refer to **Section 8.3** and **Table 11).**

A review of the core logs (**Appendix C**) suggests that at a sporadic pattern of impact to sediment exists across the Site where at the majority of sampled locations along arms 1, 2 and 3 of the proposed Marina, less impacted material is underlain by more impacted material (Refer to PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC16, PC19, PC25, PC27), which at other locations more impacted material is present in surficial sediments (PC14 and PC15 located along the former coal loading wharf.

The sediment mobility assessment undertaken by URS presented in Appendix E of the URS (2006a) concluded that wind, wave and tidal currents are unlikely to significantly influence the re-suspension of sediments in Kendall Bay. However, Rivercat wakes (long waves) are capable of causing near bed oscillatory flows that are able to re-suspend bed sediment and increase near bed turbidity by up to a factor of 20 and may resuspend particles up to 0.5m above the bed level and this may be a contributing factor to the pattern observed during this investigation where more impacted material appeared to be underlain by less impacted material (URS, 2006a).

Core logs describing the shallow subsurface sediment profile encountered during the investigation are included in **Appendix C**.

7.2 Particle Size Distribution

The particle size distribution results were consistent with typical estuarine sediments. The results are generally indicative of fine to medium textured sandy silty clays.

7.3 Field screening and visual observations

PID readings obtained ranged from 0.5 parts per million (ppm) (PC7_0.4 m) to 180 ppm at PC15_0.0 m. The PID screening results are provided on the core logs presented in **Appendix C**. The field screening results indicate moderate hydrocarbon impact at some sample locations and in general the screening results generally correlate with hydrocarbon odours and sheen observed during handling of the samples. Photographic logs of the sediment cores and grab samples are presented in **Appendix C** of this report.

Table 6 presents a summary of sampled locations where, sheen and hydrocarbon odours were noted.

Table 6: Field Screening and Observations

Sample location and depth (m)	PID Result (ppm)	Visual and Olfactory observations
PC3_0.3 m	5.6	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC4_0.25 m	1.4	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC5_0.3 m	1.4	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC6_0.4 m	1.7	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC7_0.4 m	0.5	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC8_0.2 m	0.9	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC9_0.25 m	10.7	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC10_0.1 and 0.45 m	1.8	Sheen and hydrocarbon odour noted with visible product observed
PC11_0.2 m	ND	Sheen and hydrocarbon odour with dark hydrocarbon staining noted.
PC12_0.1 m	ND	Significant sheen and hydrocarbon odour noted/ pockets of dark staining
PC14_0.0-0.02 m	110	Sheen and hydrocarbon odour noted
PC15_0.0 – 0. 15 m	180	Sheen and hydrocarbon odour with black hydrocarbon staining noted.
PC16_0.3 m	14.1	Sheen and hydrocarbon odour noted
PC19_0.02 m	11.8	Sheen and hydrocarbon odour noted
PC21_0.35 m	60.2	Sheen and hydrocarbon odour noted
PC25_0.15 m	15.2	Significant sheen and hydrocarbon odour noted
PC27_0.2m	11.7	Slight hydrocarbon sheen / odour noted

Notes: ND – Not Detected

7.4 Sediment Analytical Results

The sediment analytical results were assessed against the adopted screening levels and are presented in **Table T1** in the table section of this report.

7.4.1 Background Sample Results

Sediment samples were collected from three background locations (PC28, PC29 and PC30). Samples from these locations were analysed for TOC, Cyanide (total and free) TPH/BTEX and PAH. Note that PAH results have been normalised for TOC. The results are summarised below:

- **Free Cyanide and Total Cyanide** concentrations were less than the laboratory LOR for all background sediment samples analysed.
- **BTEX** concentrations were less than the laboratory LOR for all background sediment samples analysed.
- **TPH (C_6-C_9)** concentrations were less than the laboratory LOR for all background sediment samples analysed.
- **TPH (C_{10}-C_{36})** concentrations greater than the laboratory LOR were detected in 5 of the 9 sediment samples analysed in the 515 mg/kg to 1205 mg/kg range
- **Low Molecular weight PAH concentrations** greater than the ISQG – Low (0.552 mg/kg) were detected in 6 of the 9 background samples analysed in the 0.82 mg/kg to 2.21 mg/kg range.
- **High Molecular weight PAH concentrations** greater than the ISQG – Low (1.7 mg/kg) were detected in 5 of the 9 background samples analysed and ranged between 0.29 to 9.29 mg/kg. High molecular weight PAH concentrations greater than the ISQH – H were detected in 2 of the 9 background samples analysed in the 12.27 mg/kg to 15.08 mg/kg range.
- **Total PAH concentrations** greater than the ISQG – Low (4 mg/kg) were detected in 6 of the 9 background samples analysed and ranged between 0.32 mg/kg to 17.29 mg/kg range.

7.4.2 Proposed Marina Bed Sample Results

7.4.2.1 TPH/BTEX

TPH (C_6-C_9) concentrations greater than the laboratory LOR were detected in 4 of the 103 sediment samples analysed and ranged from 51 to 182 mg/kg. The detectable concentrations (above LOR) were greater than the background concentrations reported.

TPH (C_{10}-C_{36}) concentrations greater than the laboratory LOR were detected in 58 of the 103 sediment samples analysed and ranged from 455 to 92900 mg/kg. The detectable concentrations (above LOR) were generally similar to the background concentrations (which ranged between 515 and 1205 mg/kg), with a small portion (about 20% of the samples) were greater than the background concentrations reported.

In general the highest concentrations of TPH (C_{10}-C_{36}) reported were from sample locations nearest the shoreline at PC1, PC5, PC12, PC14, PC15, PC19 and SG8. Locations PC14 and PC15 are located within and to the east of the URS proposed remediation area.

Benzene concentrations greater than the laboratory LOR (0.2 mg/kg) were detected in 5 of the 103 sediment samples analysed. Concentrations ranged from 0.2 to 5.2 mg/kg and were greater than the backgrounds concentrations reported (which were below the laboratory LOR).

Toluene concentrations greater than the laboratory LOR (0.5 mg/kg) were detected in 5 of the 103 sediment samples analysed. Concentrations ranged from 0.6 to 8.5 mg/kg and were greater than the backgrounds concentrations reported (which were below the laboratory LOR).

Ethylbenzene concentrations greater than the laboratory LOR (0.5 mg/kg) were detected in 5 of the 103 sediment samples analysed. Concentrations ranged from 1.0 to 18 mg/kg and were greater than the background concentrations reported (which were below the laboratory LOR)

Xylene (Total) concentrations greater than the laboratory LOR (0.5mg/kg) were reported in 4 of the 103 sediment samples analysed. Concentrations ranged from 2.7 to 58.4 mg/kg and were greater than the background concentrations reported (which were below the laboratory LOR).

7.4.2.2 PAH

Table 7 provides a summary of SAC exceedances for individual low and high molecular weigh PAH and Total PAH. A complete set of results is presented in **Table T1** of this report.

Table 7: Summary of PAH Concentrations

Analyte	Concentration Range (normalised to 1% TOC)	Units	Number of SAC Exceedances	
			Exceeding ANZECC (2000) ISQG - Low Concentration	Exceeding ANZECC (2000) ISQG - High Concentration
Low Molecular Weight PAH Concentrations				
Acenaphthene	0.01 - 13.22	mg/kg	**17**	**14**
Acenaphthylene	0.01 – 55.74	mg/kg	-	-
Anthracene	0.04- 27.03	mg/kg	**57**	**12**
Fluorene	0.001 – 28.43	mg/kg	**31**	**14**
Naphthalene	0.03 – 186.27	mg/kg	**18**	**8**
Phenanthrene	0.01 – 119.33	mg/kg	**34**	**12**
High Molecular Weight PAH Concentrations				
Benzo(k)Fluoranthene	0.18 - 5.59	mg/kg	-	-
Benz(a)anthracene	0.03 - 22.13	mg/kg	**51**	**17**
Benzo(a)pyrene	0.05 – 13.05	mg/kg	**54**	**32**
Benzo(b)Fluoranthene	0.05 – 14.43	mg/kg	-	-
Benzo(g.h.i)perylene	0.01 – 5.29	mg/kg	-	-

Analyte	Concentration Range (normalised to 1% TOC)	Units	Number of SAC Exceedances	
			Exceeding ANZECC (2000) ISQG - Low Concentration	Exceeding ANZECC (2000) ISQG - High Concentration
Dibenz(a.h)anthracene	0.063 – 0.42	mg/kg	**26**	**22**
Fluoranthene	0.04 – 65.92	mg/kg	**26**	**15**
Indeno(1.2.3-cd)pyrene	0.013 – 3.76	mg/kg	-	-
Pyrene	0.04 – 64.95	mg/kg	**44**	**26**
Chrysene	0.14 – 16.81	mg/kg	**28**	**13**
Total Low and High Molecular Weight PAH Concentrations				
Low Molecular Weight PAHs	0.04 – 453.84	mg/kg	**54**	**23**
High Molecular Weight PAHs	0.38 – 210.2	mg/kg	**58**	**34**
Total PAH Concentrations				
Total PAHs	0.32 – 634.59	mg/kg	**60**	**17**

Notes:
- No exceedance

High Molecular Weight PAH (HMWPAH)

Concentrations of HMWPAH for each sampling depth interval have been mapped and are presented on **Figure F3** (0.0-0.02 m), **Figure F4** (0.02 -0.1) and **Figure F5** (0.2 -0.4 m).

Concentrations of HMWPAH along the shoreline exceeded the ISQG-H trigger value for all sampling depth intervals at all sample locations.

Concentrations of HMWPAH in surficial samples (0.0-0.02 m depth) collected along the length of the former coal loading wharf (PC14, PC15, PC16, PC17, PC20, PC21, PC22 and PC12 also exceeded the ISQG-H trigger value (9.6 mg/kg). The remainder of samples locations away from the shoreline (with the exception of PC12 and PC27) and to the south east of the former coal loading wharf generally exceed the ISQG-L value (1.7 mg/kg) only.

A similar pattern exists for sediments in the 0.02 – 0.1 m depth interval where concentrations of HMWPAH in near shore areas generally exceed the ISQG-H trigger value. Concentrations generally decrease with distance from the shoreline with the majority of samples exceeding the ISQG-L value.

Sediments in the 0.2 – 0.4 m depth interval exhibit greater concentrations of PAHs with approximately 65% of the samples exceeding the ISQG-H value. Sediments along the line of the former coal loading wharf generally exceed the ISQG-L value. AECOM understands that a second oil/tar pipeline wharf may have been present to the north of the former coal loading wharf along the shore line. Concentrations of

HMWPAH reported in the sediments at the north eastern end of the former coal loading wharf (PC22) are greater than the laboratory LOR but below the ISQG-L value only.

Overall, with the exception of the URS remediation area, concentrations of HMWPAH generally increased with depth, this trend is consistent with the URS (2006) report.

Low Molecular Weight PAH (LMWPAH)

Concentrations of LMWPAH for each sampling depth interval has been mapped and are presented on **Figures F6** (0.0-0.02 m), **Figure F7** (0.02 -0.1) and **Figure F8** (0.2 -0.4 m).

Concentrations of LMWPAH greater than the ISQG – H trigger value of 3.16 mg/kg follow a similar pattern to the concentrations reported for the HMWPAH. However, the impact appears to be less extensive, with only 50% of the near shore surficial samples exceeding the ISQH-H.

A review of the results indicates concentrations of LMWPAH greater than the ISQG – H in surficial sediments along part of the former coal wharf at sample locations PC13, PC14, PC15, PC16 and PC21

Concentrations of HMWPAH in the sediments away from the shoreline generally exceed the ISQG-L value (0.552 mg/kg), with the exception of SG1, PC2, PC3, PC4, SG6 and PC22, which reported concentrations greater than the laboratory LOR but less than the ISQG-L.

A similar pattern exists for sediments in the 0.02 – 0.1 m depth interval where concentrations of LMWPAH in near shore areas generally exceed the ISQG-H trigger value. However, sediments away from the shoreline generally exceeded the ISQG-L value only, with the exception of sample locations PC2, PC16, PC17, PC19, PC21 and PC24 with reported concentrations greater than the laboratory LOR but less than the ISQG-L.

Sediments in the 0.2 – 0.4 m depth interval exhibit greater concentrations of LMWPAH with approximately 50% of the sediments exceeding the ISQG-H value. Similar to the surficial sediments, LMWPAH concentrations in near shore sediments and along the length of the former oil/tar pipeline wharf generally exceed the ISQG-H trigger value. This pattern is similar to the concentrations of HMWPAH at the 0.2-0.4 m depth interval.

Concentrations of LMWPAH in sediments at the north eastern end of the former coal loading wharf (PC17, PC22, PC23, PC24 and PC26) are greater than the laboratory LOR but below the ISQG-L.

Overall, the sample results for LMWPAH indicate a similar trend to those for the HMWPAH, where concentrations of LMWPAH generally increased with depth, this trend is consistent with the URS (2006) report.

Total PAH

In general, total PAH concentrations displayed a pronounced gradient with generally decreasing concentrations with increasing distance from the shoreline. The highest concentrations of total PAH were noted along the former coal loading wharf (PC14, PC15 and PC16) and along the former oil/tar pipeline wharf (PC9, PC11 and PC12) areas at all sample depths, with significant impact noted between 0.3-0.5 m where the majority of samples exceeded the ISQG – H for Total PAH (45 mg/kg).

The samples collected from the remainder of the footprint either had reported concentrations marginally above the ISQG -H or exceeded the ISQG – L with the exception of PC22_0.3-0.5 m and PC28_0.3-0.5 m that had reported concentrations of high, low and total PAH greater than the laboratory LOR but below the ISQG-L. In the background locations (PC28, PC29 and PC30), concentrations of Total PAH generally exceeded the ISQG – L (4 mg/kg)

7.4.2.3 Cyanide

Free Cyanide concentrations were less than the laboratory LOR for all sediment samples analysed.

Total Cyanide (normalised to 1% TOC) concentrations greater than the laboratory LOR (1 mg/kg) were detected in 11 of the 103 sediment samples analysed. Concentrations ranged from 0.11 to 1.96 mg/kg and were greater than the background concentrations reported (which were less than the LOR of 1mg/kg) , but less than the ISQG-L for all samples analysed.

7.4.2.4 TOC

TOC results ranged from 0.55 % to 49.1 %. The TOC results were generally within the range expected for estuarine sediment (2-8%) with the exception of 4 samples (PC1_0.0-0.02, PC5_0.0-0.02, PC9_0.0-0.02 and SG1_0.0-0.2) which had TOC values between 9.18 and 46.9%.

7.4.2.5 SPOCAS (Acid Sulphate)

The reported oxidisable sulphur values ranged between 0.54 to 2.53 % which were above the ASSMAC (1998) action levels of 0.06 % (1-1000 tonne) and 0.03 % (>1000 tonne) for fine to medium grained material in all 5 samples tested.

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8.0 Site Characterisation

8.1 Sediment characteristics

Sediment within and around the Site are predominantly composed of fine to medium grained material consisting of sandy silty clays with some coarser gravels present near shore. Silty and clayey material appears to increase towards the central section of the Site. These characteristics are consistent with those reported for the sediments within Kendall Bay in URS (2006a).

The reported TOC results are consistent with typical estuarine sediments with the exception of four samples (PC1_0.0-0.02, PC5_0.0-0.02, PC9_0.0-0.02 and SG1_0.0-0.2) with TOC values between 9.18 and 46.9%. These samples with elevated TOC were collected from near the shoreline and correlate with the elevated concentrations of TPH and PAH concentrations, which suggests that the TPH and PAH concentrations are contributing to the high TOC.

Review of the TOC results (determined by laboratory analysis and not calculated as an average value) indicates that, TOC content was generally highest in the upper 20 cm of the bed profile and decreased with depth.

8.2 Acid Sulphate

The analytical results for SPOCAS analysis indicated the presence of acid sulphate material between 0.2 and 0.4 m (anoxic layer) at the sample locations tested.

8.3 Extent and Nature of Contamination

The analytical results are generally consistent with the URS (2006) findings, with the concentrations of TPH and total PAHs generally highest in the near shore sediments (particularly in the URS proposed remediation area) and around the areas previously occupied by the former coal loading and tar/oil wharf.

PAH concentrations generally decrease with depth between the surficial and 0.02-0.1 m depth interval but then increase in the 0.2-0.4 m depth interval suggesting that relatively clean material overlies contaminated sediments, consistent with the URS (2006) findings. However there are also sporadic locations across the Site where contaminated material overlies cleaner material (e.g. PC5, PC12, PC14, PC17, PC19, PC20, PC21, PC23, PC26, PC28, PC29 and PC30). This is consistent with observations made during the investigation where sheen and hydrocarbon odours were observed at a number of locations at a distance from the shoreline (PC8, PC12, PC24 and PC27) at varying depths throughout the bed profile.

Sheen, discolouration and hydrocarbon odours were noted at 16 of the sample locations (PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC14, PC15, PC16, PC19, PC21, PC25 and PC27), refer to **Table 6**. The majority of these samples were within subsurface sediments. Dark sediment was noted in PC9 (0.15 -0.3 m) and PC11_0.2 m. Visible hydrocarbon sheen was observed in PC3 at 0.3 m, PC10 at 0.45 m depth and PC15 at 0.15-0.62 m depth, these sample locations were approximately 50 to 100 m from the shoreline.

Metal concentrations do not follow a trend and are inconsistent across the Site. Mercury, Nickel and Zinc concentrations generally exceed their respective ISQG – H screening values for the majority of surface grab samples analysed. Concentrations of arsenic, chromium and copper exceeded their respective ISQG – L screening values only for the majority of surface grab samples analysed.

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9.0 Conclusions

The following conclusions can be drawn from the sediment investigation:

- Sediments comprised fine to medium grained sandy silty clay and are representative of typical estuarine sediments;
- TOC content was generally highest in the upper 20 cm of the bed profile and decreased with depth;
- The sediments at the Site contain elevated concentrations of TPH and PAH;
- Approximately 35% the samples collected at the Site had reported PAH concentrations that were greater than the ISQG-H and approximately 65% of the samples had reported PAH concentrations that were greater than the ISQG-L;
- The highest concentrations of PAHs were in the sub-surface sediments (between 0.02 – 0.1 m and increasing between 0.2-0.4 m) with lower concentrations detected in the surficial sediments (between 0.0 - 0.02m); and
- Potential acid sulphate soils are present at depths between 0.2 and 0.4 m below bed level.

Based on the above, AECOM considers that a Marina can be constructed over the sediments provided the following should are prepared and implemented:

- Construction Environmental Management Plan; and
- Operational Environmental Management Plan.

These documents should address the following:

- Appropriate environmental controls;
- Contaminated sediment management procedures;
- Monitoring procedures; and
- Vessel access and navigation.

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10.0 References

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Tables

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Table T1.
Sediment Analytical Results
(Inorganics,BTEX, TPH and PAH (inc normalised to 1% TOC)

AECOM

	Analyte	Units	LOR	ANZECC (2000) Interim Sediment Quality Guidelines - High	ANZECC (2000) Interim Sediment Quality Guidelines - Low	PC1 0.0 - 0.02 29/04/2009	PC1 0.02 - 0.1 29/04/2009	PC1 0.2 - 0.4 29/04/2009	PC2 0.0 - 0.02 29/04/2009	PC2 0.02 - 0.1 29/04/2009	PC2 0.25 - 0.4 29/04/2009	PC3 0.0 - 0.02 29/04/2009	PC3 0.02 - 0.1 29/04/2009	PC3 0.1 - 0.25 29/04/2009	PC3 0.3 - 0.4 29/04/2009	PC4 0.0 - 0.02 29/04/2009	PC4 0.02 - 0.1 29/04/2009	PC4 0.25 - 0.4 29/04/2009	PC5 0.0 - 0.02 29/04/2009	PC5 0.02 - 0.1 29/04/2009	PC5 0.25 - 0.4 29/04/2009	PC6 0.0 - 0.02 29/04/2009	PC6 0.02 - 0.1 29/04/2009
Metals	Mercury	mg/kg	0.1	1	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arsenic	mg/kg	5	70	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cadmium	mg/kg	1	10	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Chromium	mg/kg	2	370	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Copper	mg/kg	5	270	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	5	220	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nickel	mg/kg	2	52	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zinc	mg/kg	5	410	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inorganics	Cyanide (Free)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Moisture	%	1			39.5	29.1	27.2	47.7	41.7	36.1	63.2	55.5	49	54	58	54	48	57.2	28.1	25	59.6	51.2
	TOC	%	0.02			9.18	7.26	3.13	4.62	2.83	2.7	5.27	4.5	4.02	4.2	4.23	4.13	3.51	14.9	3.06	0.55	5.28	7.14 ^
BTEX	Benzene	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene Total	mg/kg				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50			70	<50	<50	<50	<50	<50	<100	<50	<50	<100	<50	<50	<50	<100	160	<50	<50	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100			1280	1620	990	310	340	400	<200	460	540	730	190	450	330	2680	2430	130	530	490
	TPH C_{29}-C_{36} Fraction	mg/kg	100			1150	1440	890	400	350	380	460	510	600	610	240	520	380	2390	940	<100	600	430
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg				2500	3085	1905	735	715	805	610	995	1165	1390	455	995	735	5120	3530	205	1155	945
LABORATORY REPORTED PAH	Acenaphthene	mg/kg	RLCA			<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.5	<0.8	24.2	1.7	<0.8	<0.8
	Acenaphthylene	mg/kg	RLCA			8.6	10.8	6.1	1	2.1	2.5	1	1.8	1.5	1.3	0.8	1.6	0.7	10	32.4	3.6	3.3	3.7
	Anthracene	mg/kg	RLCA			2.7	3.8	2.2	<0.5	0.8	0.9	<0.8	0.9	0.8	<0.8	<0.8	<0.8	<0.5	3.6	49.4	3.6	1.5	1
	Benz(a)anthracene	mg/kg	RLCA			8.3	8.1	5.2	0.9	2	2.9	<0.8	1.3	1.1	1.5	<0.8	1.3	0.8	5.9	38.8	0.9	1.7	1.8
	Benzo(a) pyrene	mg/kg	RLCA			22.3	26.1	16.2	2	4	5.2	1.8	3.5	3.2	3.3	1.6	3.1	1.9	14.7	30	0.6	5.3	5.1
	Benzo(b)fluoranthene	mg/kg	RLCA			23.2	25	15.8	1.7	3.6	5.7	1.9	3.4	3.7	3.6	1.4	3.6	1.8	16	31.1	0.6	6	5.5
	Benzo(g,h,i)perylene	mg/kg	RLCA			11.7	13.8	8.3	1.2	2.5	3.1	1.2	2.7	2.3	1.8	1.2	2.2	1.2	8.5	15.3	<0.5	3.4	3.8
	Benzo(k)fluoranthene	mg/kg	RLCA			6.7	12.7	8.4	1	1.9	1.8	<0.8	1.2	1.2	1.1	0.9	1	1.1	5.4	9.5	<0.5	1.8	2.3
	Chrysene	mg/kg	RLCA			6.8	7.9	4.2	0.8	1.8	2.5	<0.8	1.3	1.2	1.6	<0.8	1.4	0.8	6	29	0.7	1.8	1.4
	Dibenz(a,h)anthracene	mg/kg	RLCA			2.5	3	1.8	<0.5	<0.5	0.6	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.5	1.7	2.8	<0.5	<0.8	0.9
	Fluoranthene	mg/kg	RLCA			15.4	12.6	6.3	1.2	2.8	4	1.3	2.3	2	2.4	1.2	2.3	1.5	9.8	54.9	4.5	3.2	2.6
	Fluorene	mg/kg	RLCA			0.8	1.1	<0.5	<0.5	<0.5	<0.5	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.5	1.2	4.5	2.6	<0.8	<0.8
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA			9.4	11.2	6.8	0.9	1.8	2.3	0.9	1.9	1.7	1.4	0.8	1.5	0.9	6.4	11.5	<0.5	2.6	2.9
	Naphthalene	mg/kg	RLCA			2.5	3.5	1.3	<0.5	0.8	0.8	<0.8	<0.8	0.6	<0.8	<0.8	<0.8	<0.5	4.2	6.7	5.4	2.1	<0.8
	Phenanthrene	mg/kg	RLCA			1.8	2.8	1.5	<0.5	0.9	0.8	<0.8	1	0.9	<0.8	<0.8	1	<0.5	3	85.3	10.9	1.8	0.9
	Pyrene	mg/kg	RLCA			35.4	43.4	25.5	2.4	5.5	6.9	2.2	3.9	3.3	7.2	1.7	3.5	2.2	22.1	55.1	4.3	5.7	4.1
	Total PAH	mg/kg	0.01-0.8			158	186	110	13	31	40	10	25	24	25	10	23	13	119	481	39	40	36
SVOC	3-methylcholanthrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-(acetylamino) fluorene	mg/kg	0.1			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Benzo(e)pyrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coronene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Perylene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAH Normalised to 1% TOC	Acenaphthene	mg/kg	RLCA	0.5	0.016	<0.5	0.07	<0.5	<0.5	<0.5	<0.5	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.5	<0.8	7.91	3.09	<0.8	<0.8
	Acenaphthylene	mg/kg	RLCA			0.94	1.49	1.95	0.22	0.74	0.93	0.19	0.40	0.37	0.31	0.19	0.39	0.20	0.67	10.59	6.55	0.63	0.52
	Anthracene	mg/kg	RLCA	1.1	0.085	0.29	0.52	0.70	<0.5	0.28	0.33	<0.8	0.20	0.20	<0.8	<0.8	<0.8	<0.5	0.24	16.14	6.55	0.28	0.14
	Benz(a)anthracene	mg/kg	RLCA	1.6	0.261	0.90	1.12	1.66	0.19	0.71	1.07	<0.8	0.29	0.27	0.36	<0.8	0.31	0.23	0.40	12.68	1.64	0.32	0.25
	Benzo(a) pyrene	mg/kg	RLCA	1.6	0.43	2.43	3.60	5.18	0.43	1.41	1.93	0.34	0.78	0.80	0.79	0.38	0.75	0.54	0.99	9.80	1.09	1.00	0.72
	Benzo(b)fluoranthene	mg/kg	RLCA	-	-	2.53	3.44	5.05	0.37	1.27	2.11	0.36	0.76	0.92	0.86	0.33	0.87	0.51	1.07	10.16	1.09	1.14	0.77
	Benzo(g,h,i)perylene	mg/kg	RLCA	-	-	1.27	1.90	2.65	0.26	0.88	1.15	0.23	0.60	0.57	0.43	0.28	0.53	0.34	0.57	5.00	<0.5	0.64	0.53
	Benzo(k)fluoranthene	mg/kg	RLCA	-	-	0.73	1.75	2.68	0.22	0.67	0.67	<0.8	0.27	0.30	0.26	0.21	0.24	0.31	0.36	3.10	<0.5	0.34	0.32
	Chrysene	mg/kg	RLCA	2.8	0.384	0.74	1.09	1.34	0.17	0.64	0.93	<0.8	0.29	0.30	0.38	<0.8	0.34	0.23	0.40	9.48	1.27	0.34	0.20
	Dibenz(a,h)anthracene	mg/kg	RLCA	0.26	0.063	0.27	0.41	0.58	<0.5	<0.5	0.22	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.5	0.11	0.92	<0.5	<0.8	0.13
	Fluoranthene	mg/kg	RLCA	5.1	0.6	1.68	1.74	2.01	0.26	0.99	1.48	0.25	0.51	0.50	0.57	0.28	0.56	0.43	0.66	17.94	8.18	0.61	0.36
	Fluorene	mg/kg	RLCA	0.54	0.019	0.09	0.15	<0.5	<0.5	<0.5	<0.5	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.5	0.08	1.47	4.73	<0.8	<0.8
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	-	-	1.02	1.54	2.17	0.19	0.64	0.85	0.17	0.42	0.42	0.33	0.19	0.36	0.26	0.43	3.76	<0.5	0.49	0.41
	Naphthalene	mg/kg	RLCA	2.1	0.16	0.27	0.48	0.42	<0.5	0.28	0.30	<0.8	<0.8	0.15	<0.8	<0.8	<0.8	<0.5	0.28	2.19	9.82	0.40	<0.8
	Phenanthrene	mg/kg	RLCA	1.5	0.24	0.20	0.39	0.48	<0.5	0.32	0.30	<0.8	0.22	0.22	<0.8	<0.8	0.24	<0.5	0.20	27.88	19.82	0.34	0.13
	Pyrene	mg/kg	RLCA	2.6	0.665	3.86	5.98	8.15	0.52	1.94	2.56	0.42	0.87	0.82	1.71	0.40	0.85	0.63	1.48	18.01	7.82	1.08	0.58
PAH Normalised to 1% TOC																							
	Low Molecular weight PAHs			3.16	0.552	2.54	4.16	5.30	0.41	1.98	2.41	0.36	1.24	1.22	0.64	0.38	0.99	0.46	1.62	67.75	50.55	1.65	0.79
	High molecular weight PAHs			9.600	1.700	15.44	22.56	31.47	2.62	9.15	12.96	1.76	4.78	4.90	5.69	2.08	4.82	3.48	6.48	90.85	21.09	5.97	4.26
	Total PAHs			45.0	4	17.22	25.66	35.02	2.84	10.78	14.81	1.95	5.60	5.85	6.00	2.27	5.45	3.68	7.95	157.03	71.64	7.61	5.05
Total Cyanide normalised to 1% TOC																							
	Total Cyanide	mg/kg	1	-	25*	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Bold text and highlighted cells denote concentrations greater than the adopted screening levels
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
ANZECC (2000) = Australian and New Zealand Interim Sediment Quality Guidelines (Low and High)
* Sediment quality value is derived from Chronic marine EqP threshold at 1% TOC (Bolton et al 1985, cited in MacDonaled et al 1999) where ANZECC ISQG Value not available
RLCA - Refer to Laboratory Certificates of Analysis
^ = Value derived from average of TOC results

Data Entry: LW
Checked By: CD
AECOM

Table T1.
Sediment Analytical Results
(Inorganics,BTEX, TPH and PAH (inc normalised to 1% TOC)

AECOM

	Analyte	Units	LOR	ANZECC (2000) Interim Sediment Quality Guidelines - High	ANZECC (2000) Interim Sediment Quality Guidelines - Low	PC6 0.25 - 0.4 29/04/2009	PC7 0.0 - 0.02 29/04/2009	PC7 0.02 - 0.1 29/04/2009	PC7 0.25 - 0.45 29/04/2009	PC8 0.0 - 0.02 29/04/2009	PC8 0.02 - 0.1 29/04/2009	PC8 0.25 - 0.4 29/04/2009	PC9 0.0 - 0.02 29/04/2009	PC9 0.02 - 0.1 29/04/2009	PC9 0.3 - 0.4 29/04/2009	PC10 0.0 - 0.02 29/04/2009	PC10 0.02 - 0.1 29/04/2009	PC10 0.2 - 0.35 29/04/2009	PC11 0.0 - 0.02 29/04/2009	PC11 0.02 - 0.1 29/04/2009	PC11 0.25 - 0.5 29/04/2009	PC12 0.0 - 0.02 29/04/2009
Metals	Mercury	mg/kg	0.1	1	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arsenic	mg/kg	5	70	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cadmium	mg/kg	1	10	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Chromium	mg/kg	2	370	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Copper	mg/kg	5	270	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	5	220	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nickel	mg/kg	2	52	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zinc	mg/kg	5	410	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inorganics	Cyanide (Free)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	**2**	<1	**4**	<1	<1	<1	<1	<1	<1	<1
	Moisture	%	1			54.5	56	49.3	60.6	56.4	51.3	54.5	58.3	49.4	62.7	55.7	55.5	56.1	56.7	44.9	57.6	55.3
	TOC	%	0.02			5.19	7.14 ^	7.14 ^	3.43	7.14 ^	4.29	5.08	15.3	12.8	7.57	7.14 ^	7.14 ^	5.9	7.14 ^	7.14 ^	7.14 ^	4.99
BTEX	Benzene	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene Total	mg/kg				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50			<50	<50	<50	130	<50	<50	<50	<50	150	350	<50	<50	230	<50	<50	290	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100			650	430	360	1260	260	250	560	2120	2190	3970	720	760	2470	530	1430	3040	710
	TPH C_{29}-C_{36} Fraction	mg/kg	100			500	380	320	710	180	250	360	1710	1720	1880	600	780	1310	540	950	1290	570
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg				1175	835	705	2100	465	525	945	3855	4060	6200	1345	1565	4010	1095	2405	4620	1305
LABORATORY REPORTED PAH	Acenaphthene	mg/kg	RLCA			<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.8	3.5	3.1	1	<0.8	<0.8	0.8	<0.8	<0.5	29.7	<0.8
	Acenaphthylene	mg/kg	RLCA			5	3.2	4	4.8	2	2.6	2.8	40.4	37	14.7	7	8.4	12.4	7.1	8.8	25	5.6
	Anthracene	mg/kg	RLCA			1.3	<0.8	1	1.4	<0.8	<0.8	0.9	13	11.6	5.6	1.6	1.8	4	1.7	2.5	16.9	1.4
	Benz(a)anthracene	mg/kg	RLCA			2.7	2.1	2.6	2.1	1.4	1.6	2.1	19	16.2	26.5	2.7	2.8	12.8	3.1	2.7	31.5	2.8
	Benzo(a) pyrene	mg/kg	RLCA			8.4	4.9	6.1	10.6	3	3.8	6.1	38.6	38.1	23.5	9.3	15.1	17	10	14.8	24.5	9.4
	Benzo(b)fluoranthene	mg/kg	RLCA			8.6	5.4	6.6	11.4	3.3	4.4	6.6	40.2	44.8	28	9.8	17.3	19.7	10.2	17	27.1	11
	Benzo(g,h,i)perylene	mg/kg	RLCA			5.1	3.8	4.4	6.1	2.1	2.7	3.7	22.9	22.4	11.6	5.6	9.4	8.2	5.8	7.8	11.5	5.4
	Benzo(k)fluoranthene	mg/kg	RLCA			4.4	2.3	2.9	5.6	1.4	1.7	2.8	22.9	15.9	10.6	4.6	6.4	6.9	4.8	5.9	13.4	3.1
	Chrysene	mg/kg	RLCA			2.2	1.5	1.9	3.7	1	1.1	1.7	18.7	16.4	25.9	1.9	2.4	12.4	2.1	4.4	28.8	2.4
	Dibenz(a,h)anthracene	mg/kg	RLCA			1	<0.8	0.8	1.4	<0.8	<0.8	<0.8	5.3	5.5	3	1.2	1.8	2.3	1.4	2.1	3.2	1.1
	Fluoranthene	mg/kg	RLCA			4.2	2.7	3	5.6	1.9	2.1	2.7	23	19.6	57.3	3	2.9	21.6	4	3.8	71.2	4.8
	Fluorene	mg/kg	RLCA			<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.8	6	5.2	2.2	<0.8	0.8	1.6	<0.8	1.3	5.4	<0.8
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA			3.8	2.9	3.2	4.8	1.6	2	2.9	17.7	18.4	8.9	4.5	7.6	6.7	4.4	6.4	9.6	4.5
	Naphthalene	mg/kg	RLCA			0.9	<0.8	0.6	<0.8	<0.8	1	<0.8	9.4	7.2	3.4	1.2	1.1	2	1.4	2.8	5	1.3
	Phenanthrene	mg/kg	RLCA			1.1	0.8	0.9	0.9	<0.8	<0.8	0.9	9.1	7.5	3.3	1.1	1.2	2.5	1.2	1.9	6.9	1
	Pyrene	mg/kg	RLCA			9.9	4.4	5.2	20.4	2.8	3.2	7.6	40.3	35.9	66	7.2	11	6.4	8.9	2.4	73.6	9.9
	Total PAH	mg/kg	0.01-0.8			59	34	43	79	21	26	41	330	305	292	61	90	137	66	85	383	64
SVOC	3-methylcholanthrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-(acetylamino) fluorene	mg/kg	0.1			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Benzo(e)pyrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coronene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Perylene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAH Normalised to 1% TOC	Acenaphthene	mg/kg	RLCA	0.5	0.016	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.8	0.23	0.24	0.13	<0.5	<0.5	0.14	<0.8	<0.5	4.16	<0.8
	Acenaphthylene	mg/kg	RLCA			0.96	0.45	0.56	1.40	0.28	0.61	0.55	2.64	2.89	1.94	0.98	1.18	2.10	0.99	1.23	3.50	1.12
	Anthracene	mg/kg	RLCA	1.1	0.085	0.25	<0.8	0.14	0.41	<0.8	<0.8	0.18	0.85	0.91	0.74	0.22	0.25	0.68	0.24	0.35	2.37	0.28
	Benz(a)anthracene	mg/kg	RLCA	1.6	0.261	0.52	0.29	0.36	0.61	0.20	0.37	0.41	1.24	1.27	3.50	0.38	0.39	2.17	0.43	0.38	4.41	0.56
	Benzo(a) pyrene	mg/kg	RLCA	1.6	0.43	1.62	0.69	0.85	3.09	0.42	0.89	1.20	2.52	2.98	3.10	1.30	2.11	2.88	1.40	2.07	3.43	1.88
	Benzo(b)fluoranthene	mg/kg	RLCA	-	-	1.66	0.76	0.92	3.32	0.46	1.03	1.30	2.63	3.50	3.70	1.37	2.42	3.34	1.43	2.38	3.80	2.20
	Benzo(g,h,i)perylene	mg/kg	RLCA	-	-	0.98	0.53	0.62	1.78	0.29	0.63	0.73	1.50	1.75	1.53	0.78	1.32	1.39	0.81	1.09	1.61	1.08
	Benzo(k)fluoranthene	mg/kg	RLCA	-	-	0.85	0.32	0.41	1.63	0.20	0.40	0.55	1.50	1.24	1.40	0.64	0.90	1.17	0.67	0.83	1.88	0.62
	Chrysene	mg/kg	RLCA	2.8	0.384	0.42	0.21	0.27	1.08	0.14	0.26	0.33	1.22	1.28	3.42	0.27	0.34	2.10	0.29	0.62	4.03	0.48
	Dibenz(a,h)anthracene	mg/kg	RLCA	0.26	0.063	0.19	<0.8	0.11	0.41	<0.8	<0.8	<0.8	0.35	0.43	0.40	0.17	0.25	0.39	0.20	0.29	0.45	0.22
	Fluoranthene	mg/kg	RLCA	5.1	0.6	0.81	0.38	0.42	1.63	0.27	0.49	0.53	1.50	1.53	7.57	0.42	0.41	3.66	0.56	0.53	9.97	0.96
	Fluorene	mg/kg	RLCA	0.54	0.019	<0.8	<0.8	<0.5	<0.8	<0.8	<0.8	<0.8	0.39	0.41	0.29	<0.8	0.11	0.27	<0.8	0.18	0.76	<0.8
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	-	-	0.73	0.41	0.45	1.40	0.22	0.47	0.57	1.16	1.44	1.18	0.63	1.06	1.14	0.62	0.90	1.34	0.90
	Naphthalene	mg/kg	RLCA	2.1	0.16	0.17	<0.8	0.08	<0.8	<0.8	0.23	<0.8	0.61	0.56	0.45	0.17	0.15	0.34	0.20	0.39	0.70	0.26
	Phenanthrene	mg/kg	RLCA	1.5	0.24	0.21	0.11	0.13	0.26	<0.8	<0.8	0.18	0.59	0.59	0.44	0.15	0.17	0.42	0.17	0.27	0.97	0.20
	Pyrene	mg/kg	RLCA	2.6	0.665	1.91	0.62	0.73	5.95	0.39	0.75	1.50	2.63	2.80	8.72	1.01	1.54	1.08	1.25	0.34	10.31	1.98
PAH Normalised to 1% TOC																						
	Low Molecular weight PAHs			3.16	0.552	1.60	0.56	0.91	2.07	0.28	0.84	0.91	5.32	5.59	3.99	1.53	1.86	3.95	1.60	2.42	12.45	1.86
	High molecular weight PAHs			9.600	1.700	9.69	4.20	5.14	20.90	2.59	5.27	7.13	16.25	18.22	34.52	6.97	10.74	19.32	7.66	9.43	41.23	10.90
	Total PAHs			45.0	4	11.29	4.76	6.05	22.97	2.87	6.11	8.03	21.57	23.81	38.51	8.50	12.61	23.27	9.26	11.85	53.68	12.77
Total Cyanide normalised to 1% TOC																						
	Total Cyanide	mg/kg	1	-	25*	<1	<1	<1	<1	<1	<1	<1	0.13	<1	0.53	<1	<1	<1	<1	<1	<1	<1

Bold text and highlighted cells denote concentrations greater than the adopted screening levels
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
ANZECC (2000) = Australian and New Zealand Interim Sediment Quality Guidelines (Low and High)
* Sediment quality value is derived from Chronic marine EqP threshold at 1% TOC (Bolton et al 1985, cited in MacDonaled et al 1999) where ANZECC ISQG Value not available
RLCA - Refer to Laboratory Certificates of Analysis
^ = Value derived from average of TOC results

Data Entry: LW
Checked By: CD
AECOM

Table T1.
Sediment Analytical Results
(Inorganics,BTEX, TPH and PAH (inc normalised to 1% TOC)

AECOM

	Analyte	Units	LOR	ANZECC (2000) Interim Sediment Quality Guidelines - High	ANZECC (2000) Interim Sediment Quality Guidelines - Low	PROPOSED URS REMEDIATION AREA														PROPOSED URS REMEDIATION AREA		
						PC12	PC12	PC14	PC14	PC14	PC15	PC15	PC15	PC16	PC16	PC16	PC17	PC17	PC17	PC19	PC19	PC19
						0.02 - 0.1	0.25 - 0.4	0.0 - 0.02	0.02 - 0.1	0.3 - 0.5	0.0 - 0.02	0.02 - 0.1	0.3 - 0.5	0.0 - 0.02	0.02 - 0.1	0.3 - 0.6	0.0 - 0.02	0.02 - 0.1	0.2 - 0.5	0.0 - 0.02	0.02 - 0.1	0.3 - 0.5
						29/04/2009	29/04/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009
Metals	Mercury	mg/kg	0.1	1	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arsenic	mg/kg	5	70	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cadmium	mg/kg	1	10	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Chromium	mg/kg	2	370	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Copper	mg/kg	5	270	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	5	220	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nickel	mg/kg	2	52	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zinc	mg/kg	5	410	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inorganics	Cyanide (Free)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1			<1	<1	**3**	**10**	**11**	<1	**5**	**14**	<1	<1	<1	<1	<1	<1	**4**	**2**	<1
	Moisture	%	1			45.3	43.4	47	49	40.2	65	52.3	54.7	62.5	64.9	50.2	69.3	56.2	51.7	32.8	49	54.5
	TOC	%	0.02			7.14 ^	3.11	7.14 ^	49.1	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^
BTEX	Benzene	mg/kg	0.2			<0.2	<0.2	0.2	0.9	5.2	<0.2	0.2	1.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.5			<0.5	<0.5	<0.5	5	18	1	6.5	17.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	2	8.5	0.6	0.9	8.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5	<0.5	<0.5	3.4	34.2	<0.5	1.6	24.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.5			<0.5	<0.5	<0.5	3.1	24.2	<0.5	1.1	16.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene Total	mg/kg				<1	<1	<1	6.5	58.4	<1	2.7	40.7	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10			<10	<10	<10	51	162	<10	66	182	<10	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50			<50	800	760	2400	7720	930	2880	19800	<50	<50	<50	<50	<50	<50	300	470	130
	TPH C_{15} - C_{28} Fraction	mg/kg	100			1100	9940	9190	30000	26800	8680	19200	61100	210	310	730	<100	580	460	4100	6150	2380
	TPH C_{29}-C_{36} Fraction	mg/kg	100			900	4280	4540	11000	9120	4160	6490	12000	210	290	760	<100	640	520	2800	4110	1810
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg				2025	15020	14490	43400	43640	13770	28570	92900	445	625	1515	<250	1245	1005	7200	10730	4320
LABORATORY REPORTED PAH	Acenaphthene	mg/kg	RLCA			<0.5	4.5	11.6	139	59.6	17.6	47.2	94.4	<0.8	<0.8	<0.8	0.16	<0.8	<0.8	5.1	7.7	1.7
	Acenaphthylene	mg/kg	RLCA			4.8	24	44	236	181	65.6	134	398	1.2	1.8	2.9	1.95	1.6	1.1	45.6	61.5	16.3
	Anthracene	mg/kg	RLCA			1.8	27.7	36.5	281	193	43.2	114	258	<0.8	<0.8	1.2	0.85	<0.8	<0.8	17.2	21.5	4.6
	Benz(a)anthracene	mg/kg	RLCA			2.4	54.4	57.3	163	129	55.9	85.2	158	1	1.3	1.8	2.38	1.3	0.8	30.4	41	<0.8
	Benzo(a) pyrene	mg/kg	RLCA			10.5	40.6	42.7	103	76.5	50.2	57	91.7	2.1	2.9	4.4	5.24	3.1	2.4	45.8	62.4	21.4
	Benzo(b)fluoranthene	mg/kg	RLCA			12	48.3	45.9	111	85.3	51.7	63.8	103	1.8	2.7	4.4	4.2	3.3	2.5	48.2	67.6	24.1
	Benzo(g,h,i)perylene	mg/kg	RLCA			6.9	19.3	20.5	56.2	34	15.6	25.3	37.8	1.2	1.7	2.8	3.55	2.2	1.7	16.2	21.6	8
	Benzo(k)fluoranthene	mg/kg	RLCA			5.5	17.4	16.2	29.5	22.8	19.1	16.8	25.8	0.9	1.3	1.9	2.74	1.2	1	10.5	14.7	9.2
	Chrysene	mg/kg	RLCA			2.6	47	48	128	108	46.8	73	120	1	1.3	1.8	2.15	1.2	0.9	25.4	33	<0.8
	Dibenz(a,h)anthracene	mg/kg	RLCA			1.2	4	4.1	8.6	<8	3.7	<8	<16	<0.8	<0.8	<0.8	0.73	<0.8	<0.8	3.8	5.4	1.8
	Fluoranthene	mg/kg	RLCA			4.8	205	132	395	271	158	187	352	1.4	1.9	3.4	3.61	2	1.5	72.9	94	9.5
	Fluorene	mg/kg	RLCA			0.7	4.6	14.2	316	203	18	108	308	<0.8	<0.8	0.8	0.4	<0.8	<0.8	6.7	8.2	2
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA			5.4	16	15	37.1	26	13.8	19.6	28.3	1	1.4	2.2	2.64	1.7	1.3	14.5	20.4	6.8
	Naphthalene	mg/kg	RLCA			3.9	5.8	21.5	160	1110	72.1	86.9	1330	0.8	0.8	1.6	1.06	<0.8	<0.8	17.3	17.5	2.5
	Phenanthrene	mg/kg	RLCA			2.1	8.4	59.1	1320	597	66.1	342	852	<0.8	0.9	2.8	1.47	0.9	0.8	22	31.2	5
	Pyrene	mg/kg	RLCA			18.3	202	144	551	292	175	210	374	2.2	3.1	4.3	5.24	3	2.1	111	150	61.8
	Total PAH	mg/kg	0.01-0.8			83	729	713	4034	3388	872	1570	4531	15	21	36	38	22	16	493	658	175
SVOC	3-methylcholanthrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	<0.01	-	-	-	-	-
	2-(acetylamino) fluorene	mg/kg	0.1			-	-	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	0.44	-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	<0.01	-	-	-	-	-
	Benzo(e)pyrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	2.74	-	-	-	-	-
	Coronene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	0.68	-	-	-	-	-
	Perylene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	-	-	0.98	-	-	-	-	-
PAH Normalised to 1% TOC	Acenaphthene	mg/kg	RLCA	0.5	0.016	<0.5	1.45	1.62	2.83	8.35	2.46	6.61	13.22	<0.8	<0.8	<0.8	0.02	<0.8	<0.8	0.71	1.08	0.24
	Acenaphthylene	mg/kg	RLCA			0.67	7.72	6.16	4.81	25.35	9.19	18.77	55.74	0.17	0.25	0.41	0.27	0.22	0.15	6.39	8.61	2.28
	Anthracene	mg/kg	RLCA	1.1	0.085	0.25	8.91	5.11	5.72	27.03	6.05	15.97	36.13	<0.8	<0.8	0.17	0.12	<0.8	<0.8	2.41	3.01	0.64
	Benz(a)anthracene	mg/kg	RLCA	1.6	0.261	0.34	17.49	8.03	3.32	18.07	7.83	11.93	22.13	0.14	0.18	0.25	0.33	0.18	0.11	4.26	5.74	<0.8
	Benzo(a) pyrene	mg/kg	RLCA	1.6	0.43	1.47	13.05	5.98	2.10	10.71	7.03	7.98	12.84	0.29	0.41	0.62	0.73	0.43	0.34	6.41	8.74	3.00
	Benzo(b)fluoranthene	mg/kg	RLCA	-	-	1.68	15.53	6.43	2.26	11.95	7.24	8.94	14.43	0.25	0.38	0.62	0.59	0.46	0.35	6.75	9.47	3.38
	Benzo(g,h,i)perylene	mg/kg	RLCA	-	-	0.97	6.21	2.87	1.14	4.76	2.18	3.54	5.29	0.17	0.24	0.39	0.50	0.31	0.24	2.27	3.03	1.12
	Benzo(k)fluoranthene	mg/kg	RLCA	-	-	0.77	5.59	2.27	0.60	3.19	2.68	2.35	3.61	0.13	0.18	0.27	0.38	0.17	0.14	1.47	2.06	1.29
	Chrysene	mg/kg	RLCA	2.8	0.384	0.36	15.11	6.72	2.61	15.13	6.55	10.22	16.81	0.14	0.18	0.25	0.30	0.17	0.13	3.56	4.62	<0.8
	Dibenz(a,h)anthracene	mg/kg	RLCA	0.26	0.063	0.17	1.29	0.57	0.18	<8	0.52	<8	<16	<0.8	<0.8	<0.8	0.10	<0.8	<0.8	0.53	0.76	0.25
	Fluoranthene	mg/kg	RLCA	5.1	0.6	0.67	65.92	18.49	8.04	37.96	22.13	26.19	49.30	0.20	0.27	0.48	0.51	0.28	0.21	10.21	13.17	1.33
	Fluorene	mg/kg	RLCA	0.54	0.019	0.10	1.48	1.99	6.44	28.43	2.52	15.13	43.14	<0.8	<0.8	0.11	0.06	<0.8	<0.8	0.94	1.15	0.28
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	-	-	0.76	5.14	2.10	0.76	3.64	1.93	2.75	3.96	0.14	0.20	0.31	0.37	0.24	0.18	2.03	2.86	0.95
	Naphthalene	mg/kg	RLCA	2.1	0.16	0.55	1.86	3.01	3.26	155.46	10.10	12.17	186.27	0.11	0.11	0.22	0.15	<0.8	<0.8	2.42	2.45	0.35
	Phenanthrene	mg/kg	RLCA	1.5	0.24	0.29	2.70	8.28	26.88	83.61	9.26	47.90	119.33	<0.8	0.13	0.39	0.21	0.13	0.11	3.08	4.37	0.70
	Pyrene	mg/kg	RLCA	2.6	0.665	2.56	64.95	20.17	11.22	40.90	24.51	29.41	52.38	0.31	0.43	0.60	0.73	0.42	0.29	15.55	21.01	8.66
PAH Normalised to 1% TOC	Low Molecular weight PAHs			3.16	0.552	1.86	24.12	26.18	49.94	328.24	39.58	116.54	453.84	0.28	0.49	1.30	0.82	0.35	0.27	15.95	20.67	4.50
	High molecular weight PAHs			9.600	1.700	9.75	210.29	73.63	32.23	146.30	82.61	103.32	180.76	1.76	2.46	3.78	4.55	2.66	1.99	53.04	71.44	19.97
	Total PAHs			45.0	4	11.61	234.41	99.80	82.17	474.54	122.18	219.86	634.59	2.04	2.96	5.08	5.37	3.01	2.25	68.99	92.11	24.47
Total Cyanide normalised to 1% TOC	Total Cyanide	mg/kg	1	-	25*	<1	<1	0.42	0.20	1.54	<1	0.70	1.96	<1	<1	<1	<1	<1	<1	0.56	0.28	<1

Bold text and highlighted cells denote concentrations greater than the adopted screening levels
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
ANZECC (2000) = Australian and New Zealand Interim Sediment Quality Guidelines (Low and High)
* Sediment quality value is derived from Chronic marine EqP threshold at 1% TOC (Bolton et al 1985, cited in MacDonaled et al 1999) where ANZECC ISQG Value not available
RLCA - Refer to Laboratory Certificates of Analysis
^ = Value derived from average of TOC results

Data Entry: LW
Checked By: CD
AECOM

Table T1.
Sediment Analytical Results
(Inorganics,BTEX, TPH and PAH (inc normalised to 1% TOC)

AECOM

	Analyte	Units	LOR	ANZECC (2000) Interim Sediment Quality Guidelines - High	ANZECC (2000) Interim Sediment Quality Guidelines - Low	PC20 0.0 - 0.02 1/05/2009	PC20 0.02 - 0.1 1/05/2009	PC20 0.3 - 0.5 1/05/2009	PC21 0.0 - 0.02 1/05/2009	PC21 0.02 - 0.1 1/05/2009	PC21 0.35 - 0.6 1/05/2009	PC22 0.0 - 0.02 1/05/2009	PC22 0.02 - 0.1 1/05/2009	PC22 0.3 - 0.5 1/05/2009	PC23 0.0 - 0.02 1/05/2009	PC23 0.02 - 0.1 1/05/2009	PC23 0.2 - 0.5 1/05/2009	PC24 0.0 - 0.02 1/05/2009	PC24 0.02 - 0.1 1/05/2009	PC24 0.25 - 0.4 1/05/2009	PC25 0.0 - 0.02 1/05/2009	PC25 0.02 - 0.1 1/05/2009
Metals	Mercury	mg/kg	0.1	1	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arsenic	mg/kg	5	70	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cadmium	mg/kg	1	10	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Chromium	mg/kg	2	370	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Copper	mg/kg	5	270	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	5	220	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nickel	mg/kg	2	52	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zinc	mg/kg	5	410	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inorganics	Cyanide (Free)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Moisture	%	1			67.2	47	41.4	55.6	37.5	44.2	68.1	59.7	47	69.1	64.8	52.4	67.7	58.6	52.5	50.1	31.5	
	TOC	%	0.02			7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	7.14 ^	2.74	7.14 ^	7.14 ^
BTEX	Benzene	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene Total	mg/kg				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50			<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100			510	590	650	1000	580	620	330	470	350	<100	450	470	<100	400	460	320	270	
	TPH C_{29}-C_{36} Fraction	mg/kg	100			520	540	610	610	430	560	320	450	370	<100	470	490	<100	430	510	280	230	
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg				1055	1155	1285	1635	1035	1205	675	945	745	<250	945	985	<250	855	995	625	525	
LABORATORY REPORTED PAH	Acenaphthene	mg/kg	RLCA			<0.8	<0.5	<0.5	0.9	0.8	<0.5	<0.8	<0.8	<0.5	0.15	<0.8	<0.8	0.12	<0.8	<0.8	<0.8	<0.5	
	Acenaphthylene	mg/kg	RLCA			3.5	4.4	4	6	3.9	3.9	1.9	2.1	0.8	1.84	1.9	1.4	1.58	1.3	1	4.4	3.2	
	Anthracene	mg/kg	RLCA			1.8	2.1	1.8	3.3	2.1	1.5	<0.8	0.8	<0.5	0.74	<0.8	<0.8	0.64	<0.8	<0.8	0.9	1	
	Benz(a)anthracene	mg/kg	RLCA			1.8	2.1	1.9	6.1	1.5	1.6	2.5	2	0.8	1.81	1.6	1.1	1.73	1.3	0.9	1.8	1.9	
	Benzo(a) pyrene	mg/kg	RLCA			3.3	4.8	5.3	8.8	4.1	5.4	3.5	3.6	1.9	4.43	3.5	2.8	4.18	2.8	2.3	4.3	4.4	
	Benzo(b)fluoranthene	mg/kg	RLCA			3	4.6	5	9.8	4.7	6.2	3.3	3.6	1.8	3.62	3.6	2.8	3.38	2.8	2.3	4.6	4.7	
	Benzo(g,h,i)perylene	mg/kg	RLCA			1.5	1.9	2.1	6.2	2.5	3.4	1.9	2.1	1.3	2.59	2.3	1.8	2.6	1.9	1.6	2.6	2.3	
	Benzo(k)fluoranthene	mg/kg	RLCA			1	2.4	2.4	3.7	1.7	1.9	1.3	1.4	0.8	2.62	2	1.2	1.86	1.1	1	1.4	1.4	
	Chrysene	mg/kg	RLCA			1.9	2	1.7	5.4	1.1	1.2	2.1	1.8	0.8	1.82	1.5	1.1	1.69	1.2	0.9	1.3	1.3	
	Dibenz(a,h)anthracene	mg/kg	RLCA			<0.8	<0.5	<0.5	1.2	0.5	0.9	<0.8	<0.8	<0.5	0.43	<0.8	<0.8	0.64	<0.8	<0.8	<0.8	<0.5	
	Fluoranthene	mg/kg	RLCA			3.2	3.5	2.8	12.7	2.9	2.5	2.6	2.5	1.4	2.88	2.3	1.8	2.82	2	1.5	2.1	2	
	Fluorene	mg/kg	RLCA			<0.8	0.7	0.6	1.6	1.2	0.8	<0.8	<0.8	<0.5	0.38	<0.8	<0.8	0.3	<0.8	<0.8	<0.8	<0.5	
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA			1.1	1.5	1.6	4.7	1.9	2.5	1.5	1.7	0.9	1.06	1.8	1.4	1.55	1.4	1.2	1.9	1.9	
	Naphthalene	mg/kg	RLCA			1.7	3.4	2.1	5.5	6.9	2.6	<0.8	1.4	0.6	0.89	0.9	<0.8	0.72	<0.8	<0.8	1.4	0.9	
	Phenanthrene	mg/kg	RLCA			2	2.3	2.1	9.6	3	1.8	<0.8	1.1	0.9	1.22	1.1	0.8	1.15	0.9	<0.8	1.1	0.7	
	Pyrene	mg/kg	RLCA			6.1	8	6.5	15.8	6.3	4.4	4.4	5.3	2.2	4.43	3.7	2.7	4.18	3	2.2	4.5	5.9	
	Total PAH	mg/kg	0.01-0.8			32	44	40	101	45	41	25	29	14	31	26	19	29	20	15	32	32	
SVOC	3-methylcholanthrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	<0.01	-	-	<0.01	-	-	-	-	
	2-(acetylamino) fluorene	mg/kg	0.1			-	-	-	-	-	-	-	-	-	<0.1	-	-	<0.1	-	-	-	-	
	2-methylnaphthalene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	0.41	-	-	0.34	-	-	-	-	
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	<0.01	-	-	<0.01	-	-	-	-	
	Benzo(e)pyrene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	2.26	-	-	2.14	-	-	-	-	
	Coronene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	0.08	-	-	0.34	-	-	-	-	
	Perylene	mg/kg	0.01			-	-	-	-	-	-	-	-	-	0.85	-	-	0.78	-	-	-	-	
PAH Normalised to 1% TOC	Acenaphthene	mg/kg	RLCA	0.5	0.016	<0.8	<0.5	<0.5	0.13	0.11	<0.5	<0.8	<0.8	<0.5	<0.5	<0.8	<0.8	0.02	<0.8	<0.8	<0.8	<0.5	
	Acenaphthylene	mg/kg	RLCA			0.49	0.62	0.56	0.89	0.55	0.55	0.27	0.29	0.11	0.26	0.27	0.20	0.22	0.18	0.36	0.62	0.45	
	Anthracene	mg/kg	RLCA	1.1	0.085	0.25	0.29	0.25	0.49	0.29	0.21	<0.8	0.11	<0.5	0.10	<0.8	<0.8	0.09	<0.8	<0.8	0.13	0.14	
	Benz(a)anthracene	mg/kg	RLCA	1.6	0.261	0.25	0.29	0.27	0.90	0.21	0.22	0.35	0.28	0.11	0.25	0.22	0.15	0.24	0.18	0.33	0.25	0.27	
	Benzo(a) pyrene	mg/kg	RLCA	1.6	0.43	0.46	0.67	0.74	1.30	0.57	0.76	0.49	0.50	0.27	0.62	0.49	0.39	0.59	0.39	0.84	0.60	0.62	
	Benzo(b)fluoranthene	mg/kg	RLCA	-	-	0.42	0.64	0.70	1.45	0.66	0.87	0.46	0.50	0.25	0.51	0.50	0.39	0.47	0.39	0.84	0.64	0.66	
	Benzo(g,h,i)perylene	mg/kg	RLCA	-	-	0.21	0.27	0.29	0.92	0.35	0.48	0.27	0.29	0.18	0.36	0.32	0.25	0.36	0.27	0.58	0.36	0.32	
	Benzo(k)fluoranthene	mg/kg	RLCA	-	-	0.14	0.34	0.34	0.55	0.24	0.27	0.18	0.20	0.11	0.37	0.28	0.17	0.26	0.15	0.36	0.20	0.20	
	Chrysene	mg/kg	RLCA	2.8	0.384	0.27	0.28	0.24	0.80	0.15	0.17	0.29	0.25	0.11	0.25	0.21	0.15	0.24	0.17	0.33	0.18	0.18	
	Dibenz(a,h)anthracene	mg/kg	RLCA	0.26	0.063	<0.8	<0.5	<0.5	0.18	0.07	0.13	<0.8	<0.8	<0.5	0.060	<0.8	<0.8	0.09	<0.8	<0.8	<0.8	<0.5	
	Fluoranthene	mg/kg	RLCA	5.1	0.6	0.45	0.49	0.39	1.88	0.41	0.35	0.36	0.35	0.20	0.40	0.32	0.25	0.39	0.28	0.55	0.29	0.28	
	Fluorene	mg/kg	RLCA	0.54	0.019	<0.8	0.10	0.08	0.24	0.17	0.11	<0.8	<0.8	<0.5	0.05	<0.8	<0.8	0.04	<0.8	<0.8	<0.8	<0.5	
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	-	-	0.15	0.21	0.22	0.70	0.27	0.35	0.21	0.24	0.13	0.15	0.25	0.20	0.22	0.20	0.44	0.27	0.27	
	Naphthalene	mg/kg	RLCA	2.1	0.16	0.24	0.48	0.29	0.81	0.97	0.36	<0.8	0.20	0.08	0.12	0.13	<0.8	0.10	<0.8	<0.8	0.20	0.13	
	Phenanthrene	mg/kg	RLCA	1.5	0.24	0.28	0.32	0.29	1.42	0.42	0.25	<0.8	0.15	0.13	0.17	0.15	0.11	0.16	0.13	<0.8	0.15	0.10	
	Pyrene	mg/kg	RLCA	2.6	0.665	0.85	1.12	0.91	2.34	0.88	0.62	0.62	0.74	0.31	0.62	0.52	0.38	0.59	0.42	0.80	0.63	0.83	
PAH Normalised to 1% TOC																							
	Low Molecular weight PAHs			3.16	0.552	1.26	1.81	1.48	3.99	2.51	1.48	0.27	0.76	0.32	0.71	0.55	0.31	0.63	0.31	0.36	1.09	0.81	
	High molecular weight PAHs			9.600	1.700	3.21	4.31	4.10	11.02	3.81	4.20	3.24	3.36	1.67	3.60	3.12	2.34	3.45	2.45	5.07	3.43	3.61	
	Total PAHs			45.0	4	4.47	6.12	5.59	15.01	6.32	5.69	3.50	4.12	1.99	4.31	3.67	2.65	4.08	2.76	5.44	4.52	4.43	
Total Cyanide normalised to 1% TOC																							
	Total Cyanide	mg/kg	1	-	25*	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	

Bold text and highlighted cells denote concentrations greater than the adopted screening levels
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
ANZECC (2000) = Australian and New Zealand Interim Sediment Quality Guidelines (Low and High)
* Sediment quality value is derived from Chronic marine EqP threshold at 1% TOC (Bolton et al 1985, cited in MacDonaled et al 1999) where ANZECC ISQG Value not available
RLCA - Refer to Laboratory Certificates of Analysis
^ = Value derived from average of TOC results

Data Entry: LW
Checked By: CD
AECOM

Table T1.
Sediment Analytical Results
(Inorganics,BTEX, TPH and PAH (inc normalised to 1% TOC)

AECOM

	Analyte	Units	LOR	ANZECC (2000) Interim Sediment Quality Guidelines - High	ANZECC (2000) Interim Sediment Quality Guidelines - Low	BACKGROUND LOCATIONS																
						PC25	PC26	PC26	PC26	PC27	PC27	PC27	PC28	PC28	PC28	PC29	PC29	PC29	PC30	PC30	PC30	SG1	SG2
						0.15 - 0.25	0.0 - 0.02	0.02 - 0.1	0.35 - 0.4	0.0 - 0.02	0.02 - 0.1	0.2 - 0.35	0.0 - 0.02	0.02 - 0.1	0.3 - 0.5	0.0 - 0.02	0.02 - 0.1	0.25 - 0.4	0.0 - 0.02	0.02 - 0.1	0.3 - 0.5	0.0 - 0.1	0.0 - 0.1
						1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	1/05/2009	8/05/2009	8/05/2009
Metals	Mercury	mg/kg	0.1	1	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5
	Arsenic	mg/kg	5	70	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	14
	Cadmium	mg/kg	1	10	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1
	Total Chromium	mg/kg	2	370	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	41
	Copper	mg/kg	5	270	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	44
	Lead	mg/kg	5	220	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	181	74
	Nickel	mg/kg	2	52	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	5
	Zinc	mg/kg	5	410	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	212	171
Inorganics	Cyanide (Free)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	**5**	<1
	Moisture	%	1			41.2	66.9	55.6	50.6	49.8	47.8	42.9	50.6	37.2	28	53.2	43.8	45.4	54	41.3	28	44.3	32
	TOC	%	0.02			7.14 ^	7.14 ^	7.14 ^	7.14 ^	3.46	7.14 ^	7.14 ^	4.6	2.65	7.14 ^	7.14 ^	7.14 ^	7.14 ^	2.87	1.58	7.14 ^	46.9	2.95
BTEX	Benzene	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene Total	mg/kg				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50			590	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100			5480	400	430	490	330	490	790	360	240	<100	330	590	370	<100	<100	<100	1110	190
	TPH C_{29}-C_{36} Fraction	mg/kg	100			2390	420	470	520	290	490	590	360	250	<100	360	590	380	<100	<100	<100	840	180
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg				8460	845	925	1035	645	1005	1405	745	515	<250	715	1205	775	<250	<250	<250	1975	395
LABORATORY REPORTED PAH	Acenaphthene	mg/kg	RLCA			1.9	<0.8	<0.8	<0.8	<0.5	<0.5	<0.5	0.15	0.11	<0.01	0.08	0.15	0.1	0.05	0.03	<0.01	<0.5	<0.5
	Acenaphthylene	mg/kg	RLCA			22.7	2.8	2.7	1.7	3.2	4	5.2	2.61	2.71	0.16	1.03	3.99	2.4	0.67	0.5	0.08	7.4	2.1
	Anthracene	mg/kg	RLCA			10.5	1.1	1	<0.8	1.4	1.3	1.9	0.89	0.68	0.05	0.48	0.86	0.78	0.32	0.24	0.04	2.1	0.6
	Benz(a)anthracene	mg/kg	RLCA			42	2.4	2.1	1.3	2.2	2.4	2.2	3.28	3.25	0.25	1.33	7.5	3.48	1.33	1.04	0.19	10.8	2.1
	Benzo(a) pyrene	mg/kg	RLCA			39.4	4.5	4.1	2.8	4.4	5.8	12	8.24	7.94	0.51	3.38	12.8	8.58	2.24	0.2	0.33	15.4	3.6
	Benzo(b)fluoranthene	mg/kg	RLCA			42	4.3	5	3.3	4.1	5.5	10.9	6.56	7.14	0.57	3.02	11.2	7.16	2.11	1.84	0.39	15.2	3.1
	Benzo(g,h,i)perylene	mg/kg	RLCA			18.7	3.1	2.9	2.2	2.5	3.7	4.3	3.99	3.47	0.1	2.12	6.6	4.34	1.26	1.14	0.1	7.1	1.8
	Benzo(k)fluoranthene	mg/kg	RLCA			13.8	2.5	1.5	1.2	2.4	3.4	5.9	3.99	3.01	0.32	1.67	7.92	5.04	1.24	0.86	0.22	7.8	2.4
	Chrysene	mg/kg	RLCA			42.8	1.7	1.6	1	1.6	1.8	3.6	2.94	2.74	0.22	1.27	5.61	3.1	1.11	0.79	0.16	9.2	1.7
	Dibenz(a,h)anthracene	mg/kg	RLCA			4.6	0.8	<0.8	<0.8	0.6	0.8	1.6	1.19	1.12	0.04	0.42	1.74	1.21	0.29	0.17	0.03	2.2	<0.5
	Fluoranthene	mg/kg	RLCA			109	3.4	3.2	2	2.4	2.7	2.6	3.54	3.16	0.25	2.03	9.72	5.04	2.09	1.67	0.27	16.4	2.5
	Fluorene	mg/kg	RLCA			4	<0.8	<0.8	<0.8	<0.5	0.6	0.7	0.4	0.31	0.02	0.2	0.34	0.26	0.11	0.07	0.01	0.9	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA			15.6	2.5	2.2	1.5	2.1	2.9	3.4	3.3	2.98	0.1	1.6	5.32	3.63	0.98	0.88	0.09	5.5	1.4
	Naphthalene	mg/kg	RLCA			6.2	0.9	0.9	<0.8	0.9	1.1	1.2	0.96	0.8	0.03	0.56	0.52	0.47	0.19	0.13	0.02	2	0.6
	Phenanthrene	mg/kg	RLCA			9.1	1.4	1.4	<0.8	0.9	1.4	1.1	1.28	1.24	0.09	0.88	1.11	1.83	0.79	0.53	0.1	4.4	0.6
	Pyrene	mg/kg	RLCA			134	5.3	4.7	2.8	6	5.9	26.8	5.69	5.15	0.34	2.74	19.2	6.17	2.39	1.99	0.29	22.4	3.8
	Total PAH	mg/kg	0.01-0.8			516	37	33	20	35	43	83	49	46	3	23	95	54	17	12	2	129	26
SVOC	3-methylcholanthrene	mg/kg	0.01			-	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	-	-
	2-(acetylamino) fluorene	mg/kg	0.1			-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	2-methylnaphthalene	mg/kg	0.01			-	-	-	-	-	-	-	0.46	0.36	0.01	0.24	0.25	0.21	0.1	0.06	0.01	-	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01			-	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
	Benzo(e)pyrene	mg/kg	0.01			-	-	-	-	-	-	-	3.83	3.68	0.22	1.62	6.37	3.66	1.24	1.09	0.16	-	-
	Coronene	mg/kg	0.01			-	-	-	-	-	-	-	0.61	0.45	<0.01	0.11	1.03	0.62	0.14	0.05	<0.01	-	-
	Perylene	mg/kg	0.01			-	-	-	-	-	-	-	1.58	1.51	0.08	0.7	2.99	1.39	0.38	0.28	0.06	-	-
PAH Normalised to 1% TOC	Acenaphthene	mg/kg	RLCA	0.5	0.016	0.27	<0.8	<0.8	<0.8	<0.5	<0.5	<0.5	0.03	0.04	<0.01	0.01	0.02	0.01	0.02	0.02	<0.01	<0.5	<0.5
	Acenaphthylene	mg/kg	RLCA			3.18	0.39	0.38	0.24	0.92	0.56	0.73	0.57	1.02	0.02	0.14	0.56	0.34	0.23	0.32	0.01	0.16	0.71
	Anthracene	mg/kg	RLCA	1.1	0.085	1.47	0.15	0.14	<0.8	0.40	0.18	0.27	0.19	0.26	0.01	0.07	0.12	0.11	0.11	0.15	0.01	0.04	0.20
	Benz(a)anthracene	mg/kg	RLCA	1.6	0.261	5.88	0.34	0.29	0.18	0.64	0.34	0.31	0.71	1.23	0.04	0.19	1.05	0.49	0.46	0.66	0.03	0.23	0.71
	Benzo(a) pyrene	mg/kg	RLCA	1.6	0.43	5.52	0.63	0.57	0.39	1.27	0.81	1.68	1.79	3.00	0.07	0.47	1.79	1.20	0.78	0.13	0.05	0.33	1.22
	Benzo(b)fluoranthene	mg/kg	RLCA	-	-	5.88	0.60	0.70	0.46	1.18	0.77	1.53	1.43	2.69	0.08	0.42	1.57	1.00	0.74	1.16	0.05	0.32	1.05
	Benzo(g,h,i)perylene	mg/kg	RLCA	-	-	2.62	0.43	0.41	0.31	0.72	0.52	0.60	0.87	1.31	0.01	0.30	0.92	0.61	0.44	0.72	0.01	0.15	0.61
	Benzo(k)fluoranthene	mg/kg	RLCA	-	-	1.93	0.35	0.21	0.17	0.69	0.48	0.83	0.87	1.14	0.04	0.23	1.11	0.71	0.43	0.54	0.03	0.17	0.81
	Chrysene	mg/kg	RLCA	2.8	0.384	5.99	0.24	0.22	0.14	0.46	0.25	0.50	0.64	1.03	0.03	0.18	0.79	0.43	0.39	0.50	0.02	0.20	0.58
	Dibenz(a,h)anthracene	mg/kg	RLCA	0.26	0.063	0.64	0.11	<0.8	<0.8	0.17	0.11	0.22	0.26	0.42	0.01	0.059	0.24	0.17	0.10	0.11	0.004	0.05	<0.5
	Fluoranthene	mg/kg	RLCA	5.1	0.6	15.27	0.48	0.45	0.28	0.69	0.38	0.36	0.77	1.19	0.04	0.28	1.36	0.71	0.73	1.06	0.04	0.35	0.85
	Fluorene	mg/kg	RLCA	0.54	0.019	0.56	<0.8	<0.8	<0.8	<0.5	0.08	0.10	0.09	0.12	0.003	0.03	0.05	0.04	0.04	0.04	0.001	0.02	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	-	-	2.18	0.35	0.31	0.21	0.61	0.41	0.48	0.72	1.12	0.014	0.22	0.75	0.51	0.34	0.56	0.013	0.12	0.47
	Naphthalene	mg/kg	RLCA	2.1	0.16	0.87	0.13	0.13	<0.8	0.26	0.15	0.17	0.21	0.30	0.004	0.08	0.07	0.07	0.07	0.08	0.003	0.04	0.20
	Phenanthrene	mg/kg	RLCA	1.5	0.24	1.27	0.20	0.20	<0.8	0.26	0.20	0.15	0.28	0.47	0.01	0.12	0.16	0.26	0.28	0.34	0.01	0.09	0.20
	Pyrene	mg/kg	RLCA	2.6	0.665	18.77	0.74	0.658	0.39	1.73	0.83	3.75	1.24	1.94	0.05	0.38	2.69	0.86	0.83	1.26	0.04	0.48	1.29
PAH Normalised to 1% TOC																							
	Low Molecular weight PAHs			3.16	0.552	7.62	0.87	0.84	0.24	1.85	1.18	1.41	1.37	2.21	0.049	0.45	0.98	0.82	0.74	0.95	0.04	0.36	1.32
	High molecular weight PAHs			9.600	1.700	64.69	4.27	3.82	2.54	8.18	4.89	10.27	9.29	15.08	0.38	2.74	12.27	6.69	5.24	6.70	0.29	2.39	7.59
	Total PAHs			45.0	4	72.31	5.14	4.66	2.77	10.03	6.06	11.68	10.65	17.29	0.43	3.19	13.25	7.51	5.98	7.65	0.32	2.75	8.92
Total Cyanide normalised to 1% TOC																							
	Total Cyanide	mg/kg	1	-	25*	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.11	<1

Bold text and highlighted cells denote concentrations greater than the adopted screening levels
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
ANZECC (2000) = Australian and New Zealand Interim Sediment Quality Guidelines (Low and High)
* Sediment quality value is derived from Chronic marine EqP threshold at 1% TOC (Bolton et al 1985, cited in MacDonaled et al 1999) where ANZECC ISQG Value not available
RLCA - Refer to Laboratory Certificates of Analysis
^ = Value derived from average of TOC results

Data Entry: LW
Checked By: CD
AECOM

Table T1.
Sediment Analytical Results
(Inorganics,BTEX, TPH and PAH (inc normalised to 1% TOC)

AECOM

	Analyte	Units	LOR	ANZECC (2000) Interim Sediment Quality Guidelines - High	ANZECC (2000) Interim Sediment Quality Guidelines - Low	SG3 0.0 - 0.1 8/05/2009	SG4 0.0 - 0.1 8/05/2009	SG5 0.0 - 0.1 8/05/2009	SG6 0.0 - 0.1 8/05/2009	SG7 0.0 - 0.1 8/05/2009	SG8 0.0 - 0.1 8/05/2009	SG9 0.0 - 0.1 8/05/2009	SG10 0.0 - 0.1 8/05/2009	SG11 0.0 - 0.1 8/05/2009	SG12 0.0 - 0.1 8/05/2009	SG13 0.0 - 0.1 8/05/2009	SG14 0.0 - 0.1 8/05/2009	SG15 0.0 - 0.1 8/05/2009	SG16 0.0 - 0.1 8/05/2009	SW1 0.0 - 0.1 1/05/2009	SW2 0.0 - 0.1 1/05/2009
Metals	Mercury	mg/kg	0.1	1	0.15	1.6	5.2	2.4	0.4	1.5	2	1.8	1.7	1.3	2.3	1.6	1.5	-	-	-	-
	Arsenic	mg/kg	5	70	20	28	21	31	20	28	25	29	26	24	38	27	27	-	-	-	-
	Cadmium	mg/kg	1	10	1.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-
	Total Chromium	mg/kg	2	370	80	150	37	168	47	159	83	173	161	123	214	153	127	-	-	-	-
	Copper	mg/kg	5	270	65	160	47	174	77	154	145	184	183	133	240	157	137	-	-	-	-
	Lead	mg/kg	5	220	50	244	148	265	181	237	190	269	274	194	364	229	202	-	-	-	-
	Nickel	mg/kg	2	52	21	18	9	19	11	17	19	20	19	15	25	18	16	-	-	-	-
	Zinc	mg/kg	5	410	200	623	195	667	254	597	492	686	660	493	858	588	510	-	-	-	-
Inorganics	Cyanide (Free)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1			<1	<1	<1	<1	<1	**3**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Moisture	%	1			62.4	45	58.6	46.7	55.4	57.8	57.7	63	59.5	66.1	55.3	61.8	63	46.9	43.4	29.4
	TOC	%	0.02			4.61	46.3	5.64	47	5.77	27.8	3.96	3.12	5.12	3.12	4.51	6.88	6.43	5.81	7.14 ^	7.14 ^
BTEX	Benzene	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene Total	mg/kg				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50			<50	160	<50	<50	<50	1250	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100			390	2780	370	830	1190	17800	850	<100	730	<100	<100	1140	520	980	1780	250
	TPH C_{29}-C_{36} Fraction	mg/kg	100			430	1480	380	600	710	8480	680	<100	620	<100	<100	840	380	780	1390	200
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg				845	4420	775	1455	1925	27530	1555	<250	1375	<250	<250	2005	925	1785	3195	475
LABORATORY REPORTED PAH	Acenaphthene	mg/kg	RLCA			<0.8	6.2	<0.8	0.8	<0.8	49.2	<0.8	0.09	<0.8	0.11	0.26	<0.8	<0.8	<0.5	1.4	<0.5
	Acenaphthylene	mg/kg	RLCA			3.2	24.3	2.6	8.8	5.3	147	5.5	0.68	4.6	1.24	6.15	9.2	4.1	8.4	18	2.4
	Anthracene	mg/kg	RLCA			1	21.3	0.9	3.5	1.7	120	1.8	0.59	1.3	0.48	1.42	2.9	1.3	2.4	8	0.8
	Benz(a)anthracene	mg/kg	RLCA			2.7	32.4	1.6	8.1	2.8	160	2.4	0.84	2.6	1.28	5.03	6	2.9	4.7	10.7	2.4
	Benzo(a) pyrene	mg/kg	RLCA			5.4	27.2	4.5	10.6	8.3	172	6.3	1.89	8	2.95	13.1	13.9	7.3	15.4	31.4	4
	Benzo(b)fluoranthene	mg/kg	RLCA			4.8	28.4	4.2	12.3	8.9	173	5.7	2.1	6.8	2.97	13.3	15	7.5	16.7	35.1	3.6
	Benzo(g,h,i)perylene	mg/kg	RLCA			3.3	15.2	2.7	6.2	5	79.4	3.4	1.38	2.8	1.96	5.7	7.2	4	8.4	16.4	1.6
	Benzo(k)fluoranthene	mg/kg	RLCA			3.3	18.8	2.8	4.4	3.9	66.1	3.6	0.73	3.4	1.24	5.32	5.8	3.2	6.8	12.8	1.9
	Chrysene	mg/kg	RLCA			1.9	22.2	1.2	7.2	2.1	134	2	0.76	2.6	1.05	4.25	6.6	3.2	5.2	11.2	2.1
	Dibenz(a,h)anthracene	mg/kg	RLCA			<0.8	2.9	<0.8	<0.5	<0.8	22.8	<0.8	0.32	0.9	0.32	1.99	2.8	1.4	3	5.6	<0.5
	Fluoranthene	mg/kg	RLCA			3.7	62.3	2.5	12.9	4	312	3.8	1.32	3	1.8	4.69	7.4	3.5	4.5	12.4	3.5
	Fluorene	mg/kg	RLCA			<0.8	1.9	<0.8	1.3	<0.8	25.5	<0.8	0.21	<0.8	0.27	0.84	1.6	<0.8	1	2.6	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA			2.5	12.1	2.1	4.8	3.9	63.6	2.7	0.99	2.5	1.43	4.86	5.4	3	6.4	15.2	1.4
	Naphthalene	mg/kg	RLCA			0.9	3.5	1.1	3.8	2.5	47.4	2.5	0.66	1.8	0.77	2.32	4.1	1.9	2.6	6.1	0.8
	Phenanthrene	mg/kg	RLCA			1.1	39.1	1	5.1	1.8	62.7	1.9	0.88	1.4	0.88	1.92	3.7	1.6	1.6	5.7	1.2
	Pyrene	mg/kg	RLCA			5.5	61	4.6	16.4	7.4	390	6.1	1.91	7.5	2.92	11.1	15.2	7.4	16.1	37.4	5
	Total PAH	mg/kg	0.01-0.8			39	379	32	106	58	2025	48	15	49	22	82	107	52	103	230	31
SVOC	3-methylcholanthrene	mg/kg	0.01			-	-	-	-	-	-	-	<0.01	-	<0.01	<0.01	-	-	-	-	-
	2-(acetylamino) fluorene	mg/kg	0.1			-	-	-	-	-	-	-	<0.1	-	<0.1	<0.1	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01			-	-	-	-	-	-	-	0.28	-	0.33	0.88	-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01			-	-	-	-	-	-	-	<0.01	-	<0.01	<0.01	-	-	-	-	-
	Benzo(e)pyrene	mg/kg	0.01			-	-	-	-	-	-	-	1	-	1.52	6.19	-	-	-	-	-
	Coronene	mg/kg	0.01			-	-	-	-	-	-	-	0.11	-	0.1	0.92	-	-	-	-	-
	Perylene	mg/kg	0.01			-	-	-	-	-	-	-	0.51	-	0.53	2.46	-	-	-	-	-
PAH Normalised to 1% TOC	Acenaphthene	mg/kg	RLCA	0.5	0.016	<0.8	0.13	<0.8	0.02	<0.8	1.77	<0.8	0.03	<0.8	0.04	0.06	<0.8	<0.8	<0.5	0.20	<0.5
	Acenaphthylene	mg/kg	RLCA			0.69	0.52	0.46	0.19	0.92	5.29	1.39	0.22	0.90	0.40	1.36	1.34	0.64	1.45	2.52	0.34
	Anthracene	mg/kg	RLCA	1.1	0.085	0.22	0.46	0.16	0.07	0.29	4.32	0.45	0.19	0.25	0.15	0.31	0.42	0.20	0.41	1.12	0.11
	Benz(a)anthracene	mg/kg	RLCA	1.6	0.261	0.59	0.70	0.28	0.17	0.49	5.76	0.61	0.27	0.51	0.41	1.12	0.87	0.45	0.81	1.50	0.34
	Benzo(a) pyrene	mg/kg	RLCA	1.6	0.43	1.17	0.59	0.80	0.23	1.44	6.19	1.59	0.61	1.56	0.95	2.90	2.02	1.14	2.65	4.40	0.56
	Benzo(b)fluoranthene	mg/kg	RLCA	-	-	1.04	0.61	0.74	0.26	1.54	6.22	1.44	0.67	1.33	0.95	2.95	2.18	1.17	2.87	4.92	0.50
	Benzo(g,h,i)perylene	mg/kg	RLCA	-	-	0.72	0.33	0.48	0.13	0.87	2.86	0.86	0.44	0.55	0.63	1.26	1.05	0.62	1.45	2.30	0.22
	Benzo(k)fluoranthene	mg/kg	RLCA	-	-	0.72	0.41	0.50	0.09	0.68	2.38	0.91	0.23	0.66	0.40	1.18	0.84	0.50	1.17	1.79	0.27
	Chrysene	mg/kg	RLCA	2.8	0.384	0.41	0.48	0.21	0.15	0.36	4.82	0.51	0.24	0.51	0.34	0.94	0.96	0.50	0.90	1.57	0.29
	Dibenz(a,h)anthracene	mg/kg	RLCA	0.26	0.063	<0.8	0.063	<0.8	<0.5	<0.8	0.82	<0.8	0.10	0.18	0.10	0.44	0.41	0.22	0.52	0.78	<0.5
	Fluoranthene	mg/kg	RLCA	5.1	0.6	0.80	1.35	0.44	0.27	0.69	11.22	0.96	0.42	0.59	0.58	1.04	1.08	0.54	0.77	1.74	0.49
	Fluorene	mg/kg	RLCA	0.54	0.019	<0.8	0.04	<0.8	0.03	<0.8	0.92	<0.8	0.07	<0.8	0.09	0.19	0.23	<0.8	0.17	0.36	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	-	-	0.54	0.26	0.37	0.10	0.68	2.29	0.68	0.32	0.49	0.46	1.08	0.78	0.47	1.10	2.13	0.20
	Naphthalene	mg/kg	RLCA	2.1	0.16	0.20	0.08	0.20	0.08	0.43	1.71	0.63	0.21	0.35	0.25	0.51	0.60	0.30	0.45	0.85	0.11
	Phenanthrene	mg/kg	RLCA	1.5	0.24	0.239	0.84	0.18	0.11	0.31	2.26	0.48	0.28	0.27	0.28	0.43	0.54	0.25	0.28	0.80	0.17
	Pyrene	mg/kg	RLCA	2.6	0.665	1.19	1.32	0.82	0.35	1.28	14.03	1.54	0.61	1.46	0.94	2.46	2.21	1.15	2.77	5.24	0.70
PAH Normalised to 1% TOC																					
	Low Molecular weight PAHs			3.16	0.552	1.34	2.08	0.99	0.496	1.96	16.25	2.95	1.00	1.78	1.20	2.86	3.13	1.38	2.75	5.85	0.73
	High molecular weight PAHs			9.600	1.700	7.18	6.10	4.65	1.76	8.02	56.58	9.09	3.92	7.83	5.74	15.37	12.40	6.75	15.01	26.36	3.57
	Total PAHs			45.0	4	8.52	8.18	5.64	2.26	9.98	72.83	12.05	4.92	9.61	6.95	18.24	15.52	8.13	17.76	32.21	4.30
Total Cyanide normalised to 1% TOC																					
	Total Cyanide	mg/kg	1	-	25*	<1	<1	<1	<1	<1	0.11	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Bold text and highlighted cells denote concentrations greater than the adopted screening levels
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
ANZECC (2000) = Australian and New Zealand Interim Sediment Quality Guidelines (Low and High)
* Sediment quality value is derived from Chronic marine EqP threshold at 1% TOC (Bolton et al 1985, cited in MacDonaled et al 1999) where ANZECC ISQG Value not available
RLCA - Refer to Laboratory Certificates of Analysis
^ = Value derived from average of TOC results

Data Entry: LW
Checked By: CD
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Table T2.
SPOCAS Analytical Results

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	Field ID	PC2_0.25-0.4	PC3_0.3-0.44	PC5_0.25-0.45	PC7_0.25-0.45	PC9_0.3-0.4
	Location	PC2	PC3	PC5	PC7	PC9
	Depth (m)	0.25 - 0.4	0.3 - 0.4	0.25 - 0.45	0.25 - 0.4	0.3 - 0.4
	Sample Date	29/04/2009	29/04/2009	29/04/2009	29/04/2009	29/04/2009
	Analyte	Units	ASSMAC 1998 Action Criteria (% POS) *	LOR					
SPOCAS	Acid Reacted Calcium	% Ca		0.02	1.01	0.66	6.33	1.23	0.8
SPOCAS	Acid Reacted Magnesium	% Mg		0.02	0.27	0.59	0.2	0.7	0.92
SPOCAS	acidity - Acid Reacted Calcium	mole H+/t		10	504	332	3160	613	401
SPOCAS	acidity - Acid Reacted Magnesium	mole H+/t		10	219	482	166	575	757
SPOCAS	acidity - Excess Acid Neutralising Capacity	mole H+/t		10	126	-	1080	126	-
SPOCAS	acidity - Peroxide Oxidisable Sulfur	mole H+/t		10	339	825	362	766	1580
SPOCAS	ANC Fineness Factor	-		0.5	1.5	1.5	1.5	1.5	1.5
SPOCAS	Calcium in Peroxide	% Ca		0.02	1.17	0.9	6.5	1.52	1.06
SPOCAS	Excess Acid Neutralising Capacity	% CaCO3		0.02	0.63	-	5.39	0.63	-
SPOCAS	KCl Extractable Calcium	% Ca		0.02	0.16	0.23	0.17	0.29	0.26
SPOCAS	KCl Extractable Magnesium	% Mg		0.02	0.06	0.14	0.04	0.19	0.14
SPOCAS	KCl Extractable Sulfur	% S		0.02	0.06	0.11	0.04	0.14	0.15
SPOCAS	Liming Rate	kg CaCO3/t		1	2	23	<1	13	57
SPOCAS	Magnesium in Peroxide	% Mg		0.02	0.32	0.73	0.24	0.89	1.06
SPOCAS	Net Acidity (acidity units)	mole H+/t		10	29	309	<10	171	766
SPOCAS	Net Acidity (sulfur units)	% S		0.02	0.05	0.5	<0.02	0.27	1.23
SPOCAS	Peroxide Oxidisable Sulfur	% S	0.06	0.02	0.54	1.32	0.58	1.23	2.53
SPOCAS	pH KCl	pH Unit		0.1	8.9	8.4	9.2	8.6	8.6
SPOCAS	pH OX	pH Unit		0.1	7.8	5.3	7.8	7.7	3.9
SPOCAS	sulfidic - Acid Reacted Calcium	% S		0.02	0.81	0.53	5.06	0.98	0.64
SPOCAS	sulfidic - Acid Reacted Magnesium	% S		0.02	0.35	0.77	0.27	0.92	1.21
SPOCAS	sulfidic - Excess Acid Neutralising Capacity	% S		0.02	0.2	-	1.72	0.2	-
SPOCAS	sulfidic - Titratable Actual Acidity	% pyrite S		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SPOCAS	sulfidic - Titratable Peroxide Acidity	% pyrite S		0.02	<0.02	0.08	<0.02	<0.02	0.58
SPOCAS	sulfidic - Titratable Sulfidic Acidity	% pyrite S		0.02	<0.02	0.08	<0.02	<0.02	0.58
SPOCAS	Sulfur in Peroxide	% S		0.02	0.6	1.44	0.62	1.37	2.69
SPOCAS	Titratable Actual Acidity	mole H+/t		2	<2	<2	<2	<2	<2
SPOCAS	Titratable Peroxide Acidity	moleH+/t	36	2	<2	51	<2	<2	359
SPOCAS	Titratable Sulfidic Acidity	moleH+/t	36	2	<2	51	<2	<2	359

Notes:
LOR = Limit of Reporting
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
* * Based on 1-1000 tonnes of medium texture material being disturbed as part of the proposed marina development

Data Entry: LW
Checked by: CD
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			Field ID	PC1_0.0-0.02	PC5_0.02-0.1	PC6_0.02-0.1	PC9_0.0-0.02	PC10_0.0-0.02	PC29_0.0-0.02	SG1	SG4	SG6	SG8
			Location	PC1	PC5	PC6	PC9	PC10	PC29	SG1	SG4	SG6	SG8
			Depth (m)	0.0 - 0.02	0.02 - 0.1	0.02 - 0.1	0.0 - 0.02	0.0 - 0.02	0.0 - 0.02	0.0 - 0.1	0.0 - 0.1	0.0 - 0.1	0.0 - 0.1
			Sample Date	29/04/2009	29/04/2009	29/04/2009	29/04/2009	29/04/2009	1/05/2009	8/05/2009	8/05/2009	8/05/2009	8/05/2009
	Fraction	Units	LOR										
PSD	+1180µm	%	1	<1	<1	1	<1	1	1	15	11	5	6
	+150µm	%	1	53	53	5	14	8	11	72	68	70	31
	+19.0mm	%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	+2.36mm	%	1	<1	<1	1	<1	<1	1	8	8	1	2
	+300µm	%	1	35	32	3	5	4	5	53	37	42	19
	+37.5mm	%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	+4.75mm	%	1	<1	<1	1	<1	<1	1	6	5	<1	1
	+425µm	%	1	17	16	2	3	3	3	42	25	28	15
	+600µm	%	1	3	4	2	1	2	2	31	18	18	11
	+75.0mm	%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	+75µm	%	1	63	60	13	31	18	19	81	81	77	44
	+9.5mm	%	1	<1	<1	<1	<1	<1	<1	2	1	<1	<1
	Clay (<2 µm)	%	1	28	30	46	37	47	45	12	12	15	15
	Cobbles (>6cm)	%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Gravel (>2mm)	%	1	<1	<1	2	<1	<1	1	8	8	1	2
	Sand (0.06-2.00 mm)	%	1	63	61	14	35	23	17	73	73	78	44
	Silt (2-60 µm)	%	1	9	9	38	28	30	37	7	7	6	39

Notes:
PSD = Particle Size Distribution
LOR = Limit of Reporting
µm = micrometres
mm = millimeters
cm = centimetres
< = percentage not detected greater than the Laboratory LOR.

AECOM

			Sample	PC5_0.0-0.02	DUP01	RPD (%)	TRIP 01	RPD (%)	PC5_0.02-0.1	DUP02	RPD (%)	TRIP 02	RPD (%)	PC5_0.25-0.45	DUP03	RPD (%)	TRIP 03	RPD (%)	PC7_0.25-0.45	DUP04	RPD (%)
			Location	PC5	PC5		PC5		PC5	PC5		PC5		PC5	PC5		PC5		PC7	PC7	
			Depth (m)	0.0 - 0.02	0 - 0.02		0.0 - 0.02		0.02-0.1	0.02-0.1		0.02-0.1		0.25-0.45	0.25-0.45		0.25-0.45		0.025-0.45	0.025-0.45	
			Date	29/04/2009	29/04/2009		29/04/2009		29/04/2009	29/04/2009		29/04/2009		29/04/2009	29/04/2009		29/04/2009		29/04/2009	29/04/2009	
			Type	Primary	Intralaboratory duplicate core		Interlaboratory duplicate core		Primary	Intralaboratory duplicate core		Interlaboratory duplicate core		Primary	Intralaboratory duplicate core		Interlaboratory duplicate core		Primary	Intralaboratory duplicate split sample	
	Analyte	Units	LOR																		
Inorganic	TOC	%	0.02	14.9	13.8	8	2.4	145	3.06	9.94	106	1.7	57	0.55	0.75	31	1.2	74	3.43	3.54	3
	Cyanide (Free)	mg/kg	1	<1	<1	nc	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc
	Cyanide Total	mg/kg	1	<1	<1	nc	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc
	Moisture	%	1	57.2	52.6	8	42	31	28.1	37.9	30	39	32	25	31.1	22	29	15	60.6	62.5	3
BTEX	Benzene	mg/kg	0.2	<0.2	<0.2	nc	<0.2	nc	<0.2	<0.2	nc	<0.2	nc	<0.2	<0.2	nc	<0.2	nc	<0.2	<0.2	nc
	Ethylbenzene	mg/kg	0.5	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc
	Toluene	mg/kg	0.5	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc
	Xylene (m & p)	mg/kg	0.5	<0.5	<0.5	nc	<1	nc	<0.5	<0.5	nc	<1	nc	<0.5	<0.5	nc	<1	nc	<0.5	<0.5	nc
	Xylene (o)	mg/kg	0.5	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc
	Xylene Total	mg/kg		<1	<1	nc	<1.5	nc	<1	<1	nc	<1.5	nc	<1	<1	nc	<1.5	nc	<1	<1	nc
TPH	TPH C_6 - C_9 Fraction	mg/kg	10	<10	<10	nc	<10	nc	<10	<10	nc	<10	nc	<10	<10	nc	<10	nc	<10	<10	nc
	TPH C_{10} - C_{14} Fraction	mg/kg	50	<100	<50	nc	<50	nc	160	140	13	140	13	<50	<50	nc	<50	nc	130	200	42
	TPH C_{15} - C_{28} Fraction	mg/kg	100	2680	2570	4	1540	54	2430	1750	33	2320	5	130	170	27	<100	nc	1260	1730	31
	TPH C_{29}-C_{36} Fraction	mg/kg	100	2390	2130	12	940	87	940	1410	40	920	2	<100	<100	nc	<100	nc	710	820	14
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg		5120	4725	8	2480	69	3530	3300	7	3380	4	205	245	18	<250	nc	2100	2750	27
PAH/Phenols	Acenaphthene	mg/kg	RLCA	<0.8	1.5	nc	<1	nc	24.2	1.1	183	<1	nc	1.7	1.4	19	0.53	105	<0.8	<0.8	nc
	Acenaphthylene	mg/kg	RLCA	10	22.1	75	7	35	32.4	17.5	60	6	138	3.6	2.6	32	2.33	43	4.8	5.9	21
	Anthracene	mg/kg	RLCA	3.6	7.3	68	2	57	49.4	6	157	3	177	3.6	2.5	36	1.41	87	1.4	2	35
	Benz(a)anthracene	mg/kg	RLCA	5.9	14.8	86	5	17	38.8	13	100	11	112	0.9	1.6	56	0.12	153	2.1	3	35
	Benzo(a) pyrene	mg/kg	RLCA	14.7	32.4	75	12	20	30	29.7	1	12	86	0.6	1.4	80	0.05	169	10.6	16.5	44
	Benzo(b)fluoranthene	mg/kg	RLCA	16	38.3	82	17	6	31.1	31.2	0	17	59	0.6	1.4	80	0.07	158	11.4	16.5	37
	Benzo(g,h,i)perylene	mg/kg	RLCA	8.5	16.6	65	5	52	15.3	14.6	5	5	101	<0.5	0.6	nc	0.02	nc	6.1	8.6	34
	Benzo(k)fluoranthene	mg/kg	RLCA	5.4	13.2	84	17	104	9.5	10.6	11	17	57	<0.5	<0.5	nc	0.07	nc	5.6	7.9	34
	Chrysene	mg/kg	RLCA	6	12.5	70	7	15	29	11.3	88	12	83	0.7	1.4	67	0.1	150	3.7	6	47
	Dibenz(a,h)anthracene	mg/kg	RLCA	1.7	3.5	69	2	16	2.8	2.9	4	1	95	<0.5	<0.5	nc	<0.01	nc	1.4	2.3	49
	Fluoranthene	mg/kg	RLCA	9.8	23.3	82	9	9	54.9	21.7	87	24	78	4.5	5.5	20	1.22	115	5.6	27.8	133
	Fluorene	mg/kg	RLCA	1.2	2.1	55	1	18	4.5	1.9	81	2	77	2.6	1.2	74	1.71	41	<0.8	0.9	nc
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	6.4	12.9	67	5	25	11.5	11.6	1	5	79	<0.5	<0.5	nc	0.02	nc	4.8	6.2	25
	Naphthalene	mg/kg	RLCA	4.2	10.4	85	5	17	6.7	7.4	10	4	50	5.4	3.2	51	2.58	71	<0.8	<0.8	nc
	Phenanthrene	mg/kg	RLCA	3	6.1	68	3	0	85.3	3.9	183	2	191	10.9	4	93	4.8	78	0.9	1.4	43
	Pyrene	mg/kg	RLCA	22.1	51.9	81	16	32	55.1	47.6	15	31	56	4.3	6	33	1.1	119	20.4	42.7	71
SVOC	3-methylcholanthrene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
	2-(acetylamino) fluorene	mg/kg	0.1	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
	2-methylnaphthalene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
	Benzo(e)pyrene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
	Coronene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
	Perylene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc
						nc		nc			nc		nc			nc		nc			nc

Notes:
RPD = Relative Percentage Difference
Highlighted cells denote RPDs that are greater than 50% acceptable level.
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
SVOC = Semi Volatile Organic Compounds
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
nc = not calculable
RLCA - Refer to Laboratory Certificates of Analysis

AECOM

			Sample	PC9_0.3-0.4	DUP05	RPD (%)	PC24_0.25-0.4	DUP06	RPD (%)	TRIP 05	RPD (%)	PC16_0.0-0.02	DUP07	RPD (%)	TRIP 06	RPD (%)	PC16_0.02-0.1	DUP08	RPD (%)	TRIP 07	RPD (%)
			Location	PC9	PC9		PC24	PC24		PC24		PC16	PC16		PC16		PC16	PC16		PC16	
			Depth (m)	0.3-0.4	0.3-0.4		0.25-0.4	0.25-0.4		0.25-0.4		0 - 0.02	0 - 0.02		0 - 0.02		0.02-0.1	0.02-0.1		0.02-0.1	
			Date	29/04/2009	29/04/2009		1/05/2009	1/05/2009		1/05/2009		1/05/2009	1/05/2009		1/05/2009		1/05/2009	1/05/2009		1/05/2009	
			Type	Primary	Intralaboratory duplicate split sample		Primary	Intralaboratory duplicate split sample		Interlaboratory duplicate split sample		Primary	Intralaboratory duplicate core		Interlaboratory duplicate core		Primary	Intralaboratory duplicate core		Interlaboratory duplicate core	
	Analyte	Units	LOR																		
Inorganic	TOC	%	0.02	7.57	12.1	46	2.74	2.76	1	3.5	24		-	nc	3.9	nc	-	-	nc	3.6	nc
	Cyanide (Free)	mg/kg	1	<1	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc	<1	nc
	Cyanide Total	mg/kg	1	4	5	22	<1	<1	nc	3	nc	<1	<1	nc	<1	nc	<1	<1	nc	1	nc
	Moisture	%	1	62.7	61.1	3	52.5	53.6	2	52	1	62.5	65.4	5	66	5	64.9	51.9	22	53	20
BTEX	Benzene	mg/kg	0.2	<0.2	<0.2	nc	<0.2	<0.2	nc	<0.2	nc	<0.2	<0.2	nc	<0.2	nc	<0.2	<0.2	nc	<0.2	nc
	Ethylbenzene	mg/kg	0.5	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc
	Toluene	mg/kg	0.5	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc
	Xylene (m & p)	mg/kg	0.5	<0.5	<0.5	nc	<0.5	<0.5	nc	<1	nc	<0.5	<0.5	nc	<1	nc	<0.5	<0.5	nc	<1	nc
	Xylene (o)	mg/kg	0.5	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	nc
	Xylene Total	mg/kg		<1	<1	nc	<1	<1	nc	<1.5	nc	<1	<1	nc	<1.5	nc	<1	<1	nc	<1.5	nc
TPH	TPH C_6 - C_9 Fraction	mg/kg	10	<10	<10	nc	<10	<10	nc	<10	nc	<10	<10	nc	<10	nc	<10	<10	nc	<10	nc
	TPH C_{10} - C_{14} Fraction	mg/kg	50	350	340	3	<50	<50	nc	<50	nc	<50	<50	nc	<50	nc	<50	<50	nc	<50	nc
	TPH C_{15} - C_{28} Fraction	mg/kg	100	3970	3640	9	460	650	34	<100	nc	210	390	60	170	21	310	630	68	150	70
	TPH C_{29}-C_{36} Fraction	mg/kg	100	1880	1900	1	510	690	30	<100	nc	210	430	69	210	0	290	650	77	180	47
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg		6200	5880	5	995	1365	31	<250	nc	445	845	62	380	16	625	1305	70	330	62
PAH/Phenols	Acenaphthene	mg/kg	RLCA	1	1.4	33	<0.8	<0.8	nc	<0.01	nc	<0.8	<0.8	nc	<0.01	nc	<0.8	<0.8	nc	0.05	nc
	Acenaphthylene	mg/kg	RLCA	14.7	21.6	38	1	1.4	33	0.15	148	1.2	2.2	59	0.59	68	1.8	3.9	74	0.49	114
	Anthracene	mg/kg	RLCA	5.6	7.9	34	<0.8	<0.8	nc	0.08	nc	<0.8	<0.8	nc	0.19	nc	<0.8	1.4	nc	0.18	nc
	Benz(a)anthracene	mg/kg	RLCA	26.5	39.2	39	0.9	1.3	36	0.22	121	1	1.5	40	0.49	68	1.3	2.3	56	0.42	102
	Benzo(a) pyrene	mg/kg	RLCA	23.5	34.4	38	2.3	3.1	30	0.48	131	2.1	3.7	55	1.12	61	2.9	5.1	55	0.95	101
	Benzo(b)fluoranthene	mg/kg	RLCA	28	47.1	51	2.3	3.1	30	0.71	106	1.8	3.3	59	1.68	7	2.7	5.9	74	1.42	62
	Benzo(g,h,i)perylene	mg/kg	RLCA	11.6	16.9	37	1.6	2.2	32	0.32	133	1.2	2.2	59	0.72	50	1.7	3.8	76	0.55	102
	Benzo(k)fluoranthene	mg/kg	RLCA	10.6	22.8	73	1	1.2	18	0.71	34	0.9	1.8	67	1.68	60	1.3	2.6	67	1.42	9
	Chrysene	mg/kg	RLCA	25.9	31	18	0.9	1.3	36	0.25	113	1	1.6	46	0.57	55	1.3	1.9	38	0.5	89
	Dibenz(a,h)anthracene	mg/kg	RLCA	3	3.9	26	<0.8	<0.8	nc	0.09	nc	<0.8	<0.8	nc	0.19	nc	<0.8	<0.8	nc	0.16	nc
	Fluoranthene	mg/kg	RLCA	57.3	76.3	28	1.5	2.1	33	0.4	116	1.4	2.5	56	0.77	58	1.9	3.6	62	0.72	90
	Fluorene	mg/kg	RLCA	2.2	3.2	37	<0.8	<0.8	nc	0.03	nc	<0.8	<0.8	nc	0.1	nc	<0.8	<0.8	nc	0.09	nc
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	8.9	13.6	42	1.2	1.6	29	0.27	127	1	1.7	52	0.61	48	1.4	2.8	67	0.51	93
	Naphthalene	mg/kg	RLCA	3.4	3.9	14	<0.8	<0.8	nc	0.06	nc	0.8	1.1	32	0.19	123	0.8	1.7	72	0.2	120
	Phenanthrene	mg/kg	RLCA	3.3	3.9	17	<0.8	1	nc	0.17	nc	<0.8	1.2	nc	0.26	nc	0.9	1.7	62	0.36	86
	Pyrene	mg/kg	RLCA	66	94.3	35	2.2	3	31	0.58	117	2.2	4	58	1.21	58	3.1	5.2	51	1.06	98
SVOC	3-methylcholanthrene	mg/kg	0.01	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
	2-(acetylamino) fluorene	mg/kg	0.1	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
	2-methylnaphthalene	mg/kg	0.01	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
	Benzo(e)pyrene	mg/kg	0.01	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
	Coronene	mg/kg	0.01	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
	Perylene	mg/kg	0.01	-	-	nc	-	-	nc	-	nc	-	-	nc	-	nc	-	-	nc	-	nc
						nc			nc		nc			nc		nc			nc		nc

Notes:
RPD = Relative Percentage Difference
Highlighted cells denote RPDs that are greater than 50% acceptable level.
LOR = Limit of Reporting
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BTEX = Benzene, Toluene, Ethylbenzene, Xylene
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AECOM

	Sample			PC16_0.3-0.6	DUP09	RPD (%)	TRIP 08	RPD (%)	PC25_0.02-0.1	DUP10	RPD (%)	PC30_0.3-0.5	DUP11	RPD (%)	TRIP 09	RPD (%)	PC14-0.3-0.5	DUP12	RPD (%)	PC20_0.0-0.02
	Location			PC16	PC16		PC16		PC25	PC25		PC30	PC30		PC30		PC14	PC14		PC20
	Depth (m)			0.3-0.6	0.3-0.6		0.3-0.6		0.02-0.1	0.02-0.1		0.3-0.5	0.3-0.5		0.3-0.5		0.3-0.5	0.3-0.5		0 - 0.02
	Date			1/05/2009	1/05/2009		1/05/2009		1/05/2009	1/05/2009		1/05/2009	1/05/2009		1/05/2009		1/05/2009	1/05/2009		1/05/2009
	Type			Primary	Intralaboratory duplicate core		Interlaboratory duplicate core		Primary	Intralaboratory duplicate split sample		Primary	Intralaboratory duplicate split sample		Interlaboratory duplicate split sample		Primary	Intralaboratory duplicate split sample		Primary
	Analyte	Units	LOR																	
Inorganic	TOC	%	0.02	-	-	nc	4.1	nc	-	-	nc	-	-	nc	1.4	nc	-	-	nc	-
	Cyanide (Free)	mg/kg	1	<1	<1	nc	<1	nc	<1	<1	nc	<1	<1	nc	<1	nc	<1	<1	nc	<1
	Cyanide Total	mg/kg	1	<1	<1	nc	3	nc	<1	<1	nc	<1	<1	nc	<1	nc	11	6	59	<1
	Moisture	%	1	50.2	51.7	3	50	0	31.5	43.2	31	28	30.3	8	33	16	40.2	40.6	1	67.2
BTEX	Benzene	mg/kg	0.2	<0.2	<0.2	nc	<0.2	nc	<0.2	<0.2	nc	<0.2	<0.2	nc	<0.2	nc	5.2	0.2	185	<0.2
	Ethylbenzene	mg/kg	0.5	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	18	0.6	187	<0.5
	Toluene	mg/kg	0.5	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	8.5	0.6	174	<0.5
	Xylene (m & p)	mg/kg	0.5	<0.5	<0.5	nc	<1	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	<1	nc	34.2	0.5	194	<0.5
	Xylene (o)	mg/kg	0.5	<0.5	<0.5	nc	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	nc	24.2	<0.5	nc	<0.5
	Xylene Total	mg/kg		<1	<1	nc	<1.5	nc	<1	<1	nc	<1	<1	nc	<1.5	nc	58.4	0.75	195	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10	<10	<10	nc	<10	nc	<10	<10	nc	<10	<10	nc	<10	nc	162	12	172	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50	<50	<50	nc	<50	nc	<50	<50	nc	<50	<50	nc	<50	nc	7720	2020	117	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100	730	810	10	<100	nc	270	260	4	<100	<100	nc	<100	nc	26800	24600	9	510
	TPH C_{29}-C_{36} Fraction	mg/kg	100	760	720	5	<100	nc	230	260	12	<100	<100	nc	<100	nc	9120	8520	7	520
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg		1515	1555	3	<250	nc	525	545	4	<250	<250	nc	<250	nc	43640	35140	22	1055
PAH/Phenols	Acenaphthene	mg/kg	RLCA	<0.8	1.4	nc	0.27	nc	<0.5	<0.5	nc	<0.01	0.01	nc	<0.01	nc	59.6	77.6	26	<0.8
	Acenaphthylene	mg/kg	RLCA	2.9	5.7	65	0.7	122	3.2	2.5	25	0.08	0.21	90	0.07	13	181	111	48	3.5
	Anthracene	mg/kg	RLCA	1.2	2.9	83	0.35	110	1	1	0	0.04	0.1	86	0.04	0	193	182	6	1.8
	Benz(a)anthracene	mg/kg	RLCA	1.8	3.2	56	0.51	112	1.9	2.2	15	0.19	0.46	83	0.15	24	129	108	18	1.8
	Benzo(a) pyrene	mg/kg	RLCA	4.4	5.1	15	0.76	141	4.4	3.7	17	0.33	0.83	86	0.29	13	76.5	64.2	17	3.3
	Benzo(b)fluoranthene	mg/kg	RLCA	4.4	6	31	1.15	117	4.7	3.8	21	0.39	0.93	82	0.42	7	85.3	68.3	22	3
	Benzo(g,h,i)perylene	mg/kg	RLCA	2.8	3.6	25	0.38	152	2.3	2	14	0.1	0.16	46	0.17	52	34	32	6	1.5
	Benzo(k)fluoranthene	mg/kg	RLCA	1.9	2	5	1.15	49	1.4	1.3	7	0.22	0.54	84	0.42	63	22.8	15.4	39	1
	Chrysene	mg/kg	RLCA	1.8	2.5	33	0.57	104	1.3	1.7	27	0.16	0.36	77	0.16	0	108	82.8	26	1.9
	Dibenz(a,h)anthracene	mg/kg	RLCA	<0.8	<0.8	nc	0.11	nc	<0.5	<0.5	nc	0.03	0.07	80	0.06	67	<8	<8	nc	<0.8
	Fluoranthene	mg/kg	RLCA	3.4	7.6	76	1.14	100	2	2.5	22	0.27	0.57	71	0.26	4	271	253	7	3.2
	Fluorene	mg/kg	RLCA	0.8	1.4	55	0.23	111	<0.5	<0.5	nc	0.01	0.03	100	0.01	0	203	131	43	<0.8
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	2.2	2.6	17	0.35	145	1.9	1.5	24	0.09	0.18	67	0.15	50	26	20.8	22	1.1
	Naphthalene	mg/kg	RLCA	1.6	4.1	88	0.87	59	0.9	1	11	0.02	0.05	86	<0.01	nc	1110	63.8	178	1.7
	Phenanthrene	mg/kg	RLCA	2.8	4.7	51	0.71	119	0.7	0.7	0	0.1	0.23	79	0.08	22	597	696	15	2
	Pyrene	mg/kg	RLCA	4.3	8.2	62	1.31	107	5.9	5.3	11	0.29	0.64	75	0.28	4	292	376	25	6.1
SVOC	3-methylcholanthrene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	<0.1	<0.1		-	nc	-	-	nc	-
	2-(acetylamino) fluorene	mg/kg	0.1	-	-	nc	-	nc	-	-	nc	0.01	0.02	67	-	nc	-	-	nc	-
	2-methylnaphthalene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	<0.01	<0.01		-	nc	-	-	nc	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	<0.01	<0.01		-	nc	-	-	nc	-
	Benzo(e)pyrene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	0.16	0.38	81	-	nc	-	-	nc	-
	Coronene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	<0.01	<0.01		-	nc	-	-	nc	-
	Perylene	mg/kg	0.01	-	-	nc	-	nc	-	-	nc	0.06	0.12	67	-	nc	-	-	nc	-

Notes:
RPD = Relative Percentage Difference
Highlighted cells denote RPDs that are greater than 50% acceptable level.
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
SVOC = Semi Volatile Organic Compounds
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
nc = not calculable
RLCA - Refer to Laboratory Certificates of Analysis

AECOM

			Sample	DUP13	RPD (%)	PC20_0.02-0.1	DUP14	RPD (%)	PC20_0.3-0.5	DUP15	RPD (%)	PC15-0.0-0.02	DUP16	RPD (%)	PC15-0.02-0.1	DUP17	RPD (%)	PC15-0.3-0.5	DUP18	RPD (%)	SG8
			Location	PC20		PC20	PC20		PC20	PC20		PC15	PC15		PC15	PC15		PC15	PC15		SG8
			Depth (m)	0 - 0.02		0.02-0.1	0.02-0.1		0.3-0.5	0.3-0.5		0 - 0.02	0 - 0.02		0.02-0.1	0.02-0.1		0.3-0.5	0.3-0.5		
			Date	1/05/2009		1/05/2009	1/05/2009		1/05/2009	1/05/2009		1/05/2009	1/05/2009		1/05/2009	1/05/2009		1/05/2009	1/05/2009		8/05/2009
			Type	Intralaboratory duplicate core		Primary	Intralaboratory duplicate core		Primary	Intralaboratory duplicate core		Primary	Intralaboratory duplicate core		Primary	Intralaboratory duplicate core		Primary	Intralaboratory duplicate core		Primary
	Analyte	Units	LOR																		
Inorganic	TOC	%	0.02	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	27.8
	Cyanide (Free)	mg/kg	1	<1	nc	<1	<1	nc	<1	<1	nc	<1	<1	nc	<1	<1	nc	<1	<1	nc	<1
	Cyanide Total	mg/kg	1	<1	nc	<1	<1	nc	<1	<1	nc	<1	2	nc	5	2	86	14	3	129	3
	Moisture	%	1	66	2	47	44.3	6	41.4	39.8	4	65	55.4	16	52.3	45.6	14	54.7	55.3	1	57.8
BTEX	Benzene	mg/kg	0.2	<0.2	nc	<0.2	<0.2	nc	<0.2	<0.2	nc	<0.2	0.2	nc	0.2	<0.2	nc	1.3	<0.2	nc	<0.2
	Ethylbenzene	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	1	2.8	95	6.5	<0.5	nc	17.4	4.6	116	<0.5
	Toluene	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	0.6	0.9	40	0.9	<0.5	nc	8.3	0.8	165	<0.5
	Xylene (m & p)	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	1	nc	1.6	<0.5	nc	24.6	2.6	162	<0.5
	Xylene (o)	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	<0.5	0.5	nc	1.1	<0.5	nc	16.1	2.7	143	<0.5
	Xylene Total	mg/kg		<1	nc	<1	<1	nc	<1	<1	nc	<1	1.5	nc	2.7	<1	nc	40.7	5.3	154	<1
TPH	TPH C_6 - C_9 Fraction	mg/kg	10	<10	nc	<10	<10	nc	<10	<10	nc	<10	28	nc	66	<10	nc	182	40	128	<10
	TPH C_{10} - C_{14} Fraction	mg/kg	50	<50	nc	<50	<50	nc	<50	<50	nc	930	1190	25	2880	160	179	19800	2820	150	1250
	TPH C_{15} - C_{28} Fraction	mg/kg	100	690	30	590	510	15	650	590	10	8680	9630	10	19200	3410	140	61100	18600	107	17800
	TPH C_{29}-C_{36} Fraction	mg/kg	100	660	24	540	460	16	610	550	10	4160	3810	9	6490	1890	110	12000	5810	70	8480
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg		1375	26	1155	995	15	1285	1165	10	13770	14630	6	28570	5460	136	92900	27230	109	27530
PAH/Phenols	Acenaphthene	mg/kg	RLCA	<0.8	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	17.6	27.1	43	47	85	58	94	87	9	49
	Acenaphthylene	mg/kg	RLCA	4.9	33	4.4	4	10	4	4	0	65.6	80.9	21	134	256	63	398	162	84	147
	Anthracene	mg/kg	RLCA	2.5	33	2.1	1.7	21	1.8	1.7	6	43.2	72.3	50	114	176	43	258	157	49	120
	Benz(a)anthracene	mg/kg	RLCA	2.6	36	2.1	1.8	15	1.9	1.6	17	55.9	56.8	2	85	150	55	158	113	33	160
	Benzo(a) pyrene	mg/kg	RLCA	5.3	47	4.8	3.1	43	5.3	5.8	9	50.2	43.5	14	57	105	59	92	87	5	172
	Benzo(b)fluoranthene	mg/kg	RLCA	4.4	38	4.6	4.5	2	5	6.3	23	51.7	44.9	14	64	116	58	103	96	7	173
	Benzo(g,h,i)perylene	mg/kg	RLCA	2	29	1.9	2	5	2.1	2.2	5	15.6	11.4	31	25	46	58	38	43	12	79
	Benzo(k)fluoranthene	mg/kg	RLCA	2.5	86	2.4	2.5	4	2.4	1.9	23	19.1	11	54	17	50	100	26	27	3	66
	Chrysene	mg/kg	RLCA	2.7	35	2	1.8	11	1.7	1.6	6	46.8	51.1	9	73	124	52	120	107	11	134
	Dibenz(a,h)anthracene	mg/kg	RLCA	<0.8	nc	<0.5	<0.5	nc	<0.5	<0.5	nc	3.7	2.8	28	<8	11	nc	<16	13	nc	23
	Fluoranthene	mg/kg	RLCA	4.3	29	3.5	3	15	2.8	2.6	7	158	166	5	187	336	57	352	250	34	312
	Fluorene	mg/kg	RLCA	<0.8	nc	0.7	<0.5	nc	0.6	0.5	18	18	43.7	83	108	167	43	308	155	66	26
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	1.6	37	1.5	1.5	0	1.6	1.7	6	13.8	10.3	29	20	43	75	28	33	14	64
	Naphthalene	mg/kg	RLCA	2.2	26	3.4	1.4	83	2.1	2.2	5	72.1	96.9	29	87	131	40	1330	178	153	47
	Phenanthrene	mg/kg	RLCA	2.2	10	2.3	1.4	49	2.1	1.6	27	66.1	172	89	342	467	31	852	370	79	63
	Pyrene	mg/kg	RLCA	8.3	31	8	7.2	nc	6.5	6.2	5	175	179	2	210	355	51	374	278	29	390
SVOC	3-methylcholanthrene	mg/kg	0.01	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
	2-(acetylamino) fluorene	mg/kg	0.1	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
	2-methylnaphthalene	mg/kg	0.01	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
	Benzo(e)pyrene	mg/kg	0.01	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
	Coronene	mg/kg	0.01	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
	Perylene	mg/kg	0.01	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-	-	nc	-
					nc			nc			nc			nc			nc			nc	

Notes:
RPD = Relative Percentage Difference
Highlighted cells denote RPDs that are greater than 50% acceptable level.
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
SVOC = Semi Volatile Organic Compounds
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
nc = not calculable
RLCA - Refer to Laboratory Certificates of Analysis

AECOM

			Sample	DUP19	RPD (%)	SG11	DUP20	RPD (%)	RB01	RB02	RB03
			Location	SG8		SG11	SG11				
			Depth (m)								
			Date	8/05/2009		8/05/2009	8/05/2009		29/04/2009	1/05/2009	8/05/2009
			Type	Intralaboratory duplicate split sample		Primary	Intralaboratory duplicate split sample		Rinsate Blank (µg/L)	Rinsate Blank (µg/L)	Rinsate Blank (µg/L)
	Analyte	Units	LOR								
Inorganic	TOC	%	0.02	26.2	6	5.12	5.45	6	-	-	<1
	Cyanide (Free)	mg/kg	1	<1	nc	<1	<1	nc	<4	<4	<4
	Cyanide Total	mg/kg	1	3	0	<1	<1	nc	<4	<4	<4
	Moisture	%	1	55.8	4	59.5	60	1	-	-	-
BTEX	Benzene	mg/kg	0.2	<0.2	nc	<0.2	<0.2	nc	<1	<1	<1
	Ethylbenzene	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<2	<2	<2
	Toluene	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<5	<5	<5
	Xylene (m & p)	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<2	<2	<2
	Xylene (o)	mg/kg	0.5	<0.5	nc	<0.5	<0.5	nc	<2	<2	<2
	Xylene Total	mg/kg		<1	nc	<1	<1	nc	<4	-	-
TPH	TPH C_6 - C_9 Fraction	mg/kg	10	<10	nc	<10	<10	nc	<20	<20	<20
	TPH C_{10} - C_{14} Fraction	mg/kg	50	1230	2	<50	<50	nc	<50	<50	<50
	TPH C_{15} - C_{28} Fraction	mg/kg	100	16100	10	730	720	1	<100	<100	<100
	TPH C_{29}-C_{36} Fraction	mg/kg	100	8120	4	620	590	5	<50	<50	<50
	TPH+C_{10} - C_{36} (Sum of total)	mg/kg		25450	8	1375	1335	3	<200	-	-
PAH/Phenols	Acenaphthene	mg/kg	RLCA	32	44	<0.8	<0.8	nc	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	RLCA	125	16	5	6	23	<0.1	<0.1	<0.1
	Anthracene	mg/kg	RLCA	70	53	1	2	27	<0.1	<0.1	<0.1
	Benz(a)anthracene	mg/kg	RLCA	161	1	3	3	21	<0.1	<0.1	<0.1
	Benzo(a) pyrene	mg/kg	RLCA	169	2	8	10	17	<0.05	<0.05	<0.05
	Benzo(b)fluoranthene	mg/kg	RLCA	174	1	7	10	36	<0.1	<0.1	<0.1
	Benzo(g,h,i)perylene	mg/kg	RLCA	62	24	3	5	51	<0.1	<0.1	<0.1
	Benzo(k)fluoranthene	mg/kg	RLCA	55	19	3	4	8	<0.1	<0.1	<0.1
	Chrysene	mg/kg	RLCA	129	4	3	4	30	<0.1	<0.1	<0.1
	Dibenz(a,h)anthracene	mg/kg	RLCA	23	0	1	2	67	<0.1	<0.1	<0.1
	Fluoranthene	mg/kg	RLCA	299	4	3	4	29	<0.1	<0.1	<0.1
	Fluorene	mg/kg	RLCA	31	19	<0.8	1	nc	<0.1	<0.1	<0.1
	Indeno(1,2,3-c,d)pyrene	mg/kg	RLCA	48	27	3	4	41	<0.1	<0.1	<0.1
	Naphthalene	mg/kg	RLCA	46	3	2	4	67	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	RLCA	93	39	1	2	35	<0.1	<0.1	<0.1
	Pyrene	mg/kg	RLCA	345	12	8	10	26	<0.1	<0.1	<0.1
SVOC	3-methylcholanthrene	mg/kg	0.01	-	nc	-	-		<0.1	<0.1	<0.1
	2-(acetylamino) fluorene	mg/kg	0.1	-	nc	-	-		<0.1	<0.1	<0.1
	2-methylnaphthalene	mg/kg	0.01	-	nc	-	-		<0.1	<0.1	<0.1
	7,12-dimethylbenz(a)anthracene	mg/kg	0.01	-	nc	-	-		<0.1	<0.1	<0.1
	Benzo(e)pyrene	mg/kg	0.01	-	nc	-	-		<0.1	<0.1	<0.1
	Coronene	mg/kg	0.01	-	nc	-	-		<0.1	<0.1	<0.1
	Perylene	mg/kg	0.01	-	nc	-	-		<0.1	<0.1	<0.1
					nc				<0.1	<0.1	<0.1

Notes:
RPD = Relative Percentage Difference
Highlighted cells denote RPDs that are greater than 50% acceptable level.
LOR = Limit of Reporting
mg/kg = milligrams per kilogram
TOC = Total Organic Carbon
BTEX = Benzene, Toluene, Ethylbenzene, Xylene
TPH = Total Petroleum Hydrocarbons
PAH = Polycyclic Aromatic Hydrocarbons
SVOC = Semi Volatile Organic Compounds
< = concentration not detected greater than the Laboratory LOR.
- = not analysed
nc = not calculable
RLCA - Refer to Laboratory Certificates of Analysis

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Figures

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Background sample

AECOM

0 200m

Site Location

Breakfast Point Pty Ltd

Sediment Investigation

Inner West Marina

Parramatta River, Sydney

Figure

F1

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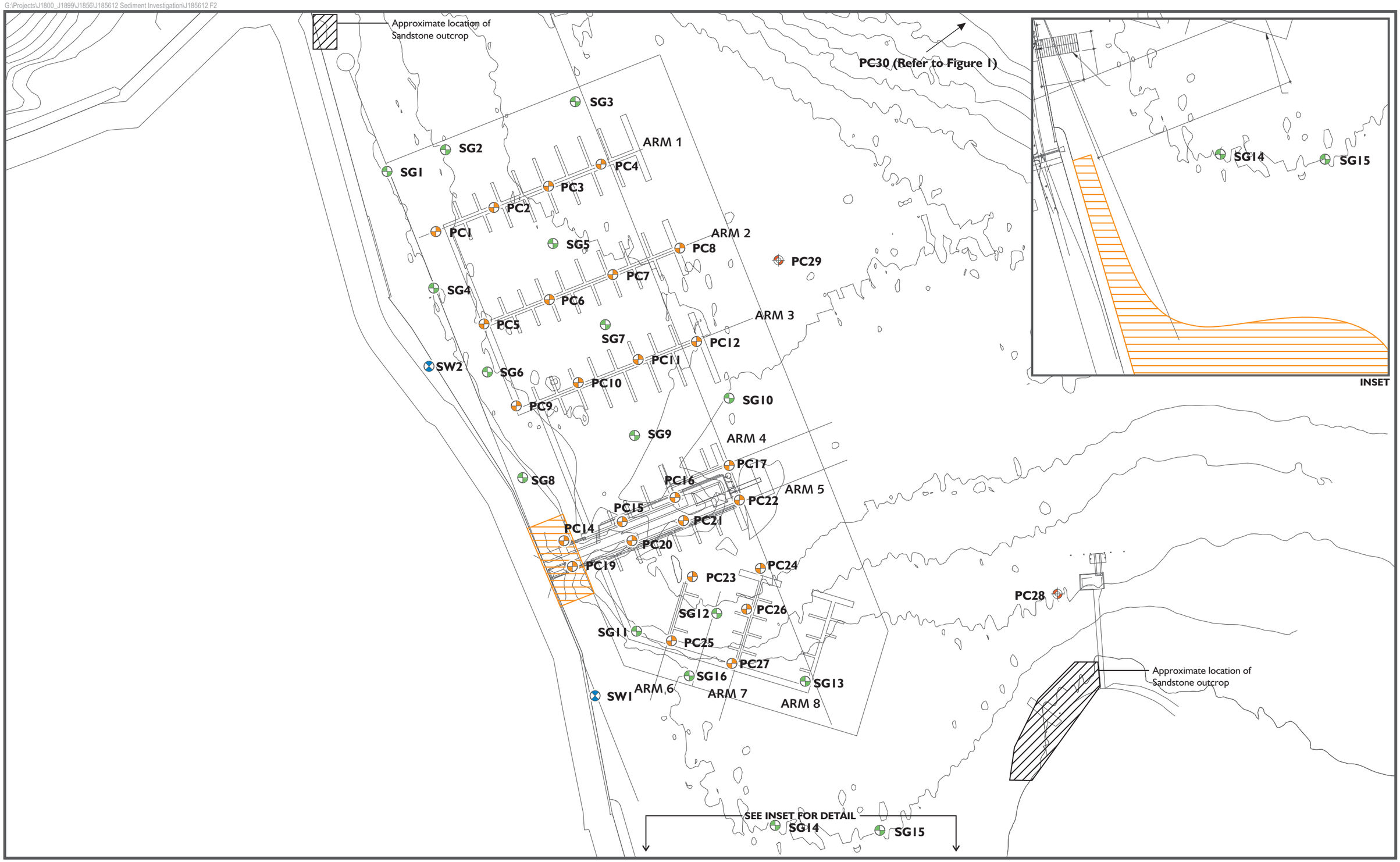
Project ID: J1856

Created By: TO

Last Modified: 15/06/2009

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F2



AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 15/06/2009

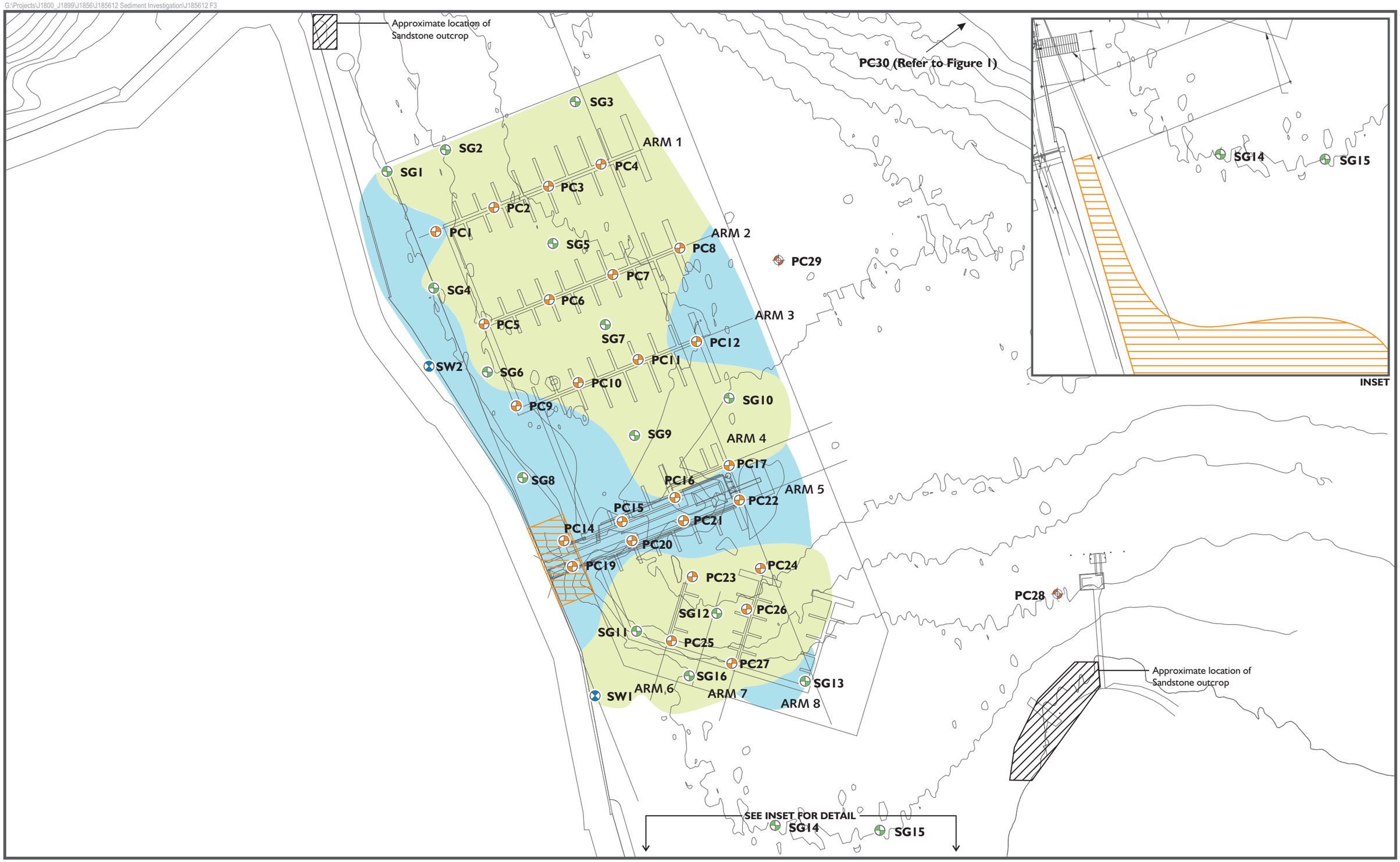
- Approximate extent of Proposed Remediation Areas (URS,2008)
- Sediment grab sample targeting stormwater outlet
- Sediment grab sample
- Push core
- Background sample

Site Layout and Sediment Investigation Sample Locations

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F2

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F3



AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 19/08/2009

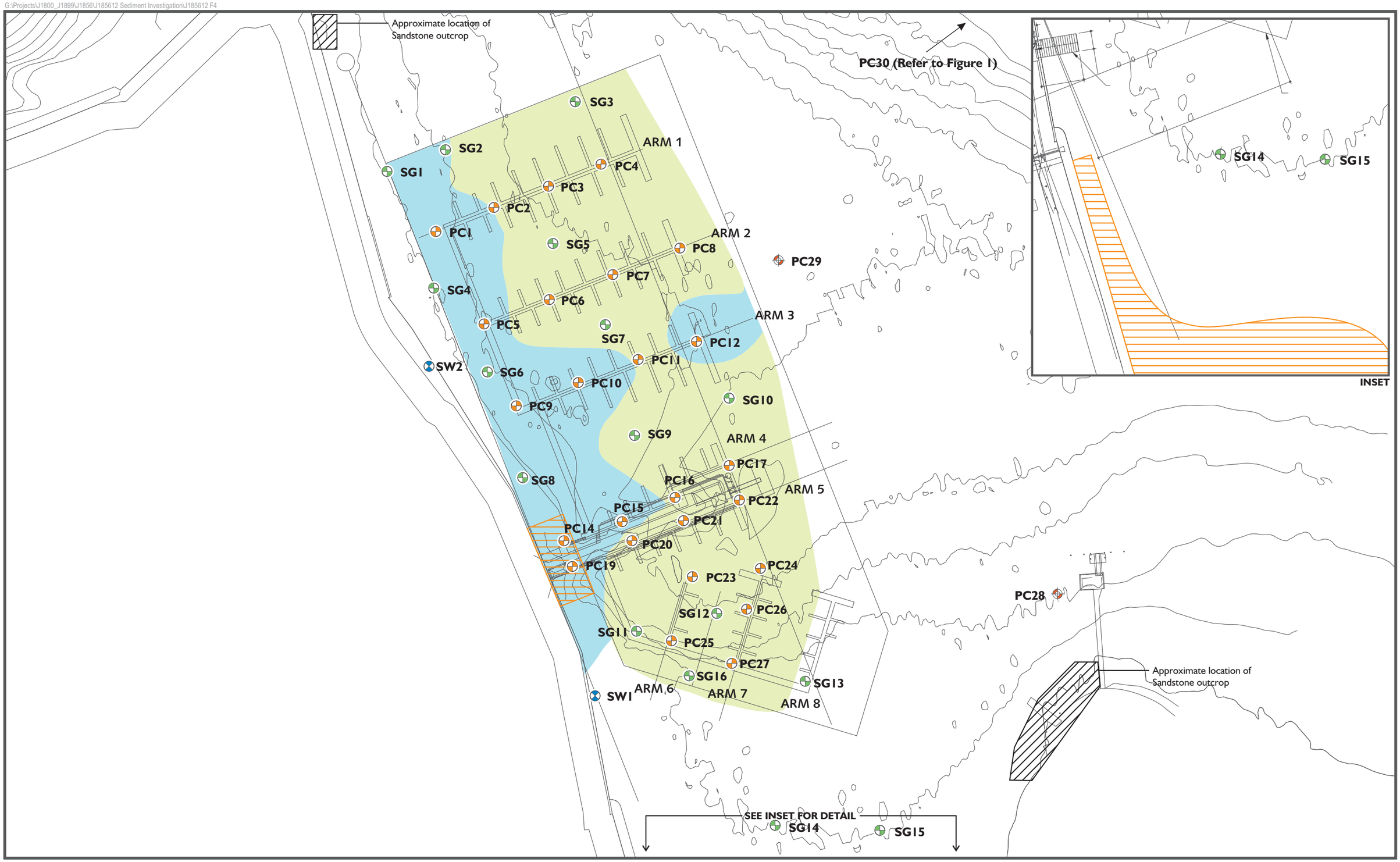
- Approximate extent of Proposed Remediation Areas (URS,2008)
- 1.700 - 9.6 mg/kg (>ISQGL to ISQGH)
- >9.6 mg/kg (>ISQG High)
- Sediment grab sample targeting stormwater outlet
- Sediment grab sample
- Push core
- Background sample

Concentrations of High Molecular Weight PAH in Sediment (0.00-0.002m Depth)

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F3

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F4



AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 19/08/2009

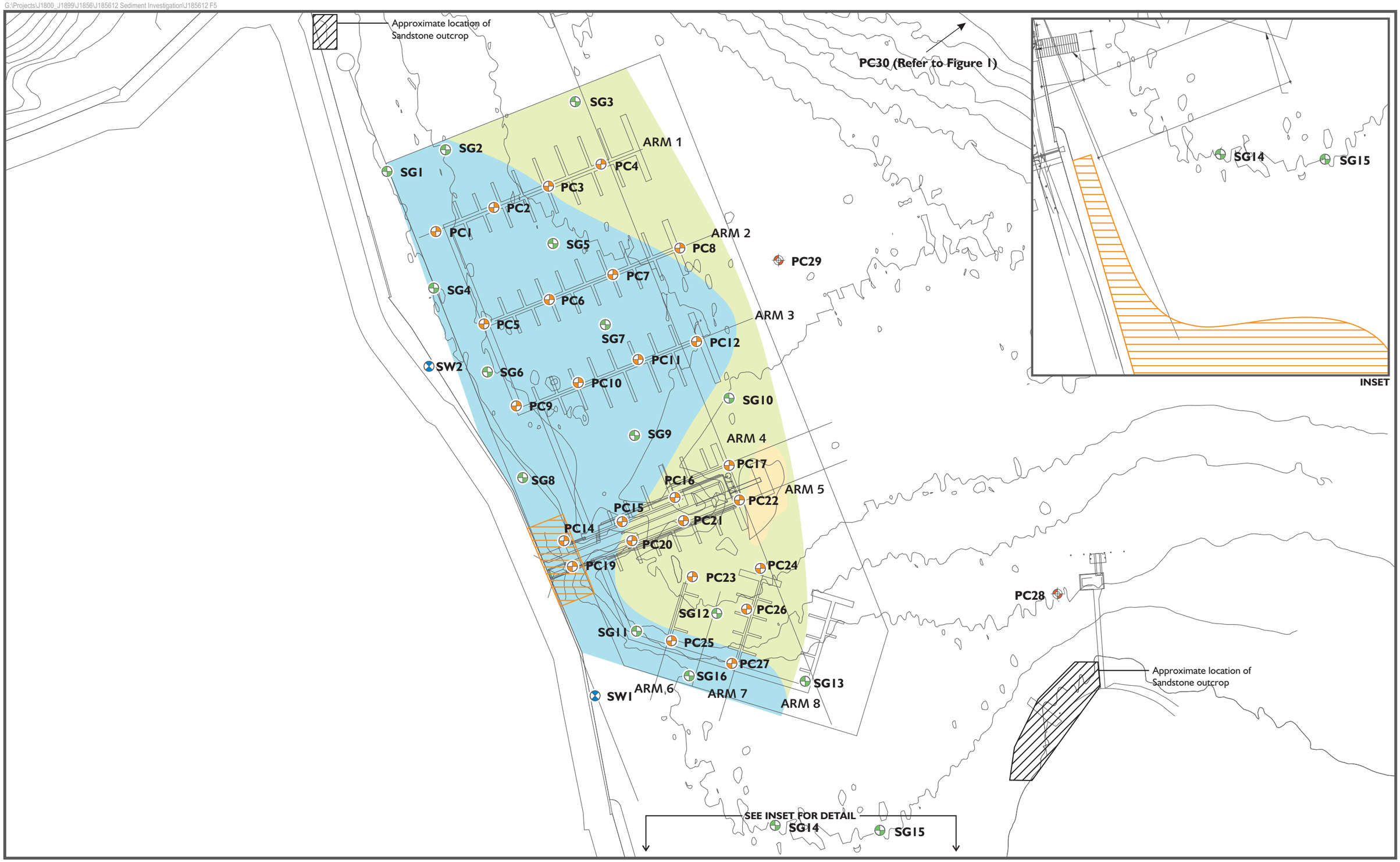
- Approximate extent of Proposed Remediation Areas (URS,2008)
- 1.700 - 9.6 mg/kg (>ISQGL to ISQGH)
- >9.6 mg/kg (>ISQG High)
- Sediment grab sample targeting stormwater outlet
- Sediment grab sample
- Push core
- Background sample

Concentrations of High Molecular Weight PAH in Sediment (0.02-0.1m Depth)

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F4

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F5



AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 19/08/2009

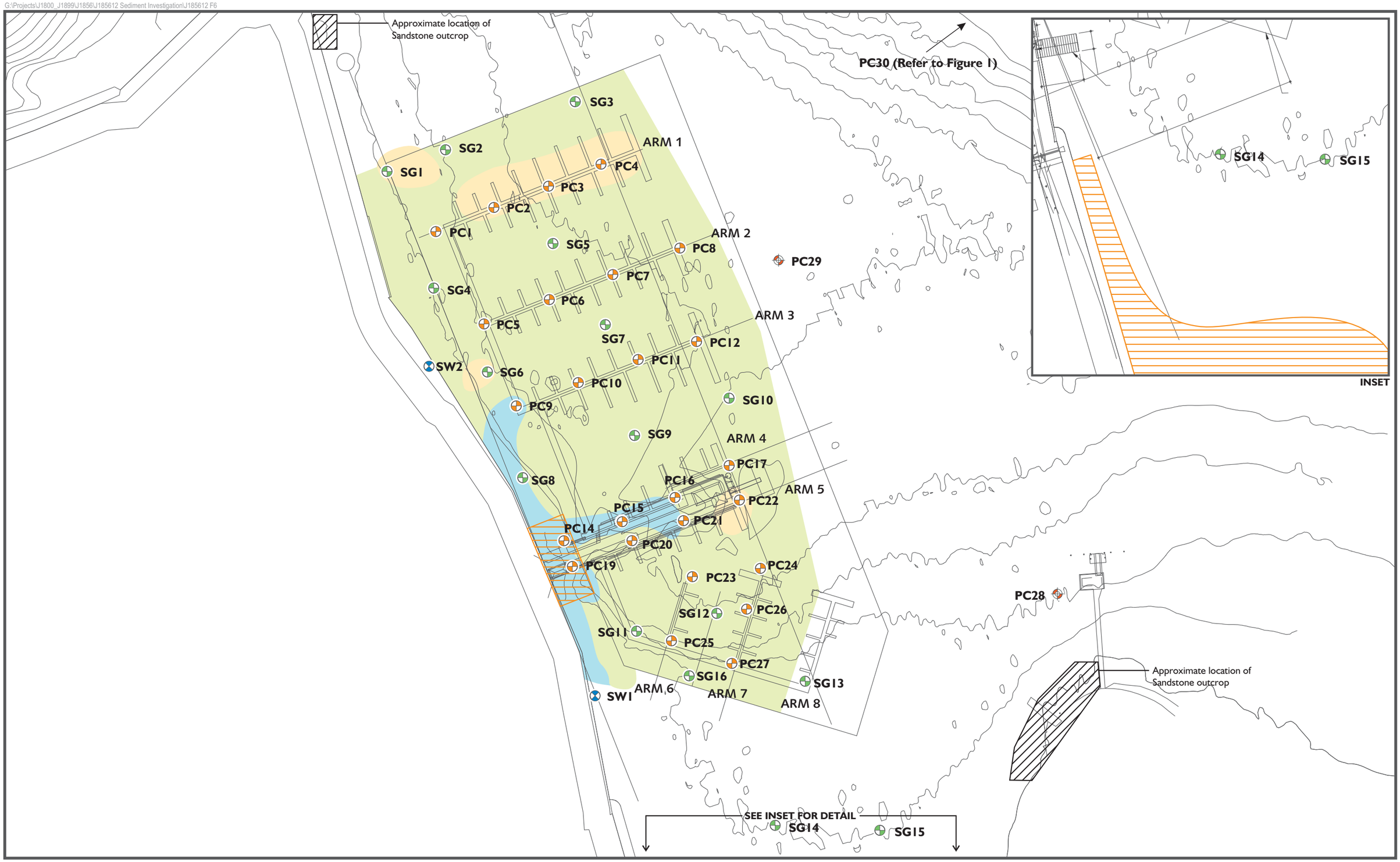
- Approximate extent of Proposed Remediation Areas (URS,2008)
- 0 - 1.700 mg/kg (<ISQG Low)
- 1.700 - 9.6 mg/kg (>ISQGL to ISQGH)
- >9.6 mg/kg (>ISQG High)
- Sediment grab sample targeting stormwater outlet
- Sediment grab sample
- Push core
- Background sample

Concentrations of High Molecular Weight PAH in Sediment (0.2-0.4m Depth)

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F5

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F6



AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 19/08/2009

- Approximate extent of Proposed Remediation Areas (URS,2008)
- 0 - 0.552 mg/kg (<ISQG Low)
- 0.552 - 3.16 mg/kg (>ISQGL to ISQGH)
- >3.16 mg/kg (>ISQG High)
- Sediment grab sample targeting stormwater outlet
- Sediment grab sample
- Push core
- Background sample

Concentrations of Low Molecular Weight PAH in Sediment (0.0-0.02m Depth)

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F6

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F7

Approximate location of Sandstone outcrop

PC30 (Refer to Figure 1)

SG3
SG2
SG1
PC4
PC3
PC2
PC1
SG5
PC8
PC29
PC7
SG4
PC6
PC5
SG7
PC12
PC11
SW2
SG6
PC10
PC9
SG10
SG9
PC17
SG8
PC16
PC22
PC15
PC21
PC14
PC20
PC19
PC24
PC23
PC28
SG12
PC26
SG11
PC25
PC27
SG16
SG13
SW1

Approximate location of Sandstone outcrop

SEE INSET FOR DETAIL
SG14
SG15

INSET
SG14
SG15

AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 19/08/2009

- Approximate extent of Proposed Remediation Areas (URS,2008)
- 0 - 0.552 mg/kg (<ISQG Low)
- 0.552 - 3.16 mg/kg (>ISQGL to ISQGH)
- >3.16 mg/kg (>ISQG High)
- Sediment grab sample targeting stormwater outlet
- Sediment grab sample
- Push core
- Background sample

Concentrations of Low Molecular Weight PAH in Sediment (0.02-0.1m Depth)

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F7

G:\Projects\J1800_J1899\J1856\J185612 Sediment Investigation\J185612 F8

Approximate location of Sandstone outcrop

PC30 (Refer to Figure 1)

SG3
SG2
SG1
PC4
PC3
PC2
PC1
SG5
PC8
PC29
PC7
SG4
PC6
PC5
SG7
PC12
PC11
SW2
SG6
PC10
PC9
SG10
SG9
PC17
SG8
PC16
PC22
PC15
PC21
PC14
PC20
PC19
PC24
PC23
PC28
SG12
PC26
SG11
PC25
PC27
SG16
SG13
SW1

SG14
SG15

INSET

Approximate location of Sandstone outcrop

SEE INSET FOR DETAIL

SG14
SG15

Approximate extent of Proposed Remediation Areas (URS,2008)
0 - 0.552 mg/kg (<ISQG Low)
0.552 - 3.16 mg/kg (>ISQGL to ISQGH)
>3.16 mg/kg (>ISQG High)
Sediment grab sample targeting stormwater outlet
Sediment grab sample
Push core
Background sample

AECOM

0 100m

Project ID: J185612
Created By: TO
Last Modified: 19/08/2009

Concentrations of Low Molecular Weight PAH in Sediment (0.2-0.4m Depth)

Breakfast Point Pty Ltd
Sediment Investigation
Inner West Marina
Parramatta River, Sydney

Figure
F8

Plates

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AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
1	29 April 2009

Description:

Photograph showing PC1.

Plate No.	Date:
2	29 April 2009

Description:

Photograph showing PC2. Note the soft surface sediments.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
3	29 April 2009

Description:

Photograph showing PC3. Note the black silt pockets towards the base of the core.

Plate No.	Date:
4	29 April 2009

Description:

Photograph showing PC4. Note the black silt pockets towards the base of the core.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
5	29 April 2009

Description:

Photograph showing PC5. Note the coarse grained material in the lower half of the core.

Plate No.	Date:
6	29 April 2009

Description:

Photograph showing PC6. Note the black hydrocarbon staining at the base of the core.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
7	29 April 2009

Description:

Photograph showing PC7.

Plate No.	Date:
8	29 April 2009

Description:

Photograph showing PC8.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
9	29 April 2009

Description:

Photograph showing PC9. Note the black hydrocarbon staining from 0.15 m depth, becoming very heavy from 0.3 m depth.

Plate No.	Date:
10	29 April 2009

Description:

Photograph showing PC10. Note the sheen visible from 0.45 m depth.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
11	29 April 2009

Description:

Photograph showing PC11.

Plate No.	Date:
12	29 April 2009

Description:

Photograph showing PC12.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
14	1 May 2009

Description:

Photograph showing PC14. Note black stained layer from 0.02 – 0.10 m depth.

Plate No.	Date:
15	1 May 2009

Description:

Photograph showing PC15. Note sheen is visible from 0.15 – 0.62 m depth and cracks where product is present.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
16	1 May 2009

Description:

Photograph showing PC16.

Plate No.	Date:
17	1 May 2009

Description:

Photograph showing PC17.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
19	1 May 2009

Description:

Photograph showing PC19. Note the soft surface sediments.

Plate No.	Date:
20	1 May 2009

Description:

Photograph showing PC20. Note the soft surface sediments

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
21	1 May 2009

Description:

Photograph showing PC21.

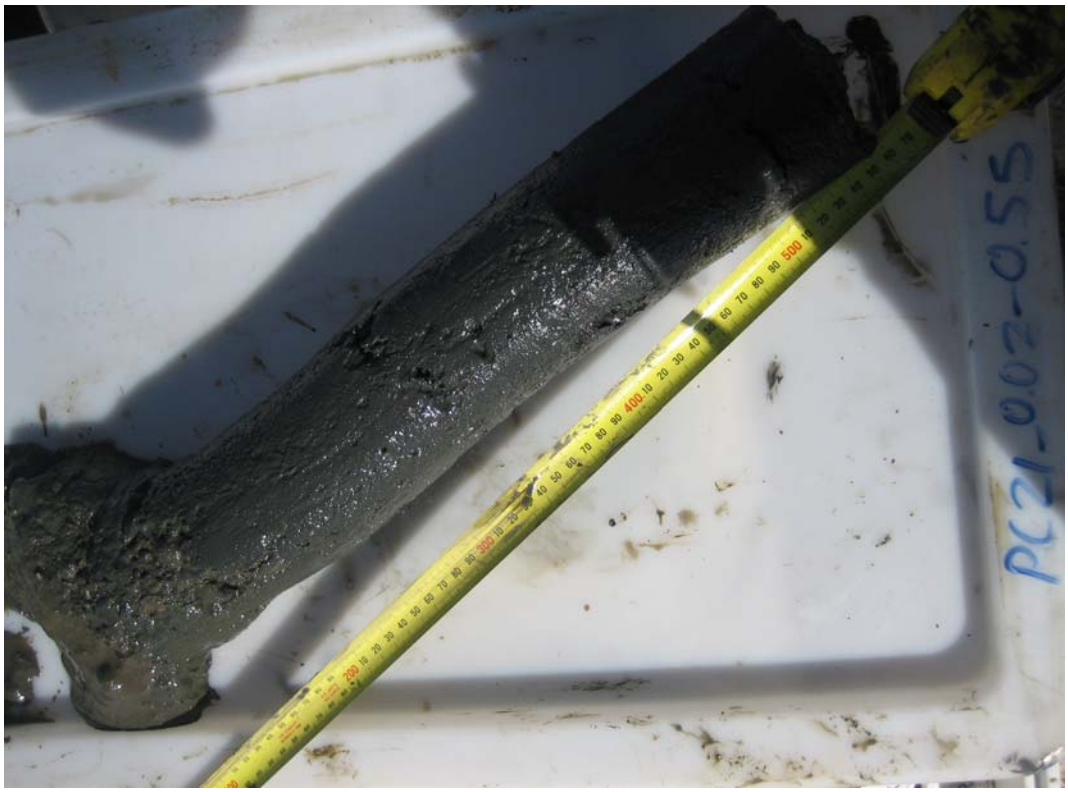


Plate No.	Date:
22	1 May 2009

Description:

Photograph showing PC22. Note the soft surface sediments.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
23	1 May 2009

Description:

Photograph showing PC23.

Plate No.	Date:
24	1 May 2009

Description:

Photograph showing PC24.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
25	1 May 2009

Description:

Photograph showing PC25. Note the product and sheen visible from 0.1 – 0.2 m

Plate No.	Date:
26	1 May 2009

Description:

Photograph showing PC26.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
27	1 May 2009

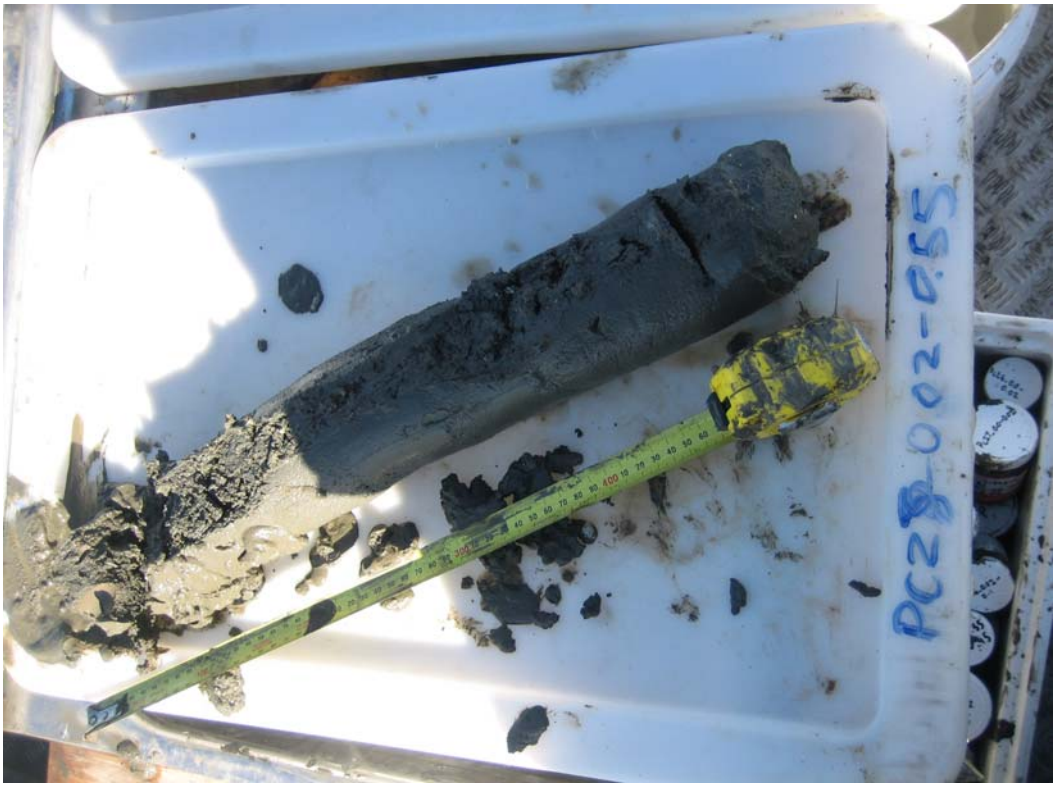
Description:

Photograph showing PC27.

Plate No.	Date:
28	1 May 2009

Description:

Photograph showing PC28.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
29	1 May 2009

Description:

Photograph showing PC29..

Plate No.	Date:
30	1 May 2009

Description:

Photograph showing PC30.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
31	8 May 2009

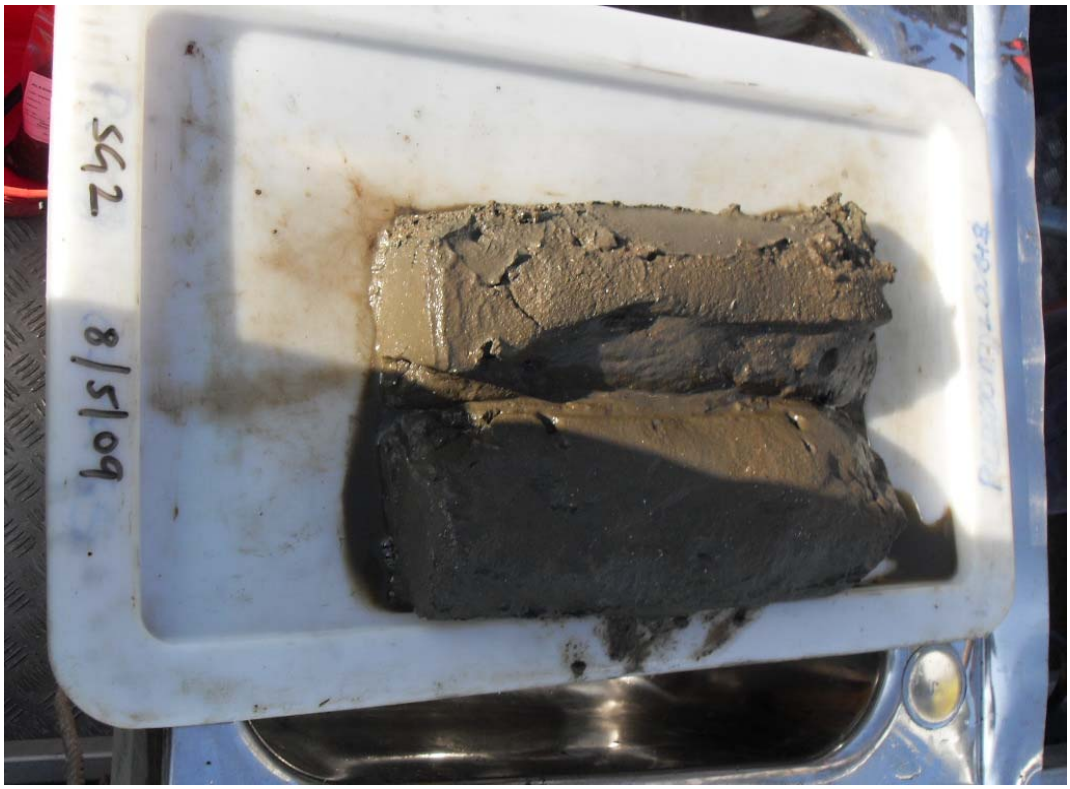
Description:

Photograph showing SG1. Note the sandy consistency of the material being from near to the shoreline.

Plate No.	Date:
32	8 May 2009

Description:

Photograph showing SG2.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
33	8 May 2009

Description:

Photograph showing SG3. Note the soft sediments from areas further away from the shoreline.

Plate No.	Date:
34	8 May 2009

Description:

Photograph showing SG4.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
35	8 May 2009

Description:

Photograph showing SG5.

Plate No.	Date:
36	8 May 2009

Description:

Photograph showing SG6.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
37	8 May 2009

Description:

Photograph showing SG7.

Plate No.	Date:
38	8 May 2009

Description:

Photograph showing SG8.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
39	8 May 2009

Description:

Photograph showing SG9.

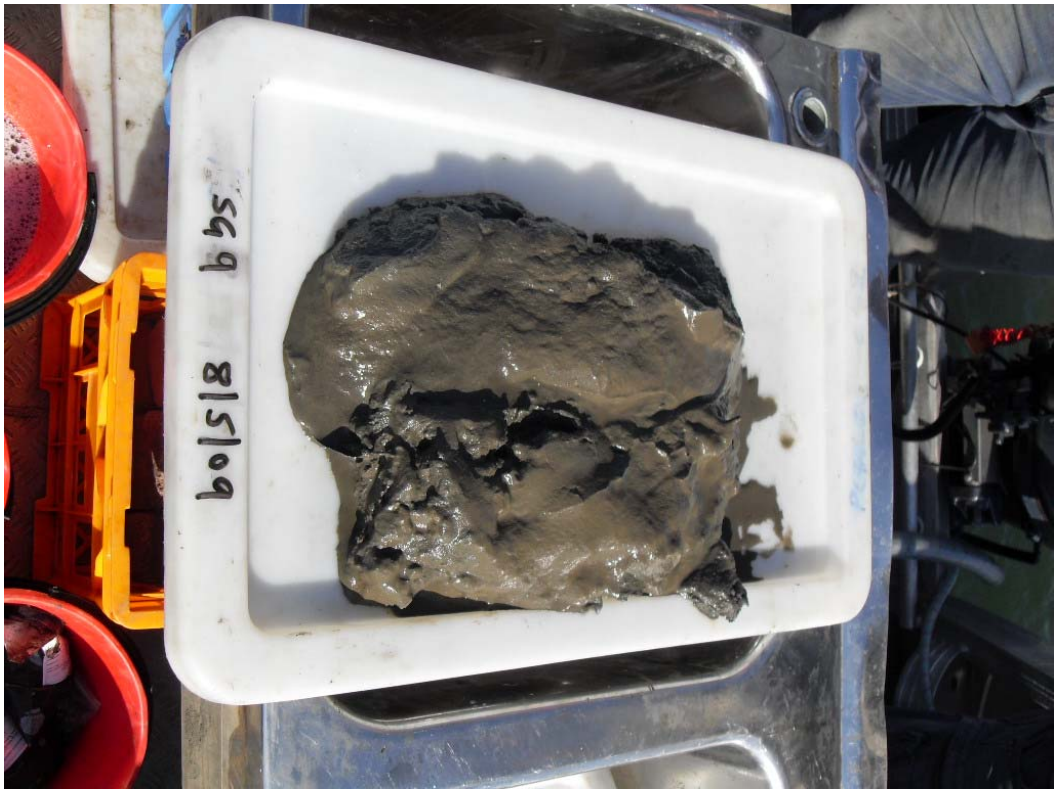


Plate No.	Date:
40	8 May 2009

Description:

Photograph showing SG10.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
41	8 May 2009

Description:

Photograph showing SG11.

Plate No.	Date:
42	8 May 2009

Description:

Photograph showing SG12.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
43	8 May 2009

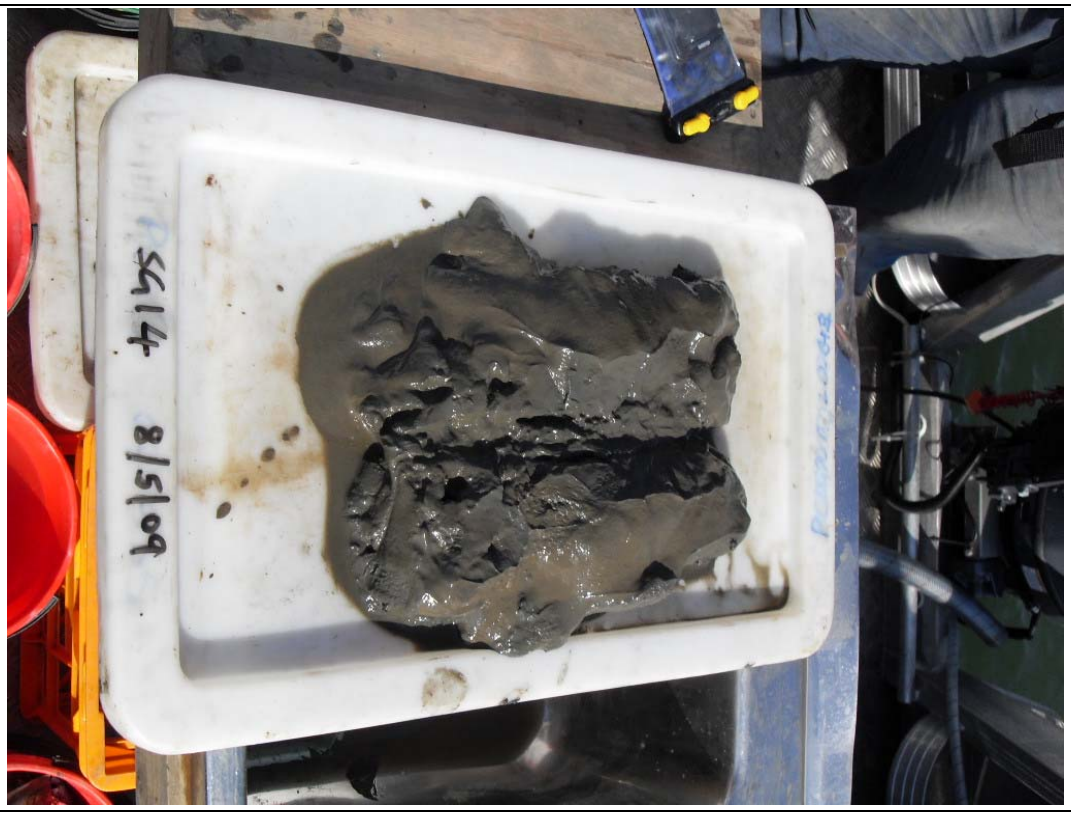
Description:

Photograph showing SG13.

Plate No.	Date:
44	8 May 2009

Description:

Photograph showing SG14.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
45	8 May 2009

Description:

Photograph showing SG15.

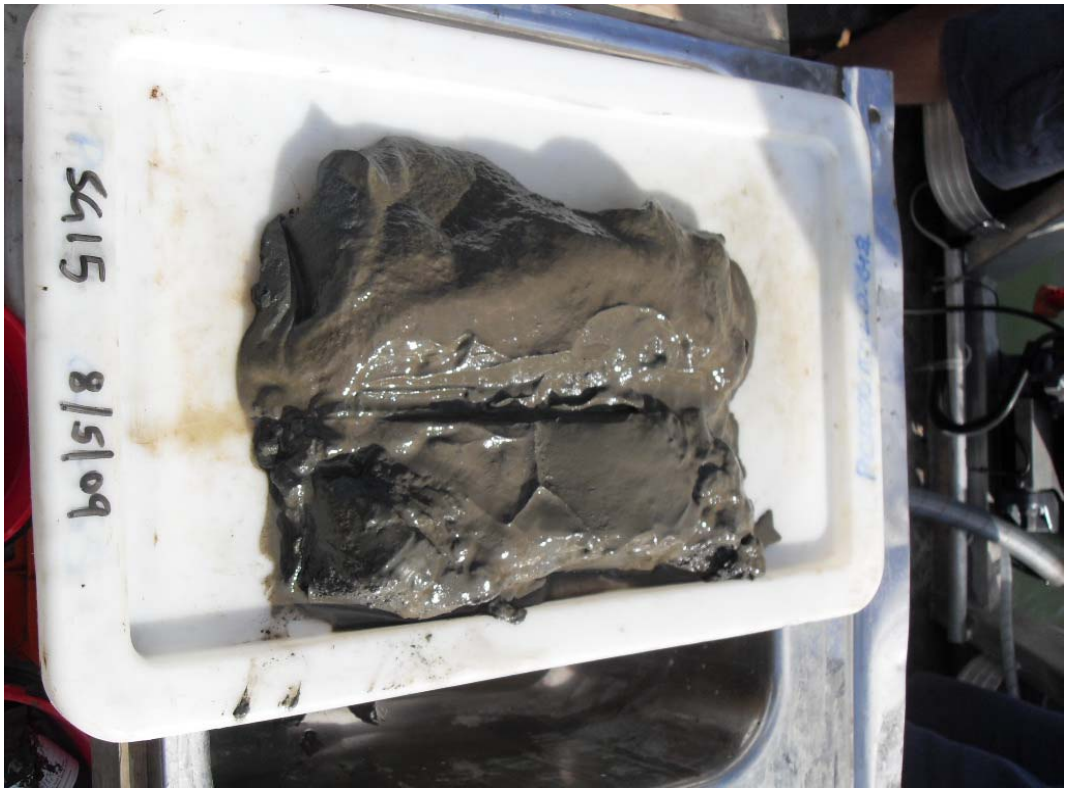


Plate No.	Date:
46	8 May 2009

Description:

Photograph showing SG16.

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No:
Proposed Inner West Marina	Kendall Bay, Parramatta River, NSW	J185612

Plate No.	Date:
47	8 May 2009

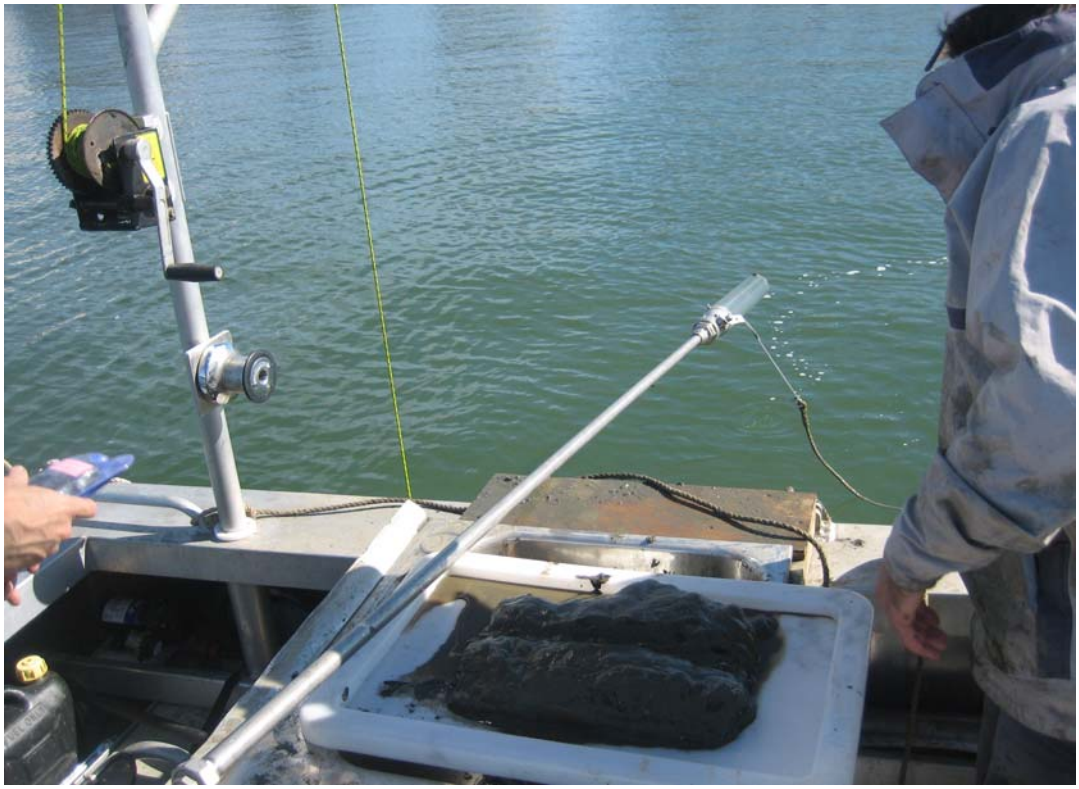
Description:

Photograph showing the Van Veen grab sampler.

Plate No.	Date:
48	8 May 2009

Description:

Photograph showing the Push Core.



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Appendix A

Data Validation

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DATA VALIDATION

A1.0 Introduction

The following sections describe components of the Quality Assurance and Control Plan used to conduct the Sediment Investigation at the footprint of the proposed Marina, Kendall Bay, NSW.

An evaluation of the conformance of the results of the investigation against predetermined Data Quality Objectives (DQOs), as provided in the AECOM (2009) Sampling, Analysis and Quality Plan (SAQP) is included.

AECOM has adopted the USEPA published validation guidelines (USEPA SW-846) for guidance of the review of analytical data produced from laboratories. These guidelines incorporate laboratory analysis, methods and information on laboratory quality control data. These guidelines along with the following objectives have been used to evaluate the data for this report.

The data quality objectives (DQO) process is a systematic, seven-step process that defines the criteria that an investigation should satisfy. DQOs for this investigation have been developed based on the USEPA seven step DQO process (Guidance for the Data Quality Objectives Process – EPA QA/G-4, USEPA, August 2000). These guidelines incorporate field quality control and laboratory analysis, methods and information on laboratory quality control data. They were used, in conjunction with the following objectives, to validate the field and analytical data for this investigation.

A1.1 Step 1: State the Problem

The purpose of the Sediment Investigation was to gather further sediment contamination data within the footprint of the proposed Marina to enable the development of future management strategies during construction and operational stages of the proposed Marina.

Previous investigations have determined that the historical use of the former Mortlake AGL Gasworks site activities has contaminated the near shore bed sediments (within 200 m of the former gas works boundary). The bed sediments were found to be impacted with total PAH above the ANZECC (2000) sediment quality guideline levels. Although there are no criteria for TPH these were also present in the sediment at significant concentrations.

The NSW Environmental Protection Agency (EPA) (now a part of the Department of Environment and Climate Change, and herein referred to as the DECC) have determined that the near shore sediments adjoining the former Mortlake Gasworks site pose a significant risk of harm (SRoH). As a result, the DECC have declared the sediments a remediation site under section 21 of the Contaminated Land Management Act 1997 and have subsequently issued a remediation order (Number 23022, Declaration 21055) under section 23 of the Contaminated Land Management Act 1997).

A1.2 Step 2: Identify the Decisions

The aim of the investigation was to collect sediment data to draw informed conclusions regarding the current status of the sediment within the footprint of the proposed Marina so that management options can be assessed and implemented based on the results of both previous (URS data) and the current investigation.

The primary decisions requiring determination were as follows:

- Is there sufficient data on the distribution and characteristics of the sediment contamination to allow preparation of management plans?

- Do the findings of the investigation provide an understanding of the concentrations of contaminants of concern within the development footprint of the proposed Marina?
- Is there sufficient data to enable management strategies to be developed, if required?

A1.3 Step 3: Identify Inputs to the Decision

The inputs required to make the above decisions are as follows:

- Historical data;
- Site condition data (sediment, water depth etc.);
- Laboratory analysis of sediment samples;
- Comparison of the results with relevant assessment criteria;
- Assessment of the type and location of contamination; and
- Use of the DQO Process.

A1.4 Step 4 – Define the Study Boundary

The boundaries of the investigation have been identified as follows:

- Spatial boundaries – The investigation boundary was limited to the area defined in **Figure 2**, which is located in Kendall Bay (Kendall Bay is located on the eastern side of Breakfast Point on the Parramatta River). The proposed Marina development footprint extends approximately 150 m into Kendall Bay, and approximately 140 metres west of the Cabarita Ferry Wharf. The study area does not include the terrestrial portion of the former gas works site (now Breakfast Point).
- The investigation area covers approximately 20,000 m^2. The vertical extent of the investigation was limited to the top 0.5 m of the sediment profile.
- The investigation included:
  - URS proposed remediation area which is located on the shoreline, at the shore end of the former coal loading wharf;
  - Stormwater outlet areas; and
  - Locations away from the investigation area to assess background concentrations of contaminants;

A1.5 Step 5 – Develop a Decision Rule

Adopted decision rules for this investigation were as follows:

- The analytical data generated were compared to the ANCECC (2000) sediment quality guidelines (ISQG) values and background concentrations in the absence of guideline values (refer to **Section 3**); and
- Field and laboratory data quality indicators (DQIs) meeting acceptable limits for precision accuracy, representativeness comparability and completeness then the data can be relied on. This is discussed further in the following section.

A1.6 Step 6 – Specify Limits of Decision Error

The acceptable limits on decision errors to be applied in the investigation and the manner of addressing possible decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness, and are presented in **Section 5.6.1** of this SAQP.

DATA VALIDATION

The potential for significant decision errors were minimised by completing a robust QA/QC program and by completing an investigation that has an appropriate sampling and analytical density for the purposes of the investigation.

A1.7 Step 7 – Optimise the Design for Obtaining Data

This was achieved by the development of an SAQP (AECOM, 2009) to enable the collection of data required from appropriate locations, in appropriate quantities and of acceptable quality to allow the objectives of the study to be addressed.

The sampling design was optimised by the following:

- Undertaking a review of previous investigations undertaken at the Site;
- Targeting the area of the proposed Marina footprint, which will be the area disturbed during future construction and operation;
- Targeting potential contaminants of concern;
- Use of available information, Site observations and understanding sediment conditions and depth to and of sediment;
- The use of rigorous QA/QC procedures in field and laboratory; and
- Investigation at a level that was consistent with DEC (2006).

A1.8 Step 6 – Specify Limits of Decision Error

The acceptable limits on decision errors to be applied in the investigation and the manner of addressing possible decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness. The potential for significant decision errors will be minimised by completing a robust QA/QC program and by completing an investigation that has an appropriate sampling and analytical density for the purposes of the investigation.

A1.9 Step 7 – Optimise the Design for Obtaining Data

This was achieved by the development of this SAQP to enable the collection of data required from appropriate locations, in appropriate quantities and of acceptable quality to allow the objectives of the study to be addressed.

The sampling design was optimised by the following:

- Undertaking a review of previous investigations undertaken at the Site;
- Targeting the area of the proposed Marina footprint, which will be the area disturbed during future construction and operation;
- Targeting potential contaminants of concern;
- Use of available information, Site observations and understanding sediment conditions and depth to sediment;
- The use of rigorous QA/QC procedures in field and laboratory; and
- Investigation at a level that was consistent with DEC (2006).

DATA VALIDATION

A2.0 Analytical Data Quality

A2.1 Data Quality Indicators

The following sections describe the components of the Quality Assurance and Control Plan that assess the achievement of the DQOs set out in Section 2.0, by consideration of the data quality indicators (DQI's) that will demonstrate that the precision, accuracy, representativeness, completeness and comparability of the data set and that the data set is of acceptable quality to meet the objectives of the sediment investigation.

Full details of the QA/QC plan are presented in the SAQP (AECOM 2009). The DQIs and how they were assessed are summarised in **Table** 1 below:

Table 1: Summary of DQIs

DQI	Field	Laboratory	Acceptability Limits
Precision	Sampling methodologies appropriate and complied with. Collection of intra-laboratory duplicate and inter-laboratory duplicate samples	Analysis of: Field intra-laboratory duplicate samples (1 in 10 samples) Field inter-laboratory duplicate samples (1 in 20 samples) Laboratory duplicate samples	 RPD of < 50% RPD of < 50% RPD of < 50%
Accuracy	Sampling methodologies appropriate and complied with. Collection of rinsate blanks	Analysis of: Rinsate blanks (1/day/equipment) Method blanks Matrix spikes Surrogate spikes Laboratory control samples Laboratory prepared spikes Reagent blanks Reference materials	 Non-detect for CoC Non-detect for CoC 70 to 130% 70 to 130% 70 to 130 % 70 to 130% Non-detect for CoC Varies
Representativeness	Appropriate media sampled according to SAQP	All samples analysed according to SAQP	-
Comparability	Same sampling methodologies used on each day of sampling Experienced sampler Climatic conditions Same types of samples collected	Same analytical methods used (including clean-up) Sample laboratory detection limits (justify/quantify if different) Same laboratories (NATA accredited) Same units	As per NEPC (1999) < nominated criteria

DATA VALIDATION

DQI	Field	Laboratory	Acceptability Limits
Completeness	All critical locations and media sampled All samples collected Sampling methodologies appropriate and complied with Experienced sampler Documentation correct	All critical samples analysed and all analytes analysed according to SAQP Appropriate methods Appropriate laboratory detection limits Sample documentation complete Sample holding times complied with	As per NEPC (1999) < nominated criteria As per NEPC (1999)

A2.2 Field QA/QC

- A total of three rinsate blanks were collected and analysed (RB01 on 29 April 2009, RB02 on 1 May 2009 and RB03 on 8 May 2009), which met the requirements of the SAQP of one per sampling day. Concentrations for all CoPCs were reported as less than laboratory limit of reporting (LOR) which meets the DQOs for this investigation;
- A total of 20 intra-laboratory duplicate samples were analysed. This meets the rate of one duplicate per 10 primary samples.
- A total of 8 inter-laboratory duplicate samples were analysed. This meets the rate of one duplicate per 20 primary samples.
- The relative percentage differences (RPDs) of the primary and the intra and inter laboratory duplicate samples were within the acceptable range (<50%) for all analytes, except those listed in Table 2 below and detailed in **Table T4** in the tables section of this report.

Table 2: RPD Exceedance Summary for Field Duplicates

Sample ID	Primary Sample ID	Type	Analysis	RPD Exceedances
DUP01	PC5_0.0-0.02	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD = 55% - 86% (all PAHs)
DUP02	PC5_0.02-0.1	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD = 60 - 183% (all PAHs)
DUP03	PC5_0.25-0.45	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD range for PAHs = 51-80%
DUP04	PC7_0.25-0.45	Duplicate split sample – Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD range for PAHs = 71-133%
DUP05	PC9_0.3-0.4	Duplicate split sample – Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD range for PAHs = 51-73%

DATA VALIDATION

Sample ID	Primary Sample ID	Type	Analysis	RPD Exceedances
DUP07	PC16_0.00-0.02	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD range for TPH = 60-72% RPD range for PAHs = 58-67%
DUP08	PC16_0.02-0.1	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD range for TPH = 68-77% RPD range for PAHs = 51-76%
DUP11	PC30_0.3-0.5	Duplicate split sample – Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD range for PAHs = 67-100% RPD = 67% (2-(acetylamino) fluorene) RPD = 81% (Benzo-e-pyrene) RPD = 67% Coronene
DUP12	PC14_0.3-0.5	Duplicate split sample – Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD = 59% (Cyanide) RPD range for BTEX = 174-195% RPD range for TPH = 117-172% RPD = 178% Naphthalene
DUP13	PC20_0-0.02	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD = 86% (Benzo(k)fluoranthene)
DUP14	PC20_0.3-0.5	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD = 83% (Naphthalene)
DUP16	PC15_0.0-0.02	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD range for PAHs = 50-89% RPD = 95% (Ethylbenzene)
DUP17	PC15_0.02-0.1	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD = 86% (Cyanide) RPD range for TPH = 136-179% RPD range for PAH = 51-100%
DUP18	PC15_0.3-0.5	Duplicate Core - Intralab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD = 129% (Cyanide) RPD range for BTEX = 116-162% RPD range for TPH = 70-128% RPD range for PAH = 84-153%
DUP19	SG8	Duplicate split sample – Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD = 53% Acenaphthylene
DUP20	SG11	Duplicate split sample – Intralab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD range for PAH = 51-67%
TRIP01	PC5_0.0-0.02	Duplicate Core - Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD = 145% (TOC) RPD range for TPH = 54-87% RPD Range for PAH = 52-104%
TRIP02	PC5_0.02-0.1	Duplicate Core - Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD = 106% (TOC) RPD Range for PAH = 50-191%

DATA VALIDATION

Sample ID	Primary Sample ID	Type	Analysis	RPD Exceedances
TRIP03	PC5_0.25-0.45	Duplicate Core - Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD = 74% (cyanide) RPD Range for PAH = 87-119%
TRIP05	PC24_0.25-0.45	Duplicate split sample – Interlab	Total Cyanide, Free Cyanide, pH BTEX, TPH, PAH	RPD Range for PAH = 117-148%
TRIP06	PC16_0-0.02	Duplicate Core - Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD Range for PAH = 58-123%
TRIP07	PC16_0.02-0.1	Duplicate Core - Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD Range for TPH = 62-70% RPD Range for PAH =62-120%
TRIP08	PC16_0.3-0.6	Duplicate Core - Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD Range for PAH =59-122%
TRIP09	PC30_0.3-0.5	Duplicate split sample – Interlab	Total Cyanide, Free Cyanide, pH TOC, BTEX, TPH, PAH	RPD Range for PAH =50-67%

As indicated in **Table 2** and **Table T4,** RPDs for several inter and intra laboratory duplicates were outside the adopted acceptability limits for PAHs and selected duplicate pairs for TPH, BTEX and cyanide indicating variability on contaminant concentrations.

It is noted that the high RPDs reported for cyanide were generally associated with low concentrations, which were below or close to ten times the LOR and are not considered to affect the overall use of the data.

High RPDs for PAHs, and selected TPH and BTEX, are considered to be associated with the heterogeneous nature of the sediments, particularly within the tidal zone. Due to the potential for loss of volatiles, samples were not homogenised in the field prior to splitting. The RPDs indicate the variability in concentrations and this variability will betaken into account when assessing the data.

A2.3 Laboratory QA/QC

A2.3.1 Analytical Laboratories

The laboratory quality assurance procedures adopted for the investigation are presented in **Table 9** below.

Table 3: Laboratory QA/QC

Data Type	Comments and Acceptable Control Limits
Sample Analysis	All sample analyses to be conducted using NATA certified laboratories that will implement a quality control plan in accordance with NEPM (1999).
Holding times	Maximum acceptable sample holding times: 14 days for organic analyses and 6 months for inorganic

DATA VALIDATION

Data Type	Comments and Acceptable Control Limits
Laboratory detection limits	All laboratory detection limits to be less than the site investigation criteria.
Laboratory Blanks	Laboratory blanks to be analysed at a rate of 1 in 20, with a minimum of one analysed per batch. Concentration of analytes to be less than the laboratory detection limits.
Laboratory Duplicates	Laboratory duplicates to be analysed at a rate of 1 in 20, with a minimum of one analysed per batch. RPDs to be less than 50%.
Laboratory Control Samples (LCS)	LCSs to be analysed at a rate of 1 in 20, with a minimum of one analysed per analytical batch. Control limits: 70 to 130 % Acceptable Recovery
Surrogates	Surrogate compound concentrations will be required to be spiked at similar concentration to sample results, at a rate of 1 in 20. Control limits: 70% to 130 % Acceptable recovery.
Matrix spikes	Matrix spikes matrix spike duplicate prepared by dividing a field sample into two aliquots, then spiking each with identical concentrations of the analytes at a rate of 1 in 20. Matrix spike control limits: 70–130 % Acceptable recovery.

Specific elements of the laboratory QA/QC for the project are detailed in the following sections.

A2.3.2 Sample Analysis

All analysse were undertaken by laboratories that are NATA accredited for the analyses undertaken. The analytical methodologies are detailed in the laboratory certificates in **Appendix E**.

A2.3.3 Holding Times

Review of the chain-of-custody documentation, sample receipt notices and the laboratory reports indicated that soil and groundwater samples were extracted and analysed within acceptable holding times.

A2.3.4 Laboratory Detection Limits

LORs were below the adopted assessment criteria values for all analytes except for some PAH compounds which required dilution due to the presence of high levels of contaminants and where the moisture content of the sample was high. This is not considered to compromise the overall quality of the data.

A2.3.5 Laboratory (Method) Blanks

Review of the laboratory QA/QC reports indicated that the results for all method blanks were below the laboratory detection limit:

A2.3.6 Laboratory Duplicates

One laboratory duplicate was analysed per laboratory batch, which meets the project control limits.

DATA VALIDATION

Review of the laboratory QA/QC reports indicated that RPDs for three of the laboratory duplicate pairs were outside the project RPD limits (<50%) for selected individual PAHs. RPDs above the limits were reported for reported for benzo (k) fluoranthene (57%), benzo(a)pyrene (159%), coronene (116%) and ideno(123cd)pyrene (51% and 55%) indicating poor duplicate precision for those samples. The remainder of the RPDs were within the acceptable control limits.

The RPD reported for benzo (k) fluoranthene was associated with low concentrations (< 10 x LOR) and is not considered to affect the overall use of the data. The remainder of the high RPDs noted above were reported for two samples from laboratory batch ES0906376. The LORs were raised for the analyses due to high background concentrations in the samples. The laboratory confirmed the original results following re-extraction and re-analysis of the samples. RPD exceedances for these laboratory duplicates were considered to be associated with sample heterogeneity and heterogeneous distribution of PAH contaminants in the sample matrix.

As noted in Section Error! Reference source not found.**,** the variability in PAHs concentrations will be taken into considered when assessing the data.

A2.3.7 Laboratory Control Samples

Review of the laboratory QA/QC reports indicated that the percent recoveries for soil laboratory control samples (LCS) were outside the laboratory control limits for some LCS recoveries, However, the LCS recoveries (soil matrix) were all within the project acceptance criteria (70-130%).

A2.3.8 Matrix Spikes

Review of the laboratory QA/QC reports indicated that the percent recoveries for matrix spike samples generally met the control limits (70-120%), with the following exceptions:

- Recoveries of N-2-flouorphenyl acetamide (148%) and naphthalene (33.9%) for a matrix spike from laboratory batch ES0906376. Note that the recovery of the surrogate, 4-terphenyl-d14 (57.3%) was also outside the project control limits for this matrix spike.
- Recoveries of anthracene (21.6%), coronene (61.2%), naphthalene (65.5%) and 2-methylnaphthalene (67.7%) for one matrix spike and recovery of pyrene (158%) of another matrix spike from laboratory batch ES0906688.
- Matrix spike recoveries for 26 samples could not be determined due to concentrations being greater than four times the spike level or sample matrix interference suggesting that these samples were significantly impacted.

Whilst recoveries of some individual PAHs were outside the control limits for selected matrix spike samples, based on an overall assessment, the data is considered suitable for use. Given that the remainder of the percent recoveries for matrix spike samples were within the control limits, it is considered that the reliance on the data has not been affected by these outliers.

A2.3.9 Surrogates

Review of the laboratory reports indicated that several semi volatile surrogate recoveries were outside the project control limits (70-130%). However, all recoveries were either within the laboratory control limits and/or USEPA surrogate recovery limits with the exception of the recovery of anthracene-d10 (144%) for the sample SG12 (laboratory batch ES0906688).

Based on an overall assessment of the surrogate recoveries, together with other data, the one recovery over the control limit is not considered to affect the overall accuracy and reliance on the data.

DATA VALIDATION

A2.4 QA/QC Summary

The data validation procedure employed in the assessment of the field and laboratory QA/QC data indicated that the reported analytical results are representative of sediment conditions at the sample locations and that the overall quality of the analytical data produced is acceptably reliable for the purpose of this investigation. However, the potential variability in PAH concentrations should be considered when assessing the data.

Appendix B

Figures from URS Report

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Client: AGL	Project: Environmental Risk Assessment AGL Mortlake	Title: **Remediation Site**
URS	Drawn: AJW | Approved: DRAFT | Date: 10-05-06 Job No: **43217439** | File No: 43217439.002.wor	Figure: **1** | Rev: A | **A4**

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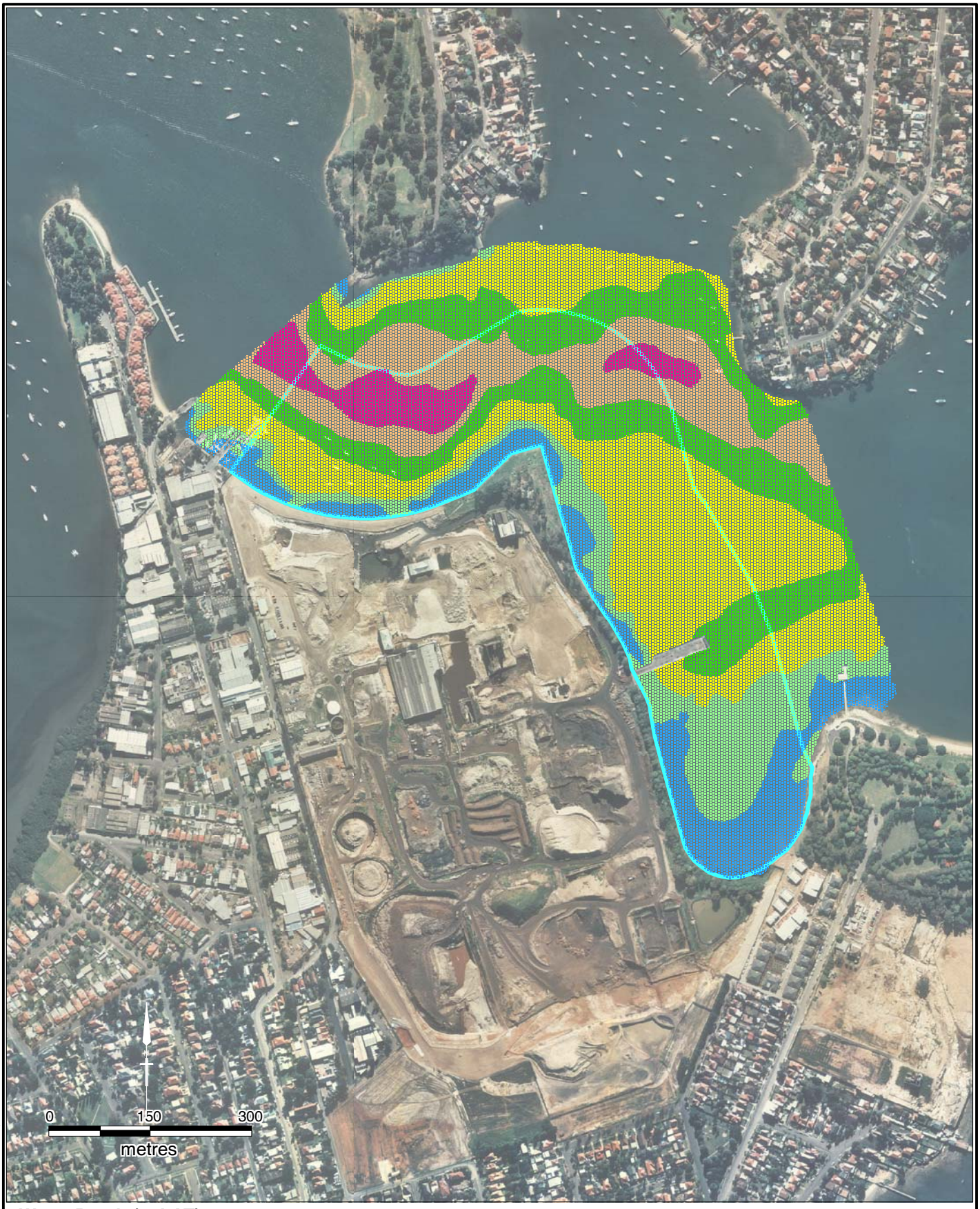

Water Depth (m LAT)

< 1m	2-5m	10-15m
1-2m	5-10m	>15m

Client: AGL	Project: Environmental Risk Assessment AGL Mortlake		Title: **Bathymetry at the Remediation Site**
URS	Drawn: CM	Approved: DRAFT	Date: 29-05-06
	Job No: **43217439**	File No: 43217439.025.wor	Figure: **2**
			Rev: B
			A4

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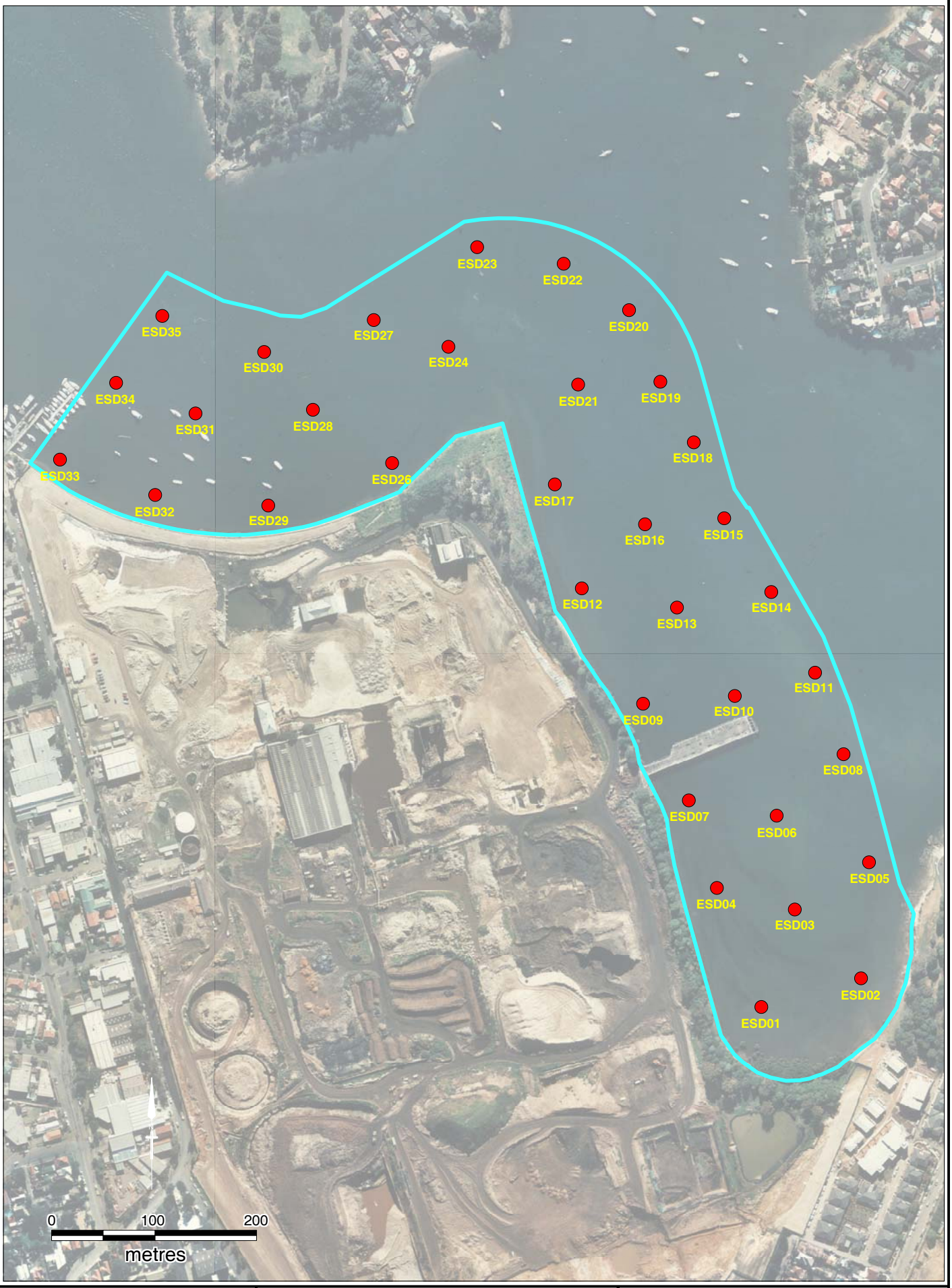

Client: AGL	Project: Environmental Risk Assessment, AGL Mortlake	Title: **Sample Location Plan - Sediment Sampling**	
URS	Drawn: CM	Approved: DRAFT	Date: 29-05-06
	Job No: **43217439**	File No: 43217439.022.wor	Figure: **3**
			Rev: B
			A4

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Client	Project	Title
AGL	Environmental Risk Assessment AGL Mortlake	**Sample Location Plan - Water Samples**

URS

Drawn: CM	Approved: DRAFT	Date: 29-05-06	Figure: **4a**	Rev: B
Job No: **43217439**	File No: 43217439.022.wor			**A4**

Tab Data Stored in T:\Proj\GIS\08051\049\GIS

Client: AGL	Project: Environmental Risk Assessment AGL Mortlake	Title: **Sample Location Plan - SPM Traps**
URS	Drawn: CM | Approved: DRAFT | Date: 10-05-06	Figure: **4 b** | Rev: B
	Job No: **43217439** | File No: 43217439.023.wor	**A4**

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Client: AGL	Project: Environmental Risk Assessment AGL Mortlake	Title: **Sample Location Plan - Sediment Mobility Assessment**
URS	Drawn: CM | Approved: DRAFT | Date: 29-05-06	Figure: **4 c** | Rev: B
	Job No: **43217439** | File No: 43217439.024.wor	**A4**

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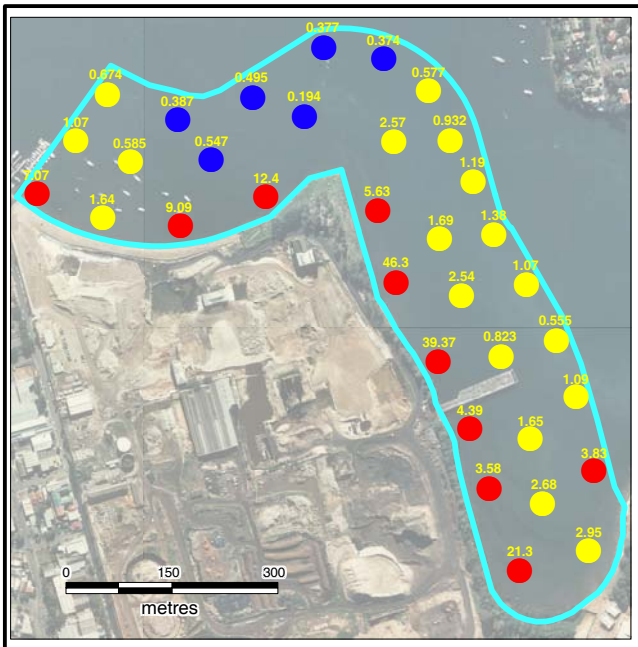
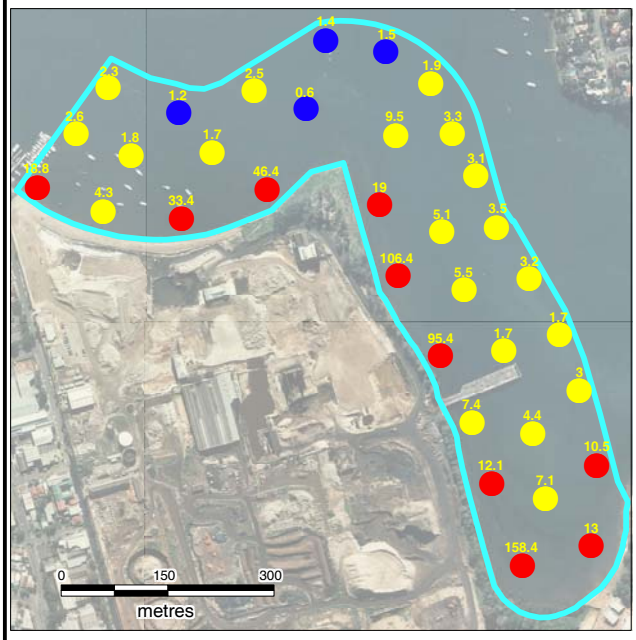


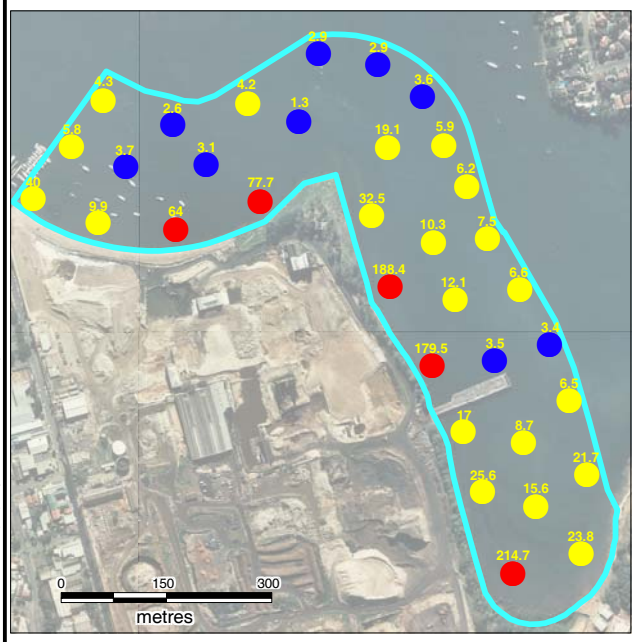
ERA Sediment Chemistry (0 to 2 cm)
Low Molecular Weight PAHs (normalized) [mg/kg]

- >3.16 (>ISQG-H)
- >0.552 to 3.16 (>ISQG-L to ISQG-H)
- 0 to 0.552 (<ISQG low)



ERA Sediment Chemistry (0 to 2 cm)
High Molecular Weight PAHs (normalized) [mg/kg]

- >9.6 (>ISQG-H)
- >1.7 to 9.6 (>ISQG-L to ISQG-H)
- 0 to 1.7 (<ISQG low)



ERA Sediment Chemistry (0 to 2 cm)
Total PAHs (normalized) [mg/kg]

- >45 (>ISQG-H)
- >4 to 45 (>ISQG-L to ISQG-H)
- 0 to 4 (<ISQG-L)

Client	Project	Title
AGL	Environmental Risk Assessment AGL Mortlake	**Concentrations of PAHs in Sediment (0.00-0.02 m depth)**

URS

Drawn: CM	Approved: DRAFT	Date: 29-05-06	Figure: **5**	Rev: B
Job No: **43217439**	File No: 43217439.019.wor			**A4**

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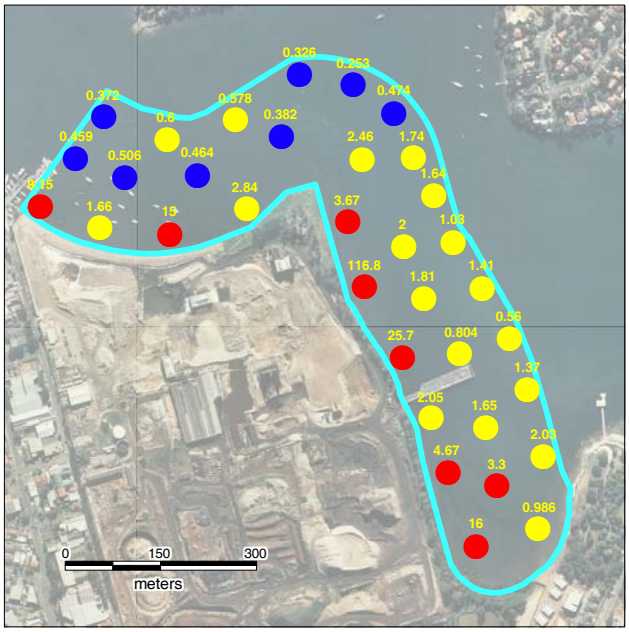
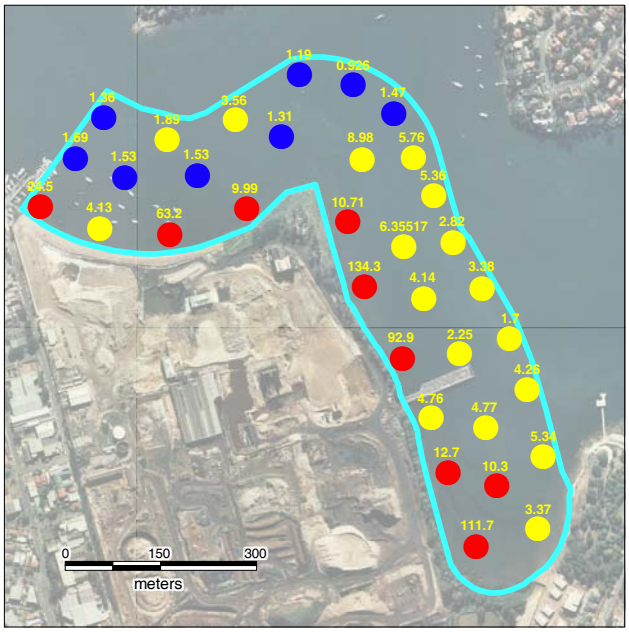


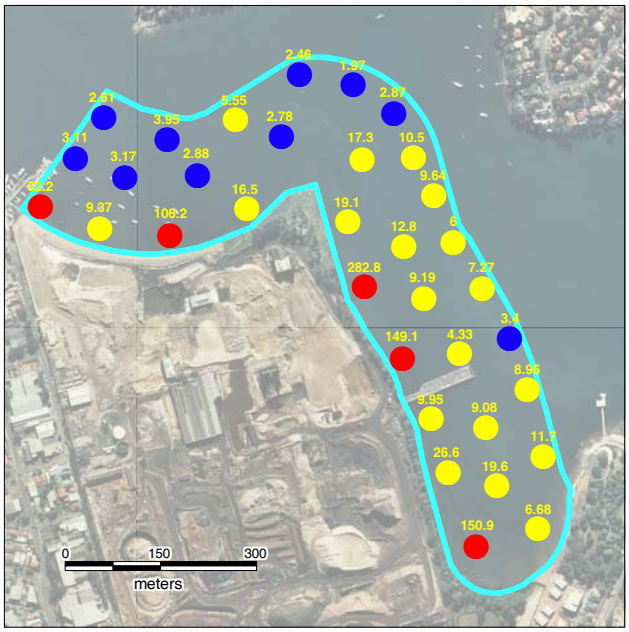
ERA Sediment Chemistry (2 to 10 cm)
Low Molecular Weight PAHs (normalized) [mg/kg]

- >3.16 (>ISQG-H)
- >0.552 to 3.16 (>ISQG-L to ISQG-H)
- 0 to 0.552 (<ISQG-L)



ERA Sediment Chemistry (2 to 10 cm)
High Molecular Weight PAHs (normalized) [mg/kg]

- >9.6 (>ISQG-H)
- >1.7 to 9.6 (>ISQG-L to ISQG-H)
- 0 to 1.7 (<ISQG-L)



ERA Sediment Chemistry (2 to 10 cm)
Total PAHs (normalized) [mg/kg]

- >45 (>ISQG-H)
- >4 to 45 (>ISQG-L to ISQG-H)
- 0 to 4 (<ISQG-L)

Client	Project	Title
AGL	Environmental Risk Assessment AGL Mortlake	**Concentrations of PAHs in Sediments (0.02-0.10 m)**
URS	Drawn: CM | Approved: DRAFT | Date: 29-05-06 Job No: **43217439** | File No: 43217439.020.wor	Figure: **6** | Rev: B | **A4**

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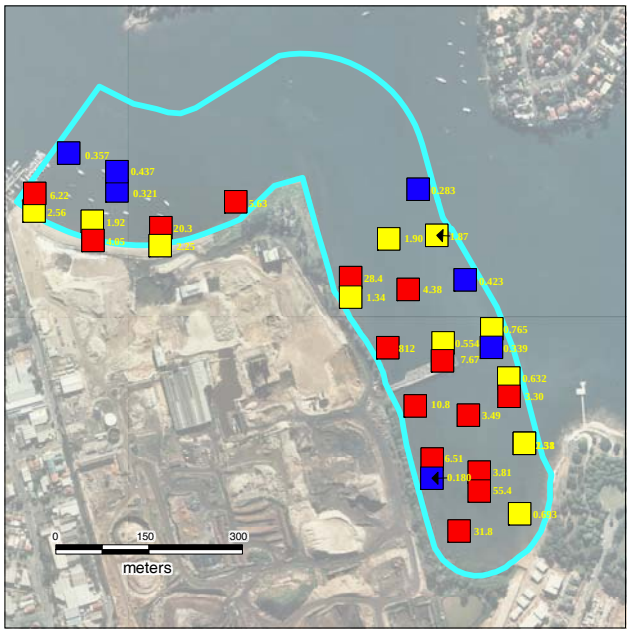
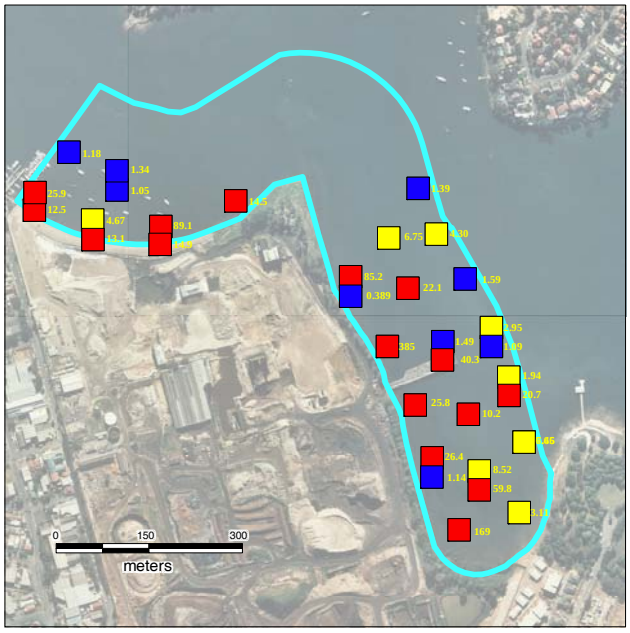


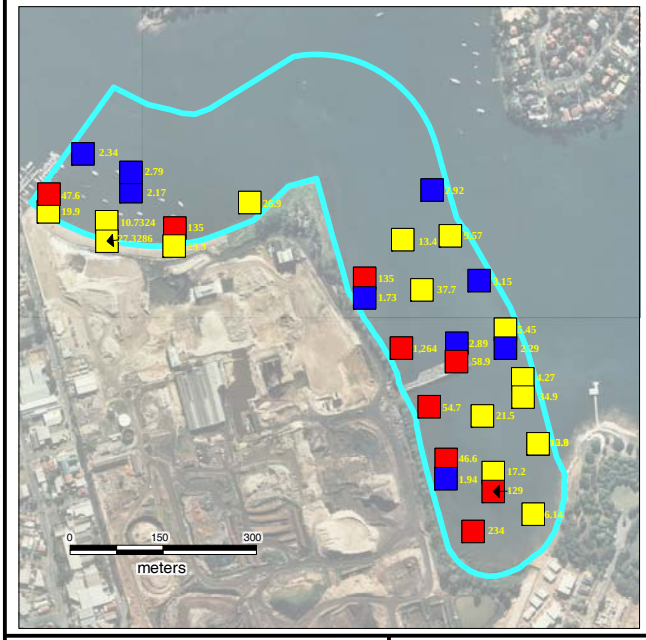
ERA Sediment Chemistry (deeper than 10cm)
Low Molecular Weight PAHs (normalized) [mg/kg] (depth range in m)

- >3.16 (>ISQG-H)
- >0.552 to 3.16 (>ISQG-L to ISQG-H)
- 0 to 0.552 (<ISQG-L)



ERA Sediment Chemistry (deeper than 10cm)
High Molecular Weight PAHs (normalized) [mg/kg] (depth range in m)

- >9.6 (>ISQG-H)
- >1.7 to 9.16 (>ISQG-L to ISQG-H)
- 0 to 1.7 (<ISQG-L)



ERA Sediment Chemistry (deeper than 10cm)
Total PAHs (normalized) [mg/kg] (depth range in m)

- >45 (>ISQG-H)
- >4 to 45 (>ISQG-L to ISQG-H)
- <4 (<ISQG-L)

Client	Project	Title
AGL	Environmental Risk Assessment AGL Mortlake	**Concentrations of PAHs in Sediment (>0.10 m depth)**

URS

Drawn: CM	Approved: DRAFT	Date: 29-05-06	Figure: **7**	Rev: B
Job No: **43217439**	File No: 43217439.021.wor			**A4**

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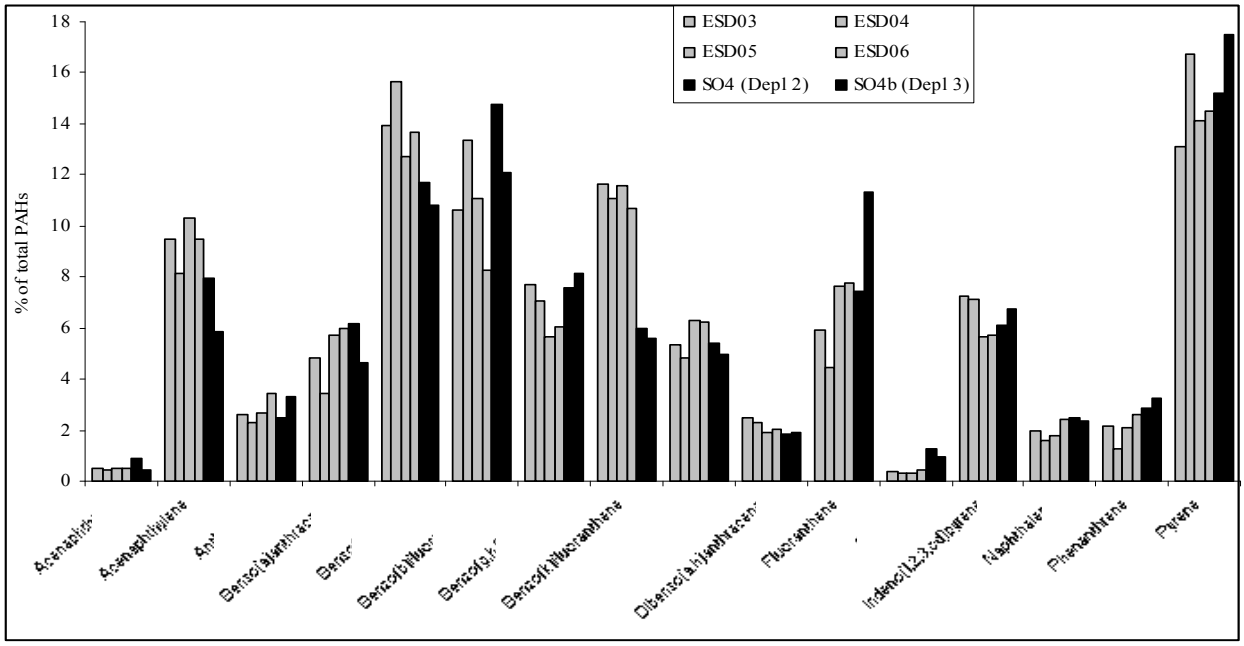

Figure 8a: Relative Abundances (in %) of Individual PAHs in Surficial Sediments (0-2 cm depth) and SPM from Site SO4 at the Remediation Site.

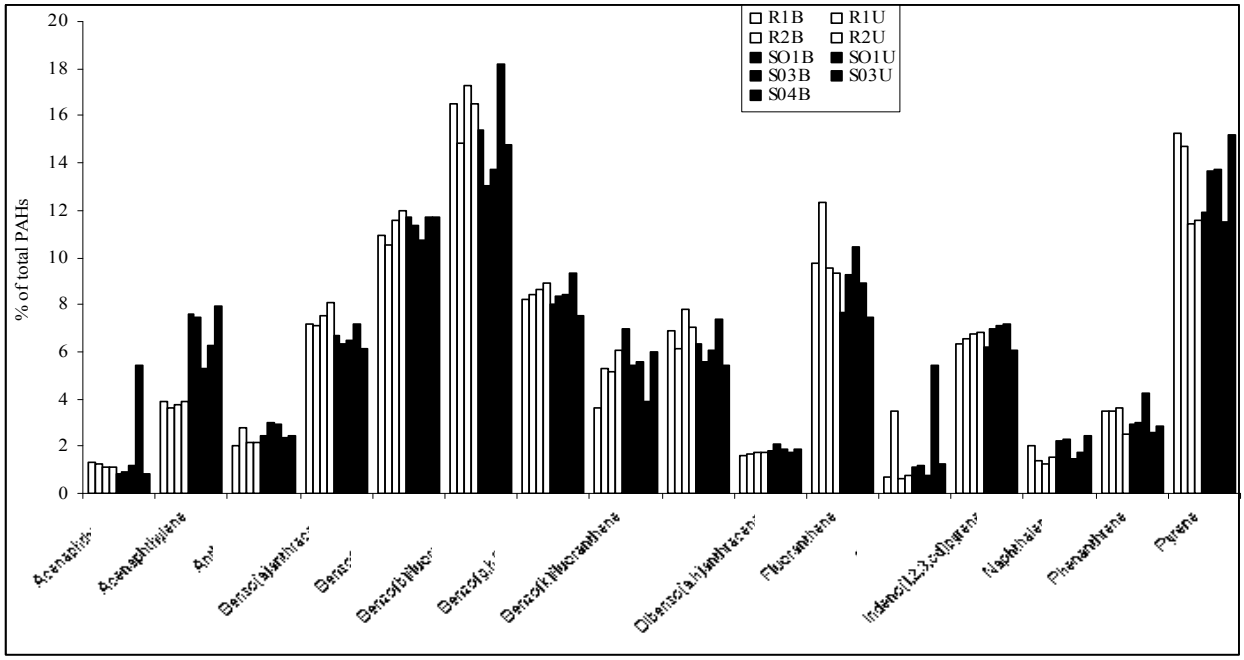

Figure 8b: Relative Abundances (in %) of Individual PAHs in SPM from the Reference Sites and Site and the Remediation Site.

Appendix C

Core Logs

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AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC1

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
2		PC1_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
1.8		PC1_0.02-0.1	✳	0.1				
				0.2				
0.8		PC1_0.2-0.4	✳	0.3				
				0.4				
				0.5				
							Total Depth: 0.57 m	0.57

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC10

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
na		PC10_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
na		PC10_0.02-0.1	✳				Dark brown black staining and hydrocarbon odour.	
				0.1				
				0.2				
na		PC10_0.2-0.35	✳				Heavy sheen and strong hydrocarbon odour.	
				0.3				
				0.4				
				0.5				
							Total Depth: 0.56 m	0.56

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC11

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
na		PC11_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
na		PC11_0.02-0.1	✳	0.1			Pockets of black staining and hydrocarbon odour.	
				0.2			Heavy Staining and strong hydrocarbon odour.	
				0.3				
na		PC11_0.25-0.5	✳	0.4				
				0.5				
				0.6				0.62
							Total Depth: 0.62 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC12

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
na		PC12_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
na		PC12_0.02-0.1	✳	0.1			Pockets of black staining and hydrocarbon odour.	
				0.2				
				0.3				
na		PC12_0.25-0.4	✳					
				0.4				
				0.5				
				0.6				0.61
							Total Depth: 0.61 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC13

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
							Refusal at surface. Total Depth: 0.00 m	0.00

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC14

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
110		PC14_0.0-0.02	✳			MLS	Very soft dark black SILT. Strong odour and sheen. Saturated.	0.02
110		DUP12	✳			ML	Very soft dark black SILT. Loose. Very strong odour and sheen. Saturated.	
110		TRIP10	✳					
128		PC14_0.02-0.1	✳	0.1				
				0.2				
				0.3				
				0.4				
149		PC14_0.35-0.5	✳	0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC15

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
149		PC15_0.0-0.02	✳			MLS	Very soft dark black SILT. Odour and sheen. Saturated.	
180		PC15_0.02-0.1	✳	0.1				
				0.2				
				0.3				
159		PC15_0.3-0.5	✳	0.4				
				0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC16

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
9.5 9.5 9.5		PC16_0-0.02 DUP07 TRIP06				MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
17.5 17.5 17.5		PC16_0.02-0.1 DUP08 TRIP07		0.1		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2				
				0.3		MLS	Soft dark black SILT. Loose. Hydrocarbon odour and sheen noted. Saturated	0.30
				0.4				
14.1 14.1 14.1		PC16_0.3-0.4 DUP09 TRIP08		0.5				
				0.6			Total Depth: 0.60 m	0.60

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC17

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
0.9		PC17_0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
1.9		PC17_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT with frequent fragments of shell. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.10
				0.2		MLS	Soft dark grey SILT. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.3				
2.8		PC17_0.2-0.5	✳	0.4				
				0.5				
				0.6			Total Depth: 0.62 m	0.62

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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Gordon, NSW, 2072

BOREHOLE LOG PC18

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
							Refusal at surface. Total Depth: 0.00 m	0.00

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Gordon, NSW, 2072

BOREHOLE LOG PC19

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
2.9		PC19_0.0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. Saturated. No obvious contamination.	0.02
						MLG	Very soft dark black gravelly SILT. Loose. Saturated. Frequent fragemens of crushed shells. Odour and sheen.	
11.8		PC19_0.02-0.1	✳	0.1				
				0.2				
				0.3				
				0.4				
14.9		PC19_0.35-0.5	✳	0.5				0.50
							Total Depth: 0.50 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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BOREHOLE LOG PC2

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
0.5		PC2_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
1.7		PC2_0.02-0.1	✳	0.1				
				0.2				
				0.3				
0.5		PC2_0.25-0.4	✳	0.4				
							Total Depth: 0.45 m	0.45

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM

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Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC20

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
5.6		PC20_0.0-0.02	✳			MLS	Very soft light grey SILT. Very loose. Saturated. No obvious contamination.	
5.8		PC20_0.02-0.1	✳	0.1				
				0.2				
				0.3				
10.9		PC20_0.3-0.45	✳	0.4				
							Total Depth: 0.45 m	0.45

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM

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BOREHOLE LOG PC21

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
55.8		PC21_0-0.02	✳			MLG	Soft dark grey SILT with inclusions of shell and gravel fragments. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
49.7		PC21_0.02-0.1		0.1				
				0.2				
				0.3				
								0.35
				0.4		MLG	Soft dark black SILT with inclusions of shell and gravel fragments. Hydrocarbon odour and sheen noted. Saturated	
60.2		PC21_0.35-0.45	✳	0.5				
				0.6				0.60
							Total Depth: 0.60 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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BOREHOLE LOG PC22

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
2.1		PC22_0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
3.5		PC22_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2				
				0.3		MLS	Soft dark grey SILT with frequent fragments of shell. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.30
3.1		PC22_0.3-0.5	✳	0.4				
				0.5				0.58
							Total Depth: 0.58 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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BOREHOLE LOG PC23

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
2.4		PC23_0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
2.2		PC23_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2		MLS	Very soft dark grey SILT with fragments of shell. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.20
2.6		PC23_0.2-0.5	✳	0.3				
				0.4				
				0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM

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Gordon, NSW, 2072

BOREHOLE LOG PC24

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
4.2		PC24_0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
						MLS	Soft dark grey SILT with fragments of shell. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
3.1		PC24_0.02-0.1	✳	0.1				
				0.2				
				0.3				
5.3		PC24_0.25-0.4	✳					
5.3		DUP06	✳					
5.3		TRIP05	✳					
				0.4			Total Depth: 0.40 m	0.40

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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BOREHOLE LOG PC25

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
4.7		PC25_0-0.02	✳			MLS	Very soft light grey SILT. Very loose.No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
						MLS	Soft dark grey SILT with fragments of shell. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
4.9		PC25_0.02-0.1	✳					
4.9		DUP10	✳					
				0.1				
						MLS	Soft black SILT. Loose. Hydrocarbon odour and sheen noted. Saturated.	0.15
15.2		PC25_0.15-0.25	✳	0.2				
							Refusal on dense shell and gravel material Total Depth: 0.25 m	0.25

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM

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Gordon, NSW, 2072

BOREHOLE LOG PC26

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
4.1		PC26_0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
6.7		PC26_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2				
				0.3				0.35
5.1		PC26_0.35-0.45	✳	0.4		MLS	Soft dark grey SILT with fragments of shell. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.45
							Total Depth: 0.45 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM

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BOREHOLE LOG PC27

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
6.9		PC27_0-0.02	✳			MLS	Soft light grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
5.6		PC27_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2		MLS	Soft black SILT. Loose. Hydrocarbon odour and staining noted. Saturated.	0.20
11.7		PC27_0.2-0.35	✳	0.3				
							Refusal on dense shell and gravel material Total Depth: 0.35 m	0.35

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Gordon, NSW, 2072

BOREHOLE LOG PC28

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
2.7		PC28_0-0.02	✳			MLS	Soft light grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
4.9		PC28_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2				
				0.3		MLS	Soft dark grey SILT with fragments of shell. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.30
2.9		PC28_0.3-0.4	✳	0.4				
				0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Gordon, NSW, 2072

BOREHOLE LOG PC29

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
45.9		PC29_0-0.02	✳			MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
30.7		PC29_0.02-0.1	✳	0.1		MLS	Soft dark grey SILT with minor inclusions of shell fragments. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
				0.2		MLS	Soft dark grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.20
22.5		PC29_0.25-0.4	✳	0.3				
				0.4			Total Depth: 0.40 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Gordon, NSW, 2072

BOREHOLE LOG PC3

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
1.3		PC3_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
0.4		PC3_0.02-0.1	✳	0.1				
3.7		PC3_0.1-0.3	✳	0.2				
				0.3			Dark brown black staining, visible sheen and hydrocarbon odour.	
5.6		PC3_0.3-0.44	✳	0.4				
							Total Depth: 0.44 m	0.44

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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BOREHOLE LOG PC30

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
2.9		PC30_0-0.02	✳			MLS	Very soft light grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.02
						MLS	Very soft dark grey SILT. Very loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
3.5		PC30_0.02-0.1	✳	0.1				
				0.2				
				0.3		MLS	Soft dark grey SILT with inclusions of shell fragments. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.30
2.1		PC30_0.3-0.5	✳	0.4				
2.1		DUP11	✳					
2.1		TRIP09	✳					
				0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

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Gordon, NSW, 2072

BOREHOLE LOG PC4

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
0		PC4_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
0.7		PC4_0.02-0.1	✳	0.1				
				0.2			Dark brown black staining and hydrocarbon odour.	
1.4		PC4_0.25-0.4	✳	0.3				
				0.4			Total Depth: 0.41 m	0.41

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC5

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
1.6		PC5_0-0.02	✳	0.1		MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
3.7		PC5_0.02-0.1	✳	0.2				0.24
				0.3		SP-SM	Loose dark brown black silty gravelly SAND. Sands are fine to coarse grained and gravels are angular and fine grained comprising shell fragments. Dark brown black staining, visible sheen and hydrocarbon odour.	
1.4		PC5_0.25-0.45	✳	0.4				
				0.5				0.52
							Total Depth: 0.52 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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BOREHOLE LOG PC6

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
0.1		PC6_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
0.3		PC6_0.02-0.1	✳	0.1				
				0.2				
		PC6_0.25-0.45	✳	0.3				
1.7				0.4			Dark brown black staining and hydrocarbon odour.	
				0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Level 5, 828 Pacific Highway
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BOREHOLE LOG PC7

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
0		PC7_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
1.2		PC7_0.02-0.1	✳	0.1				
				0.2				
				0.3				
0.5		PC7_0.25-0.45	✳					
0.5		DUP04		0.4			Dark brown black staining and sheen and hydrocarbon odour.	
				0.5				
				0.6				
							Total Depth: 0.62 m	0.62

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
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Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG PC8

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
0.3		PC8_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
0.9		PC8_0.02-0.1	✳	0.1				
				0.2			Dark brown black staining and sheen and hydrocarbon odour.	
				0.3				
0.5		PC8_0.25-0.4	✳					
				0.4				
				0.5			Total Depth: 0.50 m	0.50

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM

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BOREHOLE LOG PC9

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Direct-Push
SAMPLING METHOD Surface Grab / Push Core

DATE 29 Apr 09

LOGGED BY L. Taylor
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
1.3		PC9_0-0.02	✳			MLS	Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Occasional pockets of black silt with organic odour. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	
0.7		PC9_0.02-0.1	✳	0.1			Dark brown black staining and sheen and hydrocarbon odour.	
				0.2				
				0.3			Heavy sheen and strong hydrocarbon odour.	
10.7 10.7 10.7		PC9_0.3-0.4 DUP05 TRIP04	✳	0.4				
				0.5		GWS MLS	Loose brown, light brown and orange sandy fine GRAVEL. Sand is fine to coarse. Gravel is angular of brick a. Heavy sheen and strong hydrocarbon odour.	0.51 0.52
							Very soft brown grey sandy SILT with frequent fragments of shell. Sands are fine to medium grained. Dark brown black staining, heavy sheen and strong hydrocarbon odour. Saturated.	0.57
							Total Depth: 0.57 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG SW1

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Surface Grab
SAMPLING METHOD Surface Grab

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

EASTING 6253809

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
4.8		SW1_0-0.1		0.1		MLS	Soft light grey SILT. Loose. No hydrocarbon odour or visual hydrocarbon staining / sheen. Saturated.	0.10
							Total Depth: 0.10 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

AECOM
ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG SW2

PROJECT NUMBER J185612
PROJECT NAME Breakfast Point Marina
LOCATION Marina
DRILLING METHOD Surface Grab
SAMPLING METHOD Surface Grab

DATE 01 May 09

LOGGED BY R. Cole
COMMENTS

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
8.7		SW2		0.1		SM	Light grey very loose sandy SILT with minor crushed shells. Saturated. No obvious contamination.	0.10
							Total Depth: 0.10 m	

J185612_BREAKFAST_POINT_MEDARD_MAY08.GPJ 02/06/09

APPENDIX 13:

- SEDIMENT MANAGEMENT REPORT

Environment Protection Authority

Declaration of remediation site

Section 21 of the Contaminated Land Management Act 1997

Declaration Number 21055
Area number 3335

The Environment Protection Authority ("EPA") declares the following land to be a remediation site under the Contaminated Land Management Act 1997 ("the Act"):

1. Land to which this declaration applies:

The sediments of the bed of Kendall Bay and the Parramatta River in the area adjacent to the former Mortlake gasworks which fall within 200 metres from the land based boundary of the former Mortlake gasworks as outlined by the thick black line in the diagram by URS titled *Site layout and sediment Sampling Plan* dated 20 March 2002. The diagram can be inspected at the offices of the Department of Environment and Conservation, 59-61 Goulburn Street, Sydney.

2. Nature of the substances causing the contamination:

The following contaminants have been found in the land to which this declaration applies: petroleum hydrocarbons and polycyclic aromatic hydrocarbons (all referred to in this declaration as "the contaminants").

3. Nature of harm that the substances may cause:

The EPA has considered the matters in s.9 of the Act and found that:

- The concentration of total polycyclic aromatic hydrocarbons (both low and high molecular weight components) in some locations is elevated above ANZECC 2000 sediment quality guideline levels. Total petroleum hydrocarbon concentrations are also present in the sediments in significant concentrations and separate phase product has been observed.
- There is less benthic biota present in the land compared with other unimpacted and nearby sites. The nature and concentration of the contaminants in the sediments could result in a lack of benthic biota;
- There are potential exposure pathways from the contamination to biota and to humans; and
- Disturbance of the sediments could mobilise the contaminants and the prospects of disturbance are likely to increase with development of the area.

4. Further action under the Act:

The making of this declaration does not prevent the carrying out of a voluntary remediation of the site and any person may submit a voluntary remediation proposal for the site to the EPA. If the proposal satisfies the requirements of s.26 of the Act, the EPA may agree not to issue a remediation order to the person or persons bringing the proposal.

5. Submissions invited:

The EPA advises that the public may make written submissions to the EPA on whether the EPA should issue a remediation order in relation to the site or any other matter concerning the site.

Submissions should be made in writing to:

Director Contaminated Sites
Department of Environment and Conservation
PO Box A290
SYDNEY SOUTH NSW 1232

or faxed to: (02) 9995 5999

by not later than **25 June 2004**

C Strange

CAROLYN STRANGE
Director Contaminated Sites
Department of Environment and Conservation

Date: 25/5/04

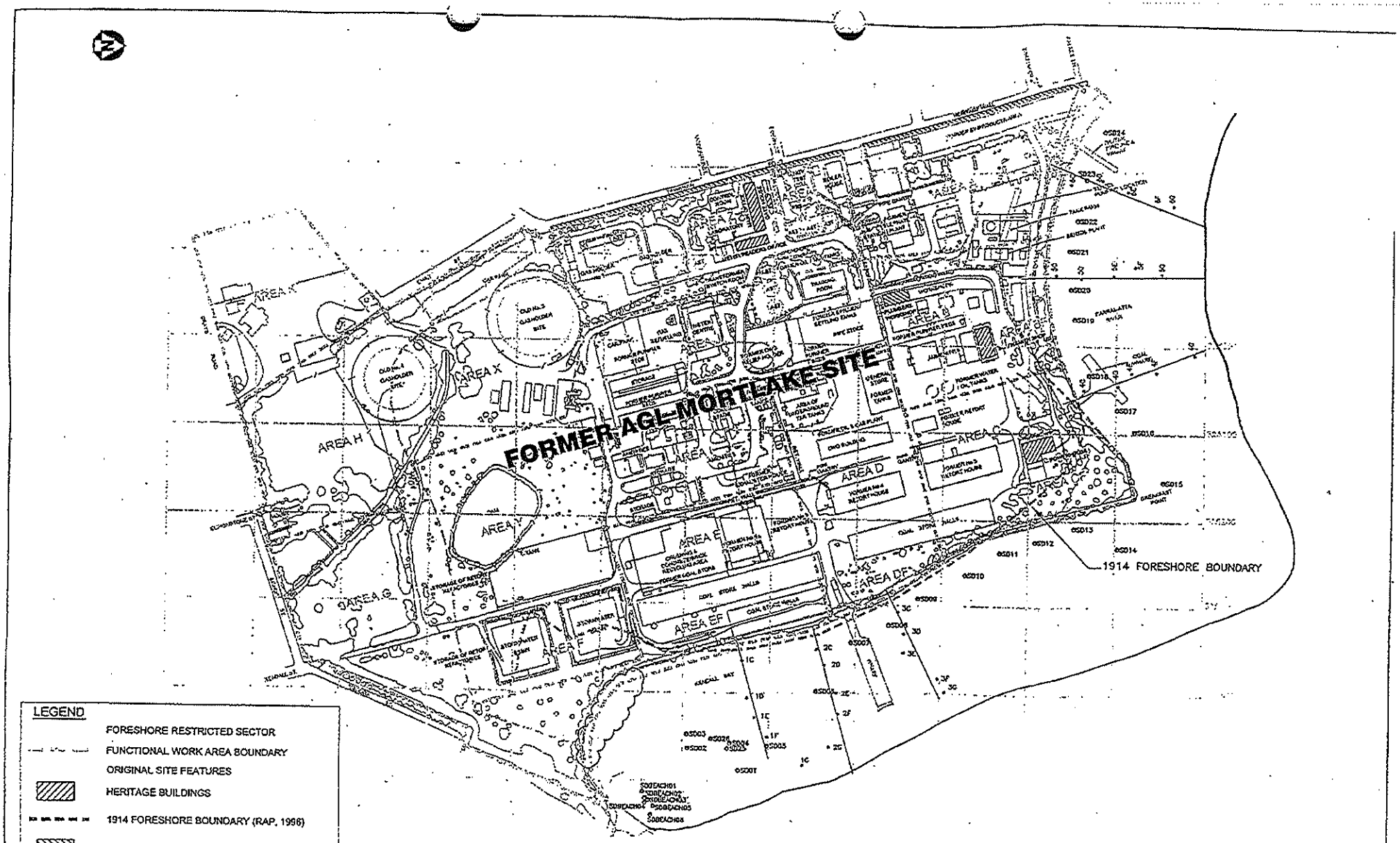
NOTE:

Remediation order may follow
If remediation of the site or part of the site is required, the EPA may issue a remediation order under s.23 of the Act.

Variation/Revocation
This declaration may be varied by subsequent declarations. It remains in force until it is revoked. A declaration may only be revoked when the EPA does not have reasonable grounds to believe that land is contaminated in such as way as to present a significant risk of harm (s.44 of the Act).

Information recorded by the EPA
Section 58 of the Contaminated Land Management Act 1997 requires the EPA to maintain a public record. A copy of this remediation declaration will be included in the public record.

Information recorded by councils
Section 59 of the Act requires the EPA to inform the relevant local council as soon as practicable that a declaration has been made. The council is then required to note on its planning certificate issued pursuant to s.149 (2) of the Environmental Planning and Assessment Act that the land is currently within a remediation site. The EPA is required to notify council as soon as practicable when the declaration is no longer in force and the council is then required to remove the notation from the s.149 (2) certificate.



NOTE: SAMPLE LOCATIONS FOR SE AND SD22 APPROXIMATE ONLY

CLIENT
THE AUSTRALIAN GAS LIGHT COMPANY
PROJECT
SEDIMENT INVESTIGATION

TITLE
SITE LAYOUT AND SEDIMENT SAMPLING PLAN

0 100 200
1:4000 (metres)

DESIGNED: JR
DRAWN: SNJT
CHECKED: 20/03/02

APPROVED:
DATE:
STATUS: DRAFT

PROJECT: 08051-049
CAD FILE: 001.DWG
REVISION: A

URS

A3

FIGURE 1

APPENDIX 13:

- **DECLARATION OF REMEDIATION FILL FROM ENVIRONMENTAL PROTECTION AGENCY**

CLIENTS | PEOPLE | PERFORMANCE

8 April 2009

Mr Ray Kearns
Breakfast Point Pty Limited
51 Riley Street
Woolloomooloo NSW 2011

Our ref: 21/18414/149470
Your ref:

Dear Ray,

Kendall Bay Marina - Site Audit
Interim Audit Advice 02 - SAQP and EMP

1 Introduction

Andrew Kohlrusch of GHD Australia Pty Ltd (the auditor) was engaged by Breakfast Point Pty Limited to undertake a site audit of the area proposed for the Kendall Bay Marina, Breakfast Point. The auditor understands that the site has been declared a remediation site under section 21 of the *Contaminated Land Management Act* (1997). A remediation order (issued under section 23 of the Act) has subsequently been issued in relation to the sediments of Kendall Bay in the vicinity of the proposed marina. Among the actions required by the order are:

- Prior to being provided to the EPA, the report must be reviewed by an EPA accredited Site Auditor, in relation to the suitability of the plans; and
- Plans must be prepared in accordance with the EPA publication titled "*Guidelines for Consultants reporting on Contaminated Sites*" 1997 as it relates to investigation and/or remedial action.

This interim audit advice (IAA) followed a review by the auditor of previous versions of the reports, the outcome of which was documented in an IAA (01). IAA01 evaluated whether the reports met the requirements as outlined in NSW EPA/DEC/DECC *Guidelines for Consultants Reporting on Contaminated Sites* (the *Consultant Guidelines*) and the *Guidelines for the NSW Site Auditor Scheme* (the *Auditor Guidelines*).

The review of the SAQP also evaluated whether it established a set of data quality objectives as per the *Auditor Guidelines* and whether it had a conceptual site model to demonstrate key source/pathway/receptor relationships and whether it:

- Considered background sediment concentrations;
- Clearly articulated the rationale for the sampling program;
- Adequately defined the proposed methodologies for the collection of the various media that may have been affected by the former site activities;
- Established a robust field and lab quality assurance program.

The review of the EMP evaluated whether the manner in which the sampling program is to be conducted is protective of the environment.