FINAL REPORT

# Q27/2006 Sediment and Antifoul Monitoring Program

## Stage 2 - Antifoul Study

*Prepared for*

**Hornsby Shire Council**

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# Contents

# Contents

# Tables, Figures, Plates, Drawings Appendices

## Tables

## Figures

## Appendices

# Section 1 Introduction

## 1.1 Background

URS Australia Pty Ltd (URS) was commissioned by Hornsby Shire Council to assess the contaminant status of the estuaries within Hornsby Shire, identify which contaminants are present and establish baseline data on levels of contamination to allow an assessment of the risks posed by contamination to human use and amenity, and ecological values of the Lower Hawkesbury River. The work was undertaken by URS in accordance with a proposal dated 29 August 2006. This report details findings of the Antifoul Stage 2 investigation. The findings of the Stage 1 Sediment Study have been previously submitted to Hornsby Shire Council and presented at the Estuary Management Committee Meeting on 8 February 2007. The amended Final Report for the Stage 1 Sediment Investigation is presented in Appendix A. The Sampling and Analysis Plan (SAP) for the Stage 1 Sediment Study was agreed upon by Hornsby Shire Council and is shown in Appendix B. A final report synthesis will be provided in September 2007.

## 1.2 Study Area

The study area is identified as the primary waterways of the Lower Hawkesbury River which include the Hawkesbury River, from the upstream limit of Wisemans Ferry to the downstream limit of Parsley Bay/Croppy Point, Marramarra Creek, Berowra Creek and Cowan Creek. Mooney Mooney and Mullet Creeks on the northern side of the river were also sampled during the Sediment Study (Stage 1). The overall study area incorporates the two study areas defined in the Berowra Creek and Brooklyn Estuary Process Studies with adjustments and includes the connecting water body from the mouth of Berowra Creek to the Freeway Bridge (Figure 1).

## 1.3 Scope of Work - Antifoul Study (Stage 2)

Based on the outcomes of the Sediment Study (Stage 1), 16 priority locations were identified and agreed upon for the Antifoul Study (Stage 2)(see Sampling and Analysis Plan for Antifoul Study (Stage 2) - Appendix C) (Table 1 and Figure 1). The 16 sampling locations are a subset of the 52 sampling locations visited during the Sediment Study (Stage 1) and were considered to adequately represent the areas of potential sediment contamination, in particular with respect to tributyltin (TBT), other organic contaminants and paint booster biocides (i.e. diuron, chlorothalonil, Irgarol 1051 and dichlofluanid). Paint booster biocides were considered at only four locations due to limitations of resources for the specialized analytical requirements pertaining to these compounds (Locations H37 (Brooklyn), H9 (Berowra Creek Marina), H38 (Sandbrook Inlet) and H31 (Refuge Bay)).

Surficial sediment samples were collected up to a depth of 10 cm, using an Ekman$^{TM}$ grab sampler, at each sampling location. At two sampling locations, two QA/QC field replicate samples were obtained by splitting the sample. The homogenized sediment samples were analysed for the following:

- TBT; and
- Organic contaminants at Ultra Trace levels of analytical detection (polychlorinated biphenyls, polycyclic aromatic hydrocarbons, organochlorine pesticides, organophosphorus pesticides, total petroleum hydrocarbons (C6-C36) and BTEX).

The date and time of sampling, water depth, latitude and longitude (GPS) and a field description of the sediment type were recorded in the field and a photograph of the sample was taken.

The regional sediment geochemical data was displayed spatially on a GIS system (Mapinfo$^{TM}$) and the data screened against ANZECC/ARMCANZ (2000) sediment quality guideline values.

### 1.3.1 Additional Sampling and Analysis

**Proposed Hawkesbury River STP Site**

Three additional sampling locations adjacent to the proposed Sewage Treatment Plant (STP) outfall beneath the Peats Ferry Bridge were also included in the Antifoul Study (Stage 2) investigation (i.e. locations H40, H41 and H42 – Figure 1). At these three locations the coarse and gravelly sediment texture, high current velocities, and water depths >20 m made sampling using the Ekman$^{TM}$ grab sampler difficult during the Sediment Study (Stage 1) investigation. Sediment samples from these three sampling locations (and one additional QA/QC field duplicate sample) were analysed for:

- TKN, TOC, NOX;
- Al, As, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, Mg, Mn, Ni, Pb, Sr, V, and Zn;
- Polychlorinated biphenyls (PCBs);
- Polycyclic aromatic hydrocarbons (PAHs);
- Organochlorine pesticides (OCs);
- Organophosphorus pesticides (OPs);
- Total petroleum hydrocarbons (TPHs) ($C_6$-$C_{36}$); and
- BTEX.

Organic compounds were analysed for standard limits of reporting and not Ultra Trace levels and grainsize in four fractions (63 μm; 63 μm-250 μm; 250 μm-2 mm; >2 mm) was determined for samples from locations H40, H41 and H42.

**Silver in Surficial Sediments in Berowra Creek**

Sediment samples from three locations (H3, H5 and H7) in Berowra Creek were collected and analysed for silver only to identify possible contributions of silver from potential sewage or stormwater contributions in Berowra Creek.

## 1.4 Previous Contaminant Investigations of Sediment and Biota in the Hawkesbury River

Organic and inorganic anthropogenic contaminants have been assessed in the Hawkesbury River for over 20 years. Early work included the determination of the speciation of iron, copper and zinc in waters of the Hawkesbury River by Pik et al. (1982) and the assessment of heavy metal enrichment in the surface water microlayer of the Hawkesbury-Nepean River system (Barnes et al., 1982). Markich and Brown (1998) conducted a survey of trace metal concentrations in the freshwater reaches of the Hawkesbury River, the first such survey of a permanent coastal river in Australia using ‘clean’ sampling and handling techniques. That study established that concentrations of nutrients, organic carbon and trace metals in the Hawkesbury River increased as a consequence of anthropogenic inputs, particularly point discharges from sewage treatment plants (STPs) as well as diffuse urban and agricultural runoff during storm events. Markich and Brown (1998) established that the temporal variability of trace metals is correlated to the variability in water discharge. An increase in concentrations of trace metals by a factor of up to 2 was correlated with increased water discharge and was cited as evidence of anthropogenic point and diffuse source contributions during high flow events.

Anthropogenic contaminants in surface waters of the Hawkesbury River are highly variable and transient in nature. In contrast, sediments, which represent a sink for contaminants in aquatic systems, may be used to establish a time-integrated signature of anthropogenic contributions in aquatic environments. Anthropogenic heavy metal contaminants in sediments in the Hawkesbury River have been extensively studied since the mid-1990s and a number of contaminant investigations of sediments in the Hawkesbury River estuary have been conducted by the Environmental Geology Group (EGG) at the University of Sydney and others (i.e. Parker, 1992; Shotter, 1994; Hardiman and Pearson, 1995; O'Donnell, 1995; Hayes and Buckney, 1998; Birch et al., 1998, 1999; Simonovski et al., 2003). A study of sediments in the Cowan Creek catchment was conducted by Miller (1993) who concluded that the presence of anomalously high concentrations of chromium, copper, lead, zinc, vanadium and arsenic in sediments near developed sites in the upper Cowan Creek catchment areas are the result of anthropogenic contributions to the aquatic system.

A baseline contaminant survey of the Hawkesbury River estuary in December 1990-January 1991 (EPA, 1996) established the concentrations of a range of organic and inorganic contaminants in sediments of the Hawkesbury River estuary, including the concentrations of tributyltin (TBT).

Concentrations of heavy metals and other contaminants in sediments of the Hawkesbury River are generally low and close to background, but are substantially elevated in the headwaters of Berowra Creek, Cowan Creek and in southeast Pittwater (Birch et al. 1998, Birch et al., 1999). In addition, high levels of contamination of sediments have been found adjacent to the West Hornsby Sewage Treatment Plant (STP) and the Hornsby Heights STP. Simonowski et al. (2003) reported that sediments in the upper Hawkesbury-Nepean River are not heavily polluted by heavy metals, although elevated concentrations of heavy metals were found in sediments near industrialized areas and STPs.

Other previous studies of sediments in the Hawkesbury River estuary include Bourgues et al. (1998) (nutrients), Mann et al. (1996) (nutrients and algal blooms), Coastal & Marine Geosciences (1998) (nutrients and heavy metals) and University of New South Wales (2002).

## 1.5 Tributyltin and Antifouling Paint Booster Biocides

The need for effective antifoulants, which prevent the settlement and growth of marine organisms on submerged structures, such as buoys, fish cages and ship's hulls, is recognised universally (Evans et al., 2000; Konstantinou and Albanis, 2004). For many years, tributyltin (TBT) compounds were the most widely used active ingredients in paint formulations. However, the use of TBT has been regulated internationally since 1990 (in New South Wales, Australia since 1989), due to its severe impact on the aquatic ecosystem (Fent, 1996) and the demonstrated effects of TBT on the disruption of the endocrine system by mimicking or inhibiting the action of gonadal steroid hormones, oestradiol and testosterone (Makita and Omura, 2006).

Prolonged release of TBT from ship-bottom coatings has resulted in the imposition of male sexual characteristics upon female gastropods, or imposex, a phenomenon which was first described by Blaber (1970) in the United Kingdom. Imposex in marine gastropods has subsequently been linked to the exposure of these benthic biota to TBT in aquatic systems worldwide (e.g. Smith, 1981a,b,c; Santos et al., 2004). This cause and effects relationship ultimately resulted in a global ban of TBT. The decline in the occurrence of imposex following worldwide bans has been used as a biomarker and biological indicator for environmental monitoring of TBT since the introductions of these bans in countries worldwide (Axiak et al., 2003).

Restrictions on the use of TBT-based antifouling paints were implemented in New South Wales (NSW) in 1989, first on small vessels under 25 m length and then on larger vessels, which have been allowed the continuing use of TBT-based antifouling paints, as long as the maximum leaching rate is below 5 $\mu g/cm^2/d$ (Moore, 1988). However, despite the partial ban on the use of TBT in Australia, a survey of imposex in *Thais orbita* (Neogastropoda) along the NSW coast found imposex was still widespread 10 years after the introduction of the ban, in particular within harbour/bay areas, where contamination “hotspots” are still present and where physical remobilization and dispersion processes may be less pronounced compared to high-energy coastal areas (Gibson and Wilson, 2003).

Copper-based antifouling paints, particularly those that continually erode (ablating antifoulings) have been widely used since the banning of tributyltin and represent a major source of copper (Taylor, 2000). Marinas are a possible source of trace metal contaminants to the estuaries as antifouling is applied and removed from vessels on slipways. The impact of recreational boating facilities was investigated by Taylor (2000) by sampling sediment near a number of marinas in Sydney Harbour. Trace metals in sediment collected more than 100 m away from boating facilities were not enriched above ambient concentrations. However, sediment collected within 50 m of boat slipways in Sailors and Long Bays contained enriched concentrations of copper (401 and 455 μg/g, respectively) compared to average copper sediment concentrations in the embayment headwaters (284 and 247 μg/g, respectively). However, the increase in copper concentrations near marinas was minimal compared to copper gradients away from stormwater drains (Taylor, 2000).

An additional aspect of the potential environmental impact of antifouling products for use in boating and marine infrastructure is the use of organic booster biocides in antifouling paints, which have replaced TBT-based coatings. This may represent an alternative that could represent toxic effects as a result of the synergistic interactions between various biocides used in these alternative products (Evans et al., 2000). The most commonly used biocides in antifouling paints following the introduction of the ban on TBT include Irgarol 1051 (not a registered compound in Australia – Amog Consulting, 2002), diuron, Sea-nine 211, dichlofluanid, chlorothalonil, zinc pyrithione, TCMS (2,3,3,6-tetrachloro-4-methylsulfonyl) pyridine, TCMTB [2-(thiocyanomethylthio) bezothiazole], and zineb. These compounds have shown to be present in increasing concentrations in waters and sediments in coastal environments in countries worldwide, including Australia (Konstantinou and Albanis, 2004).

There are currently limited data available on the potential ecotoxicological effects of the increasingly widespread use of organic booster biocides in the aquatic environment, although a recent review by Konstantinou and Albanis (2004) suggests that alternative antifouling products, which are based on copper metal oxides and organic biocides may require continued research regarding potential environmental effects in water and sediments and ecotoxicity in biota. The monitoring, behaviour and toxicity of degradation products of these compounds should be emphasized in establishing criteria for the occurrence, fate and effects of organic booster biocides in antifouling paints.

## 1.6 Antifoul Study - Objectives

The overall project Q27/2006 was divided into two stages, namely the Sediment Study (Stage 1) and the Antifoul Study (Stage 2) (see URS Proposal dated 29 August 2006). The objectives of the Antifoul Study (Stage 2) investigation are to:

- Determine whether or not the use of antifouling products in the Lower Hawkesbury River has resulted in contamination of the estuaries within Hornsby Shire;
- Identify which contaminants are present in the estuaries within Hornsby Shire as a result of the use of antifouling products;
- Look at a range of commercially available antifouling products and document current research;

- Establish a set of baseline data, and compare to recognised standards, on the level of contamination resulting from the use of antifouling products in the sediments of the estuaries within Hornsby Shire; and
- Provide recommendations and remedial management actions based on results arising from the above objectives.

The Antifoul Study (Stage 2) provides Hornsby Shire Council with an understanding of the current status of contamination as a result of the use of antifoul products within the estuaries of Hornsby Shire. In addition, the recommendations from this study will be used by Council for incorporation into associated management strategies as required.

A further objective to establish baseline sediment quality data prior to the commencement of discharge from the Brooklyn and Dangar Island Sewerage Scheme outfall was excluded from the objectives of the Sediment Study (Stage 1) investigation at locations H40, H41 and H42 (Hawkesbury River east, beneath and west of Peats Ferry Bridge). The sediment quality assessment at these three locations was therefore included in the Stage 2 investigation.

In addition, the assessment of particulate matter contributions from sewage or stormwater discharges to sediments in lower Berowra Creek was addressed by the analysis of silver in surficial sediments at three sampling locations (H3, H5 & H7) in Berowra Creek.

# Section 2 Methodology

## 2.1 Sediment Sampling

Sediment sampling was undertaken by Dr Carsten Matthai (URS Australia Pty Ltd) and Kristy Guise and Peter Coad (Hornsby Shire Council) using a tall Ekman$^{TM}$ grab sampler (0.15m x 0.15 m x 0.225 m) at all 16 sampling locations. A larger and heavier Ponar grab sampler was deployed at sampling locations near the proposed STP discharge point west of the Hawkesbury River Road Bridge (sampling locations H40, H41, and H42) because the sediment at these locations was generally too gravelly and sandy to be sampled with the Ekman$^{TM}$ grab sampler. Up to 1000 ml of sediment were collected at each site for geochemical analyses. Sampling was conducted on 26 March 2007 from a small motorized boat supplied by Hornsby Shire Council. A Global Positioning System (GPS) was used to locate the sampling locations throughout the study area.

### 2.1.1 Sediment Subsampling

One sample was collected to a maximum depth of 10 cm at each sampling location. The depth penetration of the grab sampler varied between 3 cm and 10 cm, depending on the sediment texture. The penetration of the grab sampler was generally less in sandy sediment compared to muddy sediment, where a depth penetration of up to 10 cm was achieved. Following retrieval, samples were photographed (Appendix D) and homogenized using a clean stainless steel spoon and bowl. Homogenized samples were transferred into two 250 ml clean, laboratory-supplied, glass jars for geochemical analyses (TBT and organic contaminants), one 150 ml glass jar (silver analysis - sampling locations H3, H5, and H7 only) and one 500 ml resealable plastic bag (grain size analysis - sampling locations H40, H41, and H42 only). One 250 ml glass jar was filled for analysis of organic booster biocides (Irgarol 1051, diuron, dichlofluanid, and chlorothalonil - sampling locations H9, H31, H37, and H37 only). Sample containers were pre-labelled and filled with zero headspace. Samples were then stored in eskies on ice. All eskies were filled to capacity and sealed with adhesive tape.

Samples collected from each sampling location were given unique sample numbers (H3, H5, H7, H8, H9, H10, H17, H18, H21, H22, H23, H24, H25, H26, H28, H31, H37, H38, H40, H41, and H42). A chain-of-custody (CoC) form was included in the esky. The samples were delivered to the laboratory within 48 hours of sampling for processing and analysis. Sample labels included the sampling date and sample point number/designation.

Essentially, all sample handling and processing were performed to minimize contamination and possible cross-contamination of the samples. The workspace on the boat was frequently washed down with ambient seawater to clean all surfaces and minimize dust contamination of samples. Nitrile gloves were worn by the sampling personnel.

### 2.1.2 General Field Activities Documentation

Field activity records and observations were noted in bound field logbooks. The aim of the documentation within the field logbooks was to allow future reconstruction of field activities without relying on the memory of field team members. To supplement the information and data collected during sample collection and field testing, field data sheets were also completed and were compiled in Table 2.

Items that were recorded into the field logbook include the sample collection method and health and safety documentation. Field documentation also included the following information:

- Project name and number;

- Date, time, weather conditions;
- Personnel present;
- Type of sample;
- Sampling method;
- Sampling location description, ID and time of collection;
- Sample depth;
- Visual descriptions;
- Sample container type; and
- Photograph number (where applicable).

The field logbook and the field data sheets contain the field data collected during the investigation and the information is summarized in Table 2.

## 2.2 Sample Handling, Processing and Analysis

This section outlines the general procedures necessary for sample custody that were performed by the analytical laboratory. It is understood that the laboratory (ALS) acted in full accordance with the terms of its NATA Registration for Chemical Testing.

The National Measurement Institute (NMI) performed the analyses of the paint booster biocide compounds (diuron and chlorothalonil - quantitative analysis; Irgarol 1051 and dichlofluanid - semi-quantitative analysis). These analyses are not NATA-accredited and the analytical methodology needed to be developed by NMI because these analytes are not routinely determined by the laboratory.

### 2.2.1 Chain of Custody Protocols

A chain of custody (CoC) record was utilised by field personnel to document possession of all samples collected for chemical analysis. The CoC record included the following information:

- Project name and number;
- Name(s) of sampler(s);
- Sample type, identification number and location;
- Date and time of collection;
- Number and type of containers;
- Required analyses;
- Preservatives; and
- Signatures documenting change of sample custody.

The eskies containing the samples were sealed with tape and secured with a signed custody seal. The custody seal provided an indication of whether the cooler was opened by unauthorised personnel. The temperature that the samples were stored at following transit to the lab and upon receipt was noted on the CoC forms.

The original CoC record accompanied the samples to the analytical laboratory. A copy of the CoC record was placed in the appropriate project file. Samples were delivered to the laboratory within 48 hours of sample collection to ensure the specified analytical holding times were met.

### 2.2.2 Laboratory Receipt of Samples

Field samples for this project were delivered to the laboratory pre-contained and pre-preserved (as appropriate) in accordance with laboratory procedures. Sample containers used for the collection of field samples were supplied by ALS Environmental, pre-cleaned and inspected. Accompanying each delivery of samples was a CoC form (Appendix E).

The following items were checked and performed by the laboratory upon receipt of samples with the CoC:

- The custody seals and tape on the cooler were unbroken and uncut;
- The signature on the external custody seal matched one of the sampler(s) signature(s) on the internal CoC;
- Measurement was taken to determine if samples had arrived at the appropriate temperature;
- The sample containers within the cooler were intact;
- The identification on the sample containers corresponded to the entries on the CoC;
- The number of sample containers received was equal to the number of samples listed on the CoC;
- When sample custody was confirmed to be valid, the samples were logged in by the laboratory as per the standard operating procedure;
- A copy of the CoC was delivered electronically to the Project Manager within three working days.

### 2.2.3 Pre-and Post-analysis Storage

Samples were transported to a laboratory within 48 hours of sample collection. After the Sample Custodian logged in the samples, they were placed in temporary refrigerated storage, and maintained at a temperature of $6^0$C or less until analyses were performed. Sample analyses were scheduled as soon as practicable following delivery to the laboratory and extractions and analyses were consistent with the analyte holding times specified by the laboratory.

### 2.2.4 Sediment Analyses

Whole sediment samples from each of the 16 sampling locations, as well as additional samples from the STP site sediment quality assessment and silver analyses of Berowra Creek sediments, were submitted to ALS Environmental, an independent NATA accredited laboratory, for analysis of the analytes listed in Section 1.3. Samples for PAHs, OCPs, OPPs and PCBs were analysed at Ultra Trace limits of reporting, except the three sediment samples from the proposed STP site (H40, H41, and H42), which were analysed at standard limits of detection. All analytical methods are NATA accredited for all of the tests, except for particle size distribution (subcontracted by ALS Environmental to Golder Associates). Analyses of organic booster biocide compounds were performed by the National Measurement Institute (NMI). Certificates of analysis and QA/QC reports are reported in Appendix E.

### 2.2.5 Analytical Quality Assurance/Quality Control (QA/QC)

Specific mechanisms for checking the accuracy and precision of analytical data in order to ensure that data quality objectives were met, involve the analysis of the laboratory and field QA check samples.

**Laboratory QA/QC Samples**

*Blanks* - contaminant free samples designed to monitor the introduction of artefacts into a process. Reagent blanks or method blanks were analysed to assess the level of contamination which exists in the analytical system and which might lead to the reporting of elevated concentrations or false positive data. A reagent/method blank consists of reagents specific to the method that were carried through clean-up and analysis. Ideally, the concentration of an analyte in the blank is below the reporting limit of that analyte.

*Calibration Check Standards* – are pre-prepared from the same solution and were used to confirm linearity of the initial calibration curve. Acceptance must be within predicted limits.

*Laboratory Duplicates* - samples prepared by dividing a field sample into two or more aliquots, then analysed separately. Duplicate samples were considered to be two replicates. Replicate samples should ideally be representative of the originating sample, but in many cases this is not practical due to the nature of the sample; hence the analysis of replicate samples provide an indication of the effect of sample matrix variability on precision, in addition to assessing analytical precision.

*Matrix Spikes* - are field samples to which predetermined concentrations of analytes have been added. The matrix spike (MS) was taken through the entire analytical procedure and the percent recovery of each analyte was calculated as follows:

$$\text{Percent Recovery} = (SX-X)/(S) \times 100\%$$

where, SX = the concentration measured for the spiked sample;

X = the concentration spiked into the sample; and

S = the concentration measured for the sample (not spiked).

Percent recovery values provided an indication of the effect of sample matrix on the accuracy of the analysis, in addition to analytical accuracy.

*Surrogates* - are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in field samples. These compounds were spiked into all sample aliquots prior to preparation and analysis. Percent recoveries were calculated for each surrogate, providing an indication of analytical accuracy including unusual matrix effects and gross sample processing errors.

The following QC checks were performed at a frequency of 1 in 20 field samples or greater for volatile, semi-volatile and metal analytes:

- Reagent/method blanks;
- Calibration check standards;

- Laboratory duplicates;
- Control spikes; and
- Laboratory Control Samples.

With respect to routine organics analysis, ALS Environmental used spiked samples because of the difficulty in obtaining appropriate, matrix-matched, certified reference materials for all target analytes. ALS QC protocols require the use of an Independent Calibration Verification standard (ICV) for all methods. An ICV was prepared from target analytes obtained from an independent source from those used for calibration standards or as spiking solutions for laboratory control samples and matrix spikes. This provided an indirect independent check of the accuracy of laboratory control and matrix spikes.

### 2.2.6 Data Handling

All analytical data generated by the analytical laboratory was appropriately reduced and has undergone comprehensive validation prior to reporting. Records and numerical calculations are legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

The originating analyst reduced and validated a given data package to ensure that:

- Holding times were met;
- Appropriate standard operating procedures were followed;
- Field sample results were correct and complete (if applicable);
- QC check sample results were correct and complete;
- QC check sample results were within established control limits and data quality objectives; and
- Documentation was complete.

If the originating analyst finds that the validity of data is in doubt due to non-conformance with the above checklist, then the data would be flagged and appropriate corrective procedures initiated.

Once the originating analyst reduced and validated the data package, it was passed onto the Document Control/Quality Assurance Officer, Laboratory Manager, or other appropriately qualified senior personnel for independent review.

A NATA approved signatory signed and released the work reported.

The requirements of the reports include the following:

- The format of the final report is in full accordance with NATA requirements for Chemical Testing, including the provision of a NATA stamp on the covering page if appropriate;
- A summary table of sample number, matrix, date sampled, date received, date prepared/extracted and date analysed is completed;
- All field sample results for each type of sample matrix, as listed on the CoC, are reported collectively on separate tables noting URS sample ID, Laboratory ID and Laboratory sample Batch Number;
- All QA check results are reported. Each type of sample matrix, as listed on the CoC, are reported collectively on separate tables;

- All water matrix results are expressed as mg/L or µg/L;
- All solid matrix results are expressed as mg/kg or µg/kg (dry weight);
- Full reference to analytical procedures used are stated;
- Modifications to procedures performed outside the requirements of this Methodology Section have been stated;
- Non-conformance to any of the analytical requirements of this Methodology Section are clearly stated;
- A key to abbreviations is provided; and
- Analyte nomenclature remains consistent throughout the entire project.

Following completion, the final report was signed by the appropriate NATA signatory and submitted to URS.

### 2.2.7 Data Validation

The primary objective of the data validation process is to ensure that the data reported can be used to achieve the project objectives. The validity of all analytical data reported was assessed by URS by critical review of the QC check sample results. This was performed in general accordance with guidance by US EPA guidelines as presented in the document “National Functional Guidelines For Organic Data Review, Multimedia, Multiconcentration (OLMO 1.0) and Low Concentration Water (OLCO 1.0), June 1991”, where appropriate (USEPA, 1991).

Two field replicates (QC 3 and QC 4) were collected to assess the reproducibility of the geochemical analyses of TBT and organic compounds and the sampling and subsampling methodology. One field replicate was collected for the three samples near the proposed STP site (H40, H41, and H42) (QC 1) and one field replicate was collected for the three samples obtained for silver analyses (H3, H5, and H7) (QC 2).

The four QC samples represent duplicates of the following primary samples: QC1 = H42, QC2 = H7, QC3 = H31, and QC4 = H9. Field duplicates were used to measure the precision of the whole sampling and analysis process (sample collection, sample preparation and sample analysis). Significant variation in field duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity. Field duplicates were analysed for all analytes listed in Section 1.3.

The data validation summary reports for the three analytical batches of samples are shown in Appendix F. These show that the analytical sample batches are suitable for environmental interpretive use. However, due to poor matrix spike recoveries of organic analytes and poor surrogate recoveries in the first batch, samples were reanalysed as discussed below.

Recoveries of OC, PCB and OP surrogates were unusually low for most samples. For the OC surrogate compound, dibromo-DDE, recoveries ranged from 0 (not detected) to 65%, although, only one sample (H23) was below the lower data quality objective set by the laboratory. Recoveries were 0 to 83% for the PCB surrogate compound decachlorobiphenyl, and again, the recovery was below the lower data quality objective for sample H23. Recoveries were 0 to 46% for the OP surrogate compound, DEF, and were below the lower data quality objective of 51% for all 18 samples.

Matrix spike recoveries of OC, PCB and OP compounds were also generally low: 16-75%, 36% and 0-44%, respectively. Most recoveries were below the lower static data quality objective of 70%. In contrast, laboratory control sample (LCS) recoveries of OC, PCB and OP compounds were within acceptable dynamic recovery limits (specified on a per compound basis). In addition, recoveries of OC, PCB and OP surrogates were acceptable for method blank and LCS samples: 70-74%, 75-94% and 111-118% for OC, PCB and OP surrogates, respectively.

Despite the low OC surrogate and matrix spike recoveries, the field duplicate results for samples H9 and QC4 showed good precision for DDE (the only OC pesticide that was detected) with a relative percent difference (RPD) of 17% (for DDE concentrations of 1.12 µg/kg and 1.33 µg/kg ). Laboratory duplicate results for OCs were all below LORs. Similarly, field and laboratory duplicate results for PCBs and OPs were all below LORs.

Recoveries of PAH surrogates were substantially higher than for OC, PCB and OP surrogates. Recoveries of 2-fluorobiphenyl, anthracene-d10 and 4-terphenyl-d14 in samples were 50-71%, 55-81% and 54-75%, and were within the laboratory recovery limits. Recoveries of PAHs in matrix spike and LCS samples were also within the dynamic recovery limits. Precision of PAH data for field and laboratory duplicates were also reasonable and RPDs were generally below 50%.

The fact that OC, PCB and OP surrogate recoveries were low for all samples, but were not low for the quality control (blank and LCS) samples was suggestive of an unusual matrix interference. The matrix spike results also suggested a strong interference. This matrix interference was atypical in that the chromatograms showed no evidence of interference from co-eluting compounds or high background. Rather, the low surrogate and matrix spike recoveries appeared to be due to strong adsorption to the sediment matrices.

To further investigate matrix interferences, an experiment was conducted in which the sample weight was reduced relative to the solvent volume, from 20 grams to 10grams and 5 grams, in an attempt to increase extraction efficiency. Two samples were tested in this trial: H21 and QC4. These results are attached in Table 1 (Appendix G). While surrogate recoveries were generally improved with the reduced sample weights, there was still some variation in recoveries, particularly for PCBs. Results for OCs and PCBs also showed significant variation from that reported for the positive analytes DDE and Aroclor 1254 (PCB). Results from this trial were inconclusive.

Given that the samples had high water contents that may hinder extraction efficiencies, further testing was undertaken on the samples following ambient air-drying. Results for this testing are attached in Table 2 (Appendix G). Again, surrogate recoveries for OCs, PCBs and OPs in samples were generally low: 16-79%, 9-83% and 15-50%, respectively. Surrogate recoveries for individual samples were also inconsistent between the first and second analyses. There was also some variability in analyte results between the two analyses. Although, this is not unexpected, given that the (non-TOC normalised) concentrations of the detected analytes DDE and Aroclor 1254 were low, only about 1-3 times the analytical limit of reporting.

Like the first analyses, matrix spike recoveries of OC, PCB and OP compounds (for sample H25) were highly variable and frequently low for the second analyses. Also, like the first analyses, surrogate recoveries for the blank and LCS samples were acceptable. Field and laboratory duplicate results for DDE were also acceptable for the second set of analyses with RPDs of 42% and 8%, respectively.

PAH surrogate recoveries for the second set of analyses with sample pre-dying were generally better than those for the initial testing conducted with wet samples: 71-100%, 73-101% and 77-112% for 2-fluorobiphenyl, anthracene-d10 and 4-terphenyl-d14, respectively. PAH analyte results also generally increased with pre-drying, with the exception of the more volatile naphthalene, which would have been reduced in concentration during the drying process. All blank and LCS data for PAHs for the second analyses were acceptable, as were the field and laboratory duplicate data (RPDs generally <50%).

In summary, the results of the investigation show that the sample matrix for these particular sediment samples interferes significantly in the determination of OPs, OCs and PCBs. ALS has not previously seen such low surrogate recoveries for these analytes in sediment work. The inconsistent analytical results also suggest that the samples may be heterogeneous.

It was suggested that, while analysed outside of holding times, the air dried PAH results be reported, with the exception of naphthalene, given that they have generally increased and are likely to be more representative. Given the inconsistent nature of results and surrogate recoveries for the other analytes, no changes to the originally reported results were considered warranted (Appendix E).

## 2.3 Geographic Information System

Geochemical data was imported into a GIS database (Mapinfo$^{TM}$ Professional) for generation and interpretation of spatial data.

## 2.4 Independent Peer Review

The Draft Report for the Antifoul Study (Stage 2) was reviewed by Dr Stuart Simpson (Principal Research Scientist, Centre for Environmental Contaminants Research, CSIRO) (Appendix H), whose constructive comments have all been addressed and incorporated in this Final Report.

# Section 3 Results

## 3.1 Sediment Chemistry (Antifoul Study)

### 3.1.1 Tributyltin

The concentrations of tributyltin (TBT) were determined in sixteen sediment samples from locations in upper Berowra Creek (H7, H8, H9, and H10), Sandbrook Inlet (H17, H18, and H38), Hawkesbury River Marina (H37), and Cowan Creek, including Bobbin Head marina (H21), Apple Tree Bay (H22), Waratah Bay (H23), Smiths Creek (H24), Coal and Candle Creek (H25 and H26), Cottage Point (H28), and Refuge Bay (H31) (Appendix E).

Concentrations of TBT were above the analytical limit of reporting (0.5 μgSn/kg) in all samples from all 16 sampling locations, and varied from 1.4 μgSn/kg to 125 μgSn/kg. The concentrations of TBT in sediments in Berowra Creek decrease from 6.6 μgSn/kg at H10 to 1.6 μgSn/kg at H7. Sediments in Sandbrook inlet have TBT concentrations that vary from 1.6 μgSn/kg to 4.5 μgSn/kg. The concentration of TBT in sediments at the marina at Brooklyn (H37) is 10.4 μgSn/kg. In Cowan Creek and its tributary creeks, the concentrations of TBT are highly variable, with concentrations of <2 μgSn/kg at Waratah Bay, Smiths Creek and Refuge Bay, compared to concentrations of 22.9 μgSn/kg (H25) and 114 μgSn/kg (H26) at Akuna Bay marina, 41.5 μgSn/kg at Cottage Point, 10.4 μgSn/kg at Apple Tree Bay and 125 μgSn/kg at Bobbin Head marina (Figure 2).

Four of the six highest TBT concentrations in sediments were obtained from sampling locations at or near marinas, including the two highest concentrations (Figure 2). In contrast, the five lowest concentrations of TBT of <2 μgSn/kg were all from locations that were not adjacent to marinas. Sediments in areas of high boat use, such as Refuge Bay, also contained concentrations of TBT <2 μgSn/kg.

### 3.1.2 Organic Compounds

The concentrations of organic compounds in sediments from the sixteen sampling locations are shown in Appendix E and summarized below. As discussed in Section 2.2.7, the concentrations of PAHs of reanalysed pre-dried samples, with the exception of naphthalene, are reported:

**BTEX:**

The concentrations of Benzene, Toluene, Ethylbenzene, meta- & para-Xylene, and ortho-Xylene were below the analytical limit of reporting (<0.2 mg/kg for all samples, except H25 and H28 - 0.1 mg/kg) in all samples.

**Total Petroleum Hydrocarbons:**

The concentrations of total petroleum hydrocarbons (TPH) were below the analytical limit of reporting in all samples. The analytical limit of reporting varied from 10 mg/kg for the C6-C9 fraction, 50-140mg/kg for the C10-C14 fraction, 100-270 mg/kg for the C15-C28 fraction, and 100-270 mg/kg for the C29-C36 fraction.

**Organophosphorus Pesticides:**

The concentrations of all organophosphorus pesticide compounds analysed (Bromophos-ethyl, Carbophenothion, Chlorfenvinphos (E), Chlorfenvinphos (Z), Chlorpyrifos, Chlorpyrifos-methyl, Demeton-S-methyl, Diazinon, Dichlorvos, Dimethoate, Ethion, Fenamiphos, Fenthion, Malathion, Azinphos Methyl, Monocrotophos, Parathion, Parathion-methyl, Pirimphos-ethyl, and Prothiofos) were below the analytical limit of reporting of 0.5 μg/kg in all samples.

**Organochlorine Pesticides:**

The concentrations of all organochlorine pesticide compounds analysed (Aldrin, alpha-BHC, beta-BHC, delta-BHC, 4.4'-DDD, 4.4'-DDE, 4.4'-DDT, DDT (total), Dieldrin, alpha-Endosulfan, beta-Endosulfan, Endosulfan sulphate, Endosulfan, Endrin, Endrin aldehyde, Endrin ketone, Heptachlor, Heptachlor epoxide, Hexachlorobenzene (HCB), gamma-BHC, Methoxychlor, cis-Chlordane, trans-Chlordane, and total Chlordane) were below the analytical limit of reporting of 10 μg/kg in all samples, with the exception of 4.4' DDE in samples from Berowra Creek (H8 - 0.66 μg/kg, H9 - 1.12 μg/kg, H10 - 0.53 μg/kg), and upper Cowan Creek (H21 - 1.04 μg/kg).

**Polychlorinated Biphenyls:**

The concentrations of all PCBs analysed (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260) were below the analytical limit of reporting of 5 μg/kg in all samples, with the exception of Aroclor 1254 in samples from Cowan Creek (H21 – 13.9 μg/kg) and Cottage Point (H28 - 16 μg/kg).

**Polynuclear Aromatic Hydrocarbons:**

The analytical limit of reporting for concentrations of PAHs (2-Methylnaphthalene, 7.12-Dimethylbenz(a)anthracene, Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(e)pyrene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Chrysene, Coronene, Dibenz(a.h)anthracene, Fluoranthene, Fluorene, Indeno(1.2.3.cd)pyrene, N-2-Fluorenyl Acetamide, Naphthalene, Perylene, Phenanthrene, Pyrene) was 10 μg/kg (except for N-2-Fluorenyl Acetamide - 100 μg/kg).

As discussed in Section 2.2.7, the pre-dried analytical data are reported below (Table 3), except for naphthalene, for which the originally analysed data is reported.

The concentrations of PAH compounds exceeded the analytical limit of reporting in one or more samples for almost all compounds, except for 3-methylcholanthrene, 7.12-Dimthylbenz(a)anthracene and N-2-fluorenyl acetamide, which were below the limit of reporting in all samples (Table 3). Low molecular weight PAHs (assuming half the detection limit for compounds that were below the analytical limit of reporting) varied between 65 μg/kg and 420 μg/kg. High molecular weight PAHs varied between 165 μg/kg and 3,960 μg/kg and total PAH concentrations varied between 405 μg/kg and 7,040 μg/kg.

Total PAH concentrations <1,000 μg/kg were found in samples from Cowan Creek - Smiths Creek (H24), Refuge Bay (H31), Akuna Bay marina (H25) and Cottage Point (H28). In contrast, total PAH concentrations of >2,000 μg/kg were present in sediments from Sandbrook Inlet (H18, H38), Hawkesbury River marina (H37), Cowan Creek marina (H21), Apple Tree Bay (H22), and Akuna Bay marina refuelling station (H26).

### 3.1.3 Organic Booster Biocides

The analysis of the four organic booster biocide compounds diuron, chlorothalonil, Irgarol and dichlofluanid in sediments from sampling locations H9 (Berowra Creek marina), H31 (Refuge Bay), H37 (Hawkesbury River marina), and H38 (Sandbrook Inlet) resulted in all analyte concentrations being reported below the analytical limit of reporting (<0.1 mg/kg) in all four samples. However, inspection of chromatograms allowed a greater sensitivity of analysis with a detection limit of 0.001 mg/kg and revealed low concentrations of diuron in sediments at three of the four sampling locations, with concentrations of 0.009 mg/kg (H37), 0.01 mg/kg (H38), 0.03 mg/kg (H9), and 0.04 mg/kg (QC5 = H9). There was no visible chromatographic peak for diuron in the sediment from sampling location H31 (Refuge Bay) (<0.001 mg/kg), which was sampled to determine if areas of high boat use significantly contribute biocides to the estuary. An effort was made to sample both marina and non marina areas with high boat use for comparison.

It should be noted that these analytes are not routinely analysed by any major laboratory in Australia (i.e. ALS Environmental, National Measurement Institute – NMI) and that NMI, the analytical laboratory which performed the organic booster biocide analyses of sediments in this investigation, needed to develop the analytical methodology, which included the purchase of laboratory-grade standards and instrument calibration assays.

## 3.2 STP Site Sediment Chemistry

### 3.2.1 Sediment Texture and Grain Size

Sediments were collected in the immediate vicinity of the proposed Brooklyn and Dangar Island Sewage Treatment Plant (STP) discharge point beneath Peats Ferry Bridge at water depths between 15.4 and 18.5 m. Large bivalve shells and shell fragments were observed at all three sampling locations and these were removed by hand prior to wet-sieving. Hence, there was no gravel (>2 mm) present in any sample. Sediment texture at the three locations varied from dark grey, shelly, clayey sand to silty clay with some sand (Appendix E). Mud contents varied from 26% (H40) to 77% (H41).

### 3.2.2 Inorganic Analytes and Nutrients

The concentration ranges of inorganic analytes are summarized in Appendix E. The concentrations of analytes in the three samples were below the analytical limit of reporting for organic contaminants and generally similar for most analytes, although highly variable for calcium (Range: 5,320 mg/kg to 30,900 mg/kg) due to the large shell component in the sample.

#### *Aluminium*

The concentrations of aluminium vary from 6,860 mg/kg to 14,000 mg/kg which reflects the variations of mud content (<63 μm fraction) in the sediment. The highest concentration of aluminium of 14,000 mg/kg in sediment at location H41 has a corresponding mud content of 71%, compared to a concentration of aluminium of 6,860 mg/kg in sediment from location H40 (mud content: 26%).

### *Arsenic*

Concentrations of arsenic varied from 12-14 mg/kg, which is below the highest observed concentrations of arsenic of >20 mg/kg in sediments in Sandbrook Inlet, Refuge Bay, and Coal and Candle Creek, as shown in the Sediment Study (Stage 1) (Appendix A).

### *Barium*

Barium concentrations varied from 20-30 mg/kg, which is similar to the concentrations of barium in sediments determined during the Sediment Study (Stage 1) (Appendix A).

### *Beryllium*

The concentrations of beryllium varied from <1 mg/kg to 1 mg/kg, which is is similar to the concentrations of beryllium in sediments determined during the Sediment Study (Stage 1) (Appendix A).

### *Cadmium*

The concentrations of cadmium were below the analytical limit of reporting (<1 mg/kg) in all three samples.

### *Chromium*

Concentrations of chromium varied from 11-20 mg/kg, which is below the concentrations of >30 mg/kg previously observed at Berowra Creek marina, Bobbin Head marina, Akuna Bay marina, and Hawkesbury River marina (Appendix A).

### *Cobalt*

Concentrations of cobalt in sediments varied from 8-11 mg/kg, which corresponds to the previous assessment (Appendix A) that showed cobalt concentrations of generally <10 mg/kg in sediments which contain a relatively high sand component (i.e. sandy clays and clayey sands).

### *Copper*

Copper concentrations varied from 8-18 mg/kg, which is substantially below the concentrations of copper of up to >65 mg/kg in sediments at several locations in headwaters of Cowan Creek, Berowra Creek and at Cottage Point (Appendix A). In contrast, concentrations of copper at other locations in the main Hawkesbury River channel were generally <20 mg/kg (Appendix A).

### *Iron*

Concentrations of iron varied from 17,100 mg/kg to 25,700 mg/kg, which compares to iron concentrations >30,000 mg/kg in sediments from a number of locations in the upper Hawkesbury River, Berowra Creek, Sandbrook Inlet and Cowan Creek (Appendix A).

### Lead

Concentrations of lead varied from 13-21 mg/kg, which is substantially below the concentrations of lead of >50 mg/kg and up to 179 mg/kg in sediments at Berowra Creek, Cowan Creek (including Coal and Candle Creek and Akuna Bay) and at Hawkesbury River marina (Appendix A). Concentrations of lead in sediments of the Hawkesbury River channel at other locations were generally <30 mg/kg (Appendix A).

### Magnesium

Concentrations of magnesium varied from 2,500 mg/kg to 4,390 mg/kg, which is similar to the concentrations of magnesium in sediments at other locations of the main Hawkesbury River Channel (<5,000 mg/kg) (Appendix A).

### Manganese

Manganese concentrations varied from 261-347 mg/kg, which is substantially less than manganese concentrations >800 mg/kg and up to 9,820 mg/kg in sediments of the upper study area of the Lower Hawkesbury River, Mullet Creek, Cowan Creek and Berowra Creek (Appendix A).

### Mercury

Concentrations of mercury varied from below the limit of reporting (<0.1 mg/kg) to 0.2 mg/kg in sample H40, compared to concentrations of up to 0.9 mg/kg observed during the Sediment Study (Stage 1) (Appendix A).

### Nickel

Nickel concentrations in sediments varied from 8-15 mg/kg. The highest concentrations of nickel (>15 mg/kg) are present in the mud flats of Berowra Creek, Cowan Creek and Sandbrook Inlet, as well as in the upper sections of the Hawkesbury River (Appendix A).

### Strontium

Strontium concentrations in surficial sediments in the study area varied from 54-139 mg/kg, which compares favourably to concentrations of up to 147 mg/kg observed previously (Appendix A).

### Vanadium

Vanadium concentrations in sediments varied from 30-46 mg/kg, which compares to vanadium concentrations >60 mg/kg in Cowan Creek, Sandbrook Inlet and Mullet Creek (Appendix A).

### Zinc

Concentrations of zinc in sediments varied from 47-61 mg/kg, which is substantially lower than the maximum concentration of zinc observed previously (412 mg/kg) but similar to the concentrations of zinc in sediments of the main Hawkesbury River channel (<90 mg/kg) (Appendix A).

### *Calcium*

Concentrations of calcium varied from 5,320 mg/kg to 30,900 mg/kg. Although sediments in the main Hawkesbury River channel generally contain <5,000 mg/kg calcium (Appendix A), the presence of abundant shell fragments in sediment from sample location H40 accounts for the high calcium concentration >30,000 mg/kg at that location.

### *Nitrate and Nitrite*

Concentrations of nitrate and nitrite varied from 0.12-0.26 mg/kg. In contrast, the concentrations of nitrate and nitrite in sediments at other locations in the Hawkesbury River were generally very low, (<0.1 mg/kg to 0.2 mg/kg) (Appendix A). The highest concentration of nitrate and nitrite of 0.26 mg/kg was observed at location H40, where abundant shell fragments and bivalves indicate a high biological activity.

### *Total Kjeldahl Nitrogen*

The concentrations of TKN varied from 640 mg/kg to 1,420 mg/kg, which compares to TKN concentrations >3,000 mg/kg (Maximum: 9,980 mg/kg) in sediments of Cowan Creek and Berowra Creek (Appendix A). Sediments in the main Hawkesbury River Channel generally contain <1,500 mg/kg (Appendix A).

### *Reactive Phosphorus*

Concentrations of reactive phosphorus varied from <0.1 mg/kg to 0.11 mg/kg, which is similar to the concentrations in sediments at other locations in the Hawkesbury River (Appendix A).

### *Total Organic Carbon*

The concentrations of total organic carbon (TOC) varied from 1.0% to 4.0%. Organic-rich sediments (>10% TOC) are present in Berowra Creek and southwest of Milson Island in the Hawkesbury River (Appendix A). In addition, a distinct regional trend in the TOC contents of sediments is present in the Hawkesbury River, where sediments contain between 5% and 10% TOC, decreasing east of Mooney Mooney to <5% TOC (Appendix A).

## 3.2.3 Organic Contaminants

All organic contaminants (polychlorinated biphenyls, organochlorine pesticides, organophosphorus pesticides, polynuclear aromatic hydrocarbons, total petroleum hydrocarbons and BTEX) in sediments from sample locations H40, H41 and H42 were below the standard analytical limits of reporting (Appendix E).

## 3.3 Silver Concentrations in Sediments in Berowra Creek

The concentrations of silver in surficial sediments at sampling locations H3, H5, and H7 were <0.1 mg/kg, 0.1 mg/kg and 0.2 mg/kg, respectively.

# Section 4 Discussion

## 4.1 Sediment Quality

The sediment geochemical data for TBT and other organic compounds was screened against ANZECC/ARMCANZ (2000) sediment quality guideline values (ISQG-L (Trigger Value) and ISQG-H). The general approach outlined in the ANZECC/ARMCANZ (2000) sediment quality guidelines stipulates that if the lower sediment quality guideline values for a contaminant (i.e. ISQG-L – Trigger Value) is not exceeded, it is unlikely that it will result in any biological disturbance for organisms inhabiting that sediment. If the trigger value is exceeded, either management (including remedial) action is taken, or additional site-specific studies may be conducted to determine whether this exceedence poses a risk to the ecosystem.

Normalization of the concentrations to 1% total organic carbon is required for organic compounds and tributyltin. Table 4 summarizes the normalized concentrations of PAH compounds and TBT (normalized to 1% total organic carbon) (all other compounds are below the limit of reporting, except for concentrations of 4.4' DDE and total DDT in four samples, which vary between 0.53 μg/kg and 1.12 μg/kg, which is below the sediment quality guideline values for these compounds). Table 4 also displays the total organic carbon content of sediments at each sampling location.

The total organic carbon content at each sampling location exceed 1.96% (Range: 1.96% to 6.75%). Using the TOC concentrations at each location and normalizing the concentrations of PAHs and TBT to 1% TOC results in concentrations below the ANZECC/ARMCANZ sediment quality guideline ISQG-L values for all PAHs and TBT at all locations, except for TBT (5 μgSn/kg) at four locations (H21 – Bobbin Head marina; H25 and H26 - Akuna Bay marina; H28 - Cottage Point kiosk). Concentrations of PAH compounds (normalized to 1% organic carbon) do not exceed the sediment quality guideline values at any of the 16 sampling locations (Table 4). It should be noted that PAH compounds are ubiquitous in sediments in the lower Hawkesbury/Nepean system and that most PAH compounds that were quantified in the current investigation are present at concentrations that are greater than five times the analytical limit of reporting, although all PAHs were below the ANZECC/ARMCANZ (2000) ISQG-L values.

The presence of PAHs in these sediments is likely to be of anthropogenic origin, in particular at locations adjacent to increased boating activity. However, PAHs are also produced by combustion of wood during bushfires and the widespread distribution of these compounds in sediments in the lower Hawkesbury/Nepean River suggests that natural contributions from burnt organic matter originating from bushfires over long periods of time may have resulted in this regional contaminant distribution, especially as the concentrations of silver in surficial sediments at sampling locations H3, H5 and H7 in Berowra Creek were below the analytical detection limit.

Exceedences of sediment quality guideline values are limited to TBT at locations in the vicinity of marinas in Cowan Creek and Coal and Candle Creek, and the kiosk at Cottage Point, where a high density of recreational boating activity exists.

## 4.2 Potential Sources of TBT to Sediments

Tributyltin (TBT) is a biocide and catalyst used worldwide. TBT compounds have particularly been used as biocides in antifouling paints and wood preservatives (Hagger et al., 2005). The need for effective antifoulants, which prevent the settlement and growth of marine organisms on submerged structures, such as buoys, fish cages and ship's hulls, is recognised universally (Evans et al., 2000; Konstantinou and Albanis, 2004). For many years, tributyltin (TBT) compounds were the most widely used active ingredients in paint formulations. However, use of TBT has been regulated internationally since 1990 (1989 in New South Wales, Australia – Gibson and Wilson, 2003) due to its severe impact on the aquatic ecosystem (Fent, 1996) and the demonstrated effects of TBT on the disruption of the endocrine system by mimicking or inhibiting the action of gonadal steroid hormones, oestradiol and testosterone (Makita and Omura, 2006). Leachate of TBT compounds has contaminated both marine and freshwater habitats and it has been considered one of the most toxic agents entering the environment (Hagger et al., 2005).

Prior to the ban on the use of TBT as antifouling compound, the source of alkyltins (monobutyltin, dibutyltin and tributyltin) to the waterways of the Hawkesbury River system used to be chiefly from the leaching of antifouling paints from locally moored commercial and recreational vessels and to a lesser extent leaching from PVC pipes used in domestic and industrial plumbing (EPA, 1996). However, elevated concentrations of alkyltins in estuarine sediments are principally associated with commercial marinas and boatyard facilities in areas of limited water movement or tidal flushing (SPCC, 1988). TBT compounds tend to have medium range water solubility and tend to sorb to particulate matter and suspended solids. These compounds are therefore settling with the particulate matter and, as a result, increase the concentrations of TBT in the sediments (Dowson, 1992). The water solubility of tributyltin is strongly affected by pH. TBT's solubility ranges from 0.75 to 31 g/kg over the pH-range of 2.6 to 8.1 (Uhler et al., 2000).

Of particular concern has been the induction of reproductive abnormalities and sterilisation of female marine prosobranch snails caused by tributyltin based compounds. Prolonged release of TBT from ship-bottom coatings has resulted in the imposition of male sexual characteristics upon female gastropods, or imposex, a phenomenon which was first described by Blaber (1970) in the United Kingdom. Imposex in marine gastropods has subsequently been linked to the exposure of these benthic biota to TBT in aquatic systems worldwide (e.g. Smith, 1981a,b,c; Santos et al., 2004). This cause and effects relationship ultimately resulted in a global ban of TBT. The decline in the occurrence of imposex following worldwide bans has been used as a biomarker and biological indicator for environmental monitoring of TBT since the introductions of these bans in countries worldwide (Axiak et al., 2003). The ban on the use of TBT, is primarily due to the adverse effects on the various shellfish, in particular the occurrence of imposex in aquatic biota (Gibson and Wilson, 2003).

The use of TBT for antifouling was regulated from 1989 in New South Wales (Gibson and Wilson, 2003). TBT is banned from use on small vessels (i.e. less than 25m in length) and is being phased out on larger and international vessels. However, despite the partial ban on the use of TBT in Australia, a survey of imposex in *Thais orbita* (Neogastropoda) along the NSW coast found imposex was still widespread 10 years after the introduction of the ban, in particular within harbour/bay areas, where contamination "hotspots" are still present and where physical remobilization and dispersion processes may be less pronounced compared to high-energy coastal areas (Gibson and Wilson, 2003).

Australia is signatory to the *International Convention on the Control of Harmful Anti-fouling Systems on Ships* (2001), which prohibits the use of harmful organotins in anti-fouling paints used on ships and which establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. Under the terms of the Convention, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their authority and all ships that enter a port, shipyard or offshore terminal of a Party.

Ships of above 400 gross tonnage and above engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will be required to undergo an initial survey before the ship is put into service or before the International Anti-fouling System Certificate is issued for the first time; and a survey when the anti-fouling systems are changed or replaced. Ships of 24 m or more in length but less than 400 gross tonnage engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorized agent.

The harmful environmental effects of organotin compounds were recognized by IMO in 1989. In 1990 IMO's Marine Environment Protection Committee (MEPC) adopted a resolution which recommended that Governments adopt measures to eliminate the use of anti-fouling paint containing TBT on non-aluminium hulled vessels of less than 25 m in length and eliminate the use of anti-fouling paints with a leaching rate of more than 4 μg/d of TBT.

In November 1999, IMO adopted an Assembly resolution that called on the MEPC to develop an instrument, legally binding throughout the world, to address the harmful effects of anti-fouling systems used on ships. The resolution called for a global prohibition on the application of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition by 1 January 2008.

By 1 January 2008 (effective date), ships either:

- shall not bear such compounds on their hulls or external parts or surfaces; or
- shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

This applies to all ships (including fixed and floating platforms, floating storage units (FSUs), and Floating Production Storage and Offtake units (FPSOs).

Importantly, the presence of TBT in sediments is not necessarily linked to silts and muds because TBT may occur in flakes that may be deposited in higher energy sandy areas, such as shipping channels. Therefore, TBT may potentially be present in measurable quantities in sediments in areas that may not otherwise exhibit elevated concentrations of inorganic analytes or organic compounds.

The USEPA (2003) has undertaken a review on TBT which contains a very extensive review of biological effects of TBT. It has been proposed by CSIRO to the Department of Environment and Water Resources (DEW) that these guidelines be adopted for TBT in Australia.

## 4.3 Temporal Variations of TBT in Hawkesbury River Sediments

### 4.3.1 1990-1991 Baseline Contaminant Survey (EPA, 1996)

A baseline contaminant survey of the Hawkesbury River estuary in December 1990-January 1991 (EPA, 1996) established the concentrations of alkyltin compounds in sediments at a number of locations within the Hawkesbury River estuary. The EPA (1996) baseline survey of sediments involved the collection of 158 surface sediment grab samples from 102 sample locations and analysis for trace metals, organochlorine compounds, nutrients, TBT, grain size and organic matter. The sampling locations were selected randomly from a sample grid and random triplicate samples were collected at 28 sampling locations.

The concentrations of TBT in the 1990-1991 sediment investigation of Hawkesbury River estuary sediments at 28 sampling locations varied from 0.1 μgSn/kg to 9.6 μgSn/kg, with a mean concentration of 0.9 μgSn/kg (EPA, 1996). However, the highest concentrations of TBT in sediments were found in Pittwater, which was not included in the current Antifoul Study (Stage 2). The outcomes of the EPA (1996) sediment study are summarized as follows:

- Berowra Creek: 4 sampling locations; Mean concentrations vary from 0.1-0.4 μgSn/kg;
- Brooklyn/Sandbrook Inlet: 3 sampling locations; Mean concentrations vary from 0.8-2.1 μgSn/kg;
- Cowan Creek: 5 sampling locations; Mean concentrations vary from 0.1-2.8 μgSn/kg;
- Hawkesbury River: 8 sampling locations; Mean concentrations vary from 0.1-0.6 μgSn/kg;

- Mooney Mooney Creek: 1 sampling location; Mean concentration of 0.1 μgSn/kg; and
- Mullet Creek: 1 sampling location; Mean concentration of 0.1 μgSn/kg.

The highest mean concentrations of TBT in sediments reported in EPA (1996) were in the eastern end of Sandbrook Inlet (the Gut) (2.1 μgSn/kg), upper Coal and Candle Creek (near Akuna Bay marina) (1.1 μgSn/kg) and upper Cowan Creek (2.8 μgSn/kg).

### 4.3.2 2007 Antifoul Study

A significant difference between the EPA (1996) investigation of sediments in the Hawkesbury River estuary (sampled in 1990-1991) and the current Antifoul Study (Stage 2) in 2007 is that in the current investigation the sampling locations were selected based on a hierarchical approach that was based on the outcomes of the Sediment Study (Stage 1) and the inferred proximity to anthropogenic sources of contaminants, in particular TBT, from marinas.

The concentrations of TBT in sediments at the 16 sampling locations within the Hawkesbury River system, including Cowan Creek and Berowra Creek, are high at a number of sampling locations adjacent to marinas compared to locations elsewhere. This corresponds to elevated concentrations of heavy metals at these locations in the vicinity of marinas, as shown in the Sediment Study (Stage 1) (Appendix A). There is a pronounced regional distribution of concentrations of TBT in sediments that identifies local point sources within the Hawkesbury River system, in particular in areas of recreational boating activities. These results are consistent with previous sediment chemistry investigations for other organic and inorganic contaminants in the Hawkesbury River system (EPA, 1996, Birch et al., 1998, Birch et al., 1999), which have also highlighted high density boating activities as significant but localized contributors of contaminants to sediments.

Sediments in upper Cowan Creek (Locations H21 and H22) and upper Berowra Creek (Locations H9 and H10) display elevated concentrations of inorganic and organic contaminants, thereby demonstrating the potential for water-related recreational facilities to affect pristine environments. Although the current Antifoul Study (Stage 2) investigation is not addressing the potential for bioavailability of TBT, it has been shown that TBT is chemically mobile and therefore bioavailable to aquatic organisms and fish, an aspect that may require further investigations in the future.

The spatial distribution of TBT (Section 3.1.1) and the exceedances of ISQG-L (Trigger Value) and ISQG-H (High) sediment quality guideline values have established that there is a distinct relationship between proximity to recreational boating centres (marinas) and elevated concentrations of TBT in surficial sediments (Figure 3). The outcomes of the current Antifoul Study (Stage 2) are summarized as follows:

- Brooklyn/Sandbrook Inlet: 4 sampling locations; Concentrations vary from 1.6-10.4 μgSn/kg;
- Cowan Creek: 8 sampling locations; Concentrations vary from 1.4-125 μgSn/kg;
- Hawkesbury River: not sampled;
- Mooney Mooney Creek: not sampled; and
- Mullet Creek: not sampled.

### 4.3.3 Summary of Temporal Changes in TBT Concentrations

The locations in upper Berowra Creek, Sandbrook Inlet and Cowan Creek (Akuna Bay) have shown to display elevated concentrations of TBT in sediments in both the EPA (1996) sediment investigation and the current investigation. However, the concentrations of TBT in 2007 are substantially higher compared to the concentrations of TBT in sediments sampled in 1990-1991 (EPA, 1996). However, it should also be noted that sediment TBT heterogeneity is often high and that there is always much uncertainty in TBT analyses, which makes a comparison of TBT data with differences of less than 1-2 orders of magnitude problematic (S. Simpson, CSIRO, pers. comm., 2007).

TBT concentrations in Berowra Creek sediments, as determined in 2007, exhibit a distinct gradient, with concentrations decreasing from 6.6 μgSn/kg to 1.6 μgSn/kg. These concentrations are substantially greater than the mean concentrations of 0.1-0.4 μgSn/kg measured in 1990-1991 (EPA, 1996). Similarly, the mean concentrations of TBT in sediments in Sandbrook Inlet and at Brooklyn varied from 0.8 μgSn/kg to 2.1 μgSn/kg in 1990-1991 (EPA, 1996), compared to a range from 1.6 μgSn/kg to 10.4 μgSn/kg in 2007. In addition, the mean concentrations of TBT in sediments in Cowan Creek (including Coal and Candle Creek) were <2.8 μgSn/kg (range: 0.1-2.8 μgSn/kg) (EPA, 1996) compared to a range of 1.4-125 μgSn/kg in 2007.

The temporal increase in the concentrations of TBT in sediments in Berowra Creek, Sandbrook Inlet/Brooklyn and Cowan Creek between 1990/91 and 2007 is likely to be a result of the different sampling methodologies used in the two studies. Whereas the EPA (1996) investigation utilized a random grit sampling methodology, the 2007 Antifoul Study (Stage 2) followed a hierarchical sampling approach with the intention to establish contaminant concentrations at likely point sources of contaminants (i.e. marinas and urban developments). The outcomes of these substantially different approaches are therefore not directly comparable, although it should be noted that TBT has been banned in NSW and Australia since the late 1980s and that it would be expected that a period of 16 years between the two sampling programmes results in substantially lower concentrations of TBT in the surficial sediments in 2007 compared to 1990-1991 (i.e. <10 cm depth).

A significant factor in the assessment of the concentrations of TBT and other contaminants in sediments is the likelihood of the concentrations of contaminants varying substantially over small spatial scales of a few metres and less. This is particularly important in the case of TBT, since it often appears in the form of paint flakes, resulting in a generally patchy contaminant distribution, or local ‘hot spots’ (S. Taylor, pers. comm., 2007). Regional trends, although apparent, may be confounded by the presence of local hot spots of contamination, in particular in the vicinity of known or potential point sources of contamination.

The presence of elevated concentrations of TBT in surficial sediments adjacent to marinas in 2007 suggests that the deposition of present-day TBT-free particulate matter is consistently bioturbated and mixed with underlying TBT-enriched sediments. This continuous mixing process results in only slight dilutions near existing recreational boating facilities, which have been operating for many years prior to the implementation of the TBT ban, and where the presence of high concentrations of TBT in the sediments is likely to be a legacy of past shore-based activities and hull cleaning operations at slipways.

Although temporal changes in the concentrations of TBT and other contaminants in sediments are unlikely to be discernible in the bioturbated surface layer of sediments (i.e. approximately the upper 10 to 50 cm of sediments), deep sediment cores (>1m depth) at these sampling locations would allow an assessment of the long-term variations of contaminant concentrations beyond the currently assessed 16 year period. It is possible that although the concentrations of TBT are relatively high and possibly constant throughout the bioturbated sediment layer there may be even higher concentrations of TBT in sediments below the bioturbated mixing zone. This would reflect the past widespread use of TBT in marine boating and result in peak concentrations of TBT in sediment at a depth that corresponds to the time prior to the commencement of the TBT ban (i.e. pre-1989). However, unless additional core data is obtained, especially at some locations where the concentrations of TBT in the sediments exceed the ISQG-L (Trigger value) of 5 μgSn/kg, it is not possible to ascertain the vertical extent and lateral distribution of the elevated TBT concentrations.

An important finding is the presence of TBT at least three times greater than the analytical limit of reporting (0.5 μgSn/kg) at all sixteen sampling locations, despite the absence of any apparent point sources of TBT at some locations (e.g. H7 – Berowra Creek (Calabash Bay); H23 – Waratah Bay; H24 – Smiths Creek; H31 – Refuge Bay). This suggests a regional presence of TBT in sediments that is likely to be the result of resuspension and downstream transport of particulates from the upper reaches of the two major Creeks and the dispersion and transport of TBT from recreational vessel movements into previously pristine areas. Although concentrations of <5 μgSn/kg are unlikely to result in adverse biological effects in benthic biota, the widespread presence of TBT, albeit at low concentrations, is an indication of an enlarged anthropogenic footprint beyond the immediate proximity of marinas, due to increasingly common recreational boating activity in this region.

### 4.3.4 Other Previous TBT Studies

Previous investigations to characterise the physical and geochemical characteristics of sediments to be removed from Hawkesbury River marina during maintenance dredging included the determination of TBT and have been discussed in Patterson Britton (2003). Dames and Moore (1999) reported that isolated areas of TBT exceedances in sediments above the then applicable ANZECC (1992) interim sediment quality guideline values of 5 μgSn/kg and 37 μgSn/kg existed in the area of assessment at Brooklyn Harbour. Concentrations of 7 μgSn/kg and 37 μgSn/kg were determined at two 'isolated areas' at the edge of the navigation channel in the vicinity of the Brooklyn Baths and at a location within the navigation channel opposite the slipway.

A sediment investigation by Patterson Britton (2001) detected TBT at concentrations above the ANZECC/ARMCANZ (2000) ISQG-L sediment quality guideline value, with concentrations varying from 8-56 μgSn/kg at five of ten sampling locations. The high concentrations of TBT were confirmed by the result of the current investigation, which established a TBT concentration of 10.4 μgSn/kg at sampling location H37 (Hawkesbury River marina). Given the procedural uncertainties that are associated with sampling and analysis and small-scale spatial variability of the concentrations of TBT in the sediments, this outcome confirms the presence of elevated concentrations of TBT in sediments at Hawkesbury River marina.

### 4.3.5 TBT in Hawkesbury River Sediments Compared to Sediments Worldwide

The concentrations of TBT in sediments in the lower Hawkesbury River varies substantially at the 16 sampling locations, from 1.4 μgSn/kg to 125 μgSn/kg, with at TBT concentration of >5 μgSn/kg at 9 of the 16 locations. The TBT concentrations at these locations exceed the ANZECC/ARMCANZ (2000) sediment quality guideline trigger values of 5 μgSn/kg (low) and 70 μgSn/kg (high). However, it should be noted that the concentrations of TBT in sediments of the lower Hawkesbury River system are low compared to other regions in Australia and worldwide (Table 5). For example, concentrations of TBT >100 μgSn/kg are commonly exceeded in sediments in harbours, shipyards and even coastal areas in Europe and Asia. Even sediments in the Ross Sea (Antarctica) where anthropogenic activities are generally restricted, has shown to contain elevated concentrations of TBT in sediments of >2,000 μgSn/kg. Concentrations of TBT in sediments of >3,000 μgSn/kg and up to 53,000 μgSn/kg have been found in sediments in coastal areas in Thailand, marinas and shipyards in Hong Kong and the North and Baltic Sea, and United Kingdom estuaries (Table 5). In contrast, the Hawkesbury River system is generally considered a pristine river system surrounded by National Parks, with only localized contamination in the vicinity of marinas and in the upper reaches of Berowra Creek and Cowan Creek.

## 4.4 Organic Paint Booster Biocides

Although copper is effective against the majority of fouling organism, several algal biofoulers show marked physiological tolerance to copper (Voulvoulis et al., 2000; Amog Consulting, 2002). A booster biocide is therefore usually incorporated in copper based antifouling paints to control copper-resistant species. In the United Kingdom, for example, twelve booster biocides are used as active ingredients in approved antifouling products: Irgarol 1051, diuron, Kathon 5287 (Sea-Nine 211), maneb, zineb, thiram, ziram, chlorothalonil, dichlofluanid, TMTB, TCMS pyridine, and zinc pyrithione (Amog Consulting, 2002). Irgarol 1051 is active against macroalgae, wherease chlorothalonil shows more broad-spectrum activity. Biodegradability can also vary considerably, ranging from readily biodegradable (Sea-Nine 211) to non-biodegradable (diuron and Irgarol 1051). Anaerobic half-lives of <0.5 days were calculated for chlorothalonil and dichlofluanid, between 14 and 35 days for diuron and over 226 days for Irgarol 1051 (Thomas et al., 2003), confirming the greater non-biodegradability of diuron and Irgarol 1051 relative to chlorothalonil and dichlofluanid. Therefore, the release of booster biocides associated with paint particles into marinas has the potential to lead to their accumulation unless activities such as hull cleaning are strictly regulated.

Although TBT still exceeds risk quotients by the greatest margins in environmental risk assessment of biological effects in the United Kingdom, widespread effects due to Irgarol 1051 and less so diuron cannot be ruled out, particularly if use patterns change (Thomas et al., 2001). Khandeparker et al. (2005) reported that the larval development and post-settlement metamorphosis of the barnacle *Balanus albicostatus* Pilsbry (Crustacea: Cirripedia) and the larval metamorphosis of a serpulid polychaete, *Pomatoleios kraussii* Baird was affected when exposed to Irgarol 1051, due to the promotory biofilms becoming toxic. Similarly, exposure of tropical seagrasses to diuron resulted in photosynthetic stress and a decline in the effective quantum yield within hours of exposure in *Cymodocea serrulata*, *Halophila ovalis* and *Zostera capricorni* (Haynes et al., 2000b). It is therefore likely that adverse biological effects from the use of organic booster biocides in antifoul paints may also be present in areas of high recreational boating activity in the Hawkesbury River system.

The availability of booster biocide compounds in registered antifoulant products available in Australia is summarized in Table 6. It should be noted that the summary is considered to be neither complete nor exhaustive, and that is intended to provide only a general indication of the prevalence of organic booster biocides in antifoul products in Australia.

Organic booster biocides are not routinely assessed in environmental media in Australia, although some studies have been conducted in Australia (Konstantinou and Albanis, 2004 and references therein). Given the relative scarcity of data and analytical costs and uncertainties, an assessment of organic booster biocides necessarily required a compromise approach both in terms of the number of sample locations and the number of analytes to be assessed. It was decided that diuron and Irgarol 1051 should be included in the suite of organic booster biocide analytes due to their relative non-biodegradability (Amog Consulting, 2002). Although Irgarol 1051 is not registered with the National Registration Authority (NRA) in Australia (Amog Consulting, 2002), precluding its use in marine and other products, the presence of this compound in sediments would indicate that contributions from overseas vessels may be responsible. In addition, dichlofluanid and chlorothalonil were considered to be of value in the assessment of sediments at some locations in the Hawkesbury River system because these compounds are present in registered antifoul products in Australia (Table 6). Information on these four booster biocide compounds has been summarized below and is based on the information provided in Amog Consulting (2002):

### 4.4.1 Irgarol 1051

Irgarol 1051® (Ciba-Geigy) **(**2-methylthio-4-t-butylamino-6-cyclopropylamino-s-triazine) is an agricultural herbicide that is highly effective against freshwater and marine algae (Amog Consulting, 2002). It belongs to the *s*-triazine group of compounds that act as photosystem-II inhibitors, by inhibiting photosynthetic electron capture transport in chloroplasts (Dahl & Blanck, 1996; Voulvoulis et al., 1999). Irgarol is primarily used as a booster biocide to improve a coating's resistance to slime and algae.

Readman (1996) expressed concerns, and raised the question as to whether coastal ecosystems were at risk from Irgarol. Irgarol has now been detected in marine and estuarine water and sediment samples from areas associated with boating activity in the United Kingdom (Gough et al., 1994; Scarlett et al. 1997; Thomas et al., 2001), France (Tolosa et al., 1996), Spain (Martinez et al., 2001), Germany (Biselli et al., 2000), Japan (Liu et al., 1999), Bermuda (Connelly et al., 2001) and Australia (Scarlett et al., 1999).

The highest levels detected in water at Plymouth Sound, UK, (>120 ng/L) significantly inhibited the growth of Enteromorpha spores under laboratory conditions and the no effect concentration on photosynthetic activity in adult Enteromorpha fronds was 22 ng/L (Scarlett et al., 1997). Available data suggests that Irgarol is more toxic to algae than other trophic levels, and can inhibit algal growth at concentrations between 10 and 100μg/L (Rogers et al., 1996). A probabilistic risk assessment of the use of Irgarol indicated low ecological risk in estuaries, coastal areas and various open-type marinas (Hall et al., 1999). Irgarol is not readily degraded in seawater (Callow & Willingham, 1996). White rot fungus, *Phanerochaete chrysosporium*, appears to biotransform Irgarol, but does not cleave the heterocyclic ring, suggesting that degradation products may accumulate in the environment (Liu et al., 1997; Voulvoulis et al., 1999).

A number of countries have recently imposed restrictions on the use of Irgarol as an antifouling biocide because of its persistence in the marine environment. Irgarol has been considered, but not approved, by the National Registration Authority (NRA) for use as an antifouling biocide in Australia (Amog Consulting, 2002).

### 4.4.2 Diuron

Diuron (dichlorophenyl dimethylurea) inhibits photosynthesis and is one of the major urea herbicides used in agriculture since the 1950s for weed control in no-crop areas (Amog Consulting, 2002). In the UK, where data are available, it was estimated that 45-52% of recreational craft were painted with antifoulings containing diuron (Boxall et al., 2000). On the Mediterranean coast of Spain, diuron, together with Irgarol 1051, was the most ubiquitous antifouling biocide detected. It was found in every marina and harbour sampled (Martinez et al., 2001). Diuron has not been found to be readily degraded in seawater (Callow & Willingham, 1996). In the United Kingdom, diuron and Irgarol 1051 were found in water samples from areas of high yachting activity and diuron was measured at the highest concentrations (Thomas et al., 2001). In a survey of sediments, diuron was detected in samples at one site, a marina in Southampton Water (Thomas et al., 2000). Its presence was thought to be associated with paint chippings, emphasising the importance of environmental management of shore-side practices.

Concentrations of diuron measured in sediments on the Queensland coast are considered sufficiently high to result in ecosystem impacts (Haynes et al., 2000a,b). However, this contamination was attributed to the widespread use of diuron as a herbicide by the sugarcane industry rather than use in antifouling paints. In the marine environment, diuron can inhibit photosynthesis and growth in periphyton, phytoplankton and seagrasses (Molander et al., 1992; Mayer, 1987; Ralph, 2000; Haynes et al., 2000b). Diuron concentrations in sediments in the United Kingdom have been reported to be as high as 395 μg/kg at a marina in Orwell (Boxall et al., 2000) and 1,420 μg/kg at the end of the boating season in Southampton water (Thomas et al., 2000).

### 4.4.3 Chlorothalonil

Chlorothalonil (2,4,5,6-tetrachloroiso-phthalonitrile) also known as Nopcocide N-96® (Henkel), is used in agriculture as a fungicide and in paints and adhesives as a preservative. It is highly toxic to fish and aquatic invertebrates, but not phytotoxic (Caux et al., 1996). A study of the degradation of chlorothalonil in seawater found degradation to become apparent after four weeks and to proceed more rapidly in seawater supplemented with cultured marine bacteria (Callow & Willingham, 1996).

High concentrations of chlorothalonil were measured in water and sediment in the Blackwater estuary in the UK, but the cause appeared more likely to be agricultural run-off than to its use in antifouling paints (Voulvoulis et al., 2000). In 2000, the UK Advisory Committee on Pesticides recommended that all amateur uses of antifouling products containing chlorothalonil should be revoked because information on humans indicated that the risk of skin sensitisation in humans was unacceptable (Advisory Committee on Pesticides, 2000). There is currently no available information on the restrictions of the use of chlorothalonil in non-agricultural industries in Australia.

### 4.4.4 Dichlofluanid

Dichlofluanid (N-dimethyl-N-phenylsulphamide) is used as an agricultural fungicide (Amog Consulting, 2002). In the United Kingdom, 38 approved antifouling products contain dichlofluanid (Health & Safety Executive, 2001). Dichlofluanid was present in only 0.6% of antifouling paint sold by chandlers surveyed in a UK study, but was nevertheless detected in relatively high concentrations at several localities in the region after a boating season (Voulvoulis et al., 2000). Dichlofluanid has also been detected in marina waters in Spain (Martinez et al*.,* 2001). Dichlofluanid is much less soluble in water than both Irgarol 1051 and diuron, which may allow it to become associated with particulate matter and thus have the potential to bioaccumulate. Thomas et al. (2000) also comment that although dichlofluanid has been used extensively on various crops, very little is known about its environmental fate and effects. There is currently no available information on the environmental fate and effects of dichlofluanid in Australia and further research in this field is necessary.

### 4.4.5 Organic Booster Biocides in Sediments in the Hawkesbury River System

The concentrations of paint booster biocide compounds dichlofluanid, Irgarol 1051, diuron, and chlorothalonil were below the specified analytical limit of reporting (<100 μg/kg) in all four sediment samples, which makes a determination of the presence of these compounds in sediments of the Lower Hawkesbury River system inconclusive. Although the analytical detection limits of these compounds in the international scientific literature in both water and sediments are routinely reported in the low μg/kg range (1-10 μg/kg), the quantitative analytical determination of these compounds is not routinely performed by any of the major commercial and NATA-accredited laboratories in Australia.

However, the analysis of the detailed mass spectrometry data from the analyses provided a more sensitive analytical limit of reporting, which resulted in the detection of diuron in three of the four samples, namely 30 μg/kg (40 μg/kg), 9 μg/kg and 10 μg/kg in sediment from locations H9 (QC5), H37, and H38, respectively (no evidence of diuron in sample H31 from Refuge Bay).

Based on the chemical data reported in the international scientific literature, booster biocide concentrations of >100 μg/kg in sediments have been reported previously for Irgarol 1051 (<1-1,011 μg/kg) (Boxall et al., 2000; Konstantinou and Albanis, 2004), diuron (<0.4-1,420 μg/kg) (Thomas et al., 2000), dichlofluanid (<1.6-688.2 μg/kg) (Voulvoulis et al., 2000), and chlorothalonil (16-165 μg/kg) (Albanis et al., 2002). The absence of Irgarol 1051, dichlofluanid, and chlorothalonil in Hawkesbury River sediments at concentrations of 100 μg/kg and below is not an indication of the absence of these compounds, although it suggests that if these compounds are present, the concentrations are likely to be below the maximum concentrations found in European ports and marina sediments. Irgarol 1051 is not legally registered in any antifoul compounds in Australia but it has previously been detected in water and sediments on the Queensland coast (Konstantinou, 2004 and references therein), which justifies the inclusion of this compound in the current investigation.

The concentrations of these four booster biocide compounds have also been previously determined in waters from marinas and coastal ports in Europe, with ranges for Irgarol 1051 (<0.001-4.2 μg/l) (Basheer et al., 1993), diuron (<0.001-6.74 μg/l) (Thomas et al., 2001), dichlofluanid (<0.004-0.6 μg/l) (Martinez et al., 2000), and chlorothalonil (<0.01-1.38 μg/l) (Voulvoulis et al., 2000).

At present, no reliable data on the solid phase-dissolved phase partitioning of booster biocides exists. It is therefore difficult to determine if the generally observed lower concentrations in waters in comparison with sediments have to do with the booster biocide compounds' preference towards sorptive partitioning. Gough et al. (1994) have also observed even lower concentrations of Irgarol 1051 in sediments in the Humble Estuary, UK, suggesting that partitioning onto settled or suspended particulate matter may prove to be a critical process in determining the compounds fate in the aquatic environment.

### Diuron

Diuron is the most common (in Australia – Table 6) of the four booster biocide compounds assessed in the current investigation, which makes its presence in sediments at concentrations of approximately 9 μg/kg to 40 μg/kg unsurprising. In contrast, dichlofluanid and chlorothalonil are registered in only one antifoul product in Australia and Irgarol 1051 is not legally registered in any antifoul compounds, which corresponds to the absence of these compounds in sediments at these four locations in the Hawkesbury River system. It should be noted that diuron is no longer approved for use in the UK as an active ingredient in antifouling paints, on any size of vessel, due to its demonstrated toxicity (Konstantinou and Albanis, 2002).

Diuron also inhibits photosynthesis and was found to have similar toxicity with Irgarol 1051 using *D. magna*, Zostera caprocorni seagrass, sea urchin eggs, and embryos and suspension cultured fish cells in various bioassays (Fernández-Alba et al., 2002; Kobayashi and Okamura, 2002; Okamura et al., 2002; Macinnis-Ng and Ralph, 2003). For diuron a maximum permissible concentration of 430 ng/l has been derived by Dutch authorities (Lamore et al., 2002).

For *D. magna* toxicity assay, the toxicity order of compounds was Sea-nine 211 (not assessed in the current study) > chlorothalonil > TCMTB (not assessed in the current study) > dichlofluanid > Irgarol 1051 > diuron (Konstantinou and Albanis, 2002). This toxicity order confirms the comparatively low toxicity of diuron relative to other booster biocide compounds. However, diuron is reported to be relatively persistent in seawater (Callow and Willingham, 1996) and considerably stable to hydrolysis and sunlight irradiation (Okamura, 2002). Due to the relatively high solubility of diuron in water (35 mg/l), it is suggested that diuron is predominantly found in the dissolved phase and only weakly sorbed to sediments. Voulvoulis et al. (2002) has found that diuron exhibited the least preference for sorptive behaviour between Irgarol 1051, chlorothalonil, and dichlofluanid. Therefore, the presence of diuron in sediments at three locations in the lower Hawkesbury River system at concentrations of up to 40 μg/kg suggests that this compound is also substantially more likely to be present in water relative to Irgarol 1051, chlorothalonil, and dichlofluanid.

Diuron concentrations are greater than the concentrations of TBT in corresponding samples at sampling locations H9 (Berowra Creek marina) and H38 (Sandbrook Inlet), but similar at sampling location H37 (Hawkesbury River marina). In contrast, diuron was not detected at sampling location H31 (Refuge Bay), where the concentration of TBT was also low (1.4 μgSn/kg) (Figure 4 and Table 7).

The low concentrations of both diuron and TBT in sediments in Refuge Bay (H31) confirm that the sediments at that location are uncontaminated, which is most likely due to the absence of marinas and only temporary mooring for small recreational vessels in the Bay. In contrast, the higher TBT concentrations of up to 10.4 μgSn/kg and diuron concentrations of up to 40 μg/kg at the other three locations corresponds to the substantially higher boating activity at marinas in upper Berowra Creek, Sandbrook Inlet and Brooklyn Harbour. The diuron concentrations of 9-40 μg/kg in sediments in the lower

Hawkesbury River are generally lower compared to concentrations in sediments at marinas and in estuaries in the United Kingdom (e.g. Orwell marina - <12-395 µg/kg (Boxall et al., 2000); Southampton Water - <100-1,420 µg/kg (Thomas et al., 2000)) and Spain (e.g. Ebre Delta ports - <0.4-100 µg/kg (Martinez and Barceló, 2001)).

## 4.5 Contaminants in Sediments at Proposed STP Site

The concentration ranges of inorganic analytes in sediments at three sampling locations in the vicinity of the STP are summarized in Section 3.2. The concentrations of inorganic analytes arsenic, cadmium, chromium, copper, lead, nickel, and zinc are below the ISQG-L (Trigger Level) of the (ANZECC/ARMCANZ (2000) sediment quality guidelines in sediments from all three sampling locations. However, the concentration of mercury in sediment at sampling location H40 (0.2 mg/kg) exceeds the ISQG-L value for mercury of 0.15 mg/kg.

All organic contaminants (polychlorinated biphenyls, organochlorine pesticides, organophosphorus pesticides, polynuclear aromatic hydrocarbons, total petroleum hydrocarbons and BTEX) in sediments from sample locations H40, H41 and H42 were below the standard limits of reporting.

The analytical results confirm that the concentrations of inorganic analytes in sediments at the three sampling locations in the vicinity of the proposed STP site are low, and similar to the concentrations in sediments in the main Hawkesbury River channel, as established in the Sediment Study (Stage 1) (Appendix A).

## 4.6 Silver Concentrations in Sediments in Berowra Creek

The concentrations of silver in surficial sediments at three locations in Berowra Creek (H3, H5, and H7) were determined to assess possible sewage and stormwater contributions to these sediments, based on elevated total organic carbon contents observed in Berowra Creek sediments during the Sediment Study (Stage 1) (Appendix A).

The low silver concentrations of <0.1mg/kg-0.2mg/kg and the small concentration range suggests that sewage particulate matter concentrations and stormwater contributions are unlikely to be linked to the elevated total organic carbon concentrations in the sediments in Berowra Creek. However, a more detailed assessment of the spatial distributions of silver and the vertical concentration gradients in sediments adjacent to stormwater discharge points in Berowra Creek would be required to provide a more conclusive outcome.

# Section 5 Conclusions

The Sediment Study (Stage 1) (Appendix A) has resulted in the following outcomes:

- Sediment texture is generally muddy (>80% mud) in deep waters of the creeks (Cowan Creek, Berowra Creek, Marramarra Creek, Mullet Creek, Mooney Mooney Creek) and sandier in the main Hawkesbury River channel and the headwaters of the major creeks;
- Normalized contaminant concentrations (using the lithogenic element aluminium) generally decrease from upper Berowra Creek and upper Cowan Creek towards the main Hawkesbury River channel, with locally elevated concentrations in the vicinity of marinas and areas of increased recreational boating activity. Normalized contaminant concentrations in sediments of Sandbrook Inlet (the Gut) are generally higher than in the main Hawkesbury River channel, where normalized contaminant concentrations are low from Wisemans Ferry to the confluence with Cowan Creek;
- Concentrations of inorganic contaminants (copper, lead, zinc, mercury, arsenic) exceed ANZECC/ARMCANZ (2000) sediment quality guideline values in sediments of upper Berowra Creek, Cowan Creek, Sandbrook Inlet (the Gut), mainly adjacent to marinas, and at some locations in the Hawkesbury River (southwest of Spectacle Island and south of Dangar Island). Nineteen of the 52 sampling locations exceed at least one sediment quality guideline value;
- Concentrations of organic compounds are below the limits of reporting in sediments at most sample locations and below ANZECC/ARMCANZ (2000) sediment quality guideline values where present above the limits of reporting. Total petroleum hydrocarbons are present at concentrations above the limits of reporting in sediments at Waratah Bay, Mooney Mooney Creek, Cowan Creek and Smiths Creek. Fluoranthene and Pyrene, were detected in sediments in Mooney Mooney Creek and at Bobbin Head marina and PCBs were detected in sediments at Bobbin Head marina; and
- Normalized concentrations of copper, chromium, lead and zinc are higher in upper Berowra Creek sediments in 2007 compared to 1998, possibly reflecting increased contaminant contributions to receiving waters from the upper Berowra Creek catchment. In contrast, total organic carbon contents in sediments are lower in upper Berowra Creek sediments when compared over the same 9 year period, which suggests that elevated contaminant concentrations in upper Berowra Creek sediments may be related to sources other than stormwater discharge.

The Antifoul Study (Stage 2) has resulted in the following outcomes:

- Concentrations of TBT (normalized to 1% TOC) in sediments exceed the ISQG-L (Trigger Value) of the ANZECC/ARMCANZ (2000) sediment quality guidelines (5 μgSn/kg) at four locations in the vicinity of marinas (i.e. Akuna Bay marina - H25 and H26; Bobbin Head marina - H21) and other points of high recreational boating activity (i.e. Cowan Creek – Cottage Point - H28);
- The occurrence of TBT in the Hawkesbury River estuary system is widespread, albeit at low concentrations in areas other than in close proximity to marinas. Concentrations of >1.4 μgSn/kg in sediments were found at each of the 16 locations assessed in the current study, including locations remote from marinas (i.e. Calabash Bay, Refuge Bay, and Smiths Creek);
- TBT concentrations in sediments at marinas and in areas of high recreational boating activity in the lower Hawkesbury River system are substantially lower compared to many other harbours and coastal areas worldwide, indicating that antifoul-related contamination is comparatively minor and localized to areas of known boating activity;
- Concentrations of organic compounds in surifical sediments are generally below the analytical limits of reporting (i.e. TPH, OP pesticides, BTEX, OC pesticides (except for DDE at four sampling locations), and PCBs (except for Aroclor 1254 at two locations)). However, PAH compounds are generally ubiquitous in sediments in the lower Hawkesbury/Nepean River system and the concentrations of most PAH compounds quantified in this investigation are generally above the analytical limits of reporting at all sampling locations and likely to be at least partially due to natural PAH contributions from burnt organic matter generated during bushfires;

# Section 5 Conclusions

- Organic paint booster biocides Irgarol 1051, chlorothalonil and dichlofluanid have not been detected in sediments in the lower Hawkesbury River system at concentrations at or above 0.1 mg/kg. However, the presence of diuron at concentrations between 0.009 mg/kg and 0.04 mg/kg at three locations (Berowra Waters marina, Brooklyn Harbour, Sandbrook Inlet) suggests that these compounds (and other antifoul compounds not assessed in the current investigation, e.g. zinc pyrithione, thiram) may be present at lower concentrations;

- Sediments in the vicinity of the proposed Sewage Treatment Plant discharge point at the Peats Ferry road bridge have shown to be uncontaminated, except for an exceedance of the ISQG-L (Trigger Level) for mercury at one location (H40), which may be due to road runoff in the vicinity of that location. Contaminant concentrations at these locations are similar to the levels found in other parts of the main Hawkesbury River channel; and

- Concentrations of silver in surficial sediments in lower Berowra Creek are low (<0.1mg/kg-0.2mg/kg), suggesting that the high total organic carbon concentrations in sediments in Berowra Creek are unlikely to be associated with stormwater and sewage discharges.

# Section 6 Recommendations

## 6.1 Recommendations

The Sediment and Antifoul Study (Hornsby Shire Council Project Q27/2006) has resulted in important findings, as summarized in Section 5. Additional assessments may be considered by Hornsby Shire Council in the ongoing environmental management of the waterways of the Lower Hawkesbury River estuary. In particular, the following issues may be considered further:

1. Elevated concentrations of TBT in sediments at several sampling locations in the Hawkesbury River system indicate that there is a residual environmental effect, even 18 years after the ban on TBT-based antifoulants. This confirms the assessment by Gibson and Wilson (2003) who established that imposex phenomena in gastropods were still evident in eastern Australia 10 years after the implementation of TBT restrictions. Additional data is needed to ascertain the vertical extent and variability of TBT concentrations in sediments at locations where the surficial sediment concentrations (<10 cm depth) exceed the ISQG-L (Trigger value) of 5 μgSn/kg (ANZECC/ARMCANZ (2000). These locations are H8, H9, and H10 (upper Berowra Creek), H21 and H22 (upper Cowan Creek), H25 and H26 (Akuna Bay marina in Coal and Candle Creek), H28 (Cottage Point) and H37 (Hawkesbury River marina). Vertical contaminant concentration profiles (TBT, heavy metals and organic compounds) are likely to establish the thickness of contaminated sediments, which may have direct implications for future management of sediments at these locations, including maintenance dredging, trawling, relocations of moorings, and other types of sediment disturbances.

2. The abundance and spatial distribution of organic booster biocides in antifouling paints, such as Irgarol 1051, diuron, dichlofluanid, and chlorothalonil (and other booster biocide compounds that were not assessed in the current investigation, such as zinc pyrithione and thiram) near marinas and other areas of high recreational boating activity in the Hawkesbury River system, has not been satisfactorily resolved. Due to the well-known toxicity of these TBT-replacement antifoulants, the demonstrated presence of diuron, and the likelihood of the presence of other booster biocide compounds, aquatic biota in the vicinity of these areas may be adversely affected. It may be possible that toxicity effects to aquatic biota in the vicinity of marinas that are not due to the presence of elevated concentrations of TBT, heavy metals or other commonly analysed organic compounds (i.e. PAHs, PCBs, OC pesticides), are the result of the presence of organic booster biocides in water and sediments. However, this link has not been established in the current investigation and would require additional assessments that identify these compounds and quantify their concentrations in water and sediments in the Hawkesbury River system. A hierarchical assessment, culminating in the determination of ecological risk of these compounds to the environment in the Hawkesbury River system may be warranted, based on the demonstrated prevalence of environmental effects in other areas of intense boating activity throughout the world.

Additional assessments would require substantially lower analytical limits of reporting (0.001 mg/kg in sediments and 0.001 μg/l in water) to allow direct comparisons with results from other studies worldwide and assess the potential ecological implications of the presence of organic booster biocides in environmental media in the Hawkesbury River system. Zinc pyrithione and thiram, which are both registered compounds in Australia, but which have not been assessed in the current investigation may also be included in future environmental assessments of marinas in the Hawkesbury River system.

3. The concentrations of contaminants in sediments at the proposed STP site at the Hawkesbury River road bridge are low, with the exception of mercury (0.2mg/kg) at one location (H40) (possibly due to road runoff), and generally similar to the concentrations of contaminants in the main Hawkesbury River channel. It is recommended to obtain additional sediment grab samples at these sampling locations (H40, H41 and H42), following the commissioning of the STP, at various time-points (e.g. 3 months, 6 months and 12 months post-commissioning) and analyse these samples for an identical suite of contaminants compared to the current investigation. This post-commissioning monitoring programme would allow an assessment of possible contaminant accumulation in sediments in the vicinity of the STP diffusers, as a

result of particulate matter contributions from the STP discharge. However, based on the findings of the current investigation it is unlikely that fine particulate matter from the STP discharge would accumulate in the vicinity of the Hawkesbury River road bridge because of the high energy environment prevalent in the centre of the Hawkesbury River channel. Large tidal movements and high velocity currents in the main river channel has resulted in generally sandy substrate with abundant shells and corals and few fine particulates.

4. The presence of high total organic carbon contents in excess of 12% in sediments in lower Berowra Creek downstream of Calabash Bay (H3 to H7) is unlikely to be due to organic-rich contributions of particulate matter from sewage or stormwater discharges, because the concentrations of contaminants, in particular heavy metals, in these sediments are generally low. Concentrations of silver in surficial sediments in lower Berowra Creek have shown to be at or below the analytical limit of reporting (0.1mg/kg), which suggests that the elevated TOC contents in these sediments may be the result of natural organic matter contributions from the surrounding National Park. However, the source of the organic carbon and a confirmation of its natural origin would require additional sampling and analysis of sediments in the vicinity of known stormwater discharge points in Berowra Creek, to establish if there is a spatial gradient in the TOC content in surficial sediments and a decrease in TOC content with distance from the inferred discharge source.

5. The bioavailability of TBT and other inorganic and organic contaminants in sediments in the vicinity of known point sources (i.e. marinas) and the potential effects on aquatic biota are currently poorly understood in the Lower Hawkesbury River estuary. Further research into the ecotoxicological effects of bioavailable contaminant sources near marinas would therefore provide additional information and maximize the efficiency of estuary management of the Lower Hawkesbury River.

6. Analytical procedures for the quantification of booster biocide compounds in sediments need to be further developed before a more detailed spatial assessment of the distribution of these compounds in sediments of the Lower Hawkesbury River estuary can be undertaken.

7. A compilation of the usage profiles and availability of booster biocide compounds in registered antifoulant products available in Australia may provide further information about the likelihood of these compounds to be present in sediments and water near marinas and other areas of high commercial and recreational boating within the Lower Hawkesbury River estuary.

8. Long-term monitoring in high priority oyster lease areas via sampling and analysis of sediments for inorganic and organic contaminants may be necessary to ascertain that contaminants do not accumulate in these areas over time.

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# Section 8 Limitations

URS Australia Pty Ltd (URS) has prepared this Final Report in accordance with the usual care and thoroughness of the consulting profession for the use of Hornsby Shire Council and only those third parties who have been authorised in writing by URS to rely on the Final Report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Final Report. It is prepared in accordance with the Proposal dated 29 August 2006 and the Sampling and Analysis Plans for the Sediment Study (Stage 1) and Antifoul Study (Stage 2) (Appendices B and C).

The methodology adopted and sources of information used by URS are outlined in this Final Report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this Final Report as provided to URS was false.

This Final Report was prepared between 15 April and 20 September 2007 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This Final Report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This Final Report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

# Tables

## Table 1. Antifoul Study (Stage 2) Sampling Locations

| Sample ID | Location Description | Easting* | Northing* | Analytes |
|---|---|---|---|---|
| H7 | Berowra Creek Calabash Bay | 325530 | 6282107 | TBT, PCBs, PAHs, OCPs, OPPs, Silver |
| H8 | Berowra Creek east of Crossland Bay | 325808 | 6281083 | TBT, PCBs, PAHs, OCPs, OPPs |
| H9 | Berowra Creek at Marina | 325771 | 6280706 | TBT, PCBs, PAHs, OCPs, OPPs, diuron chlorothalonil, Irgarol 1051, and dichlofluanid |
| H10 | Berowra Creek | 325685 | 6280026 | TBT, PCBs, PAHs, OCPs, OPPs |
| H17 | Hawkesbury River Sandbrook Inlet West - at Marina | 333320 | 6286561 | TBT, PCBs, PAHs, OCPs, OPPs |
| H18 | Hawkesbury River Sandbrook Inlet East | 335098 | 6287024 | TBT, PCBs, PAHs, OCPs, OPPs |
| H21 | Cowan Creek Bobbin Head - at Marina | 329680 | 6273756 | TBT, PCBs, PAHs, OCPs, OPPs |
| H22 | Cowan Creek Apple Tree Bay | 328980 | 6274926 | TBT, PCBs, PAHs, OCPs, OPPs |
| H23 | Cowan Creek east of Waratah Bay | 330452 | 6277834 | TBT, PCBs, PAHs, OCPs, OPPs |
| H24 | Cowan Creek Smiths Creek | 332960 | 6277113 | TBT, PCBs, PAHs, OCPs, OPPs |
| H25 | Cowan Creek Akuna Bay - at Marina adjacent to slipway | 336465 | 6275815 | TBT, PCBs, PAHs, OCPs, OPPs |
| H26 | Cowan Creek Akuna Bay - at Marina refueling station | 336487 | 6276077 | TBT, PCBs, PAHs, OCPs, OPPs |
| H28 | Cowan Creek Cottage Point - adjacent to kiosk | 333768 | 6278915 | TBT, PCBs, PAHs, OCPs, OPPs |
| H31 | Cowan Creek Refuge Bay | 337481 | 6280993 | TBT, PCBs, PAHs, OCPs, OPPs, diuron chlorothalonil, Irgarol 1051, and dichlofluanid |
| H37 | Hawkesbury River Brooklyn Jetty - at Marina | 335462 | 6286738 | TBT, PCBs, PAHs, OCPs, OPPs, diuron chlorothalonil, Irgarol 1051, and dichlofluanid |
| H38 | Hawkesbury River, Brooklyn Harbour at Hawkesbury River Marina | 334339 | 6286858 | TBT, PCBs, PAHs, OCPs, OPPs, diuron chlorothalonil, Irgarol 1051, and dichlofluanid |
| H3 | Berowra Creek west of Berowra Point | 327506 | 6287314 | Silver |
| H5 | Berowra Creek west of Bujwa Creek | 326962 | 6283927 | Silver |
| H40 | Hawkesbury River northwest of Long Island (STP site) | 333300 | 6287277 | TKN, TOC, NOX, Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd, PCBs, PAHs, OCPs, OPPs, TPHs, BTEX, grain size |
| H41 | Hawkesbury River north of Kangaroo Point (STP site) | 332885 | 6287343 | TKN, TOC, NOX, Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd, PCBs, PAHs, OCPs, OPPs, TPHs, BTEX, grain size |
| H42 | Hawkesbury River west of Hawkesbury Road Bridge (STP site) | 332557 | 6287461 | TKN, TOC, NOX, Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd, PCBs, PAHs, OCPs, OPPs, TPHs, BTEX, grain size |

*Map Grid of Australia MGA94 (Zone 55)

## Table 2. Antifoul Study (Stage 2) Field Descriptions

| Sample ID | Location Decription | Easting | Northing | Date Sampled | Time Sampled | Weather | Water Depth (m) | Sample Thickness (cm) | Gravel | Sand | Silt and Clay | Sediment Type | Colour | Additional Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H7 | Berowra Creek east of Calabash Bay at monitoring buoy | 325527 | 6282093 | 26/03/2007 | 2.30pm | Cloudy | 13.8 | 6 | ND | ND | ND | Mud | Dark Olive | Black organic material in upper hydrous layer |
| H8 | Berowra Creek east of Crossland Bay | 325829 | 6281081 | 26/03/2007 | 2.45pm | Cloudy | 7.6 | 8 | ND | ND | ND | Mud | Dark Olive | Thin hydrous layer |
| H9 | Berowra Creek at Marina | 325729 | 6280693 | 26/03/2007 | 3.00pm | Cloudy/ Rain | 7.4 | 10 | ND | ND | ND | Mud | Dark Olive | Blck organic-rich surface layer, anoxic, slight H2S odour |
| H10 | Berowra Creek | 325690 | 6280066 | 26/03/2007 | 3.15pm | Cloudy | 3.5 | 8 | ND | ND | ND | Sandy Mud | Dark Olive | Strong H2S odour, anoxic, organic-rich |
| H17 | Hawkesbury River Sanbrook Inlet West - at Marina | 333325 | 6286538 | 26/03/2007 | 11.45am | Fine, sunny | 1.9 | 8 | ND | ND | ND | Muddy Sand | Olive-brown | |
| H18 | Hawkesbury River Sanbrook Inlet East | 335050 | 6287057 | 26/03/2007 | 11.15am | Fine, sunny | 1.3 | 8 | ND | ND | ND | Mud | Olive-brown | Trace sand |
| H21 | Cowan Creek Bobbin Head - at Marina | 329680 | 6273756 | 26/03/2007 | 6.45am | Fine | 3.0 | 8 | ND | ND | ND | Sandy Mud | Dark Olive | Some shells (bivalves) and twigs |
| H22 | Cowan Creek Apple Tree Bay | 329070 | 6274948 | 26/03/2007 | 7.15am | Fine | 8.5 | 8 | ND | ND | ND | Sandy Mud | Dark Olive | Some leaves |
| H23 | Cowan Creek east of Waratah Bay | 330467 | 6277909 | 26/03/2007 | 7.45am | Fine | 22.8 | 10 | ND | ND | ND | Mud | Dark Olive | Rugged surface |
| H24 | Cowan Creek Smiths Creek | 332950 | 6277136 | 26/03/2007 | 8.05am | Fine | 22.0 | 10 | ND | ND | ND | Mud | Dark Olive | Dark filamentous organic-rich material, burnt wood |
| H25 | Cowan Creek Akuna Bay - at Marina adjacent to slipway | 336464 | 6275822 | 26/03/2007 | 8.55am | Fine, sunny | 8.9 | 6 | ND | ND | ND | Muddy Sand | Dark Olive | Carbonate shell-rich |
| H26 | Cowan Creek Akuna Bay - at Marina refueling station | 336476 | 6276057 | 26/03/2007 | 8.45am | Fine, sunny | 12.3 | 6 | ND | ND | ND | Sandy Mud | Dark Olive | Some carbonate shells, white, flaky |
| H28 | Cowan Creek Cottage Point - adjacent to kiosk | 333713 | 6278954 | 26/03/2007 | 8.30am | Fine, sunny | 12.0 | 7 | ND | ND | ND | Muddy Sand | Olive | Worm tube holes at surface |
| H31 | Cowan Creek Refuge Bay | 337460 | 6280785 | 26/03/2007 | 9.20am | Fine, sunny | 4.5 | 10 | ND | ND | ND | Mud | Olive | Worm tubes |
| H37 | Hawkesbury River, Brooklyn Channel at Hawkesbury River marina | 335448 | 6286745 | 26/03/2007 | 10.10am | Fine, sunny | 3.6 | 7 | ND | ND | ND | Mud | Olive | Thin hydrous layer |
| H38 | Hawkesbury River south of Sandbrook Inlet (centre) | 334333 | 6286841 | 26/03/2007 | 11.30am | Sunny | 1.6 | 8 | ND | ND | ND | Mud | Olive-brown | 2-3 cm long shrimp |
| H40 | Hawkesbury River STP Site near bridge | 333123 | 6287254 | 26/03/2007 | 12.15pm | Sunny | 18.5 | 3 | ND | ND | ND | Muddy Sand | Olive-brown | Shelly/bivalves (1-3 cm diameter), armoured bed |
| H41 | Hawkesbury River STP Site | 332771 | 6287434 | 26/03/2007 | 4.15pm | Cloudy | 16.5 | 8 | ND | ND | ND | Mud | Olive | Abundant shells and bivalves |
| H42 | Hawkesbury River STP Site | 332385 | 6287518 | 26/03/2007 | 12.40pm | Sunny | 15.4 | 8 | ND | ND | ND | Muddy Sand | Olive-brown | Shells, armoured bed |
| H3 | Berowra Creek west of Berowra Point | 327629 | 6287252 | 26/03/2007 | 1.45pm | Sunny | 2.1 | 3 | ND | ND | ND | Mud | Olive | Ag sample only |
| H5 | Berowra Creek west of Bujwa Creek | 326876 | 6284021 | 26/03/2007 | 2.15pm | Sunny | 4.8 | 3 | ND | ND | ND | Mud | Olive | Ag sample only |

## Table 3. Concentrations of PAHs (in μg/kg) in Whole Sediments.

| Analyte[a] | H7 | H8 | H9 | H10 | H17 | H18 | H21 | H22 | H23 | H24 | H25 | H26 | H28 | H31 | H37 | H38 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-Methylcholanthrene | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| 2-Methylnaphthalene | 20 | 20 | 20 | 20 | 10 | 20 | 30 | 20 | 10 | 10 | <10 | <10 | <10 | 10 | 20 | 10 |
| 7.12-Dimethylbenz(a)anthracene | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Acenaphthene | <10 | <10 | <10 | <10 | <10 | 30 | 10 | <10 | <10 | <10 | <10 | 10 | <10 | <10 | 10 | <10 |
| Acenaphthylene | 10 | 20 | 30 | 20 | 20 | 60 | 60 | 40 | 20 | 10 | <10 | 20 | <10 | 10 | 50 | 30 |
| Anthracene | 10 | 20 | 20 | 20 | 20 | 70 | 60 | 40 | 20 | 10 | <10 | 60 | <10 | <10 | 60 | 30 |
| Benz(a)anthracene | 70 | 70 | 70 | 60 | 140 | 600 | 160 | 130 | 50 | 30 | 20 | 480 | 30 | 40 | 210 | 170 |
| Benzo(a)pyrene | 90 | 100 | 100 | 90 | 180 | 630 | 250 | 200 | 90 | 50 | 20 | 560 | 40 | 50 | 230 | 210 |
| Benzo(b)fluoranthene | 110 | 120 | 130 | 120 | 250 | 760 | 310 | 250 | 100 | 60 | 20 | 460 | 40 | 60 | 470 | 240 |
| Benzo(e)pyrene | 60 | 70 | 80 | 70 | 120 | 440 | 180 | 140 | 60 | 40 | 10 | 220 | 30 | 40 | 170 | 140 |
| Benzo(g.h.i)perylene | 50 | 40 | 40 | 40 | 50 | 430 | 90 | 70 | 70 | 40 | 20 | 220 | 30 | 40 | 140 | 160 |
| Benzo(k)fluoranthene | 70 | 80 | 100 | 90 | 130 | 310 | 200 | 160 | 60 | 40 | 20 | 230 | 20 | 30 | 160 | 150 |
| Chrysene | 80 | 80 | 80 | 80 | 160 | 610 | 200 | 210 | 60 | 40 | 20 | 460 | 30 | 40 | 450 | 200 |
| Coronene | <10 | <10 | <10 | <10 | <10 | 20 | 20 | 20 | 20 | 20 | <10 | 50 | <10 | 10 | 40 | 50 |
| Dibenz(a.h)anthracene | 20 | 10 | <10 | <10 | 20 | 50 | 30 | 20 | 10 | <10 | <10 | 50 | <10 | <10 | 40 | 40 |
| Fluoranthene | 130 | 140 | 160 | 140 | 280 | 1080 | 410 | 320 | 130 | 70 | 50 | 930 | 50 | 80 | 520 | 380 |
| Fluorene | <10 | <10 | <10 | <10 | <10 | 40 | 20 | 10 | <10 | <10 | <10 | 10 | <10 | <10 | 20 | 10 |
| Indeno(1.2.3.cd)pyrene | 40 | 30 | 30 | 30 | 50 | 430 | 70 | 60 | 60 | 40 | 10 | 210 | 20 | 30 | 110 | 120 |
| N-2-Fluorenyl Acetamide | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| Naphthalene[b] | 70 | <10 | 70 | 40 | 50 | 50 | 50 | <10 | 70 | 50 | 30 | 30 | 30 | 40 | 60 | 50 |
| Perylene | 60 | 60 | 60 | 40 | 90 | 150 | 60 | 60 | 40 | 30 | 10 | 100 | 30 | 40 | 120 | 90 |
| Phenanthrene | 40 | 50 | 50 | 50 | 70 | 210 | 150 | 110 | 40 | 40 | 30 | 200 | 20 | 30 | 130 | 90 |
| Pyrene | 140 | 160 | 170 | 140 | 260 | 990 | 420 | 320 | 140 | 80 | 50 | 1000 | 60 | 90 | 540 | 370 |
| Low molecular weight PAHs | 180 | 135 | 210 | 150 | 200 | 420 | 290 | 180 | 170 | 120 | 65 | 235 | 85 | 115 | 340 | 225 |
| High molecular weight PAHs | 530 | 560 | 585 | 515 | 1040 | 3960 | 1470 | 1200 | 480 | 275 | 165 | 3480 | 215 | 305 | 1990 | 1370 |
| Total PAHs | 1145 | 1150 | 1290 | 1130 | 1975 | 7040 | 2840 | 2250 | 1120 | 735 | 405 | 5365 | 525 | 720 | 3610 | 2605 |

[a] Pre-dried analytical results

[b] Initial analytical results

# Tables

## Table 4. Normalized (to 1% Total Organic Carbon) Concentrations of PAHs (in µg/kg) and TBT (in ngSn/g) in Whole Sediment and Sediment Quality Guideline Values (ANZECC/ARMCANZ (2000).

| Analyte[a] | ISQG-L (ANZECC/ ARMCANZ (2000)* | ISQG-H (ANZECC/ ARMCANZ (2000)* | H7 | H8 | H9 | H10 | H17 | H18 | H21 | H22 | H23 | H24 | H25 | H26 | H28 | H31 | H37 | H38 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-Methylcholanthrene | na | na | 1.5 | 1.2 | 1.1 | 0.9 | 1.8 | 2.0 | 0.7 | 1.0 | 1.4 | 1.3 | 2.4 | 1.2 | 2.6 | 2.2 | 1.6 | 1.9 |
| 2-Methylnaphthalene | 70 | 670 | 6.1 | 4.8 | 4.2 | 3.7 | 3.7 | 7.9 | 4.4 | 3.9 | 2.8 | 2.6 | 2.4 | 1.2 | 2.6 | 4.3 | 6.2 | 3.9 |
| 7.12-Dimethylbenz(a)anthracene | na | na | 1.5 | 1.2 | 1.1 | 0.9 | 1.8 | 2.0 | 0.7 | 1.0 | 1.4 | 1.3 | 2.4 | 1.2 | 2.6 | 2.2 | 1.6 | 1.9 |
| Acenaphthene | 16 | 500 | 1.5 | 1.2 | 1.1 | 0.9 | 1.8 | 12 | 1.5 | 1.0 | 1.4 | 1.3 | 2.4 | 2.4 | 2.6 | 2.2 | 3.1 | 1.9 |
| Acenaphthylene | 44 | 640 | 3.1 | 4.8 | 6.3 | 3.7 | 7.4 | 24 | 8.9 | 7.8 | 5.6 | 2.6 | 2.4 | 4.9 | 2.6 | 4.3 | 16 | 12 |
| Anthracene | 85 | 1100 | 3.1 | 4.8 | 4.2 | 3.7 | 7.4 | 28 | 8.9 | 7.8 | 5.6 | 2.6 | 2.4 | 15 | 2.6 | 2.2 | 19 | 12 |
| Benz(a)anthracene | 261 | 1600 | 21 | 17 | 15 | 11 | 51 | 237 | 24 | 25 | 14 | 8 | 9.4 | 117 | 15 | 17 | 65 | 66 |
| Benzo(a)pyrene | 430 | 1600 | 28 | 24 | 21 | 17 | 66 | 249 | 37 | 39 | 25 | 13 | 9.4 | 136 | 20 | 22 | 72 | 81 |
| Benzo(b)fluoranthene | na | na | 34 | 29 | 27 | 22 | 92 | 300 | 46 | 49 | 28 | 16 | 9.4 | 112 | 20 | 26 | 146 | 93 |
| Benzo(e)pyrene | na | na | 18 | 17 | 17 | 13 | 44 | 174 | 27 | 27 | 17 | 11 | 4.7 | 54 | 15 | 17 | 53 | 54 |
| Benzo(g.h.i)perylene | na | na | 15 | 10 | 8 | 7 | 18 | 170 | 13 | 14 | 19 | 11 | 9.4 | 54 | 15 | 17 | 44 | 62 |
| Benzo(k)fluoranthene | na | na | 21 | 19 | 21 | 17 | 48 | 123 | 30 | 31 | 17 | 11 | 9.4 | 56 | 10 | 13 | 50 | 58 |
| Chrysene | 384 | 2800 | 25 | 19 | 17 | 15 | 59 | 241 | 30 | 41 | 17 | 11 | 9.4 | 112 | 15 | 17 | 140 | 77 |
| Coronene | na | na | 1.5 | 1.2 | 1.1 | 0.9 | 1.8 | 7.9 | 3.0 | 3.9 | 5.6 | 5.3 | 2.4 | 12 | 2.6 | 4.3 | 12 | 19 |
| Dibenz(a.h)anthracene | 63 | 260 | 6.1 | 2.4 | 1.1 | 0.9 | 7.4 | 20 | 4.4 | 3.9 | 2.8 | 1.3 | 2.4 | 12 | 2.6 | 2.2 | 12 | 15 |
| Fluoranthene | 600 | 5100 | 40 | 34 | 34 | 26 | 103 | 427 | 61 | 62 | 36 | 18 | 24 | 226 | 26 | 35 | 162 | 147 |
| Fluorene | 19 | 540 | 1.5 | 1.2 | 1.1 | 0.9 | 1.8 | 16 | 3.0 | 1.9 | 1.4 | 1.3 | 2.4 | 2.4 | 2.6 | 2.2 | 6.2 | 3.9 |
| Indeno(1.2.3.cd)pyrene | na | na | 12 | 7.2 | 6.3 | 5.6 | 18 | 170 | 10 | 12 | 17 | 11 | 4.7 | 51 | 10 | 13 | 34 | 46 |
| N-2-Fluorenyl Acetamide | na | na | 15 | 12 | 11 | 9.3 | 18 | 20 | 7.4 | 10 | 14 | 13 | 24 | 12 | 26 | 22 | 16 | 19 |
| Naphthalene[b] | 160 | 2100 | 21 | 1.2 | 15 | 7.4 | 18 | 20 | 7.4 | 1.0 | 19 | 13 | 14 | 7.3 | 15 | 17 | 19 | 19 |
| Perylene | na | na | 18 | 14 | 13 | 7.4 | 33 | 59 | 8.9 | 12 | 11 | 7.9 | 4.7 | 24 | 15 | 17 | 37 | 35 |
| Phenanthrene | 240 | 1500 | 12 | 12 | 11 | 9.3 | 26 | 83 | 22 | 21 | 11 | 11 | 14 | 49 | 10 | 13 | 40 | 35 |
| Pyrene | 665 | 2600 | 43 | 38 | 36 | 26 | 96 | 391 | 62 | 62 | 39 | 21 | 24 | 243 | 31 | 39 | 168 | 143 |
| Low molecular weight PAHs | 552 | 3160 | 55 | 32 | 44 | 28 | 74 | 166 | 43 | 35 | 47 | 32 | 31 | 57 | 43 | 50 | 106 | 87 |
| High molecular weight PAHs | 1700 | 9600 | 163 | 135 | 124 | 95 | 382 | 1565 | 218 | 234 | 134 | 72 | 78 | 847 | 110 | 132 | 620 | 529 |
| Total PAHs | 4000 | 45000 | 351 | 276 | 273 | 209 | 726 | 2783 | 421 | 439 | 312 | 193 | 191 | 1305 | 268 | 312 | 1125 | 1006 |
| TBT (ngSn/g) | 5 | 70 | 0.5 | 1.3 | 1.2 | 1.2 | 1.3 | 0.6 | **18.5** | 2.0 | 0.5 | 0.5 | **10.8** | **27.7** | **21.2** | 0.6 | 3.2 | 1.7 |
| TOC content (%) | - | - | 3.26 | 4.16 | 4.73 | 5.4 | 2.72 | 2.53 | 6.75 | 5.13 | 3.59 | 3.8 | 2.12 | 4.11 | 1.96 | 2.31 | 3.21 | 2.59 |

[a] Pre-dried analytical results

[b] Initial analytical results

na - not available

*Normalized to 1% total organic carbon.

**Exceedence of ISQG-L**

Note: Concentrations in this Table are normalized to 1% total organic carbon as required by ANZECC/ARMCANZ (2000)

# Tables

## Table 5. Concentrations of Tributyltin (TBT) in Sediments Worldwide

| Location | Country | TBT Concentration Range (ngSn/g) | Authors |
|---|---|---|---|
| Ross Sea | Antarctica | 28 - 2,110 | Negri et al. (2004) |
| Coastal area | Thailand | 4 - 4,500 | Kan-Atireklap et al. (1997) |
| Marinas and shipyards | Hong Kong | <10 - 53,000 | Ko et al. (1995) |
| Auckland shipyards | New Zealand | <2 - 1,360 | de Mora et al. (1995) |
| North and Baltic Sea marinas | Germany | 570 - 17,000 | Biselli et al. (2000) |
| Arcachon Bay | France | 1 - 650 | Sarradin et al. (1994) |
| East Coast estuaries | United Kingdom | <3 - 3,935 | Dowson et al. (1992) |
| Coastal area | Bahrain | 128 - 1,930 | Hasan and Juma (1992) |
| Coastal area | Mediterranean Sea | 30 - 1,375 | Gabrielides et al. (1990) |
| Port Curtis, Queensland | Australia | 25 - 655 | Jones et al. (2005) |
| Hawkesbury River | Australia | 0.1 - 9.6 | EPA (1996) |
| Hawkesbury River Marina at Brooklyn | Australia | 5 - 37 | Patterson Britton (2001) |
| Hawkesbury River | Australia | 1.4 - 125 | URS (2007) |
| Trigger value (low)[a] | | 5 | ANZECC/ARMCANZ (2000) |
| Trigger value (high)[a] | | 70 | ANZECC/ARMCANZ (2000) |

[a] Sediment quality guideline trigger values (ANZECC/ARMCANZ, 2000). Note: Concentrations of TBT are usually normalized to 1% Total Organic Carbon.

# Tables

## Table 6. General Information on Organic Booster Biocides

**GENERAL INFORMATION**

| Antifouling biocide (common name) | Chemical group | systematic name | Approved in Australia | No. antifouling products registered in Aust. | First registered in antifouling product(s) | Other uses in Australia |
|---|---|---|---|---|---|---|
| Diuron | urea herbicide | dichlorophenyl dimethylurea | Yes | 23 | | herbicide, algalcide (~87 products) |
| Irgarol 1051 (Kathon 5287) | s-triazine herbicide | 2-methylthio-4-t-butylamino-6-cyclopropylamino-s-triazine | No | | | |
| Sea-nine 211 | isothiazolone | 4,5-dichloro-2-n-octyl-4-isothiazolin-3-one | No | | | |
| Dichlofluanid | | N-dimethyl-N-phenylsulfamide | Yes | 1 | 2005 | wood preservative |
| Chlorothalonil | | 2,4,5,6-tetrachloroiso-phthalonitrile | Yes | 1 | 2006 | fungicide (~41 products) |
| Zinc pyrithione (ZPT) | pyrithione complex | zinc 2-pyridinethiol-1-oxide | Yes | 5 | 2002 to 2006 | parasiticide (4 products) |
| TCMS pyridine | | 2,3,5,6-tetrachloro-4-(methylsulfonyl)pyridine | No | | | |
| TCMTB | | 2-(thiocyanomethylthio) benzothiazole | No | | | |
| Zineb | dithiocarbamate | zinc ethylene bisdithiocarbamate | Yes | 1 | 1997 | fungicide (~3 products) |
| Thiram | dithiocarbamate | bis(dimethylthiocarbamoyl)disulfide | Yes | 5 | 2002 to 2003 | fungicide (~22 products) |

**PHYSICOCHEMICAL BEHAVIOUR**

| Antifouling biocide (common name) | Half-life (in sea water) | Water solubility (mg/L) | Sediment-water partition coefficient L/kg (log Kd) | Octanol-water partition coefficient (log Kow) | General description of behaviour |
|---|---|---|---|---|---|
| Diuron | ~14 to 35 days | 35 | 8.9 ± 13.4 | 2.8 | Relatively persistent in seawater, only weakly sorbed to sediments |
| Irgarol 1051 | ~100 days | 7 | 3.4 | 3.95 | Considered to be non or slowly biodegradable/ persistent in the environment |
| Sea-nine 211 | <24 hrs | | 625 | 2.8 | Degrades rapidly, binds strongly to sediment |
| Dichlofluanid | 53 hours | <2 | | 3.7 | Degrades rapidly, binds very strongly to sediment |
| Chlorothalonil | ~ 2 to 8 days | 0.9 | | 2.88 | Degrades rapidly, degradant is persistent and ecotoxic |
| Zinc pyrithione | <24 hrs | | | 0.97 | Degrades rapidly, binds strongly to sediment |
| TCMS pyridine | | | | | |
| TCMTB | ~30 days | 10.4 | | | |
| Zineb | 4 days | 0.07-10 | | 1.31 | Not readily biodegradable, considered persistent, binds strongly to sediment |
| Thiram | | 30 | | 1.73 | Not readily biodegradable, considered persistent |

Note: All booster biocides can accumulate in sediments if introduced as paint particles

Source: Amog Consulting (2002) and references therein.

# Tables

**Table 7. Concentrations of Tributyltin (TBT) and Diuron in Sediments at Sampling Locations H9, H31, H37, and H38.**

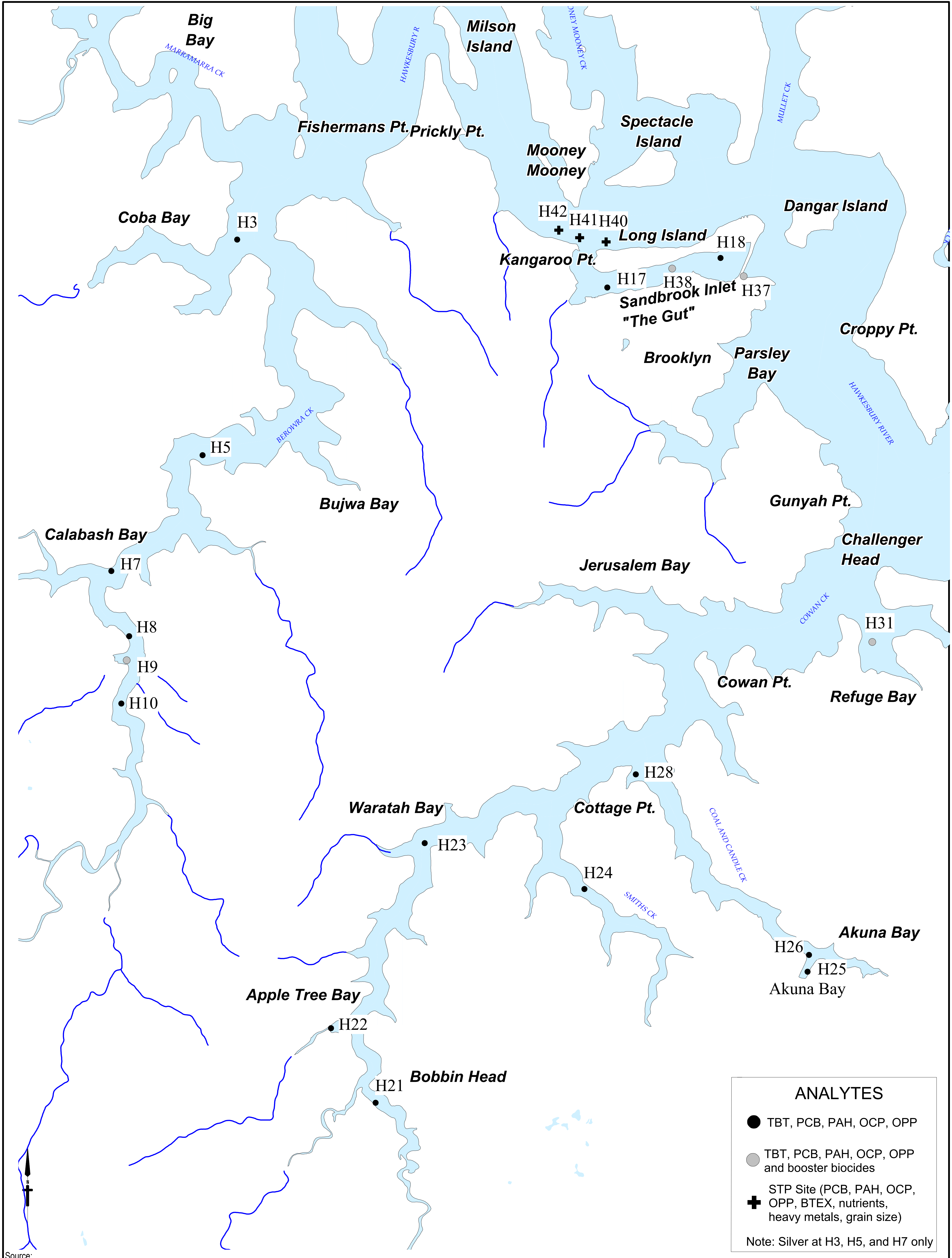
| Sampling Location | TBT | Diuron |
|---|---|---|
| H9 | 14 | 30 |
| H31* | 3 | <1 |
| H37 | 25 | 9 |
| H38 | 11 | 10 |
| QC5 (H9) | 20 | 40 |

Concentrations in µg/kg

Note: TBT-Sn concentrations were converted to TBT (the compound). Molecular weight of TBT = 2.44 x TBT-Sn.

# Figures

Figure 1. Sampling Locations.



Client
Hornsby Shire Council

Project
ANTIFOUL STUDY (STAGE 2)

Title
**Sampling Locations**

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Approved: DRAFT
Date: 22-05-07
Job No: **43217595**
File No: Figure 1 Sampling Locations.wor
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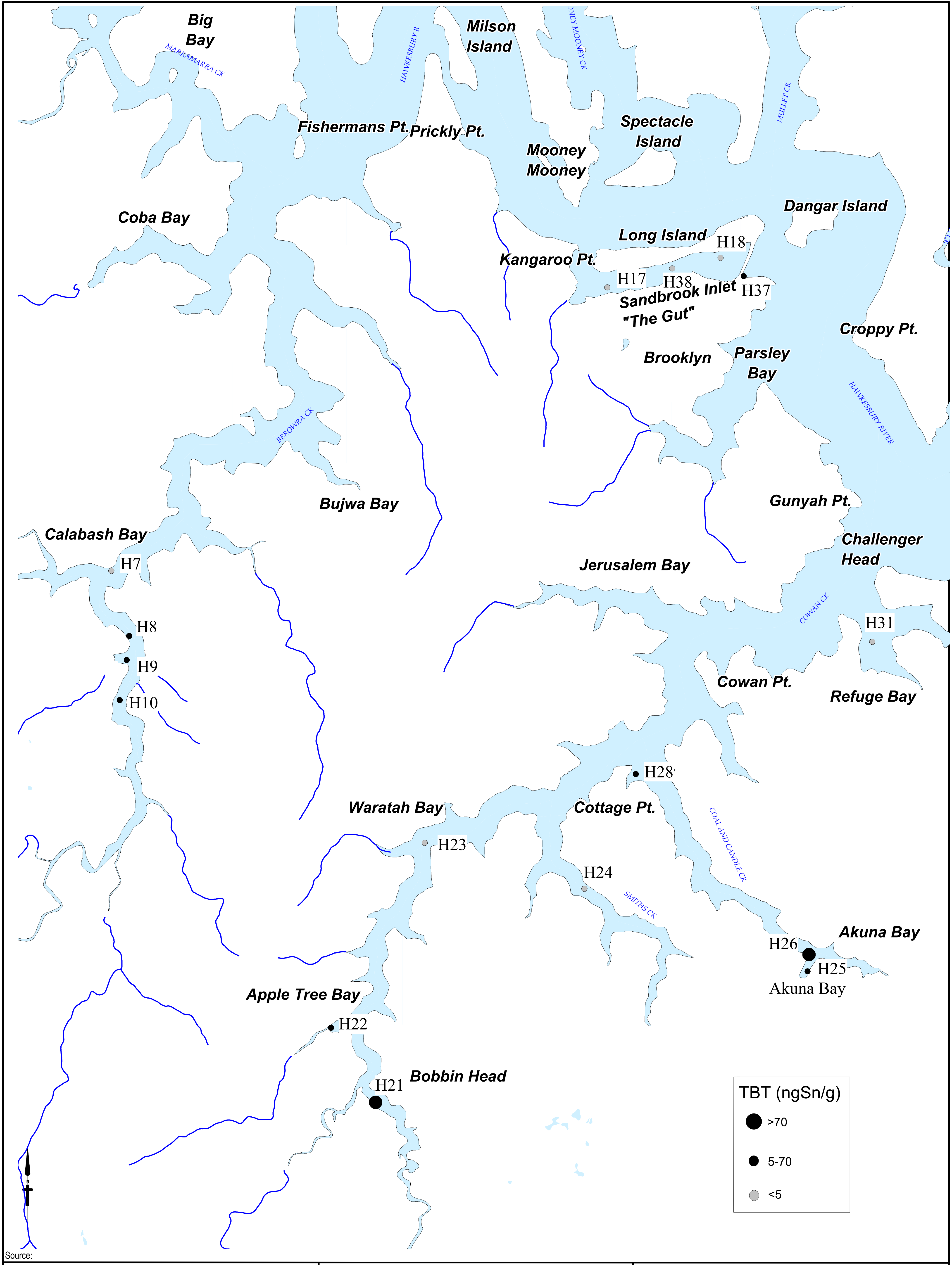
Rev: A
**A4**

# Figures

Figure 2. Concentrations of TBT in Sediments.



Source:

Client

Hornsby Shire Council

URS

Project

ANTIFOUL STUDY (STAGE 2)

Drawn: CM
Approved: DRAFT
Date: 22-05-07
Job No: **43217595**
File No: Figure 2 TBT.wor

Title

**TBT in Sediments**

Figure: 2

Rev: A

**A4**

# Figures

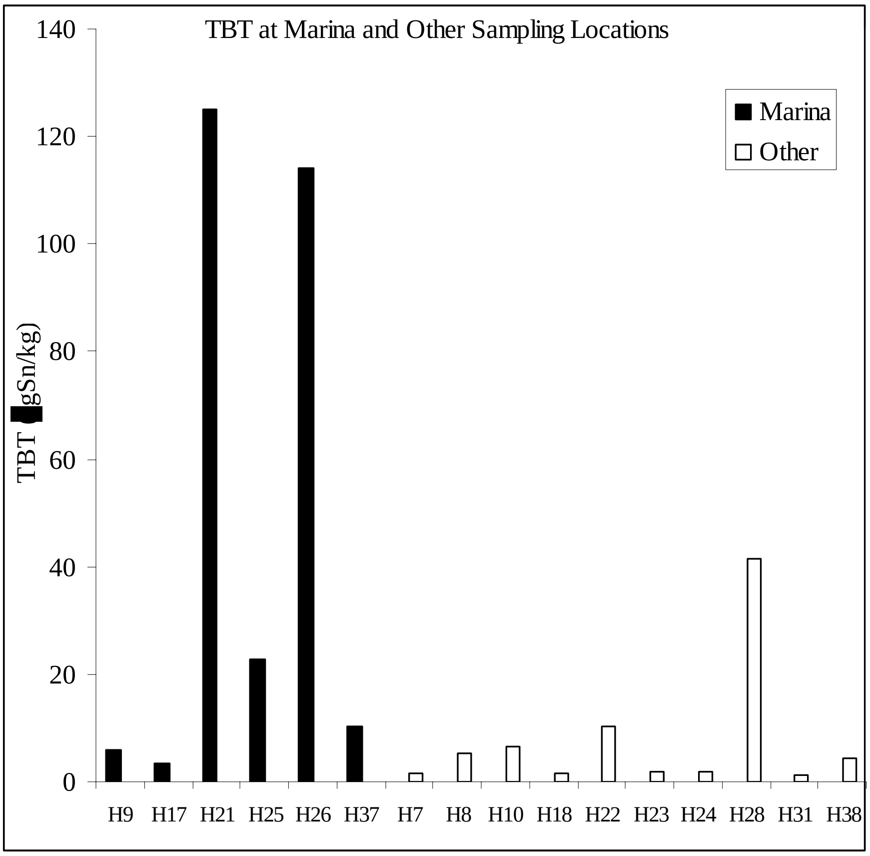


Figure 3. Concentrations of TBT in 16 Sediment Samples from Marinas and Other Sampling Locations.

# Figures

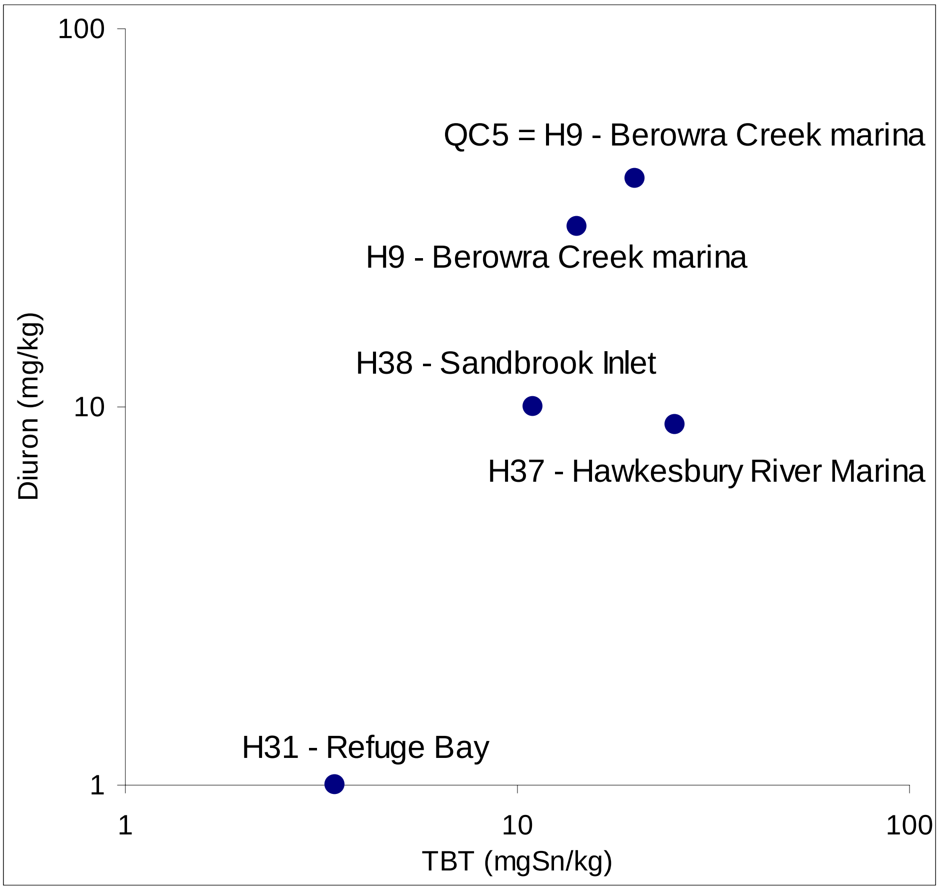


Figure 4. Concentrations of Tributyltin (TBT) and Diuron in Sediments at Sampling Locations H9, H31, H37, and H38. Note: TBT-Sn concentrations were converted to TBT (the compound). Molecular weight of TBT = 2.44 x TBT-Sn.

Appendix A – Sediment Study (Stage 1) Final Report

# Appendices

Appendix B – Sediment Study (Stage 1) – Sampling and Analysis Plan

# SAMPLING AND ANALYSIS PLAN

# Sediment and Antifoul Monitoring Program – Stage 1 Sediment Study

*Prepared for*

**Hornsby Shire Council**

22 November 2006

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Date: **22 November 2006**
Reference: Stage 1 Sediment Study SAP Final 22-11-06.doc
Status: Final

# Contents

# List of Tables and Figures

## Tables

## Figure

## 1.1 Background

To foster better management of estuaries, the New South Wales (NSW) Government formulated an Estuary Management Policy that advocates the integrated, balanced, responsible and ecologically sustainable use of the State's estuaries. The Estuary Management Policy is defined in the Estuary Management Manual (NSW Government, 1992) and outlines a structured management process leading to the implementation of Estuary Management Plans for estuaries in NSW. Estuary Management Plans encompass all values and uses of the estuary, along with the principles of ecologically sustainable development and total catchment management.

The Estuary Management Manual recommends an eight step process to prepare and implement an Estuary Management Plan, as follows:

1) Form an estuary management committee;

2) Assemble existing data (data compilation study);

3) Undertake estuary processes study;

4) Undertake estuary management study;

5) Prepare draft estuary management plan;

6) Public review of draft plan;

7) Adopt and implement estuary management plan; and

8) Monitor and review the management process as necessary.

In compliance with step seven, the Berowra Creek Estuary Management Plan was implemented in 2000. The Brooklyn Estuary Management Plan is due for completion in 2006. The need to establish a Sediment Study (Stage 1) and Antifoul Study (Stage 2), to establish the level of anthropogenic contamination within the estuaries of Hornsby Shire, was identified in the Berowra Creek Estuary Process Study (Coastal and Marine Geosciences, 1998), Brooklyn Estuary Process Study (University of New South Wales, 2002) and the Berowra Creek and Brooklyn Estuary Management Plans.

## 1.2 Scope of Sampling and Analysis Plan

This Sampling and Analysis Plan (SAP) presents specific quality assurance and quality control (QA/QC) details to be employed during the investigation and it covers the following aspects of the investigation:

- Scope of work;
- Rationale for selection of sampling locations;
- Brief description of sampling locations;

- Identify contaminants of potential concern (COPC);
- Project organisation and responsibilities;
- Field methods and procedures including:
  - Occupational health and safety (OH&S) procedures
  - Contingency plan;
  - Sediment sampling equipment;
  - Sample location;
  - Equipment decontamination; and
  - Field documentation.
- Laboratory analytical program including:
  - NATA-accredited Laboratory to be used;
  - Analytical testing program, including detection limits (LORs);
  - Sample handling, preservation and storage;
  - Analytical QA/QC and data validation; and
  - Data management procedures.

## 1.3 Objectives

The sediment sampling will augment the previous geochemical sediment sampling program conducted during the Berowra Creek Estuary process Study (1998) and the Brooklyn Estuary Process Study (2002). The Stage 1 Sediment Study has the following objectives:

1) Determine the location and magnitude of contaminated sediments within the study area;

2) Compare current levels of sediment contamination with levels established in previous studies to identify possible areas of accumulation (identify sinks);

3) Identify sources of contaminants present in sediments;

4) Determine trends in contamination of sediments;

5) Assess potential anthropogenic impacts on sediment quality;

6) Establish a set of baseline (‘before’) sediment quality data prior to the commencement of discharge from the Brooklyn and Dangar Island Sewerage Scheme outfall; and

7) Provide recommendations for remedial management actions based on the above objectives.

## 2.1 Previous Sediment Studies

The Hawkesbury River has been studied for the presence of anthropogenic trace metal contaminants for over 20 years. Early work included the determination of the speciation of iron, copper and zinc in waters of the Hawkesbury River by Pik et al. (1982) and the assessment of heavy metal enrichment in the surface microlayer of the Hawkesbury-Nepean River system (Barnes et al., 1982). Markich and Brown (1998) conducted a survey of trace metal concentrations in the freshwater reaches of the Hawkesbury River, the first such survey of a permanent coastal river in Australia using ‘clean’ sampling and handling techniques. That study established that concentrations of nutrients, organic carbon and trace metals in the Hawkesbury River increased as a consequence of anthropogenic inputs, particularly point discharges from sewage treatment plants (STPs) as well as diffuse urban and agricultural runoff during storm events. Markich and Brown (1998) established that the temporal variability of the mean concentrations of trace metals is related to the variability in water discharge, with an increase in the concentrations of trace metals by a factor of up to 2 with increasing water discharge, thereby supporting the presence of the effects of anthropogenic point and diffuse source contributions during high flow events.

However, anthropogenic contaminants in surface waters of the Hawkesbury River are highly variable and transient in nature. In contrast, studies of sediments, which represent a sink for anthropogenic contaminants in aquatic systems, may establish a time-integrated signature of anthropogenic contributions in an aquatic environment. The study of anthropogenic heavy metal contaminants in sediments in the Hawkesbury River has only been conducted since the mid-1990s and the majority of contaminant investigations of sediments in the Hawkesbury River estuary have been conducted by the Environmental Geology Group (EGG) at the University of Sydney, lead by Professor Gavin Birch, although other studies were conducted as well (i.e. Parker, 1992; Shotter, 1994; Hardiman and Pearson, 1995; O’Donnell, 1995; Hayes and Buckney, 1998; Birch et al., 1998; Simonovski et al., 2003).

Birch et al. (1998) established that the concentrations of heavy metals in bed sediments of the Hawkesbury River are low and close to background, but are substantially elevated in the headwaters of Berowra Creek, Cowan Creek and in southeast Pittwater. In addition, high levels of contamination of sediments have been found in the upper and lower sections of the river adjacent to the Hornsby STP and the Calna Creek STP. Simonowski et al. (2003) reported that sediments in the upper Hawkesbury-Nepean River are not heavily polluted by heavy metals, although elevated concentrations of heavy metals were found in sediments near industrialized areas and sewage treatment plants. Other previous sediment studies of sediments in the Hawkesbury River estuary include Bourgues et al. (1998) (nutrients), Mann et al. (1996) (nutrients and algal blooms), Coastal & Marine Geosciences (1998) (nutrients and heavy metals) and University of New South Wales (2002).

The Berowra Creek Estuary Process Study Technical Report: Sediment Characteristics and Processes (Coastal and Marine Geosciences, 1998), completed as a component of the Berowra Creek Estuary Process Study, identified surface sediments in Berowra Creek estuary enriched in nutrients (TKN, TP) and heavy metals (Cu, Pb, Zn, Cr and As). A recommendation of the study was further investigation of sediment texture/composition and contamination relationships.

The Brooklyn Estuary Processes Study (UNSW, 2002) identified that data quality and coverage of previous studies was insufficient to adequately describe the degree of sediment contamination in the Brooklyn estuary study area. A recommendation of this report was to establish a detailed sampling program to analyse and interpret sediment contamination in the area.

## 2.2 Characterisation of Study Area and Catchment

The Hawkesbury River system has a diverse range of uses and is a highly valued ecological, social and economic resource. Pressures on the environment have increased with growing populations and changes in land use patterns, resulting in an overall decline in the health of the river and its tributaries. The estuaries within Hornsby Shire are part of the larger Hawkesbury River system which is a popular location for both recreational and commercial boat users.

The Stage 1 Sediment Study will be conducted in a section of the Lower Hawkesbury River within the Hornsby Shire Local Government Area. The study area is identified as the primary waterways within Hornsby Shire, which include the Hawkesbury River, Berowra Creek and Cowan Creek. The study area covers the Hawkesbury River channel and associated tidal water bodies from the upstream limit of Wisemans Ferry to the downstream limit of Walker Point and Flint and Steel Point (including Berowra Creek and Marramarra Creek). Mooney Mooney and Mullet Creeks on the northern side of the river are excluded from this study with the exception of one sample location in each of these two creeks, respectively, to allow for the resampling of Sites 1 and 3 of the Brooklyn Estuary Process Study (UNSW 2002). Therefore the study area incorporates the two study areas as defined in the Berowra Creek and Brooklyn Estuary Process Studies with adjustments to exclude Mooney Mooney and Mullet Creeks and include the connecting water body of the main Hawkesbury River from Wisemans Ferry to Walker Point and Flint and Steel Point.

The Berowra Creek estuary catchment covers an area of approximately 310 km$^2$ consisting primarily of natural bushland with urban and semi-rural developments along the ridges of the upper catchment area. Due to the topography of the catchment there is limited development directly adjacent to the waterway. A number of small river settlements exist along the foreshores of the estuary and are generally only accessible by boat. The estuary extends for over 23 km in a southerly direction from the Hawkesbury River to the tidal limit at Rocky Fall Rapids.

The Brooklyn estuary catchment covers an area of approximately 185 km$^2$. The majority of the catchment is steep bushland lying within the National Park boundaries of Kuring-gai Chase National Park on the southern shore and Brisbane Water National Park on the northern shore. The most densely populated areas on the Brooklyn estuary are the settlements at Brooklyn, Dangar Island and on the banks of Mooney Mooney Creek. A new development affecting the Brooklyn estuary is the construction of the Sydney Water Corporation’s Brooklyn and Dangar Island Sewerage Scheme. It is estimated that residents will begin decommissioning current on-site sewerage management systems and connecting to the new system from September 2007. The STP outfall will be located on the second foundation pier from the southern bank of the Peats Ferry road bridge and is estimated to discharge approximately 0.71 MLd$^{-1}$ of treated effluent into the Lower Hawkesbury River.

There are a number of estuary based industries in the area including tourism, recreation and commercial boating and fishing, oyster and prawn leases. Recreational and commercial boating and fishing are one of the primary uses of these waterways and the escalating popularity of these activities and their impact on the surrounding environment is an issue of concern. Oyster leases within the estuary have recently suffered a decline since the introduction of QX disease in the Hawkesbury.

## 2.3 Sediment Study (Stage 1) - Scope of Work

The current investigation includes the following:

- Determine the distribution of sediment contamination within the study area;
- Compare current levels of sediment contamination with levels established in previous studies to identify possible areas of contaminant accumulation;
- Assess the bioavailability of contaminants present in the sediments;
- Identify major potential sources of contamination;
- Assess potential anthropogenic impacts on sediment quality;
- Establish a set of baseline (‘before’) sediment quality data prior to the commencement of discharge from the Brooklyn and Dangar Island Sewerage Scheme outfall; and
- Provide recommendations for management actions based on the above objectives.

The assessment of historical inputs of anthropogenic contaminants to the Hawkesbury River System sediments and an evaluation of data from previous investigations, in particular from the Brooklyn Estuary Process Study (2002) and the Berowra Creek Estuary Process Study (1998), has demonstrated that surficial sediments in the Lower Hawkesbury River System displayed anthropogenic enrichments of some inorganic and organic contaminants and that sediments at some locations exceeded the ANZECC/ARMCANZ (2000) sediment quality guideline values.

Fifty-five proposed locations were selected for the sampling of surficial sediments. One homogenised sample will be collected of the upper 0.1 m of sediment at each sampling location. Samples will be homogenized using stainless steel utensils and a stainless steel bowl and analysed for CoPC.

Topic-related literature was evaluated to support the sampling rationale. The proposed sampling locations were selected based on the review of the following studies: Berowra Creek Estuary Process Study (Coastal & Marine Geosciences, 1998), Brooklyn Estuary Process Study (University of New South Wales, 2002), Bourgues et al. (1998), Mann et al. (1996), Birch et al. (1998), EPA (1996), Taylor (2000) and Simonovski et al. (2003).

The proposed 55 sampling locations include the 20 locations that were sampled during the Berowra Creek Estuary Process Study (1998) (13 Locations: VCBC1 to VCBC11, MCAH1 and MCAC2; Note: Sampling Location MCAH2 in Marramarra Creek is proposed to be moved to the mouth of Marramarra

Creek east of Kulkah Creek) and the Brooklyn Estuary Process Study (2002) (7 Locations: Site 1, Site 3 and Sites 5 to 9; Note: Site 1 and Site 3 are located in Mooney Mooney Creek and Mullet Creek, respectively, and are outside the current study area and are therefore included as single resampling locations only without considering additional sampling locations in these two creeks. The resampling of sediments at 19 of the 20 sampling locations allows a comparison with previous data, enhance the robustness of the overall data to increases in spatial variability and provide a dataset that is relatively robust. The 35 proposed new sampling locations were selected using existing information about known point sources of contamination and previously identified sediment contamination data, including the database from the Environmental Geology Group at the University of Sydney, which comprises contaminant data for more than 7,000 sample locations in estuaries in the Sydney metropolitan area and surrounding regions, as well as considering a balanced regional distribution of sampling locations in the Lower Hawkesbury River estuary.

Sampling will be conducted from a small motorized boat provided by Hornsby Shire Council over a period of two days from 13 to 14 December 2006, weather permitting. The date and time of sampling, water depth, latitude and longitude and a description of the sediment type will be recorded in the field.

The regional sediment geochemical data will be displayed spatially on a GIS system (Mapinfo$^{TM}$) and the data will be screened against ANZECC/ARMCANZ (2000) sediment quality guideline values. An assessment of contaminant sources will be performed by utilizing elemental normalization with Al or other analytes of lithogenic (i.e. non-anthropogenic) origin (e.g. Sr, Co). An assessment of background concentrations based on available data for the Hawkesbury River and other estuarine sediments in the Sydney area (Taylor, 2000) will enable the estimation of enrichments above pre-anthropogenic background for the various analytes (except nutrients).

An assessment of potential sources of Cu-based antifouling agents will be performed using an assessment of the Cu/Zn concentration ratios in the surficial sediments as a “TBT-proxy” indicator. This approach has been used successfully by Taylor (2000) to assess anthropogenic contributions of contaminants from marinas and areas of increased boating activities in the waterways of Port Jackson and in the Hawkesbury River.

## 2.4 Contaminants of Potential Concern

Sediment samples collected during the Sediment Study (Stage 1) sampling will be analysed for the following:

- TKN, TOC, NOX;
- Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd;
- Polychlorinated Biphenyls;
- Polycyclic Aromatic Hydrocarbons;
- Organochlorines;

- Organophosphates;

Grainsize in four fractions (0.063 mm; 0.063 mm-0.25 mm; 0.25 mm-2 mm; >2 mm) will be determined.

Organic compounds will be analysed for standard limits of reporting and not ultratrace levels.

Additional analytes (not included in the required scope of works) include total petroleum hydrocarbons (TPH) ($C_6$-$C_{36}$) and BTEX, which will be analysed in all primary and QA/QC sediment samples without additional costs to the project budget.

# Project Organisation and Responsibilities

The project organisation identifies the reporting structure and responsibilities of individuals involved in the project. The roles of responsible individuals under this SAP are described below:

## 3.1 Project Director – Stuart Taylor

The Project Director has the overall responsibility for the project. The Project Director monitors the project work and provides supervision and support to the Project Manager (defined below). Specific responsibilities of the Project Director include:

- Ensure that contracting and risk mitigation requirements are met, that the work is conducted in accordance with the terms of the contract, and that contractual changes are formally approved;
- Ensure that the Project Manager and staff are technically and professionally qualified, have adequate relevant experience, and represent sufficient resources to meet project objectives;
- Review project work and deliverables at least at designated project milestones;
- Ensure that appropriate peer reviews are conducted;
- Ensure that project files are established and that staff orientations are conducted;
- Ensure that project deliverables are provided on time and within budget; and
- Establish and maintain communications with the client project manager and assure that the objectives of the project, as prescribed by the contract terms, are met to Hornsby Shire Council's satisfaction.

## 3.2 Project Manager – Carsten Matthai

The Project Manager reports to the Project Director and has primary responsibility for all aspects of the project including meeting the needs of Hornsby Shire Council. Specifically, responsibilities include the quality of the work product, schedule and budget control, asset management, and communications with staff and superiors. Specific duties of the Project Manager include:

- Implement contracting and risk mitigation requirements and determine if the services rendered are consistent with the terms of the contract;
- Determine that all contractual terms, including changes in scope, schedule and budget are formally agreed to by authorised representatives of Hornsby Shire Council and that such agreements are documented in writing;
- Determine, in consultation with the Project Director, that qualified staff are assigned to the project and represent sufficient resources to meet project objectives;

- Conduct the project so that deliverables are of professional quality and formally reviewed at predetermined times by qualified staff. Reviewers may include project consultants, the Project Director and the Peer Reviewer (Dr Stuart Simpson, CSIRO);
- Expedite the work of Peer Reviewers involved in the project by formally communicating peer review schedules and providing the information required for peer reviews in a timely fashion;
- Establish and maintain project files; maintain written documentation of relevant contractual, financial and administrative transactions, work plan conformance, quality assurance conformance, deliverables submitted and other relevant technical and managerial data. Close the files upon completion of the project or of major project phases;
- Monitor schedules and budgets; provide notification to Hornsby Shire Council of requirements for budget or schedule adjustments before overruns have occurred and document justification for such changes;
- Maintain close communications with and be readily available to Hornsby Shire Council's representative to periodically assure that Hornsby Shire Council's objectives are being satisfactorily met within the terms of the contract;
- Review, in a timely manner, all invoices to verify charges and their conformance with contractual terms; communicate with Hornsby Shire Council concerning inquiries about invoices and interact with Accounting to facilitate collections; and
- Present deliverables and, subsequently, contact Hornsby Shire Council's representative to verify his/her understanding and ascertain his/her assessment of the work.

## 4.1 Introduction

This section of the SAP details the procedures to be used as part of the geochemical investigation of the sediments in the Lower Hawkesbury River estuary. By defining the procedures to be used, it is possible to develop a uniform approach to the Stage 1 Sediment Study and the subsequent Antifoul Study (Stage 2) investigations and thereby, minimise potential impacts on the quality and representativeness of data collected.

## 4.2 Sampling Site Location

The scope of works for the Stage 1 Sediment Study investigation comprises the collection and analysis of sediment grab samples to a maximum sediment depth of 0.1 m depth at 55 locations (Sample Locations H1 to H55) in the study area (Figure 1). Sampling will be undertaken from a small motorized vessel provided by Hornsby Shire Council. Samples will be located with a GPS positioning accuracy of +/-5 m. The GPS unit will be provided by Hornsby Shire Council. The location and collection of samples in the field will be the responsibility of the URS field team comprising Dr Carsten Matthai and two Hornsby Shire Council staff (names to be provided).

## 4.3 Sampling Contingency Plans

The sampling will be undertaken in the channels, creeks and embayments of the Lower Hawkesbury River, which is relatively protected during storms. However, in the case of adverse weather which may present an OH&S risk to field staff, sampling would be discontinued and rescheduled. It is likely that the sampling program will be completed over a period of two consecutive days, weather permitting.

## 4.4 Sediment Subsampling

Samples H1 to H55 will be analysed to enable classification of the contaminant status of the sediments. Samples will be collected to a depth of up to 0.1 m at each sampling location, as detailed in Table 1.

Grab samples collected during the Stage 1 Sediment Study investigation will be collected with a stainless steel tall Ekman grab sampler (dimensions: 0.15 m x 0.15 m x 0.225 m) wherever possible. A Ponar grab sampler may be required to sample sandy sediments at some sampling locations. Sample management procedures on the sampling vessel include the careful collection of the sediment samples from the grab sampler, following the recovery of the sediment from the estuary floor. Essentially, all sample handling and processing will be performed to minimize contamination and sample mix-ups. The workspace on the boat will be washed down with ambient seawater to clean all surfaces and minimize dust contamination of samples. Nitrile gloves will be worn by the sampling personnel.

Subsampling will be performed using a stainless steel sampling spoon. The sampler, who is wearing nitrile gloves, will maintain utmost care in ensuring that no cross-contamination between samples is possible. Samples collected from each interval will be homogenised in a stainless steel bowl and then placed into appropriately cleaned and preserved containers provided by the laboratories (glass sampling containers with Teflon-lined lids and a plastic bag for grain size analysis). Sample containers will be filled with zero headspace and labelled immediately. Samples will then be stored in eskies on ice. All eskies will be filled to capacity and sealed with adhesive tape. A CoC form will be included in the esky. Following return to shore, the samples will be delivered to the laboratory within 48 hours of sampling for processing and analysis.

## 4.5 Sediment Analyses and Analytical Detection Limits

Whole sediment samples from locations outlined in Table 1 will be submitted to an independent NATA accredited laboratory, ALS Environmental, for analysis of the COPCs listed in Section 2.5. Samples for PAHs, OCPs, OPPs and PCBs will be analysed for standard limits of reporting and not ultratrace levels. All analytical methods are NATA accredited for all of the tests, except for particle size distribution.

## 5.1 Documentation of Field Activities

### 5.1.1 General Field Activities Documentation

Bound field logbooks will provide the means for recording most field activity records and observations. The aim of the documentation within the field logbooks is to allow future reconstruction of field activities without relying on the memory of field team members. To supplement the information and data collected during sample collection and field testing, field data sheets may also be completed.

Items that will be recorded into the field logbook include:

- Sample collection method; and
- Health and safety documentation.

Field documentation will include, at a minimum, the following information as is applicable to the specific task at hand:

- Project name and number;
- Date, time, weather conditions;
- Personnel present;
- Type of sample;
- Sampling method;
- Sampling location description, ID and time of collection;
- Sample depth;
- Visual descriptions;
- Sample container type;
- Photograph number (where applicable); and
- Other information and observations.

The field logbook and the field data sheets will compile the field data collected during the investigation.

### 5.1.2 Sampling Containers

Containers for samples are cleaned and prepared by the laboratory. Glass jars for chemical analyses and plastic bags for grain size analyses will be provided by the analytical laboratory.

### 5.1.3 Sample Labelling

Each sample container will be clearly labelled and marked with ink in the field. Samples collected from each sampling location will have unique sample numbers.

Sample labels will include the following information:

- Sampling date;
- Sample point number/designation; and
- Comments, as required.

### 5.1.4 Chain of Custody Protocols

A chain of custody (CoC) record will be utilised by field personnel to document possession of all samples collected for chemical analysis. The CoC record may include, but is not limited to, the following information:

- Project name and number;
- Name(s) of sampler(s);
- Sample type, identification number and location;
- Date and time of collection;
- Number and type of containers;
- Required analyses;
- Preservatives; and
- Signatures documenting change of sample custody.

The esky containing the samples will be sealed with tape and secured with a signed custody seal. The custody seal will provide an indication of whether the cooler was opened by unauthorised personnel. The temperature that the samples were stored at following transit to the lab and upon receipt is noted on the CoC forms.

The original CoC record will accompany the samples to the analytical laboratory. A copy of the CoC record will be placed in the appropriate project file. Samples will be delivered to the laboratory within 48 hours of sample collection to ensure the specified holding times are met.

### 5.1.5 Decontamination

All sampling equipment and measurement equipment will be decontaminated before and after each use. In general, the principal decontamination objective is the decontamination of all equipment prior to arriving on-site, including the removal of encrusted materials by scraping and ambient seawater rinse.

## 5.2 Field QA/QC Samples

Field duplicate QA/QC samples will be collected for at least 10% of primary samples collected (i.e. six samples). Field duplicates, labelled QC1 to QC4, are samples that are prepared in the field by splitting a field sample, then submitting it to the laboratory as two independent samples. Field duplicates are used to measure the precision of the whole sampling and analysis process (sample collection, sample preparation and sample analysis). Significant variation in field duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity. Field duplicates will be analysed for all analytes listed in Section 2.5.

## 5.3 Surveying

The sampling locations will be located using a global positioning system (GPS), provided by Hornsby Shire Council with an estimated accuracy of +/-5m.

## 6.1 Laboratory Analysis Program

Only commercial analytical laboratories that are accredited with the National Association of Testing Authorities (NATA) for the project specific analyses, which have been independently audited and approved by URS environmental chemists, will be used for the project. All analytical procedures performed by the laboratory (ALS) are NATA-accredited.

The objective of this SAP is to describe the methods and procedures that will be used by the selected laboratories to ensure quality, accuracy, precision and completeness of the analytical data generated as part of this investigation. The primary focus is to acquire environmental data that are scientifically sound, legally defensible and of acceptable quality.

## 6.2 Analytical Testing Program

The following sections provide descriptions of the analytical methodologies that will be used for the duration of this project. All United States Environmental Protection Agency (USEPA) methods referred to are from “Test Methods for Evaluating Solid Waste (SW-846)”, Revision A, July 1992, US EPA.

## 6.3 Sample Handling, Preservation and Storage

This section outlines the general procedures necessary for sample custody that are to be performed by the laboratory. It is understood that the laboratory will act in full accordance with the terms of its NATA Registration for Chemical Testing.

### 6.3.1 Laboratory Receipt of Samples

Field samples for this project will be delivered to the laboratory pre-contained and pre-preserved (as appropriate) in accordance with laboratory procedures. Sample containers used for the collection of field samples are, wherever possible, to be supplied by the relevant analytical laboratory, pre-cleaned and inspected. Accompanying each delivery of samples will be a Chain of Custody (CoC) Record.

The following items are checked and performed by the laboratory upon receipt of samples with the CoC:

- The custody seals and tape on the cooler are unbroken and uncut;
- The signature on the external custody seal matches one of the sampler(s) signature(s) on the internal CoC;
- Measurement is taken to determine if samples have arrived at the appropriate temperature;
- The sample containers within the cooler are intact;
- The identification on the sample containers correspond to the entries on the CoC;

- The number of sample containers received is equal to the number of samples listed on the CoC;
- If sample custody is valid, the samples are logged in by the laboratory as per the standard operating procedure;
- A copy of the CoC is delivered to the Project Manager within three working days.

If CoC discrepancies exist, appropriate notes (signed and dated) are made on the CoC and the Project Manager is notified by the laboratory. In the event that the laboratory Sample Custodian judges the sample custody (or part thereof) to be invalid (e.g. samples arrive damaged or custody seals are broken), the Project Manager will be advised immediately and those samples will not be analysed until authorised by the Project Manager.

Any problem with a sample will be noted on the CoC Record and notified to URS in writing as soon as practicable for action or response. Laboratory capacity will be pre-agreed by the laboratory and confirmed in writing to URS prior to the submission of samples to the laboratory.

### 6.3.2 Pre-and Post-analysis Storage

Samples should be transported to a laboratory within 48 hours of sample collection. After the Sample Custodian has logged in the samples, they are placed in temporary refrigerated storage, and maintained at a temperature of $4^0$C or less until analyses are performed. Sample analyses are scheduled as soon as practicable following delivery to the laboratory and extractions and analyses are consistent with the analyte holding times specified by the laboratory.

After analysis, sediment samples will be stored by the laboratory for a period of up to two months. Sediment samples will remain refrigerated for one month and on a shelf at room temperature for a further month.

## 6.4 Analytical Quality Assurance/Quality Control (QA/QC)

Specific mechanisms for checking the accuracy and precision of analytical data in order to ensure that data quality objectives are met, involve the analysis of the laboratory and field QA check samples.

### 6.4.1 Laboratory QA/QC Samples

*Blanks* - contaminant free samples designed to monitor the introduction of artefacts into a process. Reagent blanks or method blanks are analysed to assess the level of contamination which exists in the analytical system and which might lead to the reporting of elevated concentrations or false positive data. A reagent/method blank consists of reagents specific to the method that are carried through clean-up and analysis. Ideally, the concentration of an analyte in the blank is below the reporting limit of that analyte.

*Calibration Check Standards* – are pre-prepared from the same solution and are used to confirm linearity of the initial calibration curve. Acceptance must be within predicted limits.

*Laboratory Duplicates* - samples prepared by dividing a field sample into two or more aliquots, then analysed separately. Duplicate samples are considered to be two replicates. Replicate samples should ideally be representative of the originating sample, but in many cases this is not practical due to the nature of the sample; hence the analysis of replicate samples provide an indication of the effect of sample matrix variability on precision, in addition to assessing analytical precision.

*Matrix Spikes* - are field samples to which predetermined concentrations of analytes have been added. The matrix spike (MS) is taken through the entire analytical procedure and the percent recovery of each analyte is calculated as follows:

Percent Recovery = X/T x 100%

where, X = the observed value of measurement; and

T = “true “ value (value of primary sample with no spiking matrix added).

Percent recovery values provide an indication of the effect of sample matrix on the accuracy of the analysis, in addition to analytical accuracy.

*Surrogates* - are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in field samples. These compounds are spiked into all sample aliquots prior to preparation and analysis. Percent recoveries are calculated for each surrogate, providing an indication of analytical accuracy including unusual matrix effects and gross sample processing errors.

The following QC checks are to be performed at a frequency of 1 in 20 field samples or greater for volatile, semi-volatile and metal analytes:

- Reagent/method blanks;
- Calibration check standards;
- Laboratory duplicates;
- Control spikes;
- Laboratory Control Samples; and
- MS/MSDs (metals only).

With respect to routine organics analysis, ALS use spiked samples because of the difficulty in obtaining appropriate, matrix-matched, certified reference materials for all target analytes. ALS QC protocols require the use of an Independent Calibration Verification standard (ICV) for all methods. An ICV is prepared from target analytes obtained from an independent source from those used for calibration standards or as spiking solutions for laboratory control samples and matrix spikes. This provides an indirect independent check of the accuracy of laboratory control and matrix spikes.

### 6.4.2 Data Handling

All analytical data generated by the analytical laboratory will be appropriately reduced and undergo comprehensive validation prior to reporting. Records and numerical calculations will be legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

The originating analyst will reduce and validate a given data package to ensure that:

- Holding times have been met;
- Appropriate standard operating procedures have been followed;
- Field sample results are correct and complete (if applicable);
- QC check sample results are correct and complete;
- QC check sample results are within established control limits and data quality objectives; and
- Documentation is complete.

If the originating analyst finds that the validity of data is in doubt due to non-conformance with the above checklist, then the data is flagged and appropriate corrective procedures are initiated.

Once the originating analyst has reduced and validated the data package, it is then passed onto the Document Control/Quality Assurance Officer, Laboratory Manager, or other appropriately qualified senior personnel for independent review.

A NATA approved signatory signs and releases the work reported.

The requirements of the reports include the following:

- The format of the final report is in full accordance with NATA requirements for Chemical Testing, including the provision of a NATA stamp on the covering page if appropriate;
- A summary table of sample no., matrix, date sampled, date received, date prepared/extracted and date analysed is completed;
- All field sample results for each type of sample matrix, as listed on the CoC, are reported collectively on separate tables noting URS sample ID, Laboratory ID and Laboratory sample Batch No;
- All QA check results are reported. Each type of sample matrix, as listed on the CoC, are reported collectively on separate tables;
- All water matrix results are expressed as mg/L or µg/L;
- All solid matrix results are expressed as mg/kg or µg/kg (dry weight);
- Full reference to analytical procedures used are stated;

- Modifications to procedures performed outside the requirements of this SAP have been stated;
- Non-conformance to any of the analytical requirements of this SAP are clearly stated;
- A key to abbreviations is provided; and
- Analyte nomenclature remains consistent throughout the entire project.

If complete, the final report is then signed by the appropriate NATA signatory and submitted to URS.

In the event that a preliminary test report is issued, the degree to which the data has been validated by the laboratory must be clearly indicated, and the final test report must contain an appropriate reference to the original one.

If, after the issuing of a report, data are found to be invalid, the original report must be withdrawn and replaced by one marked “Replacement for Report No”, with a version number clearly marked.

### 6.4.3 Data Validation

The primary objective of the data validation process is to ensure that the data reported can be used to achieve the project objectives.

The validity of all analytical data reported will be assessed by URS by critical review of the QC check sample results. This will be performed in general accordance with guidance by US EPA guidelines and NODG as presented in the document “National Functional Guidelines For Organic Data Review, Multimedia, Multiconcentration (OLMO 1.0) and Low Concentration Water (OLCO 1.0), June 1991”, where appropriate (USEPA, 1991).

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URS Australia Pty Ltd (URS) has prepared this document in accordance with the usual care and thoroughness of the consulting profession for the use of Hornsby Shire Council and their consultants and only those third parties who have been authorised in writing by URS to rely on the document. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this document. It is prepared in accordance with the Proposal dated 29 August 2006 and was modified to include the outcomes of the meeting between Peter Coad, Kristy Guise, Carsten Matthai and Stuart Taylor at the URS office in North Sydney on 21 November 2006.

The methodology adopted and sources of information used by URS are outlined in this document. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this document as provided to URS was false.

This Sampling and Analysis Plan (SAP) for sediment investigations has been developed in accordance with the scope of works provided by Hornsby Shire Council and was prepared between 3 November and 22 November 2006. The SAP is based on the conditions encountered and information reviewed at the time of preparation.

This document should be read in full. No responsibility is accepted for use of any part of this document in any other context or for any other purpose or by third parties. This document does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Opinions and recommendations contained in this plan are based upon data provided by representatives of Hornsby Shire Council, information gained during a literature review and a project inception meeting on 6 October 2006 and information provided from government authorities’ records and other third parties. This approach reflects current professional practice for sediment investigations.

This investigation addresses the likelihood of hazardous substance contamination resulting from past and current known uses of the study area. Given the limited and mutually agreed scope of work, URS does not guarantee that hazardous materials do not exist in an area of sediment. Similarly, an area of sediment which appears to be unaffected by hazardous materials at the time of our assessment may later, due to natural phenomena or human intervention, become contaminated.

Subsurface conditions can vary across a particular site and cannot be explicitly defined by these investigations. It is unlikely therefore that the results and estimations expressed in this document will represent the extremes of conditions within the site or the conditions at any location removed from the specific points of sampling. Subsurface conditions including contaminant concentrations can also change in a short time.

The information in this document is considered to be accurate at the date of issue and is in accordance with known conditions at the site.

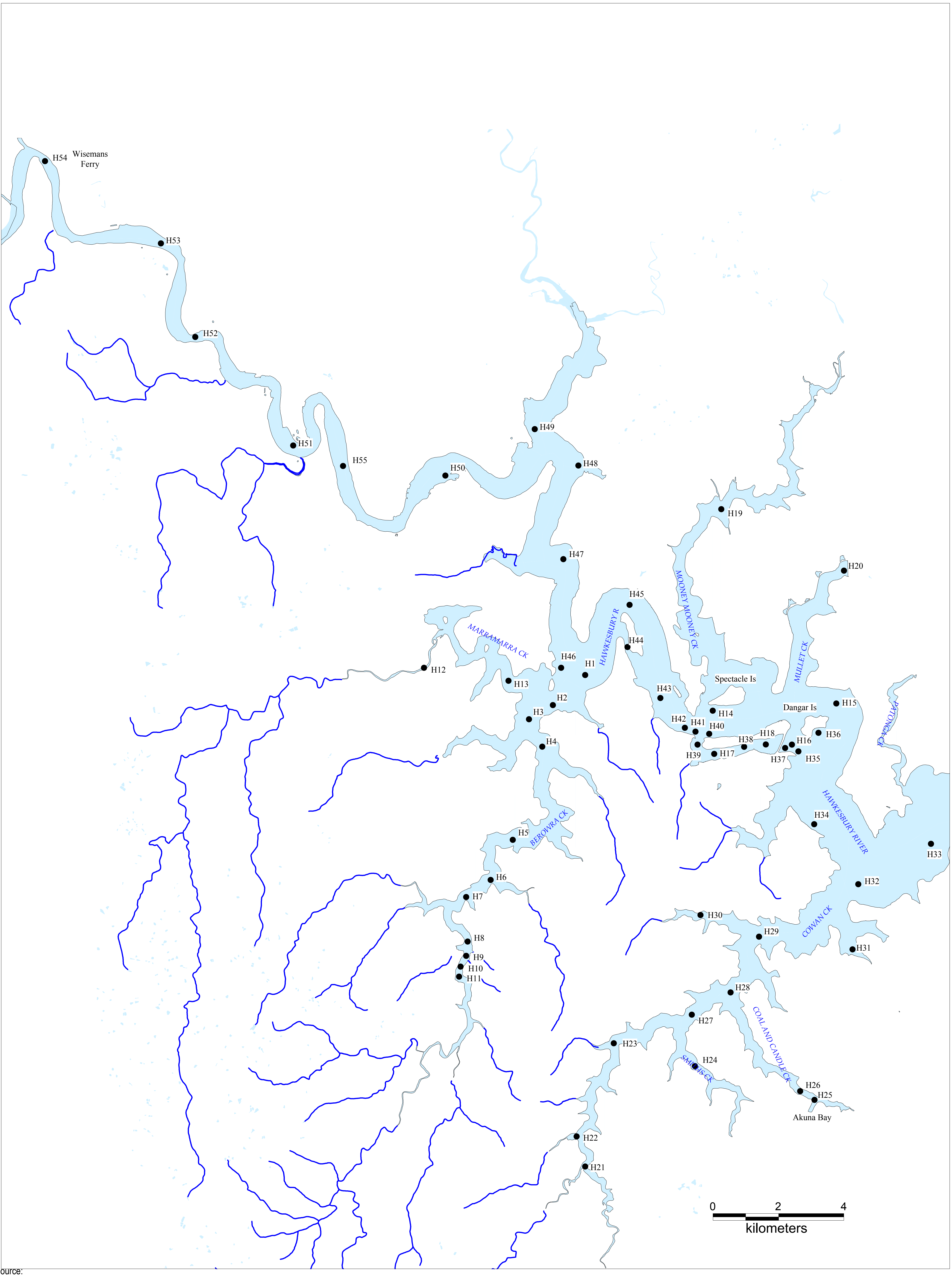
This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this document.

## Table 1. Proposed Sampling Locations

| Sample Location ID | Previous Sample Location ID | Longitude | Latitude | Location Description | Notes |
|---|---|---|---|---|---|
| H1 | BCVC1 | 329090 | 6289010 | Hawkesbury River south of Bar Point | Resampling location from Coastal & Marine Geosciences (1998) |
| H2 | BCVC2 | 328454 | 6287982 | Berowra Creek south of Bar Island | Resampling location from Coastal & Marine Geosciences (1998) |
| H3 | BCVC3 | 327668 | 6287327 | Berowra Creek west of Berowra Point | Resampling location from Coastal & Marine Geosciences (1998) |
| H4 | BCVC4 | 328052 | 6286683 | Berowra Creek south of Berowra Point | Resampling location from Coastal & Marine Geosciences (1998) |
| H5 | BCVC5 | 327149 | 6283864 | Berowra Creek west of Bujwa Creek | Resampling location from Coastal & Marine Geosciences (1998) |
| H6 | BCVC6 | 326438 | 6282596 | Berowra Creek north of Oaky Point | Resampling location from Coastal & Marine Geosciences (1998) |
| H7 | BCVC7 | 325705 | 6282049 | Berowra Creek east of Calabash Bay | Resampling location from Coastal & Marine Geosciences (1998) |
| H8 | BCVC8 | 325846 | 6280688 | Berowra Creek east of Crossland Bay | Resampling location from Coastal & Marine Geosciences (1998) |
| H9 | BCVC9 | 325761 | 6280295 | Berowra Creek south of Crossland Bay ferry crossing | Resampling location from Coastal & Marine Geosciences (1998) |
| H10 | BCVC10 | 325587 | 6279982 | Berowra Creek south of Crossland Bay ferry crossing | Resampling location from Coastal & Marine Geosciences (1998) |
| H11 | BCVC11 | 325560 | 6279726 | Berowra Creek south of Crossland Bay ferry crossing | Resampling location from Coastal & Marine Geosciences (1998) |
| H12 | MCAH1 | 323843 | 6288976 | Marramarra Creek | Resampling location from Coastal & Marine Geosciences (1998) |
| H13 | MCAH2 | 322175 | 6289012 | Mouth of Marramarra Creek west of Bar Island | Resampling location from Coastal & Marine Geosciences (1998) moved to mouth of Marramarra Creek |
| H14 | Site 5 | TBD | TBD | Hawkesbury River south of Spectacle Island | Resampling location from UNSW (2002) |
| H15 | Site 6 | TBD | TBD | Hawkesbury River northeast of Dangar Island | Resampling location from UNSW (2002) |
| H16 | Site 7 | TBD | TBD | Hawkesbury River southwest of Dangar Island | Resampling location from UNSW (2002) |
| H17 | Site 8 | TBD | TBD | Hawkesbury River Sanbrook Inlet West | Resampling location from UNSW (2002) |
| H18 | Site 9 | TBD | TBD | Hawkesbury River Sanbrook Inlet East | Resampling location from UNSW (2002) |
| H19 | Site 1 | TBD | TBD | Mooney Mooney Creek | Resampling location from UNSW (2002) |
| H20 | Site 3 | TBD | TBD | Mullet Creek | Resampling location from UNSW (2002) |
| H21 | NA | TBD | TBD | Cowan Creek Bobbin Head | New sampling location |
| H22 | NA | TBD | TBD | Cowan Creek Apple Tree Bay | New sampling location |
| H23 | NA | TBD | TBD | Cowan Creek east of Waratah Bay | New sampling location |
| H24 | NA | TBD | TBD | Cowan Creek Smiths Creek | New sampling location |
| H25 | NA | TBD | TBD | Cowan Creek Akuna Bay | New sampling location |
| H26 | NA | TBD | TBD | Cowan Creek northwest of Akuna Bay | New sampling location |
| H27 | NA | TBD | TBD | Cowan Creek north of Smiths Creek | New sampling location |
| H28 | NA | TBD | TBD | Cowan Creek northeast of Cottage Point | New sampling location |
| H29 | NA | TBD | TBD | Cowan Creek north of Cowan Point | New sampling location |
| H30 | NA | TBD | TBD | Cowan Creek Jerusalem Bay (north of Pinta Bay) | New sampling location |
| H31 | NA | TBD | TBD | Cowan Creek Refuge Bay | New sampling location |
| H32 | NA | TBD | TBD | Cowan Creek north of Challenger Head | New sampling location |
| H33 | NA | TBD | TBD | Hawkesbury River Walker Point/Flint & Steel Point | New sampling location |
| H34 | NA | TBD | TBD | Hawkesbury River northwest of Gunyah Point | New sampling location |
| H35 | NA | TBD | TBD | Hawkesbury River east of Flat Rock Point | New sampling location |
| H36 | NA | TBD | TBD | Hawkesbury River south of Dangar Island | New sampling location |
| H37 | NA | TBD | TBD | Hawkesbury River east of Long Island Jetty | New sampling location |
| H38 | NA | TBD | TBD | Hawkesbury River south of Sanbrook Inlet (centre) | New sampling location |
| H39 | NA | TBD | TBD | Hawkesbury River south Kangaroo Point | New sampling location |
| H40 | NA | TBD | TBD | Hawkesbury River north of Long Island (west) | New sampling location |
| H41 | NA | TBD | TBD | Hawkesbury River north of Kangaroo Point | New sampling location |
| H42 | NA | TBD | TBD | Hawkesbury River west of Hawkesbury Road Bridge | New sampling location |
| H43 | NA | TBD | TBD | Hawkesbury River southwest of Peat Island | New sampling location |
| H44 | NA | TBD | TBD | Hawkesbury River southeast of Prickly Point | New sampling location |
| H45 | NA | TBD | TBD | Hawkesbury River north of Milson Island | New sampling location |
| H46 | NA | TBD | TBD | Hawkesbury River east of Fishermans Point | New sampling location |
| H47 | NA | TBD | TBD | Hawkesbury River northeast of Pumpkin Point | New sampling location |
| H48 | NA | TBD | TBD | Hawkesbury River west of Marlows Creek | New sampling location |
| H49 | NA | TBD | TBD | Hawkesbury River south of Triangle (no name) | New sampling location |
| H50 | NA | TBD | TBD | Hawkesbury River northeast of Haycock Reach | New sampling location |
| H51 | NA | TBD | TBD | Hawkesbury River west of Sentry Box Reach | New sampling location |
| H52 | NA | TBD | TBD | Hawkesbury River (no name) | New sampling location |
| H53 | NA | TBD | TBD | Hawkesbury River (no name) | New sampling location |
| H54 | NA | TBD | TBD | Hawkesbury River south of Wisemans Ferry | New sampling location |
| H55 | NA | TBD | TBD | Hawkesbury River between H50 and H51 | New sampling location |

*Map Grid of Australia MGA94 (Zone 55); TBD = To be determined

# Figure



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Hornsby Shire Council

URS

Project

SEDIMENT AND ANTIFOUL
MONITORING STUDY

Drawn: CM

Approved: DRAFT

Date: 22-11-06

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Title

**Proposed Sample Locations**

Figure: 1

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# Appendices

## Appendix C - Antifoul Study (Stage 2) – Sampling and Analysis Plan

SAMPLING AND ANALYSIS PLAN

# Sediment and Antifoul Monitoring Program – Stage 2 Antifoul Study

*Prepared for*

**Hornsby Shire Council**

20 March 2007

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## Table

## Figure

## 1.1 Background

To foster better management of estuaries, the New South Wales (NSW) Government formulated an Estuary Management Policy that advocates the integrated, balanced, responsible and ecologically sustainable use of the State's estuaries. The Estuary Management Policy is defined in the Estuary Management Manual (NSW Government, 1992) and outlines a structured management process leading to the implementation of Estuary Management Plans for estuaries in NSW. Estuary Management Plans encompass all values and uses of the estuary, along with the principles of ecologically sustainable development and total catchment management.

The Estuary Management Manual recommends an eight step process to prepare and implement an Estuary Management Plan, as follows:

1) Form an estuary management committee;

2) Assemble existing data (data compilation study);

3) Undertake estuary processes study;

4) Undertake estuary management study;

5) Prepare draft estuary management plan;

6) Public review of draft plan;

7) Adopt and implement estuary management plan; and

8) Monitor and review the management process as necessary.

In compliance with step seven, the Berowra Creek Estuary Management Plan was implemented in 2000. The Brooklyn Estuary Management Plan was completed in December 2006. The need to establish a Sediment Study (Stage 1) and Antifoul Study (Stage 2), to establish the level of anthropogenic contamination within the estuaries of Hornsby Shire, was identified in the Berowra Creek Estuary Process Study (Coastal and Marine Geosciences, 1998), Brooklyn Estuary Process Study (University of New South Wales, 2002) and the Berowra Creek and Brooklyn Estuary Management Plans.

The Stage 1 Sediment Study was completed between December 2006 and February 2007 and the outcomes of the sediment investigation were presented at an Estuary Management Committee Meeting at Hornsby Shire Council on 8 February 2007.

## 1.2 Scope of Sampling and Analysis Plan

This Sampling and Analysis Plan (SAP) was developed following consultation with Hornsby Shire Council and stakeholders following the Management Committee Meeting at Hornsby Shire Council on 8 February 2007 and a follow-up meeting with Hornsby Sire Council staff on 21 February 2007. The SAP also presents specific quality assurance and quality control (QA/QC) details to be employed during the investigation and it covers the following aspects of the investigation:

- Scope of work;
- Rationale for selection of sampling locations;
- Brief description of sampling locations;
- Identification of contaminants of potential concern (COPC);
- Project organisation and responsibilities;
- Field methods and procedures including:
  - Occupational health and safety (OH&S) procedures;
  - Contingency plan;
  - Sediment sampling equipment;
  - Sample location;
  - Equipment decontamination; and
  - Field documentation.
- Laboratory analytical program including:
  - NATA-accredited Laboratory to be used;
  - Analytical testing program, including detection limits (LORs);
  - Sample handling, preservation and storage;
  - Analytical QA/QC and data validation; and
  - Data management procedures.

## 1.3 Objectives

The proposed sediment sampling will augment the previous geochemical sediment sampling program conducted during the Stage 1 Sediment Study, which was completed between December 2006 and February 2007, in addition to the work completed as part of the Berowra Creek Estuary process Study (1998) and the Brooklyn Estuary Process Study (2002). The Stage 2 Sediment Study has the following objectives:

- Direct assessment of commercially available antifouling products and document current research;
- Assess whether the use of antifouling products has resulted in contamination of sediment in the study area;
- Identify which contaminants are present in sediment due to the use of antifouling products;
- Establish baseline data, and compare to recognised standards (where available), the level of contamination in sediments resulting from the use of antifouling products in the study area; and
- Provide recommendations and remedial management actions based on results arising from the objectives above.

In addition, the three sampling locations adjacent to the proposed Sewage Treatment Plant (STP) at locations H40, H41 and H42 will be sampled and analysed for the same suite of analytes as the 52 Stage 1 Sediment Study samples.

Following the discussions during the meeting on 21 February 2007, sediment samples from three additional sample locations (H3, H5 and H7) will be analysed for silver (one QA/QC field duplicate sample is recommended).

## 2.1 Effects of TBT and Antifouling Paint Booster Biocides

The need for effective antifoulants, which prevent the settlement and growth of marine organisms on submerged structures, such as buoys, fish cages and ship's hulls, is recognised universally (Evans et al., 2000; Konstantinou and Albanis, 2004). For many years, tributyltin (TBT) was the most widely used active ingredient in paint formulations. However, use of TBT has been regulated internationally since 1990 due to its severe impact on the aquatic ecosystem (Fent, 1996) and the demonstrated effects of TBT on the disruption of the endocrine system by mimicking or inhibiting the action of gonadal steroid hormones, oestradiol and testosterone (Makita and Omura, 2006).

Prolonged release of TBT from ship-bottom coatings has resulted in the imposition of male sexual characteristics upon female gastropods, or imposex, a phenomenon which was first described by Blaber (1970) in the United Kingdom. Imposex in marine gastropods has subsequently been linked to the exposure of these benthic biota to TBT in aquatic systems worldwide (e.g. Smith, 1981a,b,c; Santos et al., 2004). Recognition of this cause and effects relationship ultimately resulted in a global ban of TBT. The decline in the occurrence of imposex following worldwide bans has been used as a biomarker and biological indicator for environmental monitoring of TBT since the introductions of these bans in countries worldwide (Axiak et al., 2003).

Restrictions on the use of TBT-based antifouling paints were implemented in New South Wales (NSW) in 1989, first on small vessels under 25 m length and then on larger vessels, which have been allowed the continuing use of TBT-based antifouling paints, as long as the maximum leaching rate is $<5$ μg $cm^{-2}$ $d^{-1}$ (Moore, 1988). However, despite the partial ban on the use of TBT in Australia, a survey of imposex in *Thais orbita* (Neogastropoda) along the NSW coast found imposex was still widespread 10 years after the introduction of the ban, in particular within harbour/bay areas, where contamination "hotspots" are still present and where physical remobilization and dispersion processes may be less pronounced compared to high-energy coastal areas (Gibson and Wilson, 2003).

Copper-based antifouling paints, particularly those that continually erode (ablating antifoulings) have been widely used since the banning of tributyltin and represent a source of Cu to sediment (Taylor, 2000). The Stage 1 Sediment Study has shown that marinas are a possible source of trace metal contaminants to the estuaries as antifouling is applied and removed from vessels on slipways.

An additional aspect of the potential environmental impact of antifouling products for use in boating and marine infrastructure is the use of organic booster biocides in antifouling paints in addition to copper, which have replaced TBT-based coatings. This may represent additional potential for toxic effects as a result of the synergistic interactions between various biocides used in these alternative products (Evans et al., 2000). Commonly used biocides in antifouling paints following the introduction of the ban on TBT include Diuron, Chlorothalonil, Irgarol and Dichlofluanid, although other compounds have also been studied (e.g. Sea-nine 211, zinc pyrithione, TCMS (2,3,3,6-tetrachloro-4-methylsulfonyl) pyridine, TCMTB [2-(thiocyanomethylthio) bezothiazole], and zineb). These compounds have shown to be present in increasing concentrations in waters and sediments in coastal environments in countries worldwide, including Australia (Konstantinou and Albanis, 2004).

Diuron is used as a herbicide in land-based applications and the presence of this compound in sediment may not be entirely related to antifouling products.

There are currently limited data available on the potential ecotoxicological effects of the increasingly widespread use of organic booster biocides in the aquatic environment, although a recent review by Konstantinou and Albanis (2004) suggests that alternative antifouling products, which are based on copper metal oxides and organic biocides require continued research regarding potential environmental effects in water and sediments and ecotoxicity in biota. The monitoring, behaviour and toxicity of degradation products of these compounds should be considered in establishing criteria for the occurrence, fate and effects of organic antifouling paint booster biocides.

## 2.2 Antifoul Study (Stage 2) – Sampling Locations

The sampling locations were selected based on the outcomes of the Stage 1 Sediment Study. It should be noted that during the Stage 2 sampling, TBT is the primary analyte of potential concern, although other organic contaminants analysed at Ultra Trace level of detection are proposed to assess the presence of anthropogenic contamination. In addition, the other antifoul-related analytes that are indicators of post-TBT restriction era contamination are Diuron and, to a lesser extent, Chlorothalonil, Irgarol and Dichlofluanid.

The assessment of historical inputs of anthropogenic contaminants to the Hawkesbury River System sediments and an evaluation of data from previous investigations, in particular from the Stage 1 Sediment Study, the Brooklyn Estuary Process Study (2002) and the Berowra Creek Estuary Process Study (1998), has demonstrated that surficial sediments in the Lower Hawkesbury River System are enriched in some contaminants and that sediments at some locations exceeded the ANZECC/ARMCANZ (2000) sediment quality guideline values.

Based on the outcomes of the Stage 1 Sediment Study, 16 of the 52 sampling locations were selected for the re-sampling of surficial sediments and additional geochemical analysis. The 16 sampling locations are:

- Upper Berowra Creek (H7, H8, H9, H10)
- Cowan Creek (H21 – Bobbin Head marina, H22 – Apple Tree Bay boat ramp, H23 – Waratah Bay, H24 - Smiths Creek, H25 – Akuna Bay marina slipway, H26 - Akuna Bay marina refuelling station, H28 – Cottage Point kiosk, H31 – Refuge Bay)
- Sandbrook Inlet (the Gut) (H17, H18, H38)
- Brooklyn (H37)

The rationale and level of priority for the selection of each of these 16 sample locations is briefly summarized below:

H7: No ANZECC/ARMCANZ exceedences, slight enrichment above regional baseline in Berowra Creek – Medium Priority;

H8: ANZECC/ARMCANZ exceedence of Pb, enrichment above regional baseline in Berowra Creek – Medium Priority;

H9: ANZECC/ARMCANZ exceedence of Pb, Cu, marina location, High Priority;

H10: ANZECC/ARMCANZ exceedence of Pb, Cu, in vicinity of marina, High Priority;

H17: ANZECC/ARMCANZ exceedence of As, Sandbrook Inlet location, enrichment of metals following normalization, High Priority;

H18: ANZECC/ARMCANZ exceedence of As, Sandbrook Inlet location, enrichment of metals following normalization, High Priority;

H21: ANZECC/ARMCANZ exceedence of Cu, Pb, Zn, Hg, Cowan Creek Bobbin Head at marina, High Priority;

H22: ANZECC/ARMCANZ exceedence of Cu, Pb, Hg, Cowan Creek Apple Tree Bay, High Priority;

H23: ANZECC/ARMCANZ exceedence of Pb, Cowan Creek east of Waratah Bay, enrichment of metals following normalization, Medium Priority;

H24: ANZECC/ARMCANZ exceedence of Pb, Cowan Creek – Smiths Creek, slight enrichments of metals (Pb, Cu) following normalization, Medium Priority;

H25: ANZECC/ARMCANZ exceedence of Cu, Akuna Bay at marina, High Priority;

H26: ANZECC/ARMCANZ exceedence of Cu, Pb, Hg, Akuna Bay at marina, High Priority;

H28: ANZECC/ARMCANZ exceedence of Cu, Pb, Hg, Cowan Creek Cottage Point, enrichment of metals following normalization, Medium Priority;

H31: ANZECC/ARMCANZ exceedence of As, Cowan Creek - Refuge Bay non-marina and high boating activity location, High Priority

H37: ANZECC/ARMCANZ exceedence of Pb, Hg, marina, High Priority;

H38: ANZECC/ARMCANZ exceedence of As, Sandbrook Inlet, High Priority;

## 2.3 Contaminants of Potential Concern

Sediment samples collected during the Antifoul Study (Stage 2) sampling will be analysed for the following:

- TBT;

- Polychlorinated Biphenyls - Ultra Trace limits of reporting;
- Polycyclic Aromatic Hydrocarbons (24 analytes) - Ultra Trace limits of reporting;
- Organochlorine Pesticides - Ultra Trace limits of reporting; and
- Organophosphate Pesticides - Ultra Trace limits of reporting;

Four samples from locations H37 (Brooklyn), H9 (Berowra Creek Marina), H38 (Sandbrook Inlet) and H31 (Refuge Bay) will be analysed for antifouling booster biocides:

- Diuron and Chlorothalonil (quantitative analysis);
- Irgarol and Dichlofluanid (semi-quantitative analysis).

Although additional sampling locations could have been included for the analysis of these antifouling booster biocides (i.e. H21 – Bobbin Head marina and H26 – Akuna Bay marina), these locations are outside the Hornsby Shire Council LGA and the limited resources have been directed toward the determination of the concentrations of these analytes in sediments sampled at locations H9, H31, H37 and H38.

The three sampling locations adjacent to the proposed Sewage Treatment Plant (STP) (locations H40, H41 and H42 will be analysed for:

- TKN, TOC, NOX;
- Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd;
- Polychlorinated Biphenyls;
- Polycyclic Aromatic Hydrocarbons;
- Organochlorines;
- Organophosphates;
- Total petroleum hydrocarbons (TPH) ($C_6$-$C_{36}$); and
- BTEX.

Grainsize in four fractions (0.063 mm; 0.063 mm-0.25 mm; 0.25 mm-2 mm; >2 mm) will be determined.

Organic compounds will be analysed for standard limits of reporting and not ultratrace levels.

One QA/QC field duplicate sample will be collected and also analysed for the above suite of analytes.

Sediment samples from three locations (H3, H5 and H7) in Berowra Creek will be collected and analysed for Ag only.

# Project Organisation and Responsibilities

The project organisation identifies the reporting structure and responsibilities of individuals involved in the project. The roles of responsible individuals under this SAP are described below:

## 3.1 Project Director – Stuart Taylor

The Project Director has the overall responsibility for the project. The Project Director monitors the project work and provides supervision and support to the Project Manager (defined below). Specific responsibilities of the Project Director include:

- Ensure that contracting and risk mitigation requirements are met, that the work is conducted in accordance with the terms of the contract, and that contractual changes are formally approved;
- Ensure that the Project Manager and staff are technically and professionally qualified, have adequate relevant experience, and represent sufficient resources to meet project objectives;
- Review project work and deliverables at least at designated project milestones;
- Ensure that appropriate peer reviews are conducted;
- Ensure that project files are established and that staff orientations are conducted;
- Ensure that project deliverables are provided on time and within budget; and
- Establish and maintain communications with the client project manager and assure that the objectives of the project, as prescribed by the contract terms, are met to Hornsby Shire Council's satisfaction.

## 3.2 Project Manager – Carsten Matthai

The Project Manager reports to the Project Director and has primary responsibility for all aspects of the project including meeting the needs of Hornsby Shire Council. Specifically, responsibilities include the quality of the work product, schedule and budget control, asset management, and communications with staff and superiors. Specific duties of the Project Manager include:

- Implement contracting and risk mitigation requirements and determine if the services rendered are consistent with the terms of the contract;
- Determine that all contractual terms, including changes in scope, schedule and budget are formally agreed to by authorised representatives of Hornsby Shire Council and that such agreements are documented in writing;
- Determine, in consultation with the Project Director, that qualified staff are assigned to the project and represent sufficient resources to meet project objectives;

- Conduct the project so that deliverables are of professional quality and formally reviewed at predetermined times by qualified staff;
- Expedite the work of Peer Reviewers involved in the project by formally communicating peer review schedules and providing the information required for peer reviews in a timely fashion;
- Establish and maintain project files; maintain written documentation of relevant contractual, financial and administrative transactions, work plan conformance, quality assurance conformance, deliverables submitted and other relevant technical and managerial data. Close the files upon completion of the project or of major project phases;
- Monitor schedules and budgets; provide notification to Hornsby Shire Council of requirements for budget or schedule adjustments before overruns have occurred and document justification for such changes;
- Maintain close communications with and be readily available to Hornsby Shire Council’s representative to periodically assure that Hornsby Shire Council’s objectives are being satisfactorily met within the terms of the contract;
- Review, in a timely manner, all invoices to verify charges and their conformance with contractual terms; communicate with Hornsby Shire Council concerning inquiries about invoices and interact with Accounting to facilitate collections; and
- Present deliverables and, subsequently, contact Hornsby Shire Council’s representative to verify his/her understanding and ascertain his/her assessment of the work.

## 4.1 Introduction

This section of the SAP details the procedures to be used during the Stage 2 Antifoul Study of the sediments in the Hawkesbury River system. By defining the procedures to be used, it is possible to develop a uniform approach to the Antifoul Study (Stage 2) investigation and thereby, minimise potential impacts on the quality and representativeness of data collected.

The Antifoul Study will include the following:

1. The number of sampling locations for the Antifoul Study (Stage 2) would be reduced to 16 sampling locations, based on the prioritisation obtained from the Stage 1 Sediment Study. Surficial sediment samples will be collected using an Ekman grab sampler at 16 sampling locations (plus 2 additional QA/QC field replicates). One homogenized sample from the upper 10 cm of sediment will be analysed for the following:

- TBT; and
- Organic Contaminants (PCBs, PAHs (24 analytes), OC Pesticides, OP Pesticides) – Ultra Trace limits of reporting.

In addition, four samples will be collected for the analysis of antifouling booster biocides (TBT-replacement products) from locations H37 (Brooklyn), H9 (Berowra Creek marina), H38 (Sandbrook Inlet) and H31 (Refuge Bay). These sampling locations were selected as a subset of the 16 sampling locations of the Stage 2 investigation. These samples will be analysed for:

- Diuron and Chlorothalonil (quantitative analysis);
- Irgarol and Dichlofluanid (semi-quantitative analysis - analytical availability and cost to be confirmed)

## 4.2 Sampling Site Location

The scope of works for the Stage 2 Antifoul Study comprises the collection and analysis of sediment grab samples to a maximum sediment depth of 0.1 m depth at 16 locations, as defined in Section 2.2) (Figure 1). Sampling will be undertaken from a small motorized vessel provided by Hornsby Shire Council. Samples will be located with a GPS positioning accuracy of +/-5 m. The GPS unit will be provided by Hornsby Shire Council. The location and collection of samples in the field will be the responsibility of the URS field team comprising Dr Carsten Matthai and Kristy Guise and Peter Coad (Hornsby Shire Council).

One homogenised sample will be collected of the upper 0.1 m of sediment at each sampling location. Samples will be homogenized using stainless steel utensils and a stainless steel bowl and analysed for CoPC. Subsamples for antifoul booster biocide analysis will be collected at three of the 16 sampling locations (i.e. H37 – Brooklyn marina petrol refuelling station; H38 - Sandbrook Inlet; H9 – Berowra Creek marina; H31 - Refuge Bay).

The sediment geochemical data will be displayed spatially on a GIS system (Mapinfo$^{TM}$) and the data will be screened against ANZECC/ARMCANZ (2000) sediment quality guideline values.

## 4.3 Sampling Contingency Plans

The sampling will be undertaken in the channels, creeks and embayments of the Lower Hawkesbury River, which is relatively protected during storms. However, in the case of adverse weather which may present an OH&S risk to field staff, sampling would be discontinued and rescheduled. It is likely that the sampling program will be completed over a period of one full day, weather permitting.

## 4.4 Sediment Subsampling

Grab samples collected during the Stage 2 Antifoul Study will be collected with a stainless steel tall Ekman grab sampler (dimensions: 0.15 m x 0.15 m x 0.225 m) wherever possible. A Ponar grab sampler may be required to sample sandy sediments at some locations. Sample management procedures on the sampling vessel include the careful collection of the sediment samples from the grab sampler, following the recovery of the sediment from the estuary floor. Essentially, all sample handling and processing will be performed to minimize contamination and sample mix-ups. The workspace on the boat will be washed down with ambient seawater to clean all surfaces and minimize dust contamination of samples. Nitrile gloves will be worn by the sampling personnel.

Subsampling will be performed using a stainless steel sampling spoon. The sampler, who is wearing nitrile gloves, will maintain utmost care in ensuring that no cross-contamination between samples is possible. Samples collected from each interval will be homogenised in a stainless steel bowl and then placed into appropriately cleaned and preserved containers provided by the laboratories (glass sampling containers with Teflon-lined lids). Sample containers will be filled with zero headspace and labelled immediately. Samples will then be stored in eskies on ice. All eskies will be filled to capacity and sealed with adhesive tape. A CoC form will be included in the esky. Following return to shore, the samples will be delivered to the laboratory within 48 hours of sampling for processing and analysis.

## 4.5 Sediment Analyses and Analytical Detection Limits

Whole sediment samples from locations outlined in Section 2.2 will be submitted to an independent NATA accredited laboratory, ALS Environmental (TBT and Organics) and NMI (organic booster biocide analyses), for analysis of the COPCs listed in Section 2.3. Samples for PAHs, OCPs, OPPs and PCBs will be analysed for Ultra Trace limits of reporting (PAH: 10-100 µg/kg; OC Pesticides; 0.5 µg/kg; OP Pesticides: 10 µg/kg; PCB: 5 µg/kg). All analytical methods are NATA accredited for all of the tests, except for the organic booster biocide analyses, some of which are semi-quantitative.

## 5.1 Documentation of Field Activities

### 5.1.1 General Field Activities Documentation

Bound field logbooks will provide the means for recording most field activity records and observations. The aim of the documentation within the field logbooks is to allow future reconstruction of field activities without relying on the memory of field team members. To supplement the information and data collected during sample collection and field testing, field data sheets may also be completed.

Items that will be recorded into the field logbook include:

- Sample collection method; and
- Health and safety documentation.

Field documentation will include, at a minimum, the following information as is applicable to the specific task at hand:

- Project name and number;
- Date, time, weather conditions;
- Personnel present;
- Type of sample;
- Sampling method;
- Sampling location description, ID and time of collection;
- Sample depth;
- Visual descriptions;
- Sample container type;
- Photograph number (where applicable); and
- Other information and observations.

The field logbook and the field data sheets will compile the field data collected during the investigation.

### 5.1.2 Sampling Containers

Containers for samples are cleaned and prepared by the laboratory. Glass jars for chemical analyses and plastic bags for grain size analyses will be provided by the analytical laboratory.

### 5.1.3 Sample Labelling

Each sample container will be clearly labelled and marked with ink in the field. Samples collected from each sampling location will have unique sample numbers.

Sample labels will include the following information:

- Sampling date;
- Sample point number/designation; and
- Comments, as required.

### 5.1.4 Chain of Custody Protocols

A chain of custody (CoC) record will be utilised by field personnel to document possession of all samples collected for chemical analysis. The CoC record may include, but is not limited to, the following information:

- Project name and number;
- Name(s) of sampler(s);
- Sample type, identification number and location;
- Date and time of collection;
- Number and type of containers;
- Required analyses;
- Preservatives; and
- Signatures documenting change of sample custody.

The esky containing the samples will be sealed with tape and secured with a signed custody seal. The custody seal will provide an indication of whether the cooler was opened by unauthorised personnel. The temperature that the samples were stored at following transit to the lab and upon receipt is noted on the CoC forms.

The original CoC record will accompany the samples to the analytical laboratory. A copy of the CoC record will be placed in the appropriate project file. Samples will be delivered to the laboratory within 48 hours of sample collection to ensure the specified holding times are met.

### 5.1.5 Decontamination

All sampling equipment and measurement equipment will be decontaminated before and after each use. In general, the principal decontamination objective is the decontamination of all equipment prior to arriving on-site, including the removal of encrusted materials by scraping and ambient seawater rinse.

## 5.2 Field QA/QC Samples

Field duplicate QA/QC samples will be collected for at least 10% of primary samples collected (i.e. two samples), except for the organic booster biocide analyses, which are partly analysed on a semi-quantitative basis. Field duplicates, labelled QC1 and QC2, are samples that are prepared in the field by splitting a field sample, then submitting it to the laboratory as two independent samples. Field duplicates are used to measure the precision of the whole sampling and analysis process (sample collection, sample preparation and sample analysis). Significant variation in field duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity. Field duplicates will be analysed for all analytes listed in Section 2.2 (TBT and organics).

## 5.3 Surveying

The sampling locations will be located using a global positioning system (GPS), provided by Hornsby Shire Council with an estimated accuracy of +/-5m.

## 5.4 Sampling Date

Sampling will be conducted from a small motorized boat provided by Hornsby Shire Council over a period of one full day on 26 March 2007 (with a second contingency date of 28 March 2008), but will be dependent on weather conditions at the time. The date and time of sampling, water depth, latitude and longitude and a description of the sediment type will be recorded in the field.

## 6.1 Laboratory Analysis Program

Only commercial analytical laboratories that are accredited with the National Association of Testing Authorities (NATA) for the project specific analyses will be used for the project. All analytical procedures performed by the laboratory (ALS) are NATA-accredited, except for the organic booster biocide analyses (performed by the National Measurement Institure – NMI), some of which are semi-quantitative.

The objective of this SAP is to describe the methods and procedures that will be used by the selected laboratories to ensure quality, accuracy, precision and completeness of the analytical data generated as part of this investigation. The primary focus is to acquire environmental data that are scientifically sound, legally defensible and of acceptable quality.

## 6.2 Analytical Testing Program

The following sections provide descriptions of the analytical methodologies that will be used for the duration of this project. All United States Environmental Protection Agency (USEPA) methods referred to are from “Test Methods for Evaluating Solid Waste (SW-846)”, Revision A, July 1992, US EPA.

## 6.3 Sample Handling, Preservation and Storage

This section outlines the general procedures necessary for sample custody that are to be performed by the laboratory. It is understood that the laboratory will act in full accordance with the terms of its NATA Registration for Chemical Testing.

### 6.3.1 Laboratory Receipt of Samples

Field samples for this project will be delivered to the laboratory pre-contained and pre-preserved (as appropriate) in accordance with laboratory procedures. Sample containers used for the collection of field samples are, wherever possible, to be supplied by the relevant analytical laboratory, pre-cleaned and inspected. Accompanying each delivery of samples will be a Chain of Custody (CoC) Record.

The following items are checked and performed by the laboratory upon receipt of samples with the CoC:

- The custody seals and tape on the cooler are unbroken and uncut;
- The signature on the external custody seal matches one of the sampler(s) signature(s) on the internal CoC;
- Measurement is taken to determine if samples have arrived at the appropriate temperature;
- The sample containers within the cooler are intact;

- The identification on the sample containers correspond to the entries on the CoC;
- The number of sample containers received is equal to the number of samples listed on the CoC;
- If sample custody is valid, the samples are logged in by the laboratory as per the standard operating procedure;
- A copy of the CoC is delivered to the Project Manager within three working days.

If CoC discrepancies exist, appropriate notes (signed and dated) are made on the CoC and the Project Manager is notified by the laboratory. In the event that the laboratory Sample Custodian judges the sample custody (or part thereof) to be invalid (e.g. samples arrive damaged or custody seals are broken), the Project Manager will be advised immediately and those samples will not be analysed until authorised by the Project Manager.

Any problem with a sample will be noted on the CoC Record and notified to URS in writing as soon as practicable for action or response. Laboratory capacity will be pre-agreed by the laboratory and confirmed in writing to URS prior to the submission of samples to the laboratory.

### 6.3.2 Pre-and Post-analysis Storage

Samples should be transported to a laboratory within 48 hours of sample collection. After the Sample Custodian has logged in the samples, they are placed in temporary refrigerated storage, and maintained at a temperature of $6^0$C or less until analyses are performed. Sample analyses are scheduled as soon as practicable following delivery to the laboratory and extractions and analyses are consistent with the analyte holding times specified by the laboratory.

## 6.4 Analytical Quality Assurance/Quality Control (QA/QC)

Specific mechanisms for checking the accuracy and precision of analytical data in order to ensure that data quality objectives are met, involve the analysis of the laboratory and field QA check samples.

### 6.4.1 Laboratory QA/QC Samples

*Blanks* - contaminant free samples designed to monitor the introduction of artefacts into a process. Reagent blanks or method blanks are analysed to assess the level of contamination which exists in the analytical system and which might lead to the reporting of elevated concentrations or false positive data. A reagent/method blank consists of reagents specific to the method that are carried through clean-up and analysis. Ideally, the concentration of an analyte in the blank is below the reporting limit of that analyte.

*Calibration Check Standards* – are pre-prepared from the same solution and are used to confirm linearity of the initial calibration curve. Acceptance must be within predicted limits.

*Laboratory Duplicates* - samples prepared by dividing a field sample into two or more aliquots, then analysed separately. Duplicate samples are considered to be two replicates. Replicate samples should ideally be representative of the originating sample, but in many cases this is not practical due to the nature of the sample; hence the analysis of replicate samples provide an indication of the effect of sample matrix variability on precision, in addition to assessing analytical precision.

*Matrix Spikes* - are field samples to which predetermined concentrations of analytes have been added. The matrix spike (MS) is taken through the entire analytical procedure and the percent recovery of each analyte is calculated as follows:

Percent Recovery = X/T x 100%

where, X = the observed value of measurement; and

T = “true “ value (value of primary sample with no spiking matrix added).

Percent recovery values provide an indication of the effect of sample matrix on the accuracy of the analysis, in addition to analytical accuracy.

*Surrogates* - are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in field samples. These compounds are spiked into all sample aliquots prior to preparation and analysis. Percent recoveries are calculated for each surrogate, providing an indication of analytical accuracy including unusual matrix effects and gross sample processing errors.

The following QC checks are to be performed at a frequency of 1 in 20 field samples or greater for volatile, semi-volatile and metal analytes:

- Reagent/method blanks;
- Calibration check standards;
- Laboratory duplicates;
- Control spikes;
- Laboratory Control Samples; and
- MS/MSDs (metals only).

With respect to routine organics analysis, ALS use spiked samples because of the difficulty in obtaining appropriate, matrix-matched, certified reference materials for all target analytes. ALS QC protocols require the use of an Independent Calibration Verification standard (ICV) for all methods. An ICV is prepared from target analytes obtained from an independent source from those used for calibration standards or as spiking solutions for laboratory control samples and matrix spikes. This provides an indirect independent check of the accuracy of laboratory control and matrix spikes.

### 6.4.2 Data Handling

All analytical data generated by the analytical laboratory will be appropriately reduced and undergo comprehensive validation prior to reporting. Records and numerical calculations will be legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

The originating analyst will reduce and validate a given data package to ensure that:

- Holding times have been met;
- Appropriate standard operating procedures have been followed;
- Field sample results are correct and complete (if applicable);
- QC check sample results are correct and complete;
- QC check sample results are within established control limits and data quality objectives; and
- Documentation is complete.

If the originating analyst finds that the validity of data is in doubt due to non-conformance with the above checklist, then the data is flagged and appropriate corrective procedures are initiated.

Once the originating analyst has reduced and validated the data package, it is then passed onto the Document Control/Quality Assurance Officer, Laboratory Manager, or other appropriately qualified senior personnel for independent review.

A NATA approved signatory signs and releases the work reported.

The requirements of the reports include the following:

- The format of the final report is in full accordance with NATA requirements for Chemical Testing, including the provision of a NATA stamp on the covering page if appropriate;
- A summary table of sample no., matrix, date sampled, date received, date prepared/extracted and date analysed is completed;
- All field sample results for each type of sample matrix, as listed on the CoC, are reported collectively on separate tables noting URS sample ID, Laboratory ID and Laboratory sample Batch No;
- All QA check results are reported. Each type of sample matrix, as listed on the CoC, are reported collectively on separate tables;
- All water matrix results are expressed as mg/L or µg/L;
- All solid matrix results are expressed as mg/kg or µg/kg (dry weight);
- Full reference to analytical procedures used are stated;

- Modifications to procedures performed outside the requirements of this SAP have been stated;
- Non-conformance to any of the analytical requirements of this SAP are clearly stated;
- A key to abbreviations is provided; and
- Analyte nomenclature remains consistent throughout the entire project.

If complete, the final report is then signed by the appropriate NATA signatory and submitted to URS.

In the event that a preliminary test report is issued, the degree to which the data has been validated by the laboratory must be clearly indicated, and the final test report must contain an appropriate reference to the original one.

If, after the issuing of a report, data are found to be invalid, the original report must be withdrawn and replaced by one marked “Replacement for Report No”, with a version number clearly marked.

### 6.4.3 Data Validation

The primary objective of the data validation process is to ensure that the data reported can be used to achieve the project objectives.

The validity of all analytical data reported will be assessed by URS by critical review of the QC check sample results. This will be performed in general accordance with guidance by US EPA guidelines and NODG as presented in the document “National Functional Guidelines For Organic Data Review, Multimedia, Multiconcentration (OLMO 1.0) and Low Concentration Water (OLCO 1.0), June 1991”, where appropriate (USEPA, 1991).

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# Limitations

URS Australia Pty Ltd (URS) has prepared this document in accordance with the usual care and thoroughness of the consulting profession for the use of Hornsby Shire Council and their consultants and only those third parties who have been authorised in writing by URS to rely on the document. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this document. It is prepared in accordance with the Proposal dated 29 August 2006 and was modified to reflect the outcomes of the Stage 1 Sediment Study.

The methodology adopted and sources of information used by URS are outlined in this document. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this document as provided to URS was false.

This Sampling and Analysis Plan (SAP) for sediment investigations has been developed in accordance with the scope of works provided by Hornsby Shire Council and the outcomes and feedback from the Estuary Management Committee Meeting at Hornsby Shire Council on 8 February 2007, and was prepared between 8 and 20 February 2007. The SAP is based on the conditions encountered and information reviewed at the time of preparation.

This document should be read in full. No responsibility is accepted for use of any part of this document in any other context or for any other purpose or by third parties. This document does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Opinions and recommendations contained in this plan are based upon data provided by representatives of Hornsby Shire Council, information gained as a result of the Stage 1 Sediment Study and other information provided from government authorities' records and other third parties. This approach reflects current professional practice for sediment investigations.

This investigation addresses the likelihood of hazardous substance contamination resulting from past and current known uses of the study area. Given the limited and mutually agreed scope of work, URS does not guarantee that hazardous materials do not exist in an area of sediment. Similarly, an area of sediment which appears to be unaffected by hazardous materials at the time of our assessment may later, due to natural phenomena or human intervention, become contaminated.

Subsurface conditions can vary across a particular site and cannot be explicitly defined by these investigations. It is unlikely therefore that the results and estimations expressed in this document will represent the extremes of conditions within the site or the conditions at any location removed from the specific points of sampling. Subsurface conditions including contaminant concentrations can also change in a short time.

The information in this document is considered to be accurate at the date of issue and is in accordance with known conditions at the site.

This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this document.

## Table 1. Sampling Locations

| Sample ID | Location Decription | Easting | Northing | Analytes |
|---|---|---|---|---|
| H7 | Berowara Creek Calabash Bay | 325530 | 6282107 | TBT, PCBs, PAHs, OCPs, OPPs, Silver |
| H8 | Berowra Creek east of Crossland Bay | 325808 | 6281083 | TBT, PCBs, PAHs, OCPs, OPPs |
| H9 | Berowra Creek at Marina | 325771 | 6280706 | TBT, PCBs, PAHs, OCPs, OPPs, Diuron and Chlorothalonil (quantitative analysis), Irgarol and Dichlofluanid (semi-quantitative analysis) |
| H10 | Berowra Creek | 325685 | 6280026 | TBT, PCBs, PAHs, OCPs, OPPs |
| H17 | Hawkesbury River Sandbrook Inlet West - at Marina | 333320 | 6286561 | TBT, PCBs, PAHs, OCPs, OPPs |
| H18 | Hawkesbury River Sandbrook Inlet East | 335098 | 6287024 | TBT, PCBs, PAHs, OCPs, OPPs |
| H21 | Cowan Creek Bobbin Head - at Marina | 329680 | 6273756 | TBT, PCBs, PAHs, OCPs, OPPs |
| H22 | Cowan Creek Apple Tree Bay | 328980 | 6274926 | TBT, PCBs, PAHs, OCPs, OPPs |
| H23 | Cowan Creek east of Waratah Bay | 330452 | 6277834 | TBT, PCBs, PAHs, OCPs, OPPs |
| H24 | Cowan Creek Smiths Creek | 332960 | 6277113 | TBT, PCBs, PAHs, OCPs, OPPs |
| H25 | Cowan Creek Akuna Bay - at Marina adjacent to slipway | 336465 | 6275815 | TBT, PCBs, PAHs, OCPs, OPPs |
| H26 | Cowan Creek Akuna Bay - at Marina refueling station | 336487 | 6276077 | TBT, PCBs, PAHs, OCPs, OPPs |
| H28 | Cowan Creek Cottage Point - adjacent to kiosk | 333768 | 6278915 | TBT, PCBs, PAHs, OCPs, OPPs |
| H31 | Cowan Creek Refuge Bay | 337481 | 6280993 | TBT, PCBs, PAHs, OCPs, OPPs (possibly diuron and |

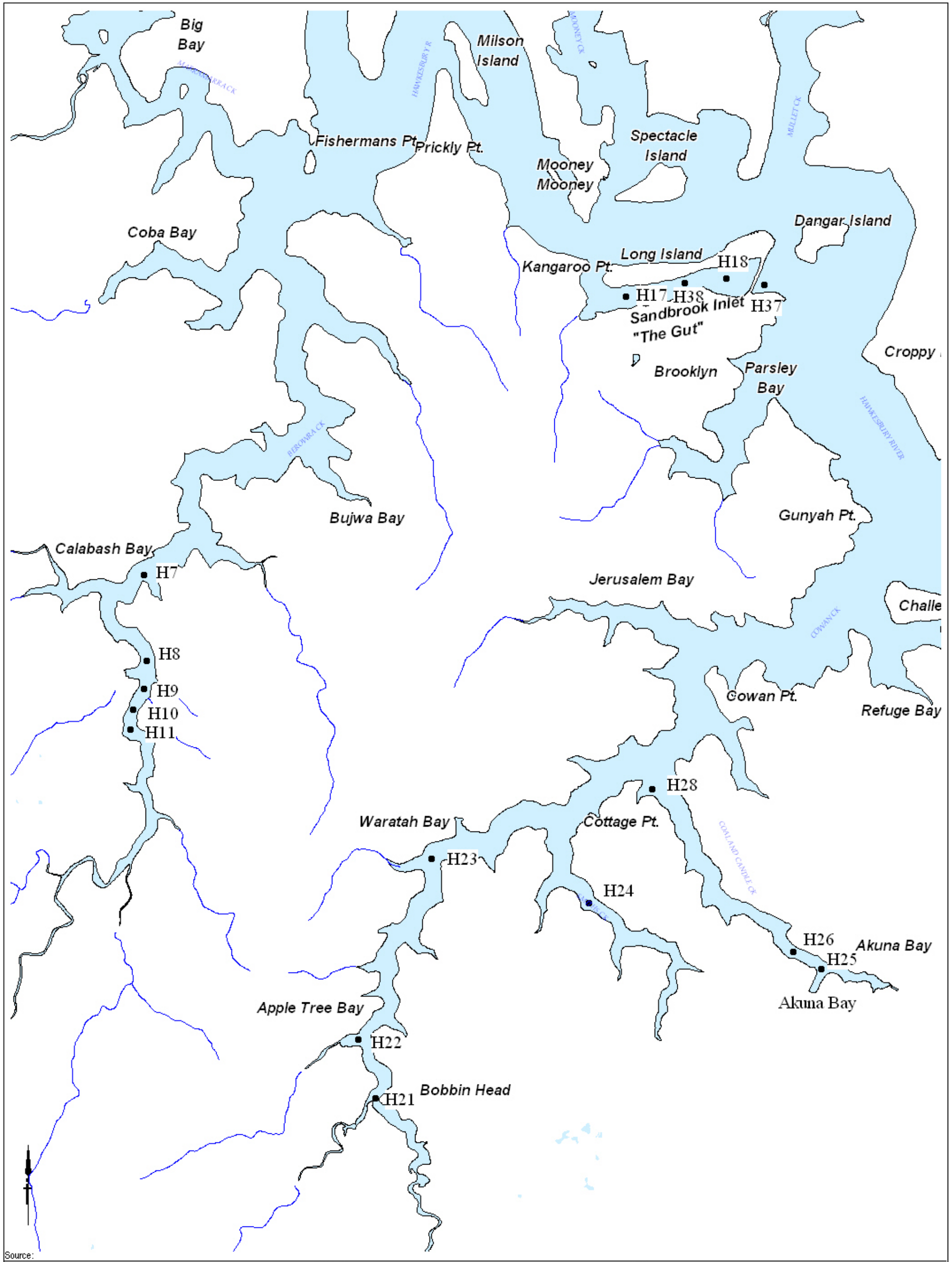
| | | | | |
|---|---|---|---|---|
| | | | | chlorothalonil (quantitative analysis), irgarol and dichlofluanid (semi-quantitative analysis) if no samples collected at H40 to H42) |
| H31 | Cowan Creek Refuge Bay | 337481 | 6280993 | TBT, PCBs, PAHs, OCPs, OPPs, diuron and chlorothalonil (quantitative analysis), irgarol and dichlofluanid (semi-quantitative analysis) |
| H37 | Hawkesbury River Brooklyn Jetty - at Marina | 335462 | 6286738 | TBT, PCBs, PAHs, OCPs, OPPs, diuron and chlorothalonil (quantitative analysis), irgarol and dichlofluanid (semi-quantitative analysis) |
| H38 | Hawkesbury River south of Sandbrook Inlet (centre) | 334339 | 6286858 | TBT, PCBs, PAHs, OCPs, OPPs, diuron and chlorothalonil (quantitative analysis), irgarol and dichlofluanid (semi-quantitative analysis) |
| H3 | Berowra Creek west of Berowra Point | 327506 | 6287314 | Silver |
| H5 | Berowra Creek west of Bujwa Creek | 326962 | 6283927 | Silver |
| H40 | Hawkesbury River northwest of Long Island (STP site) | 333300 | 6287277 | TKN, TOC, NOX, Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd, PCBs, PAHs, OCPs, OPPs, TPHs, BTEX, grain size |
| H41 | Hawkesbury River north of Kangaroo Point (STP site) | 332885 | 6287343 | TKN, TOC, NOX, Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd, PCBs, PAHs, OCPs, OPPs, TPHs, BTEX, grain size |

| | | | | |
|---|---|---|---|---|
| H42 | Hawkesbury River west of Hawkesbury Road Bridge (STP site) | 332557 | 6287461 | TKN, TOC, NOX, Ca, Mg, Be, Al, V, Cr, Mn, Fe, Co, Cu, Zn, As, Sr, Ni, Ba, Pb, Cd, PCBs, PAHs, OCPs, OPPs, TPHs, BTEX, grain size |

*Map Grid of Australia MGA94 (Zone 55); TBD = To be determined

Three samples from locations H37 (Brooklyn), H9 (Berowra Creek Marina) and H38 (Sandbrook Inlet) will be analysed for antifouling booster biocides diuron and chlorothalonil (quantitative analysis) and irgarol and dichlofluanid (semi-quantitative analysis) (with possibly a fourth sample from location H31 in Refuge Bay, if no samples are collected at H40, H41 and H42). Three samples from Berowra Creek will be analysed for Silver (H3, H5 and H7).

# Figure



Source:

Client
Hornsby Shire Council

Project
SEDIMENT AND ANTIFOUL
MONITORING STUDY (STAGE 2)

Title
**Proposed Sample Locations**

Drawn: CM
Approved: DRAFT
Date: 13-02-07
Job No: **43217595**
File No: Proposed Sampling 4.wor
Figure: 1
Rev: A
A4

# Appendices

Appendix D – Photographs (provided electronically only)

# Appendices

## Appendix E – Analytical Data

**ALS Environmental**

# CERTIFICATE OF ANALYSIS

| | | | | | |
|---|---|---|---|---|---|
| *Client* | : **URS AUSTRALIA (NSW) PTY LTD** | *Laboratory* | : **Environmental Division Sydney** | *Page* | : **1 of 15** |
| *Contact* | : **MR CARSTEN MATTHAI** | *Contact* | : **Victor Kedicioglu** | *Work Order* | : **ES0703904** |
| *Address* | : **LEVEL 3, 116 MILLER STREET NORTH**<br>**SYDNEY NSW AUSTRALIA 2060** | *Address* | : **277-289 Woodpark Road Smithfield NSW**<br>**Australia 2164** | *Amendment No.* | : **3** |
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| *Facsimile* | : **89255555** | *Facsimile* | : **61-2-8784 8500** | | |
| *Project* | : **42317595 Sediment Study** | *Quote number* | : **SY/019/07 V2** | *Date received* | : **27 Mar 2007** |
| *Order number* | : **- Not provided -** | | | *Date issued* | : **10 May 2007** |
| *C-O-C number* | : **- Not provided -** | | | *No. of samples* - *Received* | : **18** |
| *Site* | : **- Not provided -** | | | *Analysed* | : **18** |

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This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatory* | *Position* | *Department* |
|---|---|---|
| **Pabi Subba** | | **Organics - NATA 825 (10911 - Sydney)** |
| **PHALAK INTHAKESONE** | **Organics Co-ordinator** | **Organics - NATA 825 (10911 - Sydney)** |
| **Rassem Ayoubi** | **Senior Organic Chemist** | **Organics - NATA 825 (10911 - Sydney)** |

## Comments

This report for the ALSE reference ES0703904 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order **ES0703904**

EP130, EP131A: Matrix spike and surrogate recoveries are low or not determined due to sample matrix effects.

## Analytical Results

| | | | **Client Sample ID :** | **H7** | **H8** | **H9** | **H10** | **H17** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703904-001** | **ES0703904-002** | **ES0703904-003** | **ES0703904-004** | **ES0703904-005** |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 74.0 | 74.7 | 75.7 | 65.0 | 62.1 |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| C6 - C9 Fraction | | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| C10 - C14 Fraction | | 50 | mg/kg | <110 | <100 | <70 | <50 | <50 |
| C15 - C28 Fraction | | 100 | mg/kg | <220 | <190 | <140 | <110 | <100 |
| C29 - C36 Fraction | | 100 | mg/kg | <220 | <190 | <140 | <110 | <100 |
| **EP080: BTEX** | | | | | | | | |
| Benzene | 71-43-2 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Toluene | 108-88-3 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Ethylbenzene | 100-41-4 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| meta- & para-Xylene | 108-38-3<br>106-42-3 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| ortho-Xylene | 95-47-6 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | | | |
| Bromophos-ethyl | 4824-78-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Carbophenothion | 786-19-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorfenvinphos (E) | 470-90-6 | 10.0 | µg/kg | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| Chlorfenvinphos (Z) | 470-90-8 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorpyrifos | 2921-88-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorpyrifos-methyl | 5598-13-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Demeton-S-methyl | 919-86-8 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Diazinon | 333-41-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Dichlorvos | 62-73-7 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Dimethoate | 60-51-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Ethion | 563-12-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Fenamiphos | 22224-92-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Fenthion | 55-38-9 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Malathion | 121-75-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Azinphos Methyl | 86-50-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Monocrotophos | 6923-22-4 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Parathion | 56-38-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Parathion-methyl | 298-00-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Pirimphos-ethyl | 23505-41-1 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Prothiofos | 34643-46-4 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| Aldrin | 309-00-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| alpha-BHC | 319-84-6 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |

## Analytical Results

| **Client Sample ID :** | | | | **H7** | **H8** | **H9** | **H10** | **H17** |
|---|---|---|---|---|---|---|---|---|
| Sample Matrix Type / Description : | | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| Sample Date / Time : | | | | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| Laboratory Sample ID : | | | | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703904-001** | **ES0703904-002** | **ES0703904-003** | **ES0703904-004** | **ES0703904-005** |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| beta-BHC | 319-85-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| delta-BHC | 319-86-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4'-DDD | 72-54-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4'-DDE | 72-55-9 | 0.50 | µg/kg | <0.50 | 0.66 | 1.12 | 0.53 | <0.50 |
| 4.4'-DDT | 50-29-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| DDT (total) | | 0.50 | µg/kg | <0.50 | 0.66 | 1.12 | 0.53 | <0.50 |
| Dieldrin | 60-57-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| alpha-Endosulfan | 959-98-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| beta-Endosulfan | 33213-65-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endosulfan sulfate | 1031-07-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endosulfan | 115-29-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin | 72-20-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin aldehyde | 7421-93-4 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin ketone | 53494-70-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Heptachlor | 76-44-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Heptachlor epoxide | 1024-57-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Hexachlorobenzene (HCB) | 118-74-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| gamma-BHC | 58-89-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Methoxychlor | 72-43-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| cis-Chlordane | 5103-71-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| trans-Chlordane | 5103-74-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Total Chlordane | | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | | | |
| Total Polychlorinated biphenyls | | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Aroclor 1016 | 12974-11-2 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| Aroclor 1221 | 11104-28-2 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| Aroclor 1232 | 11141-16-5 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| Aroclor 1242 | 53469-21-9 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| Aroclor 1248 | 12672-29-6 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| Aroclor 1254 | 11097-69-1 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| Aroclor 1260 | 11096-82-5 | 5.0 | µg/kg | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| 3-Methylcholanthrene | 56-49-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| 2-Methylnaphthalene | 91-57-6 | 10 | µg/kg | 70 | <10 | 70 | 40 | 50 |
| 7.12-Dimethylbenz(a)anthracene | 57-97-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Acenaphthene | 83-32-9 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Acenaphthylene | 208-96-8 | 10 | µg/kg | <10 | 10 | 10 | 20 | 20 |

## Analytical Results

| | | | **Client Sample ID :** | **H7** | **H8** | **H9** | **H10** | **H17** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703904-001** | **ES0703904-002** | **ES0703904-003** | **ES0703904-004** | **ES0703904-005** |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| Anthracene | 120-12-7 | 10 | µg/kg | 10 | <10 | 20 | 20 | 20 |
| Benz(a)anthracene | 56-55-3 | 10 | µg/kg | 50 | 30 | 40 | 50 | 110 |
| Benzo(a)pyrene | 50-32-8 | 10 | µg/kg | 70 | 50 | 50 | 70 | 140 |
| Benzo(b)fluoranthene | 205-99-2 | 10 | µg/kg | 60 | 50 | 60 | 80 | 150 |
| Benzo(e)pyrene | 192-97-2 | 10 | µg/kg | 50 | 40 | 40 | 60 | 100 |
| Benzo(g.h.i)perylene | 191-24-2 | 10 | µg/kg | 60 | 50 | 50 | 70 | 110 |
| Benzo(k)fluoranthene | 207-08-9 | 10 | µg/kg | 60 | 40 | 40 | 50 | 130 |
| Chrysene | 218-01-9 | 10 | µg/kg | 60 | 40 | 50 | 70 | 150 |
| Coronene | 191-07-1 | 10 | µg/kg | 10 | 10 | 20 | 20 | 30 |
| Dibenz(a.h)anthracene | 53-70-3 | 10 | µg/kg | 10 | <10 | <10 | <10 | 20 |
| Fluoranthene | 206-44-0 | 10 | µg/kg | 90 | 70 | 70 | 110 | 240 |
| Fluorene | 86-73-7 | 10 | µg/kg | 10 | <10 | 10 | <10 | 10 |
| Indeno(1.2.3.cd)pyrene | 193-39-5 | 10 | µg/kg | 50 | 40 | 30 | 40 | 90 |
| N-2-Fluorenyl Acetamide | 53-96-3 | 100 | µg/kg | <100 | <100 | <100 | <100 | <100 |
| Naphthalene | 91-20-3 | 10 | µg/kg | 70 | <10 | 70 | 40 | 50 |
| Perylene | 198-55-0 | 10 | µg/kg | 30 | 20 | 20 | 30 | 60 |
| Phenanthrene | 85-01-8 | 10 | µg/kg | 50 | 30 | 50 | 50 | 80 |
| Pyrene | 129-00-0 | 10 | µg/kg | 100 | 70 | 80 | 110 | 220 |
| **EP080S: TPH(V)/BTEX Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 0.1 | % | 105 | 85.3 | 112 | 87.5 | 86.4 |
| Toluene-D8 | 2037-26-5 | 0.1 | % | 110 | 80.0 | 89.0 | 80.0 | 85.6 |
| 4-Bromofluorobenzene | 460-00-4 | 0.1 | % | 92.6 | 81.0 | 99.2 | 81.5 | 82.1 |
| **EP130S: Organophosphorus Pesticide Surrogate** | | | | | | | | |
| DEF | 78-48-8 | 0.1 | % | 21.8 | 32.4 | 30.0 | Not Determined | 34.9 |
| **EP131S: OC Pesticide Surrogate** | | | | | | | | |
| Dibromo-DDE | 21655-73-2 | 0.1 | % | 25.3 | 35.1 | 45.6 | 18.3 | 24.4 |
| **EP131T: PCB Surrogate** | | | | | | | | |
| Decachlorobiphenyl | 2051-24-3 | 0.1 | % | 26.6 | 39.9 | 47.9 | 21.9 | 23.5 |
| **EP132T: Base/Neutral Extractable Surrogates** | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | 0.1 | % | 62.9 | 49.8 | 55.2 | 64.7 | 65.0 |
| Anthracene-d10 | 1719-06-8 | 0.1 | % | 67.7 | 67.3 | 66.8 | 72.4 | 72.6 |
| 4-Terphenyl-d14 | 1718-51-0 | 0.1 | % | 63.7 | 61.8 | 63.5 | 72.3 | 72.4 |

## Analytical Results

| | | | **Client Sample ID :** | **H18** | **H21** | **H22** | **H23** | **H24** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | **ES0703904-006** | **ES0703904-007** | **ES0703904-008** | **ES0703904-009** | **ES0703904-010** |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 61.6 | 65.0 | 71.7 | 78.2 | 76.0 |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| C6 - C9 Fraction | | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| C10 - C14 Fraction | | 50 | mg/kg | <50 | <50 | <50 | <140 | <60 |
| C15 - C28 Fraction | | 100 | mg/kg | <100 | <100 | <100 | <270 | <120 |
| C29 - C36 Fraction | | 100 | mg/kg | <100 | <100 | <100 | <270 | <120 |
| **EP080: BTEX** | | | | | | | | |
| Benzene | 71-43-2 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Toluene | 108-88-3 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Ethylbenzene | 100-41-4 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| meta- & para-Xylene | 108-38-3<br>106-42-3 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| ortho-Xylene | 95-47-6 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | | | |
| Bromophos-ethyl | 4824-78-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Carbophenothion | 786-19-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorfenvinphos (E) | 470-90-6 | 10.0 | µg/kg | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| Chlorfenvinphos (Z) | 470-90-8 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorpyrifos | 2921-88-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorpyrifos-methyl | 5598-13-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Demeton-S-methyl | 919-86-8 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Diazinon | 333-41-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Dichlorvos | 62-73-7 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Dimethoate | 60-51-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Ethion | 563-12-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Fenamiphos | 22224-92-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Fenthion | 55-38-9 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Malathion | 121-75-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Azinphos Methyl | 86-50-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Monocrotophos | 6923-22-4 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Parathion | 56-38-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Parathion-methyl | 298-00-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Pirimphos-ethyl | 23505-41-1 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Prothiofos | 34643-46-4 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| Aldrin | 309-00-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| alpha-BHC | 319-84-6 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |

## Analytical Results

| | | | Client Sample ID : | **H18** | **H21** | **H22** | **H23** | **H24** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | **ES0703904-006** | **ES0703904-007** | **ES0703904-008** | **ES0703904-009** | **ES0703904-010** |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| beta-BHC | 319-85-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| delta-BHC | 319-86-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4’-DDD | 72-54-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4’-DDE | 72-55-9 | 0.50 | µg/kg | <0.50 | 1.04 | <0.50 | <0.50 | <0.50 |
| 4.4’-DDT | 50-29-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| DDT (total) | | 0.50 | µg/kg | <0.50 | 1.04 | <0.50 | <0.50 | <0.50 |
| Dieldrin | 60-57-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| alpha-Endosulfan | 959-98-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| beta-Endosulfan | 33213-65-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endosulfan sulfate | 1031-07-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endosulfan | 115-29-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin | 72-20-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin aldehyde | 7421-93-4 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin ketone | 53494-70-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Heptachlor | 76-44-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Heptachlor epoxide | 1024-57-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Hexachlorobenzene (HCB) | 118-74-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| gamma-BHC | 58-89-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Methoxychlor | 72-43-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| cis-Chlordane | 5103-71-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| trans-Chlordane | 5103-74-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Total Chlordane | | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | | | |
| Total Polychlorinated biphenyls | | 5.0 | µg/kg | <5.0 | 13.9 | <5.0 | <5.0 | <5.0 |
| Aroclor 1016 | 12974-11-2 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <6.2 | <6.2 |
| Aroclor 1221 | 11104-28-2 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <6.2 | <6.2 |
| Aroclor 1232 | 11141-16-5 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <6.2 | <6.2 |
| Aroclor 1242 | 53469-21-9 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <6.2 | <6.2 |
| Aroclor 1248 | 12672-29-6 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <6.2 | <6.2 |
| Aroclor 1254 | 11097-69-1 | 5.0 | µg/kg | <5.0 | 13.9 | <5.0 | <6.2 | <6.2 |
| Aroclor 1260 | 11096-82-5 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <6.2 | <6.2 |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| 3-Methylcholanthrene | 56-49-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| 2-Methylnaphthalene | 91-57-6 | 10 | µg/kg | 50 | 50 | <10 | 70 | 50 |
| 7.12-Dimethylbenz(a)anthracene | 57-97-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Acenaphthene | 83-32-9 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Acenaphthylene | 208-96-8 | 10 | µg/kg | 30 | 50 | 20 | 20 | 10 |

## Analytical Results

| | | | Client Sample ID : | **H18** | **H21** | **H22** | **H23** | **H24** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | **ES0703904-006** | **ES0703904-007** | **ES0703904-008** | **ES0703904-009** | **ES0703904-010** |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| Anthracene | 120-12-7 | 10 | µg/kg | 20 | 50 | 20 | 20 | 10 |
| Benz(a)anthracene | 56-55-3 | 10 | µg/kg | 140 | 110 | 70 | 40 | 30 |
| Benzo(a)pyrene | 50-32-8 | 10 | µg/kg | 190 | 160 | 110 | 60 | 50 |
| Benzo(b)fluoranthene | 205-99-2 | 10 | µg/kg | 210 | 160 | 90 | 60 | 50 |
| Benzo(e)pyrene | 192-97-2 | 10 | µg/kg | 140 | 120 | 70 | 50 | 40 |
| Benzo(g.h.i)perylene | 191-24-2 | 10 | µg/kg | 160 | 120 | 80 | 50 | 40 |
| Benzo(k)fluoranthene | 207-08-9 | 10 | µg/kg | 160 | 150 | 100 | 60 | 40 |
| Chrysene | 218-01-9 | 10 | µg/kg | 170 | 150 | 90 | 50 | 40 |
| Coronene | 191-07-1 | 10 | µg/kg | 40 | 40 | 30 | 20 | 10 |
| Dibenz(a.h)anthracene | 53-70-3 | 10 | µg/kg | 30 | 30 | 10 | 10 | <10 |
| Fluoranthene | 206-44-0 | 10 | µg/kg | 260 | 250 | 160 | 90 | 60 |
| Fluorene | 86-73-7 | 10 | µg/kg | 10 | 10 | <10 | 10 | <10 |
| Indeno(1.2.3.cd)pyrene | 193-39-5 | 10 | µg/kg | 120 | 90 | 60 | 40 | 30 |
| N-2-Fluorenyl Acetamide | 53-96-3 | 100 | µg/kg | <100 | <100 | <100 | <100 | <100 |
| Naphthalene | 91-20-3 | 10 | µg/kg | 50 | 50 | <10 | 70 | 50 |
| Perylene | 198-55-0 | 10 | µg/kg | 60 | 50 | 30 | 20 | 20 |
| Phenanthrene | 85-01-8 | 10 | µg/kg | 70 | 110 | 60 | 50 | 40 |
| Pyrene | 129-00-0 | 10 | µg/kg | 260 | 260 | 160 | 100 | 70 |
| **EP080S: TPH(V)/BTEX Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 0.1 | % | 87.6 | 87.1 | 116 | 101 | 106 |
| Toluene-D8 | 2037-26-5 | 0.1 | % | 86.1 | 80.8 | 116 | 106 | 117 |
| 4-Bromofluorobenzene | 460-00-4 | 0.1 | % | 81.9 | 77.8 | 94.2 | 90.0 | 96.0 |
| **EP130S: Organophosphorus Pesticide Surrogate** | | | | | | | | |
| DEF | 78-48-8 | 0.1 | % | 32.2 | Not Determined | 29.4 | Not Determined | 28.3 |
| **EP131S: OC Pesticide Surrogate** | | | | | | | | |
| Dibromo-DDE | 21655-73-2 | 0.1 | % | 41.7 | 28.1 | 47.2 | Not Determined | 15.5 |
| **EP131T: PCB Surrogate** | | | | | | | | |
| Decachlorobiphenyl | 2051-24-3 | 0.1 | % | 51.6 | 25.9 | 55.5 | Not Determined | 19.2 |
| **EP132T: Base/Neutral Extractable Surrogates** | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | 0.1 | % | 53.9 | 54.8 | 50.0 | 57.5 | 71.3 |
| Anthracene-d10 | 1719-06-8 | 0.1 | % | 67.0 | 62.4 | 62.0 | 68.0 | 81.5 |
| 4-Terphenyl-d14 | 1718-51-0 | 0.1 | % | 63.2 | 54.3 | 60.1 | 62.8 | 75.4 |

## Analytical Results

| | | | Client Sample ID : | **H25** | **H26** | **H28** | **H31** | **H37** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703904-011** | **ES0703904-012** | **ES0703904-013** | **ES0703904-014** | **ES0703904-015** |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 37.7 | 60.4 | 48.5 | 62.4 | 64.7 |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| C6 - C9 Fraction | | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| C10 - C14 Fraction | | 50 | mg/kg | <50 | <50 | <50 | <50 | <60 |
| C15 - C28 Fraction | | 100 | mg/kg | <100 | <100 | <100 | <100 | <110 |
| C29 - C36 Fraction | | 100 | mg/kg | <100 | <100 | <100 | <100 | <110 |
| **EP080: BTEX** | | | | | | | | |
| Benzene | 71-43-2 | 0.1 | mg/kg | <0.1 | <0.2 | <0.1 | <0.2 | <0.2 |
| Toluene | 108-88-3 | 0.1 | mg/kg | <0.1 | <0.2 | <0.1 | <0.2 | <0.2 |
| Ethylbenzene | 100-41-4 | 0.1 | mg/kg | <0.1 | <0.2 | <0.1 | <0.2 | <0.2 |
| meta- & para-Xylene | 108-38-3<br>106-42-3 | 0.1 | mg/kg | <0.1 | <0.2 | <0.1 | <0.2 | <0.2 |
| ortho-Xylene | 95-47-6 | 0.1 | mg/kg | <0.1 | <0.2 | <0.1 | <0.2 | <0.2 |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | | | |
| Bromophos-ethyl | 4824-78-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Carbophenothion | 786-19-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorfenvinphos (E) | 470-90-6 | 10.0 | µg/kg | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| Chlorfenvinphos (Z) | 470-90-8 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorpyrifos | 2921-88-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Chlorpyrifos-methyl | 5598-13-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Demeton-S-methyl | 919-86-8 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Diazinon | 333-41-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Dichlorvos | 62-73-7 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Dimethoate | 60-51-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Ethion | 563-12-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Fenamiphos | 22224-92-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Fenthion | 55-38-9 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Malathion | 121-75-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Azinphos Methyl | 86-50-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Monocrotophos | 6923-22-4 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Parathion | 56-38-2 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Parathion-methyl | 298-00-0 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Pirimphos-ethyl | 23505-41-1 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Prothiofos | 34643-46-4 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| Aldrin | 309-00-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| alpha-BHC | 319-84-6 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |

## Analytical Results

| | | | Client Sample ID : | H25 | H26 | H28 | H31 | H37 |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | | | | | |
| *Analyte* | *CAS number* | *LOR* | *Units* | **ES0703904-011** | **ES0703904-012** | **ES0703904-013** | **ES0703904-014** | **ES0703904-015** |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| beta-BHC | 319-85-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| delta-BHC | 319-86-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4'-DDD | 72-54-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4'-DDE | 72-55-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 4.4'-DDT | 50-29-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| DDT (total) | | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Dieldrin | 60-57-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| alpha-Endosulfan | 959-98-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| beta-Endosulfan | 33213-65-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endosulfan sulfate | 1031-07-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endosulfan | 115-29-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin | 72-20-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin aldehyde | 7421-93-4 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Endrin ketone | 53494-70-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Heptachlor | 76-44-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Heptachlor epoxide | 1024-57-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Hexachlorobenzene (HCB) | 118-74-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| gamma-BHC | 58-89-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Methoxychlor | 72-43-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| cis-Chlordane | 5103-71-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| trans-Chlordane | 5103-74-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Total Chlordane | | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | | | |
| Total Polychlorinated biphenyls | | 5.0 | µg/kg | <5.0 | <5.0 | 16.0 | <5.0 | <5.0 |
| Aroclor 1016 | 12974-11-2 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Aroclor 1221 | 11104-28-2 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Aroclor 1232 | 11141-16-5 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Aroclor 1242 | 53469-21-9 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Aroclor 1248 | 12672-29-6 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Aroclor 1254 | 11097-69-1 | 5.0 | µg/kg | <5.0 | <5.0 | 16.0 | <5.0 | <5.0 |
| Aroclor 1260 | 11096-82-5 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| 3-Methylcholanthrene | 56-49-5 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| 2-Methylnaphthalene | 91-57-6 | 10 | µg/kg | 30 | 30 | 30 | 40 | 50 |
| 7.12-Dimethylbenz(a)anthracene | 57-97-6 | 10 | µg/kg | <10 | <10 | <10 | <10 | <10 |
| Acenaphthene | 83-32-9 | 10 | µg/kg | <10 | 20 | 20 | <10 | 10 |
| Acenaphthylene | 208-96-8 | 10 | µg/kg | <10 | 20 | 20 | <10 | 40 |

## *Analytical Results*

| | | | Client Sample ID : | **H25** | **H26** | **H28** | **H31** | **H37** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703904-011** | **ES0703904-012** | **ES0703904-013** | **ES0703904-014** | **ES0703904-015** |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| Anthracene | 120-12-7 | 10 | µg/kg | <10 | 80 | 60 | <10 | 40 |
| Benz(a)anthracene | 56-55-3 | 10 | µg/kg | 20 | 370 | 320 | 20 | 160 |
| Benzo(a)pyrene | 50-32-8 | 10 | µg/kg | 20 | 410 | 380 | 30 | 170 |
| Benzo(b)fluoranthene | 205-99-2 | 10 | µg/kg | 20 | 370 | 340 | 30 | 200 |
| Benzo(e)pyrene | 192-97-2 | 10 | µg/kg | 10 | 220 | 210 | 20 | 120 |
| Benzo(g.h.i)perylene | 191-24-2 | 10 | µg/kg | 20 | 220 | 210 | 20 | 110 |
| Benzo(k)fluoranthene | 207-08-9 | 10 | µg/kg | 10 | 260 | 250 | 30 | 130 |
| Chrysene | 218-01-9 | 10 | µg/kg | 20 | 360 | 310 | 30 | 190 |
| Coronene | 191-07-1 | 10 | µg/kg | <10 | 50 | 50 | <10 | 30 |
| Dibenz(a.h)anthracene | 53-70-3 | 10 | µg/kg | <10 | 50 | 60 | <10 | 20 |
| Fluoranthene | 206-44-0 | 10 | µg/kg | 50 | 750 | 590 | 40 | 370 |
| Fluorene | 86-73-7 | 10 | µg/kg | <10 | 20 | 10 | <10 | 20 |
| Indeno(1.2.3.cd)pyrene | 193-39-5 | 10 | µg/kg | 10 | 180 | 170 | 20 | 90 |
| N-2-Fluorenyl Acetamide | 53-96-3 | 100 | µg/kg | <100 | <100 | <100 | <100 | <100 |
| Naphthalene | 91-20-3 | 10 | µg/kg | 30 | 30 | 30 | 40 | 60 |
| Perylene | 198-55-0 | 10 | µg/kg | <10 | 100 | 90 | 20 | 60 |
| Phenanthrene | 85-01-8 | 10 | µg/kg | 40 | 270 | 180 | 30 | 100 |
| Pyrene | 129-00-0 | 10 | µg/kg | 40 | 820 | 660 | 50 | 350 |
| **EP080S: TPH(V)/BTEX Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 0.1 | % | 93.3 | 81.8 | 120 | 105 | 84.4 |
| Toluene-D8 | 2037-26-5 | 0.1 | % | 86.9 | 79.9 | 96.0 | 112 | 79.6 |
| 4-Bromofluorobenzene | 460-00-4 | 0.1 | % | 83.6 | 77.9 | 105 | 90.2 | 80.0 |
| **EP130S: Organophosphorus Pesticide Surrogate** | | | | | | | | |
| DEF | 78-48-8 | 0.1 | % | 41.4 | 22.6 | Not Determined | 27.3 | 45.9 |
| **EP131S: OC Pesticide Surrogate** | | | | | | | | |
| Dibromo-DDE | 21655-73-2 | 0.1 | % | 64.9 | 57.6 | 24.4 | 41.6 | 61.1 |
| **EP131T: PCB Surrogate** | | | | | | | | |
| Decachlorobiphenyl | 2051-24-3 | 0.1 | % | 61.0 | 82.6 | 24.5 | 43.7 | 64.1 |
| **EP132T: Base/Neutral Extractable Surrogates** | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | 0.1 | % | 60.0 | 54.5 | 60.0 | 55.2 | 59.3 |
| Anthracene-d10 | 1719-06-8 | 0.1 | % | 67.2 | 57.8 | 67.6 | 55.4 | 67.5 |
| 4-Terphenyl-d14 | 1718-51-0 | 0.1 | % | 64.0 | 66.4 | 65.9 | 56.7 | 69.2 |

## Analytical Results

| | | | Client Sample ID : | **H38** | **QC3** | **QC4** | | |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | | |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | | |
| | | | Laboratory Sample ID : | **ES0703904-016** | **ES0703904-017** | **ES0703904-018** | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 60.0 | 59.5 | 74.5 | | |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| C6 - C9 Fraction | | 10 | mg/kg | <10 | <10 | <10 | | |
| C10 - C14 Fraction | | 50 | mg/kg | <50 | <50 | <50 | | |
| C15 - C28 Fraction | | 100 | mg/kg | <100 | <110 | <100 | | |
| C29 - C36 Fraction | | 100 | mg/kg | <100 | <110 | <100 | | |
| **EP080: BTEX** | | | | | | | | |
| Benzene | 71-43-2 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | | |
| Toluene | 108-88-3 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | | |
| Ethylbenzene | 100-41-4 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | | |
| meta- & para-Xylene | 108-38-3<br>106-42-3 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | | |
| ortho-Xylene | 95-47-6 | 0.1 | mg/kg | <0.2 | <0.2 | <0.2 | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | | | |
| Bromophos-ethyl | 4824-78-6 | 10 | µg/kg | <10 | <10 | <10 | | |
| Carbophenothion | 786-19-6 | 10 | µg/kg | <10 | <10 | <10 | | |
| Chlorfenvinphos (E) | 470-90-6 | 10.0 | µg/kg | <10.0 | <10.0 | <10.0 | | |
| Chlorfenvinphos (Z) | 470-90-8 | 10 | µg/kg | <10 | <10 | <10 | | |
| Chlorpyrifos | 2921-88-2 | 10 | µg/kg | <10 | <10 | <10 | | |
| Chlorpyrifos-methyl | 5598-13-0 | 10 | µg/kg | <10 | <10 | <10 | | |
| Demeton-S-methyl | 919-86-8 | 10 | µg/kg | <10 | <10 | <10 | | |
| Diazinon | 333-41-5 | 10 | µg/kg | <10 | <10 | <10 | | |
| Dichlorvos | 62-73-7 | 10 | µg/kg | <10 | <10 | <10 | | |
| Dimethoate | 60-51-5 | 10 | µg/kg | <10 | <10 | <10 | | |
| Ethion | 563-12-2 | 10 | µg/kg | <10 | <10 | <10 | | |
| Fenamiphos | 22224-92-6 | 10 | µg/kg | <10 | <10 | <10 | | |
| Fenthion | 55-38-9 | 10 | µg/kg | <10 | <10 | <10 | | |
| Malathion | 121-75-5 | 10 | µg/kg | <10 | <10 | <10 | | |
| Azinphos Methyl | 86-50-0 | 10 | µg/kg | <10 | <10 | <10 | | |
| Monocrotophos | 6923-22-4 | 10 | µg/kg | <10 | <10 | <10 | | |
| Parathion | 56-38-2 | 10 | µg/kg | <10 | <10 | <10 | | |
| Parathion-methyl | 298-00-0 | 10 | µg/kg | <10 | <10 | <10 | | |
| Pirimphos-ethyl | 23505-41-1 | 10 | µg/kg | <10 | <10 | <10 | | |
| Prothiofos | 34643-46-4 | 10 | µg/kg | <10 | <10 | <10 | | |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| Aldrin | 309-00-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| alpha-BHC | 319-84-6 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |

## Analytical Results

| | | | **Client Sample ID :** | **H38** | **QC3** | **QC4** | | |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | | |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | | |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703904-016** | **ES0703904-017** | **ES0703904-018** | | |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| beta-BHC | 319-85-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| delta-BHC | 319-86-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| 4.4'-DDD | 72-54-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| 4.4'-DDE | 72-55-9 | 0.50 | µg/kg | <0.50 | <0.50 | 1.33 | | |
| 4.4'-DDT | 50-29-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| DDT (total) | | 0.50 | µg/kg | <0.50 | <0.50 | 1.33 | | |
| Dieldrin | 60-57-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| alpha-Endosulfan | 959-98-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| beta-Endosulfan | 33213-65-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Endosulfan sulfate | 1031-07-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Endosulfan | 115-29-7 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Endrin | 72-20-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Endrin aldehyde | 7421-93-4 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Endrin ketone | 53494-70-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Heptachlor | 76-44-8 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Heptachlor epoxide | 1024-57-3 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Hexachlorobenzene (HCB) | 118-74-1 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| gamma-BHC | 58-89-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Methoxychlor | 72-43-5 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| cis-Chlordane | 5103-71-9 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| trans-Chlordane | 5103-74-2 | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| Total Chlordane | | 0.50 | µg/kg | <0.50 | <0.50 | <0.50 | | |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | | | |
| Total Polychlorinated biphenyls | | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1016 | 12974-11-2 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1221 | 11104-28-2 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1232 | 11141-16-5 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1242 | 53469-21-9 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1248 | 12672-29-6 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1254 | 11097-69-1 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| Aroclor 1260 | 11096-82-5 | 5.0 | µg/kg | <5.0 | <5.0 | <5.0 | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| 3-Methylcholanthrene | 56-49-5 | 10 | µg/kg | <10 | <10 | <10 | | |
| 2-Methylnaphthalene | 91-57-6 | 10 | µg/kg | 50 | 40 | 40 | | |
| 7.12-Dimethylbenz(a)anthracene | 57-97-6 | 10 | µg/kg | <10 | <10 | <10 | | |
| Acenaphthene | 83-32-9 | 10 | µg/kg | <10 | <10 | <10 | | |
| Acenaphthylene | 208-96-8 | 10 | µg/kg | 30 | <10 | 20 | | |

## Analytical Results

| | | | **Client Sample ID :** | **H38** | **QC3** | **QC4** | | |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | | |
| | | | Sample Date / Time : | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | | |
| | | | Laboratory Sample ID : | **ES0703904-016** | **ES0703904-017** | **ES0703904-018** | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| Anthracene | 120-12-7 | 10 | µg/kg | 20 | <10 | 10 | | |
| Benz(a)anthracene | 56-55-3 | 10 | µg/kg | 130 | 20 | 40 | | |
| Benzo(a)pyrene | 50-32-8 | 10 | µg/kg | 160 | 30 | 60 | | |
| Benzo(b)fluoranthene | 205-99-2 | 10 | µg/kg | 180 | 40 | 70 | | |
| Benzo(e)pyrene | 192-97-2 | 10 | µg/kg | 120 | 30 | 50 | | |
| Benzo(g.h.i)perylene | 191-24-2 | 10 | µg/kg | 120 | 30 | 50 | | |
| Benzo(k)fluoranthene | 207-08-9 | 10 | µg/kg | 140 | 30 | 50 | | |
| Chrysene | 218-01-9 | 10 | µg/kg | 150 | 30 | 60 | | |
| Coronene | 191-07-1 | 10 | µg/kg | 40 | <10 | 20 | | |
| Dibenz(a.h)anthracene | 53-70-3 | 10 | µg/kg | 30 | <10 | <10 | | |
| Fluoranthene | 206-44-0 | 10 | µg/kg | 240 | 50 | 80 | | |
| Fluorene | 86-73-7 | 10 | µg/kg | 10 | <10 | <10 | | |
| Indeno(1.2.3.cd)pyrene | 193-39-5 | 10 | µg/kg | 90 | 20 | 40 | | |
| N-2-Fluorenyl Acetamide | 53-96-3 | 100 | µg/kg | <100 | <100 | <100 | | |
| Naphthalene | 91-20-3 | 10 | µg/kg | 50 | 40 | 40 | | |
| Perylene | 198-55-0 | 10 | µg/kg | 60 | 20 | 30 | | |
| Phenanthrene | 85-01-8 | 10 | µg/kg | 70 | 30 | 40 | | |
| Pyrene | 129-00-0 | 10 | µg/kg | 240 | 50 | 90 | | |
| **EP080S: TPH(V)/BTEX Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 0.1 | % | 96.5 | 108 | 100 | | |
| Toluene-D8 | 2037-26-5 | 0.1 | % | 91.2 | 102 | 95.1 | | |
| 4-Bromofluorobenzene | 460-00-4 | 0.1 | % | 77.2 | 86.8 | 82.3 | | |
| **EP130S: Organophosphorus Pesticide Surrogate** | | | | | | | | |
| DEF | 78-48-8 | 0.1 | % | 26.5 | 37.7 | 38.2 | | |
| **EP131S: OC Pesticide Surrogate** | | | | | | | | |
| Dibromo-DDE | 21655-73-2 | 0.1 | % | 30.2 | 42.4 | 56.1 | | |
| **EP131T: PCB Surrogate** | | | | | | | | |
| Decachlorobiphenyl | 2051-24-3 | 0.1 | % | 37.1 | 47.0 | 56.8 | | |
| **EP132T: Base/Neutral Extractable Surrogates** | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | 0.1 | % | 57.9 | 59.9 | 60.3 | | |
| Anthracene-d10 | 1719-06-8 | 0.1 | % | 63.4 | 66.7 | 67.6 | | |
| 4-Terphenyl-d14 | 1718-51-0 | 0.1 | % | 61.7 | 64.7 | 66.4 | | |

# Surrogate Control Limits

***Matrix Type: SOIL - Surrogate Control Limits*** ***Surrogate Control Limits***

| ***Method name*** | ***Analyte name*** | ***Lower Limit*** | ***Upper Limit*** |
|---|---|---|---|
| **EP080: TPH Volatiles/BTEX** | | | |
| EP080S: TPH(V)/BTEX Surrogates | 1,2-Dichloroethane-D4 | 80 | 120 |
| | Toluene-D8 | 81 | 117 |
| | 4-Bromofluorobenzene | 74 | 121 |
| **EP130: Organophosphorus Pesticides (Ultra-trace)** | | | |
| EP130S: Organophosphorus Pesticide Surrogate | DEF | 51.3 | 136.9 |
| **EP131A: Organochlorine Pesticides (Ultra-trace)** | | | |
| EP131S: OC Pesticide Surrogate | Dibromo-DDE | 10 | 136 |
| **EP131B: PCB's (Ultra-trace)** | | | |
| EP131T: PCB Surrogate | Decachlorobiphenyl | 10 | 164 |
| **EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace)** | | | |
| EP132T: Base/Neutral Extractable Surrogates | 2-Fluorobiphenyl | 30 | 115 |
| | Anthracene-d10 | 27 | 133 |
| | 4-Terphenyl-d14 | 18 | 137 |

ALS Environmental

# *QUALITY CONTROL REPORT*

| | | | | | |
|---|---|---|---|---|---|
| **Client** | **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | Environmental Division Sydney | **Page** | **1 of 18** |
| **Contact** | CARSTEN MATTHAI | **Contact** | Victor Kedicioglu | | |
| **Address** | LEVEL 3, 116 MILLER STREET NORTH<br>SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | **ES0703904** |
| | | | | **Amendment No.** | **3** |
| **Project** | 42317595 Sediment Study | **Quote number** | SY/019/07 V2 | **Date received** | **27 Mar 2007** |
| **Order number** | - Not provided - | | | **Date issued** | **10 May 2007** |
| **C-O-C number** | - Not provided - | | | | |
| **Site** | - Not provided - | | | | |
| **E-mail** | carsten_matthai@urscorp.com | **E-mail** | Victor.Kedicioglu@alsenviro.com | **No. of samples** | |
| **Telephone** | 89255500 | **Telephone** | 61-2-8784 8555 | **Received** | 18 |
| **Facsimile** | 89255555 | **Facsimile** | 61-2-8784 8500 | **Analysed** | 18 |

This final report for the ALSE work order reference ES0703904 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

**Work order specific comments**

EP130, EP131A: Matrix spike and surrogate recoveries are low or not determined due to sample matrix effects.

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NATA

WORLD RECOGNISED ACCREDITATION

**NATA Accredited Laboratory - 825**

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| **Signatory** | **Department** |
|---|---|
| Pabi Subba | Organics - NATA 825 (10911 - Sydney) |
| PHALAK INTHAKESONE | Organics - NATA 825 (10911 - Sydney) |
| Rassem Ayoubi | Organics - NATA 825 (10911 - Sydney) |

# *Quality Control Report - Laboratory Duplicates (DUP)*

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations: **LOR** = Limit of Reporting, **RPD** = Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EA055: Moisture Content** | | | | | | |
| **EA055: Moisture Content - ( QC Lot: 381165 )** | | | | **%** | **%** | **%** |
| ES0703904-001 | H7 | Moisture Content (dried @ 103°C) | 1.0 % | 74.0 | 71.5 | 3.4 |
| ES0703904-010 | H24 | Moisture Content (dried @ 103°C) | 1.0 % | 76.0 | 76.2 | 0.2 |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381125 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703904-001 | H7 | C6 - C9 Fraction | 10 mg/kg | <10 | <10 | 0.0 |
| ES0703904-011 | H25 | C6 - C9 Fraction | 10 mg/kg | <10 | <10 | 0.0 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381390 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703904-001 | H7 | C10 - C14 Fraction | 50 mg/kg | <110 | <100 | 0.0 |
| | | C15 - C28 Fraction | 100 mg/kg | <220 | <200 | 7.8 |
| | | C29 - C36 Fraction | 100 mg/kg | <220 | <200 | 7.8 |
| ES0703904-011 | H25 | C10 - C14 Fraction | 50 mg/kg | <50 | <50 | 0.0 |
| | | C15 - C28 Fraction | 100 mg/kg | <100 | <100 | 0.0 |
| | | C29 - C36 Fraction | 100 mg/kg | <100 | <100 | 0.0 |
| **EP080: BTEX** | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703904-001 | H7 | Benzene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Toluene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Ethylbenzene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | meta- & para-Xylene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | ortho-Xylene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| ES0703904-011 | H25 | Benzene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | Toluene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | Ethylbenzene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | meta- & para-Xylene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | ortho-Xylene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 )** | | | | µg/kg | µg/kg | % |
| ES0703904-001 | H7 | Bromophos-ethyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Carbophenothion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Chlorfenvinphos (E) | 10.0 µg/kg | <10.0 | <10.0 | 0.0 |
| | | Chlorfenvinphos (Z) | 10 µg/kg | <10 | <10 | 0.0 |
| | | Chlorpyrifos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Chlorpyrifos-methyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Demeton-S-methyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Diazinon | 10 µg/kg | <10 | <10 | 0.0 |
| | | Dichlorvos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Dimethoate | 10 µg/kg | <10 | <10 | 0.0 |
| | | Ethion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Fenamiphos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Fenthion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Malathion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Methyl Azinphos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Monocrotophos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Parathion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Parathion-methyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Pirimphos-ethyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Prothiofos | 10 µg/kg | <10 | <10 | 0.0 |
| ES0703904-011 | H25 | Bromophos-ethyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Carbophenothion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Chlorfenvinphos (E) | 10.0 µg/kg | <10.0 | <10.0 | 0.0 |
| | | Chlorfenvinphos (Z) | 10 µg/kg | <10 | <10 | 0.0 |
| | | Chlorpyrifos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Chlorpyrifos-methyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Demeton-S-methyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Diazinon | 10 µg/kg | <10 | <10 | 0.0 |
| | | Dichlorvos | 10 µg/kg | <10 | <10 | 0.0 |

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - continued** | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 ) - continued** | | | | µg/kg | µg/kg | % |
| ES0703904-011 | H25 | Dimethoate | 10 µg/kg | <10 | <10 | 0.0 |
| | | Ethion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Fenamiphos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Fenthion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Malathion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Methyl Azinphos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Monocrotophos | 10 µg/kg | <10 | <10 | 0.0 |
| | | Parathion | 10 µg/kg | <10 | <10 | 0.0 |
| | | Parathion-methyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Pirimphos-ethyl | 10 µg/kg | <10 | <10 | 0.0 |
| | | Prothiofos | 10 µg/kg | <10 | <10 | 0.0 |
| **EP131A: Organochlorine Pesticides** | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 )** | | | | µg/kg | µg/kg | % |
| ES0703904-001 | H7 | Aldrin | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | alpha-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | beta-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | delta-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | 4,4’-DDD | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | 4,4’-DDE | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | 4,4’-DDT | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | DDT (total) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Dieldrin | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | alpha-Endosulfan | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | beta-Endosulfan | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endosulfan sulfate | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endosulfan (sum) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endrin | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endrin aldehyde | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endrin ketone | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP131A: Organochlorine Pesticides - continued** | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 ) - continued** | | | | µg/kg | µg/kg | % |
| ES0703904-001 | H7 | Heptachlor | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Heptachlor epoxide | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Hexachlorobenzene (HCB) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | gamma-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Methoxychlor | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | cis-Chlordane | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | trans-Chlordane | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Total Chlordane (sum) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| ES0703904-011 | H25 | Aldrin | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | alpha-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | beta-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | delta-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | 4,4’-DDD | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | 4,4’-DDE | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | 4,4’-DDT | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | DDT (total) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Dieldrin | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | alpha-Endosulfan | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | beta-Endosulfan | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endosulfan sulfate | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endosulfan (sum) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endrin | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endrin aldehyde | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Endrin ketone | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Heptachlor | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Heptachlor epoxide | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Hexachlorobenzene (HCB) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | gamma-BHC | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Methoxychlor | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP131A: Organochlorine Pesticides - continued** | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 ) - continued** | | | | **µg/kg** | **µg/kg** | **%** |
| ES0703904-011 | H25 | cis-Chlordane | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | trans-Chlordane | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| | | Total Chlordane (sum) | 0.50 µg/kg | <0.50 | <0.50 | 0.0 |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | |
| **EP131B: Polychlorinated Biphenyls (as Aroclors) - ( QC Lot: 381240 )** | | | | **µg/kg** | **µg/kg** | **%** |
| ES0703904-001 | H7 | Total Polychlorinated biphenyls | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1016 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1221 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1232 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1242 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1248 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1254 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1260 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| ES0703904-011 | H25 | Total Polychlorinated biphenyls | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1016 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1221 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1232 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1242 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1248 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1254 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| | | Aroclor 1260 | 5.0 µg/kg | <5.0 | <5.0 | 0.0 |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 )** | | | | **µg/kg** | **µg/kg** | **%** |
| ES0703904-001 | H7 | 3-Methylcholanthrene | 10 µg/kg | <10 | <10 | 0.0 |
| | | 2-Methylnaphthalene | 10 µg/kg | 70 | 70 | 0.0 |
| | | 7,12-Dimethylbenz(a)anthracene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Acenaphthene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Acenaphthylene | 10 µg/kg | <10 | 10 | 0.0 |
| | | Anthracene | 10 µg/kg | 10 | 20 | 0.0 |

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP132B: Polynuclear Aromatic Hydrocarbons - continued** | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 ) - continued** | | | | µg/kg | µg/kg | % |
| ES0703904-001 | H7 | Benz(a)anthracene | 10 µg/kg | 50 | 50 | 0.0 |
| | | Benzo(a)pyrene | 10 µg/kg | 70 | 70 | 0.0 |
| | | Benzo(b)fluoranthene | 10 µg/kg | 60 | 70 | 14.9 |
| | | Benzo(e)pyrene | 10 µg/kg | 50 | 50 | 0.0 |
| | | Benzo(g,h,i)perylene | 10 µg/kg | 60 | 60 | 0.0 |
| | | Benzo(k)fluoranthene | 10 µg/kg | 60 | 50 | 0.0 |
| | | Chrysene | 10 µg/kg | 60 | 60 | 0.0 |
| | | Coronene | 10 µg/kg | 10 | 10 | 0.0 |
| | | Dibenz(a,h)anthracene | 10 µg/kg | 10 | 10 | 0.0 |
| | | Fluoranthene | 10 µg/kg | 90 | 100 | 0.0 |
| | | Fluorene | 10 µg/kg | 10 | 10 | 0.0 |
| | | Indeno(1,2,3,cd)pyrene | 10 µg/kg | 50 | 40 | 0.0 |
| | | N-2-Fluorenyl Acetamide | 100 µg/kg | <100 | <100 | 0.0 |
| | | Naphthalene | 10 µg/kg | 70 | 70 | 0.0 |
| | | Perylene | 10 µg/kg | 30 | 30 | 0.0 |
| | | Phenanthrene | 10 µg/kg | 50 | 50 | 0.0 |
| | | Pyrene | 10 µg/kg | 100 | 100 | 0.0 |
| ES0703904-011 | H25 | 3-Methylcholanthrene | 10 µg/kg | <10 | <10 | 0.0 |
| | | 2-Methylnaphthalene | 10 µg/kg | 30 | 20 | 0.0 |
| | | 7,12-Dimethylbenz(a)anthracene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Acenaphthene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Acenaphthylene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Anthracene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Benz(a)anthracene | 10 µg/kg | 20 | 10 | 0.0 |
| | | Benzo(a)pyrene | 10 µg/kg | 20 | 10 | 0.0 |
| | | Benzo(b)fluoranthene | 10 µg/kg | 20 | 10 | 0.0 |
| | | Benzo(e)pyrene | 10 µg/kg | 10 | 10 | 0.0 |
| | | Benzo(g,h,i)perylene | 10 µg/kg | 20 | 10 | 0.0 |
| | | Benzo(k)fluoranthene | 10 µg/kg | 10 | 10 | 0.0 |

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP132B: Polynuclear Aromatic Hydrocarbons - continued** | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 ) - continued** | | | | µg/kg | µg/kg | % |
| ES0703904-011 | H25 | Chrysene | 10 µg/kg | 20 | 10 | 0.0 |
| | | Coronene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Dibenz(a,h)anthracene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Fluoranthene | 10 µg/kg | 50 | 30 | 44.7 |
| | | Fluorene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Indeno(1,2,3,cd)pyrene | 10 µg/kg | 10 | <10 | 0.0 |
| | | N-2-Fluorenyl Acetamide | 100 µg/kg | <100 | <100 | 0.0 |
| | | Naphthalene | 10 µg/kg | 30 | 20 | 0.0 |
| | | Perylene | 10 µg/kg | <10 | <10 | 0.0 |
| | | Phenanthrene | 10 µg/kg | 40 | 20 | 46.1 |
| | | Pyrene | 10 µg/kg | 40 | 30 | 37.9 |

# *Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)*

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| *Analyte name* | *LOR* | | | *LCS* | *Low* | *High* |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381125 )** | | mg/kg | mg/kg | % | % | % |
| C6 - C9 Fraction | 10 mg/kg | ---- | 26 | 101 | 68.4 | 128 |
| | 10 mg/kg | <10 | ---- | ---- | ---- | ---- |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381390 )** | | mg/kg | mg/kg | % | % | % |
| C10 - C14 Fraction | 50 mg/kg | <50 | ---- | ---- | ---- | ---- |
| | 50 mg/kg | ---- | 200 | 91.0 | 75.2 | 116 |
| C15 - C28 Fraction | 100 mg/kg | <100 | ---- | ---- | ---- | ---- |
| | 100 mg/kg | ---- | 200 | 91.0 | 75.3 | 113 |
| C29 - C36 Fraction | 100 mg/kg | ---- | 200 | 96.0 | 72.6 | 117 |
| | 100 mg/kg | <100 | ---- | ---- | ---- | ---- |
| **EP080: BTEX** | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 )** | | mg/kg | mg/kg | % | % | % |
| Benzene | 0.2 mg/kg | ---- | 1 | 108 | 67.5 | 125 |
| | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| Ethylbenzene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 1 | 106 | 65.3 | 126 |
| meta- & para-Xylene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 2 | 103 | 66.5 | 124 |
| ortho-Xylene | 0.5 mg/kg | ---- | 1 | 103 | 66.7 | 123 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Toluene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 1 | 89.2 | 69 | 122 |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 )** | | µg/kg | µg/kg | % | % | % |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| | | | | *LCS* | *Low* | *High* |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - continued** | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 ) - continued** | | µg/kg | µg/kg | % | % | % |
| Methyl Azinphos | 10 µg/kg | ---- | 50 | 35.3 | 8.13 | 159 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Bromophos-ethyl | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 50 | 120 | 36.9 | 142 |
| Carbophenothion | 10 µg/kg | ---- | 50 | 84.7 | 0.5 | 157 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Chlorfenvinphos (E) | 10 µg/kg | ---- | 5 | 94.4 | 50.3 | 137 |
| | 10.0 µg/kg | <10.0 | ---- | ---- | ---- | ---- |
| Chlorfenvinphos (Z) | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 45 | 110 | 55.9 | 152 |
| Chlorpyrifos | 10 µg/kg | ---- | 50 | 112 | 49 | 140 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Chlorpyrifos-methyl | 10 µg/kg | ---- | 50 | 119 | 28.1 | 142 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Demeton-S-methyl | 10 µg/kg | ---- | 50 | 120 | 36.6 | 172 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Diazinon | 10 µg/kg | ---- | 50 | 114 | 37.2 | 148 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Dichlorvos | 10 µg/kg | ---- | 50 | 116 | 32.7 | 153 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Dimethoate | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 50 | 113 | 33.2 | 150 |
| Ethion | 10 µg/kg | ---- | 50 | 91.5 | 44 | 146 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Fenamiphos | 10 µg/kg | ---- | 50 | 87.2 | 3.08 | 162 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Fenthion | 10 µg/kg | ---- | 50 | 124 | 10.6 | 157 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Malathion | 10 µg/kg | ---- | 50 | 114 | 38.1 | 143 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results*<br>*Spike concentration* | *Actual Results*<br>*Spike Recovery*<br>*LCS* | *Recovery Limits*<br>*Dynamic Recovery Limits*<br>*Low* | *Recovery Limits*<br>*Dynamic Recovery Limits*<br>*High* |
|---|---|---|---|---|---|---|
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - continued** | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 ) - continued** | | µg/kg | µg/kg | % | % | % |
| Monocrotophos | 10 µg/kg | ---- | 50 | 74.9 | 19.7 | 176 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Parathion | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 50 | 116 | 39.2 | 145 |
| Parathion-methyl | 10 µg/kg | ---- | 50 | 135 | 23.5 | 152 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Pirimphos-ethyl | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 50 | 106 | 47.1 | 141 |
| Prothiofos | 10 µg/kg | ---- | 50 | 102 | 36.1 | 148 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| **EP131A: Organochlorine Pesticides** | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 )** | | µg/kg | µg/kg | % | % | % |
| 4,4’-DDD | 0.5 µg/kg | ---- | 5 | 80.8 | 42.5 | 141 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| 4,4’-DDE | 0.5 µg/kg | ---- | 5 | 70.3 | 34.8 | 140 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| 4,4’-DDT | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 75.6 | 38 | 143 |
| Aldrin | 0.5 µg/kg | ---- | 5 | 72.6 | 31.7 | 140 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| alpha-BHC | 0.5 µg/kg | ---- | 5 | 69.0 | 24.5 | 150 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| alpha-Endosulfan | 0.5 µg/kg | ---- | 5 | 74.3 | 23.7 | 139 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| beta-BHC | 0.5 µg/kg | ---- | 5 | 97.0 | 36.9 | 139 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| beta-Endosulfan | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 68.9 | 35.8 | 138 |
| cis-Chlordane | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 74.4 | 22.3 | 145 |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| *Analyte name* | *LOR* | | | *LCS* | *Low* | *High* |
| **EP131A: Organochlorine Pesticides - continued** | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 ) - continued** | | µg/kg | µg/kg | % | % | % |
| DDT (total) | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| delta-BHC | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 69.9 | 38.2 | 137 |
| Dieldrin | 0.5 µg/kg | ---- | 5 | 90.3 | 43.2 | 134 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| Endosulfan (sum) | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| Endosulfan sulfate | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 76.5 | 7.45 | 158 |
| Endrin | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 78.1 | 21.6 | 162 |
| Endrin aldehyde | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 73.8 | 19.3 | 131 |
| Endrin ketone | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 87.6 | 17.9 | 141 |
| gamma-BHC | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 80.6 | 30.7 | 145 |
| Heptachlor | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 83.7 | 31 | 153 |
| Heptachlor epoxide | 0.5 µg/kg | ---- | 5 | 81.8 | 34.3 | 138 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| Hexachlorobenzene (HCB) | 0.5 µg/kg | ---- | 5 | 63.6 | 18.6 | 146 |
| | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| Methoxychlor | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 71.8 | 15 | 157 |
| Total Chlordane (sum) | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| trans-Chlordane | 0.50 µg/kg | <0.50 | ---- | ---- | ---- | ---- |
| | 0.5 µg/kg | ---- | 5 | 63.8 | 42.4 | 139 |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | |
| **EP131B: Polychlorinated Biphenyls (as Aroclors) - ( QC Lot: 381240 )** | | µg/kg | µg/kg | % | % | % |
| Aroclor 1016 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results*<br>*Spike concentration* | *Actual Results*<br>*Spike Recovery*<br>*LCS* | *Recovery Limits*<br>*Dynamic Recovery Limits*<br>*Low* | *Recovery Limits*<br>*Dynamic Recovery Limits*<br>*High* |
|---|---|---|---|---|---|---|
| **EP131B: Polychlorinated Biphenyls (as Aroclors) - continued** | | | | | | |
| **EP131B: Polychlorinated Biphenyls (as Aroclors) - ( QC Lot: 381240 ) - continued** | | µg/kg | µg/kg | % | % | % |
| Aroclor 1221 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| Aroclor 1232 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| Aroclor 1242 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| Aroclor 1248 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| Aroclor 1254 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| | 5 µg/kg | ---- | 50 | 95.4 | 61.3 | 121 |
| Aroclor 1260 | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| Total Polychlorinated biphenyls | 5.0 µg/kg | <5.0 | ---- | ---- | ---- | ---- |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 )** | | µg/kg | µg/kg | % | % | % |
| 2-Methylnaphthalene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 86.2 | 66.6 | 122 |
| 3-Methylcholanthrene | 10 µg/kg | ---- | 100 | 79.6 | 34.8 | 123 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| 7,12-Dimethylbenz(a)anthracene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 71.0 | 6.88 | 147 |
| Acenaphthene | 10 µg/kg | ---- | 100 | 92.4 | 62.9 | 124 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Acenaphthylene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 89.8 | 58.2 | 117 |
| Anthracene | 10 µg/kg | ---- | 100 | 88.2 | 61.4 | 117 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Benz(a)anthracene | 10 µg/kg | ---- | 100 | 87.5 | 65.7 | 125 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Benzo(a)pyrene | 10 µg/kg | ---- | 100 | 86.2 | 60.7 | 119 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Benzo(b)fluoranthene | 10 µg/kg | ---- | 100 | 91.2 | 68.6 | 126 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Benzo(e)pyrene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 88.4 | 70 | 129 |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results* Spike concentration | *Actual Results* Spike Recovery LCS | *Recovery Limits* Dynamic Recovery Limits Low | *Recovery Limits* Dynamic Recovery Limits High |
|---|---|---|---|---|---|---|
| **EP132B: Polynuclear Aromatic Hydrocarbons - continued** | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 ) - continued** | | µg/kg | µg/kg | % | % | % |
| Benzo(g,h,i)perylene | 10 µg/kg | ---- | 100 | 93.3 | 52.4 | 135 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Benzo(k)fluoranthene | 10 µg/kg | ---- | 100 | 98.1 | 70.4 | 126 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Chrysene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 88.0 | 67.5 | 126 |
| Coronene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 100 | 34.7 | 141 |
| Dibenz(a,h)anthracene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 94.1 | 61.7 | 129 |
| Fluoranthene | 10 µg/kg | ---- | 100 | 96.2 | 68.7 | 126 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Fluorene | 10 µg/kg | ---- | 100 | 93.8 | 66.7 | 123 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Indeno(1,2,3,cd)pyrene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 93.4 | 56.6 | 131 |
| N-2-Fluorenyl Acetamide | 100 µg/kg | ---- | 100 | 94.4 | 50 | 138 |
| | 100 µg/kg | <100 | ---- | ---- | ---- | ---- |
| Naphthalene | 10 µg/kg | ---- | 100 | 91.1 | 63.2 | 120 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| Perylene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 84.8 | 58.6 | 119 |
| Phenanthrene | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 µg/kg | ---- | 100 | 95.5 | 65.4 | 124 |
| Pyrene | 10 µg/kg | ---- | 100 | 98.4 | 67.9 | 127 |
| | 10 µg/kg | <10 | ---- | ---- | ---- | ---- |

# *Quality Control Report - Matrix Spikes (MS)*

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations: **LOR** = Limit of Reporting, **RPD** = Relative Percent Difference.*

* Indicates failed QC

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| | | | | | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|---|---|
| | | | | | *Sample Result* | *Spike Recovery* | *Static Limits* | |
| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | | *MS* | *Low* | *High* |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381125 )** | | | | mg/kg | mg/kg | % | % | % |
| C6 - C9 Fraction | ES0703904-001 | H7 | 10 mg/kg | 26 | <10 | 88.1 | 70 | 130 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381390 )** | | | | mg/kg | mg/kg | % | % | % |
| C10 - C14 Fraction | ES0703904-001 | H7 | 50 mg/kg | 490 | <110 | 91.0 | 70 | 130 |
| C15 - C28 Fraction | | | 100 mg/kg | 3380 | <220 | 100 | 70 | 130 |
| C29 - C36 Fraction | | | 100 mg/kg | 2260 | <220 | 104 | 70 | 130 |
| **EP080: BTEX** | | | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 )** | | | | mg/kg | mg/kg | % | % | % |
| Benzene | ES0703904-001 | H7 | 0.1 mg/kg | 2.5 | <0.2 | 95.9 | 70 | 130 |
| Toluene | | | 0.1 mg/kg | 2.5 | <0.2 | 84.2 | 70 | 130 |
| Ethylbenzene | | | 0.1 mg/kg | 2.5 | <0.2 | 97.6 | 70 | 130 |
| meta- & para-Xylene | | | 0.1 mg/kg | 2.5 | <0.2 | 112 | 70 | 130 |
| ortho-Xylene | | | 0.1 mg/kg | 2.5 | <0.2 | 111 | 70 | 130 |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)** | | | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 )** | | | | µg/kg | µg/kg | % | % | % |
| Bromophos-ethyl | ES0703904-001 | H7 | 10 µg/kg | 50 | <10 | 26.8 | 70 | 130 |
| Carbophenothion | | | 10 µg/kg | 50 | <10 | 21.7 | 70 | 130 |
| Chlorfenvinphos (E) | | | 10 µg/kg | 5 | <10.0 | * Not Determined | 70 | 130 |
| Chlorfenvinphos (Z) | | | 10 µg/kg | 45 | <10 | * Not Determined | 70 | 130 |
| Chlorpyrifos | | | 10 µg/kg | 50 | <10 | 23.6 | 70 | 130 |
| Chlorpyrifos-methyl | | | 10 µg/kg | 50 | <10 | 28.7 | 70 | 130 |
| Demeton-S-methyl | | | 10 µg/kg | 50 | <10 | 35.4 | 70 | 130 |
| Diazinon | | | 10 µg/kg | 50 | <10 | 38.6 | 70 | 130 |
| Dichlorvos | | | 10 µg/kg | 50 | <10 | 43.8 | 70 | 130 |
| Dimethoate | | | 10 µg/kg | 50 | <10 | 27.1 | 70 | 130 |

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| | | | | | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|---|---|
| | | | | | *Sample Result* | *Spike Recovery* | *Static Limits* | |
| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | | *MS* | *Low* | *High* |
| **EP130A: Organophosphorus Pesticides (Ultra-trace)  - continued** | | | | | | | | |
| **EP130A: Organophosphorus Pesticides (Ultra-trace) - ( QC Lot: 381238 )  - continued** | | | | µg/kg | µg/kg | % | % | % |
| Ethion | ES0703904-001 | H7 | 10 µg/kg | 50 | <10 | 24.3 | 70 | 130 |
| Fenamiphos | | | 10 µg/kg | 50 | <10 | * Not Determined | 70 | 130 |
| Fenthion | | | 10 µg/kg | 50 | <10 | 21.8 | 70 | 130 |
| Malathion | | | 10 µg/kg | 50 | <10 | 25.8 | 70 | 130 |
| Methyl Azinphos | | | 10 µg/kg | 50 | <10 | 22.4 | 70 | 130 |
| Monocrotophos | | | 10 µg/kg | 50 | <10 | * Not Determined | 70 | 130 |
| Parathion | | | 10 µg/kg | 50 | <10 | 27.6 | 70 | 130 |
| Parathion-methyl | | | 10 µg/kg | 50 | <10 | 37.5 | 70 | 130 |
| Pirimphos-ethyl | | | 10 µg/kg | 50 | <10 | 21.0 | 70 | 130 |
| Prothiofos | | | 10 µg/kg | 50 | <10 | 27.9 | 70 | 130 |
| **EP131A: Organochlorine Pesticides** | | | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 )** | | | | µg/kg | µg/kg | % | % | % |
| Aldrin | ES0703904-001 | H7 | 0.5 µg/kg | 5 | <0.50 | 16.0 | 70 | 130 |
| alpha-BHC | | | 0.5 µg/kg | 5 | <0.50 | 34.5 | 70 | 130 |
| beta-BHC | | | 0.5 µg/kg | 5 | <0.50 | 33.8 | 70 | 130 |
| delta-BHC | | | 0.5 µg/kg | 5 | <0.50 | 37.1 | 70 | 130 |
| 4,4'-DDD | | | 0.5 µg/kg | 5 | <0.50 | 63.4 | 70 | 130 |
| 4,4'-DDE | | | 0.5 µg/kg | 5 | <0.50 | 52.9 | 70 | 130 |
| 4,4'-DDT | | | 0.5 µg/kg | 5 | <0.50 | 74.6 | 70 | 130 |
| Dieldrin | | | 0.5 µg/kg | 5 | <0.50 | 31.1 | 70 | 130 |
| alpha-Endosulfan | | | 0.5 µg/kg | 5 | <0.50 | 48.7 | 70 | 130 |
| beta-Endosulfan | | | 0.5 µg/kg | 5 | <0.50 | 52.3 | 70 | 130 |
| Endosulfan sulfate | | | 0.5 µg/kg | 5 | <0.50 | 112 | 70 | 130 |
| Endrin | | | 0.5 µg/kg | 5 | <0.50 | 55.4 | 70 | 130 |
| Endrin aldehyde | | | 0.5 µg/kg | 5 | <0.50 | 21.3 | 70 | 130 |
| Endrin ketone | | | 0.5 µg/kg | 5 | <0.50 | 36.2 | 70 | 130 |
| Heptachlor | | | 0.5 µg/kg | 5 | <0.50 | 18.7 | 70 | 130 |
| Heptachlor epoxide | | | 0.5 µg/kg | 5 | <0.50 | 31.4 | 70 | 130 |
| Hexachlorobenzene (HCB) | | | 0.5 µg/kg | 5 | <0.50 | 32.2 | 70 | 130 |
| gamma-BHC | | | 0.5 µg/kg | 5 | <0.50 | 37.6 | 70 | 130 |

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| | | | | | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|---|---|
| | | | | | *Sample Result* | *Spike Recovery* | *Static Limits* | |
| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | | *MS* | *Low* | *High* |
| **EP131A: Organochlorine Pesticides - continued** | | | | | | | | |
| **EP131A: Organochlorine Pesticides - ( QC Lot: 381239 ) - continued** | | | | µg/kg | µg/kg | % | % | % |
| Methoxychlor | ES0703904-001 | H7 | 0.5 µg/kg | 5 | <0.50 | 19.0 | 70 | 130 |
| cis-Chlordane | | | 0.5 µg/kg | 5 | <0.50 | 25.8 | 70 | 130 |
| trans-Chlordane | | | 0.5 µg/kg | 5 | <0.50 | 32.9 | 70 | 130 |
| **EP131B: Polychlorinated Biphenyls (as Aroclors)** | | | | | | | | |
| **EP131B: Polychlorinated Biphenyls (as Aroclors) - ( QC Lot: 381240 )** | | | | µg/kg | µg/kg | % | % | % |
| Aroclor 1254 | ES0703904-001 | H7 | 5 µg/kg | 50 | <5.0 | 36.0 | 70 | 130 |
| **EP132B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 )** | | | | µg/kg | µg/kg | % | % | % |
| 3-Methylcholanthrene | ES0703904-001 | H7 | 10 µg/kg | 100 | <10 | 76.1 | 21 | 129 |
| 2-Methylnaphthalene | | | 10 µg/kg | 100 | 70 | 61.6 | 40 | 130 |
| 7,12-Dimethylbenz(a)anthracene | | | 10 µg/kg | 100 | <10 | 79.3 | 8 | 158 |
| Acenaphthene | | | 10 µg/kg | 100 | <10 | 78.3 | 38 | 127 |
| Acenaphthylene | | | 10 µg/kg | 100 | <10 | 77.1 | 35 | 122 |
| Anthracene | | | 10 µg/kg | 100 | 10 | 83.4 | 44 | 124 |
| Benz(a)anthracene | | | 10 µg/kg | 100 | 50 | 66.9 | 48 | 124 |
| Benzo(a)pyrene | | | 10 µg/kg | 100 | 70 | 71.6 | 44 | 123 |
| Benzo(b)fluoranthene | | | 10 µg/kg | 100 | 60 | 71.5 | 43 | 129 |
| Benzo(e)pyrene | | | 10 µg/kg | 100 | 50 | 68.6 | 46 | 130 |
| Benzo(g,h,i)perylene | | | 10 µg/kg | 100 | 60 | 74.2 | 43 | 129 |
| Benzo(k)fluoranthene | | | 10 µg/kg | 100 | 60 | 71.4 | 54 | 123 |
| Chrysene | | | 10 µg/kg | 100 | 60 | 68.5 | 55 | 122 |
| Coronene | | | 10 µg/kg | 100 | 10 | 81.3 | 33 | 134 |
| Dibenz(a,h)anthracene | | | 10 µg/kg | 100 | 10 | 78.1 | 46 | 129 |
| Fluoranthene | | | 10 µg/kg | 100 | 90 | 73.0 | 52 | 125 |
| Fluorene | | | 10 µg/kg | 100 | 10 | 77.4 | 45 | 121 |
| Indeno(1,2,3,cd)pyrene | | | 10 µg/kg | 100 | 50 | 74.8 | 41 | 132 |
| N-2-Fluorenyl Acetamide | | | 100 µg/kg | 100 | <100 | 106 | 28 | 152 |
| Naphthalene | | | 10 µg/kg | 100 | 70 | 65.5 | 34 | 130 |
| Perylene | | | 10 µg/kg | 100 | 30 | 70.9 | 38 | 124 |

***Matrix Type: SOIL*** ***Matrix Spike (MS) Report***

| | | | | | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|---|---|
| | | | | | ***Sample Result*** | ***Spike Recovery*** | ***Static Limits*** | |
| ***Analyte name*** | ***Laboratory Sample ID*** | ***Client Sample ID*** | ***LOR*** | ***Spike Concentration*** | | ***MS*** | ***Low*** | ***High*** |
| **EP132B: Polynuclear Aromatic Hydrocarbons - continued** | | | | | | | | |
| **EP132B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381234 ) - continued** | | | | µg/kg | µg/kg | % | % | % |
| Phenanthrene | ES0703904-001 | H7 | 10 µg/kg | 100 | 50 | 80.5 | 45 | 124 |
| Pyrene | | | 10 µg/kg | 100 | 100 | 72.4 | 51 | 129 |

# INTERPRETIVE QUALITY CONTROL REPORT

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Client** | : | **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | : | Environmental Division Sydney | **Page** | : | **1 of 9** |
| **Contact** | : | CARSTEN MATTHAI | **Contact** | : | Victor Kedicioglu | | | |
| **Address** | : | LEVEL 3, 116 MILLER STREET NORTH SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | : | 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | : | **ES0703904** |
| | | | | | | **Amendment No.** | : | **3** |
| **Project** | : | 42317595 Sediment Study | **Quote number** | : | SY/019/07 V2 | **Date received** | : | 27 Mar 2007 |
| **Order number** | : | - Not provided - | | | | **Date issued** | : | 10 May 2007 |
| **C-O-C number** | : | - Not provided - | | | | | | |
| **Site** | : | - Not provided - | | | | | | |
| **E-mail** | : | carsten_matthai@urscorp.com | **E-mail** | : | Victor.Kedicioglu@alsenviro.com | **No. of samples** | | |
| **Telephone** | : | 89255500 | **Telephone** | : | 61-2-8784 8555 | **Received** | : | 18 |
| **Facsimile** | : | 89255555 | **Facsimile** | : | 61-2-8784 8500 | **Analysed** | : | 18 |

This Interpretive Quality Control Report was issued on 10 May 2007 for the ALS work order reference ES0703904 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

# *Interpretive Quality Control Report - Analysis Holding Time*

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

***Matrix Type: SOIL*** ***Analysis Holding Time and Preservation***

| **Method** | | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|---|
| **Container /** Client Sample ID(s) | | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EA055-103: Moisture Content | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7,<br>H9,<br>H17,<br>H21,<br>H23,<br>H25,<br>H28,<br>H37,<br>QC3, | H8,<br>H10,<br>H18,<br>H22,<br>H24,<br>H26,<br>H31,<br>H38,<br>QC4 | **26 Mar 2007** | ---- | ---- | ---- | **28 Mar 2007** | 2 Apr 2007 | Pass |
| EP071: TPH - Semivolatile Fraction | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7,<br>H9,<br>H17,<br>H21,<br>H23,<br>H25,<br>H28,<br>H37,<br>QC3, | H8,<br>H10,<br>H18,<br>H22,<br>H24,<br>H26,<br>H31,<br>H38,<br>QC4 | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **2 Apr 2007** | 7 May 2007 | Pass |
| EP080: TPH Volatiles/BTEX | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7,<br>H9,<br>H17,<br>H21,<br>H23,<br>H25,<br>H28,<br>H37,<br>QC3, | H8,<br>H10,<br>H18,<br>H22,<br>H24,<br>H26,<br>H31,<br>H38,<br>QC4 | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **31 Mar 2007** | 9 Apr 2007 | Pass |
| EP130: Organophosphorus Pesticides (Ultra-trace) | | | | | | | | |

***Matrix Type: SOIL*** ***Analysis Holding Time and Preservation***

| **Method** | | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|---|
| **Container /** Client Sample ID(s) | | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EP130: Organophosphorus Pesticides (Ultra-trace) **- continued** | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **30 Mar 2007** | 7 May 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |
| EP131A: Organochlorine Pesticides (Ultra-trace) | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **30 Mar 2007** | 7 May 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |
| EP131B: PCB's (Ultra-trace) | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **30 Mar 2007** | 7 May 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **30 Mar 2007** | 7 May 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |

# *Interpretive Quality Control Report - Frequency of Quality Control Samples*

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

***Matrix Type: SOIL*** ***Frequency of Quality Control Samples***

| Quality Control Sample Type<br>Method | Count QC | Count Regular | Rate (%) Actual | Rate (%) Expected | Quality Control Specification |
|---|---|---|---|---|---|
| Laboratory Duplicates (DUP) | | | | | |
| EA055-103: Moisture Content | 2 | 20 | **10.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP071: TPH - Semivolatile Fraction | 2 | 19 | **10.5** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 2 | 20 | **10.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Laboratory Control Samples (LCS) | | | | | |
| EP071: TPH - Semivolatile Fraction | 1 | 19 | **5.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 1 | 20 | **5.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Method Blanks (MB) | | | | | |
| EP071: TPH - Semivolatile Fraction | 1 | 19 | **5.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 1 | 20 | **5.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Matrix Spikes (MS) | | | | | |
| EP071: TPH - Semivolatile Fraction | 1 | 19 | **5.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 1 | 20 | **5.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |

# *Interpretive Quality Control Report - Summary of Outliers*

## *Outliers : Quality Control Samples*

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

### *Non-surrogates*

| ALS QC Lot | Matrix Type | Laboratory Sample ID | Client Sample ID | Analyte | Data | Limits | Comment |
|---|---|---|---|---|---|---|---|
| **Matrix Spikes (MS)** | | | | | | | |
| EP130A: Organophosphorus Pesticides (Ultra-trace) | SOIL | ES0703904-001 | H7 | Bromophos-ethyl | 26.8 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Carbophenothion | 21.7 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Chlorfenvinphos (E) | ND | ---- | Matrix spike recovery not determined due to sample matrix interference. |
| | | | | Chlorfenvinphos (Z) | ND | ---- | Matrix spike recovery not determined due to sample matrix interference. |
| | | | | Chlorpyrifos | 23.6 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Chlorpyrifos-methyl | 28.7 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Demeton-S-methyl | 35.4 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Diazinon | 38.6 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Dichlorvos | 43.8 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Dimethoate | 27.1 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Ethion | 24.3 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Fenamiphos | ND | ---- | Matrix spike recovery not determined due to sample matrix interference. |
| | | | | Fenthion | 21.8 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Malathion | 25.8 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Methyl Azinphos | 22.4 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Monocrotophos | ND | ---- | Matrix spike recovery not determined due to sample matrix interference. |
| | | | | Parathion | 27.6 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Parathion-methyl | 37.5 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Pirimphos-ethyl | 21.0 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Prothiofos | 27.9 % | 70-130 % | Recovery less than lower data quality objective |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| EP131A: Organochlorine Pesticides | SOIL | ES0703904-001 | H7 | Aldrin | 16.0 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | alpha-BHC | 34.5 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | beta-BHC | 33.8 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | delta-BHC | 37.1 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | 4,4’-DDD | 63.4 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | 4,4’-DDE | 52.9 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Dieldrin | 31.1 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | alpha-Endosulfan | 48.7 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | beta-Endosulfan | 52.3 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Endrin | 55.4 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Endrin aldehyde | 21.3 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Endrin ketone | 36.2 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Heptachlor | 18.7 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Heptachlor epoxide | 31.4 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Hexachlorobenzene (HCB) | 32.2 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | gamma-BHC | 37.6 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | Methoxychlor | 19.0 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | cis-Chlordane | 25.8 % | 70-130 % | Recovery less than lower data quality objective |
| | | | | trans-Chlordane | 32.9 % | 70-130 % | Recovery less than lower data quality objective |
| EP131B: Polychlorinated Biphenyls (as Aroclors) | SOIL | ES0703904-001 | H7 | Aroclor 1254 | 36.0 % | 70-130 % | Recovery less than lower data quality objective |

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**

## *Surrogates*

| ALS QC Lot | Matrix Type | Laboratory Sample ID | Client Sample ID | Analyte | Data | Limits | Comment |
|---|---|---|---|---|---|---|---|
| **Surrogates** | | | | | | | |
| EP080S: TPH(V)/BTEX Surrogates | SOIL | ES0703904-002 | H8 | Toluene-D8 | 80.0 % | 81-117 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-004 | H10 | Toluene-D8 | 80.0 % | 81-117 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-007 | H21 | Toluene-D8 | 80.8 % | 81-117 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-010 | H24 | Toluene-D8 | 117 % | 81-117 % | Recovery greater than upper data quality objective |
| | SOIL | ES0703904-012 | H26 | Toluene-D8 | 79.9 % | 81-117 % | Recovery less than lower data quality objective |
| | | | | 1,2-Dichloroethane-D4 | 120 % | 80-120 % | Recovery greater than upper data quality objective |
| | SOIL | ES0703904-015 | H37 | Toluene-D8 | 79.6 % | 81-117 % | Recovery less than lower data quality objective |
| EP130S: Organophosphorus Pesticide Surrogate | SOIL | ES0703904-001 | H7 | DEF | 21.8 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-002 | H8 | DEF | 32.4 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-003 | H9 | DEF | 30.0 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-004 | H10 | DEF | ND | ---- | Surrogate recovery not determined due to (target or non-target) matrix interferences |
| | SOIL | ES0703904-005 | H17 | DEF | 34.9 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-006 | H18 | DEF | 32.2 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-007 | H21 | DEF | ND | ---- | Surrogate recovery not determined due to (target or non-target) matrix interferences |
| | SOIL | ES0703904-008 | H22 | DEF | 29.4 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-009 | H23 | DEF | ND | ---- | Surrogate recovery not determined due to (target or non-target) matrix interferences |
| | SOIL | ES0703904-010 | H24 | DEF | 28.3 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-011 | H25 | DEF | 41.4 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-012 | H26 | DEF | 22.6 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-013 | H28 | DEF | ND | ---- | Surrogate recovery not determined due to (target or non-target) matrix interferences |
| | SOIL | ES0703904-014 | H31 | DEF | 27.3 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-015 | H37 | DEF | 45.9 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-016 | H38 | DEF | 26.5 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-017 | QC3 | DEF | 37.7 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| | SOIL | ES0703904-018 | QC4 | DEF | 38.2 % | 51.3-136.9 % | Recovery less than lower data quality objective |
| EP131S: OC Pesticide Surrogate | SOIL | ES0703904-009 | H23 | Dibromo-DDE | ND | ---- | Surrogate recovery not determined due to (target or non-target) matrix interferences |
| EP131T: PCB Surrogate | SOIL | ES0703904-009 | H23 | Decachlorobiphenyl | ND | ---- | Surrogate recovery not determined due to (target or non-target) matrix interferences |

## ***Outliers : Analysis Holding Time***

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

- **No holding time outliers occur.**

## *Outliers : Frequency of Quality Control Samples*

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

# *Method Reference Summary*

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

***Matrix Type: SEDIMENT*** ***Method Reference Summary***

## Preparation Methods

**ORG16 : Methanolic Extraction of Soils for Purge and Trap -** (USEPA SW 846 - 5030A) 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.

**ORG17A-AC : Tumbler Extraction of Solids/ Acetylation -** In-house, Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to 1 mL with exchange into cyclohexane. Phenolic compounds are reacted with acetic anhydride to yield phenyl acetates suitable for ultra-trace analysis.

**ORG17A-UTP : Tumbler Extraction of Solids/ Sample Cleanup -** In-house, Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. Samples are extracted, concentrated (by KD) and exchanged into an appropriate solvent for GPC and florisil cleanup as required.

**ORG17B : Tumbler Extraction of Solids (Option B - Non-concentrating) -** In-house, Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 20mL 1:1 DCM/Acetone by end over end tumble. The solvent is transferred directly to a GC vial for analysis.

## Analytical Methods

**EA055-103 : Moisture Content -** A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)

**EP071 : TPH - Semivolatile Fraction -** (USEPA SW 846 - 8015A) Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C36. This method is compliant with NEPM (1999) Schedule B(3) (Method 506.1)

**EP080 : TPH Volatiles/BTEX -** (USEPA SW 846 - 8260B) Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 501)

**EP130 : Organophosphorus Pesticides (Ultra-trace) -** USEPA Method 3640 (GPC cleanup), 8141 (GC/FPD - Capillary Column) This technique is compliant with NEPM (1999) Schedule B(3) (Method 505)

**EP131A : Organochlorine Pesticides (Ultra-trace) -** USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/uECD/uECD) This technique is compliant with NEPM (1999) Schedule B(3) (Method 504)

**EP131B : PCB's (Ultra-trace) -** USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/uECD/uECD) This technique is compliant with NEPM (1999) Schedule B(3) (Method 504)

**EP132 : Semivolatile Compounds by GCMS(SIM - Ultra-trace) -** 8270 GCMS Capiliary column, SIM mode.

# CHAIN OF CUSTODY FORM

1 of 1

THIS COLUMN FOR LAB USE ONLY

Job Code: 43217595

Due Date: 12-4-07

**FROM:**
**URS (AUSTRALIA)**
ACN 000 691 690
North Sydney
Level 3 116 Miller Street

**Ph: 8925 5500**

**DATE:** 27-3-07

**Fax: 8925 5555**

**TO:**
**ALS Smithfield**
277 Woodpark Rd
Smithfield 2164

**Project No:** 43217595
**Project Manager:** Carsten Matthai
**Agreement No:** SY-019-07 URS V2

**Sampler(s): Carsten Matthai**
**Signature(s):** Matthai
**Checked:**

**Custody seal intact?** [✓ YES] NO
**Sample cold?** [✓ YES] NO

Released for URS by:
Carsten Matthai
Date: 27-3-07
Time: 10:00am

Received for Laboratory by:
Frank Ferraro - ALS Sydney
Date: 27/03/07
Time: 15:40

**Container Size, Type, Preservative and Analysis**

Container Identification

| | | |
|---|---|---|
| **Size mL** | 250 | 150 |
| **Type*** | Glass | Glass |
| **Preservative Code** | | |
| Analytes | Analytes per SY-019-07 URS V2 TPH (C6-C36)/BTEX - Low Level, PAHs - 24 Analytes Ultra Trace, OC/OP/PCB Ultra Trace (Table A) | **Organo Tins (TBT)** |

| Lab identification | Date | Time | Matrix | Sample Number | Estimated Level of Contamination | Total no | Tick required analytes | | Hold |
|---|---|---|---|---|---|---|---|---|---|
| ① | 26-3-07 | | Sediment | H7 | Intermediate | | x | x | x |
| ② | | | Sediment | H8 | Intermediate | | x | x | x |
| ③ | | | Sediment | H9 | Intermediate | | x | x | x |
| ④ | | | Sediment | H10 | Intermediate | | x | x | x |
| ⑤ | | | Sediment | H17 | Intermediate | | x | x | x |
| ⑥ | | | Sediment | H18 | Intermediate | | x | x | x |
| ⑦ | | | Sediment | H21 | Intermediate | | x | x | x |
| ⑧ | | | Sediment | H22 | Intermediate | | x | x | x |
| ⑨ | | | Sediment | H23 | Intermediate | | x | x | x |
| ⑩ | | | Sediment | H24 | Intermediate | | x | x | x |
| ⑪ | | | Sediment | H25 | Intermediate | | x | x | x |
| ⑫ | | | Sediment | H26 | Intermediate | | x | x | x |
| ⑬ | | | Sediment | H28 | Intermediate | | x | x | x |
| ⑭ | | | Sediment | H31 | Intermediate | | x | x | x |
| ⑮ | | | Sediment | H37 | Intermediate | | x | x | x |
| ⑯ | | | Sediment | H38 | Intermediate | | x | x | x |
| ⑰ | | | Sediment | QC3 | Intermediate | | x | x | x |
| ⑱ | | | Sediment | QC4 | Intermediate | | x | x | x |
| | | | | | TOTAL | | 18 (2 identical jars each) | 18 | |

[redacted]

Environmental Division
Sydney
Work Order
**ES0703904**

Telephone : 61-2-8784 8555

**CONTRACT WORK**
**WO:** ES0703904
**LAB:** ALS Brisbane - TBT
**DATE:** 27/03/07
**SPLIT:** TBT split into ES0703908

Remarks:
No historical data available. Please send results to Dr Carsten Matthai (Email: carsten_matthai@urscorp.com).

* Container Type and Preservative Codes: P = Neutral Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinsed Jar; S = Solvent Washed Acid Rinsed Glass Bottle; VC = Hydrochloric Acid Preserved Vial; VS = Sulfuric

Courier Job No:

**Send results to Carsten_Matthai@urscorp.com**

**NOTE: SAMPLES MAY CONTAIN DANGEROUS AND HAZARDOUS SUBSTANCES**

# CERTIFICATE OF ANALYSIS

| | | | | | |
|---|---|---|---|---|---|
| *Client* | : **URS AUSTRALIA (NSW) PTY LTD** | *Laboratory* | : **Environmental Division Sydney** | *Page* | : **1 of 7** |
| *Contact* | : **MR CARSTEN MATTHAI** | *Contact* | : **Victor Kedicioglu** | *Work Order* | : **ES0703908** |
| *Address* | : **LEVEL 3, 116 MILLER STREET NORTH SYDNEY NSW AUSTRALIA 2060** | *Address* | : **277-289 Woodpark Road Smithfield NSW Australia 2164** | | |
| *E-mail* | : **carsten_matthai@urscorp.com** | *E-mail* | : **Victor.Kedicioglu@alsenviro.com** | | |
| *Telephone* | : **89255500** | *Telephone* | : **61-2-8784 8555** | | |
| *Facsimile* | : **89255555** | *Facsimile* | : **61-2-8784 8500** | | |
| *Project* | : **43217595 Sediment Study** | *Quote number* | : **SY/019/07 V2** | *Date received* | : **27 Mar 2007** |
| *Order number* | : **- Not provided -** | | | *Date issued* | : **23 Apr 2007** |
| *C-O-C number* | : **- Not provided -** | | | *No. of samples* | - *Received* : **18** |
| *Site* | : **- Not provided -** | | | | *Analysed* : **18** |

*ALSE - Excellence in Analytical Testing*

**NATA Accredited Laboratory**
**825**

**This document is issued in accordance with NATA's accreditation requirements.**

**Accredited for compliance with ISO/IEC 17025.**

WORLD RECOGNISED ACCREDITATION

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatory* | *Position* | *Department* |
|---|---|---|
| **Carsten Emrich** | **Senior Organic Chemist** | **Organics - NATA 825 (818 - Brisbane)** |
| **Kim McCabe** | **Senior Inorganic Chemist** | **Inorganics - NATA 825 (818 - Brisbane)** |
| **Stephen Hislop** | **Senior Inorganic Chemist** | **Inorganics - NATA 825 (818 - Brisbane)** |

## Comments

This report for the ALSE reference ES0703908 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

## Analytical Results

| *Analyte* | *CAS number* | *LOR* | *Units* | H7 | H8 | H9 | H10 | H17 |
|---|---|---|---|---|---|---|---|---|
| Sample Matrix Type / Description : | | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| Sample Date / Time : | | | | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| Laboratory Sample ID : | | | | **ES0703908-001** | **ES0703908-002** | **ES0703908-003** | **ES0703908-004** | **ES0703908-005** |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 73.3 | 74.5 | 75.2 | 64.4 | 62.2 |
| **EP090: Organotin Compounds** | | | | | | | | |
| Tributyltin | 56573-85-4 | 0.5 | µgSn/kg | 1.6 | 5.2 | 5.8 | 6.6 | 3.4 |
| **EP090S: Organotin Surrogate** | | | | | | | | |
| Tripropyltin | | 0.1 | % | 84.2 | 82.0 | 67.0 | 82.1 | 66.9 |

## Analytical Results

| Analyte | CAS number | LOR | Units | H18 | H21 | H22 | H23 | H24 |
|---|---|---|---|---|---|---|---|---|
| Sample Matrix Type / Description : | | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| Sample Date / Time : | | | | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 |
| Laboratory Sample ID : | | | | **ES0703908-006** | **ES0703908-007** | **ES0703908-008** | **ES0703908-009** | **ES0703908-010** |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 61.9 | 64.3 | 72.3 | 78.7 | 76.5 |
| **EP090: Organotin Compounds** | | | | | | | | |
| Tributyltin | 56573-85-4 | 0.5 | µgSn/kg | 1.6 | 125 | 10.4 | 1.8 | 1.8 |
| **EP090S: Organotin Surrogate** | | | | | | | | |
| Tripropyltin | | 0.1 | % | 42.0 | 75.3 | 55.8 | 70.1 | 46.1 |

## Analytical Results

| *Analyte* | *CAS number* | *LOR* | *Units* | H25 | H26 | H28 | H31 | H37 |
|---|---|---|---|---|---|---|---|---|
| Sample Matrix Type / Description : | | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| Sample Date / Time : | | | | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| Laboratory Sample ID : | | | | ES0703908-011 | ES0703908-012 | ES0703908-013 | ES0703908-014 | ES0703908-015 |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 36.5 | 59.6 | 48.1 | 61.6 | 65.0 |
| **EP090: Organotin Compounds** | | | | | | | | |
| Tributyltin | 56573-85-4 | 0.5 | µgSn/kg | 22.9 | 114 | 41.5 | 1.4 | 10.4 |
| **EP090S: Organotin Surrogate** | | | | | | | | |
| Tripropyltin | | 0.1 | % | 76.6 | 53.0 | 69.2 | 62.2 | 92.8 |

## Analytical Results

| | | | Client Sample ID : | **H38** | **QC3** | **QC4** | | |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | | |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | | |
| | | | Laboratory Sample ID : | **ES0703908-016** | **ES0703908-017** | **ES0703908-018** | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 58.9 | 63.1 | 74.6 | | |
| **EP090: Organotin Compounds** | | | | | | | | |
| Tributyltin | 56573-85-4 | 0.5 | µgSn/kg | 4.5 | 0.8 | 8.2 | | |
| **EP090S: Organotin Surrogate** | | | | | | | | |
| Tripropyltin | | 0.1 | % | 81.8 | 55.0 | 90.2 | | |

# *Surrogate Control Limits*

***Matrix Type: SOIL - Surrogate Control Limits*** ***Surrogate Control Limits***

| *Method name* | *Analyte name* | *Lower Limit* | *Upper Limit* |
|---|---|---|---|
| **EP090: Organotin Analysis** | | | |
| EP090S: Organotin Surrogate | Tripropyltin | 34 | 108 |

**ALS Environmental**

# QUALITY CONTROL REPORT

| | | | | | |
|---|---|---|---|---|---|
| **Client** | **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | Environmental Division Sydney | **Page** | **1 of 4** |
| **Contact** | CARSTEN MATTHAI | **Contact** | Victor Kedicioglu | | |
| **Address** | LEVEL 3, 116 MILLER STREET NORTH<br>SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | **ES0703908** |
| | | | | **Amendment No.** | |
| **Project** | 43217595 Sediment Study | **Quote number** | SY/019/07 V2 | **Date received** | **27 Mar 2007** |
| **Order number** | - Not provided - | | | **Date issued** | **23 Apr 2007** |
| **C-O-C number** | - Not provided - | | | | |
| **Site** | - Not provided - | | | | |
| **E-mail** | carsten_matthai@urscorp.com | **E-mail** | Victor.Kedicioglu@alsenviro.com | **No. of samples** | |
| **Telephone** | 89255500 | **Telephone** | 61-2-8784 8555 | **Received** | 18 |
| **Facsimile** | 89255555 | **Facsimile** | 61-2-8784 8500 | **Analysed** | 18 |

This final report for the ALSE work order reference ES0703908 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

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**NATA Accredited Laboratory - 825**

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| Signatory | Department |
|---|---|
| Carsten Emrich | Organics - NATA 825 (818 - Brisbane) |
| Kim McCabe | Inorganics - NATA 825 (818 - Brisbane) |
| Stephen Hislop | Inorganics - NATA 825 (818 - Brisbane) |

# *Quality Control Report - Laboratory Duplicates (DUP)*

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EA055: Moisture Content** | | | | | | |
| **EA055: Moisture Content - ( QC Lot: 382076 )** | | | | % | % | % |
| EB0703485-001 | Anonymous | Moisture Content (dried @ 103°C) | 1.0 % | 9.8 | 10.0 | 1.7 |
| ES0703908-003 | H9 | Moisture Content (dried @ 103°C) | 1.0 % | 75.2 | 75.0 | 0.2 |
| **EA055: Moisture Content - ( QC Lot: 382077 )** | | | | % | % | % |
| ES0703908-016 | H38 | Moisture Content (dried @ 103°C) | 1.0 % | 58.9 | 58.7 | 0.3 |
| **EP090: Organotin Compounds** | | | | | | |
| **EP090: Organotin Compounds - ( QC Lot: 385661 )** | | | | µgSn/kg | µgSn/kg | % |
| ES0703908-001 | H7 | Tributyltin | 0.5 µgSn/kg | 1.6 | 1.5 | 9.0 |
| ES0703908-011 | H25 | Tributyltin | 0.5 µgSn/kg | 22.9 | 19.2 | 17.6 |

# *Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)*

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| *Analyte name* | *LOR* | | | *LCS* | *Low* | *High* |
| **EP090: Organotin Compounds** | | | | | | |
| **EP090: Organotin Compounds - ( QC Lot: 385661 )** | | µgSn/kg | µgSn/kg | % | % | % |
| Tributyltin | 0.5 µgSn/kg | ---- | 25 | 92.2 | 28 | 130 |
| | 0.5 µgSn/kg | <0.5 | ---- | ---- | ---- | ---- |

# *Quality Control Report - Matrix Spikes (MS)*

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations: **LOR** = Limit of Reporting, **RPD** = Relative Percent Difference.*

* Indicates failed QC

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| | | | | | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|---|---|
| | | | | | *Sample Result* | *Spike Recovery* | *Static Limits* | |
| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | | *MS* | *Low* | *High* |
| **EP090: Organotin Compounds** | | | | | | | | |
| **EP090: Organotin Compounds - ( QC Lot: 385661 )** | | | | µgSn/kg | µgSn/kg | % | % | % |
| Tributyltin | ES0703908-002 | H8 | 0.5 µgSn/kg | 25 | 5.2 | 47.1 | 20 | 130 |

# INTERPRETIVE QUALITY CONTROL REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Client** | : | **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | : | Environmental Division Sydney | **Page** | : **1 of 5** |
| **Contact** | : | CARSTEN MATTHAI | **Contact** | : | Victor Kedicioglu | | |
| **Address** | : | LEVEL 3, 116 MILLER STREET NORTH SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | : | 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | : **ES0703908** |
| | | | | | | **Amendment No.** | : |
| **Project** | : | 43217595 Sediment Study | **Quote number** | : | SY/019/07 V2 | **Date received** | : 27 Mar 2007 |
| **Order number** | : | - Not provided - | | | | **Date issued** | : 23 Apr 2007 |
| **C-O-C number** | : | - Not provided - | | | | | |
| **Site** | : | - Not provided - | | | | | |
| **E-mail** | : | carsten_matthai@urscorp.com | **E-mail** | : | Victor.Kedicioglu@alsenviro.com | **No. of samples** | |
| **Telephone** | : | 89255500 | **Telephone** | : | 61-2-8784 8555 | **Received** | : 18 |
| **Facsimile** | : | 89255555 | **Facsimile** | : | 61-2-8784 8500 | **Analysed** | : 18 |

This Interpretive Quality Control Report was issued on 23 Apr 2007 for the ALS work order reference ES0703908 and supersedes any previous reports with this reference.

This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

# Interpretive Quality Control Report - Analysis Holding Time

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

***Matrix Type: SOIL*** ***Analysis Holding Time and Preservation***

| **Method** | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|
| **Container /** Client Sample ID(s) | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EA055-103: Moisture Content | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | ---- | ---- | ---- | **29 Mar 2007** | 2 Apr 2007 | Pass |
| EP090: Organotin Analysis | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **12 Apr 2007** | 9 Apr 2007 | **Fail by 3 days** | **20 Apr 2007** | 22 May 2007 | Pass |

# *Interpretive Quality Control Report - Frequency of Quality Control Samples*

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

***Matrix Type: SOIL*** ***Frequency of Quality Control Samples***

| Quality Control Sample Type | Count | | Rate (%) | | Quality Control Specification |
|---|---|---|---|---|---|
| Method | QC | Regular | **Actual** | **Expected** | |
| Laboratory Duplicates (DUP) | | | | | |
| EA055-103: Moisture Content | 3 | 26 | **11.5** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP090: Organotin Analysis | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Laboratory Control Samples (LCS) | | | | | |
| EP090: Organotin Analysis | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Method Blanks (MB) | | | | | |
| EP090: Organotin Analysis | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Matrix Spikes (MS) | | | | | |
| EP090: Organotin Analysis | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |

# *Interpretive Quality Control Report - Summary of Outliers*

## *Outliers : Quality Control Samples*

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

### *Non-surrogates*

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**
- **For all matrices, no matrix spike recoveries breaches occur.**

### *Surrogates*

- **For all matrices, no surrogate recovery outliers occur.**

## *Outliers : Analysis Holding Time*

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

| **Method**<br>**Container /** Client Sample ID(s) | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|
| | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EP090: Organotin Analysis | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7,<br>H8,<br>H9,<br>H10,<br>H17,<br>H18,<br>H21,<br>H22,<br>H23,<br>H24,<br>H25,<br>H26,<br>H28,<br>H31,<br>H37,<br>H38,<br>QC3,<br>QC4 | **26 Mar 2007** | **12 Apr 2007** | 9 Apr 2007 | **Fail by 3 days** | **20 Apr 2007** | 22 May 2007 | Pass |

## *Outliers : Frequency of Quality Control Samples*

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

# *Method Reference Summary*

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

***Matrix Type: SEDIMENT*** ***Method Reference Summary***

## Preparation Methods

**ORG35 : Organotin Sample Preparation -** In house. 20g sample is spiked with surrogate and leached in a methanol:acetic acid:UHP water mix and vacuum filtered. Reagents and solvents are added to the sample and the mixture tumbled. The butyltin compounds are simultaneously derivatised and extracted. The extract is further extracted with petroleum ether. The resultant extracts are combined and concentrated for analysis.

## Analytical Methods

**EA055-103 : Moisture Content -** A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)

**EP090 : Organotin Analysis -** (USEPA SW 846 - 8270D) Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.

AUSTRALIAN LABORATORY SERVICES PTY LTD ABN 84 009 936 029
277-289 Woodpark Road Smithfield NSW 2164 Australia
Telephone: 61-2-8784 8555 Facsimile: 61-2-8784 8500 http://www.alsenviro.com/

**ALS Environmental**

# *SAMPLE RECEIPT NOTIFICATION (SRN)*

## *Comprehensive report*

### *Client Details*

| | | |
|---|---|---|
| **Client** | : | **URS AUSTRALIA (NSW) PTY LTD** |
| **Contact** | : | **CARSTEN MATTHAI** |
| **Address** | : | LEVEL 3, 116 MILLER STREET NORTH<br>SYDNEY NSW AUSTRALIA 2060 |
| **Project** | : | **43217595 Sediment Study** |
| **Order number** | : | **- Not provided -** |
| **C-O-C Number** | : | **- Not provided -** |
| **Site** | : | **- Not provided -** |
| **Sampler** | : | **CARSTEN MATTHAI** |
| **E-mail** | : | carsten_matthai@urscorp.com |
| **Telephone** | : | 89255500 |
| **Facsimile** | : | 89255555 |

### *Laboratory Details*

| | | |
|---|---|---|
| **Laboratory** | : | **Environmental Division Sydney** |
| **Manager** | : | **Victor Kedicioglu** |
| **Address** | : | 277-289 Woodpark Road Smithfield NSW<br>Australia 2164 |
| **Quote number** | : | ES20070014 |
| **Work order** | : | **ES0703908** |
| **E-mail** | : | Victor.Kedicioglu@alsenviro.com |
| **Telephone** | : | 61-2-8784 8555 |
| **Facsimile** | : | 61-2-8784 8500 |

### *Dates*

| | | | | | |
|---|---|---|---|---|---|
| **Date Samples Received** | : | 27 Mar 2007 | **SRA Issue Date** | : | |
| **Scheduled Reporting Date** | : | **23 Apr 2007** | **Client Requested Date** | : | 23 Apr 2007 |

### *Delivery Details*

| | | | | | |
|---|---|---|---|---|---|
| **Mode of Delivery** | : | Carrier. | **Temperature** | : | 6.2'C - Ice present |
| **No. of coolers/boxes** | : | 1 HARD | **No. of samples - Received** | | 18 |
| **Security Seal** | : | Intact. | **- Analysed** | | 18 |

### *Comments*

- **Samples received in appropriately pretreated and preserved containers.**
- **Sample(s) have been received within recommended holding times.**
- **THIS BATCH IS FOR TBT ANALYSIS ONLY AND SPLIT FROM ES0703904.**

---

- Please direct any queries related to sample condition / numbering / breakages to Nanthini Coilparampil
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Analytical work for this work order will be conducted at ALSE Sydney.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.
- When the sampling time is not supplied on the COC documentation, ALSE defaults the sampling time to that of the COC 'relinquishment' time (if supplied). If this also is not supplied, ALSE defaults the sampling time to the 'time of receipt at Laboratory'.

## *SAMPLE RECEIPT NOTIFICATION (SRN) - continued*

**Client** : URS AUSTRALIA (NSW) PTY LTD
**Project** : 43217595 Sediment Study

**Work Order** : ES0703908
**ALS Quote Reference** : ES20070014

## *Summary of Sample(s) / Container(s) and Requested Analysis*

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as moisture and preparation tasks, that form an implicit part of that package.

| **ALS Sample ID.** | Client Sample ID - Sample Date | **Requested Analysis** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **EA055-103 - SOIL** Moisture Content | **EP090 (solids) - SOIL** Organotins | | | | | | | | |
| **ES0703908-001** | **H7 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-002** | **H8 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-003** | **H9 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-004** | **H10 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-005** | **H17 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-006** | **H18 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-007** | **H21 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-008** | **H22 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-009** | **H23 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-010** | **H24 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-011** | **H25 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-012** | **H26 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-013** | **H28 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-014** | **H31 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-015** | **H37 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-016** | **H38 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-017** | **QC3 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703908-018** | **QC4 - 26 Mar 2007** | ] | ] | | | | | | | | |
| | **Total(s) :** | **18** | **18** | | | | | | | | |

## Requested Reports

|  |  |  |
|---|---|---|
| **ACCOUNTS PAYABLE** |  |  |
| - A4 - AU Tax Invoice | Email | sydney_accounts@urscorp.com |
| **CARSTEN MATTHAI** |  |  |
| - A4 - Quality Control Report - NEPM format | Email | carsten_matthai@urscorp.com |
| - A4 - Interpretive Quality Control Report - NEPM format | Email | carsten_matthai@urscorp.com |
| - A4 - Certificate of Analysis - NEPM format | Email | carsten_matthai@urscorp.com |
| - ENMRG Export Format | Email | carsten_matthai@urscorp.com |
| - A4 - Sample Receipt Notification - Comprehensive format | Email | carsten_matthai@urscorp.com |
| - Chain of Custody Acknowledgement | Email | carsten_matthai@urscorp.com |
| - Invoice | Email | carsten_matthai@urscorp.com |

## Sample Container(s) / Preservation Non-Compliance Log

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

# CHAIN OF CUSTODY FORM

Sheet 1 of 1

**THIS COLUMN FOR LAB USE ONLY**

**Job Code:** 43217595

**Due Date:** 12-4-07

**FROM:**
**URS (AUSTRALIA)**
ACN 000 691 690
North Sydney
Level 3 116 Miller Street

**Ph: 8925 5500**

**DATE:** 27-3-07

**Fax: 8925 5555**

**TO:**
**ALS Smithfield**
277 Woodpark Rd
Smithfield 2164

**Project No:** 43217595
**Project Manager:** Carsten Matthai
**Agreement No:** SY-019-07 URS V2

**Sampler(s): Carsten Matthai**
**Signature(s):** Matthai
**Checked:**

**Custody seal intact?** [✓ YES] NO
**Sample cold?** [✓ YES] NO

Released for URS by: Carsten Matthai
Date: 27-3-07 Time: 10.00am

Received for Laboratory by: Frank Ferraro - ALS Sydney
Date: 27/03/07 Time: 15:40

**Container Size, Type, Preservative and Analysis**

Container Identification

| | | | |
|---|---|---|---|
| **Size mL** | 250 | 150 | |
| **Type*** | Glass | Glass | |
| **Preservative Code** | | | |
| Analytes | ~~Analytes per SY-019-07 URS V2 TPH (C6-C36)/BTEX Low Level, PAHs - 24 Analytes Ultra Trace, OC/OP/PCB Ultra Trace (Table A)~~ | **Organo Tins (TBT)** | **Hold** |

TBT ONLY

| **Lab identification** | **Date** | **Time** | **Matrix** | **Sample Number** | **Estimated Level of Contamination** | Total no | Tick required analytes | | **Hold** |
|---|---|---|---|---|---|---|---|---|---|
| ① | 26-3-07 | | Sediment | **H7** | **Intermediate** | | x | x | x |
| ② | | | Sediment | **H8** | **Intermediate** | | x | x | x |
| ③ | | | Sediment | **H9** | **Intermediate** | | x | x | x |
| ④ | | | Sediment | **H10** | **Intermediate** | | x | x | x |
| ⑤ | | | Sediment | **H17** | **Intermediate** | | x | x | x |
| ⑥ | | | Sediment | **H18** | **Intermediate** | | x | x | x |
| ⑦ | | | Sediment | **H21** | **Intermediate** | | x | x | x |
| ⑧ | | | Sediment | **H22** | **Intermediate** | | x | x | x |
| ⑨ | | | Sediment | **H23** | **Intermediate** | | x | x | x |
| ⑩ | | | Sediment | **H24** | **Intermediate** | | x | x | x |
| ⑪ | | | Sediment | **H25** | **Intermediate** | | x | x | x |
| ⑫ | | | Sediment | **H26** | **Intermediate** | | x | x | x |
| ⑬ | | | Sediment | **H28** | **Intermediate** | | x | x | x |
| ⑭ | | | Sediment | **H31** | **Intermediate** | | x | x | x |
| ⑮ | | | Sediment | **H37** | **Intermediate** | | x | x | x |
| ⑯ | | | Sediment | **H38** | **Intermediate** | | x | x | x |
| ⑰ | | | Sediment | **QC3** | **Intermediate** | | x | x | x |
| ⑱ | | | Sediment | **QC4** | **Intermediate** | | x | x | x |
| | | | | | **TOTAL** | | 18 (2 identical jars each) | 18 | |

Environmental Division
Sydney
Work Order
**ES0703908**

Telephone : 61-2-8784 8555

**CONTRACT WORK**
**WO:** ES0703908
**LAB:** ALS Brisbane - TBT
**DATE:** 27/03/07
**SPLIT:** TBT split from ES0703904

**Remarks:**
No historical data available. Please send results to Dr Carsten Matthai (Email: carsten_matthai@urscorp.com).

* Container Type and Preservative Codes: P = Neutral Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinsed Jar; S = Solvent Washed Acid Rinsed Glass Bottle; VC = Hydrochloric Acid Preserved Vial; VS = Sulfuric

**Courier Job No:**

**Send results to Carsten_Matthai@urscorp.com**

**NOTE: SAMPLES MAY CONTAIN DANGEROUS AND HAZARDOUS SUBSTANCES**

# CERTIFICATE OF ANALYSIS

| | | | | | |
|---|---|---|---|---|---|
| *Client* | : **URS AUSTRALIA (NSW) PTY LTD** | *Laboratory* | : **Environmental Division Sydney** | *Page* | : **1 of 8** |
| *Contact* | : **MR CARSTEN MATTHAI** | *Contact* | : **Victor Kedicioglu** | *Work Order* | : **ES0703910** |
| *Address* | : **LEVEL 3, 116 MILLER STREET NORTH SYDNEY NSW AUSTRALIA 2060** | *Address* | : **277-289 Woodpark Road Smithfield NSW Australia 2164** | *Amendment No.* | : **1** |
| *E-mail* | : **carsten_matthai@urscorp.com** | *E-mail* | : **Victor.Kedicioglu@alsenviro.com** | | |
| *Telephone* | : **89255500** | *Telephone* | : **61-2-8784 8555** | | |
| *Facsimile* | : **89255555** | *Facsimile* | : **61-2-8784 8500** | | |
| *Project* | : **43217595 Sediment Study** | *Quote number* | : **SY/019/07 V2** | *Date received* | : **27 Mar 2007** |
| *Order number* | : **- Not provided -** | | | *Date issued* | : **13 Apr 2007** |
| *C-O-C number* | : **- Not provided -** | | | *No. of samples* | - *Received* : **8** |
| *Site* | : **- Not provided -** | | | | *Analysed* : **8** |

*ALSE - Excellence in Analytical Testing*

**NATA Accredited Laboratory 825**

**This document is issued in accordance with NATA's accreditation requirements.**

**Accredited for compliance with ISO/IEC 17025.**

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatory* | *Position* | *Department* |
|---|---|---|
| **Ankit Joshi** | | **Inorganics - NATA 825 (10911 - Sydney)** |
| **Celine Conceicao** | **Spectroscopist** | **Inorganics - NATA 825 (10911 - Sydney)** |
| **Rassem Ayoubi** | **Senior Organic Chemist** | **Organics - NATA 825 (10911 - Sydney)** |

## Comments

This report for the ALSE reference ES0703910 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order **ES0703910**

Poor duplicate precision was observed for Calcium due to heterogenity.

## *Analytical Results*

| | | | **Client Sample ID :** | **H40** | **H41** | **H42** | **QC1** | **H3** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703910-001** | **ES0703910-002** | **ES0703910-003** | **ES0703910-004** | **ES0703910-005** |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 34.3 | 51.2 | 44.0 | 48.7 | 62.2 |
| **ED093T: Total Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | 30900 | 5320 | 7820 | 38100 | ---- |
| Magnesium | 7439-95-4 | 10 | mg/kg | 2500 | 4390 | 3700 | 3940 | ---- |
| **EG005T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 6860 | 14000 | 10600 | 11800 | ---- |
| Arsenic | 7440-38-2 | 5 | mg/kg | 12 | 13 | 14 | 14 | ---- |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 30 | 20 | 30 | ---- |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | 1 | <1 | 1 | ---- |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | ---- |
| Chromium | 7440-47-3 | 2 | mg/kg | 11 | 20 | 16 | 17 | ---- |
| Cobalt | 7440-48-4 | 2 | mg/kg | 8 | 11 | 9 | 9 | ---- |
| Copper | 7440-50-8 | 5 | mg/kg | 8 | 18 | 15 | 16 | ---- |
| Iron | 7439-89-6 | 50 | mg/kg | 17100 | 25700 | 21400 | 22300 | ---- |
| Lead | 7439-92-1 | 5 | mg/kg | 13 | 21 | 18 | 19 | ---- |
| Manganese | 7439-96-5 | 5 | mg/kg | 347 | 285 | 261 | 279 | ---- |
| Nickel | 7440-02-0 | 2 | mg/kg | 8 | 15 | 11 | 12 | ---- |
| Strontium | 7440-24-6 | 2 | mg/kg | 139 | 54 | 57 | 168 | ---- |
| Vanadium | 7440-62-2 | 5 | mg/kg | 30 | 46 | 36 | 39 | ---- |
| Zinc | 7440-66-6 | 5 | mg/kg | 47 | 61 | 56 | 58 | ---- |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | |
| Silver | 7440-22-4 | 0.1 | mg/kg | ---- | ---- | ---- | ---- | <0.1 |
| **EG035T: Total Mercury by FIMS** | | | | | | | | |
| Mercury | 7439-97-6 | 0.1 | mg/kg | 0.2 | <0.1 | <0.1 | <0.1 | ---- |
| **EK059G: NOX as N by Discrete Analyser** | | | | | | | | |
| Nitrite + Nitrate as N (Sol.) | | 0.100 | mg/kg | 0.259 | 0.194 | 0.116 | <0.100 | ---- |
| **EK061G: Total Kjeldahl Nitrogen as N** | | | | | | | | |
| Total Kjeldahl Nitrogen as N | | 20 | mg/kg | 640 | 1420 | 1220 | 1460 | ---- |
| **EK071G: Reactive Phosphorous as P by discrete analyser** | | | | | | | | |
| Reactive Phosphorus as P | | 0.100 | mg/kg | 0.106 | <0.100 | <0.100 | <0.100 | ---- |
| **EP004: Organic Matter** | | | | | | | | |
| Total Organic Carbon | | 0.5 | % | 1.0 | 4.0 | 3.1 | 2.5 | ---- |
| **EP066: Polychlorinated Biphenyls (PCB)** | | | | | | | | |
| Total Polychlorinated biphenyls | | 0.10 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | ---- |
| **EP068A: Organochlorine Pesticides (OC)** | | | | | | | | |
| alpha-BHC | 319-84-6 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |

## *Analytical Results*

| | | | Client Sample ID : | **H40** | **H41** | **H42** | **QC1** | **H3** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | | | | | |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | **ES0703910-001** | **ES0703910-002** | **ES0703910-003** | **ES0703910-004** | **ES0703910-005** |
| **EP068A: Organochlorine Pesticides (OC)** | | | | | | | | |
| Hexachlorobenzene (HCB) | 118-74-1 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| beta-BHC | 319-85-7 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| gamma-BHC | 58-89-9 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| delta-BHC | 319-86-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Heptachlor | 76-44-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Aldrin | 309-00-2 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Heptachlor epoxide | 1024-57-3 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| trans-Chlordane | 5103-74-2 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| alpha-Endosulfan | 959-98-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| cis-Chlordane | 5103-71-9 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Dieldrin | 60-57-1 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| 4.4’-DDE | 72-55-9 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Endrin | 72-20-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| beta-Endosulfan | 33213-65-9 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| 4.4’-DDD | 72-54-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Endrin aldehyde | 7421-93-4 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Endosulfan sulfate | 1031-07-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| 4.4’-DDT | 50-29-3 | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | ---- |
| Endrin ketone | 53494-70-5 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Methoxychlor | 72-43-5 | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | ---- |
| **EP068B: Organophosphorus Pesticides (OP)** | | | | | | | | |
| Dichlorvos | 62-73-7 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Demeton-S-methyl | 919-86-8 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Monocrotophos | 6923-22-4 | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | ---- |
| Dimethoate | 60-51-5 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Diazinon | 333-41-5 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Chlorpyrifos-methyl | 5598-13-0 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Parathion-methyl | 298-00-0 | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | ---- |
| Malathion | 121-75-5 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Fenthion | 55-38-9 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Chlorpyrifos | 2921-88-2 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Parathion | 56-38-2 | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | ---- |
| Pirimphos-ethyl | 23505-41-1 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Chlorfenvinphos | 470-90-6 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Bromophos-ethyl | 4824-78-6 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Fenamiphos | 22224-92-6 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Prothiofos | 34643-46-4 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |

## Analytical Results

| | | | Client Sample ID : | H40 | H41 | H42 | QC1 | H3 |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 | 26 Mar 2007 15:00 |
| | | | Laboratory Sample ID : | ES0703910-001 | ES0703910-002 | ES0703910-003 | ES0703910-004 | ES0703910-005 |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EP068B: Organophosphorus Pesticides (OP)** | | | | | | | | |
| Ethion | 563-12-2 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Carbophenothion | 786-19-6 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| Azinphos Methyl | 86-50-0 | 0.05 | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| Naphthalene | 91-20-3 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Acenaphthylene | 208-96-8 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Acenaphthene | 83-32-9 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Fluorene | 86-73-7 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Phenanthrene | 85-01-8 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Anthracene | 120-12-7 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Fluoranthene | 206-44-0 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Pyrene | 129-00-0 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Benz(a)anthracene | 56-55-3 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Chrysene | 218-01-9 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Benzo(b)fluoranthene | 205-99-2 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Benzo(k)fluoranthene | 207-08-9 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Benzo(a)pyrene | 50-32-8 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Indeno(1.2.3.cd)pyrene | 193-39-5 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Dibenz(a.h)anthracene | 53-70-3 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| Benzo(g.h.i)perylene | 191-24-2 | 0.5 | mg/kg | <0.5 | <0.9 | <0.5 | <0.5 | ---- |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| C6 - C9 Fraction | | 10 | mg/kg | <10 | <10 | <10 | <10 | ---- |
| C10 - C14 Fraction | | 50 | mg/kg | <50 | <60 | <50 | <50 | ---- |
| C15 - C28 Fraction | | 100 | mg/kg | <100 | <120 | <100 | <100 | ---- |
| C29 - C36 Fraction | | 100 | mg/kg | <100 | <120 | <100 | <100 | ---- |
| **EP080: BTEX** | | | | | | | | |
| Benzene | 71-43-2 | 0.2 | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | ---- |
| Toluene | 108-88-3 | 0.5 | mg/kg | <0.5 | <0.5 | <0.5 | <0.5 | ---- |
| Ethylbenzene | 100-41-4 | 0.5 | mg/kg | <0.5 | <0.5 | <0.5 | <0.5 | ---- |
| meta- & para-Xylene | 108-38-3<br>106-42-3 | 0.5 | mg/kg | <0.5 | <0.5 | <0.5 | <0.5 | ---- |
| ortho-Xylene | 95-47-6 | 0.5 | mg/kg | <0.5 | <0.5 | <0.5 | <0.5 | ---- |
| **EP066S: PCB Surrogate** | | | | | | | | |
| Decachlorobiphenyl | 2051-24-3 | 0.1 | % | 126 | 114 | 72.5 | 60.0 | ---- |
| **EP068S: Organochlorine Pesticide Surrogate** | | | | | | | | |
| Dibromo-DDE | 21655-73-2 | 0.1 | % | 73.5 | 85.6 | 105 | 92.8 | ---- |

## *Analytical Results*

| | | | Client Sample ID : | **H40** | **H41** | **H42** | **QC1** | **H3** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | **ES0703910-001** | **ES0703910-002** | **ES0703910-003** | **ES0703910-004** | **ES0703910-005** |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EP068T: Organophosphorus Pesticide Surrogate** | | | | | | | | |
| DEF | 78-48-8 | 0.1 | % | 70.0 | 76.6 | 92.2 | 83.8 | ---- |
| **EP075(SIM)S: Phenolic Compound Surrogates** | | | | | | | | |
| Phenol-d6 | 13127-88-3 | 0.1 | % | 106 | 109 | 108 | 111 | ---- |
| 2-Chlorophenol-D4 | 93951-73-6 | 0.1 | % | 92.8 | 96.2 | 95.2 | 97.1 | ---- |
| 2.4.6-Tribromophenol | 118-79-6 | 0.1 | % | 55.8 | 72.0 | 113 | 68.9 | ---- |
| **EP075(SIM)T: PAH Surrogates** | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | 0.1 | % | 91.6 | 91.1 | 91.1 | 92.3 | ---- |
| Anthracene-d10 | 1719-06-8 | 0.1 | % | 89.8 | 88.0 | 87.9 | 89.4 | ---- |
| 4-Terphenyl-d14 | 1718-51-0 | 0.1 | % | 83.7 | 81.9 | 82.6 | 83.2 | ---- |
| **EP080S: TPH(V)/BTEX Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 0.1 | % | 91.0 | 114 | 104 | 106 | ---- |
| Toluene-D8 | 2037-26-5 | 0.1 | % | 80.2 | 108 | 114 | 87.6 | ---- |
| 4-Bromofluorobenzene | 460-00-4 | 0.1 | % | 84.5 | 87.4 | 92.8 | 96.4 | ---- |

## *Analytical Results*

| *Analyte* | *CAS number* | *LOR* | *Units* | **Client Sample ID :** | **H5** | **H7** | **QC2** | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sample Matrix Type / Description : | SEDIMENT | SEDIMENT | SEDIMENT | | |
| | | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | | |
| | | | | Laboratory Sample ID : | **ES0703910-006** | **ES0703910-007** | **ES0703910-008** | | |
| **EA055: Moisture Content** | | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | | 66.1 | 75.6 | 64.7 | | |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| Silver | 7440-22-4 | 0.1 | mg/kg | | 0.1 | 0.2 | 0.1 | | |

# Surrogate Control Limits

***Matrix Type: SOIL - Surrogate Control Limits*** ***Surrogate Control Limits***

| *Method name* | *Analyte name* | *Lower Limit* | *Upper Limit* |
|---|---|---|---|
| **EP066: Polychlorinated Biphenyls (PCB)** | | | |
| EP066S: PCB Surrogate | Decachlorobiphenyl | 10 | 164 |
| **EP068: Pesticides by GCMS** | | | |
| EP068S: Organochlorine Pesticide Surrogate | Dibromo-DDE | 10 | 136 |
| EP068T: Organophosphorus Pesticide Surrogate | DEF | 10 | 136 |
| **EP075(SIM): PAH/Phenols (SIM)** | | | |
| EP075(SIM)S: Phenolic Compound Surrogates | Phenol-d6 | 24 | 113 |
| | 2-Chlorophenol-D4 | 23 | 134 |
| | 2,4,6-Tribromophenol | 19 | 122 |
| EP075(SIM)T: PAH Surrogates | 2-Fluorobiphenyl | 30 | 115 |
| | Anthracene-d10 | 27 | 133 |
| | 4-Terphenyl-d14 | 18 | 137 |
| **EP080: TPH Volatiles/BTEX** | | | |
| EP080S: TPH(V)/BTEX Surrogates | 1,2-Dichloroethane-D4 | 80 | 120 |
| | Toluene-D8 | 81 | 117 |
| | 4-Bromofluorobenzene | 74 | 121 |

ALS Environmental

# QUALITY CONTROL REPORT

| | | | | | |
|---|---|---|---|---|---|
| **Client** | URS AUSTRALIA (NSW) PTY LTD | **Laboratory** | Environmental Division Sydney | **Page** | 1 of 17 |
| **Contact** | CARSTEN MATTHAI | **Contact** | Victor Kedicioglu | | |
| **Address** | LEVEL 3, 116 MILLER STREET NORTH<br>SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | **ES0703910** |
| | | | | **Amendment No.** | 1 |
| **Project** | 43217595 Sediment Study | **Quote number** | SY/019/07 V2 | **Date received** | 27 Mar 2007 |
| **Order number** | - Not provided - | | | **Date issued** | 13 Apr 2007 |
| **C-O-C number** | - Not provided - | | | | |
| **Site** | - Not provided - | | | | |
| **E-mail** | carsten_matthai@urscorp.com | **E-mail** | Victor.Kedicioglu@alsenviro.com | **No. of samples** | |
| **Telephone** | 89255500 | **Telephone** | 61-2-8784 8555 | **Received** | 8 |
| **Facsimile** | 89255555 | **Facsimile** | 61-2-8784 8500 | **Analysed** | 8 |

This final report for the ALSE work order reference ES0703910 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

**Work order specific comments**

Poor duplicate precision was observed for Calcium due to heterogenity.

*ALSE - Excellence in Analytical Testing*

**NATA Accredited Laboratory - 825**

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Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| Signatory | Department |
|---|---|
| Ankit Joshi | Inorganics - NATA 825 (10911 - Sydney) |
| Celine Conceicao | Inorganics - NATA 825 (10911 - Sydney) |
| Rassem Ayoubi | Organics - NATA 825 (10911 - Sydney) |

# *Quality Control Report - Laboratory Duplicates (DUP)*

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations: **LOR** = Limit of Reporting, **RPD** = Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EA055: Moisture Content** | | | | | | |
| **EA055: Moisture Content - ( QC Lot: 381165 )** | | | | **%** | **%** | **%** |
| ES0703904-001 | Anonymous | Moisture Content (dried @ 103°C) | 1.0 % | 74.0 | 71.5 | 3.4 |
| ES0703904-010 | Anonymous | Moisture Content (dried @ 103°C) | 1.0 % | 76.0 | 76.2 | 0.2 |
| **EA055: Moisture Content - ( QC Lot: 381166 )** | | | | **%** | **%** | **%** |
| ES0703910-003 | H42 | Moisture Content (dried @ 103°C) | 1.0 % | 44.0 | 45.5 | 3.4 |
| **EA055: Moisture Content - ( QC Lot: 381545 )** | | | | **%** | **%** | **%** |
| EB0703312-001 | Anonymous | Moisture Content (dried @ 103°C) | 1.0 % | 29.2 | 30.1 | 3.2 |
| ES0703910-005 | H3 | Moisture Content (dried @ 103°C) | 1.0 % | 62.2 | 63.1 | 1.4 |
| **ED093T: Total Major Cations** | | | | | | |
| **ED093T: Total Major Cations - ( QC Lot: 382445 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703910-002 | H41 | Calcium | 10 mg/kg | 5320 | 2830 | 61.2 |
| | | Magnesium | 10 mg/kg | 4390 | 4360 | 0.6 |
| **EG005T: Total Metals by ICP-AES** | | | | | | |
| **EG005T: Total Metals by ICP-AES - ( QC Lot: 382443 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703910-002 | H41 | Aluminium | 50 mg/kg | 14000 | 14300 | 2.1 |
| | | Arsenic | 5 mg/kg | 13 | 12 | 8.6 |
| | | Barium | 10 mg/kg | 30 | 30 | 0.0 |
| | | Beryllium | 1 mg/kg | 1 | 1 | 0.0 |
| | | Cadmium | 1 mg/kg | <1 | <1 | 0.0 |
| | | Chromium | 2 mg/kg | 20 | 21 | 0.0 |
| | | Cobalt | 2 mg/kg | 11 | 11 | 0.0 |
| | | Copper | 5 mg/kg | 18 | 18 | 0.0 |
| | | Iron | 50 mg/kg | 25700 | 25700 | 0.2 |
| | | Lead | 5 mg/kg | 21 | 22 | 0.0 |
| | | Manganese | 5 mg/kg | 285 | 254 | 11.8 |
| | | Nickel | 2 mg/kg | 15 | 16 | 0.0 |

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EG005T: Total Metals by ICP-AES - continued** | | | | | | |
| **EG005T: Total Metals by ICP-AES - ( QC Lot: 382443 ) - continued** | | | | mg/kg | mg/kg | % |
| ES0703910-002 | H41 | Strontium | 2 mg/kg | 54 | 46 | 17.6 |
| | | Vanadium | 5 mg/kg | 46 | 47 | 3.2 |
| | | Zinc | 5 mg/kg | 61 | 63 | 2.2 |
| **EG020T: Total Metals by ICP-MS** | | | | | | |
| **EG020T: Total Metals by ICP-MS - ( QC Lot: 382446 )** | | | | mg/kg | mg/kg | % |
| ES0703910-005 | H3 | Silver | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| **EG035T: Total Mercury by FIMS** | | | | | | |
| **EG035T: Total Mercury by FIMS - ( QC Lot: 382444 )** | | | | mg/kg | mg/kg | % |
| ES0703910-002 | H41 | Mercury | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| **EK059G: NOX as N by Discrete Analyser** | | | | | | |
| **EK059G: NOX as N by Discrete Analyser - ( QC Lot: 381576 )** | | | | mg/kg | mg/kg | % |
| ES0703985-002 | Anonymous | Nitrite + Nitrate as N (Sol.) | 0.100 mg/kg | 1.22 | 1.12 | 8.1 |
| **EK061G: Total Kjeldahl Nitrogen as N** | | | | | | |
| **EK061G: Total Kjeldahl Nitrogen as N - ( QC Lot: 386986 )** | | | | mg/kg | mg/kg | % |
| ES0704079-003 | Anonymous | Total Kjeldahl Nitrogen as N | 20 mg/kg | 970 | 940 | 2.7 |
| ES0704079-004 | Anonymous | Total Kjeldahl Nitrogen as N | 20 mg/kg | 1560 | 1490 | 4.3 |
| **EK071G: Reactive Phosphorous as P by discrete analyser** | | | | | | |
| **EK071G: Reactive Phosphorous as P by discrete analyser - ( QC Lot: 381577 )** | | | | mg/kg | mg/kg | % |
| ES0703985-001 | Anonymous | Reactive Phosphorus as P | | ---- | 0.079 | |
| **EP004: Organic Matter** | | | | | | |
| **EP004: Organic Matter - ( QC Lot: 381329 )** | | | | % | % | % |
| ES0703910-002 | H41 | Total Organic Carbon | 0.5 % | 4.0 | 3.9 | 0.0 |
| **EP066: Polychlorinated Biphenyls (PCB)** | | | | | | |
| **EP066: Polychlorinated Biphenyls (PCB) - ( QC Lot: 381558 )** | | | | mg/kg | mg/kg | % |
| ES0703910-001 | H40 | Total Polychlorinated biphenyls | 0.10 mg/kg | <0.10 | <0.10 | 0.0 |
| **EP068A: Organochlorine Pesticides (OC)** | | | | | | |
| **EP068A: Organochlorine Pesticides (OC) - ( QC Lot: 381557 )** | | | | mg/kg | mg/kg | % |
| ES0703910-001 | H40 | alpha-BHC | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Hexachlorobenzene (HCB) | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP068A: Organochlorine Pesticides (OC)  - continued** | | | | | | |
| **EP068A: Organochlorine Pesticides (OC) - ( QC Lot: 381557 )  - continued** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703910-001 | H40 | beta-BHC | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | gamma-BHC | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | delta-BHC | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Heptachlor | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Aldrin | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Heptachlor epoxide | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | trans-Chlordane | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | alpha-Endosulfan | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | cis-Chlordane | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Dieldrin | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | 4,4’-DDE | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Endrin | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | beta-Endosulfan | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | 4,4’-DDD | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Endrin aldehyde | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Endosulfan sulfate | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | 4,4’-DDT | 0.2 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Endrin ketone | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Methoxychlor | 0.2 mg/kg | <0.2 | <0.2 | 0.0 |
| **EP068B: Organophosphorus Pesticides (OP)** | | | | | | |
| **EP068B: Organophosphorus Pesticides (OP) - ( QC Lot: 381557 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703910-001 | H40 | Dichlorvos | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Demeton-S-methyl | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Monocrotophos | 0.2 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Dimethoate | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Diazinon | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Chlorpyrifos-methyl | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Parathion-methyl | 0.2 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Malathion | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP068B: Organophosphorus Pesticides (OP) - continued** | | | | | | |
| **EP068B: Organophosphorus Pesticides (OP) - ( QC Lot: 381557 ) - continued** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703910-001 | H40 | Fenthion | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Chlorpyrifos | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Parathion | 0.2 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Pirimphos-ethyl | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Chlorfenvinphos | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Bromophos-ethyl | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Fenamiphos | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Prothiofos | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Ethion | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Carbophenothion | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| | | Methyl Azinphos | 0.05 mg/kg | <0.05 | <0.05 | 0.0 |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons** | | | | | | |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381393 )** | | | | **mg/kg** | **mg/kg** | **%** |
| ES0703910-001 | H40 | Naphthalene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Acenaphthylene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Acenaphthene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Fluorene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Phenanthrene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Anthracene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Fluoranthene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Pyrene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Benz(a)anthracene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Chrysene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Benzo(b)fluoranthene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Benzo(k)fluoranthene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Benzo(a)pyrene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Indeno(1,2,3,cd)pyrene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Dibenz(a,h)anthracene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Benzo(g,h,i)perylene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |

***Matrix Type: SOIL***

***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381125 )** | | | | mg/kg | mg/kg | % |
| ES0703904-001 | Anonymous | C6 - C9 Fraction | 10 mg/kg | <10 | <10 | 0.0 |
| ES0703904-011 | Anonymous | C6 - C9 Fraction | 10 mg/kg | <10 | <10 | 0.0 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381157 )** | | | | mg/kg | mg/kg | % |
| ES0703916-001 | Anonymous | C6 - C9 Fraction | 10 mg/kg | <10 | <10 | 0.0 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381392 )** | | | | mg/kg | mg/kg | % |
| ES0703910-001 | H40 | C10 - C14 Fraction | 50 mg/kg | <50 | <50 | 0.0 |
| | | C15 - C28 Fraction | 100 mg/kg | <100 | <100 | 0.0 |
| | | C29 - C36 Fraction | 100 mg/kg | <100 | <100 | 0.0 |
| ES0703930-003 | Anonymous | C10 - C14 Fraction | 50 mg/kg | <50 | <50 | 0.0 |
| | | C15 - C28 Fraction | 100 mg/kg | 240 | 280 | 14.8 |
| | | C29 - C36 Fraction | 100 mg/kg | <100 | <100 | 0.0 |
| **EP080: BTEX** | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 )** | | | | mg/kg | mg/kg | % |
| ES0703904-001 | Anonymous | Benzene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Toluene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Ethylbenzene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | meta- & para-Xylene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| | | ortho-Xylene | 0.1 mg/kg | <0.2 | <0.2 | 0.0 |
| ES0703904-011 | Anonymous | Benzene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | Toluene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | Ethylbenzene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | meta- & para-Xylene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| | | ortho-Xylene | 0.1 mg/kg | <0.1 | <0.1 | 0.0 |
| **EP080: BTEX - ( QC Lot: 381157 )** | | | | mg/kg | mg/kg | % |
| ES0703916-001 | Anonymous | Benzene | 0.2 mg/kg | <0.2 | <0.2 | 0.0 |
| | | Toluene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | Ethylbenzene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | meta- & para-Xylene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |
| | | ortho-Xylene | 0.5 mg/kg | <0.5 | <0.5 | 0.0 |

# *Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)*

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| | | | | *LCS* | *Low* | *High* |
| **ED093T: Total Major Cations** | | | | | | |
| **ED093T: Total Major Cations - ( QC Lot: 382445 )** | | mg/kg | mg/kg | % | % | % |
| Calcium | 10 mg/kg | <10 | ---- | ---- | ---- | ---- |
| Magnesium | 10 mg/kg | <10 | ---- | ---- | ---- | ---- |
| **EG005T: Total Metals by ICP-AES** | | | | | | |
| **EG005T: Total Metals by ICP-AES - ( QC Lot: 382443 )** | | mg/kg | mg/kg | % | % | % |
| Aluminium | 50 mg/kg | <50 | ---- | ---- | ---- | ---- |
| Arsenic | 5 mg/kg | <5 | ---- | ---- | ---- | ---- |
| | 5 mg/kg | ---- | 13.1 | 101 | 86.6 | 123 |
| Barium | 10 mg/kg | <10 | ---- | ---- | ---- | ---- |
| Beryllium | 1 mg/kg | <1 | ---- | ---- | ---- | ---- |
| Cadmium | 1 mg/kg | ---- | 2.76 | 92.1 | 79.9 | 120 |
| | 1 mg/kg | <1 | ---- | ---- | ---- | ---- |
| Chromium | 2 mg/kg | ---- | 60.9 | 96.6 | 87.1 | 119 |
| | 2 mg/kg | <2 | ---- | ---- | ---- | ---- |
| Cobalt | 2 mg/kg | <2 | ---- | ---- | ---- | ---- |
| Copper | 5 mg/kg | <5 | ---- | ---- | ---- | ---- |
| | 5 mg/kg | ---- | 54.7 | 98.3 | 85.2 | 117 |
| Iron | 50 mg/kg | <50 | ---- | ---- | ---- | ---- |
| Lead | 5 mg/kg | <5 | ---- | ---- | ---- | ---- |
| | 5 mg/kg | ---- | 55.2 | 93.1 | 82.1 | 117 |
| Manganese | 5 mg/kg | <5 | ---- | ---- | ---- | ---- |
| Nickel | 2 mg/kg | <2 | ---- | ---- | ---- | ---- |
| | 2 mg/kg | ---- | 54.8 | 98.7 | 88 | 122 |
| Strontium | 2 mg/kg | <2 | ---- | ---- | ---- | ---- |
| Vanadium | 5 mg/kg | <5 | ---- | ---- | ---- | ---- |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| | | | | *LCS* | *Low* | *High* |
| **EG005T: Total Metals by ICP-AES - continued** | | | | | | |
| **EG005T: Total Metals by ICP-AES - ( QC Lot: 382443 ) - continued** | | mg/kg | mg/kg | % | % | % |
| Zinc | 5 mg/kg | <5 | ---- | ---- | ---- | ---- |
| | 5 mg/kg | ---- | 104 | 96.3 | 79 | 116 |
| **EG020T: Total Metals by ICP-MS** | | | | | | |
| **EG020T: Total Metals by ICP-MS - ( QC Lot: 382446 )** | | mg/kg | mg/kg | % | % | % |
| Silver | 0.1 mg/kg | <0.1 | ---- | ---- | ---- | ---- |
| | 0.1 mg/kg | ---- | 5.6 | 82.5 | 70 | 130 |
| **EG035T: Total Mercury by FIMS** | | | | | | |
| **EG035T: Total Mercury by FIMS - ( QC Lot: 382444 )** | | mg/kg | mg/kg | % | % | % |
| Mercury | 0.1 mg/kg | <0.1 | ---- | ---- | ---- | ---- |
| | 0.1 mg/kg | ---- | 1.4 | 87.4 | 73.7 | 108 |
| **EK059G: NOX as N by Discrete Analyser** | | | | | | |
| **EK059G: NOX as N by Discrete Analyser - ( QC Lot: 381576 )** | | mg/kg | mg/kg | % | % | % |
| Nitrite + Nitrate as N (Sol.) | 0.1 mg/kg | ---- | 4.8 | 92.7 | 70 | 130 |
| | 0.100 mg/kg | <0.100 | ---- | ---- | ---- | ---- |
| **EK061G: Total Kjeldahl Nitrogen as N** | | | | | | |
| **EK061G: Total Kjeldahl Nitrogen as N - ( QC Lot: 386986 )** | | mg/kg | mg/kg | % | % | % |
| Total Kjeldahl Nitrogen as N | 20 mg/kg | <20 | ---- | ---- | ---- | ---- |
| | 20 mg/kg | ---- | 1000 | 111 | 70 | 130 |
| **EK071G: Reactive Phosphorous as P by discrete analyser** | | | | | | |
| **EK071G: Reactive Phosphorous as P by discrete analyser - ( QC Lot: 381577 )** | | mg/kg | mg/kg | % | % | % |
| Reactive Phosphorus as P | 0.1 mg/kg | ---- | 2.5 | 103 | 70 | 130 |
| | 0.100 mg/kg | <0.100 | ---- | ---- | ---- | ---- |
| **EP004: Organic Matter** | | | | | | |
| **EP004: Organic Matter - ( QC Lot: 381329 )** | | % | % | % | % | % |
| Total Organic Carbon | 0.5 % | <0.5 | ---- | ---- | ---- | ---- |
| **EP066: Polychlorinated Biphenyls (PCB)** | | | | | | |
| **EP066: Polychlorinated Biphenyls (PCB) - ( QC Lot: 381558 )** | | mg/kg | mg/kg | % | % | % |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| *Analyte name* | *LOR* | | | *LCS* | *Low* | *High* |
| **EP066: Polychlorinated Biphenyls (PCB) - continued** | | | | | | |
| **EP066: Polychlorinated Biphenyls (PCB) - ( QC Lot: 381558 ) - continued** | | mg/kg | mg/kg | % | % | % |
| Total Polychlorinated biphenyls | 0.10 mg/kg | <0.10 | ---- | ---- | ---- | ---- |
| | 0.1 mg/kg | ---- | 0.5 | 83.2 | 57.4 | 117 |
| **EP068A: Organochlorine Pesticides (OC)** | | | | | | |
| **EP068A: Organochlorine Pesticides (OC) - ( QC Lot: 381557 )** | | mg/kg | mg/kg | % | % | % |
| 4,4'-DDD | 0.05 mg/kg | ---- | 0.25 | 107 | 65.3 | 116 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| 4,4'-DDE | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 111 | 67.5 | 114 |
| 4,4'-DDT | 0.2 mg/kg | ---- | 0.25 | 118 | 58.4 | 127 |
| | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| Aldrin | 0.05 mg/kg | ---- | 0.25 | 108 | 67 | 113 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| alpha-BHC | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 109 | 60.8 | 116 |
| alpha-Endosulfan | 0.05 mg/kg | ---- | 0.25 | 110 | 65.8 | 116 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| beta-BHC | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 98.0 | 59.8 | 117 |
| beta-Endosulfan | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 110 | 66.1 | 117 |
| cis-Chlordane | 0.05 mg/kg | ---- | 0.25 | 107 | 57.3 | 120 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| delta-BHC | 0.05 mg/kg | ---- | 0.25 | 110 | 65.8 | 114 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Dieldrin | 0.05 mg/kg | ---- | 0.25 | 108 | 67.4 | 116 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Endosulfan sulfate | 0.05 mg/kg | ---- | 0.25 | 109 | 63.6 | 119 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Endrin | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 107 | 63 | 121 |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results*<br>*Spike concentration* | *Actual Results*<br>*Spike Recovery*<br>*LCS* | *Recovery Limits*<br>*Dynamic Recovery Limits*<br>*Low* | *Recovery Limits*<br>*Dynamic Recovery Limits*<br>*High* |
|---|---|---|---|---|---|---|
| **EP068A: Organochlorine Pesticides (OC) - continued** | | | | | | |
| **EP068A: Organochlorine Pesticides (OC) - ( QC Lot: 381557 ) - continued** | | mg/kg | mg/kg | % | % | % |
| Endrin aldehyde | 0.05 mg/kg | ---- | 0.25 | 87.8 | 57.3 | 115 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Endrin ketone | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 107 | 63.6 | 117 |
| gamma-BHC | 0.05 mg/kg | ---- | 0.25 | 122 | 59.8 | 118 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Heptachlor | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 114 | 65.6 | 115 |
| Heptachlor epoxide | 0.05 mg/kg | ---- | 0.25 | 109 | 65.6 | 113 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Hexachlorobenzene (HCB) | 0.05 mg/kg | ---- | 0.25 | 107 | 59.4 | 115 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Methoxychlor | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| | 0.2 mg/kg | ---- | 0.25 | 113 | 50.4 | 132 |
| trans-Chlordane | 0.05 mg/kg | ---- | 0.25 | 108 | 60.7 | 113 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| **EP068B: Organophosphorus Pesticides (OP)** | | | | | | |
| **EP068B: Organophosphorus Pesticides (OP) - ( QC Lot: 381557 )** | | mg/kg | mg/kg | % | % | % |
| Methyl Azinphos | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 105 | 29.8 | 137 |
| Bromophos-ethyl | 0.05 mg/kg | ---- | 0.25 | 109 | 64.3 | 114 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Carbophenothion | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 107 | 59.5 | 119 |
| Chlorfenvinphos | 0.05 mg/kg | ---- | 0.25 | 109 | 61.4 | 123 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Chlorpyrifos | 0.05 mg/kg | ---- | 0.25 | 110 | 64.2 | 111 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Chlorpyrifos-methyl | 0.05 mg/kg | ---- | 0.25 | 110 | 65.1 | 111 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| *Analyte name* | *LOR* | | | *LCS* | *Low* | *High* |
| **EP068B: Organophosphorus Pesticides (OP) - continued** | | | | | | |
| **EP068B: Organophosphorus Pesticides (OP) - ( QC Lot: 381557 ) - continued** | | mg/kg | mg/kg | % | % | % |
| Demeton-S-methyl | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 73.6 | 10.1 | 159 |
| Diazinon | 0.05 mg/kg | ---- | 0.25 | 111 | 64.9 | 111 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Dichlorvos | 0.05 mg/kg | ---- | 0.25 | 72.0 | 25.5 | 124 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Dimethoate | 0.05 mg/kg | ---- | 0.25 | 108 | 48.6 | 126 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Ethion | 0.05 mg/kg | ---- | 0.25 | 110 | 62 | 116 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Fenamiphos | 0.05 mg/kg | ---- | 0.25 | 97.4 | 45.5 | 128 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Fenthion | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| | 0.05 mg/kg | ---- | 0.25 | 106 | 64.7 | 110 |
| Malathion | 0.05 mg/kg | ---- | 0.25 | 111 | 60.4 | 127 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Monocrotophos | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| | 0.2 mg/kg | ---- | 0.25 | 99.4 | 2.88 | 149 |
| Parathion | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| | 0.2 mg/kg | ---- | 0.25 | 108 | 60 | 116 |
| Parathion-methyl | 0.2 mg/kg | ---- | 0.25 | 109 | 61.4 | 113 |
| | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| Pirimphos-ethyl | 0.05 mg/kg | ---- | 0.25 | 108 | 64.8 | 111 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| Prothiofos | 0.05 mg/kg | ---- | 0.25 | 108 | 65.4 | 111 |
| | 0.05 mg/kg | <0.05 | ---- | ---- | ---- | ---- |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons** | | | | | | |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381393 )** | | mg/kg | mg/kg | % | % | % |
| Acenaphthene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 104 | 81.5 | 112 |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| | | | | *LCS* | *Low* | *High* |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - continued** | | | | | | |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381393 ) - continued** | | mg/kg | mg/kg | % | % | % |
| Acenaphthylene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 102 | 79.6 | 113 |
| Anthracene | 0.5 mg/kg | ---- | 4 | 106 | 81.1 | 112 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Benz(a)anthracene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 102 | 77.2 | 112 |
| Benzo(a)pyrene | 0.5 mg/kg | ---- | 4 | 103 | 76.4 | 113 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Benzo(b)fluoranthene | 0.5 mg/kg | ---- | 4 | 109 | 71.8 | 118 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Benzo(g,h,i)perylene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 102 | 72.4 | 114 |
| Benzo(k)fluoranthene | 0.5 mg/kg | ---- | 4 | 102 | 74.2 | 117 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Chrysene | 0.5 mg/kg | ---- | 4 | 107 | 79.8 | 114 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Dibenz(a,h)anthracene | 0.5 mg/kg | ---- | 4 | 101 | 71.7 | 113 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Fluoranthene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 104 | 78.8 | 113 |
| Fluorene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 101 | 79.9 | 112 |
| Indeno(1,2,3,cd)pyrene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 102 | 71 | 113 |
| Naphthalene | 0.5 mg/kg | ---- | 4 | 104 | 81.9 | 113 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Phenanthrene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 96.0 | 79.4 | 114 |
| Pyrene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 4 | 106 | 78.9 | 113 |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| *Analyte name* | *LOR* | | | *LCS* | *Low* | *High* |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381125 )** | | mg/kg | mg/kg | % | % | % |
| C6 - C9 Fraction | 10 mg/kg | <10 | ---- | ---- | ---- | ---- |
| | 10 mg/kg | ---- | 26 | 101 | 68.4 | 128 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381157 )** | | mg/kg | mg/kg | % | % | % |
| C6 - C9 Fraction | 10 mg/kg | ---- | 26 | 96.7 | 68.4 | 128 |
| | 10 mg/kg | <10 | ---- | ---- | ---- | ---- |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381392 )** | | mg/kg | mg/kg | % | % | % |
| C10 - C14 Fraction | 50 mg/kg | <50 | ---- | ---- | ---- | ---- |
| | 50 mg/kg | ---- | 200 | 87.0 | 75.2 | 116 |
| C15 - C28 Fraction | 100 mg/kg | <100 | ---- | ---- | ---- | ---- |
| | 100 mg/kg | ---- | 200 | 91.0 | 75.3 | 113 |
| C29 - C36 Fraction | 100 mg/kg | ---- | 200 | 85.0 | 72.6 | 117 |
| | 100 mg/kg | <100 | ---- | ---- | ---- | ---- |
| **EP080: BTEX** | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 )** | | mg/kg | mg/kg | % | % | % |
| Benzene | 0.2 mg/kg | ---- | 1 | 108 | 67.5 | 125 |
| | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| Ethylbenzene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 1 | 106 | 65.3 | 126 |
| meta- & para-Xylene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 2 | 103 | 66.5 | 124 |
| ortho-Xylene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 1 | 103 | 66.7 | 123 |
| Toluene | 0.5 mg/kg | ---- | 1 | 89.2 | 69 | 122 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| **EP080: BTEX - ( QC Lot: 381157 )** | | mg/kg | mg/kg | % | % | % |
| Benzene | 0.2 mg/kg | <0.2 | ---- | ---- | ---- | ---- |
| | 0.2 mg/kg | ---- | 1 | 95.4 | 67.5 | 125 |
| Ethylbenzene | 0.5 mg/kg | ---- | 1 | 102 | 65.3 | 126 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| *Analyte name* | *LOR* | *Method blank result* | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|
| | | | *Spike concentration* | *Spike Recovery* | *Dynamic Recovery Limits* | |
| | | | | *LCS* | *Low* | *High* |
| **EP080: BTEX - continued** | | | | | | |
| **EP080: BTEX - ( QC Lot: 381157 ) - continued** | | mg/kg | mg/kg | % | % | % |
| meta- & para-Xylene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 2 | 96.9 | 66.5 | 124 |
| ortho-Xylene | 0.5 mg/kg | ---- | 1 | 95.6 | 66.7 | 123 |
| | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| Toluene | 0.5 mg/kg | <0.5 | ---- | ---- | ---- | ---- |
| | 0.5 mg/kg | ---- | 1 | 95.2 | 69 | 122 |

# *Quality Control Report - Matrix Spikes (MS)*

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations: **LOR** = Limit of Reporting, **RPD** = Relative Percent Difference.*

* Indicates failed QC

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | *Actual Results* *Sample Result* | *Actual Results* *Spike Recovery* *MS* | *Recovery Limits* *Static Limits* *Low* | *Recovery Limits* *Static Limits* *High* |
|---|---|---|---|---|---|---|---|---|
| **EG005T: Total Metals by ICP-AES** | | | | | | | | |
| **EG005T: Total Metals by ICP-AES - ( QC Lot: 382443 )** | | | | mg/kg | mg/kg | % | % | % |
| Arsenic | ES0703910-002 | H41 | 5 mg/kg | 50 | 13 | 97.5 | 70 | 130 |
| Cadmium | | | 1 mg/kg | 50 | <1 | 99.8 | 70 | 130 |
| Chromium | | | 2 mg/kg | 50 | 20 | 103 | 70 | 130 |
| Copper | | | 5 mg/kg | 250 | 18 | 110 | 70 | 130 |
| Lead | | | 5 mg/kg | 250 | 21 | 101 | 70 | 130 |
| Nickel | | | 2 mg/kg | 50 | 15 | 99.1 | 70 | 130 |
| Zinc | | | 5 mg/kg | 250 | 61 | 119 | 70 | 130 |
| **EG035T: Total Mercury by FIMS** | | | | | | | | |
| **EG035T: Total Mercury by FIMS - ( QC Lot: 382444 )** | | | | mg/kg | mg/kg | % | % | % |
| Mercury | ES0703910-002 | H41 | 0.1 mg/kg | 5 | <0.1 | 104 | 70 | 130 |
| **EK059G: NOX as N by Discrete Analyser** | | | | | | | | |
| **EK059G: NOX as N by Discrete Analyser - ( QC Lot: 381576 )** | | | | mg/kg | mg/kg | % | % | % |
| Nitrite + Nitrate as N (Sol.) | ES0703985-002 | Anonymous | 0.1 mg/kg | 3.0 | 1.22 | 85.5 | 70 | 130 |
| **EK061G: Total Kjeldahl Nitrogen as N** | | | | | | | | |
| **EK061G: Total Kjeldahl Nitrogen as N - ( QC Lot: 386986 )** | | | | mg/kg | mg/kg | % | % | % |
| Total Kjeldahl Nitrogen as N | ES0704079-003 | Anonymous | 20 mg/kg | 500 | 970 | 93.0 | 70 | 130 |
| **EK071G: Reactive Phosphorous as P by discrete analyser** | | | | | | | | |
| **EK071G: Reactive Phosphorous as P by discrete analyser - ( QC Lot: 381577 )** | | | | mg/kg | mg/kg | % | % | % |
| Reactive Phosphorus as P | ES0703985-001 | Anonymous | | 2.5 | ---- | * Not Determined | 70 | 130 |
| **EP066: Polychlorinated Biphenyls (PCB)** | | | | | | | | |
| **EP066: Polychlorinated Biphenyls (PCB) - ( QC Lot: 381558 )** | | | | mg/kg | mg/kg | % | % | % |
| Total Polychlorinated biphenyls | ES0703910-001 | H40 | 0.1 mg/kg | 0.5 | <0.10 | 88.1 | 70 | 130 |
| **EP068A: Organochlorine Pesticides (OC)** | | | | | | | | |

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | *Actual Results*<br>*Sample Result* | *Actual Results*<br>*Spike Recovery MS* | *Recovery Limits Static Limits*<br>*Low* | *Recovery Limits Static Limits*<br>*High* |
|---|---|---|---|---|---|---|---|---|
| **EP068A: Organochlorine Pesticides (OC) - continued** | | | | | | | | |
| **EP068A: Organochlorine Pesticides (OC) - ( QC Lot: 381557 )** | | | | mg/kg | mg/kg | % | % | % |
| gamma-BHC | ES0703910-001 | H40 | 0.05 mg/kg | 0.25 | <0.05 | 113 | 75.65 | 110.44 |
| Heptachlor | | | 0.05 mg/kg | 0.25 | <0.05 | 72.2 | 72.2 | 106.71 |
| Aldrin | | | 0.05 mg/kg | 0.25 | <0.05 | 82.4 | 77.54 | 107.0 |
| Dieldrin | | | 0.05 mg/kg | 0.25 | <0.05 | 80.6 | 76.37 | 109.7 |
| Endrin | | | 0.05 mg/kg | 1 | <0.05 | 85.2 | 68.51 | 119.47 |
| 4,4'-DDT | | | 0.2 mg/kg | 1 | <0.2 | 69.4 | 67.12 | 118.10 |
| **EP068B: Organophosphorus Pesticides (OP)** | | | | | | | | |
| **EP068B: Organophosphorus Pesticides (OP) - ( QC Lot: 381557 )** | | | | mg/kg | mg/kg | % | % | % |
| Diazinon | ES0703910-001 | H40 | 0.05 mg/kg | 0.25 | <0.05 | 88.0 | 75.85 | 107.06 |
| Chlorpyrifos-methyl | | | 0.05 mg/kg | 0.25 | <0.05 | 85.4 | 74.84 | 107.91 |
| Pirimphos-ethyl | | | 0.05 mg/kg | 0.25 | <0.05 | 95.8 | 67.98 | 109.42 |
| Bromophos-ethyl | | | 0.05 mg/kg | 0.25 | <0.05 | 86.0 | 74.94 | 107.37 |
| Prothiofos | | | 0.05 mg/kg | 0.25 | <0.05 | 114 | 75.45 | 106.05 |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons** | | | | | | | | |
| **EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - ( QC Lot: 381393 )** | | | | mg/kg | mg/kg | % | % | % |
| Acenaphthene | ES0703910-001 | H40 | 0.5 mg/kg | 10 | <0.5 | 86.9 | 70 | 130 |
| Pyrene | | | 0.5 mg/kg | 10 | <0.5 | 92.4 | 70 | 130 |
| **EP080/071: Total Petroleum Hydrocarbons** | | | | | | | | |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381125 )** | | | | mg/kg | mg/kg | % | % | % |
| C6 - C9 Fraction | ES0703904-001 | Anonymous | 10 mg/kg | 26 | <10 | 88.1 | 70 | 130 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381157 )** | | | | mg/kg | mg/kg | % | % | % |
| C6 - C9 Fraction | ES0703916-001 | Anonymous | 10 mg/kg | 26 | <10 | 91.7 | 70 | 130 |
| **EP080/071: Total Petroleum Hydrocarbons - ( QC Lot: 381392 )** | | | | mg/kg | mg/kg | % | % | % |
| C10 - C14 Fraction | ES0703910-001 | H40 | 50 mg/kg | 700 | <50 | 82.6 | 70 | 130 |
| C15 - C28 Fraction | | | 100 mg/kg | 3400 | <100 | 120 | 70 | 130 |
| C29 - C36 Fraction | | | 100 mg/kg | 3600 | <100 | 82.8 | 70 | 130 |
| **EP080: BTEX** | | | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 )** | | | | mg/kg | mg/kg | % | % | % |

***Matrix Type: SOIL***

***Matrix Spike (MS) Report***

| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | *Actual Results* *Sample Result* | *Actual Results* *Spike Recovery* *MS* | *Recovery Limits* *Static Limits* *Low* | *Recovery Limits* *Static Limits* *High* |
|---|---|---|---|---|---|---|---|---|
| **EP080: BTEX - continued** | | | | | | | | |
| **EP080: BTEX - ( QC Lot: 381125 ) - continued** | | | | mg/kg | mg/kg | % | % | % |
| Benzene | ES0703904-001 | Anonymous | 0.1 mg/kg | 2.5 | <0.2 | 95.9 | 70 | 130 |
| Toluene | | | 0.1 mg/kg | 2.5 | <0.2 | 84.2 | 70 | 130 |
| Ethylbenzene | | | 0.1 mg/kg | 2.5 | <0.2 | 97.6 | 70 | 130 |
| meta- & para-Xylene | | | 0.1 mg/kg | 2.5 | <0.2 | 112 | 70 | 130 |
| ortho-Xylene | | | 0.1 mg/kg | 2.5 | <0.2 | 111 | 70 | 130 |
| **EP080: BTEX - ( QC Lot: 381157 )** | | | | mg/kg | mg/kg | % | % | % |
| Benzene | ES0703916-001 | Anonymous | 0.2 mg/kg | 2.5 | <0.2 | 91.7 | 70 | 130 |
| Toluene | | | 0.5 mg/kg | 2.5 | <0.5 | 69.6 | 70 | 130 |
| Ethylbenzene | | | 0.5 mg/kg | 2.5 | <0.5 | 98.3 | 70 | 130 |
| meta- & para-Xylene | | | 0.5 mg/kg | 2.5 | <0.5 | 96.8 | 70 | 130 |
| ortho-Xylene | | | 0.5 mg/kg | 2.5 | <0.5 | 94.9 | 70 | 130 |

# INTERPRETIVE QUALITY CONTROL REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Client** | : **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | : Environmental Division Sydney | **Page** | : | **1 of 8** |
| **Contact** | : CARSTEN MATTHAI | **Contact** | : Victor Kedicioglu | | | |
| **Address** | : LEVEL 3, 116 MILLER STREET NORTH SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | : 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | : | **ES0703910** |
| | | | | **Amendment No.** | : | **1** |
| **Project** | : 43217595 Sediment Study | **Quote number** | : SY/019/07 V2 | **Date received** | : | 27 Mar 2007 |
| **Order number** | : - Not provided - | | | **Date issued** | : | 13 Apr 2007 |
| **C-O-C number** | : - Not provided - | | | | | |
| **Site** | : - Not provided - | | | | | |
| **E-mail** | : carsten_matthai@urscorp.com | **E-mail** | : Victor.Kedicioglu@alsenviro.com | **No. of samples** | | |
| **Telephone** | : 89255500 | **Telephone** | : 61-2-8784 8555 | **Received** | : | 8 |
| **Facsimile** | : 89255555 | **Facsimile** | : 61-2-8784 8500 | **Analysed** | : | 8 |

This Interpretive Quality Control Report was issued on 13 Apr 2007 for the ALS work order reference ES0703910 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

# *Interpretive Quality Control Report - Analysis Holding Time*

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

***Matrix Type: SOIL*** ***Analysis Holding Time and Preservation***

| **Method**<br>**Container /** Client Sample ID(s) | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|
| | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EA055-103: Moisture Content | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | ---- | ---- | ---- | **28 Mar 2007** | 2 Apr 2007 | Pass |
| **Soil Glass Jar - Unpreserved**<br>H3, H5,<br>H7, QC2 | **26 Mar 2007** | ---- | ---- | ---- | **29 Mar 2007** | 2 Apr 2007 | Pass |
| ED093T: Major Cations by ICPAES - Total | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **30 Mar 2007** | 22 Sep 2007 | Pass | **30 Mar 2007** | 22 Sep 2007 | Pass |
| EG005T: Total Metals by ICP-AES | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **30 Mar 2007** | 22 Sep 2007 | Pass | **30 Mar 2007** | 22 Sep 2007 | Pass |
| EG020Z-T: Total Metals by ICP-MS - Suite Z | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H3, H5,<br>H7, QC2 | **26 Mar 2007** | **30 Mar 2007** | 22 Sep 2007 | Pass | **2 Apr 2007** | 22 Sep 2007 | Pass |
| EG035T: Total Mercury by FIMS | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **30 Mar 2007** | 23 Apr 2007 | Pass | **2 Apr 2007** | 23 Apr 2007 | Pass |
| EK059G: Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **29 Mar 2007** | 22 Sep 2007 | Pass | **29 Mar 2007** | 22 Sep 2007 | Pass |
| EK061G: TKN as N By Discrete Analyser | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **10 Apr 2007** | 22 Sep 2007 | Pass | **10 Apr 2007** | 22 Sep 2007 | Pass |
| EK071G: Reactive Phosphorus as P-Soluble By Discrete Analyser | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **29 Mar 2007** | 22 Sep 2007 | Pass | **29 Mar 2007** | 22 Sep 2007 | Pass |
| EP004: Organic Matter | | | | | | | |

***Matrix Type: SOIL***

***Analysis Holding Time and Preservation***

| **Method**<br>**Container /** Client Sample ID(s) | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|
| | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EP004: Organic Matter **- continued** | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | ---- | ---- | ---- | **29 Mar 2007** | 2 Apr 2007 | Pass |
| EP066: Polychlorinated Biphenyls (PCB) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **31 Mar 2007** | 9 Apr 2007 | Pass | **2 Apr 2007** | 10 May 2007 | Pass |
| EP068: Pesticides by GCMS | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **31 Mar 2007** | 9 Apr 2007 | Pass | **2 Apr 2007** | 10 May 2007 | Pass |
| EP071: TPH - Semivolatile Fraction | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **30 Mar 2007** | 7 May 2007 | Pass |
| EP075(SIM): PAH/Phenols (SIM) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H40, H41,<br>H42, QC1 | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **30 Mar 2007** | 7 May 2007 | Pass |
| EP080: TPH Volatiles/BTEX | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H42, QC1 | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **3 Apr 2007** | 9 Apr 2007 | Pass |
| **Soil Glass Jar - Unpreserved**<br>H40, H41 | **26 Mar 2007** | **28 Mar 2007** | 9 Apr 2007 | Pass | **31 Mar 2007** | 9 Apr 2007 | Pass |

# *Interpretive Quality Control Report - Frequency of Quality Control Samples*

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

***Matrix Type: SOIL*** ***Frequency of Quality Control Samples***

| Quality Control Sample Type | Count | | **Rate (%)** | | Quality Control Specification |
|---|---|---|---|---|---|
| Method | QC | Regular | **Actual** | **Expected** | |
| Laboratory Duplicates (DUP) | | | | | |
| EA055-103: Moisture Content | 5 | 44 | **11.4** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| ED093T: Major Cations by ICPAES - Total | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG005T: Total Metals by ICP-AES | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG020Z-T: Total Metals by ICP-MS - Suite Z | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG035T: Total Mercury by FIMS | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK059G: Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser | 1 | 6 | **16.7** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK061G: TKN as N By Discrete Analyser | 2 | 10 | **20.0** | **9.5** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK071G: Reactive Phosphorus as P-Soluble By Discrete Analyser | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP004: Organic Matter | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP066: Polychlorinated Biphenyls (PCB) | 1 | 7 | **14.3** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP068: Pesticides by GCMS | 1 | 4 | **25.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP071: TPH - Semivolatile Fraction | 2 | 16 | **12.5** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP075(SIM): PAH/Phenols (SIM) | 1 | 8 | **12.5** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 3 | 23 | **13.0** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Laboratory Control Samples (LCS) | | | | | |
| EG005T: Total Metals by ICP-AES | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG020Z-T: Total Metals by ICP-MS - Suite Z | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG035T: Total Mercury by FIMS | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK059G: Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser | 1 | 6 | **16.7** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK061G: TKN as N By Discrete Analyser | 1 | 10 | **10.0** | **4.8** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK071G: Reactive Phosphorus as P-Soluble By Discrete Analyser | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP004: Organic Matter | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP066: Polychlorinated Biphenyls (PCB) | 1 | 7 | **14.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP068: Pesticides by GCMS | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP071: TPH - Semivolatile Fraction | 1 | 16 | **6.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP075(SIM): PAH/Phenols (SIM) | 1 | 8 | **12.5** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 2 | 23 | **8.7** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |

***Matrix Type: SOIL*** ***Frequency of Quality Control Samples***

| Quality Control Sample Type<br>Method | Count | | Rate (%) | | Quality Control Specification |
|---|---|---|---|---|---|
| | QC | Regular | **Actual** | **Expected** | |
| Method Blanks (MB) | | | | | |
| ED093T: Major Cations by ICPAES - Total | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG005T: Total Metals by ICP-AES | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG020Z-T: Total Metals by ICP-MS - Suite Z | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG035T: Total Mercury by FIMS | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK059G: Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser | 1 | 6 | **16.7** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK061G: TKN as N By Discrete Analyser | 1 | 10 | **10.0** | **4.8** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK071G: Reactive Phosphorus as P-Soluble By Discrete Analyser | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP004: Organic Matter | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP066: Polychlorinated Biphenyls (PCB) | 1 | 7 | **14.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP068: Pesticides by GCMS | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP071: TPH - Semivolatile Fraction | 1 | 16 | **6.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP075(SIM): PAH/Phenols (SIM) | 1 | 8 | **12.5** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 2 | 23 | **8.7** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Matrix Spikes (MS) | | | | | |
| EG005T: Total Metals by ICP-AES | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EG035T: Total Mercury by FIMS | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK059G: Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser | 1 | 6 | **16.7** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK061G: TKN as N By Discrete Analyser | 1 | 10 | **10.0** | **4.8** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EK071G: Reactive Phosphorus as P-Soluble By Discrete Analyser | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP066: Polychlorinated Biphenyls (PCB) | 1 | 7 | **14.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP068: Pesticides by GCMS | 1 | 4 | **25.0** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP071: TPH - Semivolatile Fraction | 1 | 16 | **6.3** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP075(SIM): PAH/Phenols (SIM) | 1 | 8 | **12.5** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP080: TPH Volatiles/BTEX | 2 | 23 | **8.7** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |

# *Interpretive Quality Control Report - Summary of Outliers*

## *Outliers : Quality Control Samples*

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

### *Non-surrogates*

| ALS QC Lot | Matrix Type | Laboratory Sample ID | Client Sample ID | Analyte | Data | Limits | Comment |
|---|---|---|---|---|---|---|---|
| **Laboratory Duplicates (DUP)** | | | | | | | |
| ED093T: Total Major Cations | SOIL | ES0703910-002 | H41 | Calcium | 61.2 % | 0-20 % | RPD exceeds LOR based limits |
| EK071G: Reactive Phosphorous as P by discrete analyser | SOIL | ES0703985-001 | Anonymous | Reactive Phosphorus as P | 0.079 | | Analyte not determined in allocated original sample. |
| **Laboratory Control Samples (LCS)** | | | | | | | |
| EP068A: Organochlorine Pesticides (OC) | SOIL | 419263-002 | ---- | gamma-BHC | 122 % | 59.8-118 % | Recovery greater than upper control limit |
| EP068B: Organophosphorus Pesticides (OP) | SOIL | 419263-002 | ---- | Diazinon | 111 % | 64.9-111 % | Recovery greater than upper control limit |
| **Matrix Spikes (MS)** | | | | | | | |
| EP068A: Organochlorine Pesticides (OC) | SOIL | ES0703910-001 | H40 | gamma-BHC | 113 % | 75.65-110.44 % | Recovery greater than upper data quality objective |
| EP068B: Organophosphorus Pesticides (OP) | SOIL | ES0703910-001 | H40 | Prothiofos | 114 % | 75.45-106.05 % | Recovery greater than upper data quality objective |
| EP080: BTEX | SOIL | ES0703916-001 | Anonymous | Toluene | 69.6 % | 70-130 % | Recovery less than lower data quality objective |

- **For all matrices, no method blank result outliers occur.**

### *Surrogates*

| ALS QC Lot | Matrix Type | Laboratory Sample ID | Client Sample ID | Analyte | Data | Limits | Comment |
|---|---|---|---|---|---|---|---|
| **Surrogates** | | | | | | | |
| EP080S: TPH(V)/BTEX Surrogates | SOIL | ES0703910-001 | H40 | Toluene-D8 | 80.2 % | 81-117 % | Recovery less than lower data quality objective |

## *Outliers : Analysis Holding Time*

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

- **No holding time outliers occur.**

## *Outliers : Frequency of Quality Control Samples*

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

# *Method Reference Summary*

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

***Matrix Type: SEDIMENT*** ***Method Reference Summary***

## Preparation Methods

**EK061/EK067 : TKN/TP Digestion -** APHA 21st ed., 4500 Norg- D; APHA 21st ed., 4500 P - H. Macro Kjeldahl digestion.

**EN34 : 1:5 solid / water leach for soluble analytes -** 10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

**EN69 : Hot Block Digest for metals in soils sediments and sludges -** USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)

**ORG16 : Methanolic Extraction of Soils for Purge and Trap -** (USEPA SW 846 - 5030A) 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.

**ORG17A : Tumbler Extraction of Solids (Option A - Concentrating) -** In-house, Mechanical agitation (tumbler). 20g of sample, $Na_2SO_4$ and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

**ORG17B : Tumbler Extraction of Solids (Option B - Non-concentrating) -** In-house, Mechanical agitation (tumbler). 10g of sample, $Na_2SO_4$ and surrogate are extracted with 20mL 1:1 DCM/Acetone by end over end tumble. The solvent is transferred directly to a GC vial for analysis.

## Analytical Methods

**EA055-103 : Moisture Content -** A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)

**ED093T : Major Cations by ICPAES - Total -** APHA 21st ed., 3120; USEPA SW 846 - 6010 (ICPAES) Hydrochloric Acid digests of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)

**EG005T : Total Metals by ICP-AES -** (APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)

**EG020Z-T : Total Metals by ICP-MS - Suite Z -** (APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

**EG035T : Total Mercury by FIMS -** AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection ($SnCl_2$)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by $SnCl_2$ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3)

**EK059G : Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser -** APHA 21st ed., 4500 $NO_3^-$ F. SEAL Method 2-018-1-L February 2003. Combined oxidised Nitrogen ($NO_2$+$NO_3$) in a water extract is determined by Cadmium Reduction, and direct colourimetry by SEAL.

**EK061G : TKN as N By Discrete Analyser -** APHA 21st ed., 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Seal Discrete Analyser.

***Matrix Type: SEDIMENT*** ***Method Reference Summary***

## Analytical Methods

**EK071G : Reactive Phosphorus as P-Soluble By Discrete Analyser -** APHA 21st ed., 4500 P-F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by SEAL. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2

**EP004 : Organic Matter -** AS1289.4.4.4 - 1997., Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (1999) Schedule B(3) (Method 105)

**EP066 : Polychlorinated Biphenyls (PCB) -** (USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 504)

**EP068 : Pesticides by GCMS -** (USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (1999) Schedule B(3) (Method 504,505)

**EP071 : TPH - Semivolatile Fraction -** (USEPA SW 846 - 8015A) Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C36. This method is compliant with NEPM (1999) Schedule B(3) (Method 506.1)

**EP075(SIM) : PAH/Phenols (SIM) -** (USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 502 and 507)

**EP080 : TPH Volatiles/BTEX -** (USEPA SW 846 - 8260B) Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 501)

**PSA-SOL : Particle Size Analysis (Solid) -** Particle Size Analysis of solid matrices conducted by Subcontracting Laboratory

AUSTRALIAN LABORATORY SERVICES PTY LTD ABN 84 009 936 029
277-289 Woodpark Road Smithfield NSW 2164 Australia
Telephone: 61-2-8784 8555 Facsimile: 61-2-8784 8500 http://www.alsenviro.com/

ALS Environmental

# SAMPLE RECEIPT NOTIFICATION (SRN)

## Comprehensive report

| | | | |
|---|---|---|---|
| **Client Details** | | **Laboratory Details** | |
| **Client** | : **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | : **Environmental Division Sydney** |
| **Contact** | : **CARSTEN MATTHAI** | **Manager** | : **Victor Kedicioglu** |
| **Address** | : LEVEL 3, 116 MILLER STREET NORTH<br>SYDNEY NSW AUSTRALIA 2060 | **Address** | : 277-289 Woodpark Road Smithfield NSW<br>Australia 2164 |
| **Project** | : **43217595 Sediment Study** | **Quote number** | : ES20070014 |
| **Order number** | : **- Not provided -** | **Work order** | : **ES0703910** |
| **C-O-C Number** | : **- Not provided -** | | |
| **Site** | : **- Not provided -** | | |
| **Sampler** | : **CARSTEN MATTHAI** | | |
| **E-mail** | : carsten_matthai@urscorp.com | **E-mail** | : Victor.Kedicioglu@alsenviro.com |
| **Telephone** | : 89255500 | **Telephone** | : 61-2-8784 8555 |
| **Facsimile** | : 89255555 | **Facsimile** | : 61-2-8784 8500 |

### Dates

| | | | |
|---|---|---|---|
| **Date Samples Received** | : 27 Mar 2007 | **SRA Issue Date** | : |
| **Scheduled Reporting Date** | : **3 Apr 2007** | **Client Requested Date** | : 3 Apr 2007 |

### Delivery Details

| | | | |
|---|---|---|---|
| **Mode of Delivery** | : Carrier. | **Temperature** | : 5.8'C - Ice present |
| **No. of coolers/boxes** | : 2 HARD | **No. of samples - Received** | 8 |
| **Security Seal** | : Intact. | **- Analysed** | 8 |

### Comments

- **Samples received in appropriately pretreated and preserved containers.**
- **Sample(s) have been received within recommended holding times.**
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**

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- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Nanthini Coilparampil
- Analytical work for this work order will be conducted at ALSE Sydney.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.
- When the sampling time is not supplied on the COC documentation, ALSE defaults the sampling time to that of the COC 'relinquishment' time (if supplied). If this also is not supplied, ALSE defaults the sampling time to the 'time of receipt at Laboratory'.

## *Summary of Sample(s) / Container(s) and Requested Analysis*

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as moisture and preparation tasks, that form an implicit part of that package.

| **ALS Sample ID.** | Client Sample ID - Sample Date | **Requested Analysis** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **EA055-103 - SOIL** Moisture Content | **ED093T - SOIL** Cations - Total | **EG005T (solids) - SOIL** Total Metals by ICP-AES | **EG020Z-T - SOIL** Total Metals by ICPMS - Suite Z | **EK059G (solids) - SOIL** Nitrite plus Nitrate as N (NOx) - soluble by Discrete Analys | **EK061G (Solids) - SOIL** Total Kjeldahl Nitrogen as N (TKN) By Discrete Analyser | **EK071G (solids) - SOIL** Reactive Phosphorus as P By Discrete Analyser | **EP004 (Carbon) - SOIL** Total Organic Carbon (Calc.) | **PSA-SOL - SOIL** Particle Size Analysis (Solid) | **S-03 - SOIL** 13 Metals (NEPM Suite - incl. Digestion) |
| **ES0703910-001** | **H40 - 26 Mar 2007** | | ] | ] | | ] | ] | ] | ] | ] | ] |
| **ES0703910-002** | **H41 - 26 Mar 2007** | | ] | ] | | ] | ] | ] | ] | ] | ] |
| **ES0703910-003** | **H42 - 26 Mar 2007** | | ] | ] | | ] | ] | ] | ] | ] | ] |
| **ES0703910-004** | **QC1 - 26 Mar 2007** | | ] | ] | | ] | ] | ] | ] | ] | ] |
| **ES0703910-005** | **H3 - 26 Mar 2007** | ] | | | ] | | | | | | |
| **ES0703910-006** | **H5 - 26 Mar 2007** | ] | | | ] | | | | | | |
| **ES0703910-007** | **H7 - 26 Mar 2007** | ] | | | ] | | | | | | |
| **ES0703910-008** | **QC2 - 26 Mar 2007** | ] | | | ] | | | | | | |
| | **Total(s) :** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** |

**Client** : URS AUSTRALIA (NSW) PTY LTD
**Project** : 43217595 Sediment Study

**Work Order** : ES0703910
**ALS Quote Reference** : ES20070014

| **ALS Sample ID.** | Client Sample ID - Sample Date | **Requested Analysis** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **S-07 - SOIL** TPH/BTEX/PAH (SIM) | **S-13 - SOIL** OC/OP/PCB | | | | | | | | |
| **ES0703910-001** | **H40 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703910-002** | **H41 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703910-003** | **H42 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703910-004** | **QC1 - 26 Mar 2007** | ] | ] | | | | | | | | |
| **ES0703910-005** | **H3 - 26 Mar 2007** | | | | | | | | | | |
| **ES0703910-006** | **H5 - 26 Mar 2007** | | | | | | | | | | |
| **ES0703910-007** | **H7 - 26 Mar 2007** | | | | | | | | | | |
| **ES0703910-008** | **QC2 - 26 Mar 2007** | | | | | | | | | | |
| | **Total(s) :** | **4** | **4** | | | | | | | | |

## *Requested Reports*

- **ACCOUNTS PAYABLE**

| | | |
|---|---|---|
| - A4 - AU Tax Invoice | Email | sydney_accounts@urscorp.com |

- **CARSTEN MATTHAI**

| | | |
|---|---|---|
| - A4 - Certificate of Analysis - NEPM format | Email | carsten_matthai@urscorp.com |
| - Trigger - Subcontract Report | Email | carsten_matthai@urscorp.com |
| - A4 - Interpretive Quality Control Report - NEPM format | Email | carsten_matthai@urscorp.com |
| - A4 - Quality Control Report - NEPM format | Email | carsten_matthai@urscorp.com |
| - ENMRG Export Format | Email | carsten_matthai@urscorp.com |
| - A4 - Sample Receipt Notification - Comprehensive format | Email | carsten_matthai@urscorp.com |
| - Chain of Custody Acknowledgement | Email | carsten_matthai@urscorp.com |
| - Invoice | Email | carsten_matthai@urscorp.com |

## *Sample Container(s) / Preservation Non-Compliance Log*

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

Golder Associates

MANSFIELD
LABORATORY

1/51 Secam Street, Mansfield QLD 4122
PO Box 2034 Mansfield DC QLD 4122
Phone:(07) 3343 3166 Fax:(07) 3849 4705
www.golder.com.au

# TEST RESULTS

| | | | |
|---|---|---|---|
| Client : | ALS Environmental Sydney | Job No. : | 077634002/5 |
| Project : | Delivered Samples | Date Received : | 29/03/2007 |
| Batch No. : | ES0703910 | Sampled by : | Client |

## PARTICLE SIZE SUMMARY

| Reg'n No. | Sample ID | Sample No. | Percent Gravel (+ 2 mm) | Percent Coarse to Med. Sand (2 mm - 0.250 mm) | Percent Med. To Fine Sand (0.250 mm - 0.063 mm) | Percent Silt & Clay (-0.063 mm) |
|---|---|---|---|---|---|---|
| L14174 | H40 | 1 | 0 | 42 | 32 | 26 |
| L14175 | H41 | 2 | 0 | 8 | 15 | 77 |
| L14176 | H42 | 3 | 0 | 18 | 24 | 58 |
| L14177 | QC1 | 4 | 0 | 16 | 24 | 60 |

Remarks :

Test Procedure : AS1289 3.6.1

Prepared by : NF Checked by JA

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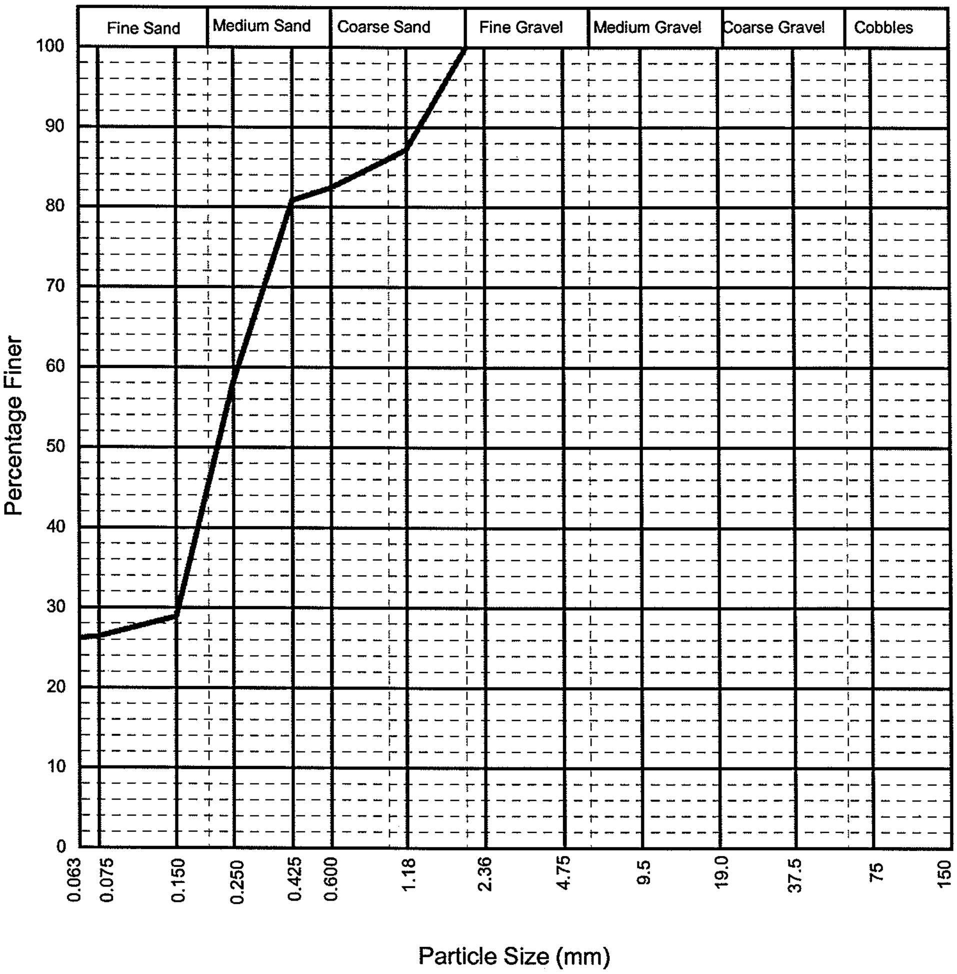
# PARTICLE SIZE DISTRIBUTION

| | | | |
|---|---|---|---|
| Client : | ALS Environmental Sydney | Report No. : | R6509 |
| Address : | 277 Woodpark Road, Smithfield NSW | Job No. : | 077634002/5 |
| Project : | Delivered Samples | Reg'n No. : | L14174 |
| Sample ID : | H40 | Batch No. : | ES0703910 - 1 |
| | | Date Received : | 29/03/07 |
| | | Sampled By : | Client |

| Sieve Size (mm) | Percent Passing |
|---|---|
| 150 | |
| 75 | |
| 37.5 | |
| 19.0 | |
| 9.5 | |
| 4.75 | |
| 2.00 | 100.0 |
| 1.18 | 87.2 |
| 0.600 | 82.4 |
| 0.425 | 80.8 |
| 0.250 | 58.2 |
| 0.150 | 28.9 |
| 0.075 | 26.4 |
| 0.063 | 26.2 |

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



| | |
|---|---|
| Remarks : | |
| Material Description : | Clayey SAND (SC) dark grey, with shell |
| Test Procedure : | AS 1289 3.6.1 |
| Prepared by : NF | Checked by : JA |

This Laboratory is accredited by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with its scope of registration.
This document shall not be reproduced, except in full.

NATA
1446

17/4/7
Authorised Signatory

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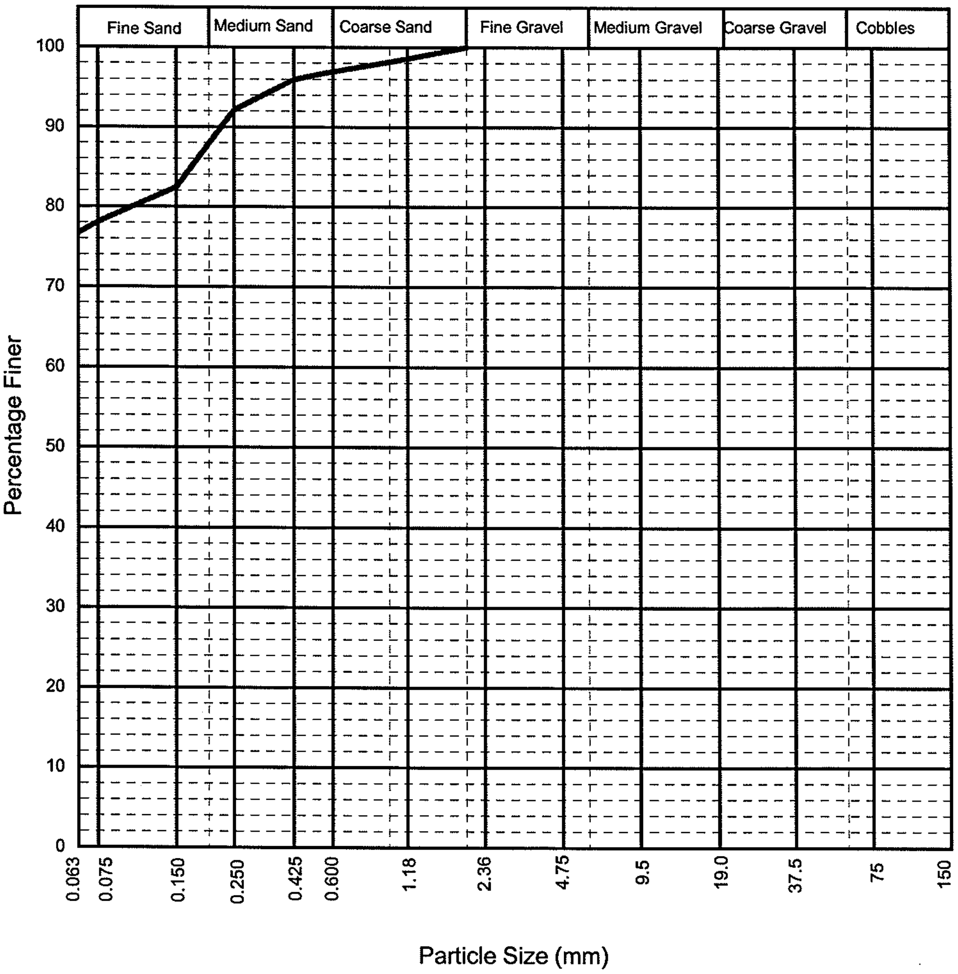
PO Box 2034 Mansfield DC Qld 4122
Ph : (07) 3343 3166 Fax : (07) 3343 4705
www.golder.com.au

# PARTICLE SIZE DISTRIBUTION

| | | | |
|---|---|---|---|
| Client : | ALS Environmental Sydney | Report No. : | R6509 |
| Address : | 277 Woodpark Road, Smithfield NSW | Job No. : | 077634002/5 |
| Project : | Delivered Samples | Reg'n No. : | L14175 |
| Sample ID : | H41 | Batch No. : | ES0703910 - 2 |
| | | Date Received : | 29/03/07 |
| | | Sampled By : | Client |

| Sieve Size (mm) | Percent Passing |
|---|---|
| 150 | |
| 75 | |
| 37.5 | |
| 19.0 | |
| 9.5 | |
| 4.75 | |
| 2.00 | 100.0 |
| 1.18 | 98.6 |
| 0.600 | 96.9 |
| 0.425 | 96.0 |
| 0.250 | 92.1 |
| 0.150 | 82.4 |
| 0.075 | 78.1 |
| 0.063 | 76.7 |

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



| | |
|---|---|
| Remarks : | |
| Material Description : | Silty CLAY (CI) dark grey, with some sand |
| Test Procedure : | AS 1289 3.6.1 |
| Prepared by : NF | Checked by : JA |

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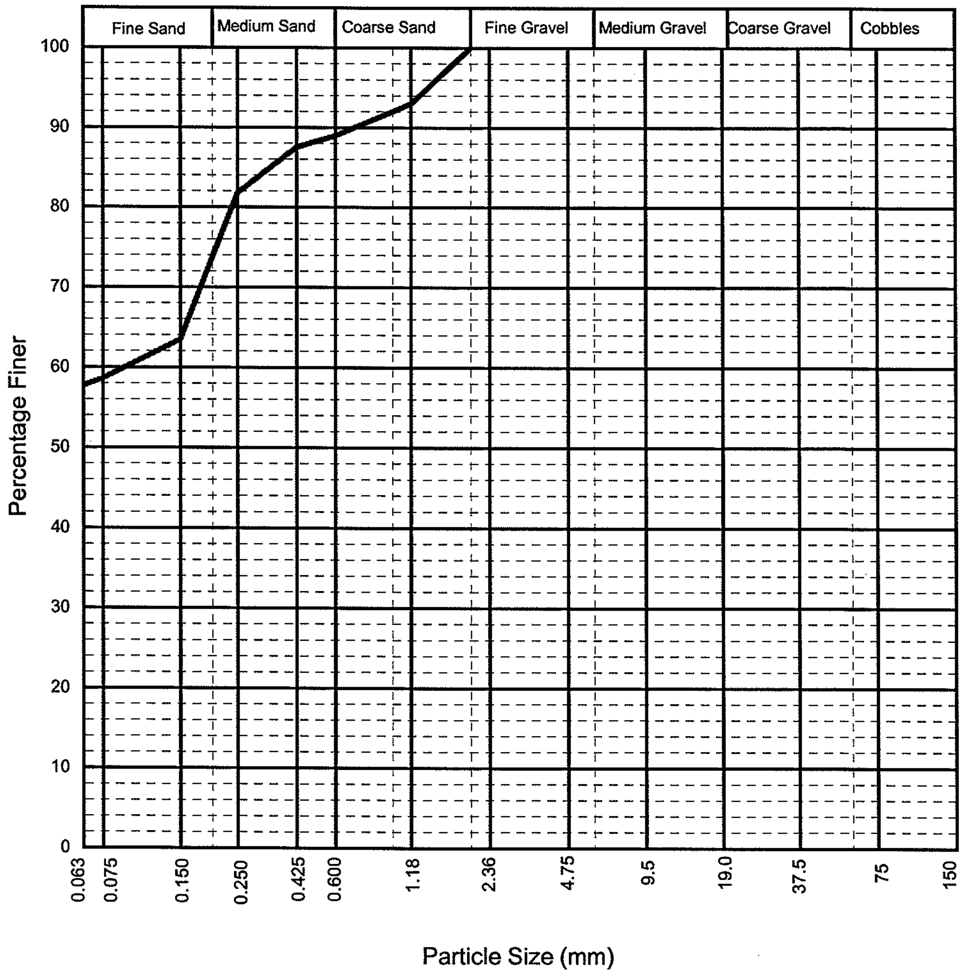
www.golder.com.au

# PARTICLE SIZE DISTRIBUTION

| | | | |
|---|---|---|---|
| Client : | ALS Environmental Sydney | Report No. : | R6509 |
| Address : | 277 Woodpark Road, Smithfield NSW | Job No. : | 077634002/5 |
| Project : | Delivered Samples | Reg'n No. : | L14176 |
| Sample ID : | H42 | Batch No. : | ES0703910 - 3 |
| | | Date Received : | 29/03/07 |
| | | Sampled By : | Client |

| Sieve Size (mm) | Percent Passing |
|---|---|
| 150 | |
| 75 | |
| 37.5 | |
| 19.0 | |
| 9.5 | |
| 4.75 | |
| 2.00 | 100.0 |
| 1.18 | 93.0 |
| 0.600 | 89.0 |
| 0.425 | 87.5 |
| 0.250 | 81.8 |
| 0.150 | 63.4 |
| 0.075 | 58.6 |
| 0.063 | 57.7 |

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



| | |
|---|---|
| Remarks : | |
| Material Description : | Sandy CLAY (CI) dark grey, with shell |
| Test Procedure : | AS 1289 3.6.1 |
| Prepared by : NF | Checked by : JA |

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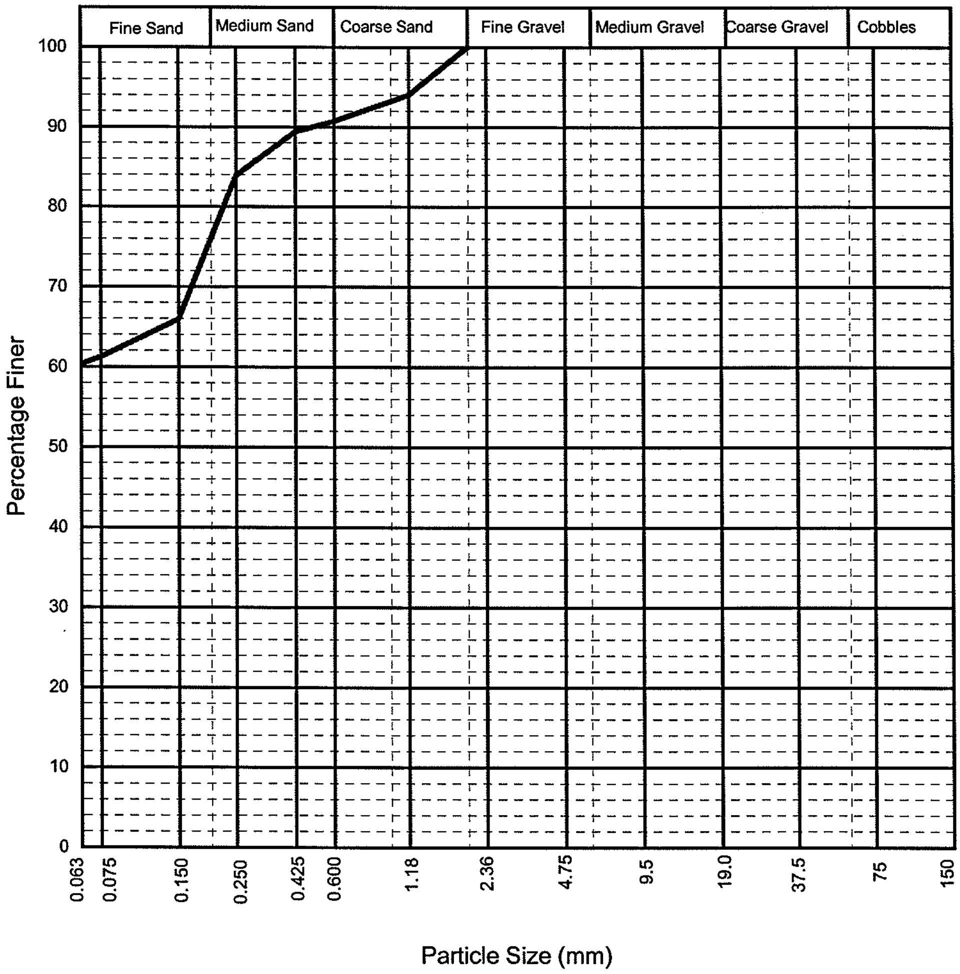
# PARTICLE SIZE DISTRIBUTION

| | | | |
|---|---|---|---|
| Client : | ALS Environmental Sydney | Report No. : | R6509 |
| Address : | 277 Woodpark Road, Smithfield NSW | Job No. : | 077634002/5 |
| Project : | Delivered Samples | Reg'n No. : | L14177 |
| Sample ID : | QC1 | Batch No. : | ES0703910 - 4 |
| | | Date Received : | 29/03/07 |
| | | Sampled By : | Client |

| Sieve Size (mm) | Percent Passing |
|---|---|
| 150 | |
| 75 | |
| 37.5 | |
| 19.0 | |
| 9.5 | |
| 4.75 | |
| 2.00 | 100.0 |
| 1.18 | 94.0 |
| 0.600 | 90.7 |
| 0.425 | 89.4 |
| 0.250 | 83.9 |
| 0.150 | 65.9 |
| 0.075 | 61.2 |
| 0.063 | 60.3 |

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



| | |
|---|---|
| Remarks : | |
| Material Description : | Sandy CLAY (CI) dark grey, with shell |
| Test Procedure : | AS 1289 3.6.1 |
| Prepared by : | Checked by : |

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# CHAIN OF CUSTODY FORM

Sheet 1 of 1

**THIS COLUMN FOR LAB USE ONLY**

**Job Code:** 43217595

**Due Date:** 12-4-07

**FROM:**
**URS (AUSTRALIA)**
ACN 000 691 690
North Sydney
Level 3 116 Miller Street
**Ph: 8925 5500**

**DATE:** 27-3-07

**Fax: 8925 5555**

**TO:**
**ALS Smithfield**
277 Woodpark Rd
Smithfield 2164

**Project No:** 43217595
**Project Manager:** Carsten Matthai
**Agreement No:** SY-019-07 URS V2

**Sampler(s):** Carsten Matthai
**Signature(s):** Matthai
**Checked:**

**Custody seal intact?** [✓ YES] ☐ NO
**Sample cold?** [✓ YES] ☐ NO

Released for URS by: Carsten Matthai
Date: 27-3-07 Time: 10:00 am

Received for Laboratory by: Frank Ferraro - ALS Sydney
Date: 27/03/07 Time: 15:40

**Container Size, Type, Preservative and Analysis**

| | Container Identification | | | Hold |
|---|---|---|---|---|
| Size mL | 250 | 500 g | 150 | |
| Type* | Glass | Plastic Bag | Glass | |
| Preservative Code | | | | |
| Analytes | Analytes per SY-019-07 URS V2 (Metals - As, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Pb, V, Zn, Hg, Al, Fe, Sr, Ca, Mg; TPH (C6-C36)/BTEX, PAHs, OC/OP/PCB, TKN, TOC, NOx), Reactive Phosphorus (Table B) | Grain Size (4 fractions: <0.063 mm; 0.063 to 0.25 mm; 0.25 mm to 2 mm; >2 mm) | **Silver (Table C)** | **Hold** |

[redacted]

| **Lab identification** | **Date** | **Time** | **Matrix** | **Sample Number** | **Estimated Level of Contamination** | Total no | Tick required analytes: Analytes per SY-019-07 URS V2 | Grain Size | Silver (Table C) | Hold |
|---|---|---|---|---|---|---|---|---|---|---|
| ① | 26-3-07 | | Sediment | **H40** | **Low** | | **x** | **x** | | **x** |
| ② | | | Sediment | **H41** | **Low** | | **x** | **x** | | **x** |
| ③ | | | Sediment | **H42** | **Low** | | **x** | **x** | | **x** |
| ④ | | | Sediment | **QC1** | **Low** | | **x** | **x** | | **x** |
| ⑤ | | | Sediment | **H3** | **Low** | | | | **x** | **x** |
| ⑥ | | | Sediment | **H5** | **Low** | | | | **x** | **x** |
| ⑦ | | | Sediment | **H7** | **Low** | | | | **x** | **x** |
| ⑧ | | | Sediment | **QC2** | **Low** | | | | **x** | **x** |
| | | | | | **TOTAL** | | 4 (2 identical jars each) | 4 | 4 | |

**CONTRACT WORK**
**WO:** ES0703910
**LAB:** Golder Associates - PSD
**DATE:** 27/03/07
**SPLIT:**

Environmental Division
Sydney
Work Order
**ES0703910**
Telephone : 61-2-8784 8555

Remarks:
No historical data available. Please send results to Dr Carsten Matthai (Email: carsten_matthai@urscorp.com).

* Container Type and Preservative Codes: P = Neutral Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinsed Jar; S = Solvent Washed Acid Rinsed Glass Bottle; VC = Hydrochloric Acid Preserved Vial; VS = Sulfuric

**Courier Job No:**

**Send results to Carsten_Matthai@urscorp.com**

**NOTE: SAMPLES MAY CONTAIN DANGEROUS AND HAZARDOUS SUBSTANCES**

**ALS Environmental**

# CERTIFICATE OF ANALYSIS

| | | | | | |
|---|---|---|---|---|---|
| *Client* | : **URS AUSTRALIA (NSW) PTY LTD** | *Laboratory* | : **Environmental Division Sydney** | *Page* | : **1 of 7** |
| *Contact* | : **MR CARSTEN MATTHAI** | *Contact* | : **Victor Kedicioglu** | *Work Order* | : **ES0706306** |
| *Address* | : **LEVEL 3, 116 MILLER STREET NORTH SYDNEY NSW AUSTRALIA 2060** | *Address* | : **277-289 Woodpark Road Smithfield NSW Australia 2164** | | |
| *E-mail* | : **carsten_matthai@urscorp.com** | *E-mail* | : **Victor.Kedicioglu@alsenviro.com** | | |
| *Telephone* | : **89255500** | *Telephone* | : **61-2-8784 8555** | | |
| *Facsimile* | : **89255555** | *Facsimile* | : **61-2-8784 8500** | | |
| *Project* | : **43217595** | *Quote number* | : **SY/019/07 V2** | *Date received* | : **14 May 2007** |
| *Order number* | : **REBATCH OF ES0703904** | | | *Date issued* | : **28 May 2007** |
| *C-O-C number* | : **- Not provided -** | | | *No. of samples* | - *Received* : **18** |
| *Site* | : **- Not provided -** | | | | *Analysed* : **18** |

*ALSE - Excellence in Analytical Testing*

**NATA Accredited Laboratory**
**825**

**This document is issued in accordance with NATA's accreditation requirements.**

**Accredited for compliance with ISO/IEC 17025.**

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatory* | *Position* | *Department* |
|---|---|---|
| **Kim McCabe** | **Senior Inorganic Chemist** | **Inorganics - NATA 825 (818 - Brisbane)** |
| **Kim McCabe** | **Senior Inorganic Chemist** | **Stafford Minerals - NATA 825 (818 - Brisbane)** |
| **PHALAK INTHAKESONE** | **Organics Co-ordinator** | **Organics - NATA 825 (10911 - Sydney)** |

## Comments

This report for the ALSE reference ES0706306 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order **ES0706306**

EP130,131A+B: Poor surrogate and matrix spike recovery due to sample heterogeneity and sample matrix effects.
EP132: Poor matrix spike recovery due to sample heterogeneity.
EP132: Poor duplicate precision due to sample heterogeneity.

## Analytical Results

| | | | Client Sample ID : | H7 | H8 | H9 | H10 | H17 |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | ES0706306-001 | ES0706306-002 | ES0706306-003 | ES0706306-004 | ES0706306-005 |
| *Analyte* | *CAS number* | *LOR* | *Units* | | | | | |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 5.9 | 8.6 | 7.4 | 9.1 | 5.7 |
| **EP005: Total Organic Carbon (TOC)** | | | | | | | | |
| Total Organic Carbon | | 0.02 | % | 3.26 | 4.16 | 4.73 | 5.40 | 2.72 |

## Analytical Results

| *Analyte* | *CAS number* | *LOR* | *Units* | **H18** | **H21** | **H22** | **H23** | **H24** |
|---|---|---|---|---|---|---|---|---|
| Sample Matrix Type / Description : | | | | SOIL | SOIL | SOIL | SOIL | SOIL |
| Sample Date / Time : | | | | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| Laboratory Sample ID : | | | | **ES0706306-006** | **ES0706306-007** | **ES0706306-008** | **ES0706306-009** | **ES0706306-010** |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 7.5 | 5.6 | 12.6 | 10.0 | 22.1 |
| **EP005: Total Organic Carbon (TOC)** | | | | | | | | |
| Total Organic Carbon | | 0.02 | % | 2.53 | 6.75 | 5.13 | 3.59 | 3.80 |

## *Analytical Results*

| | | | Client Sample ID : | **H25** | **H26** | **H28** | **H31** | **H37** |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Matrix Type / Description : | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Sample Date / Time : | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 |
| | | | Laboratory Sample ID : | **ES0706306-011** | **ES0706306-012** | **ES0706306-013** | **ES0706306-014** | **ES0706306-015** |
| ***Analyte*** | ***CAS number*** | ***LOR*** | ***Units*** | | | | | |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 1.6 | 4.8 | 2.2 | 19.9 | 7.2 |
| **EP005: Total Organic Carbon (TOC)** | | | | | | | | |
| Total Organic Carbon | | 0.02 | % | 2.12 | 4.11 | 1.96 | 2.31 | 3.21 |

## *Analytical Results*

| *Analyte* | *CAS number* | *LOR* | *Units* | **H38** | **QC3** | **QC4** | | |
|---|---|---|---|---|---|---|---|---|
| Client Sample ID : | | | | **H38** | **QC3** | **QC4** | | |
| Sample Matrix Type / Description : | | | | SOIL | SOIL | SOIL | | |
| Sample Date / Time : | | | | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | 26 Mar 2007<br>15:00 | | |
| Laboratory Sample ID : | | | | **ES0706306-016** | **ES0706306-017** | **ES0706306-018** | | |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | | 1.0 | % | 6.6 | 11.2 | 33.2 | | |
| **EP005: Total Organic Carbon (TOC)** | | | | | | | | |
| Total Organic Carbon | | 0.02 | % | 2.59 | 2.34 | 4.16 | | |

## *Surrogate Control Limits*

- **No surrogates present on this report.**

**ALS Environmental**

# QUALITY CONTROL REPORT

**Client** : **URS AUSTRALIA (NSW) PTY LTD**
**Contact** : CARSTEN MATTHAI
**Address** : LEVEL 3, 116 MILLER STREET NORTH
SYDNEY
NSW AUSTRALIA 2060

**Project** : 43217595
**Order number** : REBATCH OF ES0703904
**C-O-C number** : - Not provided -
**Site** : - Not provided -

**E-mail** : carsten_matthai@urscorp.com
**Telephone** : 89255500
**Facsimile** : 89255555

**Laboratory** : Environmental Division Sydney
**Contact** : Victor Kedicioglu
**Address** : 277-289 Woodpark Road Smithfield
NSW Australia 2164

**Quote number** : SY/019/07 V2

**E-mail** : Victor.Kedicioglu@alsenviro.com
**Telephone** : 61-2-8784 8555
**Facsimile** : 61-2-8784 8500

**Page** : **1 of 4**

**Work order** : **ES0706306**

**Amendment No.** :

**Date received** : **14 May 2007**
**Date issued** : **28 May 2007**

**No. of samples**
**Received** : 18
**Analysed** : 18

This final report for the ALSE work order reference ES0706306 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

**Work order specific comments**

EP132: Poor matrix spike recovery due to sample heterogeneity.
EP132: Poor duplicate precision due to sample heterogeneity.
EP130,131A+B: Poor surrogate and matrix spike recovery due to sample heterogeneity and sample matrix effects.

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Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| Signatory | Department |
|---|---|
| Kim McCabe | Inorganics - NATA 825 (818 - Brisbane) |
| Kim McCabe | Stafford Minerals - NATA 825 (818 - Brisbane) |
| PHALAK INTHAKESONE | Organics - NATA 825 (10911 - Sydney) |

# *Quality Control Report - Laboratory Duplicates (DUP)*

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

***Matrix Type: SOIL*** ***Laboratory Duplicates (DUP) Report***

| *Laboratory Sample ID* | *Client Sample ID* | *Analyte name* | *LOR* | *Original Result* | *Duplicate Result* | *RPD* |
|---|---|---|---|---|---|---|
| **EA055: Moisture Content** | | | | | | |
| **EA055: Moisture Content - ( QC Lot: 409839 )** | | | | % | % | % |
| ES0706306-001 | H7 | Moisture Content (dried @ 103°C) | 1.0 % | 5.9 | 5.2 | 11.9 |
| ES0706306-010 | H24 | Moisture Content (dried @ 103°C) | 1.0 % | 22.1 | 22.9 | 3.8 |
| **EP005: Total Organic Carbon (TOC)** | | | | | | |
| **EP005: Total Organic Carbon (TOC) - ( QC Lot: 417590 )** | | | | % | % | % |
| ES0706306-010 | H24 | Total Organic Carbon | 0.02 % | 3.80 | 3.84 | 1.0 |
| ES0706306-018 | QC4 | Total Organic Carbon | 0.02 % | 4.16 | 4.19 | 0.7 |

# *Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)*

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

***Matrix Type: SOIL***

***Method Blank (MB) and Laboratory Control Samples (LCS) Report***

| | | ***Method blank result*** | ***Actual Results*** | | ***Recovery Limits*** | |
|---|---|---|---|---|---|---|
| | | | ***Spike concentration*** | ***Spike Recovery*** | ***Dynamic Recovery Limits*** | |
| ***Analyte name*** | ***LOR*** | | | ***LCS*** | ***Low*** | ***High*** |
| **EP005: Total Organic Carbon (TOC)** | | | | | | |
| **EP005: Total Organic Carbon (TOC) - ( QC Lot: 417590 )** | | % | % | **%** | **%** | **%** |
| Total Organic Carbon | 0.02 % | ---- | 100 | 105 | 70 | 130 |
| | 0.02 % | <0.02 | ---- | ---- | ---- | ---- |

# *Quality Control Report - Matrix Spikes (MS)*

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*

* Indicates failed QC

***Matrix Spike (MS) Report***

| | | | | | *Actual Results* | | *Recovery Limits* | |
|---|---|---|---|---|---|---|---|---|
| | | | | | *Sample Result* | *Spike Recovery* | *Static Limits* | |
| *Analyte name* | *Laboratory Sample ID* | *Client Sample ID* | *LOR* | *Spike Concentration* | | *MS* | *Low* | *High* |
| | | | | | | | | |
| **- ( QC Lot: )** | | | | | | % | % | % |
| | | | | | ---- | | | |

- **No Matrix Spike (MS) carried out on this Work Order.**

**ALS Environmental**

# *INTERPRETIVE QUALITY CONTROL REPORT*

| | | | | | |
|---|---|---|---|---|---|
| **Client** | **URS AUSTRALIA (NSW) PTY LTD** | **Laboratory** | Environmental Division Sydney | **Page** | **1 of 8** |
| **Contact** | CARSTEN MATTHAI | **Contact** | Victor Kedicioglu | | |
| **Address** | LEVEL 3, 116 MILLER STREET NORTH SYDNEY<br>NSW AUSTRALIA 2060 | **Address** | 277-289 Woodpark Road Smithfield<br>NSW Australia 2164 | **Work order** | **ES0706306** |
| | | | | **Amendment No.** | |
| **Project** | 43217595 | **Quote number** | SY/019/07 V2 | **Date received** | 14 May 2007 |
| **Order number** | REBATCH OF ES0703904 | | | **Date issued** | 28 May 2007 |
| **C-O-C number** | - Not provided - | | | | |
| **Site** | - Not provided - | | | | |
| **E-mail** | carsten_matthai@urscorp.com | **E-mail** | Victor.Kedicioglu@alsenviro.com | **No. of samples** | |
| **Telephone** | 89255500 | **Telephone** | 61-2-8784 8555 | **Received** | 18 |
| **Facsimile** | 89255555 | **Facsimile** | 61-2-8784 8500 | **Analysed** | 18 |

This Interpretive Quality Control Report was issued on 28 May 2007 for the ALS work order reference ES0706306 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

# *Interpretive Quality Control Report - Analysis Holding Time*

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

***Matrix Type: SOIL***

***Analysis Holding Time and Preservation***

| **Method**<br>**Container /** Client Sample ID(s) | **Date Sampled** | **Extraction / Preparation**<br>Date extracted | <br>Due for extraction | <br>Pass? | **Analysis**<br>Date analysed | <br>Due for analysis | <br>Pass? |
|---|---|---|---|---|---|---|---|
| EA055-103: Moisture Content | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | ---- | ---- | ---- | **16 May 2007** | 2 Apr 2007 | **Fail by 44 days** |
| EP005: Total Organic Carbon | | | | | | | |
| **Snap Lock Bag**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **25 May 2007** | 23 Apr 2007 | **Fail by 32 day** | **25 May 2007** | 23 Apr 2007 | **Fail by 32 days** |
| EP130: Organophosphorus Pesticides (Ultra-trace) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |
| EP131A: Organochlorine Pesticides (Ultra-trace) | | | | | | | |

***Matrix Type: SOIL*** ***Analysis Holding Time and Preservation***

| **Method** | | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|---|
| **Container /** Client Sample ID(s) | | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EP131A: Organochlorine Pesticides (Ultra-trace) **- continued** | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |
| EP131B: PCB's (Ultra-trace) | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | | |
| H7, | H8, | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |
| H9, | H10, | | | | | | | |
| H17, | H18, | | | | | | | |
| H21, | H22, | | | | | | | |
| H23, | H24, | | | | | | | |
| H25, | H26, | | | | | | | |
| H28, | H31, | | | | | | | |
| H37, | H38, | | | | | | | |
| QC3, | QC4 | | | | | | | |

# *Interpretive Quality Control Report - Frequency of Quality Control Samples*

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

***Matrix Type: SOIL*** ***Frequency of Quality Control Samples***

| Quality Control Sample Type | Count | | **Rate (%)** | | Quality Control Specification |
|---|---|---|---|---|---|
| Method | QC | Regular | **Actual** | **Expected** | |
| Laboratory Duplicates (DUP) | | | | | |
| EA055-103: Moisture Content | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP005: Total Organic Carbon | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 2 | 18 | **11.1** | **10.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Laboratory Control Samples (LCS) | | | | | |
| EP005: Total Organic Carbon | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Method Blanks (MB) | | | | | |
| EP005: Total Organic Carbon | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| Matrix Spikes (MS) | | | | | |
| EP130: Organophosphorus Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131A: Organochlorine Pesticides (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP131B: PCB's (Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | 1 | 18 | **5.6** | **5.0** | NEPM 1999 Schedule B(3) and ALSE QCS3 requirement |

# *Interpretive Quality Control Report - Summary of Outliers*

## *Outliers : Quality Control Samples*

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

### *Non-surrogates*

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**
- **For all matrices, no matrix spike recoveries breaches occur.**

### *Surrogates*

- **For all matrices, no surrogate recovery outliers occur.**

## ***Outliers : Analysis Holding Time***

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

| **Method**<br>**Container /** Client Sample ID(s) | **Date Sampled** | **Extraction / Preparation** | | | **Analysis** | | |
|---|---|---|---|---|---|---|---|
| | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EA055-103: Moisture Content | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | ---- | ---- | ---- | **16 May 2007** | 2 Apr 2007 | **Fail by 44 days** |
| EP005: Total Organic Carbon | | | | | | | |
| **Snap Lock Bag**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **25 May 2007** | 23 Apr 2007 | **Fail by 32 day** | **25 May 2007** | 23 Apr 2007 | **Fail by 32 days** |
| EP130: Organophosphorus Pesticides (Ultra-trace) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |

| Method<br>Container / Client Sample ID(s) | Date Sampled | Extraction / Preparation | | | Analysis | | |
|---|---|---|---|---|---|---|---|
| | | Date extracted | Due for extraction | Pass? | Date analysed | Due for analysis | Pass? |
| EP131A: Organochlorine Pesticides (Ultra-trace) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |
| EP131B: PCB's (Ultra-trace) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |
| EP132: Semivolatile Compounds by GCMS(SIM - Ultra-trace) | | | | | | | |
| **Soil Glass Jar - Unpreserved**<br>H7, H8,<br>H9, H10,<br>H17, H18,<br>H21, H22,<br>H23, H24,<br>H25, H26,<br>H28, H31,<br>H37, H38,<br>QC3, QC4 | **26 Mar 2007** | **16 May 2007** | 9 Apr 2007 | **Fail by 37 day** | **18 May 2007** | 25 Jun 2007 | Pass |

## ***Outliers : Frequency of Quality Control Samples***

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

# *Method Reference Summary*

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

***Matrix Type: SOIL*** ***Method Reference Summary***

## Preparation Methods

**GEO30 : Dry and Pulverise (up to 100g) -**

**ORG17A-AC : Tumbler Extraction of Solids/ Acetylation -** In-house, Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to 1 mL with exchange into cyclohexane. Phenolic compounds are reacted with acetic anhydride to yield phenyl acetates suitable for ultra-trace analysis.

**ORG17A-UTP : Tumbler Extraction of Solids/ Sample Cleanup -** In-house, Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. Samples are extracted, concentrated (by KD) and exchanged into an appropriate solvent for GPC and florisil cleanup as required.

## Analytical Methods

**EA055-103 : Moisture Content -** A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)

**EP005 : Total Organic Carbon -** In-house. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automaticaly measured by infra-red detector.

Frank Ferraro
ALS Sydney
14|05|07 13:30

## Fadi Soro

**From:** Victor Kedicioglu
**Sent:** Monday, 14 May 2007 1:17 PM
**To:** Fadi Soro; Kerry Stefanovic
**Cc:** Nanthini Coilparampil; Edwandy Fadjar; Phalak Inthakesone; Scott Wythe
**Subject:** Re-Batch ES0703904

Fadi,

Could you please re-batch this entire work order for all previously requested analysis, **except** for TPH & TPH/BTEX.

I've got the samples in my office.

Thanks,

**Victor Kedicioglu**

Laboratory Manager

**ALS Laboratory Group**

**Environmental Division**
Sydney, Australia
Phone: + 61 2 8784 8555

Fax: + 61 2 8784 8500
**www.alsglobal.com <file:///C:\Documents%20and%20Settings\victor.kedicioglu\Application%20Data\Microsoft\Signatures\www.alsglobal.com>**

Environmental Division
Sydney
Work Order
***ES0706306***
Telephone : 61-2-8784 8555

① H7
② H8
③ H9
④ H10
⑤ H17
⑥ H18
⑦ H21
⑧ H22
⑨ H23
⑩ H24
⑪ H25
⑫ H26
⑬ H28
⑭ H31
⑮ H37
⑯ H38
⑰ QC3
⑱ QC4

Australian Government

National Measurement Institute

# REPORT OF ANALYSIS

Page: 1 of 4

Report No. RN615333

| | | | |
|---|---|---|---|
| Client | : URS AUST P/L<br>LEVEL 3<br>116 MILLER ST<br>NORTH SYDNEY NSW 2060 | Job No.<br>Quote No.<br>Order No.<br>Date Sampled<br>Date Received | : URS04/070327<br>: QT-00782<br>:<br>: 26-MAR-2007<br>: 27-MAR-2007 |
| Attention | : CARSTEN MATTHAI | Sampled By | : CLIENT |
| Project Name | : | | |
| Your Client Services Manager | : BRIAN WOODWARD | Phone | : (02) 94490151 |

| Lab Reg No. | Sample Ref | Sample Description |
|---|---|---|
| N07/011897 | H9 | SEDIMENT JOB 43217595 |
| N07/011898 | H31 | SEDIMENT JOB 43217595 |
| N07/011899 | H37 | SEDIMENT JOB 43217595 |
| N07/011900 | H38 | SEDIMENT JOB 43217595 |

| Lab Reg No. | Units | N07/011897 | N07/011898 | N07/011899 | N07/011900 | Method |
|---|---|---|---|---|---|---|
| Sample Reference | | H9 | H31 | H37 | H38 | |
| Herbicides | | | | | | |
| Diuron | mg/kg | < 0.1 | < 0.1 | < 0.1 | < 0.1 | NR47 |
| Miscellaneous | | | | | | |
| Organic Investigation | | See comment | See comment | See comment | See comment | NGCMS_1130 |
| Fungicides | | | | | | |
| Chlorothalonil | mg/kg | < 0.1 | < 0.1 | < 0.1 | < 0.1 | NR47 |
| Dichlofluanid | mg/kg | < 0.1 | < 0.1 | < 0.1 | < 0.1 | NR47 |
| Dates | | | | | | |
| Date extracted | | 28-MAR-2007 | 28-MAR-2007 | 28-MAR-2007 | 28-MAR-2007 | |
| Date analysed | | 14-MAY-2007 | 14-MAY-2007 | 14-MAY-2007 | 14-MAY-2007 | |

N07/011897
to
N07/011901:
Irgarol was not detected in Samples N07/011897 - N07/011901
where the Limit of Reporting is < 0.1 mg/kg.

Luke

Luke Baker, Analyst
Organics - NSW

15-MAY-2007

# REPORT OF ANALYSIS

| Lab Reg No. | Units | N07/011897 | N07/011898 | N07/011899 | N07/011900 | Method |
|---|---|---|---|---|---|---|
| Sample Reference | | H9 | H31 | H37 | H38 | |
| Trace Elements | | | | | | |
| Total Solids | % | 24.9 | 37.9 | 36.2 | 41.2 | NT2_49 |

Jim Huang, Analyst
Inorganics - NSW

15-MAY-2007

# REPORT OF ANALYSIS

Report No. RN615333

| | | | | |
|---|---|---|---|---|
| Client | : | URS AUST P/L<br>LEVEL 3<br>116 MILLER ST<br>NORTH SYDNEY NSW 2060 | Job No. | : URS04/070327 |
| | | | Quote No. | : QT-00782 |
| | | | Order No. | : |
| | | | Date Sampled | : 26-MAR-2007 |
| | | | Date Received | : 27-MAR-2007 |
| Attention | : | CARSTEN MATTHAI | Sampled By | : CLIENT |
| Project Name | : | | | |
| Your Client Services Manager | : | BRIAN WOODWARD | Phone | : (02) 94490151 |

| Lab Reg No. | Sample Ref | Sample Description |
|---|---|---|
| N07/011901 | QC5 | SEDIMENT JOB 43217595 |

| Lab Reg No. | Units | N07/011901 | | | | Method |
|---|---|---|---|---|---|---|
| Sample Reference | | QC5 | | | | |
| Herbicides | | | | | | |
| Diuron | mg/kg | < 0.1 | | | | NR47 |
| Miscellaneous | | | | | | |
| Organic Investigation | | See comment | | | | NGCMS_1130 |
| Fungicides | | | | | | |
| Chlorothalonil | mg/kg | < 0.1 | | | | NR47 |
| Dichlofluanid | mg/kg | < 0.1 | | | | NR47 |
| Dates | | | | | | |
| Date extracted | | 28-MAR-2007 | | | | |
| Date analysed | | 14-MAY-2007 | | | | |

Luke

Luke Baker, Analyst
Organics - NSW

15-MAY-2007

| Lab Reg No. | Units | N07/011901 | | | | Method |
|---|---|---|---|---|---|---|
| Sample Reference | | QC5 | | | | |
| Trace Elements | | | | | | |
| Total Solids | % | 25.3 | | | | NT2_49 |

Jim Huang, Analyst
Inorganics - NSW

15-MAY-2007

# REPORT OF ANALYSIS

All results are expressed on a dry weight basis.

Results relate only to the sample(s) tested.
This Report supersedes reports: RN608203 RN615294 RN615329

**Australian Government**

**National Measurement Institute**

# QUALITY ASSURANCE REPORT

**Client:** URS AUST P/L

**NMI QA Report No:** URS04/070327 **Sample Matrix:** Soil

| Analyte | Method | LOR | Blank | Sample Duplicates | | | Recoveries | |
|---|---|---|---|---|---|---|---|---|
| | | | | Sample | Duplicate | RPD | LCS | Matrix Spike |
| | | mg/kg | mg/kg | mg/kg | mg/kg | % | % | % |
| **Organics Section** | | | | | | | | |
| Diuron | NR47 | 0.1 | <0.1 | NA | NA | NA | 130 | NA |
| Chlorothaloni | NR47 | 0.1 | <0.1 | NA | NA | NA | 85 | NA |
| Dichlofluanid | NR47 | 0.1 | <0.1 | NA | NA | NA | 99 | NA |
| Irgarol | NR47 | 0.1 | <0.1 | NA | NA | NA | 77 | NA |

Results expressed in percentage (%) or mg/kg wherever appropriat
Acceptable Spike recovery is 50-150%
Acceptable RPDs on spikes and duplicates is 40%
'NA ' = Not Applicable
RPD= Relative Percentage Difference
This report shall not be reproduced except in ful

**Signed:**

**Danny Slee**
**Organics Manager, NMI-Pymble**

**Date:** **14/05/2007**

94400610

Australian Government
**National Measurement Institute**

DATE RECEIVED 27/3
PROJECT No
FILE No
DOCUMENT No
DISTRIBUTION C Mathai.

# SAMPLE RECEIPT NOTIFICATION

**COMPANY:** URS
**ATTENTION:** C. Mathai **FAX No:** 02 8925 5555
**DATE/TIME:** 1:10 27/3
**FROM:** NMI
**CLIENT JOB / PROJECT Name / Number**
**SAMPLE NO:** 5

**Incompleto or unclear information about samples or required tests will delay the start of analytical work.**

## SAMPLE

Samples were received at time 12:10 on date 27/3
Sampling Date documented on COC? [✓ Yes] / No
Samples received: frozen ☐ cool (ice packs) ☑ room temperature ☐

## DOCUMENTS

Complete documentation received for all samples. [ ✓ ]
No documents received. **Please advise us quickly of your requirements.** [ ]
**NMI Quotation Number included:** Yes ☐ No ☐

COMMENTS

ok

Signed: NN.

## ENQUIRIES

**Contact our Sample Management Team on (02) 9449 0135 or fax (02) 9440 0610 regarding sample condition, arrival, numbering, damage, documentation etc.**

Please direct turnaround or technical enquiries to our Customer Services Team, Brian Woodward (02) 9449 0151.

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Version #5 Created on 25/05/05

1 Suakin St (PO Box 385) Pymble NSW 2073 Tel: +61 2 9449 0111 Fax: +61 2 9449 1653 www.measurement.gov.au ABN: 51 835 430 479

**National Measurement Institute**

# CHAIN OF CUSTODY FORM

Sheet 1 of 1

| | | | |
|---|---|---|---|
| THIS COLUMN FOR LAB USE ONLY<br>Job Code: 43217595<br>Due Date: 16April07 | FROM:<br>URS (AUSTRALIA)<br>ACN 000 691 690<br>North Sydney<br>Level 3 116 Miller Street<br>Ph: 8925 5500; Mob: 0411 33111; Fax: 8925 5555 | DATE: 27-3-07 | TO:<br>NMI<br>1 Suakin St<br>Pymble, NSW 2073 |
| | Project No: 43217595<br>Project Manager: Carsten Matthai<br>Agreement No: BW07/0306A | Sampler(s): Carsten Matthai<br>Signature(s):<br>Checked: | |
| Custody seal intact? ☐ YES ☐ NO<br>Sample cold? ☐ YES ☐ NO | Released for URS by: Carsten Matthai<br>Date: 27-3-07 Time: 10 am | Received for Laboratory by:<br>Date: Time: | |

Container Size, Type, Preservative and Analysis

Container Identification

| Lab identification | Date | Time | Matrix | Sample Number | Estimated Level of Contamination | Total no | Analytes: Diuron and Chlorothalonil, Irgarol and Dichlofluanid<br>Size mL: 150<br>Type*: Glass<br>Preservative Code:<br>Tick required analytes | | | | | | | | | | | | Hold |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N07/011897 | 26-3-07 | | Sediment | H9 | Intermediate | 1 | x | | | | | | | | | | | | x |
| N07/011898 | ↓ | | Sediment | H31 | Intermediate | 1 | x | | | | | | | | | | | | x |
| N07/011899 | | | Sediment | H37 | Intermediate | 1 | x | | | | | | | | | | | | x |
| N07/011900 | | | Sediment | H38 | Intermediate | 1 | x | | | | | | | | | | | | x |
| N07/011901 | | | | QC5 | 〃 | 1 | X | | | | | | | | | | | | X |

Remarks:
No historical data available. Please send results to Dr Carsten Matthai (Email: carsten_matthai@urscorp.com).

TOTAL 5 (5 jars each) → identical jars 2 per Sample 10!

*Container Type and Preservative Codes: P = Neutral Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinsed Jar; S = Solvent Washed Acid Rinsed Glass Bottle; VC = Hydrochloric Acid Preserved Vial; VS = Sulfuric

Courier Job No:

Send results to Carsten_Matthai@urscorp.com

NOTE: SAMPLES MAY CONTAIN DANGEROUS AND HAZARDOUS SUBSTANCES

NN 12-00

# Appendices

## Appendix F – Data Validation

URS

## DATA VALIDATION SUMMARY

Note: Data validation assesses each analyte in terms of all the data validation variables and only the exceedances and outliers are reported in this form.

| | | | |
|---|---|---|---|
| **Project Name:** | Hornsby Shire Council<br>Sediment and Antifoul Study<br>Stage 2 | **Project/Task Number:** | 43217595 |
| **Analytical Laboratory:** | ALS | **Batch/Ref. Number(s):** | ES0703904 |
| **Date Sampled:** | 26/03/2007 | **Sample Type:** | Sediment |

| **Sample Handling, Receipt and Holding Times** | **Yes/No** | **Comments** |
|---|---|---|
| COC completed adequately | Yes | Yes |
| Samples received intact and chilled | Yes | Intact 11C ice present |
| Samples analysed within appropriate holding times per analytical methods. | Yes | |

| **# of Primary Samples** | **# of QAQC Samples** | **# of Duplicate Samples** | **# of Triplicate Samples** |
|---|---|---|---|
| 16 | 0 | 2 | 0 |

**Blanks**

**Method Blank (MB), Rinsate Blank (RB), Trip Blank (TB), Field Blank (FB)**

| **Type** | **Comments** |
|---|---|
| | |

**Laboratory Control Samples (LCS)**

| **Analyte** | |
|---|---|
| | |

**Matrix Spike (MS)**

| **Analyte** | **Comments** |
|---|---|
| | |

**Trip Spike /Control Trip Spike**

| **Analyte** | **% R** | **Comments** |
|---|---|---|
| n/a | | |

**Duplicates**

| **Laboratory Duplicates** | **Comments** |
|---|---|
| | |
| | |

| **Intra-Laboratory Duplicates** | **Comments** |
|---|---|
| | |
| QC5/H27 | |
| | |

| **Inter-Laboratory Duplicates** | **Comments** |
|---|---|
| N/A | |

**Surrogate Monitoring Compound Analyses**

| **Analyte** | **Comments** |
|---|---|
| | |

**Overall Comments**

This batch is suitable for environmental interpretative use

Performed By:
Date:

Reviewed By:
Date:

URS

## DATA VALIDATION SUMMARY

Note: Data validation assesses each analyte in terms of all the data validation variables and only the exceedances and outliers are reported in this form.

| | | | |
|---|---|---|---|
| **Project Name:** | Hornsby Shire Council<br>Sediment and Antifoul Study<br>Stage 2 | **Project/Task Number:** | 43217595 |
| **Analytical Laboratory:** | ALS | **Batch/Ref. Number(s):** | ES0703908 |
| **Date Sampled:** | 16/03/2007 | **Sample Type:** | Sediment |

| Sample Handling, Receipt and Holding Times | Yes/No | Comments |
|---|---|---|
| COC completed adequately | Yes | |
| Samples received intact and chilled | Yes | Received 6.2C- ice present |
| Samples analysed within appropriate holding times per analytical methods. | Yes | |

| # of Primary Samples | # of QAQC Samples | # of Duplicate Samples | # of Triplicate Samples |
|---|---|---|---|
| 16 | 0 | 2 | 0 |

**Blanks**

**Method Blank (MB), Rinsate Blank (RB), Trip Blank (TB), Field Blank (FB)**

| Type | Comments |
|---|---|
| MB | All blank results below LOR |

**Laboratory Control Samples (LCS)**

| Analyte | |
|---|---|
| | All recoveries in the LCS were acceptable |

**Matrix Spike (MS)**

| Analyte | Comments |
|---|---|
| | All spike recoveries were within acceptable limits |

**Trip Spike /Control Trip Spike**

| Analyte | % R | Comments |
|---|---|---|
| n/a | | |

**Duplicates**

| Laboratory Duplicates<br>Analyte | Comments |
|---|---|
| | All RPDS were acceptable for the laboratory duplicate analysis. |

| Intra-Laboratory Duplicates | Comments |
|---|---|
| H7/QC2 | All RPDs acceptable or results below Limit of Reporting |

| Inter-Laboratory Duplicates | Comments |
|---|---|
| N/A | |

**Surrogate Monitoring Compound Analyses**

| Analyte | Comments |
|---|---|
| | Surrogate recoveries within acceptable control limits |

**Overall Comments**

This batch is suitable for environmental interpretative use

| | | | |
|---|---|---|---|
| Performed By: | L. Alexander | Reviewed By: | |
| Date: | 27-Apr-07 | Date: | |

**URS**

## DATA VALIDATION SUMMARY

Note: Data validation assesses each analyte in terms of all the data validation variables and only the exceedances and outliers are reported in this form.

| | | | |
|---|---|---|---|
| **Project Name:** | Hornsby Shire Council<br>Sediment and Antifoul Study<br>Stage 2 | **Project/Task Number:** | 43217595 |
| **Analytical Laboratory:** | ALS | **Batch/Ref. Number(s):** | ES0703910 |
| **Date Sampled:** | 26/03/2007 | **Sample Type:** | Sediment |

| Sample Handling, Receipt and Holding Times | Yes/No | Comments |
|---|---|---|
| COC completed adequately | Yes | |
| Samples received intact and chilled | Yes | |
| Samples analysed within appropriate holding times per analytical methods. | Yes | |

| # of Primary Samples | # of QAQC Samples | # of Duplicate Samples | # of Triplicate Samples |
|---|---|---|---|
| 6 | 0 | 2 | 0 |

**Blanks**

**Method Blank (MB), Rinsate Blank (RB), Trip Blank (TB), Field Blank (FB)**

| Type | Comments |
|---|---|
| MB | All blank results below LOR |

**Laboratory Control Samples (LCS)**

| Analyte | |
|---|---|
| OCPs | Recovery of gamma-BHC (122%) in H40 greater than upper control limit (118%). |

**Matrix Spike (MS)**

| Analyte | Comments |
|---|---|
| OPPs | Recovery of gamma-BHC (113%) greater than upper data quality limit (110.44%) |
| OPPs | Recovery of Prothiofos (114%) in H40 greater than upper data quality objective (106.05%) |
| BTEX | Recovery of Toluene (69.6%) in an anonymous sample less than lower data quality objective (70%) |

**Trip Spike /Control Trip Spike**

| Analyte | % R | Comments |
|---|---|---|
| n/a | | |

**Duplicates**

| Laboratory Duplicates<br>Analyte | Comments |
|---|---|
| Total Major Cations | RPD for Calcium in H41 (61.2%) exceeds LOR based limits (0-20%) |
| Reactive Phosphorus | RPD for Reactive Phosphorus not determined in an anonymous sample |

| Intra-Laboratory | Comments |
|---|---|
| | |
| H42/QC1 | RPDs for Strontium (98.67%) and Calcium (131.88%) exceed LOR based limits. |
| H7/QC2 | All RPDs acceptable or results below Limit of Reporting |

| Inter-Laboratory Duplicates | Comments |
|---|---|
| N/A | |

**Surrogate Monitoring Compound Analyses**

| Analyte | Comments |
|---|---|
| TPH/BTEX | Surrogate recovery of Toluene-D8 (80.2%) in H40 was less than lower data quality objective (81%). |

**Overall Comments**

High recoveries of OCPs and OPPs in the LCS and Matrix spikes do not affect the quality of the data as the exceedance from control limits is minimal and all reported concentartions of these analytes are below LOR. Slightly low recovery of Toluene in the matrix spike does not affect the characterisation of the sediment as the spike was performed on an anonymous sample that cannot be considered representative of the project sample matrices.

RPD exceedances for Calcium in the Laboratory and Intra-laboratory duplicates, and Strontium in the Intra-laboratory duplicate analysis are likely a result of sample heterogeneity and do not affect the validity of the reported results.

TPH/BTEX surrogate recovery exceedance was only mininmal (0.8%) and consequently not expected to affect the quality of the batch data.

This batch is suitable for environmental interpretative use

| | | | |
|---|---|---|---|
| Performed By: | L. Alexander | Reviewed By: | |
| Date: | 16-Apr-07 | Date: | |

# Appendices

Appendix G – Laboratory Organic Ultratrace Analysis

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

Tuesday 22 May, 2007

URS Australia Pty Ltd
Level 3, 116 Miller Street
North Sydney NSW 2060

**ATTENTION: Ms Stephanie McCready**

Dear Stephanie,

**RE: Investigation of ES0703904 – Ultratrace Sediment Analysis**

As a result of unusually low surrogate recoveries for a number of analyses completed for the work order referenced above, an investigation was undertaken by ALS to determine the cause. A summary of the findings of this investigation is given below.

Initial analysis results for OC and OP Pesticides & PCBs had low surrogate recoveries in the following ranges: OCs - ND to 64.9%, OPs - ND to 45.9%, PCBs - ND to 82.6%.

Further testing was carried out by reducing the sample weight relative to the solvent volume in an attempt to increase extraction efficiency. Results for this testing are attached in Table 1. While the reduced sample weights generally improved surrogate recoveries, there was still some variation in recoveries, particularly for PCBs. Analysis results for OCs and PCBs also showed significant variation from that reported initially for two of the three positive analytes. Results from this trial were inconclusive.

Given that the samples all had very high water contents, further testing was undertaken on the samples following ambient air drying. Results for this testing are attached in Table 2. Again, results for the pesticides and PCBs showed significant variation and generally low surrogate recoveries. PAH surrogate recoveries were generally better than those seen during the initial testing, and analysis results generally increased correspondingly, with the exception of the more volatile naphthalene which would have been reduced in concentration during the drying process.

## Investigation Summary

It is our opinion that the results of the investigation show that the sample matrix for these particular sediment samples interferes significantly in the determination of OP and OC pesticides and PCBs. ALS has not previously seen such low surrogate recoveries for these analytes in sediment work. The inconsistent analytical results also suggest that the samples may be heterogeneous.

It is suggested that, while analysed outside of holding times, the air dried PAH results be reported, with the exception of naphthalene, given that they have generally increased and are likely to be more representative. Given the inconsistent nature of results and surrogate recoveries for the other analytes, no changes to the originally reported results are considered warranted.

If you require any further information or would like to discuss any of these matters any further, please feel free to contact me at anytime.

Yours sincerely

Scott Wythe
**NSW Business Manager**
**ALS Environmental**

## Table 1

ES0703904 Investigation Of Low Surrogate Recoveries For Pesticides in Sediment - Weight Tria

| Test Sample ID | Original Sample ID | Sample Weight (g) | Solvent Volume (mL) | Final Volume (mL) | OP Surr. Rec % | OP Surr. Rec originally Reported % |
|---|---|---|---|---|---|---|
| 1 | ES0703904-7 | 20 | 100 | 1 | 56.6 | **ND** |
| 2 | ES0703904-7 | 20 | 100 | 1 | 60.4 | |
| 3 | ES0703904-7 | 10 | 100 | 1 | 86.2 | |
| 4 | ES0703904-7 | 10 | 100 | 1 | 81.6 | |
| 5 | ES0703904-7 | 5 | 100 | 1 | 89.3 | |
| 6 | ES0703904-7 | 5 | 100 | 1 | 103.1 | |
| 7 | ES0703904-18 | 20 | 100 | 1 | 43.4 | **38.2** |
| 8 | ES0703904-18 | 20 | 100 | 1 | 84.4 | |
| 9 | ES0703904-18 | 10 | 100 | 1 | 112.4 | |
| 10 | ES0703904-18 | 10 | 100 | 1 | 116.9 | |
| 11 | ES0703904-18 | 5 | 100 | 1 | 92.2 | |
| 12 | ES0703904-18 | 5 | 100 | 1 | 94.2 | |

| Test Sample ID | Original Sample ID | Sample Weight (g) | Solvent Volume (mL) | Final Volume (mL) | OC Surr. Rec % | Conc DDE ug/kg | Conc DDE Reported originally ug/kg | OC Surr. Rec originally Reported % |
|---|---|---|---|---|---|---|---|---|
| 1 | ES0703904-7 | 20 | 100 | 1 | 55.0 | 8.0 | **1.04** | **28.1** |
| 2 | ES0703904-7 | 20 | 100 | 1 | 47.5 | 8.2 | | |
| 3 | ES0703904-7 | 10 | 100 | 1 | 80.0 | 11.1 | | |
| 4 | ES0703904-7 | 10 | 100 | 1 | 62.5 | 8.9 | | |
| 5 | ES0703904-7 | 5 | 100 | 1 | 77.5 | 12.1 | | |
| 6 | ES0703904-7 | 5 | 100 | 1 | 83.8 | 12.1 | | |
| 7 | ES0703904-18 | 20 | 100 | 1 | 36.3 | 1.7 | **1.33** | **56.1** |
| 8 | ES0703904-18 | 20 | 100 | 1 | 71.3 | 2.9 | | |
| 9 | ES0703904-18 | 10 | 100 | 1 | 98.8 | 3.9 | | |
| 10 | ES0703904-18 | 10 | 100 | 1 | 95.0 | 4.9 | | |
| 11 | ES0703904-18 | 5 | 100 | 1 | 95.0 | ND | | |
| 12 | ES0703904-18 | 5 | 100 | 1 | 101.3 | 5.9 | | |

| Test Sample ID | Original Sample ID | Sample Weight (g) | Solvent Volume (mL) | Final Volume (mL) | PCB Surr. Rec % | Conc PCB ug/kg | Conc PCB Reported originally ug/kg | PCB Surr. Rec originally Reported % |
|---|---|---|---|---|---|---|---|---|
| 1 | ES0703904-7 | 20 | 100 | 1 | 85.0 | 146 | **13.9** | **25.9** |
| 2 | ES0703904-7 | 20 | 100 | 1 | 56.3 | 102 | | |
| 3 | ES0703904-7 | 10 | 100 | 1 | 77.5 | 129 | | |
| 4 | ES0703904-7 | 10 | 100 | 1 | 47.5 | 150 | | |
| 5 | ES0703904-7 | 5 | 100 | 1 | 85.0 | 179 | | |
| 6 | ES0703904-7 | 5 | 100 | 1 | 71.3 | 179 | | |
| 7 | ES0703904-18 | 20 | 100 | 1 | 37.5 | | | **56.8** |
| 8 | ES0703904-18 | 20 | 100 | 1 | 67.5 | | | |
| 9 | ES0703904-18 | 10 | 100 | 1 | 80.0 | | | |
| 10 | ES0703904-18 | 10 | 100 | 1 | 78.8 | | | |
| 11 | ES0703904-18 | 5 | 100 | 1 | 65.0 | | | |
| 12 | ES0703904-18 | 5 | 100 | 1 | 67.5 | | | |

**Table 2**
**Comparison of Initial and Pre-dried Test Results**

| | | | | H7 | H7 | H8 | H8 | H9 | H9 | H10 | H10 | H17 | H17 | H17 | H18 | H18 | H18 | H21 | H21 | H22 | H22 | H23 | H23 | H24 | H24 | H25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | Lab Dup | | | Lab Dup | | | | | | | | | |
| | | | | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Pre-dried | Initial | Pre-dried | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial |
| | | | | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results |
| | | | | ES0703904001 | ES0706306001 | ES0703904002 | ES0706306002 | ES0703904003 | ES0706306003 | ES0703904004 | ES0706306004 | ES0703904005 | ES0706306005 | ES0706306005 Lab Dup | ES0703904006 | ES0706306006 | ES0706306006 Lab Dup | ES0703904007 | ES0706306007 | ES0703904008 | ES0706306008 | ES0703904009 | ES0706306009 | ES0703904010 | ES0706306010 | ES0703904011 |
| EA055-103 | Moisture Content (dried @ 103°C) | % | 1 | 74 | 5.9 | 74.7 | 8.6 | 75.7 | 7.4 | 65 | 9.1 | 62.1 | 5.7 | -- | 61.6 | 7.5 | -- | 65 | 5.6 | 71.7 | 12.6 | 78.2 | 10 | 76 | 22.1 | 37.7 |
| EP130 | Bromophos-ethyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Carbophenothion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Chlorfenvinphos (E) | µg/kg | 10 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | -- | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| EP130 | Chlorfenvinphos (Z) | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Chlorpyrifos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Chlorpyrifos-methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Demeton-S-methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Diazinon | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Dichlorvos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Dimethoate | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Ethion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Fenamiphos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Fenthion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Malathion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Azinphos Methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Monocrotophos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Parathion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Parathion-methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Pirimphos-ethyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Prothiofos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | DEF | % | 10 | 21.8 | 26.8 | 32.4 | 18.7 | 30 | 14.6 | ND | 22.6 | 34.9 | 32.5 | 27.2 | 32.2 | 37.8 | -- | ND | 16.6 | 29.4 | 26.7 | ND | 33.2 | 28.3 | 34.6 | 41.4 |
| EP131A | Aldrin | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | 0.97 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | alpha-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | beta-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | delta-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | 4.4’-DDD | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | 4.4’-DDE | µg/kg | 0.5 | <0.50 | <0.50 | 0.66 | <0.50 | 1.12 | 1.47 | 0.53 | 1.3 | <0.50 | 0.94 | 1.02 | <0.50 | 1.03 | -- | 1.04 | 1.37 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | 4.4’-DDT | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 6.62 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | DDT (total) | µg/kg | 0.5 | <0.50 | <0.50 | 0.66 | <0.50 | 1.12 | 8.1 | 0.53 | 1.3 | <0.50 | 0.94 | 1.02 | <0.50 | 1.03 | -- | 1.04 | 1.37 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Dieldrin | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | alpha-Endosulfan | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | beta-Endosulfan | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endosulfan sulfate | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endosulfan | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endrin | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endrin aldehyde | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endrin ketone | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Heptachlor | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Heptachlor epoxide | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Hexachlorobenzene (HCB) | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | gamma-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Methoxychlor | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | cis-Chlordane | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | trans-Chlordane | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.57 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | 0.87 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Total Chlordane | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.57 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | 0.87 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131B | Total Polychlorinated biphenyls | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | 13.9 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1016 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131B | Aroclor 1221 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131B | Aroclor 1232 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131B | Aroclor 1242 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131B | Aroclor 1248 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131B | Aroclor 1254 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | 13.9 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131B | Aroclor 1260 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <6.2 | <5.0 | <6.2 | <5.0 | <5.0 |
| EP131A | Dibromo-DDE | % | 0.5 | 25.3 | 17.8 | 35.1 | 16.4 | 45.6 | 22.3 | 18.3 | 21.3 | 24.4 | 72.1 | 77.0 | 41.7 | 61.1 | -- | 28.1 | 13.6 | 47.2 | 12.2 | ND | 17.5 | 15.5 | 21.1 | 64.9 |
| EP131B | Decachlorobiphenyl | % | 0.5 | 26.6 | 15.4 | 39.9 | 13.6 | 47.9 | 25.5 | 21.9 | 14 | 23.5 | 48.1 | 67.0 | 51.6 | 57.4 | -- | 25.9 | 12 | 55.5 | 8.8 | ND | 10.1 | 19.2 | 13.5 | 61 |
| EP132 | 3-Methylcholanthrene | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP132 | 2-Methylnaphthalene | µg/kg | 10 | 70 | 20 | <10 | 20 | 70 | 20 | 40 | 20 | 50 | 10 | -- | 50 | 20 | 10 | 50 | 30 | <10 | 20 | 70 | 10 | 50 | 10 | 30 |
| EP132 | 7.12-Dimethylbenz(a)anthracene | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP132 | Acenaphthene | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | 30 | <10 | <10 | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP132 | Acenaphthylene | µg/kg | 10 | <10 | 10 | 10 | 20 | 10 | 30 | 20 | 20 | 20 | 20 | -- | 30 | 60 | 40 | 50 | 60 | 20 | 40 | 20 | 20 | 10 | 10 | <10 |
| EP132 | Anthracene | µg/kg | 10 | 10 | 10 | <10 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | -- | 20 | 70 | 30 | 50 | 60 | 20 | 40 | 20 | 20 | 10 | 10 | <10 |
| EP132 | Benz(a)anthracene | µg/kg | 10 | 50 | 70 | 30 | 70 | 40 | 70 | 50 | 60 | 110 | 140 | -- | 140 | 600 | 220 | 110 | 160 | 70 | 130 | 40 | 50 | 30 | 30 | 20 |
| EP132 | Benzo(a)pyrene | µg/kg | 10 | 70 | 90 | 50 | 100 | 50 | 100 | 70 | 90 | 140 | 180 | -- | 190 | 630 | 420 | 160 | 250 | 110 | 200 | 60 | 90 | 50 | 50 | 20 |
| EP132 | Benzo(b)fluoranthene | µg/kg | 10 | 60 | 110 | 50 | 120 | 60 | 130 | 80 | 120 | 150 | 250 | -- | 210 | 760 | 480 | 160 | 310 | 90 | 250 | 60 | 100 | 50 | 60 | 20 |
| EP132 | Benzo(e)pyrene | µg/kg | 10 | 50 | 60 | 40 | 70 | 40 | 80 | 60 | 70 | 100 | 120 | -- | 140 | 440 | 300 | 120 | 180 | 70 | 140 | 50 | 60 | 40 | 40 | 10 |
| EP132 | Benzo(g.h.i)perylene | µg/kg | 10 | 60 | 50 | 50 | 40 | 50 | 40 | 70 | 40 | 110 | 50 | -- | 160 | 430 | 320 | 120 | 90 | 80 | 70 | 50 | 70 | 40 | 40 | 20 |
| EP132 | Benzo(k)fluoranthene | µg/kg | 10 | 60 | 70 | 40 | 80 | 40 | 100 | 50 | 90 | 130 | 130 | -- | 160 | 310 | 170 | 150 | 200 | 100 | 160 | 60 | 60 | 40 | 40 | 10 |
| EP132 | Chrysene | µg/kg | 10 | 60 | 80 | 40 | 80 | 50 | 80 | 70 | 80 | 150 | 160 | -- | 170 | 610 | 380 | 150 | 200 | 90 | 210 | 50 | 60 | 40 | 40 | 20 |
| EP132 | Coronene | µg/kg | 10 | 10 | <10 | 10 | <10 | 20 | <10 | 20 | <10 | 30 | <10 | -- | 40 | 20 | 20 | 40 | 20 | 30 | 20 | 20 | 20 | 10 | 20 | <10 |
| EP132 | Dibenz(a.h)anthracene | µg/kg | 10 | 10 | 20 | <10 | 10 | <10 | <10 | <10 | <10 | 20 | 20 | -- | 30 | 50 | 40 | 30 | 30 | 10 | 20 | 10 | 10 | <10 | <10 | <10 |
| EP132 | Fluoranthene | µg/kg | 10 | 90 | 130 | 70 | 140 | 70 | 160 | 110 | 140 | 240 | 280 | -- | 260 | 1080 | 580 | 250 | 410 | 160 | 320 | 90 | 130 | 60 | 70 | 50 |
| EP132 | Fluorene | µg/kg | 10 | 10 | <10 | <10 | <10 | 10 | <10 | <10 | <10 | 10 | <10 | -- | 10 | 40 | 10 | 10 | 20 | <10 | 10 | 10 | <10 | <10 | <10 | <10 |
| EP132 | Indeno(1.2.3.cd)pyrene | µg/kg | 10 | 50 | 40 | 40 | 30 | 30 | 30 | 40 | 30 | 90 | 50 | -- | 120 | 430 | 300 | 90 | 70 | 60 | 60 | 40 | 60 | 30 | 40 | 10 |
| EP132 | N-2-Fluorenyl Acetamide | µg/kg | 100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | -- | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| EP132 | Naphthalene | µg/kg | 10 | 70 | 20 | <10 | 20 | 70 | 20 | 40 | 20 | 50 | 20 | -- | 50 | 30 | 20 | 50 | 40 | <10 | 30 | 70 | 20 | 50 | 20 | 30 |
| EP132 | Perylene | µg/kg | 10 | 30 | 60 | 20 | 60 | 20 | 60 | 30 | 40 | 60 | 90 | -- | 60 | 150 | 100 | 50 | 60 | 30 | 60 | 20 | 40 | 20 | 30 | <10 |
| EP132 | Phenanthrene | µg/kg | 10 | 50 | 40 | 30 | 50 | 50 | 50 | 50 | 50 | 80 | 70 | -- | 70 | 210 | 80 | 110 | 150 | 60 | 110 | 50 | 40 | 40 | 40 | 40 |
| EP132 | Pyrene | µg/kg | 10 | 100 | 140 | 70 | 160 | 80 | 170 | 110 | 140 | 220 | 260 | -- | 260 | 990 | 590 | 260 | 420 | 160 | 320 | 100 | 140 | 70 | 80 | 40 |
| EP132 | 2-Fluorobiphenyl | % | 10 | 62.9 | 98.6 | 49.8 | 94.7 | 55.2 | 92.8 | 64.7 | 76.4 | 65 | 86.6 | -- | 53.9 | 99.8 | 83.5 | 54.8 | 91.3 | 50 | 80.2 | 57.5 | 71 | 71.3 | 82.6 | 60 |
| EP132 | Anthracene-d10 | % | 10 | 67.7 | 101 | 67.3 | 96.7 | 66.8 | 95.7 | 72.4 | 75 | 72.6 | 87.5 | -- | 67 | 99.6 | 83.6 | 62.4 | 88.2 | 62 | 80.3 | 68 | 73.4 | 81.5 | 84.8 | 67.2 |
| EP132 | 4-Terphenyl-d14 | % | 10 | 63.7 | 103 | 61.8 | 103 | 63.5 | 110 | 72.3 | 76.7 | 72.4 | 92.4 | -- | 63.2 | 106 | 85.2 | 54.3 | 104 | 60.1 | 86.7 | 62.8 | 87.3 | 75.4 | 91.1 | 64 |

**Table 2**
**Comparison of Initial and Pre-dried Test Results**

| | | | | H25 | H25 | H26 | H26 | H28 | H28 | H31 | H31 | H31 | H37 | H37 | H38 | H38 | QC3 | QC3 | QC4 | QC4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lab Dup | | | | | | | Lab Dup | | | | | | | | |
| | | | | Pre-dried | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried | Initial | Pre-dried |
| | | | | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results | Results |
| | | | | ES0706306011 | ES0706306011 Lab Dup | ES0703904012 | ES0706306012 | ES0703904013 | ES0706306013 | ES0703904014 | ES0706306014 | ES0706306014 Lab Dup | ES0703904015 | ES0706306015 | ES0703904016 | ES0706306016 | ES0703904017 | ES0706306017 | ES0703904018 | ES0706306018 |
| EA055-103 | Moisture Content (dried @ 103°C) | % | 1 | 1.6 | -- | 60.4 | 4.8 | 48.5 | 2.2 | 62.4 | 19.9 | -- | 64.7 | 7.2 | 60 | 6.6 | 59.5 | 11.2 | 74.5 | 33.2 |
| EP130 | Bromophos-ethyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Carbophenothion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Chlorfenvinphos (E) | µg/kg | 10 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | -- | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| EP130 | Chlorfenvinphos (Z) | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Chlorpyrifos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Chlorpyrifos-methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Demeton-S-methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Diazinon | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Dichlorvos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Dimethoate | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Ethion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Fenamiphos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Fenthion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Malathion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Azinphos Methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Monocrotophos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Parathion | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Parathion-methyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Pirimphos-ethyl | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | Prothiofos | µg/kg | 10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP130 | DEF | % | 10 | 49.8 | 52.9 | 22.6 | 15.7 | ND | 40.9 | 27.3 | 31.8 | -- | 45.9 | 17 | 26.5 | 46.6 | 37.7 | 27 | 38.2 | 30.2 |
| EP131A | Aldrin | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | alpha-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | beta-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | delta-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | 4.4'-DDD | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | 4.4'-DDE | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | 0.84 | <0.50 | 1.61 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | 0.95 | <0.50 | <0.50 | 1.33 | 0.96 |
| EP131A | 4.4'-DDT | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | DDT (total) | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | 0.84 | <0.50 | 1.61 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | 0.95 | <0.50 | <0.50 | 1.33 | 0.96 |
| EP131A | Dieldrin | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | alpha-Endosulfan | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | beta-Endosulfan | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endosulfan sulfate | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endosulfan | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endrin | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endrin aldehyde | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Endrin ketone | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Heptachlor | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 4.72 | <0.50 | <0.50 | -- | <0.50 | 0.73 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Heptachlor epoxide | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Hexachlorobenzene (HCB) | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | gamma-BHC | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Methoxychlor | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | cis-Chlordane | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | trans-Chlordane | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131A | Total Chlordane | µg/kg | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | -- | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| EP131B | Total Polychlorinated biphenyls | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | 16 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1016 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1221 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1232 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1242 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1248 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1254 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | 16 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131B | Aroclor 1260 | µg/kg | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | -- | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| EP131A | Dibromo-DDE | % | 0.5 | 64.7 | 62.5 | 57.6 | 22.9 | 24.4 | 79.1 | 41.6 | 63.6 | -- | 61.1 | 19.8 | 30.2 | 49.1 | 42.4 | 59.5 | 56.1 | 68.6 |
| EP131B | Decachlorobiphenyl | % | 0.5 | 59 | 49.0 | 82.6 | 30.6 | 24.5 | 83.5 | 43.7 | 57.4 | -- | 64.1 | 16.5 | 37.1 | 67.7 | 47 | 37.2 | 56.8 | 4.3 |
| EP132 | 3-Methylcholanthrene | µg/kg | 10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP132 | 2-Methylnaphthalene | µg/kg | 10 | <10 | -- | 30 | <10 | 30 | <10 | 40 | 10 | 20 | 50 | 20 | 50 | 10 | 40 | <10 | 40 | 20 |
| EP132 | 7.12-Dimethylbenz(a)anthracene | µg/kg | 10 | <10 | -- | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP132 | Acenaphthene | µg/kg | 10 | <10 | -- | 20 | 10 | 20 | <10 | <10 | <10 | <10 | 10 | 10 | <10 | <10 | <10 | <10 | <10 | <10 |
| EP132 | Acenaphthylene | µg/kg | 10 | <10 | -- | 20 | 20 | 20 | <10 | <10 | 10 | <10 | 40 | 50 | 30 | 30 | <10 | <10 | 20 | 20 |
| EP132 | Anthracene | µg/kg | 10 | <10 | -- | 80 | 60 | 60 | <10 | <10 | <10 | 10 | 40 | 60 | 20 | 30 | <10 | <10 | 10 | 20 |
| EP132 | Benz(a)anthracene | µg/kg | 10 | 20 | -- | 370 | 480 | 320 | 30 | 20 | 40 | 30 | 160 | 210 | 130 | 170 | 20 | 30 | 40 | 50 |
| EP132 | Benzo(a)pyrene | µg/kg | 10 | 20 | -- | 410 | 560 | 380 | 40 | 30 | 50 | 40 | 170 | 230 | 160 | 210 | 30 | 40 | 60 | 60 |
| EP132 | Benzo(b)fluoranthene | µg/kg | 10 | 20 | -- | 370 | 460 | 340 | 40 | 30 | 60 | 50 | 200 | 470 | 180 | 240 | 40 | 50 | 70 | 80 |
| EP132 | Benzo(e)pyrene | µg/kg | 10 | 10 | -- | 220 | 220 | 210 | 30 | 20 | 40 | 30 | 120 | 170 | 120 | 140 | 30 | 30 | 50 | 50 |
| EP132 | Benzo(g.h.i)perylene | µg/kg | 10 | 20 | -- | 220 | 220 | 210 | 30 | 20 | 40 | 30 | 110 | 140 | 120 | 160 | 30 | 30 | 50 | 50 |
| EP132 | Benzo(k)fluoranthene | µg/kg | 10 | 20 | -- | 260 | 230 | 250 | 20 | 30 | 30 | 30 | 130 | 160 | 140 | 150 | 30 | 20 | 50 | 30 |
| EP132 | Chrysene | µg/kg | 10 | 20 | -- | 360 | 460 | 310 | 30 | 30 | 40 | 40 | 190 | 450 | 150 | 200 | 30 | 40 | 60 | 60 |
| EP132 | Coronene | µg/kg | 10 | <10 | -- | 50 | 50 | 50 | <10 | <10 | 10 | 10 | 30 | 40 | 40 | 50 | <10 | 10 | 20 | 20 |
| EP132 | Dibenz(a.h)anthracene | µg/kg | 10 | <10 | -- | 50 | 50 | 60 | <10 | <10 | <10 | <10 | 20 | 40 | 30 | 40 | <10 | <10 | <10 | 10 |
| EP132 | Fluoranthene | µg/kg | 10 | 50 | -- | 750 | 930 | 590 | 50 | 40 | 80 | 70 | 370 | 520 | 240 | 380 | 50 | 60 | 80 | 100 |
| EP132 | Fluorene | µg/kg | 10 | <10 | -- | 20 | 10 | 10 | <10 | <10 | <10 | <10 | 20 | 20 | 10 | 10 | <10 | <10 | <10 | <10 |
| EP132 | Indeno(1.2.3.cd)pyrene | µg/kg | 10 | 10 | -- | 180 | 210 | 170 | 20 | 20 | 30 | 30 | 90 | 110 | 90 | 120 | 20 | 20 | 40 | 40 |
| EP132 | N-2-Fluorenyl Acetamide | µg/kg | 100 | <100 | -- | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| EP132 | Naphthalene | µg/kg | 10 | 10 | -- | 30 | 20 | 30 | 10 | 40 | 20 | 20 | 60 | 30 | 50 | 20 | 40 | 10 | 40 | 20 |
| EP132 | Perylene | µg/kg | 10 | 10 | -- | 100 | 100 | 90 | 30 | 20 | 40 | 20 | 60 | 120 | 60 | 90 | 20 | 30 | 30 | 40 |
| EP132 | Phenanthrene | µg/kg | 10 | 30 | -- | 270 | 200 | 180 | 20 | 30 | 30 | 40 | 100 | 130 | 70 | 90 | 30 | 30 | 40 | 40 |
| EP132 | Pyrene | µg/kg | 10 | 50 | -- | 820 | 1000 | 660 | 60 | 50 | 90 | 90 | 350 | 540 | 240 | 370 | 50 | 70 | 90 | 100 |
| EP132 | 2-Fluorobiphenyl | % | 10 | 96.4 | -- | 54.5 | 79.8 | 60 | 78.6 | 55.2 | 86.5 | 78.4 | 59.3 | 91.3 | 57.9 | 79.2 | 59.9 | 73.1 | 60.3 | 81.5 |
| EP132 | Anthracene-d10 | % | 10 | 96.7 | -- | 57.8 | 78.7 | 67.6 | 76.5 | 55.4 | 87.1 | 79.2 | 67.5 | 94.2 | 63.4 | 79 | 66.7 | 72.9 | 67.6 | 81.8 |
| EP132 | 4-Terphenyl-d14 | % | 10 | 112 | -- | 66.4 | 85.6 | 65.9 | 81.4 | 56.7 | 90.5 | 93.5 | 69.2 | 109 | 61.7 | 86.9 | 64.7 | 74.6 | 66.4 | 79.6 |

**Polycyclic Aromatic Hydrocarbon Results for Hawkesbury River Sediments (in µg/kg dry wt.)**

| Sample ID | H7 | H7 | | H8 | H8 | | H9 | H9 | | H10 | H10 | | H17 | H17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 |
| 2-Methylnaphthalene | 70 | 20 | 111 | <10 | 20 | - | 70 | 20 | 111 | 40 | 20 | 67 | 50 | 10 |
| Acenaphthene | <10 | <10 | - | <10 | <10 | - | <10 | <10 | - | <10 | <10 | - | <10 | <10 |
| Acenaphthylene | <10 | 10 | - | 10 | 20 | 67 | 10 | 30 | 100 | 20 | 20 | 0 | 20 | 20 |
| Anthracene | 10 | 10 | 0 | <10 | 20 | - | 20 | 20 | 0 | 20 | 20 | 0 | 20 | 20 |
| Benz(a)anthracene | 50 | 70 | 33 | 30 | 70 | 80 | 40 | 70 | 55 | 50 | 60 | 18 | 110 | 140 |
| Benzo(a)pyrene | 70 | 90 | 25 | 50 | 100 | 67 | 50 | 100 | 67 | 70 | 90 | 25 | 140 | 180 |
| Benzo(b)fluoranthene | 60 | 110 | 59 | 50 | 120 | 82 | 60 | 130 | 74 | 80 | 120 | 40 | 150 | 250 |
| Benzo(e)pyrene | 50 | 60 | 18 | 40 | 70 | 55 | 40 | 80 | 67 | 60 | 70 | 15 | 100 | 120 |
| Benzo(g.h.i)perylene | 60 | 50 | 18 | 50 | 40 | 22 | 50 | 40 | 22 | 70 | 40 | 55 | 110 | 50 |
| Benzo(k)fluoranthene | 60 | 70 | 15 | 40 | 80 | 67 | 40 | 100 | 86 | 50 | 90 | 57 | 130 | 130 |
| Chrysene | 60 | 80 | 29 | 40 | 80 | 67 | 50 | 80 | 46 | 70 | 80 | 13 | 150 | 160 |
| Coronene | 10 | <10 | - | 10 | <10 | - | 20 | <10 | - | 20 | <10 | - | 30 | <10 |
| Dibenz(a.h)anthracene | 10 | 20 | 67 | <10 | 10 | - | <10 | <10 | - | <10 | <10 | - | 20 | 20 |
| Fluoranthene | 90 | 130 | 36 | 70 | 140 | 67 | 70 | 160 | 78 | 110 | 140 | 24 | 240 | 280 |
| Fluorene | 10 | <10 | - | <10 | <10 | - | 10 | <10 | - | <10 | <10 | - | 10 | <10 |
| Indeno(1.2.3.cd)pyrene | 50 | 40 | 22 | 40 | 30 | 29 | 30 | 30 | 0 | 40 | 30 | 29 | 90 | 50 |
| Naphthalene | 70 | 20 | 111 | <10 | 20 | - | 70 | 20 | 111 | 40 | 20 | 67 | 50 | 20 |
| Perylene | 30 | 60 | 67 | 20 | 60 | 100 | 20 | 60 | 100 | 30 | 40 | 29 | 60 | 90 |
| Phenanthrene | 50 | 40 | 22 | 30 | 50 | 50 | 50 | 50 | 0 | 50 | 50 | 0 | 80 | 70 |
| Pyrene | 100 | 140 | 33 | 70 | 160 | 78 | 80 | 170 | 72 | 110 | 140 | 24 | 220 | 260 |
| **% Recovery of Surrogates** | | | | | | | | | | | | | | |
| 2-Fluorobiphenyl | 62.9 | 98.6 | | 49.8 | 94.7 | | 55.2 | 92.8 | | 64.7 | 76.4 | | 65.0 | 86.6 |
| Anthracene-d10 | 67.7 | 101.0 | | 67.3 | 96.7 | | 66.8 | 95.7 | | 72.4 | 75.0 | | 72.6 | 87.5 |
| 4-Terphenyl-d14 | 63.7 | 103.0 | | 61.8 | 103.0 | | 63.5 | 110.0 | | 72.3 | 76.7 | | 72.4 | 92.4 |

The following compounds were not detected in any samples: 3-methylcholanthrene (<10 µg/kg), 7,12-dimethylbenz(a)anthracene (<10 µg/kg), N-2-Fluorenyl Acetamide (<100 µg/kg)
Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
RPD = Relative Percent Difference

Field Duplicate Results for PAHs (in µg/kg dry wt.)

| Sample ID | H9 | QC4 | | H9 | QC4 | | H31 | QC3 | | H31 | QC3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Analysis 1 | Analysis 1 | %RPD | Analysis 2 | Analysis 2 | %RPD | Analysis 1 | Analysis 1 | %RPD | Analysis 2 | Analysis 2 | %RPD |
| 2-Methylnaphthalene | 70 | 40 | 55 | 20 | 20 | 0 | 40 | 40 | 0 | 10 | <10 | - |
| Acenaphthene | <10 | <10 | - | <10 | <10 | - | <10 | <10 | - | <10 | <10 | - |
| Acenaphthylene | 10 | 20 | 67 | 30 | 20 | 40 | <10 | <10 | - | 10 | <10 | - |
| Anthracene | 20 | 10 | 67 | 20 | 20 | 0 | <10 | <10 | - | <10 | <10 | - |
| Benz(a)anthracene | 40 | 40 | 0 | 70 | 50 | 33 | 20 | 20 | 0 | 40 | 30 | 29 |
| Benzo(a)pyrene | 50 | 60 | 18 | 100 | 60 | 50 | 30 | 30 | 0 | 50 | 40 | 22 |
| Benzo(b)fluoranthene | 60 | 70 | 15 | 130 | 80 | 48 | 30 | 40 | 29 | 60 | 50 | 18 |
| Benzo(e)pyrene | 40 | 50 | 22 | 80 | 50 | 46 | 20 | 30 | 40 | 40 | 30 | 29 |
| Benzo(g.h.i)perylene | 50 | 50 | 0 | 40 | 50 | 22 | 20 | 30 | 40 | 40 | 30 | 29 |
| Benzo(k)fluoranthene | 40 | 50 | 22 | 100 | 30 | 108 | 30 | 30 | 0 | 30 | 20 | 40 |
| Chrysene | 50 | 60 | 18 | 80 | 60 | 29 | 30 | 30 | 0 | 40 | 40 | 0 |
| Coronene | 20 | 20 | 0 | <10 | 20 | - | <10 | <10 | - | 10 | 10 | 0 |
| Dibenz(a.h)anthracene | <10 | <10 | - | <10 | 10 | - | <10 | <10 | - | <10 | <10 | - |
| Fluoranthene | 70 | 80 | 13 | 160 | 100 | 46 | 40 | 50 | 22 | 80 | 60 | 29 |
| Fluorene | 10 | <10 | - | <10 | <10 | - | <10 | <10 | - | <10 | <10 | - |
| Indeno(1.2.3.cd)pyrene | 30 | 40 | 29 | 30 | 40 | 29 | 20 | 20 | 0 | 30 | 20 | 40 |
| Naphthalene | 70 | 40 | 55 | 20 | 20 | 0 | 40 | 40 | 0 | 20 | 10 | 67 |
| Perylene | 20 | 30 | 40 | 60 | 40 | 40 | 20 | 20 | 0 | 40 | 30 | 29 |
| Phenanthrene | 50 | 40 | 22 | 50 | 40 | 22 | 30 | 30 | 0 | 30 | 30 | 0 |
| Pyrene | 80 | 90 | 12 | 170 | 100 | 52 | 50 | 50 | 0 | 90 | 70 | 25 |
| **% Recovery of Surrogates** | | | | | | | | | | | | |
| 2-Fluorobiphenyl | 55.2 | 60.3 | | 92.8 | 81.5 | | 55.2 | 59.9 | | 86.5 | 73.1 | |
| Anthracene-d10 | 66.8 | 67.6 | | 95.7 | 81.8 | | 55.4 | 66.7 | | 87.1 | 72.9 | |
| 4-Terphenyl-d14 | 63.5 | 66.4 | | 110 | 79.6 | | 56.7 | 64.7 | | 90.5 | 74.6 | |

The following compounds were not detected in any samples: 3-methylcholanthrene (<10 µg/kg), 7,12-dimethylbenz(a)anthracene (<10 µg/kg), N-2-Fluorenyl Acetamide (<100 µg/kg)
Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
RPD = Relative Percent Difference

Laboratory Duplicate Results for PAHs (in µg/kg dry wt.)

| Sample ID | H7 | H7 Dup | | H25 | H25 Dup | | H18 | H18 Dup | | H31 | H31 Dup | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Analysis 1 | Analysis 1 | %RPD | Analysis 1 | Analysis 1 | %RPD | Analysis 2 | Analysis 2 | %RPD | Analysis 2 | Analysis 2 | %RPD |
| 2-Methylnaphthalene | 70 | 70 | 0 | 30 | 20 | 40 | 20 | 10 | 67 | 10 | 20 | 67 |
| Acenaphthene | <10 | <10 | - | <10 | <10 | - | 30 | <10 | - | <10 | <10 | - |
| Acenaphthylene | <10 | 10 | - | <10 | <10 | - | 60 | 40 | 40 | 10 | <10 | - |
| Anthracene | 10 | 20 | 67 | <10 | <10 | - | 70 | 30 | 80 | <10 | 10 | - |
| Benz(a)anthracene | 50 | 50 | 0 | 20 | 10 | 67 | 600 | 220 | 93 | 40 | 30 | 29 |
| Benzo(a)pyrene | 70 | 70 | 0 | 20 | 10 | 67 | 630 | 420 | 40 | 50 | 40 | 22 |
| Benzo(b)fluoranthene | 60 | 70 | 15 | 20 | 10 | 67 | 760 | 480 | 45 | 60 | 50 | 18 |
| Benzo(e)pyrene | 50 | 50 | 0 | 10 | 10 | 0 | 440 | 300 | 38 | 40 | 30 | 29 |
| Benzo(g.h.i)perylene | 60 | 60 | 0 | 20 | 10 | 67 | 430 | 320 | 29 | 40 | 30 | 29 |
| Benzo(k)fluoranthene | 60 | 50 | 18 | 10 | 10 | 0 | 310 | 170 | 58 | 30 | 30 | 0 |
| Chrysene | 60 | 60 | 0 | 20 | 10 | 67 | 610 | 380 | 46 | 40 | 40 | 0 |
| Coronene | 10 | 10 | 0 | <10 | <10 | - | 20 | 20 | 0 | 10 | 10 | 0 |
| Dibenz(a.h)anthracene | 10 | 10 | 0 | <10 | <10 | - | 50 | 40 | 22 | <10 | <10 | - |
| Fluoranthene | 90 | 100 | 11 | 50 | 30 | 50 | 1080 | 580 | 60 | 80 | 70 | 13 |
| Fluorene | 10 | 10 | 0 | <10 | <10 | - | 40 | 10 | 120 | <10 | <10 | - |
| Indeno(1.2.3.cd)pyrene | 50 | 40 | 22 | 10 | <10 | - | 430 | 300 | 36 | 30 | 30 | 0 |
| Naphthalene | 70 | 70 | 0 | 30 | 20 | 40 | 30 | 20 | 40 | 20 | 20 | 0 |
| Perylene | 30 | 30 | 0 | <10 | <10 | - | 150 | 100 | 40 | 40 | 20 | 67 |
| Phenanthrene | 50 | 50 | 0 | 40 | 20 | 67 | 210 | 80 | 90 | 30 | 40 | 29 |
| Pyrene | 100 | 100 | 0 | 40 | 30 | 29 | 990 | 590 | 51 | 90 | 90 | 0 |
| **% Recovery of Surrogates** | | | | | | | | | | | | |
| 2-Fluorobiphenyl | 62.9 | 60.8 | | 60.0 | 58.3 | | 99.8 | 83.5 | | 86.5 | 78.4 | |
| Anthracene-d10 | 67.7 | 68.0 | | 67.2 | 64.3 | | 99.6 | 83.6 | | 87.1 | 79.2 | |
| 4-Terphenyl-d14 | 63.7 | 63.8 | | 64.0 | 64.5 | | 106 | 85.2 | | 90.5 | 93.5 | |

The following compounds were not detected in any samples: 3-methylcholanthrene (<10 µg/kg), 7,12-dimethylbenz(a)anthracene (<10 µg/kg), N-2-Fluorenyl Acetamide (<100 µg/kg)
Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
RPD = Relative Percent Difference

Laboratory Blank, Laboratory Control Spike (LCS) and Matrix Spike (MS) Results for PAHs

| Sample ID | Blank | LCS | MS (H7) | Blank | LCS | MS(H18) |
|---|---|---|---|---|---|---|
| | µg/kg | %recovery | %recovery | µg/kg | %recovery | %recovery |
| | Analysis 1 | Analysis 1 | Analysis 1 | Analysis 2 | Analysis 2 | Analysis 2 |
| 2-Methylnaphthalene | <10 | 86.2 | 61.6 | <10 | 86.5 | 79.7 |
| Acenaphthene | <10 | 92.4 | 78.3 | <10 | 94.0 | 50.6 |
| Acenaphthylene | <10 | 89.8 | 77.1 | <10 | 88.7 | 56.9 |
| Anthracene | <10 | 88.2 | 83.4 | <10 | 81.9 | 27.4 |
| Benz(a)anthracene | <10 | 87.5 | 66.9 | <10 | 88.2 | ND |
| Benzo(a)pyrene | <10 | 86.2 | 71.6 | <10 | 84.3 | ND |
| Benzo(b)fluoranthene | <10 | 91.2 | 71.5 | <10 | 93.7 | ND |
| Benzo(e)pyrene | <10 | 88.4 | 68.6 | <10 | 93.2 | ND |
| Benzo(g.h.i)perylene | <10 | 93.3 | 74.2 | <10 | 92.2 | ND |
| Benzo(k)fluoranthene | <10 | 98.1 | 71.4 | <10 | 86.9 | ND |
| Chrysene | <10 | 88.0 | 68.5 | <10 | 89.8 | ND |
| Coronene | <10 | 100.0 | 81.3 | <10 | 90.2 | 81.3 |
| Dibenz(a.h)anthracene | <10 | 94.1 | 78.1 | <10 | 92.7 | 60.6 |
| Fluoranthene | <10 | 96.2 | 73.0 | <10 | 89.1 | ND |
| Fluorene | <10 | 93.8 | 77.4 | <10 | 91.9 | 44.8 |
| Indeno(1.2.3.cd)pyrene | <10 | 93.4 | 74.8 | <10 | 95.2 | ND |
| Naphthalene | <10 | 91.1 | 65.5 | <10 | 84.3 | 80.0 |
| Perylene | <10 | 84.8 | 70.9 | <10 | 85.6 | ND |
| Phenanthrene | <10 | 95.5 | 80.5 | <10 | 88.0 | ND |
| Pyrene | <10 | 98.4 | 72.4 | <10 | 88.1 | ND |
| **% Recovery of Surrogates** | | | | | | |
| 2-Fluorobiphenyl | 84.5 | 79.4 | 68.7 | 74.0 | 87.5 | 86.1 |
| Anthracene-d10 | 111 | 91.9 | 75.7 | 72.4 | 89.8 | 72.2 |
| 4-Terphenyl-d14 | 114 | 98.4 | 70.0 | 83.3 | 95.4 | 73.4 |

Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.

|  | H18 | H18 |  | H21 | H21 |  | H22 | H22 |  | H23 | H23 |  | H24 | H24 |  | H25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 |
| 133 | 50 | 20 | 86 | 50 | 30 | 50 | <10 | 20 | - | 70 | 10 | 150 | 50 | 10 | 133 | 30 |
| - | <10 | 30 | - | <10 | 10 | - | <10 | <10 | - | <10 | <10 | - | <10 | <10 | - | <10 |
| 0 | 30 | 60 | 67 | 50 | 60 | 18 | 20 | 40 | 67 | 20 | 20 | 0 | 10 | 10 | 0 | <10 |
| 0 | 20 | 70 | 111 | 50 | 60 | 18 | 20 | 40 | 67 | 20 | 20 | 0 | 10 | 10 | 0 | <10 |
| 24 | 140 | 600 | 124 | 110 | 160 | 37 | 70 | 130 | 60 | 40 | 50 | 22 | 30 | 30 | 0 | 20 |
| 25 | 190 | 630 | 107 | 160 | 250 | 44 | 110 | 200 | 58 | 60 | 90 | 40 | 50 | 50 | 0 | 20 |
| 50 | 210 | 760 | 113 | 160 | 310 | 64 | 90 | 250 | 94 | 60 | 100 | 50 | 50 | 60 | 18 | 20 |
| 18 | 140 | 440 | 103 | 120 | 180 | 40 | 70 | 140 | 67 | 50 | 60 | 18 | 40 | 40 | 0 | 10 |
| 75 | 160 | 430 | 92 | 120 | 90 | 29 | 80 | 70 | 13 | 50 | 70 | 33 | 40 | 40 | 0 | 20 |
| 0 | 160 | 310 | 64 | 150 | 200 | 29 | 100 | 160 | 46 | 60 | 60 | 0 | 40 | 40 | 0 | 10 |
| 6 | 170 | 610 | 113 | 150 | 200 | 29 | 90 | 210 | 80 | 50 | 60 | 18 | 40 | 40 | 0 | 20 |
| - | 40 | 20 | 67 | 40 | 20 | 67 | 30 | 20 | 40 | 20 | 20 | 0 | 10 | 20 | 67 | <10 |
| 0 | 30 | 50 | 50 | 30 | 30 | 0 | 10 | 20 | 67 | 10 | 10 | 0 | <10 | <10 | - | <10 |
| 15 | 260 | 1080 | 122 | 250 | 410 | 48 | 160 | 320 | 67 | 90 | 130 | 36 | 60 | 70 | 15 | 50 |
| - | 10 | 40 | 120 | 10 | 20 | 67 | <10 | 10 | - | 10 | <10 | - | <10 | <10 | - | <10 |
| 57 | 120 | 430 | 113 | 90 | 70 | 25 | 60 | 60 | 0 | 40 | 60 | 40 | 30 | 40 | 29 | 10 |
| 86 | 50 | 30 | 50 | 50 | 40 | 22 | <10 | 30 | - | 70 | 20 | 111 | 50 | 20 | 86 | 30 |
| 40 | 60 | 150 | 86 | 50 | 60 | 18 | 30 | 60 | 67 | 20 | 40 | 67 | 20 | 30 | 40 | <10 |
| 13 | 70 | 210 | 100 | 110 | 150 | 31 | 60 | 110 | 59 | 50 | 40 | 22 | 40 | 40 | 0 | 40 |
| 17 | 260 | 990 | 117 | 260 | 420 | 47 | 160 | 320 | 67 | 100 | 140 | 33 | 70 | 80 | 13 | 40 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 53.9 | 99.8 |  | 54.8 | 91.3 |  | 50.0 | 80.2 |  | 57.5 | 71.0 |  | 71.3 | 82.6 |  | 60.0 |
|  | 67.0 | 99.6 |  | 62.4 | 88.2 |  | 62.0 | 80.3 |  | 68.0 | 73.4 |  | 81.5 | 84.8 |  | 67.2 |
|  | 63.2 | 106.0 |  | 54.3 | 104.0 |  | 60.1 | 86.7 |  | 62.8 | 87.3 |  | 75.4 | 91.1 |  | 64.0 |

| H25 | | H26 | H26 | | H28 | H28 | | H31 | H31 | | H37 | H37 | | H38 | H38 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD | Analysis 1 | Analysis 2 | %RPD |
| <10 | - | 30 | <10 | - | 30 | <10 | - | 40 | 10 | 120 | 50 | 20 | 86 | 50 | 10 | 133 |
| <10 | - | 20 | 10 | 67 | 20 | <10 | - | <10 | <10 | - | 10 | 10 | 0 | <10 | <10 | - |
| <10 | - | 20 | 20 | 0 | 20 | <10 | - | <10 | 10 | - | 40 | 50 | 22 | 30 | 30 | 0 |
| <10 | - | 80 | 60 | 29 | 60 | <10 | - | <10 | <10 | - | 40 | 60 | 40 | 20 | 30 | 40 |
| 20 | 0 | 370 | 480 | 26 | 320 | 30 | 166 | 20 | 40 | 67 | 160 | 210 | 27 | 130 | 170 | 27 |
| 20 | 0 | 410 | 560 | 31 | 380 | 40 | 162 | 30 | 50 | 50 | 170 | 230 | 30 | 160 | 210 | 27 |
| 20 | 0 | 370 | 460 | 22 | 340 | 40 | 158 | 30 | 60 | 67 | 200 | 470 | 81 | 180 | 240 | 29 |
| 10 | 0 | 220 | 220 | 0 | 210 | 30 | 150 | 20 | 40 | 67 | 120 | 170 | 34 | 120 | 140 | 15 |
| 20 | 0 | 220 | 220 | 0 | 210 | 30 | 150 | 20 | 40 | 67 | 110 | 140 | 24 | 120 | 160 | 29 |
| 20 | 67 | 260 | 230 | 12 | 250 | 20 | 170 | 30 | 30 | 0 | 130 | 160 | 21 | 140 | 150 | 7 |
| 20 | 0 | 360 | 460 | 24 | 310 | 30 | 165 | 30 | 40 | 29 | 190 | 450 | 81 | 150 | 200 | 29 |
| <10 | - | 50 | 50 | 0 | 50 | <10 | - | <10 | 10 | - | 30 | 40 | 29 | 40 | 50 | 22 |
| <10 | - | 50 | 50 | 0 | 60 | <10 | - | <10 | <10 | - | 20 | 40 | 67 | 30 | 40 | 29 |
| 50 | 0 | 750 | 930 | 21 | 590 | 50 | 169 | 40 | 80 | 67 | 370 | 520 | 34 | 240 | 380 | 45 |
| <10 | - | 20 | 10 | 67 | 10 | <10 | - | <10 | <10 | - | 20 | 20 | 0 | 10 | 10 | 0 |
| 10 | 0 | 180 | 210 | 15 | 170 | 20 | 158 | 20 | 30 | 40 | 90 | 110 | 20 | 90 | 120 | 29 |
| 10 | 100 | 30 | 20 | 40 | 30 | 10 | 100 | 40 | 20 | 67 | 60 | 30 | 67 | 50 | 20 | 86 |
| 10 | - | 100 | 100 | 0 | 90 | 30 | 100 | 20 | 40 | 67 | 60 | 120 | 67 | 60 | 90 | 40 |
| 30 | 29 | 270 | 200 | 30 | 180 | 20 | 160 | 30 | 30 | 0 | 100 | 130 | 26 | 70 | 90 | 25 |
| 50 | 22 | 820 | 1000 | 20 | 660 | 60 | 167 | 50 | 90 | 57 | 350 | 540 | 43 | 240 | 370 | 43 |
| | | | | | | | | | | | | | | | | |
| 96.4 | | 54.5 | 79.8 | | 60.0 | 78.6 | | 55.2 | 86.5 | | 59.3 | 91.3 | | 57.9 | 79.2 | |
| 96.7 | | 57.8 | 78.7 | | 67.6 | 76.5 | | 55.4 | 87.1 | | 67.5 | 94.2 | | 63.4 | 79.0 | |
| 112.0 | | 66.4 | 85.6 | | 65.9 | 81.4 | | 56.7 | 90.5 | | 69.2 | 109.0 | | 61.7 | 86.9 | |

## Organochlorine Pesticide Results for Hawkesbury River Sediments

|  | DDE (µg/kg dry wt.) |  |  |  | Surrogate % recovery (dibromo-DDE) |  |
|---|---|---|---|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 | % RPD |  | Analysis 1 | Analysis 2 |
| H7 | <0.5 | <0.5 |  |  | 25.3 | 17.8 |
| H8 | **0.66** | <0.5 |  |  | 35.1 | 16.4 |
| H9 | **1.12** | **1.47** | 27 |  | 45.6 | 22.3 |
| H10 | **0.53** | **1.30** | 84 |  | 18.3 | 21.3 |
| H17 | <0.5 | **0.94** | - |  | 24.4 | 72.1 |
| H18 | <0.5 | **1.03** | **-** |  | 41.7 | 61.1 |
| H21 | **1.04** | **1.37** | 27 |  | 28.1 | 13.6 |
| H22 | <0.5 | <0.5 |  |  | 47.2 | 12.2 |
| H23 | <0.5 | <0.5 |  |  | nd | 17.5 |
| H24 | <0.5 | <0.5 |  |  | 15.5 | 21.1 |
| H25 | <0.5 | <0.5 |  |  | 64.9 | 64.7 |
| H26 | <0.5 | **0.84** | **-** |  | 57.6 | 22.9 |
| H28 | <0.5 | **1.61** | **-** |  | 24.4 | 79.1 |
| H31 | <0.5 | <0.5 |  |  | 41.6 | 63.6 |
| H37 | <0.5 | <0.5 |  |  | 61.1 | 19.8 |
| H38 | <0.5 | **0.95** | **-** |  | 30.2 | 49.1 |

### Organochlorine Pesticide Field Duplicate Results

|  | DDE (µg/kg dry wt.) |  |  |  | Surrogate % recovery (dibromo-DDE) |  |
|---|---|---|---|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 | % RPD |  | Analysis 1 | Analysis 2 |
| H9 | **1.12** | **1.47** | 27 |  | 45.6 | 22.3 |
| QC4 | **1.33** | **0.96** | 32 |  | 56.1 | 68.6 |
| % RPD | 17 | 42 |  |  |  |  |
|  |  |  |  |  |  |  |
| H31 | <0.5 | <0.5 |  |  | 41.6 | 63.6 |
| QC3 | <0.5 | <0.5 |  |  | 42.4 | 59.5 |

### Organochlorine Pesticide Laboratory Duplicate Results

|  | DDE (µg/kg dry wt.) |  |  |  | Surrogate % recovery (dibromo-DDE) |  |
|---|---|---|---|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 |  |  | Analysis 1 | Analysis 2 |
| H7 | <0.5 | **-** |  |  | 25.3 | **-** |
| H7 Dup | <0.5 | **-** |  |  |  | **-** |
|  |  |  |  |  |  |  |
| H25 | <0.5 | <0.5 |  |  | 64.9 | 64.9 |
| H25 Dup | <0.5 | <0.5 |  |  |  | 64.7 |
|  |  |  |  |  |  |  |
| H17 | **-** | **0.94** |  |  | **-** | 72.1 |
| H17 Dup | **-** | **1.02** |  |  | **-** | 77.0 |
| % RPD |  | 8 |  |  |  |  |

Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
nd = not determined
RPD = Relative Percent Difference

No other OC pesticides were detected in any samples, with the exception that 6.62 µg/kg of p,p-DDT was detected in sample H9 in the second analysis.

Laboratory Blank, Laboratory Control Spike (LCS) and Matrix Spike (MS) Results for Organochlorine Pesticides

| | Blank | LCS | MS (for H7) | | Blank | LCS | MS (for H25) |
|---|---|---|---|---|---|---|---|
| | µg/kg | % recovery | % recovery | | µg/kg | % recovery | % recovery |
| Analyte | Analysis 1 | Analysis 1 | Analysis 1 | | Analysis 2 | Analysis 2 | Analysis 2 |
| Aldrin | < 0.5 | 72.6 | 16.0 | | < 0.5 | 79.7 | 52.6 |
| alpha-BHC | < 0.5 | 69.0 | 34.5 | | < 0.5 | 77.5 | 42.4 |
| beta-BHC | < 0.5 | 97.0 | 33.8 | | < 0.5 | 85.9 | 51.6 |
| delta-BHC | < 0.5 | 69.9 | 37.1 | | < 0.5 | 84.8 | 43.3 |
| 4.4'-DDD | < 0.5 | 80.8 | 63.4 | | < 0.5 | 118 | 92.5 |
| 4.4'-DDE | < 0.5 | 70.3 | 52.9 | | < 0.5 | 79.0 | 47.0 |
| 4.4'-DDT | < 0.5 | 75.6 | 74.6 | | < 0.5 | 88.1 | 56.8 |
| DDT (total) | < 0.5 | -- | -- | | < 0.5 | -- | -- |
| Dieldrin | < 0.5 | 90.3 | 31.1 | | < 0.5 | 104 | 61.2 |
| alpha-Endosulfan | < 0.5 | 74.3 | 48.7 | | < 0.5 | 89.7 | 48.3 |
| beta-Endosulfan | < 0.5 | 68.9 | 52.3 | | < 0.5 | 113 | 38.4 |
| Endosulfan sulfate | < 0.5 | 76.5 | 112 | | < 0.5 | 92.0 | 74.6 |
| Endosulfan | < 0.5 | -- | -- | | < 0.5 | -- | -- |
| Endrin | < 0.5 | 78.1 | 55.4 | | < 0.5 | 91.9 | 96.0 |
| Endrin aldehyde | < 0.5 | 73.8 | 21.3 | | < 0.5 | 83.4 | 35.8 |
| Endrin ketone | < 0.5 | 87.6 | 36.2 | | < 0.5 | 104 | 45.8 |
| Heptachlor | < 0.5 | 83.7 | 18.7 | | < 0.5 | 121 | 106 |
| Heptachlor epoxide | < 0.5 | 81.8 | 31.4 | | < 0.5 | 94.8 | 52.4 |
| Hexachlorobenzene | < 0.5 | 63.6 | 32.2 | | < 0.5 | 85.0 | 43.9 |
| gamma-BHC | < 0.5 | 80.6 | 37.6 | | < 0.5 | 80.0 | 53.1 |
| Methoxychlor | < 0.5 | 71.8 | 19.0 | | < 0.5 | 94.6 | 75.8 |
| cis-Chlordane | < 0.5 | 74.4 | 25.8 | | < 0.5 | 85.2 | 39.0 |
| trans-Chlordane | < 0.5 | 63.8 | 32.9 | | < 0.5 | 106 | 51.8 |
| Total Chlordane | < 0.5 | -- | -- | | < 0.5 | -- | -- |
| **% Recovery of dibromo-DDE surrogate** | 73.8 | 70.0 | 40.8 | | 111 | 119 | 87.4 |

## Polychlorinated biphenyl Results for Hawkesbury River Sediments

| | Total PCB (µg/kg dry wt.) | | Surrogate % recovery (decachlorobiphenyl) | |
|---|---|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 | Analysis 1 | Analysis 2 |
| H7 | <5 | <5 | 26.6 | 15.4 |
| H8 | <5 | <5 | 39.9 | 13.6 |
| H9 | <5 | <5 | 47.9 | 25.5 |
| H10 | <5 | <5 | 21.9 | 14.0 |
| H17 | <5 | <5 | 23.5 | 48.1 |
| H18 | <5 | <5 | 51.6 | 57.4 |
| H21 | **13.9** | <5 | 25.9 | 12.0 |
| H22 | <5 | <5 | 55.5 | 8.8 |
| H23 | <5 | <5 | nd | 10.1 |
| H24 | <5 | <5 | 19.2 | 13.5 |
| H25 | <5 | <5 | 61.0 | 59.0 |
| H26 | <5 | <5 | 82.6 | 30.6 |
| H28 | **16** | <5 | 24.5 | 83.5 |
| H31 | <5 | <5 | 43.7 | 57.4 |
| H37 | <5 | <5 | 64.1 | 16.5 |
| H38 | <5 | <5 | 37.1 | 67.7 |

Field Duplicate Results

| | Total PCB (µg/kg dry wt.) | | Surrogate % recovery (decachlorobiphenyl) | |
|---|---|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 | Analysis 1 | Analysis 2 |
| H9 | <5 | <5 | 47.9 | 25.5 |
| QC4 | <5 | <5 | 56.8 | 4.3 |
| | | | | |
| H31 | <5 | <5 | 43.7 | 57.4 |
| QC3 | <5 | <5 | 47.0 | 37.2 |

Laboratory Duplicate Results

| | Total PCB (µg/kg dry wt.) | | Surrogate % recovery (decachlorobiphenyl) | |
|---|---|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 | Analysis 1 | Analysis 2 |
| H7 | <5 | | 26.6 | |
| H7 Dup | <5 | | | |
| | | | | |
| H25 | <5 | | 61.0 | |
| H25 Dup | <5 | | | |
| | | | | |
| H17 | | <5 | | 48.1 |
| H17 Dup | | <5 | | 67.0 |

Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
nd = not determined

PCB detected consisted entirely of Aroclor 1254

Laboratory Blank, Laboratory Control Spike (LCS) and Matrix Spike (MS) Results for Polychlorinated biphenyls

| | Blank | LCS | MS (for H7) | Blank | LCS | MS (for H25) |
|---|---|---|---|---|---|---|
| | µg/kg | % recovery | % recovery | µg/kg | % recovery | % recovery |
| Analyte | Analysis 1 | Analysis 1 | Analysis 1 | Analysis 2 | Analysis 2 | Analysis 2 |
| Total PCB | < 5 | 95.4 | 36.0 | < 5 | 85.9 | 58.6 |
| Aroclor 1016 | < 5 | -- | -- | < 5 | -- | -- |
| Aroclor 1221 | < 5 | -- | -- | < 5 | -- | -- |
| Aroclor 1232 | < 5 | -- | -- | < 5 | -- | -- |
| Aroclor 1242 | < 5 | -- | -- | < 5 | -- | -- |
| Aroclor 1248 | < 5 | -- | -- | < 5 | -- | -- |
| Aroclor 1254 | < 5 | 95.4 | 36.0 | < 5 | 85.9 | 58.6 |
| Aroclor 1260 | < 5 | -- | -- | < 5 | -- | -- |
| **% Recovery of Decachloro-biphenyl surrogate** | 75.3 | 94.0 | 36.0 | 90.8 | 81.8 | 68.7 |

Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.

## Organophosphorus Pesticide Surrogate Recovery Results for Hawkesbury River Sediments

| | Surrogate % recovery (DEF) | |
|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 |
| H7 | 21.8 | 26.8 |
| H8 | 32.4 | 18.7 |
| H9 | 30 | 14.6 |
| H10 | nd | 22.6 |
| H17 | 34.9 | 32.5 |
| H18 | 32.2 | 37.8 |
| H21 | nd | 16.6 |
| H22 | 29.4 | 26.7 |
| H23 | nd | 33.2 |
| H24 | 28.3 | 34.6 |
| H25 | 41.4 | 49.8 |
| H26 | 22.6 | 15.7 |
| H28 | nd | 40.9 |
| H31 | 27.3 | 31.8 |
| H37 | 45.9 | 17.0 |
| H38 | 26.5 | 46.6 |

Field Duplicate Results

| | Surrogate % recovery (DEF) | |
|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 |
| H9 | 30 | 14.6 |
| QC4 | 38.2 | 30.2 |
| | | |
| H31 | 27.3 | 31.8 |
| QC3 | 37.7 | 27 |

Laboratory Duplicate Results

| | Surrogate % recovery (DEF) | |
|---|---|---|
| Sample ID | Analysis 1 | Analysis 2 |
| H7 | 21.8 | - |
| H7 Dup | | - |
| | | |
| H25 | 41.4 | 49.8 |
| H25 Dup | | 52.9 |
| | | |
| H17 | - | 32.5 |
| H17 Dup | - | 27.2 |

Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
nd = not determined

No OP pesticides were detected in any samples.

Laboratory Blank, Laboratory Control Spike (LCS) and Matrix Spike (MS) Results for Organophosphorus Pesticides

| | Blank<br>µg/kg | LCS<br>% recovery | MS (for H7)<br>% recovery | Blank<br>µg/kg | LCS<br>% recovery | MS (for H25)<br>% recovery |
|---|---|---|---|---|---|---|
| Analyte | Analysis 1 | Analysis 1 | Analysis 1 | Analysis 2 | Analysis 2 | Analysis 2 |
| Bromophos-ethyl | < 10 | 120 | 26.8 | < 10 | 75.3 | 56.5 |
| Carbophenothion | < 10 | 84.7 | 21.7 | < 10 | 93.2 | 90.2 |
| Chlorfenvinphos (E) | < 10 | 94.4 | nd | < 10 | 83.5 | ND |
| Chlorfenvinphos (Z) | < 10 | 110 | nd | < 10 | 80.4 | 35 |
| Chlorpyrifos | < 10 | 112 | 23.6 | < 10 | 81.5 | 46.2 |
| Chlorpyrifos-methyl | < 10 | 119 | 28.7 | < 10 | 94.2 | 41.7 |
| Demeton-S-methyl | < 10 | 120 | 35.4 | < 10 | 93.4 | 71.9 |
| Diazinon | < 10 | 114 | 38.6 | < 10 | 103 | 59.9 |
| Dichlorvos | < 10 | 116 | 43.8 | < 10 | 112 | 68.2 |
| Dimethoate | < 10 | 113 | 27.1 | < 10 | 94.3 | 41.1 |
| Ethion | < 10 | 91.5 | 24.3 | < 10 | 82.4 | 76.5 |
| Fenamiphos | < 10 | 87.2 | nd | < 10 | 93.4 | 87.6 |
| Fenthion | < 10 | 124 | 21.8 | < 10 | 79.5 | 41.8 |
| Malathion | < 10 | 114 | 25.8 | < 10 | 88.2 | 46.4 |
| Azinphos Methyl | < 10 | 35.3 | 22.4 | < 10 | 90.5 | 63.8 |
| Monocrotophos | < 10 | 74.9 | nd | < 10 | 71.5 | 59.8 |
| Parathion | < 10 | 116 | 27.6 | < 10 | 81.8 | 37.2 |
| Parathion-methyl | < 10 | 135 | 37.5 | < 10 | 95.4 | 43.5 |
| Pirimphos-ethyl | < 10 | 106 | 21.0 | < 10 | 81.6 | 32.1 |
| Prothiofos | < 10 | 102 | 27.9 | < 10 | 81.8 | 59.1 |
| **% Recovery of DEF surrogate** | 118 | 111 | 25.9 | 81.4 | 75.4 | 52.7 |

Samples were extracted as received in the first analysis.
Samples were air-dried prior to extraction in the second analysis.
nd = not determined

# Appendix H – Peer Review Report (Dr Stuart Simpson, CSIRO)

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June 8, 2007

Dr Carsten Matthai
URS Australia Pty Ltd
Level 3, 116 Miller Street
North Sydney, NSW 2060

Dear Carsten,

## Re: CSIRO Review of Q27/2006 Sediment and Antifoul Monitoring Program, Stage 2 - Antifoul Study

I offer the following comments on the Draft Report supplied by you on June 8. In general, there were some major analytical difficulties that limit the value of much of the data for organic contaminants (other than PAHs and TBT). The major outcome of the study is that the concentrations of contaminants of potential concern are low, except in the vicinity of the marinas. Improved management of marina practices, especially dry-docks for boat maintenance (paint removal and application), is therefore of great importance to limits future impacts. A review of regulations (especially those of the European Union and North America) on the use of anti-fouling paints would be useful and recommendations be made to limit use of substances for which there is now (after some years of use) evidence of ecological effects.

### Major points

1. The sampling plan and implementation appeared adequate.

2. There are some serious problems with the analyses of many of the organic contaminants undertaken for this assessment. Suitable analytical results are presented for PAHs. The analytical method validation-data (spike-recoveries etc) for TBT and the ‘organic boosters’ should be discussed in the report.

For the organic OCs/OPs/PCBs contaminants the following comments are made: (i) the 0% recoveries for analytes (matrix spike-recoveries etc) achieved by the analytical laboratory invalidates the use of this data in the assessment, (ii) the low recoveries for analytes (e.g. <75%), when achieved, result in great uncertainty in this data. As an “Assessor for NATA” I recognize that achieving recoveries of greater than 80% is not routinely feasible for analyses of many organic contaminants in sediments. However, in stating this, the sediments collected for this assessment were not unusual in nature and much better recoveries for OCs, OPs and PCBs would have been expected. The suitable recoveries in the method blanks and LCS (70-118%) do not validate the use of this data. Although not a common practice for analyses of organic contaminants, for other analytes the measured concentration is sometimes corrected for the %-recovery (i.e. as for analyses by standard additions, 0.5 µg/kg with 70% spike-recovery = 0.7 µg/kg reported concentration). If the spike-recoveries are only 10%, then the analyte concentration in the sample may have been 10 times greater than that reported.

3. Better management of the sample analyses could have been undertaken. The analytical laboratory should not have continued with the analyses of samples when the spike-recoveries did not meet the method specifications (and the method specifications should have been for recoveries >70%). A suitable approach for the laboratory (following observation of poor spike-recoveries) would have been to refine the test methods (including changing staff if required) or changing to a different analytical method (Noted: method refinement was made by the laboratory in attempt to achieve adequate recoveries). A suitable approach for the project management would be determining whether another qualified laboratory could achieve the QA/QC required. With both these options failing, analyses of the entire set of samples should not have proceeded, but perhaps a scaled-back set of samples could have been analysed (e.g. only those at the marina's where OC/OP/PCB concentrations may have been expected to be detectable).

**Recommendations Section**

1. The TBT concentrations were generally low and undertaking depth-coring of sediments to show the concentrations are lower deeper down would not appear to be good use of resources. The organisms being affected by TBT will live mostly in the surface sediments.
2. Analytical methods for these analyses must be improved before any further investigations of 'organic boosters' be considered. Any additional study of organic boosters should be limited to the marina's. It is more likely that the concentrations of TBT, heavy metals and the major organics cause toxicity to organisms near the marina's than 'organic boosters' that are currently not detectable.
3. The concentrations of mercury (Hg) were low. The ANZECC/ARMCANZ (2000) guidelines are 'trigger values', not effects thresholds, and exceeding a trigger value by a factor of 2-3 is not an immediate cause for concern.
4. The recommendation of monitoring of the proposed STP is useful.

**Specific Comments:**

1. Page 1-3. If possible, it would be useful to show the Hornsby Sewage Treatment Plant (STP) and the Calna Creek STP on the Figure 1 (map).

2. Page 2-4: The method for calculating percent-recovery of "Matrix Spikes" is not correct.

The formula should be:
Percent Recovery = (SX-X)/(S) × 100%
where,
SX = concentration measured for the spiked-sample
X = the concentration spiked into the sample (nominal spike concentration is often used for TBT)
S = the concentration measured for the sample (not spiked)

3. Page 2-6: A discussion of the data validation for TBT or 'organic boosters' would be useful (given the other analytical problems).

4. Page 2-6: The poor recoveries for organic contaminants (OCs/Ops/PCBs) invalidates the use of this data in the assessment

5. Page 3-3: "The analysis of the four organic booster biocide compounds diuron, … resulted in all analyte concentrations being reported below the analytical limit of reporting (<0.1 mg/kg) in all four samples. However, inspection of chromatograms revealed low concentrations of diuron in sediments at three of the four sampling locations, with concentrations of 0.009 mg/kg (H37), 0.01 mg/kg (H38), 0.03 mg/kg (H9), and 0.04 mg/kg (QC5 = H9). There was no visible chromatographic peak for diuron in the sediment from sampling location H31 (Refuge Bay) (<0.001 mg/kg)."

As the LOR is not useful, the detection limit (DL) must be quoted here, otherwise the 'low concentrations' being reported can be considered as analytical noise, rather than concentrations. Based on the results presented the DL was <0.001 mg diuron/kg, i.e. approximately 1/100th the LOR.

Please clarify.

6. Page 3-3: “Large bivalves shells and shell … were removed …” Was this down by hand-picking or sieving the sediments ?

7. Pages 4-1 – 4-2, “4.2 Potential Sources of TBT to Sediments”: The USEPA (2003) has undertaken a review on TBT that should be cited: “Ambient aquatic life water quality criteria for tributyltin (TBT)”. USEPA documents are free to download by the public and this document contains a very extensive review of effects. The USEPA review was very thorough. It has been proposed (by CSIRO) to the Department of Environment and Water Resources (DEW) that these guidelines be adopted for TBT in Australia.

8. Page 4-2: “TBT compounds tend to have medium range water solubility and tend to sorb to particulate matter and suspended solids.” The phrase ‘medium range’ does not mean much, so please provide the solubility of TBT (in g/kg).

9. Page 4-4: “The highest mean concentrations of TBT in sediments within the area investigated in the current Antifoul Study (Stage 2) were …” The ‘mean’ of what ? The mean of the study area ? If so, please define the study area. Should these study area’s should be shown on Figure 1?

According to “• Cowan Creek: 8 sampling locations; Concentrations vary from 1.4-125 µgSn/kg”, the TBT concentrations were much higher than these ‘means’. Is this correct ?

10. Page 4-4: “Upper Cowan Creek and Berowra Creek sediments display elevated concentrations of inorganic and organic contaminants, …” Providing the site numbers here would be useful to the reader (e.g. Upper Cowan Creek (sites H21) and Berowra Creek (H10) ?)

11. Page 4-4: “…TBT is chemically reactive and therefore mobile and bioavailable to aquatic organisms and fish …” How can TBT be both ‘chemically reactive’ (i.e. implies adsorbed strongly to sediments) and ‘therefore mobile and bioavailable’ ?

12. Page 4-5: “the concentrations of TBT in 2007 are substantially higher compared to the concentrations of TBT in sediments sampled in 1990-1991 (EPA, 1996).” I would not put too much emphasis on the past data for TBT analyses unless the differences are 1-2 orders of magnitude. Sediment-TBT heterogeneity is often high and there is always much uncertainty in TBT analyses.

13. Page 4-5: Given the low TBT concentrations in most of the surface sediments tested, further analyses to show TBT concentrations are low in deeper sediment is of little value.

14. Page 4-9: “At present, no reliable data on the solid phase-dissolved phase partitioning of booster biocides exists. It is therefore difficult to determine if the generally observed lower concentrations in waters in comparison with sediments have to do with the booster biocide compounds’ preference towards sorptive partitioning. Gough et al. (1994) have also observed even lower concentrations of Irgarol 1051 in sediments in the Humble Estuary, UK, suggesting that partitioning onto settled or suspended particulate matter may prove to be a critical process in determining the compounds fate in the aquatic environment.”

Octonol-water partition coefficient data probably exists with the producers of the products, else they would never have started using these chemicals. Like most organic chemicals, they are likely to be quite ‘hydrophobic’ and there partition strongly to sediments.

15. Page 4-10: “It should be noted that diuron is no longer approved for use in the UK as an active ingredient in antifouling paints, on any size of vessel, due to its demonstrated toxicity (Konstantinou and Albanis, 2002).”

Why was this decision made ? What other antifouling paints are being banned in countries around the world (e.g. by the European Union) ?

16. Page 4-10: “Diuron concentrations are greater than the concentrations of TBT in corresponding samples”. The concentration of TBT-Sn is reported in the current report, not TBT. Therefore the

Diuron-TBT comparison is not valid unless the 'TBT-Sn' concentration is converted to TBT (the compound), rather than TBT-Sn. The molecular weight of TBT = 2.44×TBT-Sn, so all concentration should be multiplied by this factor if the comparison is to be made. This applies to Figure 4 also.

Regards,

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## References

USEPA 2003a. Ambient aquatic life water quality criteria for tributyltin (TBT) – final. United States U.S. Environmental Protection Agency, Office of Water Report 4304T, EPA 822-R-03-031, Washington, DC, USA, 138 pp..