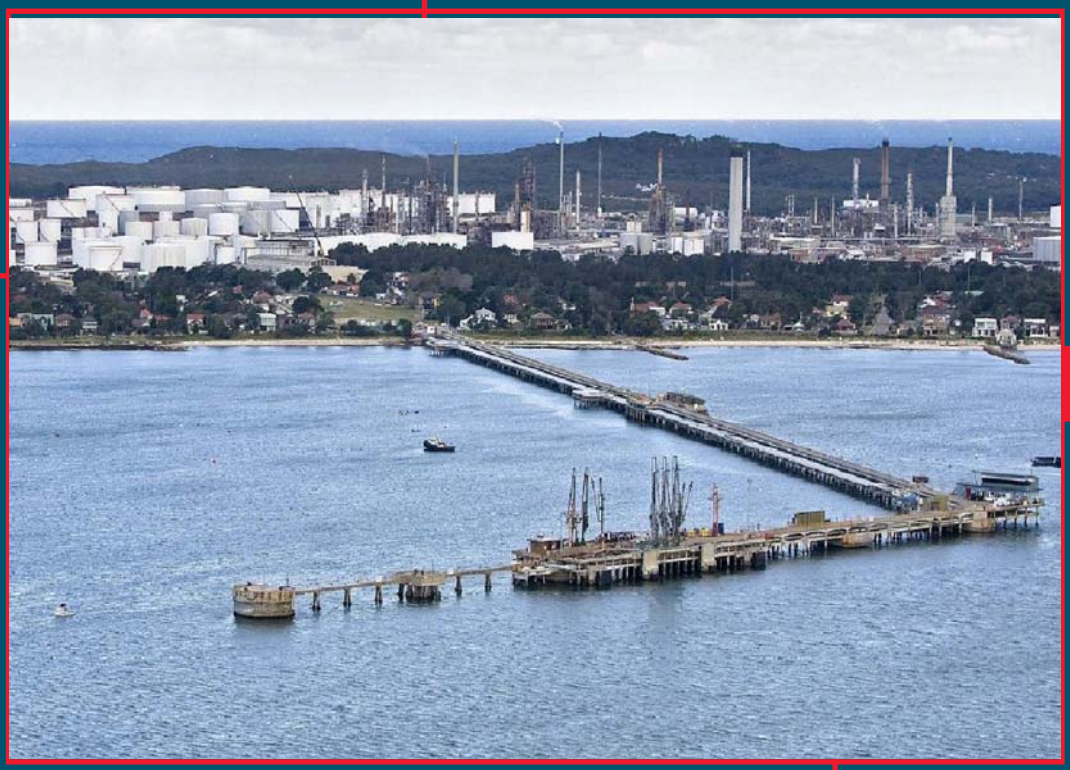
ENVIRONMENTAL IMPACT STATEMENT



VOLUME 2

Appendix D2

February 2013

Kurnell Ports and Berthing Facility

URS

CALTEX

WorleyParsons

resources & energy

EcoNomics

CALTEX REFINERIES NSW

Botany Bay, Sydney, NSW

Draft Supplementary Sediment Sampling and Analysis Plan Implementation Report (Caltex Berths 1 and 2 – Dredge Area 3)

301015-02851 – Draft Supplementary SAP Implementation Report_RevB3.docm

16 November 2012

Level 12, 141 Walker Street,
North Sydney NSW 2060
Australia
Telephone: +61 2 8923-6866
Facsimile: +61 2 8923-6877
www.worleyparsons.com
ABN 61 001 279 812

Disclaimer

This document has been prepared for the sole purpose of documenting our Supplementary Sediment Sampling and Analysis Plan Implementation Report

It is expected that this document and its contents will be treated in strict confidence by Caltex Refineries NSW.

PROJECT 301015-02448/07 - CALTEX DREDGING

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	CM	VS	LN	6 Sep 2012	n/a	
B3	Issued for client review	CM	BT	LN	16 Nov2012		
0	Final issued to client	CM	VS/BT	LN			

CONTENTS

****Please do not delete appendices below, it will not print****

Appendix 1 WorleyParsons (2012) Caltex Dredging - Sediment Sampling and Analysis Plan Implementation Report – Final Report. Prepared for Caltex Refineries NSW Pty Ltd, June 2012

Appendix 2 Botany Bay, Sydney, NSW - Supplementary Sampling and Analysis Plan (Caltex Berths 1 and 2 – Dredge Area 3) (August 2012)

Appendix 3 Core Logs

Appendix 4 Laboratory Results

Appendix 5 Dilution Modelling of Elutriate As and TBT at the Sydney Offshore Spoil Ground (Dredge Area 3 (Berths 1 and 2)

ACRONYMS USED IN THIS REPORT:

AAA	Advanced Analytical Australia
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CD	Chart Datum
DEWHA	Department of Environment, Water, Heritage and the Arts
DQO	Data Quality Objectives
SEWPAC	(Department of) Sustainability, Environment, Water, Populations and Communities
ISQG	Interim Sediment Quality Guidelines
IIWL	Indicative Interim Working Level
LOR	Limit of Reporting
MGA	Map Grid of Australia
NAGD	National Assessment Guidelines for Dredging
NODGM	National Ocean Disposal Guidelines for Dredged Material (superseded by the NAGD)
NATA	National Association of Testing Authorities
OCPs	Organochlorine Pesticides
OPPs	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PSD	Particle Size Distribution
QA/QC	Quality Assurance/ Quality Control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SPC	Sydney Ports Corporation
SVOCs	Semi-volatile Organic Compounds
TBT	Tributyltin
TOC	Total Organic Carbon

TPHs	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
VOCs	Volatile Organic Compounds

1 INTRODUCTION

1.1 Synopsis

Caltex Refineries (NSW) Pty Ltd (Caltex) is responsible for the maintenance of their port facilities that support their refinery at Kurnell on the southern side of Botany Bay (Sydney, NSW). The facilities comprise the Caltex Wharf located to the west of Sutherland Point, and associated berths and approaches.

Caltex propose to undertake maintenance dredging of the approaches and swing basin (Dredge Area 1) and sub-berth (Dredge Area 2); and capital dredging of the fixed berths (Dredge Area 3) adjacent to the refinery wharf.

This Supplementary Sampling and Analysis Plan Implementation Report presents the findings of the supplementary sediment investigation undertaken by WorleyParsons in August 2012. Subsequent to previous sediment investigations, Caltex proposed to widen the fixed berths (Berths 1 and 4 -Dredge Area 3). Therefore, this current investigation assesses sediments in the two fixed berths not previously sampled.

1.2 History of Sediment Assessments in the Dredge Area

In 2009 Caltex identified the need to undertake maintenance dredging across three dredge areas within their port facilities:

- Dredge Area 1 - Approaches and Swing Basin (to be dredged to -12.8 m relative to Chart Datum (CD));
- Dredge Area 2: Sub-berth (to be dredged to -14.0 m CD); and
- Dredge Area 3: Fixed Berths 1 and 2 (to be dredged to -12.8 m CD).

In preparation for dredging, a sampling and analysis plan (SAP) was prepared in accordance with the NAGD and implemented in November 2009. The SAP aimed to characterise the physical properties and the types, concentrations and bioavailability of chemicals present in the proposed dredge material. The dredging requirements were determined from the Sydney Ports Corporation's (SPC) (2007) hydrographic survey, which was the most recent hydrographic survey available at the time. This SAP was not submitted to the Department of Environmental, Water, Heritage and the Arts (DEWHA) (now the Department of Sustainability, Environment, Water, Populations and Communities - SEWPAC) for review prior to sampling, due to time constraints. The testing was undertaken in accordance with the National Assessment Guidelines for Dredging (NAGD) (Commonwealth of Australia, 2009) and indicated that the dredge material in Dredge Areas 1, 2 and 3 was suitable for ocean disposal at the designated Sydney Offshore Spoil Ground (WorleyParsons, 2012) (**Appendix 1**).

Subsequent to the completion of sampling, discussions with the SPC pilots and review of the SPC (2009) hydrographic survey determined that the required dredge footprint was larger than that investigated in the initial investigation. Therefore, additional sampling was undertaken to:

- Characterise the chemical properties of sediment from within the expanded areas of the dredge footprint; and
- Assess the bioavailability and toxicity of TBT with depth across the dredge footprint.

A supplementary SAP (WorleyParsons, 2010) was prepared for the additional investigation and submitted to DEWHA (now SEWPAC) for review in February 2010, following minor requested amendments, it was approved on 5 March 2010. Supplementary sediment sampling was undertaken in March 2010 in accordance with the approved SAP. The analytical results indicated that, while elevated concentrations of TBT were observed in elutriates, dilution modelling using the numerical method for material from the combined Dredge Areas 1, 2 and 3 determined that the concentrations of TBT in the dredge material would not be of concern to water quality during disposal at the Sydney Offshore Spoil Ground. In addition, toxicity was not observed by whole sediment or elutriate toxicity testing.

Following the second sediment sampling program in March 2010, Caltex further revised their dredging requirements and proposed to also undertake capital dredging in a portion of the dredge footprint to:

- Meet the required minimum number of samples specified in the NAGD, due to the increase in dredge volume;
- Provide a better spatial and vertical coverage of the three proposed Dredge Areas; and
- Identify whether, following an oily water discharge from the Caltex Refinery in March 2011, any hydrocarbon contamination was present in the surface sediments within the proposed Dredge Areas.

A second supplementary SAP (WorleyParsons, 2011) was prepared for the additional sediment investigation, specifying the program of sampling and testing that would be undertaken in accordance with the NAGD. The supplementary SAP also provided details on the methodology and results from the two previous investigations. The supplementary SAP was submitted to SEWPAC for review on 20 September 2011. Comments were received from SEWPAC on 27 October 2011 and the third sediment sampling and analysis investigation was completed in November 2011 in accordance with the supplementary SAP (WorleyParsons, 2011) and the review comments that were provided by SEWPAC on 27 October 2011 (WorleyParsons, 2012) (**Appendix 1**).

This report supplements the previously reported sediment investigations undertaken by WorleyParsons in 2009, 2010 and 2011 for the dredging of the Caltex fixed Berths 1 and 2, Sub-berth, Approaches and Swing Basin in Botany Bay (WorleyParsons, 2012) (**Appendix 1**). Data obtained from previous sediment sampling and analysis undertaken in fixed Berths 1 and 2 (Dredge Area 3) supplements the newly obtained geochemical data from the sediment investigation in August 2012, which are reported herein. The inclusion of the new geochemical data enables an overall geochemical assessment of sediments to be dredged in fixed Berths 1 and 2, in accordance with the

requirements stipulated in the NAGD (Commonwealth of Australia, 2009) and the Supplementary Sampling and Analysis Plan dated 6 August 2012 (**Appendix 2**).

The third round of supplementary sediment sampling and assessment was completed under the guidance of the third supplementary SAP, between August 14 and 16, 2012. A supplementary SAP was required due to the increase in the proposed berth widths of Berths 1 and 2 to 138 m and 103 m, respectively, and a corresponding increase in the volume of material to be dredged in Dredge Area 3 (Berths 1 and 2). This was completed prior to the approval of the Supplementary SAP by SEWPAC (submitted on 6 August 2012), due to Caltex' urgent time constraints on the development of the fixed berths.

1.3 Objectives of this Supplementary SAP Implementation Report

The purpose of this supplementary SAP Implementation Report is to describe and justify the additional sediment sampling and analysis in Dredge Area 3 (Berths 1 and 2). This report should be considered in association with the SAP Implementation Report for Dredge Areas 1-3 that was prepared following the most recent sediment sampling investigation in November 2011, and which includes a summary of the three previous sediment investigations (WorleyParsons, 2012) (**Appendix 1**).

Since the completion of the previous sediment investigations, Caltex has indicated additional capital dredging is required for fixed Berths 1 and 2 adjacent to the Caltex jetty. This is as a result of proposed widening of Berth 1 (from 35 m to 138 m) and Berth 2 (from 35 m to 103 m). Therefore, additional sediment sampling and testing was required to:

- Meet the required minimum number of samples specified in the NAGD, due to the increase in dredge volume since the previous sediment sampling and testing; and
- Provide a better spatial and vertical coverage within the entire footprint of Dredge Area 3.

The supplementary sediment sampling and analysis that was undertaken provides spatial and vertical coverage of the expanded dredge area in Berths 1 and 2 (Dredge Area 3) and meets the NAGD sampling requirements for the increased dredge volume. The supplementary sediment sampling and analysis and the previous sediment investigations of Dredge Areas 1-3 reported in WorleyParsons (2012) (**Appendix 1**) will support applications for approvals for dredging and disposal from the relevant government agencies.

The objectives of the supplementary sediment investigation in Dredge Area 3 are as follows:

- Undertake a sediment sampling and analysis programme in accordance with the supplementary SAP (dated 6 August 2012);
- Ensure an adequate spatial and vertical coverage of the proposed Dredge Area 3 to meet the NAGD minimum sampling requirements for the proposed dredge footprint and the estimated dredge volume;

- Testing and analysis of dredge material situated within the dredge footprint for a range of physical and chemical properties;
- Comparison of chemical concentrations against NAGD screening levels; and
- Determining suitability of dredge material from the expanded Dredge Area 3 for sea disposal, supplementing the previously assessed suitability of dredge material from Dredge Areas 1 and 2 (WorleyParsons, 2012).

2 COMPILATION AND REVIEW OF EXISTING DATA

2.1 Site Location (Dredge Area 3)

The Caltex refinery is located at Kurnell on the southern shore of Botany Bay, south of the Sydney Central Business District CBD (**Figure 1**). The Caltex jetty extends approximately 800 m into Botany Bay to the west of Sutherland Point, terminating in a wharf approximately 300 m long. Fixed Berths 1 and 2 are located either side of the wharf, beyond which are the approaches (including a Swing Basin) and the sub-berth.

2.2 Summary of Results from Previous Investigations

Recent sediment investigations (November 2009 and November 2011) have been undertaken which are relevant to Dredge Area 3. No sediment sampling was undertaken in Dredge Area 3 in the March 2010 investigation (WorleyParsons, 2012) (**Appendix 1**). Table 1 provides a summary of results from these two previous investigations.

The main findings of the SAP Implementation Report (WorleyParsons, 2012) (**Appendix 1**) are described below, containing the results from the previous investigations in Dredge Area. The SAP Implementation Report has not yet been reviewed by SEWPAC.

Figure 1. Overall Site Plan.

Table 1. Summary of Previous Geochemical Data for Dredge Area 3 (Berths 1 and 2) (WorleyParsons, 2012) (Appendix 1)

		Analyte	Moisture Content (dried @ 103°C)	Total Organic Carbon	Antimony	Arsenic	Cadmium	Chromium	Copper	Cobalt	Lead	Manganese	Nickel	Selenium	Silver	Vanadium	Zinc	Mercury	BTEX	TPHs					TRHs	Pesticides		PCBs			
																				C6 - C9 Fraction Normalised	C10 - C14 Fraction Normalised	C15 - C28 Fraction Normalised	C29 - C36 Fraction Normalised	Sum TPHs Normalised	C6-C10 Fraction	OC Pesticides	OP Pesticides	Total PCBs normalised	Sum of PAH normalised	TBT normalised	VOCs/ SVOCs
		Units	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µgSn/kg	mg/kg
		LOR	1	0.02	0.5	1	0.1	1	1	0.5	1	10	1	0.1	0.1	2	1	0.01	0.2	3	3	3	5	3-5	3	0.5-10	0.5	5	N/A	0.5	0.2-0.5
		NAGD / ANZECC ISQG low	-	-	2	20	1.5	80	65	-	50	-	21	-	1	-	200	0.15	-	-	-	-	-	550	-	0.32-280		23	10000	9	
		NAGD / ANZECC ISQG high	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	NA	-	-		-	-	70*	
Berth	Sampling Month	Sample ID																													
Berth 1	Nov-09	SS3B	47	3.08	<0.50	8.85	0.2	22.8	21.7	1.8	25.5	40	5.7	1	0.2	19.3	95.9	0.2	---	---	---	---	---	---	--	---	--	---	150	46	--
	Nov-09	SS3C	40	1.3	<0.50	5.85	0.1	19.1	15.2	1.4	19.9	33	4.6	0.5	0.1	15.2	64.2	0.15	---	---	---	---	---	---	--	---	--	---	1062	0.2	--
	Nov-09	SS3D	22	1.16	<0.50	1.5	*0.05*	5.3	5.1	*0.25*	4.5	12	1	0.2	*0.05*	3.8	19.1	0.03	---	---	---	---	---	---	--	---	--	---	16	1.0	--
	Nov-11	SS5E	33	2.99	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.50	19	11	31	---	---	---	---	175	0.6	--
	Nov-11	VC5C (0-0.5)	23	2.23	<0.50	1.4	*0.05*	4.4	3.5	*0.25*	5.8		1.3	0.2	*0.05*	*1*	17	0.09	---	<LOR	0.67	22	21	43	<LOR	<LOR	<LOR	<LOR	295	4.8	--
	Nov-11	VC5C (0.5-1)	64	39.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.0	--
	Nov-11	VC5D (0-0.5)	61	34.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	0.2	<LOR
	Nov-11	VC5D (1.8-2.1)	18	0.88	<0.50	17	*0.05*	*0.5*	*0.5*	*0.25*	*0.5*	*5*	*0.5*	0.4	*0.05*	*1*	2.2	*0.01*	<LOR	<LOR	---	---	---	---	<LOR	<LOR	<LOR	<LOR	---	0.3	<LOR
	Nov-11	VC5D (2.1-3.1)	30	4.61	<0.50	4.7	*0.05*	7.3	3.4	1.5	2.2	57	4.2	1.5	*0.05*	11.6	14.6	*0.01*	<LOR	<LOR	0.65	10	26	36	<LOR	<LOR	<LOR	<LOR	---	0.1	<LOR
	Nov-11	VC5E (0-0.6)	56	32.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	10.2	<LOR
	Nov-11	VC5E (0.6-0.8)	28	1.14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	42	--
	Nov-11	VC5E (1-1.6)	41	7.76	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	23	<LOR
Berth 2	Nov-09	VC3A 0-0.6	24	0.69	<0.50	1.98	*0.05*	5	3.1	*0.25*	9	*5*	1.3	0.2	*0.05*	6.4	18.4	0.06	<LOR	<LOR	*2.2*	19	22	86	--	<LOR	--	<LOR	275	7.2	--
	Nov-09	VC3A 0.6-1.3	23	0.19	<0.50	2.34	*0.05*	2.8	1.9	*0.25*	3.4	*5*	*0.05*	0.1	*0.05*	2.5	5.8	0.03	---	---	---	---	---	---	--	---	--	---	45	---	--
	Nov-09	VC3A 1.3-1.9	22	0.25	<0.50	*0.5*	*0.05*	3	2.6	*0.25*	9	*5*	*0.05*	*0.05*	*0.05*	2.1	30.1	0.04	---	---	---	---	---	---	--	---	--	---	60	---	--
	Nov-09	VC3A 1.9-2.4	22	0.14	<0.50	10.1	*0.05*	2.3	*0.5*	*0.25*	1.4	*5*	*0.05*	0.2	*0.05*	3.9	2.3	*0.01*	---	---	---	---	---	---	--	---	--	---	10	---	--
	Nov-09	VC3B 0-0.5	19	0.41	<0.50	*0.5*	*0.05*	2.2	1.3	*0.25*	2.4	*5*	*0.05*	*0.05*	*0.05*	2.5	6.3	0.02	<LOR	<LOR	*3.7*	7.3	3.7	26	--	<LOR	--	<LOR	5	3.7	--
	Nov-09	VC3B 0.5-0.9	24	0.22	<0.50	*0.5*	*0.05*	2.9	2	*0.25*	3.4	*5*	*0.05*	0.1	*0.05*	3.3	9	0.02	---	---	---	---	---	---	--	---	--	---	23	---	--
	Nov-09	SS3A	25	0.14	0.56	1.7	0.2	7.1	33.2	1.5	60.2	14	2	0.2	*0.05*	3.6	460	0.01	---	---	---	---	---	---	--	---	--	---	10	2.5	--
	Nov-11	VC5B (0-0.8)	28	0.69	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.2	48	35	83	---	---	---	---	1855	312	--
	Nov-11	VC5B (0.8-1.3)	33	7.98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.3	--
	Nov-11	VC5B (1.3-1.6)	17	1.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.2	--
COMBINED DREDGE AREA 3 (BERTHS 1 & 2)		Min		0.14	<LOR	0.5	0.05	0.5	0.5	0.25	0.5	5	0.05	0.05	0.05	1	2.2	0.01			0.5	7	4	26					5	0	
		Max		39.6	0.56	17	0.2	22.8	33.2	1.8	60.2	57	5.7	1.5	0.2	19	460	0.2			3.7	48	35	86					1855	312	
		Mean	-	6.5	<LOR	4.4	0.08	6.5	7.2	0.65	11.3	15.1	1.6	0.36	0.07	6	57	0.05	<LOR	<LOR	1.6	21	20	51	<LOR	<LOR	<LOR	<LOR	306	25	<LOR
		SD	-	12.1	N/A	5.0	0.06	6.7	10.0	0.63	16.5	17.1	2.0	0.43	0.04	6	124	0.06	N/A	N/A	1.3	14	11	27	N/A	N/A	N/A	N/A	546	73	N/A
		95% UCL	-	10.8	N/A	6.5	0.11	9.5	11.7	0.96	18.8	22.5	2.5	0.55	0.09	8	114	0.08	<LOR	<LOR	2.7	33	29	73	<LOR	<LOR	<LOR	<LOR	546	54	<LOR

Notes: All organics are normalised to 1% TOC (w ith 0.2 to 10% TOC); Where results are <LOR, half the LOR has been used in the statistical analyses (*italicised*); SD: Standard Deviation

ANZECC ISQG-low - ANZECC/ARMCANZ (2000) Guidelines for Fresh and Marine Water Quality as updated (in draft) by Simpson et al. (2008); * NAGD maximum level: 70 µgSn/kg (ANZECC ISQG-high: 80 µgSn/kg)

Analyte		Moisture Content (dried @ 103°C)	Total Organic Carbon	Metals															Pesticides			PCBs			
				Antimony	Arsenic	Cadmium	Chromium	Copper	Cobalt	Lead	Manganese	Nickel	Selenium	Silver	Vanadium	Zinc	Mercury	BTEX	Sum TPHs Normalised	OC Pesticides	OP Pesticides	Total PCBs normalised	Sum of PAH normalised	TBT normalised	VOCs/ SVOCs
Units		%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µgSn/kg	mg/kg
LOR		1	0.02	0.5	1	0.1	1	1	0.5	1	10	1	0.1	0.1	2	1	0.01	0.2	3-5	0.5-10	0.5	5		0.5	0.2-0.5
	NAGD / ANZECC ISQG low	-	-	2	20	1.5	80	65	-	50	-	21	-	1	-	200	0.15	-	550	0.32-280		23	10000	9	
	NAGD / ANZECC ISQG high	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	-		-	-	70*	
Berth 1	Nov-09 SS3B	47.4	3.08	<0.50	8.85	0.2	22.8	21.7	1.8	25.5	40	5.7	1	0.2	19.3	95.9	0.2	---	---	---	--	---	150	46	--
	Nov-09 SS3C	40	1.3	<0.50	5.85	0.1	19.1	15.2	1.4	19.9	33	4.6	0.5	0.1	15.2	64.2	0.15	---	---	---	--	---	1062	0.2	--
	Nov-09 SS3D	22	1.16	<0.50	1.5	*0.05*	5.3	5.1	*0.25*	4.5	12	1	0.2	*0.05*	3.8	19.1	0.03	---	---	---	--	---	16	1.0	--
	Nov-11 SS5E	33.2	2.99	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	31	---	---	---	175	0.6	--
	Nov-11 VC5C (0-0.5)	22.7	2.23	<0.50	1.4	*0.05*	4.4	3.5	*0.25*	5.8		1.3	0.2	*0.05*	*1*	17	0.09	---	43	<LOR	<LOR	<LOR	295	4.8	--
	Nov-11 VC5C (0.5-1)	64.3	39.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.0	--
	Nov-11 VC5D (0-0.5)	61.3	34.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	<LOR	<LOR	---	---	0.2	<LOR
	Nov-11 VC5D (1.8-2.1)	18	0.88	<0.50	17	*0.05*	*0.5*	*0.5*	*0.25*	*0.5*	*5*	*0.5*	0.4	*0.05*	*1*	2.2	*0.005*	<LOR	---	<LOR	<LOR	<LOR	---	0.3	<LOR
	Nov-11 VC5D (2.1-3.1)	30.3	4.61	<0.50	4.7	*0.05*	7.3	3.4	1.5	2.2	57	4.2	1.5	*0.05*	11.6	14.6	*0.005*	<LOR	36	<LOR	<LOR	<LOR	---	0.1	<LOR
	Nov-11 VC5E (0-0.6)	55.9	32.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	<LOR	<LOR	---	---	10.2	<LOR
	Nov-11 VC5E (0.6-0.8)	27.8	1.14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	42	--
	Nov-11 VC5E (1-1.6)	40.6	7.76	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	<LOR	<LOR	---	---	23	<LOR
Berth 2	Nov-09 VC3A 0-0.6	24	0.69	<0.50	1.98	*0.05*	5	3.1	*0.25*	9	*5*	1.3	0.2	*0.05*	6.4	18.4	0.06	<LOR	86	<LOR	--	<LOR	275	7.2	--
	Nov-09 VC3A 0.6-1.3	22.6	0.19	<0.50	2.34	*0.05*	2.8	1.9	*0.25*	3.4	*5*	*0.05*	0.1	*0.05*	2.5	5.8	0.03	---	---	---	--	---	45	---	--
	Nov-09 VC3A 1.3-1.9	21.6	0.25	<0.50	*0.5*	*0.05*	3	2.6	*0.25*	9	*5*	*0.05*	*0.05*	*0.05*	2.1	30.1	0.04	---	---	---	--	---	60	---	--
	Nov-09 VC3A 1.9-2.4	22.2	0.14	<0.50	10.1	*0.05*	2.3	*0.5*	*0.25*	1.4	*5*	*0.05*	0.2	*0.05*	3.9	2.3	*0.005*	---	---	---	--	---	10	---	--
	Nov-09 VC3B 0-0.5	19.1	0.41	<0.50	*0.5*	*0.05*	2.2	1.3	*0.25*	2.4	*5*	*0.05*	*0.05*	*0.05*	2.5	6.3	0.02	<LOR	26	<LOR	--	<LOR	5	3.7	--
	Nov-09 VC3B 0.5-0.9	23.9	0.22	<0.50	*0.5*	*0.05*	2.9	2	*0.25*	3.4	*5*	*0.05*	0.1	*0.05*	3.3	9	0.02	---	---	---	--	---	23	---	--
	Nov-09 SS3A	24.7	0.14	0.56	1.7	0.2	7.1	33.2	1.5	60.2	14	2	0.2	0.05	3.6	460	0.01	---	---	---	--	---	10	2.5	--
	Nov-11 VC5B (0-0.8)	27.5	0.69	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	83	---	---	---	1855	312	--
	Nov-11 VC5B (0.8-1.3)	33.3	7.98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.3	--
	Nov-11 VC5B (1.3-1.6)	16.6	1.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.2	--

Notes: All organics are normalised to 1% TOC (with 0.2 to 10% TI Where results are below LOR, half the LOR has been used in the statistical analyses (*italicised*)
ANZECC ISQG-low - ANZECC/ARMCANZ (2000) Guidelines for Fresh and Marine Water Quality as updated (in draft) by Simpson et al. (* NAGD maximum level = 70 µgSn/kg w hereas ANZECC ISQG-high = 80 µgSn/kg

2.2.1 Sediment Sampling Methodology

Vibrocores and surface sediment samples were previously collected from the two fixed berths in Dredge Area 3. Across the two sediment investigations, a judgmental sampling pattern was used to position sample locations in areas:

- with the greatest sediment accretion within the proposed dredge footprint (based on review of the hydrographic survey);
- which had high TBT concentrations observed in the November 2009 investigation (i.e. to ensure retrieval of sufficient sample with TBT concentrations representative of the dredge material for use in elutriate and toxicity testing); and
- which were not covered in the initial investigation (i.e. the additional areas of the broadened dredge footprint).

In total, samples were collected from eleven (11) discrete locations (seven (7) sample locations in Berth 1 (SS3B; SS3C; SS3D; SS5E; VC5C; VC5D; VC5E) and four (4) sample locations in Berth 2 (SS3A; VC3A; VC3B; VC5B).

Samples were recovered from vibrocores and surface cores to the proposed depth of dredging or core refusal in consolidated underlying material (refer to Figure 4 in **Appendix 1**) (WorleyParsons, 2012).

2.2.2 Sediment Testing

Sediment Physical Characteristics

Sediments within Dredge Area 3 have previously shown to comprise a mean sand and gravel content of 69% and 16%, respectively, with a greater proportion of fines compared to Dredge Areas 1 and 2 (17% average silt and clay). Several samples from Berths 1 and 2 contained elevated Total Organic Carbon (TOC) content of more than 7% up to about 40% (**Table 1**).

During sampling and subsampling of sediment, cores VC5D and VC5E (located in the southern end of Fixed Berth 1) were found to contain a hard, low density, black material with a chalky texture and a pitted surface. This material was identified at or near the surface to depths of 1.5 m and 0.6 m for each of these two cores, respectively. This equates to approximately -12.5 m below Chart Datum (CD). The material was subjected to testing for Volatile Organic Compounds/Semi Volatile Organic Compounds (VOCs/SVOCs) for consideration of potential hydrocarbon contamination. Subsequently, the results of visual inspections and geochemical analysis identified that the materials consisted of decomposing organic matter, or peat-like material. A review of historic borehole logs that were provided by Caltex (Australian Oil Refinery Limited (1953) Boring Plan AS6201-7 and Plan AA.6653-1), indicated that peat layers had previously been observed in the vicinity of the Caltex berths and approaches. The plans identified peat layers at depths of about -10 to -13 m CD in four boreholes located west of Dredge Area 3 and outside of the proposed dredge footprint.

Sediment Chemical Characteristics

Chemical testing of sediments from Berths 1 and 2 included:

- Inorganic contaminants (trace metals and metalloids): silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), antimony (Sb), selenium (Se), and vanadium (V);
- Organic contaminants: Polycyclic Aromatic Hydrocarbons (PAHs), Tributyltin (TBT), Polychlorinated Biphenyls (PCBs), Organochlorine Pesticides (OCPs), Organophosphorus Pesticides (OPPs), Total Petroleum Hydrocarbons (TPHs), Benzene, Toluene, Ethylbenzene, Xylene (BTEX); and
- Total Organic Carbon (TOC)

In addition, iron (Fe) and aluminium (Al) were analysed in three (3) sediment samples from the 2011 investigation.

Not all of the analytes above were assessed in all sediment samples from Dredge Area 3 (**Table 1**), as the above list of analytes represented a screening assessment to determine if these chemicals may represent contaminants of potential concern.

These previous sediment investigations confirmed the presence of elevated concentrations of TBT in sediments in Dredge Area 3 (as well as in sediments in Dredge Areas 1 and 2), above NAGD Screening Levels. Generally, the concentrations of all other analytes were below respective NAGD Screening Levels. Exceptions were Pb and Zn at location SS3A in Berth 2 and Hg at location SS3B in

Berth 1 (**Table 1**). The 95% upper confidence limit (UCL) of the mean concentration was below the NAGD Screening Level for all analytes, except for TBT (normalized to 1% TOC). The 95% UCL of the mean concentration (54 μgSn/kg) exceeded the NAGD Screening Level of 9 μgSn/kg for TBT.

The concentrations of TBT in whole sediments have shown to be elevated in sediments at some locations throughout the three Dredge Areas, although normalized TBT concentrations that exceed 9 μgSn/kg in sediments in Dredge Area 3 were mostly limited to the central and southern parts of Berths 1 and 2.

Sediments in Berth 1 have shown to contain greater than 1% TOC with up to 40% TOC in the peat layer, resulting in a reduction of TBT concentrations following normalization to 1% TOC. While normalized TBT concentrations of greater than 9 μgSn/kg were predominantly located in sediments in the other two Dredge Areas (Dredge Area 1 - Approaches and Swing Basin and Dredge Area 2 - Sub-berth), sediments at three (3) sample locations in Dredge Area 3 also exceeded the NAGD Screening Level of TBT (WorleyParsons, 2012) (**Appendix 1**).

SEDIMENT ELUTRIATE TESTING

Previous elutriate testing in all three dredge areas comprised testing of sixteen (16) selected sediment samples, as well as one (1) replicate and one (1) seawater blank sample.

From these sixteen (16) samples, elutriate TBT concentrations were determined in three (3) sediment samples from Dredge Area 3 (SS3B and VC5E_0.6-0.8 from Berth 1 (both <0.1 ngSn/L) and sample VC5B_0.0-0.8 from Berth 2 (43 ngSn/L).

Dilution calculations were undertaken using the results for total sediment TBT concentrations and the elutriate TBT data to determine the potential bioavailability of dissolved TBT concentrations in the water column during sea disposal. The dilution modelling was undertaken using the physical, geochemical and elutriate properties of material from Dredge Area 1 (Approaches and Swing Basin) only as a 'worst-case' scenario (WorleyParsons, 2012) (**Appendix 1**). Based on the outcomes of the dilution modelling the concentrations of TBT in dredged sediments were found to be unlikely to adversely affect water quality during disposal at the Sydney Offshore Spoil Ground.

WHOLE SEDIMENT AND ELUTRIATE TOXICITY TESTING

Samples were selected for elutriate and toxicity testing based on a normalised TBT concentration of greater than the NAGD maximum level (70μg Sn/kg) and as close as possible to, or slightly higher than the 95% UCL of the mean TBT concentration (WorleyParsons, 2012) (**Appendix 1**).

The mean concentrations of TBT were substantially greater in Dredge Area 1 and Dredge Area 2 compared to Dredge Area 3. Therefore whole sediment toxicity testing and elutriate toxicity testing was undertaken in samples from Dredge Areas 1 and 2 only (WorleyParsons, 2012 (**Appendix 1**)).

Whole-sediment toxicity testing was undertaken to determine if there is potential for *in situ* toxicity to benthic organisms following disposal of the dredged material. The toxicity testing of whole sediments that was undertaken assessed chronic effects (reproduction) to the epibenthic amphipod *Melita*

plumulosa. The results indicated that all test sediments were considered to be non-toxic to the reproduction and survival of *M. plumulosa*.

Elutriate toxicity testing comprised a 48 hour larval development test using the rock oyster *Saccostrea commercialis*. Laboratory results of the elutriate toxicity tests indicated that there was no detectable toxicity to the bivalve embryos from the elutriate samples tested (WorleyParsons, 2012) (**Appendix 1**).

2.2.3 Main Findings of Previous Investigations

Based on the previous chemical and ecotoxicological tests, sediments in Dredge Areas 1, 2 and 3 were considered to be suitable for unconfined ocean disposal at the designated Sydney Offshore Spoil Ground (WorleyParsons, 2012) (**Appendix 1**).

2.3 Requirement for Additional Sampling in Dredge Area 3

Since the completion of the previous sediment sampling and assessments reported in WorleyParsons (2012) (**Appendix 1**), the proposed width of fixed Berths 1 and 2 has been increased from 35 m to 138 m and from 35 m to 103 m, respectively, necessitating consideration for supplementary sediment sampling and analysis of dredged sediments in the berth areas exceeding 35 m berth width. Each berth will be dredged to a declared depth of -12.8 m CD. This will require dredging of both capital and maintenance dredge material.

The most recent hydrographic survey (SPC, 2011) was used to identify the areas, thickness and volume of dredge material in the expanded berth areas. The depth of dredging required and the areas of greatest sediment accumulation are shown in **Figure 2**.

The proposed widening of Berth 1 from 35 m to 138 m results in an increase in the dredge sediment volume (including overdredging of 0.3 m) from 13,419 m^3 to 58,918 m^3 (i.e. an additional 45,499 m^3). On 13 August 2012 (i.e. post-submission of the Supplementary SAP to SEWPAC) the proposed dredge volume was further increased by an additional 8,600 m^3, following a further widening of the proposed dredge footprint on the northeastern margin of Berth 1, to a total of 67,518 m^3 (i.e. an additional 54,099 m^3 compared to the dredge volume assessed previously).

For Berth 2 an increase in berth width from 35 m to 103 m resulted in an increase in dredge volume from 6,342 m^3 to 14,505 m^3 (i.e. an additional 8,163 m^3).

Due to the increase in dredge volume and extent, additional sampling and assessment of sediments was required in Berths 1 and 2, as outlined in the Supplementary SAP (**Appendix 2**). Based on the additional dredge volume, the total dredge volume for Dredge Area 3 is now 67,518 m^3 (Berth 1) plus 14,505 m^3 (Berth 2) = **82,023 m^3**, which requires a total of sixteen (16) sample locations for an assessment in accordance with the NAGD. One (1) additional sample location was added to the supplementary sampling programme as a result of the increase of the dredge volume by a further 8,600 m^3 post-completion of the Supplementary SAP (i.e. sample location C18 on the northeastern margin of Berth 1 within the expanded area of Berth 1).

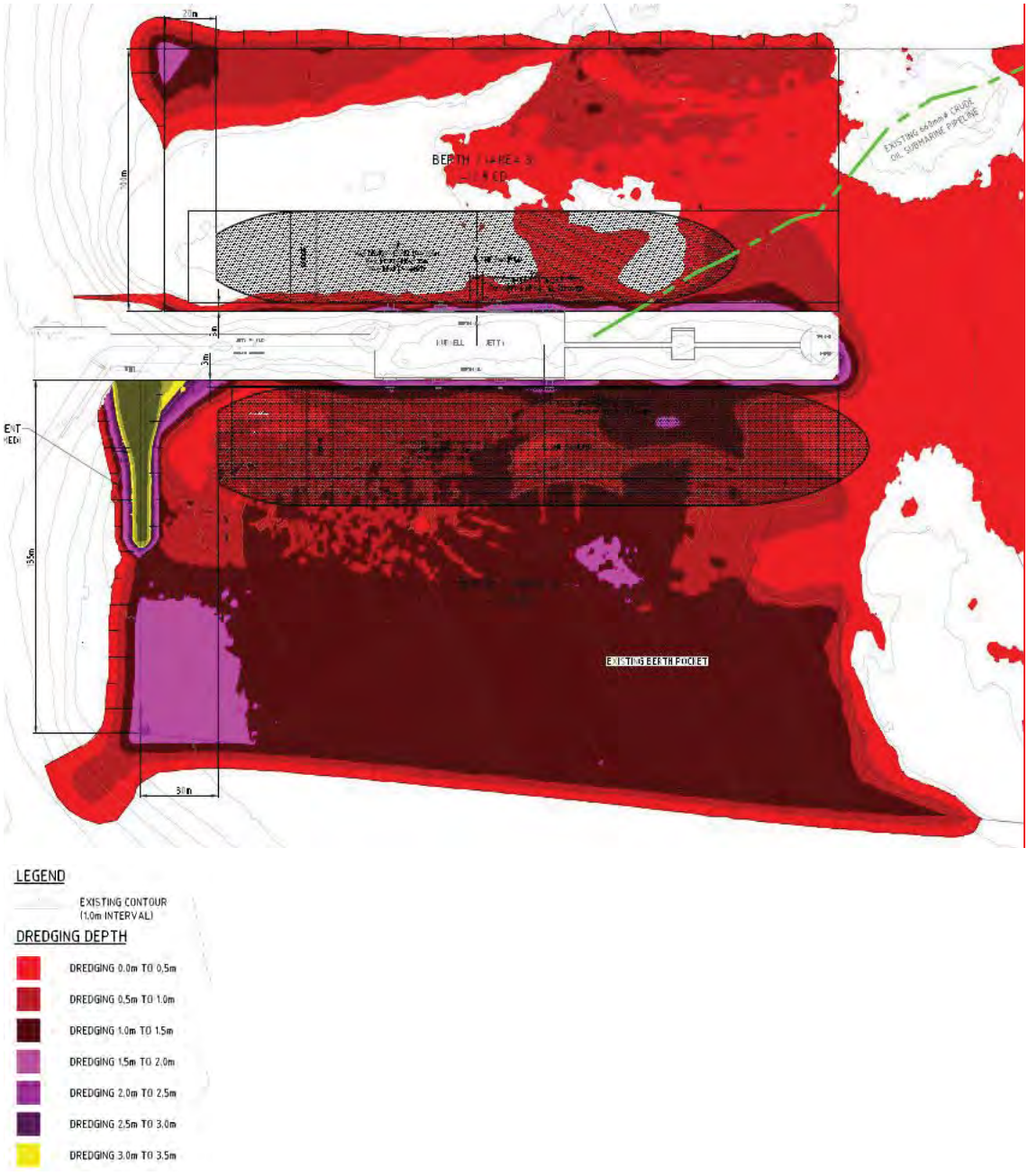


Figure 2. Areas and depths of proposed dredging in Dredge Area 3 (Berths 1 and 2). Note the widening of the proposed dredge area in the lower right of Berth 1 (i.e. the northeastern margin of Berth 1) relative to the dredge footprint shown in the Supplementary SAP (Appendix 2).

3 SUPPLEMENTARY SEDIMENT SAMPLING AND ANALYSIS PROGRAMME (AUGUST 2012)

This section provides an overview of the sampling rationale for the supplementary sediment sampling and analysis work undertaken in Dredge Area 3 and the field sampling and laboratory analytical methodologies used.

3.1 Rationale for Supplementary Sediment Sampling and Analysis Programme in Dredge Area 3

For the purpose of the sediment assessment for sea disposal under the NAGD, Berths 1 and 2 are assessed as one single dredge area (Dredge Area 3), with a total dredge volume for both berths of 82,023 m^3 (updated from 73,423 m^3, following an increase in the dredge footprint of Berth 1 on 13 August 2012 – refer to **Section 2.3**). This dredge volume requires sediment sampling and analysis at a total of **sixteen (16) sample locations** according to Table 6 of the NAGD. Previously, sediments from a total of **eleven (11) sample locations** (seven (7) sample locations in Berth 1 and four (4) sample locations in Berth 2) were sampled and analysed (WorleyParsons, 2012) (**Appendix 1**). Therefore the previous sediment sampling and assessment did not adequately cover the total proposed dredge volume of 82,023 m^3. In addition, the expanded dredge footprint to a berth width of up to 138 m (Berth 1) and up to 103 m (Berth 2) has not been assessed by the previous sediment sampling investigations (WorleyParsons, 2012) (**Appendix 1**).

To allow for coverage of the proposed widening of Berths 1 and 2, sampling at an additional sixteen (16) locations (**Table 2**) increases the total number of sample locations to **twenty-seven (27) discrete locations**. This substantially exceeds the number of sample locations that are required under the NAGD when the entire dredge footprint is considered as one dredge area (Dredge Area 3).

Therefore supplementary sediment sampling and analysis at sixteen (16) sample locations in Berths 1 and 2 enables an assessment of a dredge volume of up to 83,000 m^3 (Table 6 of NAGD). The additional geochemical data supplements the existing geochemical data from the eleven (11) previous sample locations in Berths 1 and 2 and substantially exceeds the minimum sampling requirements of the NAGD.

The proposed dredge footprint for the supplementary sediment investigation was determined through review of the most recent hydrographic survey at the time of sampling. For the supplementary sediment assessment the required depth of dredging ranges from less than 0.5 m up to 2.0 m depth across the dredge footprint in Berth 1 and from less than 0.5 m up to 1.0 m depth in Berth 2. Therefore a combination of piston push coring and vibrocoring was used to recover samples within the two berth areas. Vibrocoring was used to collect sediment samples from areas where accumulation of unconsolidated sediment exceeded more than 1 m above the design dredge levels, and where consolidated peats and clays were absent.

Table 2 shows the existing and additional number of sample locations in the expanded Dredge Area 3, following the proposed widening of the berths, and including an additional sample location

(C18), following a further widening of Berth 1 on 13 August 2012. Samples were collected from thirteen (13) additional sample locations in Berth 1 (locations C1 to C12 and C18) and from three (3) additional sample locations in Berth 2 (locations C13 to C15), which is approximately proportional to the respective dredge volumes in Berths 1 and 2 (i.e. a ratio of about 4:1).

Unlike in the previous sediment investigations undertaken (WorleyParsons, 2012) (**Appendix 1**) in which a judgmental sampling pattern was used, sample locations were assigned using a random sampling pattern that used a regular grid pattern comprising of 15 m by 15 m squares that overlie the entire dredge area in each berth. Each grid square within the dredge area was numbered (181 grid squares in Berth 1 and 128 grid squares in Berth 2) and the fifteen (15) sample locations in the two berths were selected using a random number generator. The supplementary sampling ensured that the entire area of the expanded dredge footprint in Berths 1 and 2 was covered.

A small increase in the proposed dredge area on the eastern margin of Berth 1, decided on after the completion of the supplementary SAP, required the addition of one (1) sample location (C18). This additional sample location was chosen to be approximately in the centre of the berth, about 7 metres outside the previous dredge area boundary and within the adjusted new boundary on the eastern margin of Berth 1. Therefore thirteen (13) sample locations were selected in Berth 1 (C1 to C12 and C18) and three (3) sample locations were selected in Berth 2 (C13 to C15), with sediment samples collected at the centre of each of the selected grid squares.

Another change implemented following the completion of the supplementary SAP was a southwestward move, by about 15 m, of sample location C15 located in Berth 1 due to its proximity to a submarine crude oil pipeline. It was decided to relocate sample location C15 to the next grid square south to maintain a safe working distance from the submarine pipeline, and to minimize the possibility of damaging the submarine pipeline as a result of the sediment sampling activities.

The actual supplementary sample locations (C1-C15 and C18) as well as the previous sample locations in Berths 1 and 2 are shown in **Figure 3**. The coordinates (in MGA 94 – Zone 56) and the depth of proposed sediment dredging to -12.8 m CD at each supplementary sample location is shown in **Table 3**.

Two (2) triplicate sample locations were selected from the sixteen (16) sample locations in Dredge Area 3 (i.e. sample locations C2 and C11).

Table 2. Number of Supplementary (New) and Previous Sample Locations in Dredge Area 3

Dredge Area	Total Estimated Dredge Volume (including 0.3 m overdredge) (m^3)	Total Number of Sample Locations	Minimum Required Sample Locations (Table 6 NAGD)
Combined Berths 1 and 2 Previously assessed Dredge Area 3 (width: 35 m; -12.8 m CD) (WorleyParsons, 2012)	19,761	11 previous sample locations	8
Supplementary Sampling Berth 1 width: 138 m; Berth 2 width: 103 m) (-12.8 m CD)	82,023 m^3 (updated from 73,423 m^3 (additional 62,262 m^3)	**16 new sample locations (13 in Berth 1; 3 in Berth 2) (includes additional sample location C18)**	16
Berth 1 Previously assessed Berth 1 (width: 35 m; -12.8 m CD)	13,419 m^3	7 previous sample locations	7
Supplementary Sampling Berth 1 width: 138 m (-12.8 m CD)	67,518 m^3 (updated from 58,918 m^3) (additional 54,099 m^3)	**13 new sample locations** (covering up to 138 m berth width)	15
Berth 2 Previously assessed Berth 2 (width: 35 m; -12.8 m CD)	6,342 m^3	4 previous sample locations	6*
Supplementary Sampling Berth 2 width: 103 m (-12.8 m CD)	14,505 m^3 (additional 8,163 m^3)	**3 new sample locations** (covering up to 103 m berth width	7*

*NAGD requirement if Berth 2 area was to be assessed as a separate dredge area. This is not the case in the current assessment, with Berths 1 and 2 being assessed as a single dredge area (Dredge Area 3).

Table 3. Maximum Dredge Depths and Coordinates of Sample Locations in Berths 1 and 2

Sample Location	Berth No.	Maximum Dredge Depth (m)	Maximum No. of Subsamples	Easting*	Northing*
C1	1	1.0-1.5	3	334687	6236283
C2	1	1.5-2.0	3	334727	6236262
C3	1	0.5-1.0	2	334681	6236336
C4	1	1.0-1.5	3	334747	6236335
C5	1	1.0-1.5	3	334761	6236328
C6	1	1.0-1.5	3	334748	6236368
C7	1	1.5-2.0	3	334756	6236415
C8	1	1.0-1.5	3	334821	6236414
C9	1	1.0-1.5	3	334796	6236462
C10	1	1.0-1.5	3	334849	6236434
C11	1	0.5-1.0	2	334776	6236488
C12	1	1.0-1.5	3	334836	6236474
C13	2	<0.5	1	334553	6236371
C14	2	0.5-1.0	2	334614	6236457
C15 (adjusted)	2	<0.5	1	334668	6236496
C18 (added post-SAP)	1	1.5	3	334840	6236380
Maximum Total Sample No			**41**		

*All coordinates are in MGA94 (Zone 56)

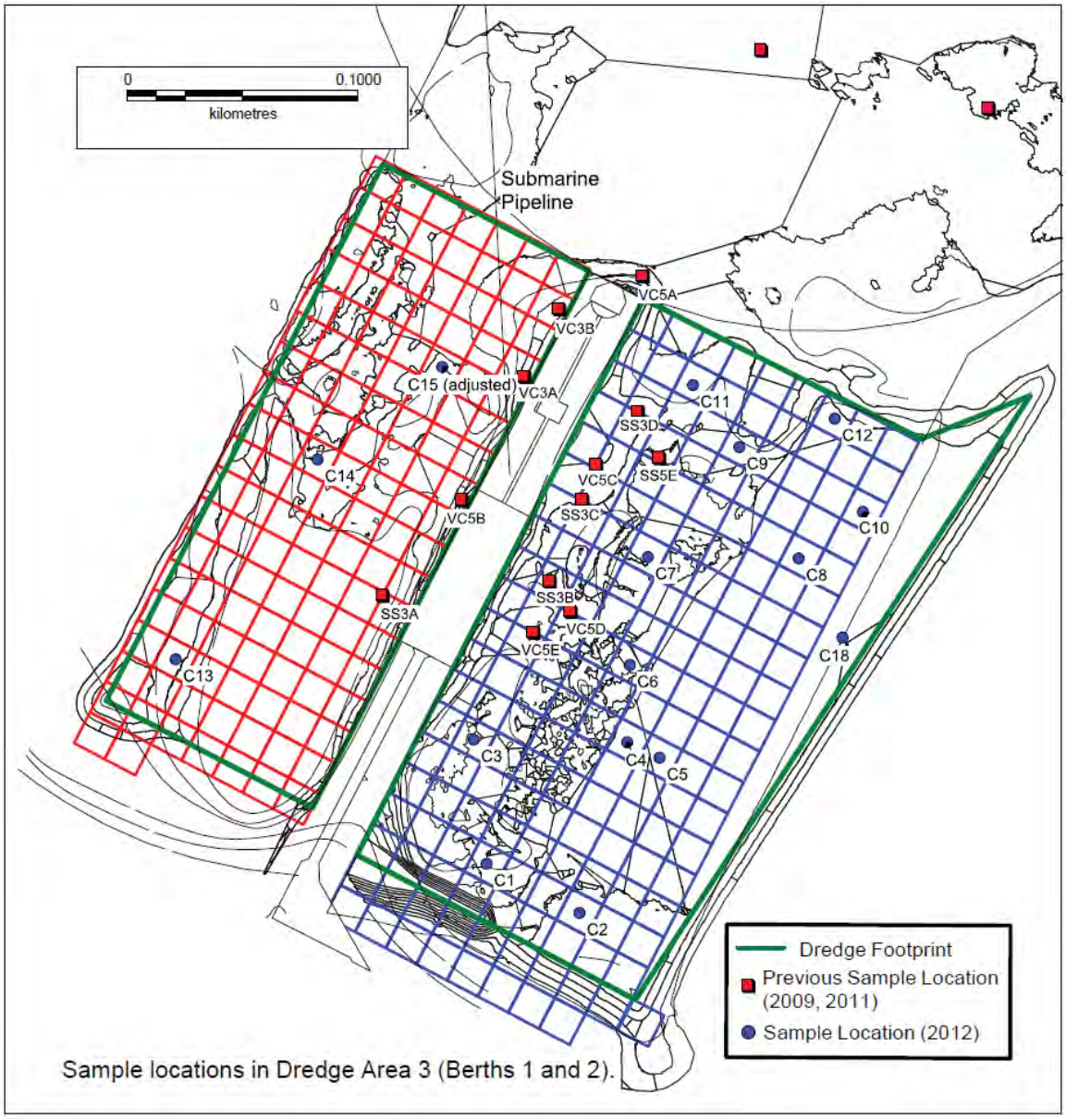


Figure 3. Supplementary (locations C1-C15 and C18) and Previous Sediment Sample Locations in Dredge Area 3.

3.2 Sediment Sample Collection

Sediment cores completed as part of the supplementary investigation on 14-16 August 2012 were collected by Geochemical Assessments Pty Ltd (GA) using a vibrocorer and/or a piston push corer. The GA sampling vessel, a purpose built aluminium hull trailer boat (length: 5 m), was used as a working platform for sediment core sampling and onboard sample processing.

Cores were collected as close as possible to the proposed sample locations. A handheld GPS with an accuracy of +/-5 m was used to record each sample location, with a three-point anchoring system deployed at some locations to prevent wind and cross-currents from moving the sampling vessel away from the designated sampling location.

A log was kept to record the sampling date, time, water depth, sample location coordinates, depth of core penetration and other relevant data for each sample location. Prior to sampling, the vessel was thoroughly inspected and washed down. Any evident sources of contamination were cleaned to avoid accidental contamination of sediment samples.

Sediment cores were collected using a combination of either a custom-fabricated piston push corer with 52 mm outer diameter (OD) steel core tubes or a light weight SDI^{TM} vibrocorer with 52 mm OD steel core tubes. Cores were driven to the depth of dredging or prior refusal in consolidated underlying material. Wherever possible, the piston push corer was used to enable a time-efficient collection of sediment cores to the depth of dredging or core refusal. When piston core refusal occurred in sandy sediment above the depth of dredging, the vibrocorer was deployed to obtain a core sample to the depth of dredging or core refusal in consolidated clay or rock.

Multiple sediment cores (up to 4 cores) were collected at several sample locations where a short core penetration (<0.15 m) in consolidated peat, did not provide sufficient volume of sediment for the required geochemical analyses. In these cases, the material from multiple cores was composited using the shortest core sample interval collected to provide a single composite sample (e.g. Core 1: 0.15 m; Core 2: 0.18 m; Core 3: 0.13 m – Composite sample of Cores 1 to 3 included only the upper 0.13 m (i.e. the length of the shortest core), with material below 0.13 m discarded to maintain consistency of reporting concentrations of chemical analytes to a known depth.

A WorleyParsons environmental scientist (Dr Carsten Matthai) determined the acceptability of the sediment core following collection. The criteria for acceptance of the core included:

- No obvious loss of surficial sediment;
- The core must have entered the sediment profile vertically;
- There were no visible disturbances or gaps in the sediment stratigraphy;
- The core reached the depth of dredging or refusal at rock or dense peat, sand or clay.

Cores at the sixteen (16) designated sample locations were collected over three (3) days of field sampling on 14 to 16 August 2012.

In addition, field triplicates were collected at two (2) sample locations (i.e. locations C2 and C11), that is, three cores were taken at the same sample location and at two separate triplicate locations (i.e. four additional cores T01A, T01B, T02A and T02B). The triplicate samples were used to give an indication of the variability in the chemical properties of the sediment at a sample location. As part of QA/QC procedures there were also split triplicate samples from two (2) sample locations (i.e. C6 and C10), i.e. a single homogenised sample from each sample interval was split into three (3) containers, with the third sample sent to a second laboratory (Advanced Analytical Australia) to assess variation associated with subsample handling, in accordance with NAGD requirements.

Ambient seawater for use in elutriate analysis was collected in a triple-rinsed plastic bucket.

Field QA/QC Procedures are described further in **Section 3.9.1**.

3.3 Sample Processing

Sample processing was undertaken on the sampling vessel immediately following sediment collection. All sample handling was performed to minimise contamination and sample mix-ups. The workspace on the sampling vessel was washed down regularly with ambient seawater to clean all surfaces and minimize dust contamination of samples. New powder-free nitrile gloves were worn by the sampler for the processing of each sample from each location. Subsampling was undertaken using stainless steel implements that were decontaminated between each sample using Decon90, followed by an ambient seawater rinse.

Piston cores and/or vibrocores were extruded from the core tube and placed on a sampling tray for subsequent logging, photographing and subsampling.

A subsample was collected at 0.5 m depth intervals in the top 1.0 m (i.e. 0.0-0.5 m and 0.5-1.0 m), followed by a composite sample from 1.0 m to the end of the core.

Sediment subsamples of entire cores, collected at 0.5 m intervals in the top 1.0 m and from 1.0 m to the end of the core were collected and stored appropriately for elutriate and bioavailability testing, if required. Cores less than 0.5 m in length comprised a single subsample from 0.0 m to the end of the core.

Samples for chemical analysis and possible elutriate testing were homogenised and placed with zero headspace in appropriate sampling containers that were provided by the analytical laboratory. Samples for physical testing (Particle Size Distributions (PSD) analysis) were placed in 250 ml plastic ziplock bags.

Sample identifiers included the sample location and the depth interval. For example, C1_0.0-0.5 indicates that the sediment sample was collected from sample location C1 over the interval from 0.0 m to 0.5 m. Triplicate samples were labelled with the prefix “T” and suffix A or B (e.g. T01A). QA/QC samples were numbered consecutively (i.e. QC1, QC2, etc.) with the type of the QA/QC sample and the key for the primary sample it relates to recorded on a separate QA/QC identification log sheet that was not revealed to the analytical laboratory.

The following sediment volumes were retained from each subsample, where relevant, for the different analyses required:

- Three 250 ml, and one 150 ml glass jar for analysis of metals, PAHs, TBT, TOC (all samples) and possible elutriate and bioavailability analysis; and
- One 250 ml ziplock bag for PSD analysis (50% of primary samples only).

Cores were logged, photographed and subsampled onboard the sampling vessel by a WorleyParsons scientist. Field logs are provided in **Appendix 3.**

3.4 Sample Preservation, Shipment and Analysis

Samples for geochemical analysis were packed an esky with ice immediately after sampling to maintain the temperature below 4°C. Samples for physical analysis were stored at ambient temperatures. Samples collected on 14 and 15 August 2012 were submitted to the following NATA-accredited analytical laboratories on 15 August 2012, under WorleyParsons Chain-of-Custody (CoC) protocols:

- ALS Laboratory Group (ALS) for primary physical and chemical testing; and
- Advanced Analytical Australia (AAA) for secondary chemical testing of split duplicates (via ALS under CoC protocol).

A second batch for sampling undertaken on 16 August 2012 was submitted to ALS on the same day of sampling.

WorleyParsons coordinated the analysis of the samples. Samples for possible elutriate and bioavailability analyses were archived in refrigerated storage by the analytical laboratory. Elutriate and bioavailability analyses (including 20% replicate samples), if required, were undertaken by ALS, following the assessment of the validated primary data and the calculations of the 95% UCLs of the mean concentrations of the analytes under investigation.

Given that the analytical holding times for sediment and elutriate samples, as specified in the NAGD, are 14 days or longer for all chemical analytes included in the supplementary sediment investigation, a submission of sediment samples within 24 hours of sampling was not critical, given that the samples were chilled and kept in the dark prior to arrival at the analytical laboratory.

3.4.1 Number of Samples

A total of twenty-one (21) primary samples and eleven (11) QA/QC samples were collected during the supplementary investigation in August 2012 (**Table 4**).

Field QA/QC samples included:

- Two (2) field triplicates comprising three sediment samples taken at the same location to give an indication of the small-scale spatial variability of the concentrations of analytes in sediments at a sample location;

- Split samples at two sample locations (i.e., a single homogenised sample split into three containers, with one sample going to a secondary laboratory) to assess variability associated with subsample handling and interlaboratory analysis to assess variability associated with analyses by different laboratories;
- Daily trip blanks to assess variability in the concentrations of trace metals associated with the sampling procedures and sample transportation. Other analytes (PAHs and TBT) were not considered to be relevant to assess sampling procedures and sample transportation, as demonstrated by the generally low concentrations of these analytes in the sediment samples collected in Berths 1 and 2; and
- Interbatch sample – Sediment sampling was originally planned for a period of two (2) days, with all samples to be submitted as a single batch. No interbatch sample was required in the supplementary SAP. However, sampling extended to a third day, requiring the submission of a small third batch of samples from only four (4) additional sampling locations (C11, C14, C15 and C18), for which no interbatch sample from the previous batch was submitted. Only eight (8) samples (5 primary samples and 3 QA/QC samples) were included in the second batch of samples, representing only one quarter of the total number of samples submitted. Therefore the importance of an interbatch sample in the supplementary sampling program is substantially reduced.

Table 4. Number of Analysed Primary and QA/QC Samples (August 2012)

	Number of Subsamples
Sample type	**Aug 2012**
Primary Samples (Vibrocore/Piston core samples)	21
Field Triplicates (2 locations)	4
Split Duplicates (including interlaboratory samples)	4 (incl. 2 interlab samples)
Daily Trip Blank (3 days)	3
Total	**32**

3.5 Analysis Schedule

The primary laboratory selected to undertake the chemical testing is the NATA-registered Australian Laboratory Services Laboratory Group (ALS). Split triplicate inter-laboratory samples were submitted to a secondary laboratory, the NATA registered Advanced Analytical Australia (AAA) laboratory. The contaminants and the detection limit of the analytical methods, which either meet or exceed the Practical Quantitation Limits (PQLs) stipulated in the NAGD, are outlined in the following sections and summarized in **Table 5**.

In addition to the analytes outlined in **Table 5** all sediment samples were analysed for aluminium (Al) and iron (Fe) to enable elemental normalization and reduce grainsize-related dependence of the whole sediment trace metal concentrations in the interpretation of the geochemical data.

Fifteen (15) sediment samples (including three QA/QC samples) were also analysed for non-volatile total petroleum hydrocarbons (TPH) (C_{10}-C_{36}) to assess the spatial distribution of TPHs in sediments in Dredge Area 3.

Table 5. Chemical Analytes for Supplementary Sediment Sampling

Test Parameter	Lab LOR/ (NAGD PQL)	units	Lab Method	NAGD Screening Level
Silver (Ag)	0.1/(0.1)	mg/kg	USEPA 6020	1
Cadmium (Cd)	0.1/(0.1)	mg/kg	USEPA 6020	1.5
Selenium (Se)	0.1/(0.1)	mg/kg	USEPA 6020	--
Cobalt (Co)	0.5/(0.5)	mg/kg	USEPA 6020	--
Antimony (Sb)	0.5/(0.5)	mg/kg	USEPA 6020	2
Copper (Cu)	1/(1)	mg/kg	USEPA 6020	65
Lead (Pb)	1/(1)	mg/kg	USEPA 6020	50
Zinc (Zn)	1/(1)	mg/kg	USEPA 6020	200
Chromium (Cr)	1/(1)	mg/kg	USEPA 6020	80
Nickel (Ni)	1/(1)	mg/kg	USEPA 6020	21
Arsenic (As)	1/(1)	mg/kg	USEPA 6020	20
Vanadium (V)	2/(2)	mg/kg	USEPA 6020	--
Manganese (Mn)	10/(--)	mg/kg	USEPA 6020	--
Mercury (Hg)	0.01(0.01)	mg/kg	APHA 3112 Hg-B	0.15
PAHs (each individual species)	4-5[1]/(100 total)	µg/kg	USEPA 3640/8270	10,000
Iron (Fe)	50/(--)	mg/kg		--
Aluminium (Al)	50/(--)	mg/kg		--
TBT	0.5/(0.5)	µgSn/kg	In-House GC/MS	9
TPH (C10-C36)	3-5/(100 total)	mg/kg		550
TOC	0.02/(0.1)	%	In house/Leco	--

Notes
1. The laboratory strived to reach this PQL but matrix interference may prevent the laboratory from reaching this very low detection limit.
2. All primary and QA/QC sediment samples were analysed for all analytes.
3. – indicates “not available”.

3.5.1 Chemical Analysis

TBT has been identified as a contaminant of potential concern based on a review of recent geochemical data for Dredge Area 3 (**Section 2.2.2**) and the surrounding Dredge Areas 1 and 2 (WorleyParsons, 2012) (**Appendix 1**). Therefore TBT is also a contaminant of potential concern for the sampling of sediments in the expanded berth area. TBT analyses were undertaken for all sediment samples collected in the supplementary sediment sampling program in Dredge Area 3, including QA/QC samples.

In addition, there were exceedances of NAGD Screening levels for Hg, Pb and Zn in at least one sediment sample collected previously in Dredge Area 3 (**Table 1**). Therefore trace metals (Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn) were included in the analysis of all sediment samples, including QA/QC samples collected in the supplementary sampling of sediments in Dredge Area 3.

While the concentrations of PAHs in sediments in Dredge Area 3 were below the NAGD Screening Levels in all sediment samples analysed, PAHs were present at concentrations above the analytical limits of reporting (LOR) in all sediment samples that were analysed, and frequently exceeded 1/10th of the NAGD Screening Level. Therefore PAH analyses were undertaken for all sediment samples collected in the expanded Dredge Area 3, including QA/QC samples.

In contrast, the concentrations of, BTEX, TPHs, OCPs, OPPs and PCBs in sediment samples collected previously in Berths 1 and 2 were generally below the LOR or below 1/10th of the NAGD Screening Levels (WorleyParsons, 2012) (**Appendix 1**). Therefore these analytes were not included in the supplementary sediment sampling program, with the exception of TPHs, which were subsequently analysed.

An analysis of twelve (12) primary samples and three (3) QA/QC samples for non-volatile TPHs (C_{10}-C_{36}) was requested from the analytical laboratory within fourteen (14) days of sampling (i.e. within the analytical holding times stipulated in the NAGD) following the initial interpretation of the analytical data, and to further characterize the geochemical characteristics of the peat and other surficial sediments in Dredge Area 3. TPHs were not included in the supplementary SAP's Contaminant List, as previous sediment sampling had shown the concentrations of TPHs in sediments in Dredge Area 3 to be below 1/10th of the Screening Level of 550 mg/kg (i.e. mean total TPHs: 51 mg/kg; n=6 samples). Therefore the subsequent inclusion of TPH analyses was not required under the assessment protocol of the NAGD, but included nevertheless to complement the interpretation of the geochemical data, in particular in relation to the presence of PAHs in the peat throughout Dredge Area 3.

Total organic carbon (TOC) contents were determined in all sediment samples to enable a normalization of the organic contaminant concentrations (i.e. TBT, PAHs, TPHs) to 1% TOC, in accordance with the guidance provided by the NAGD.

The results of the chemical analysis of the supplementary sampling program were combined with data obtained from the previous sediment sampling and analysis programs undertaken in 2009 and 2011 (WorleyParsons, 2012). The 95% UCL of the mean concentration of each contaminant in the

combined data set was calculated and compared to the NAGD Screening Levels to assess the requirement for further testing (i.e. elutriate and bioavailability).

The outcome of the previous sediment sampling resulted in omitting BTEX, OCPs and PCBs from further sampling, analysis and assessment. This conforms to the NAGD provisions for a pilot study, for which analysis of approximately 20% of the total number of samples required for the overall assessment of a dredge area is considered to be sufficient to characterize sediments within the dredge footprint, as long as these chemicals are not found to be present at significant concentrations (i.e. below 1/10th of the Screening Level) (NAGD, Commonwealth of Australia, 2009; p. 27-28).

3.5.2 Physical Analysis

Fifty per cent of primary sediment samples (i.e. up to nineteen (19) samples from the sixteen (16) sample locations) were analysed for PSD to provide an indication of the physical characteristics of the proposed dredge material in the expanded berth areas. Physical testing comprised a determination of PSD by wet sieving, using geological size fractions (including a 75 μm cut-off to enable comparison with previous PSD data), and a determination of the fine fraction content in accordance with Table 1 of NAGD (hydrometer) to determine clay (<2 μm) and silt (2 to 60 μm) fraction contents. Particle size analyses were undertaken by the ALS environmental laboratory in Newcastle.

The PSD analyses of sediments undertaken, together with field observations and visual estimates of sediment fine fraction content are adequate to characterize the textural characteristics of the sediments in Dredge Area 3.

3.5.3 Elutriate and Bioavailability Testing

Elutriate, bioavailability and toxicity testing was previously undertaken in accordance with the NAGD decision-tree approach for assessing potential contaminants. Results from the previous sediment investigations in Dredge Area 3 are documented in the SAP Implementation Report (WorleyParsons, 2012) (**Appendix 1**).

It was considered that it may not be required to undertake further elutriate or bioavailability testing in Dredge Area 3 for this assessment. However, TBT has previously shown to be a contaminant of potential concern for which elutriate testing was required (WorleyParsons, 2012) (**Appendix 1**). Therefore additional sediment material was sampled to undertake the required number of elutriate and bioavailability analyses (plus replicate sample and blank sample analyses) for contaminants of potential concern, should they be required.

After calculating the 95% UCL of the mean concentrations of all analytes for the combined data set (including results of previous sediment investigations) it was determined that elutriate analyses were required for TBT, which exceeded the NAGD Screening Level. Elutriate analyses for TBT were carried out on six (6) samples (including one (1) replicate sample) and one (1) elutriate seawater blank sample. This exceeds the minimum analysis criteria set out in the NAGD, in which a minimum of four (4) samples are required for elutriate and bioavailability analysis for dredge volumes of less than 100,000 m^3.

None of the sediment samples collected in Dredge Area 3 during the supplementary sampling programme exceeded the NAGD Screening Level concentration of TBT (9 μgSn/kg). The exceedance of the NAGD Screening Level for the 95% UCL of the mean concentration for TBT is due to the elevated concentrations of TBT in sediment samples obtained during the previous investigations in 2009 and 2011, and which were collected within the previously defined dredge area (i.e. a berth width of 35 m).

None of the sediment samples collected in the supplementary sampling programme contained a concentration of TBT (normalized to 1% TOC) that exceeded the NAGD Screening Level and the selection of samples for elutriate analyses was primarily guided by the requirements stipulated in the NAGD to obtain samples that are "representative of the *overall* dredged material composition in the dredged area" and "representative of all levels of contamination" (NAGD, p. 61). Therefore the six (6) samples (including one (1) replicate sample) chosen for elutriate analyses were:

- representative of material to be dredged in the overall dredge area, including consolidated peat and unconsolidated muddy sand (C5_0.0-0.15 (peat); C14_0.0-0.15 (peat); C2_0.0-0.5 (muddy sand); C15_0.0-0.5 (muddy sand) and C18_0.0-0.5 (muddy sand with fragmented peat); and
- representative of material to be dredged in both Berths 1 and 2 (C5_0.0-0.15 (Berth 1); C14_0.0-0.15 (Berth 2); C2_0.0-0.5 (Berth 1); C15_0.0-0.5 (Berth 2) and C18_0.0-0.5 (Berth 1).

In addition, one (1) replicate sample (QC5 - a split replicate of primary sample C2_0.0-0.5) and one (1) seawater sample (labelled "Elutriate Blank") were submitted for elutriate analyses of TBT for QA/QC purposes.

3.5.4 Toxicity Testing

Toxicity testing of elutriates and whole sediments was previously undertaken during the March 2010 investigation to determine the *in situ* effects of TBT contamination at the Sydney Offshore Spoil Ground after the disposal of dredged material from the three Dredge Areas. Typically whole sediment toxicity testing for TBT would be undertaken through porewater testing. However, extraction of porewater from sandy sediments that typically are present in the three Dredge Areas is not practical and may result in an underestimation of the porewater TBT concentrations. The methodology for the toxicity testing is described in detail in WorleyParsons (2012) (**Appendix 1**).

Based on the outcome of the assessment undertaken in the supplementary sampling programme and elutriate and bioavailability testing, no further toxicity testing was required for sediments in Dredge Area 3.

3.5.5 Summary of Testing

A summary of the physical, chemical and toxicity testing and the frequency of testing carried out in the three investigations in Dredge Area 3 is summarised in **Table 6.**

Table 6. Frequency of Testing of Analytes in Sediment Investigations in Dredge Area 3 (Berths 1 and 2) in November 2009, November 2011 and August 2012

Analyte	Frequency of Testing		
	November 2009	November 2011	August 2012
Number of Primary Samples	10 samples	12 samples	21 samples
Moisture content	All samples	All samples	All samples
Heavy metals (Ag, Cd, Se, Co, Sb, Cu, Pb, Zn, Cr, Ni, As, V, Mn and Hg)	All samples	3 surface samples	All samples
PAHs	All samples	3 surface samples	All samples
TBT	50% of samples	All samples	All samples
TOC	All samples	All samples	All samples
OC pesticides	20% of samples	50% of samples	Nil
BTEX	20% of samples	20% of samples	Nil
TPHs (C_6-C_{36})	20% of samples	4 surface samples	50% of samples from peat and muddy sands (C_{10}-C_{40} fraction)
PCBs	20% of samples	3 samples	Nil
VOCs/SVOCs	Nil	5 samples from VC5D and VC5E (Berth 1)	Nil
Particle size distribution (PSD)	2 samples (Berth 2)	5 samples (Berth 1)	50% of samples
Elutriate TBT testing	1 sample (Berth 1)	2 samples (1 in Berth 1 and 2 each)	5 samples (3 in Berth 1 and 2 in Berth 2)
Whole sediment toxicity testing	Nil	4 samples (3 samples with TBT >NAGD maximum TBT* level of 70 µgSn/kg and one blind control)	Nil
Elutriate toxicity testing	Nil	4 samples (3 samples with TBT >NAGD maximum TBT* level of 70 µgSn/kg and one blind control)	Nil

3.6 Data Management Procedure

Statistical analysis and tabulation of data was undertaken following data validation. Data management of the analysis results are in accordance with the requirements of the NAGD. Validation of data included evaluating the results from laboratory blanks, standard samples, field triplicate samples and interlaboratory and split duplicate samples.

3.7 Health and Safety Precautions

The sampling program adhered to HSE systems of WorleyParsons, Caltex and Geochemical Assessments and Safe Work Method Statements (SWMS) for the proposed works were prepared by GA.

Prior to the commencement of fieldwork, Caltex provided authorization to undertake the supplementary sampling and analysis program and confirmed that no underwater services are present at the proposed sample locations. A relocation of sample location C15 by about 15 m south was recommended by Caltex to ensure that sampling was undertaken at a safe distance from a subsurface crude oil pipeline located in Berth 2.

3.8 Sampling Contingency Plans

3.8.1 Adverse Weather and Minimum Sample Volumes

Supplementary sediment sampling was undertaken in the relatively protected waters of Botany Bay under calm conditions (<0.5 m swell and waves) and in fine weather during 14-16 August 2012.

The supplementary sampling program was scheduled to be completed over two (2) days, however a longer sampling period of an additional half a day of sampling on 16 August resulted from the requirement to obtain multiple cores (up to four cores) at a number of sample locations where consolidated peat was present at or near the sediment-water interface. Multiple cores of consolidated material in the upper 10 to 15 cm of material were required to obtain the minimum sample volume to undertake the required chemical and physical analyses.

3.8.2 Equipment Failure

Equipment used on the sampling program is highly specialized but replacement parts for the vibrocorer and piston push corer were provided on standby by the subcontractor. Repairs to critical equipment would have been undertaken as soon as practicable, although equipment failure was not observed during the supplementary sampling programme.

3.8.3 Shipping Operations

Sampling may have been delayed due to operational requirements of the Caltex berths, including shipping movements during the period of sampling or during the mobilization period. While two (2) shipping movements were observed during the three (3) field sampling days, the supplementary sampling programme was not interrupted or delayed, as the vessel movements occurred at a substantial distance of more than 500 m from Berths 1 and 2.

3.9 QA/QC Procedures

3.9.1 Field QA/QC Procedures

Field QA/QC procedures included the following:

- Use of suitably qualified environmental staff (i.e. Dr Carsten Matthai (WorleyParsons) and Dr Stuart Taylor (Geochemical Assessments Pty Ltd), each with more than 18 years' experience in sampling, logging and processing aquatic sediment samples from vibrocoring and piston push coring;
- Use of appropriate Personal Protective Equipment (PPE) (i.e. nitrile gloves, hat, long-sleeve trousers and shirt, PFD (life jacket), steel capped boots, high-SPF sunscreen), appropriate sampling utensils, and decontamination of all sampling equipment between samples, using a laboratory-grade detergent (Decon90);

- Storage of samples in appropriately pre-treated and labelled sample containers provided by the analytical laboratory;
- Following sampling, an immediate storage of samples in eskies containing bags of ice to maintain sample temperatures below 4^0C until delivery to the analytical laboratory;
- A CoC form accompanied the sediment samples at all times and included the analysis required for each sample and each laboratory;
- Sample Location: A handheld GPS position fixing system with an accuracy of +/-5 m was used to locate each sample location;
- Decontamination of Sampling Equipment: Prior to use, the survey vessel was thoroughly inspected and washed down. Any evident sources of contamination were cleaned to avoid accidental contamination of any samples. All sampling equipment that could come into contact with the sediment samples was decontaminated using Decon 90 prior to each sampling event;
- Submission of:

    1. Field triplicates: Triplicate samples were analysed and used to assess the variability in the chemical analytes in the sediment at two (2) sample locations (i.e. C2 and C11) (comprising one core subsample per core taken from two triplicate sample locations – i.e. 2 locations x 3 cores x 1 subsample = 6 samples). The cores at sample locations C2 and C11 were only 0.50 m and 0.35 m in length due to core refusal in consolidated underlying peat and required only a single subsample for the geochemical characterization of sediments at each of these core locations;
    2. Split triplicates: At two sample locations (i.e. C6 and C10) three split triplicate samples were taken (i.e. 1 subsample x 3 split triplicates = 3 samples) with two of the split triplicate core subsamples submitted to the primary laboratory (ALS Environmental), and the third subsample submitted to the secondary laboratory (AAA) for geochemical analysis. The split results were analysed to assess variability in sub-sampling and interlaboratory variability;
    3. Daily Field Blanks: Each day of field sampling a clean sand provided by the analytical laboratory (ALS) was washed through a clean steel core barrel with ambient seawater and collected in a core processing tray, from which the field blank sample was transferred into a clean laboratory-supplied 250 ml glass sampling jar. The field blank sample simulates the sample collection and processing procedure and field blank samples were analysed for trace metals;
    4. One (1) split duplicate sample for possible elutriate testing; and
    5. Validation of field data comprised calculation of relative standard deviation (RSD) for triplicate and relative percent difference (RPD) for duplicate samples. Results were compared to NAGD criteria.

- Field Documentation: Each sample location was numbered on a sampling plan in the field logbook (i.e. C1-C15 and C18). All other observations including weather, time, date of sampling, water depth, and depth of core penetration and any changes from the planned sampling protocol or sample location were noted in the field logbook. Time, date, and appearance of the sediments (e.g. texture, colour, odour) was also be recorded in the field logbook during sub-sampling;
- Cross Contamination: Each sample jar was washed with seawater following subsampling to remove sediment on the outside of the sample containers and to minimize cross-contamination;
- Sample Control: Each primary and QC sample was given a unique identification number that was recorded in the field log book, and on the Chain-of-Custody (CoC) form. Primary samples included 21 samples from 16 locations; and
- Twelve (12) QC samples included the following:

Sample ID	QC Sample Type	Primary Sample ID	Notes:
QC1	Split Triplicate	C6_0.0-0.13	
QC2	Split Triplicate - Interlaboratory Sample to AAA	C6_0.0-0.13	
QC3	Field blank Day 1	ALS-supplied clean sand	
QC4	Field blank Day 2	ALS-supplied clean sand	
QC5	Elutriate replicate	C2_0.0-0.5	Elutriate replicate
QC6	Split Triplicate	C10_0.0-0.5	
QC7	Split Triplicate - Interlaboratory Sample to AAA	C10_0.0-0.5	
QC10	Field blank Day 3	ALS-supplied clean sand	
T01A	Field Triplicate	C2_0.0-0.5	
T01B	Field Triplicate	C2_0.0-0.5	
T02A	Field Triplicate	C11_0.0-0.35	
T02B	Field Triplicate	C11_0.0-0.35	

3.9.2 Laboratory QA/QC Procedures

The primary analytical laboratory used for the chemical and physicochemical analyses of sediments, ALS Environmental, is NATA-registered for the analytical methods used. ALS is experienced in the analysis of marine sediments, with specific analytical suites available where assessment is required in accordance with the NAGD (Commonwealth of Australia, 2009). The secondary laboratory used for the analysis of two (2) interlaboratory QC samples was AAA, which is also NATA-accredited for the analyses undertaken (except selenium).

Quality control procedures relevant to the assessment of sediment geochemistry include:

- Chain-of-Custody (CoC) protocols;

- Laboratory QC protocols; and
- Interlaboratory analysis.

Laboratory QC procedures were undertaken in accordance with Appendix A of the NAGD (Commonwealth of Australia, 2009) to confirm that the analytical data quality was suitable for undertaking an assessment to characterise material proposed for dredging and disposal.

Laboratory data validation included assessment of results for laboratory blanks, standards, surrogate spike samples and matrix spikes and duplicate samples. Results were compared to laboratory and NAGD criteria.

Laboratory QA/QC procedures for the geochemical analyses included the following:

- Analysis Blanks: One per analytical run or one in every 20 samples, whichever is the smaller;
- Laboratory Duplicate: One in every 10 samples or batch, whichever is the smaller;
- Laboratory Control Standard: One per analytical run or one in every 20 samples, whichever is the smaller;
- Laboratory Matrix Spike: One in every 20 samples or batch, whichever is the smaller;
- Surrogate Spike: For determinations that are appropriate, surrogate spikes will be added to all samples for analysis; and
- Calibration Blank: One per analytical run or one in every 20 samples, whichever is the smaller.

4 FINDINGS OF SUPPLEMENTARY SEDIMENT INVESTIGATION

The findings of this supplementary sediment sampling and analysis investigation in Dredge Area 3 is in accordance with the supplementary SAP and includes a synthesis of the analytical data obtained from previous sediment investigations (WorleyParsons, 2012) (**Appendix 1**). This supplementary SAP Implementation Report assesses sediments to be dredged in the expanded Dredge Area 3 against the criteria set out in the NAGD.

This supplementary SAP Implementation Report provides a summary of the total sampling and analysis work undertaken in Dredge Area 3, and provides a classification of the suitability of sediments for offshore disposal under the NAGD. This report also details the sampling and analysis work completed and presents an assessment of the results, including the following:

- Supplementary SAP appended to report (**Appendix 2**);
- A description of the sampling completed, including sample locations, sample numbers (including replicate and QA samples), completed CoC forms, field logs and descriptions of the sediments;
- A description of any problems encountered or deviations from the procedures set out in the SAP (including justifications for deviations);
- Normalization of results for organic analytes to 1% TOC (within a range of 0.2-10%);
- Comparison of the 95% UCL of mean chemical concentrations of sediment in Dredge Area 3 with NAGD Screening Levels;
- Reporting of all QA/QC data;
- Presentation and review of the results, including QA/QC assessment of field and laboratory data, comparison to data quality objectives and data validation;
- Classification of sediment in Dredge Area 3 as acceptable (or otherwise) for unconfined ocean disposal, based on the previous and supplementary sediment assessments; and
- Appendices, including all laboratory and field data.

The findings presented in this supplementary SAP Implementation Report for Dredge Area 3 build on the previous assessment of sediments in Dredge Areas 1 and 2 reported in WorleyParsons (2012) (**Appendix 1**) and should be viewed as a combined sediment assessment for the purposes of an application for a Sea Dumping Permit with the appropriate Regulatory Authority (i.e. SEWPAC)

The supplementary sediment sampling and analysis work undertaken in August 2012 would be sufficient to assess Dredge Area 3 (Berths 1 and 2) by itself, as the scope of work for the supplementary assessment included the minimum number of sample locations (i.e. 16 sample locations) that are required for the proposed dredge volume (i.e. 80,023 m^3).

4.1 Sediment Physical Characteristics

Plates 1-3 are typical examples of the material and the textural variability observed in samples from Dredge Area 3. Sediments vary from unconsolidated sand (<5% fine fraction content) to muddy sand (10-20% mud content) to consolidated very hard and stiff peat (~30-50% fine fraction content).

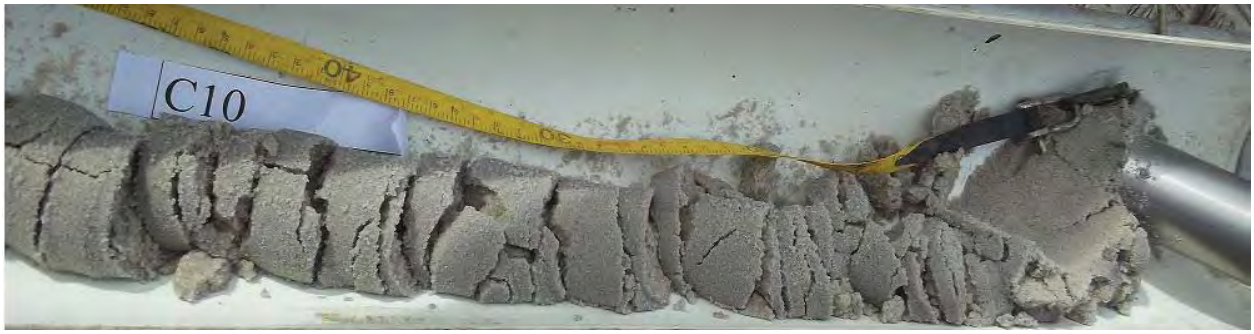


Plate 1. Unconsolidated soft light brown well sorted quartzose sand (<5% fine fraction and <0.2% TOC content) from the northeastern part of Berth 1 dredge area (Sample location C10).

Plate 2. Unconsolidated soft dark olive-gray to brown muddy sand (20% fine fraction and 1.3% TOC content) from the southern part of Berth 1 dredge area (Sample location C2).

Plate 3. Consolidated very hard and stiff dark brown to black organic-rich flaky peat (dry *in situ*) (47% fine fraction and 19% TOC content) from the eastern part of the Berth 1 Dredge Area Sample location C8).

4.1.1 Unconsolidated Sediments in Dredge Area 3

Physical characteristics for sediment samples selected for testing are summarized in **Table 7** and field core logs are provided in **Appendix 3**. Full results for the laboratory particle size distribution (PSD) are shown in **Appendix 4**.

Sediments in Dredge Area 3 comprise a mean sand and gravel content of 76% and 10%, respectively, with a greater proportion of fines in Berth 1 (Mean silt and clay: 17%) compared to Berth 2 (Mean silt and clay: 8%).

The depth of unconsolidated sediment (muddy sand) in the Berth 1 dredge area is generally very thin (5-10 cm) in the central part of the area at locations C3 to C8, with a layer of muddy sand up to 0.7 m thick in the south (Locations C1 and C2) and 0.3 m thick in the north (Locations C9 and C11) of the Berth 1 dredge area. Muddy sand (~20% fine fraction content) overlies consolidated peat (see **Section 4.1.2** below) and appears deepen to the east, with up to 0.9 m of unconsolidated muddy sand grading into fragmented and weathered peat at sample location C18 on the eastern margin of the Berth 1 dredge area.

Sediments in the northeastern part of Berth 1 at locations C10 and C12 comprise olive gray-green muddy sand, grading into light brown, well sorted medium-grained soft quartzose sand (<5% fine fraction content) at 0.3-0.5 m depth.

Unconsolidated sediments in the Berth 2 dredge area comprise slightly muddy sands (<10-15% fine fraction content) in the upper 0.5 m, generally overlain by consolidated peat (i.e. locations C14, C15), although the spatial distribution of consolidated sediments in the Berth 2 dredge area is less well defined compared to Berth 1 because of the fewer number of sample locations in Berth 2.

Table 7. Summary of Sediment Particle Size Distributions in Dredge Area 3 (including samples from 2009, 2011 and 2012 investigations)

Sample Location	Sample Depth	Sampling Date	Berth	Sediment Description	Clay (<2 µm)	Silt (2-60 µm)	Fines (<75/60 µm)	Sand (75/60µm-2 mm)	Gravel (>2mm)	Cobbles (>6cm)
C5	0-0.15	14/08/2012	1	Gravel and sand	3	*0.5*	3	43	54	<1
C7	0-0.1	14/08/2012	1	Sand	7	*0.5*	7	91	2	<1
C2	0-0.5	15/08/2012	1	Medium fine sand and clay	15	6	21	79	*0.5*	<1
C1	0-0.55	15/08/2012	1	Sand, gravel and silty clay	9	8	18	62	21	<1
C10	0-0.5	15/08/2012	1	Medium fine sand	7	4	11	89	*0.5*	<1
C10	1.0-1.5	15/08/2012	1	Medium sand	1	1	2	98	*0.5*	<1
C12	0.5-1.0	15/08/2012	1	Medium sand	3	2	5	95	*0.5*	<1
C8	0-0.12	15/08/2012	1	Silt, clay, sand and gravel	18	27	47	43	12	<1
C18	0-0.5	16/08/2012	1	Medium fine sand and clay	10	1	12	89	*0.5*	<1
SS5E	0-0.25	17/11/2011	1	Grey sand/ mud	-	-	11	88	1	<1
VC5C	0.5-1	18/11/2011	1	Black clay (shale like). Brittle, dry, flaking	-	-	18	21	61	<1
VC5D	2.1-3.3	18/11/2011	1	Stiff clay	-	-	17	76	7	<1
VC5E	0-0.6	18/11/2011	1	Peat/ mud	-	-	33	44	23	<1
VC5E	1-1.6	18/11/2011	1	Black mud interbedded w ith clay	-	-	30	66	4	<1
C15	0-0.5	16/08/2012	2	Medium fine sand and clay	11	1	14	86	2	<1
C14	0-0.15	16/08/2012	2	Sand	5	2	10	89	4	<1
C13	0-0.5	14/08/2012	2	Medium fine sand	5	1	6	94	*0.5*	<1
VC3A	0-0.6	17/11/2009	2	Dark grey sand	5	*0.5*	6	92	2	<1
VC3B	0-0.5	17/11/2009	2	Grey sand	4	2	5	95	*0.5*	<1
		Dredge Area 3		Sample No	14	14	19	19	19	19
				Mean	7	4	15	76	10	<1
				SD	5	7	12	23	18	n/a
				Maximum	18	27	47	98	61	<1
				Minimum	1	1	2	21	1	<1
		Berth 1		Sample No	9	9	14	14	14	14
				Mean	8	6	17	70	13	<1
				SD	6	8	13	24	20	na
				Maximum	18	27	47	98	61	<1
				Minimum	1	1	2	21	1	<1
		Berth 2		Sample No	5	5	5	5	5	5
				Mean	6	1	8	91	2	<1
				SD	3	1	4	4	1	na
				Maximum	11	2	14	95	4	<1
				Minimum	4	1	5	86	1	<1

Particle size classification for: Fines =<60µm for samples dated 2009 and <75µm for samples dated 2011 and 2012; Sand = 0.06-2mm for 2009 samples and 0.075-2mm for 2011/12 samples; SD = Standard Deviation

4.1.2 Consolidated Peat in Dredge Area 3

Previously a hard, low density, black material with a chalky texture and a pitted surface was observed during sampling and subsampling of sediment cores VC5D and VC5E, located in the central part of the Berth 1 dredge area (WorleyParsons, 2012) (**Appendix 1**). This material was identified at or near the surface to depths of 1.5 m and 0.6 m for each core, respectively which equates to approximately -12.5m below Chart Datum (CD). The material was subjected to testing for VOCs/SVOCs for consideration of potential hydrocarbon contamination. Subsequently, the results of visual inspections and geochemical analysis identified that the materials consisted of decomposing organic matter, or peat-like material. Peat layers had also previously been observed in the vicinity of the Caltex berths and approaches at depths of approximately -10 to -13m CD in four (4) boreholes located to the west of the Fixed Berths in Dredge Area 3 and outside of the proposed dredge footprint.

The presence of the hard, consolidated peat in Berth 1 was confirmed by the supplementary sediment sampling, which showed that peat is present at all sample locations in Berth 1, except C10 and C12, and at the surface or below a thin veneer of unconsolidated sands to muddy sands up to 0.9 m deep (**Table 8**). Similarly, consolidated peat was also present in the Berth 2 dredge area at sample locations C14 and C5, either near the surface or below unconsolidated muddy sands at about 0.5 m depth. The depth of the consolidated peat layer at each sample location could not be established due to core refusal in this very hard and stiff unit.

The spatial distribution and depth of the consolidated peat underlying unconsolidated sediment is shown in **Figure 4**.

Table 8. Field descriptions of peat in sediments in Dredge Area 3

Sample Location	Sampling Month	Berth	Core Length	Presence of Peat	Depth to Peat (m)	Depth of Peat layer (m)	Notes
SS3B	Nov-09	1	0.6	no	n/a	n/a (below 0.6 m?)	No peat (based on core photo)
SS3C	Nov-09	1	0.5	no	n/a	n/a (below 0.6 m?)	No peat (based on core photo)
SS3D	Nov-09	1	0.6	no	n/a	n/a (below 0.6 m?)	No peat (based on core photo)
VC3A	Nov-09	2	2.4	no	n/a	n/a	based on core photo (core terminated at 2.4 m)
SS5E	Nov-11	1	0.25	yes	at surface	0 to 0.25 (continuing)	Contained numerous chunks of hard black material up to 4cm in length similar to material found at VC5D and VC5E. Polychaete worms present. Was not possible to retrieve any sample at original coordinates due to hard black surface layer. Seven attempts tried at original location at sth end of berth pocket
VC5C	Nov-11	1	1.2	yes	0.4	0.4 to 1.2 (continuing)	Core retrieved following several attempts. First attempts penetrated ~100mm of sand before terminating in hard black material such as found at surface of VC5D.
VC5D	Nov-11	1	3.5	yes	at surface	0.0 to 1.8 m (grading into dark/red/brown clay)	Hard packed black surface with chalky texture. Round pebbly rocks formed from excessive vibration to get core to penetrate.
VC5E	Nov-11	1	1.65	yes	at surface	0.0 to 1.0 m (grading into black mud)	Small (<5cm) broken up pieces of very hard black peat and soft black sandy mud with black viscous fluid.
C1	Aug-12	1	0.55	yes	0.55	0.55 (continuing)	large peat fragments (up to 5 cm) in upper 25 cm, overlying stiff peat layer at 0.55 m
C2	Aug-12	1	0.5 (loss of 0.5-0.7 m)	yes	0.7	0.7 (continuing)	refusal at 0.7-0.8 m (peat at base)
C3	Aug-12	1	0.1	yes	at surface	0 to 0.1 (continuing)	refusal at 0.1 m, very stiff and hard
C4	Aug-12	1	0.1	yes	at surface	0 to 0.1 (continuing)	refusal at 0.1 m, very stiff and hard
C5	Aug-12	1	0.15	yes	at surface	0 to 0.15 (continuing)	less than 2 cm of overlying muddy sand; refusal at 0.15 m, very stiff base
C6	Aug-12	1	0.13	yes	at surface	0-0.13 (continuing)	very hard and stiff, refusal at 0.13 m
C7	Aug-12	1	0.1	yes	at surface	0-0.1 (continuing)	refusal in very hard and stiff peat at 0.1 m depth
C8	Aug-12	1	0.12	yes	at surface	0-0.12 (continuing)	very hard and stiff peat, refusal at 0.12 m
C9	Aug-12	1	0.45	yes	0.3	0.3-0.45 (continuing)	very stiff peat at 0.3 m depth, refusal at 0.45 m
C10	Aug-12	1	2	no	n/a	n/a	No peat
C11	Aug-12	1	0.35	yes	0.3	0.3-0.35 (continuing)	refusal in very stiff peat at 0.35 m depth
C12	Aug-12	1	1.5	no	n/a	n/a	No peat
C18	Aug-12	1	0.9	yes	0.9	0.9 (continuing)	refusal in dark brown stiff peat
VC3B	Nov-09	2	0.9	possibly	0.9 m?	below 0.9 m (if present)	refusal at 0.9 m (no peat at base, hard surface - based on core photo)
SS3A	Nov-09	2	0.6	no	n/a	n/a (below 0.6 m?)	No peat (based on core photo)
VC5B	Nov-11	2	2.2	no	n/a	n/a	No peat
C13	Aug-12	2	0.5	no	n/a		lost bottom 0.5 m of core (0.5-1.0 m segment), no peat
C14	Aug-12	2	0.15	yes	at surface	0-0.15 (continuing)	refusal in dark brown very hard/stiff peat at 0.15 m
C15	Aug-12	2	0.5	yes	at surface	0.0 (continuing); up to 0.5 m of unconsolidated muddy sand	peat at surface in vicinity of core location (actual core location has 0.5 m of unconsolidated muddy sand); patchy distribution of unconsolidated sediments overlying peat at location C15

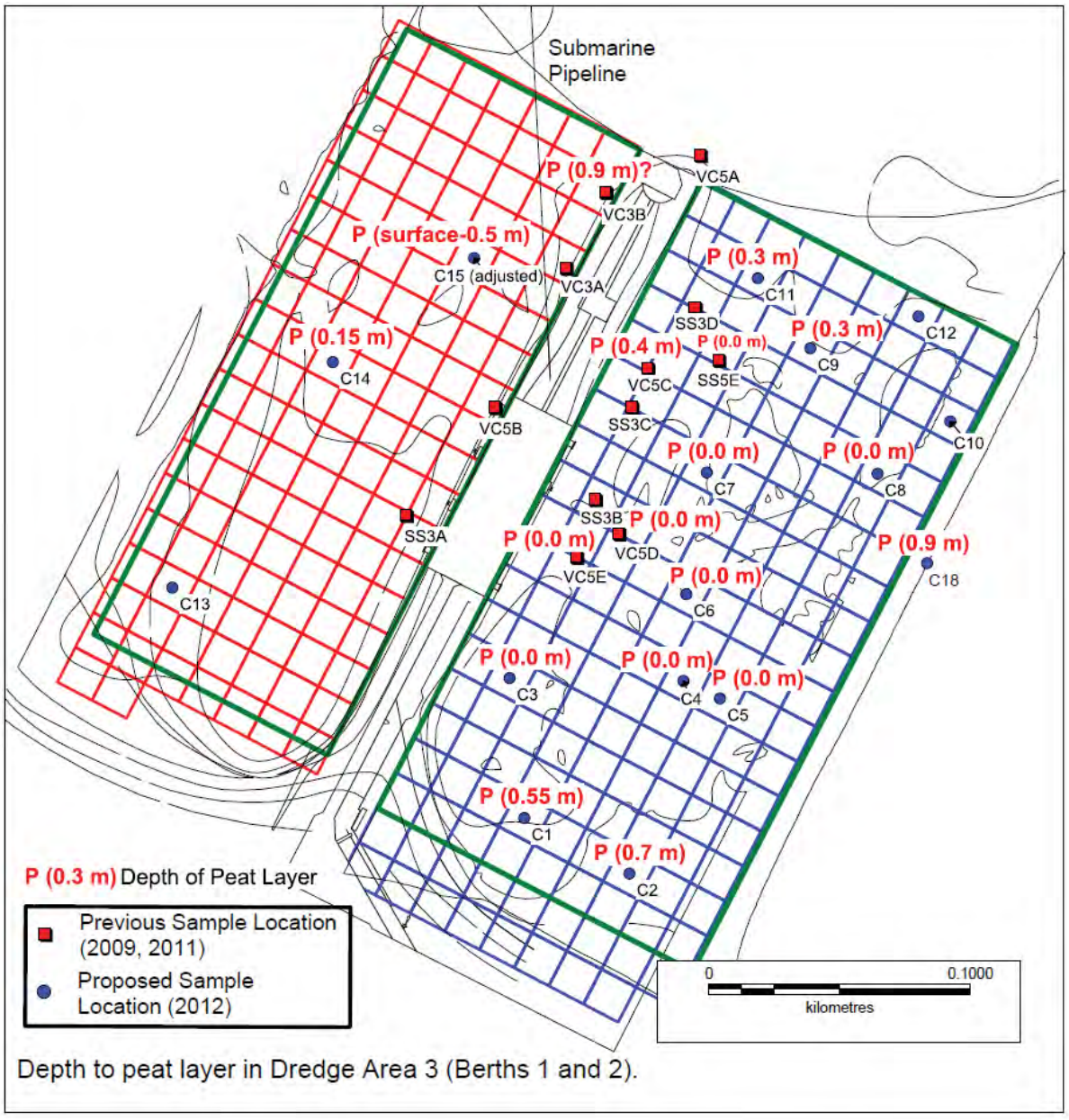


Figure 4. Depth to peat layer in Dredge Area 3.

4.2 Sediment Chemical Characteristics

All chemical laboratory reports are provided in **Appendix 4**. Results from all three investigations undertaken in Dredge Area 3 have been compiled and the results analysed statistically.

A summary of results for the chemical analyses of sediments in Dredge Area 3, includes a comparison of the results to the respective NAGD Screening Level and the calculation of the 95% UCLs of the mean, which are shown in **Table 9**.

4.2.1 Total Organic Carbon Content in Sediments in Dredge Area 3

Previously, several samples from Dredge Area 3 had shown elevated TOC of more than 7% to approximately 40%, coinciding with the presence of peat at some of the locations sampled in 2011 (locations VC5C, VC5D, and VC5E). High TOC contents in dredge material in Dredge Area 3 were confirmed in the 2012 investigation, where peat has shown to be ubiquitous in surface and subsurface sediments throughout most of Berth 1 and, to a lesser extent, in Berth 2. The consolidated peat contained between 19% and 39% TOC, which contrasts markedly with the generally substantially lower TOC content in surficial muddy sands overlying the peat (ranging from <1% to 2% TOC). Clean quartzose and well sorted sand, present at depths below 0.5 m in the northeastern part of Berth 1, contains less than 0.02% TOC.

4.2.2 Comparison of Results to Guidelines

4.2.2.1 Sediment Contaminant Concentrations

Analytical results for organic analytes (TBT, PAHs and TPHs) were normalised to 1% TOC (within limits of 0.2% to 10% TOC) and results for each contaminant were statistically analysed to calculate the mean, standard deviation (SD) and the 95% UCL of the mean concentration for sediments in Dredge Area 3, using the combined analytical dataset from the three (3) sediment investigations (2009, 2011 and 2012). All chemical analyses are reported on a dry weight basis for whole sediment samples.

Where concentrations were below the analytical laboratory limit of reporting (<LOR), a value of half the LOR was used in the statistical analysis of the results. In accordance with the NAGD, the 95% UCL of the mean concentration of each contaminant was determined using either:

- the Student-t test Method where the Shapiro-Wilk test with a 5% significance level indicated that data was normally distributed or the data set contained insufficient discrete values to use the Standard Bootstrap Method; or
- the Standard Bootstrap Method where the Shapiro-Wilk test with a 5% significance level indicated that the data were not normally distributed.

The individual results and the 95% UCL of the mean concentration of each contaminant in Dredge Area 3 were compared to the Screening Levels provided in Appendix A, Table 2 of the NAGD.

Concentrations of BTEX, light fraction hydrocarbons (C_6-C_9 and C_6-C_{10}), OCPs, OPPs and PCBs were below analytical limits of reporting in all samples analysed (i.e. 2009 and 2011 data only).

The 95% UCL of the mean concentration of all trace metals, total TPHs and total PAHs were below NAGD Screening Levels (**Table 9**).

Concentrations of TBT exceeded the NAGD Screening Level in four (4) sediment samples and the NAGD-High level (70 μgSn/kg) in only one (1) sediment sample in Dredge Area 3. All of the sediment samples with elevated TBT concentrations were collected during the investigations in 2009 and 2011. None of the 21 sediment samples collected in the 2012 sediment investigation exceeded the NAGD Screening Level for TBT (range: <LOR to 4.2 μgSn/kg (normalised to 1% TOC)). Although the majority of individual TBT concentrations in sediment samples from Dredge Area 3 (34 out of 39 samples) were below the NAGD Screening Level, the 95% UCL of the mean TBT concentration in sediments from the combined dataset exceeded the NAGD Screening Level of 9 μgSn/kg, triggering additional Phase III elutriate testing (**Section 4.2.3**).

Table 9. Geochemical Results of Chemical Analyses of Sediments in Dredge Area 3 for 2009, 2011 and 2012 Investigations

Analyte			Moisture Content (dried @103°C)	Total Organic Carbon	Aluminium	Iron	Antimony	Arsenic	Cadmium	Chromium	Copper	Cobalt	Lead	Manganese	Nickel	Selenium	Silver	Vanadium	Zinc	Mercury
					Metals															
		Units	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		LOR	1	0.02	50	50	0.5	1	0.1	1	1	0.5	1	10	1	0.1	0.1	2	1	0.01
NAGD / ANZECC ISGQ low			NA	NA	NA	NA	2	20	1.5	80	65	NA	50	NA	21	NA	1	NA	200	0.15
NAGD / ANZECC ISGQ high			NA	NA	NA	NA	25	70	10	370	270	NA	220	NA	52	NA	3.7	NA	410	1
Area 3	Aug-12	C1_0-0.55	38.4	12.3	3130	5490	<0.50	13.9	0.1	12.8	13.5	1.0	22.7	15	3.6	0.7	0.1	13.9	112	0.12
Area 3	Aug-12	C2_0.0-0.5	27.4	1.27	4090	5870	<0.50	6.59	0.2	26.2	15	1.2	28.3	27	3.9	0.05	0.3	12.3	102	0.44
Area 3	Aug-12	C3_0.0-0.1	63.6	31.8	9980	15700	<0.50	72.9	0.05	22.7	12.8	4.1	5	11	8.7	1.3	0.05	68.6	38.1	0.05
Area 3	Aug-12	C4_0.0-0.1	57.7	29.4	8100	9710	0.25	49.8	0.05	19.9	4.6	1.7	2.2	5	6.7	4.1	0.05	50.6	6.2	0.05
Area 3	Aug-12	C5_0.0-0.15	60.8	23.1	5360	13500	0.25	49.5	0.05	16.2	5.7	3.0	7.9	17	6.5	2.2	0.05	46.2	33.8	0.04
Area 3	Aug-12	C6_0.0-0.13	65.8	35.7	8620	5810	0.51	52.3	0.05	20.1	5.6	3.3	3.2	12	8.7	3.7	0.05	77.9	7.1	0.08
Area 3	Aug-12	C7_0.0-0.10	67.2	38.7	3740	4150	0.25	34.2	0.05	8.2	3.7	2.2	3	5	3.6	1.4	0.05	17.4	16	0.04
Area 3	Aug-12	C8_0.0-0.12	57.7	18.9	9300	15700	0.25	50.6	0.05	23.6	7.8	2.0	4	12	7.5	4.5	0.05	38.7	8.2	0.08
Area 3	Aug-12	C9_0.0-0.45	18.7	2.69	2350	1760	0.25	3.74	0.05	4.7	1.2	0.25	1.8	5	0.5	0.6	0.05	7.2	1.6	0.01
Area 3	Aug-12	C10_0-0.50	23.3	0.65	2060	2730	0.25	3.36	0.05	10.2	5.1	0.6	9.8	14	2.2	0.05	0.1	6.9	25.5	0.14
Area 3	Aug-12	C10_0.5-1.0	15.9	0.19	450	260	0.25	0.5	0.05	2.0	0.5	0.25	0.5	5	0.5	0.05	0.05	1	1.9	0.01
Area 3	Aug-12	C10_1.0-1.5	17.3	0.01	500	60	0.25	0.5	0.05	1.6	0.5	0.25	0.5	5	0.5	0.05	0.05	1	0.5	0.005
Area 3	Aug-12	C11_0.0-0.35	25.6	3.78	1510	2320	0.25	3.51	0.05	5.8	7.8	0.5	12	11	1.6	0.05	0.05	5.5	51.6	0.06
Area 3	Aug-12	C12_0.0-0.5	17.5	0.12	860	1800	0.25	4.45	0.05	4.1	1.6	0.25	2.7	5	1	0.05	0.05	3.1	6.1	0.07
Area 3	Aug-12	C12_0.5-1.0	17.3	0.35	640	550	0.25	1.16	0.05	1.2	0.5	0.25	0.5	5	0.5	0.05	0.05	1	0.5	0.005
Area 3	Aug-12	C12_1-1.5	16.8	0.01	600	1590	0.25	3.1	0.05	1.1	0.5	0.25	0.5	5	0.5	0.05	0.05	1	0.5	0.005
Area 3	Aug-12	C13_0.0-0.5	20.7	0.88	880	960	0.25	2.52	0.05	2.3	0.5	0.25	1.9	5	0.5	0.05	0.05	2.7	5	0.02
Area 3	Aug-12	C14_0.0-0.15	56.8	25.8	5320	10000	0.25	30.6	0.05	13.5	4.4	1.6	4.1	12	6.6	1.1	0.05	49	19.5	0.04
Area 3	Aug-12	C15_0.0-0.5	28.6	1.86	3000	4220	0.25	5.22	0.2	17.5	8.5	0.8	14.2	21	2.9	0.05	0.2	8.9	41	0.26
Area 3	Aug-12	C18_0.0-0.5	23.4	0.7	2790	4140	0.25	5.44	0.1	19	7.3	0.7	14.5	20	2.5	0.6	0.2	9	39.6	0.38
Area 3	Aug-12	C18_0.5-0.9	34.7	5.5	6860	7920	0.25	19.8	0.05	17.8	6.8	0.7	3.3	5	3.2	5.1	0.05	29.4	6.2	0.07
Area 3	Nov-09	VC3A 0-0.6	24	0.69	---	---	0.25	1.98	0.05	5	3.1	0.25	9	5	1.3	0.2	0.05	6.4	18.4	0.06
Area 3	Nov-09	VC3A 0.6-1.3	22.6	0.19	---	---	0.25	2.34	0.05	2.8	1.9	0.25	3.4	5	0.05	0.1	0.05	2.5	5.8	0.03
Area 3	Nov-09	VC3A 1.3-1.9	21.6	0.25	---	---	0.25	0.5	0.05	3.0	2.6	0.25	9	5	0.05	0.05	0.05	2.1	30.1	0.04
Area 3	Nov-09	VC3A 1.9-2.4	22.2	0.14	---	---	0.25	10.1	0.05	2.3	0.5	0.25	1.4	5	0.05	0.2	0.05	3.9	2.3	0.005
Area 3	Nov-09	VC3B 0-0.5	19.1	0.41	---	---	0.25	0.5	0.05	2.2	1.3	0.25	2.4	5	0.05	0.05	0.05	2.5	6.3	0.02
Area 3	Nov-09	VC3B 0.5-0.9	23.9	0.22	---	---	0.25	0.5	0.05	2.9	2	0.25	3.4	5	0.05	0.1	0.05	3.3	9	0.02
Area 3	Nov-09	SS3A	24.7	0.14	---	---	0.56	1.7	0.2	7.1	33.2	1.5	60.2	14	2	0.2	0.05	3.6	460	0.01
Area 3	Nov-09	SS3B	47.4	3.08	---	---	0.25	8.85	0.2	22.8	21.7	1.8	25.5	40	5.7	1	0.2	19.3	95.9	0.20
Area 3	Nov-09	SS3C	40	1.3	---	---	0.25	5.85	0.1	19.1	15.2	1.4	19.9	33	4.6	0.5	0.1	15.2	64.2	0.15
Area 3	Nov-09	SS3D	22	1.16	---	---	0.25	1.5	0.05	5.3	5.1	0.25	4.5	12	1	0.2	0.05	3.8	19.1	0.03
Area 3	Nov-11	SS5E	33.2	2.99	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5B (0-0.8)	27.5	0.69	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5B (0.8-1.3)	33.3	7.98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5B (1.3-1.6)	16.6	1.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5C (0-0.5)	22.7	2.23	2790	3350	0.25	1.4	0.05	4.4	3.5	0.25	5.8		1.3	0.2	0.05	1	17	0.09
Area 3	Nov-11	VC5C (0.5-1)	64.3	39.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5D (0-0.5)	61.3	34.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5D (1.8-2.1)	18	0.88	390	34500	0.25	17	0.05	0.5	0.5	0.25	0.5	5	0.5	0.4	0.05	1	2.2	0.005
Area 3	Nov-11	VC5D (2.1-3.1)	30.3	4.61	7040	16400	0.25	4.7	0.05	7.3	3.4	1.5	2.2	57	4.2	1.5	0.05	11.6	14.6	0.005
Area 3	Nov-11	VC5E (0-0.6)	55.9	32.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5E (0.6-0.8)	27.8	1.14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5E (1-1.6)	40.6	7.76	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dredge Area 3 (Berths 1 and 2)		Min	15.9	0.01	390	60	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<0.01
		Max	67.2	39.6	9980	34500	0.56	72.9	0.2	26.2	33.2	4.1	60.2	57	8.7	5.1	0.3	77.9	460	0.44
		Mean	33.8	8.8	3765	7020	<LOR	13.8	0.07	9.9	6.1	0.99	8.5	12.5	2.7	0.90	0.08	16	37	0.08
		SD	16.8	13.0	3089	7783	N/A	19.4	0.05	8.2	7.0	1.00	11.8	11.8	2.7	1.40	0.06	20	80	0.10
		95% UCL	nc	nc	nc	nc	<LOR	19.2	<LOR	nc	nc	nc	11.8	nc	nc	nc	nc	nc	60	0.11

Analyte			BTEX	C6 - C9 Fraction Normalised	C10 - C14 Fraction Normalised	C15 - C28 Fraction Normalised	C29 - C36 Fraction Normalised	Sum TPHs Normalised	C6-C10 Fraction	OC Pesticides	OP Pesticides	Total PCBs normalised	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
				TPHs					TRHs	Pesticides		PCBs	PAHs						
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
		LOR	0.2	3	3	3	5	3-5	3	0.5-10	0.5	5	5	5	4	4	4	4	4
NAGD / ANZECC ISGQ low			NA	NA	NA	NA	NA	550	NA	0.32-280	NA	23	NA	NA	NA	NA	NA	NA	NA
NAGD / ANZECC ISGQ high			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Area 3	Aug-12	C1_0-0.55	---	---	---	---	---	---	---	---	---	---	2.5	2.5	14	23	20	160	22
Area 3	Aug-12	C2_0.0-0.5	---	---	3	57	46	106	---	---	---	---	2.5	2.5	28	7	10	82	24
Area 3	Aug-12	C3_0.0-0.1	---	---	0	63	65	128	---	---	---	---	2.5	2.5	2.5	2.5	2.5	7	2.5
Area 3	Aug-12	C4_0.0-0.1	---	---	0	40	53	92	---	---	---	---	2.5	2.5	2.5	2.5	2.5	6	2.5
Area 3	Aug-12	C5_0.0-0.15	---	---	0	28	31	59	---	---	---	---	2.5	2.5	2.5	2.5	2.5	9	2.5
Area 3	Aug-12	C6_0.0-0.13	---	---	0	59	78	138	---	---	---	---	2.5	2.5	2.5	2.5	2.5	7	2.5
Area 3	Aug-12	C7_0.0-0.10	---	---	0	41	52	93	---	---	---	---	2.5	2.5	2.5	2.5	2.5	10	2.5
Area 3	Aug-12	C8_0.0-0.12	---	---	0	36	50	86	---	---	---	---	2.5	2.5	2.5	2.5	2.5	6	2.5
Area 3	Aug-12	C9_0.0-0.45	---	---	---	---	---	---	---	---	---	---	2.5	2.5	2	2	2	2	2
Area 3	Aug-12	C10_0-0.50	---	---	2	38	37	75	---	---	---	---	2.5	2.5	34	2	18	129	42
Area 3	Aug-12	C10_0.5-1.0	---	---	8	8	13	8	---	---	---	---	2.5	2.5	2	2	2	5	2
Area 3	Aug-12	C10_1.0-1.5	---	---	---	---	---	---	---	---	---	---	2.5	2.5	2	2	2	2	2
Area 3	Aug-12	C11_0.0-0.35	---	---	---	---	---	---	---	---	---	---	10	2.5	5	2	2	41	2
Area 3	Aug-12	C12_0.0-0.5	---	---	---	---	---	---	---	---	---	---	2.5	2.5	4	2	2	8	2
Area 3	Aug-12	C12_0.5-1.0	---	---	---	---	---	---	---	---	---	---	2.5	2.5	2	2	2	2	2
Area 3	Aug-12	C12_1-1.5	---	---	---	---	---	---	---	---	---	---	2.5	2.5	2	2	2	2	2
Area 3	Aug-12	C13_0.0-0.5	---	---	---	---	---	---	---	---	---	---	2.5	2.5	2	2	2	2	2
Area 3	Aug-12	C14_0.0-0.15	---	---	0	21	29	50	---	---	---	---	2.5	12	2.5	2.5	2.5	27	9
Area 3	Aug-12	C15_0.0-0.5	---	---	2	34	28	64	---	---	---	---	83	24	25	4	11	60	26
Area 3	Aug-12	C18_0.0-0.5	---	---	1	11	9	21	---	---	---	---	47	16	22	2	12	85	18
Area 3	Aug-12	C18_0.5-0.9	---	---	---	---	---	---	---	---	---	---	2.5	2.5	<4	6	2	2	2
Area 3	Nov-09	VC3A 0-0.6	<LOR	<LOR	2.2	19	22	86	--	<LOR	--	<LOR	16	2.5	2	4	2	14	2
Area 3	Nov-09	VC3A 0.6-1.3	---	---	---	---	---	---	--	---	--	---	9	2.5	2	2	2	2	2
Area 3	Nov-09	VC3A 1.3-1.9	---	---	---	---	---	---	--	---	--	---	5	2.5	2	2	2	2	2
Area 3	Nov-09	VC3A 1.9-2.4	---	---	---	---	---	---	--	---	--	---	2.5	2.5	2	2	2	2	2
Area 3	Nov-09	VC3B 0-0.5	<LOR	<LOR	3.7	7.3	3.7	26	--	<LOR	--	<LOR	2.5	2.5	2	2	2	2	2
Area 3	Nov-09	VC3B 0.5-0.9	---	---	---	---	---	---	--	---	--	---	5	2.5	2	2	2	2	2
Area 3	Nov-09	SS3A	---	---	---	---	---	---	--	---	--	---	2.5	2.5	2	2	2	2	2
Area 3	Nov-09	SS3B	---	---	---	---	---	---	--	---	--	---	39	7	12	2	2	33	9
Area 3	Nov-09	SS3C	---	---	---	---	---	---	--	---	--	---	2.5	13	15	2	7	45	10
Area 3	Nov-09	SS3D	---	---	---	---	---	---	--	---	--	---	5	2.5	2	2	2	2	2
Area 3	Nov-11	SS5E	---	---	0.50	19	11	31	---	---	---	---	18	6	2	2	2	31	12
Area 3	Nov-11	VC5B (0-0.8)	---	---	2.2	48	35	83	---	---	---	---	31	8	10	24	19	177	41
Area 3	Nov-11	VC5B (0.8-1.3)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5B (1.3-1.6)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5C (0-0.5)	---	<LOR	0.67	22	21	43	<LOR	<LOR	<LOR	<LOR	16	2.5	13	2	2	29	10
Area 3	Nov-11	VC5C (0.5-1)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5D (0-0.5)	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5D (1.8-2.1)	<LOR	<LOR	---	---	---	---	<LOR	<LOR	<LOR	<LOR	---	---	---	---	---	---	---
Area 3	Nov-11	VC5D (2.1-3.1)	<LOR	<LOR	0.65	10	26	36	<LOR	<LOR	<LOR	<LOR	---	---	---	---	---	---	---
Area 3	Nov-11	VC5E (0-0.6)	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5E (0.6-0.8)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Area 3	Nov-11	VC5E (1-1.6)	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	---	---	---	---	---	---
Dredge Area 3 (Berths 1 and 2)		Min	<LOR	<LOR	<LOR	7	4	8	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
		Max	<LOR	<LOR	7.5	62.6	78.2	138	<LOR	<LOR	<LOR	<LOR	83	24	34	24	20	177	42
		Mean	<LOR	<LOR	1	31	34	68	<LOR	<LOR	<LOR	<LOR	10	5	7	4	5	29	8
		SD	N/A	N/A	2	18	20	37	N/A	N/A	N/A	N/A	17	5	9	5	5	46	11
		95% UCL	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

Analyte			Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Benzo(g.h.i)perylene	Dibenz(a.h)anthracene	Indeno(1.2.3.cd)pyrene	Coronene	Sum of PAHs raw	Sum of PAH normalised	TBT raw	TBT normalised
			PAHs																
		Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µgSn/kg	µgSn/kg
		LOR	4	4	4	4	4	4	4	4	4	4	4	4	5	4			0.5
NAGD / ANZECC ISGQ low			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10000	NA	9
NAGD / ANZECC ISGQ high			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	50000	NA	70*
Area 3	Aug-12	C1_0-0.55	156	134	100	90	120	40	63	100	84	39	17	38	7	1230	123	15.9	1.6
Area 3	Aug-12	C2_0.0-0.5	102	94	74	59	90	35	52	82	48	44	2	28	2.5	859	676	2	1.6
Area 3	Aug-12	C3_0.0-0.1	30	36	9	15	18	6	13	6	331	2.5	2.5	<5	2.5	471	47	3.5	0.4
Area 3	Aug-12	C4_0.0-0.1	15	30	<5	10	35	16	22	8	542	2.5	2.5	<5	2.5	684	68	0.25	0.0
Area 3	Aug-12	C5_0.0-0.15	12	23	5	9	24	6	13	14	326	2.5	2.5	10	2.5	451	45	2.2	0.2
Area 3	Aug-12	C6_0.0-0.13	14	<5	6	16	34	13	24	19	369	2.5	2.5	<5	2.5	502	50	0.25	0.0
Area 3	Aug-12	C7_0.0-0.10	63	69	9	14	11	2.5	11	6	66	2.5	2.5	<5	2.5	259	26	0.5	0.1
Area 3	Aug-12	C8_0.0-0.12	18	2.5	2.5	8	57	21	19	15	250	42	2.5	36	2.5	472	47	0.25	0.0
Area 3	Aug-12	C9_0.0-0.45	<4	<4	<4	<4	19	8	5	5	34	2	2	6	2.5	77	29	0.25	0.1
Area 3	Aug-12	C10_0-0.50	133	112	84	64	108	39	69	85	30	36	7	25	7	1020	1569	2.7	4.2
Area 3	Aug-12	C10_0.5-1.0	6	5	2	4	2	2	2	2	2	2	2	2	2.5	20	100	0.25	1.3
Area 3	Aug-12	C10_1.0-1.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	10	0.25	1.3
Area 3	Aug-12	C11_0.0-0.35	56	52	38	21	49	11	21	35	27	26	2	26	12	430	114	5.4	1.4
Area 3	Aug-12	C12_0.0-0.5	13	14	11	10	10	4	9	5	2	6	2	2	2.5	94	470	0.25	1.3
Area 3	Aug-12	C12_0.5-1.0	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	6	0.25	0.7
Area 3	Aug-12	C12_1-1.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	10	0.25	1.3
Area 3	Aug-12	C13_0.0-0.5	6	6	4	2	6	2	4	5	36	2	2	2	2.5	67	76	0.7	0.8
Area 3	Aug-12	C14_0.0-0.15	67	85	20	24	28	12	19	18	532	2.5	2.5	2.5	2.5	853	85	1.1	0.1
Area 3	Aug-12	C15_0.0-0.5	97	97	63	52	68	24	44	65	44	46	8	33	10	884	475	2.3	1.2
Area 3	Aug-12	C18_0.0-0.5	118	100	59	51	79	19	42	65	23	53	12	41	15	877	1253	0.9	1.3
Area 3	Aug-12	C18_0.5-0.9	8	8	2	2	40	11	10	15	74	2	2	2	2.5	172	31	0.25	0.0
Area 3	Nov-09	VC3A 0-0.6	21	22	14	12	16	7	9	15	7	13	2	12	7	190	275	5	7.2
Area 3	Nov-09	VC3A 0.6-1.3	2	2	2	2	2	2	2	2	2	2	2	2	2.5	9	45	---	---
Area 3	Nov-09	VC3A 1.3-1.9	4	5	2	2	2	2	2	2	2	2	2	2	2.5	15	60	---	---
Area 3	Nov-09	VC3A 1.9-2.4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	10	---	---
Area 3	Nov-09	VC3B 0-0.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	5	1.5	3.7
Area 3	Nov-09	VC3B 0.5-0.9	2	2	2	2	2	2	2	2	2	2	2	2	2.5	5	23	---	---
Area 3	Nov-09	SS3A	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	10	0.5	2.5
Area 3	Nov-09	SS3B	54	50	28	25	42	13	21	34	16	31	6	27	13	462	150	141	46
Area 3	Nov-09	SS3C	108	158	93	107	169	44	94	192	36	124	27	119	20	1380	1062	0.25	0.2
Area 3	Nov-09	SS3D	4	4	2	2	4	2	2	2	2	2	2	2	2.5	18	16	1.2	1.0
Area 3	Nov-11	SS5E	64	57	39	34	42	19	27	47	19	51	18	38	2.5	522	175	1.8	0.6
Area 3	Nov-11	VC5B (0-0.8)	178	154	89	73	96	52	51	91	34	64	21	54	14	1280	1855	215	312
Area 3	Nov-11	VC5B (0.8-1.3)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.3	0.3
Area 3	Nov-11	VC5B (1.3-1.6)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.25	0.2
Area 3	Nov-11	VC5C (0-0.5)	40	46	30	30	63	29	29	34	224	40	4	20	<5	657	295	10.6	4.8
Area 3	Nov-11	VC5C (0.5-1)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.25	0.0
Area 3	Nov-11	VC5D (0-0.5)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.4	0.2
Area 3	Nov-11	VC5D (1.8-2.1)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.25	0.3
Area 3	Nov-11	VC5D (2.1-3.1)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.25	0.1
Area 3	Nov-11	VC5E (0-0.6)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	102	10
Area 3	Nov-11	VC5E (0.6-0.8)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	47.6	42
Area 3	Nov-11	VC5E (1-1.6)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	178	23
Dredge Area 3 (Berths 1 and 2)		Min	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	5	<LOR	<LOR
		Max	178	158	100	107	169	52	94	192	542	124	27	119	20	1380	1855	215	312
		Mean	43	43	25	23	37	13	20	29	93	19	5	18	5	411	273	19	12
		SD	51	49	32	28	41	14	23	41	153	27	6	25	5	426	469	50	50
		95% UCL	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	25

Notes: All organics are normalised to 1% TOC (with 0.2 to 10% TOC); nc = not calculated; <LOR = below analytical limit of reporting; N/A: not applicable; ---: not analysed; * NAGD maximum level = 70 µgSn/kg whereas ANZECC ISQG-high = 80 µgSn/kg

Where results are below LOR, half the LOR has been used in the statistical analyses (*italicised*); ANZECC ISQG-low - ANZECC/ARMCANZ (2000) Guidelines for Fresh and Marine Water Quality as updated (in draft) by Simpson et al. (2008)

4.2.2.2 Assessment of Ambient Baseline Levels of Arsenic in Sediments in Dredge Area 3

The 95% UCL of the mean concentration of arsenic in sediments in Dredge Area 3 is below the NAGD Screening Level (**Section 4.2.2.1**). Nevertheless exceedances of the NAGD Screening Level in individual sediment samples were shown to be present, in particular within the peat present in Dredge Area 3. Therefore the ambient baseline level for arsenic was determined using trace element ratios by normalizing to 'non pollutant' elements, such as aluminium and iron, as recommended in the NAGD.

The consolidated peat unit in Dredge Area 3 represents a different sedimentary unit compared to overlying or adjacent unconsolidated sediments (i.e. sands and muddy sands). There are definitive characteristics that distinguish the peat geochemically from other unconsolidated sediments in Dredge Area 3, including the occurrence of naturally-occurring perylene in the peat as a result of the likely *in situ* formation of perylene from biogenic precursors under anaerobic conditions during early diagenesis (**Section 4.2.3.3)**.

Using aluminium as a proxy for grain size, with elevated concentrations of aluminium representing fine-grained particulates within the sediment, a bivariate plot of the concentrations of aluminium against in whole sediments shows that high concentrations of aluminium in fine-grained peat correlate positively with elevated concentrations of arsenic in peat. Although the concentrations of arsenic in peat exceed the NAGD Screening Level concentration of 20 mg/kg, the strongly positive correlation with aluminium (i.e. grain size) suggests a natural (i.e. non-anthropogenic) and grainsize-dependent origin of arsenic within the peat (**Figure 5**).

Similar and strongly positive correlations are also present for arsenic/ iron, and arsenic/TOC content in peat and in unconsolidated sediments in Dredge Area 3 (**Figures 6 and 7)**. The consolidated peat exhibited substantially higher concentrations of iron (about 10,000-15,000 mg/kg) and TOC content (about 20-40% TOC) compared to unconsolidated sediments, which generally contained <5,000 mg/kg of iron and a TOC content of <3%.

Therefore the elevated concentrations of arsenic in the peat with respect to the NAGD Screening Level are substantially due to the fine-grained nature of the peat material and likely to be of a natural origin, which is reflective of natural background concentrations. This finding should preclude any further geochemical assessments with respect to As under Phase III of the NAGD.

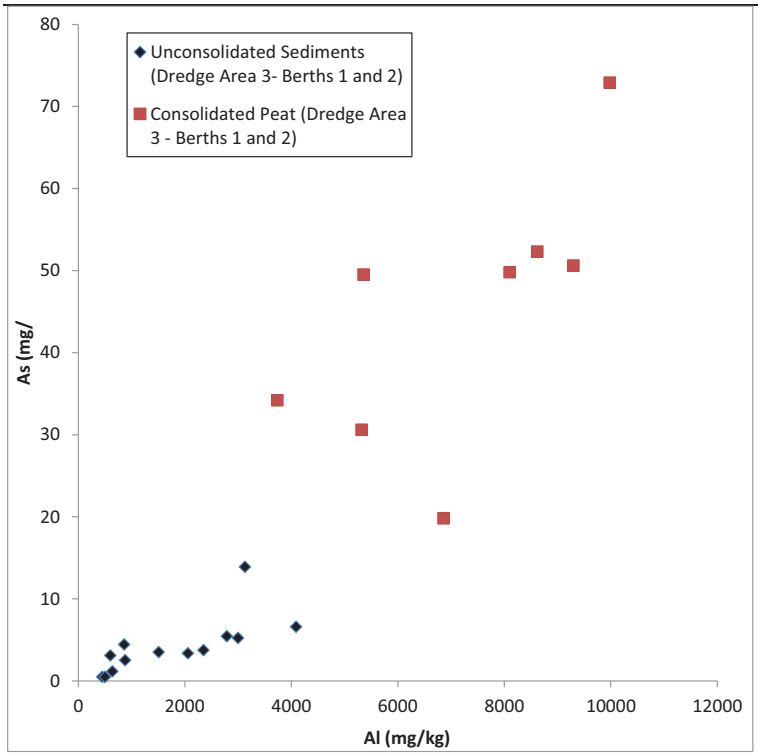


Figure 5. Al vs As in unconsolidated sediments and in peat in Dredge Area 3.

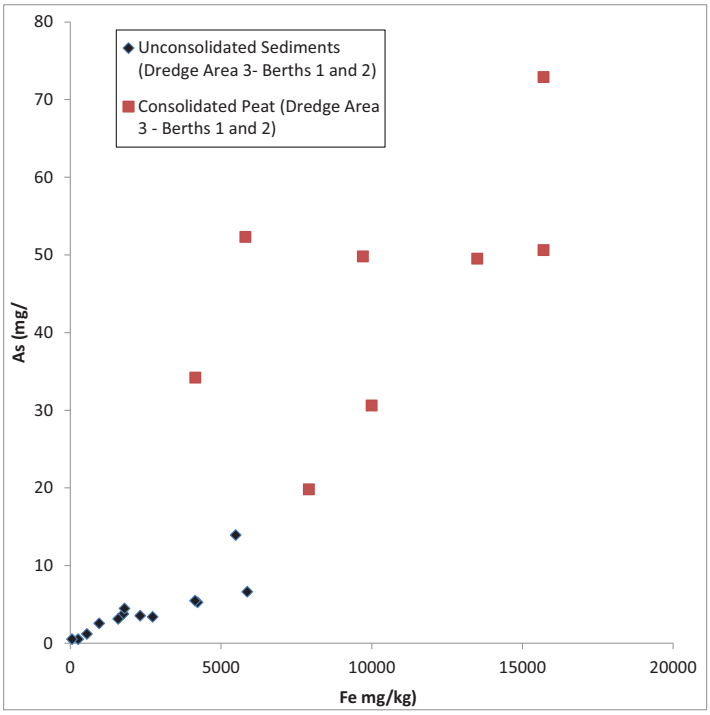


Figure 6. Fe vs As in unconsolidated sediments and in peat in Dredge Area 3.

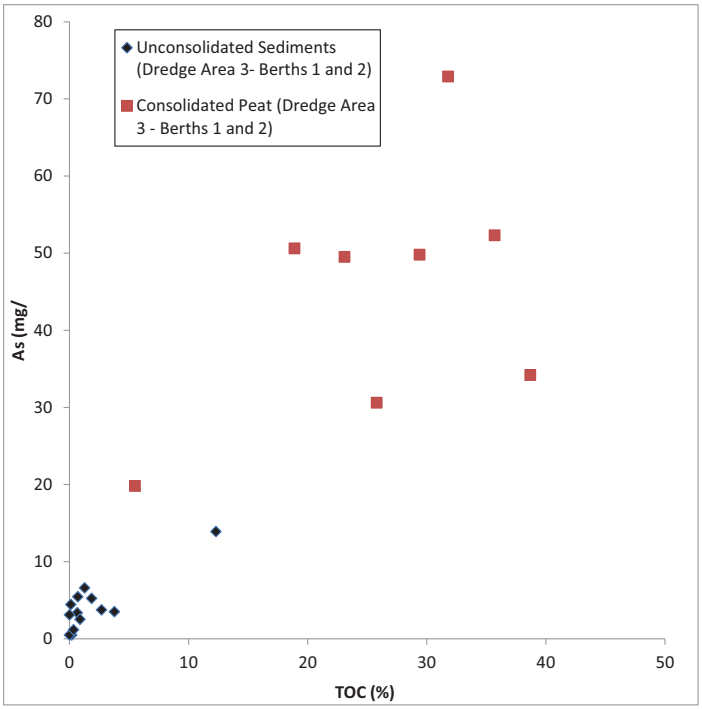


Figure 7. TOC vs As in unconsolidated sediments and in peat in Dredge Area 3.

4.2.3 Phase III – elutriate and bioavailability testing

Elutriate testing was undertaken to assess the possible impact of dissolved TBT in the water column at the dredge material disposal site. The selection of samples for elutriate analysis is presented in **Section 3.5.3**. In this supplementary sediment investigation elutriate testing was undertaken on five (5) primary samples (C2_0.0-0.5; C5_0.0-0.15, C14_0.0-0.15; C15_0.0-0.5; C18_0.0-0.5), one (1) replicate sample (QC5, a replicate of C2_0.0-0.5) and one (1) seawater elutriate blank sample, in accordance with (and exceeding) the minimum elutriate analysis requirements outlined in Table 7 of Appendix D of the NAGD.

The combined laboratory results for elutriate TBT testing are provided in **Appendix 4** and have been summarized in **Table 10**.

Table 10. Elutriate Results for TBT.

Dredge Area			Sediment TBT(1) (µgSn/kg)*	Elutriate TBT (2) (ngSn/L)
	NAGD SL (sediment)/ANZECC (2000) (elutriate)		9	6
	NAGD SL (High) (sediment)	Sampling Month	80	-
Dredge Area 3	SS3B	Nov-09	46	*1.0*
	VC5B (0.0-0.8)	Nov-11	312	43
	VC5E (0.6-0.8)	Nov-11	42	*1.0*
	C2_0.0-0.5	Aug-12	1.6	*1.0*
	C5_0.0-0.15	Aug-12	0.2	*1.0*
	C14_0.0-0.15	Aug-12	0.1	*1.0*
	C15_0.0-0.5	Aug-12	1.2	*1.0*
	C18_0.0-0.5	Aug-12	1.3	*1.0*
Dredge Area 3 - Fixed Berths		Mean	12.1*	6
		Median	1.0*	1.0
		SD	50.*	15
		95% UCL	25*	16.2Y
		90th percentile		13.6

Notes:

(1) normalised to 1% TOC

(2) corrected for TBT concentration in seawater

Where results are below LOR, half the LOR has been used in the statistical analyses (*italicised*)

*Calculated using all data from Dredge Area 3

YCalculated using Student's-t Test

4.2.3.1 Elutriate Testing - TBT

One of the three elutriate TBT results from the previous investigations in 2009 and 2011 were elevated above the ANZECC/ARMCANZ (2000) water quality trigger value for the protection of 95% of marine species (i.e. 6 ng/L). The five (5) additional elutriate analyses for TBT from the samples obtained in August 2012 were all below the analytical limit of reporting (<2 ngSn/L). The calculated 95% UCL of the mean of the TBT concentration in elutriate samples is 16.2 ngSn/L (based on

Student's t-Test), exceeding the ANZECC/ARMCANZ (2000) water quality trigger value for the protection of 95% of marine species (i.e. 6 ng/L). The 90th percentile of the elutriate concentrations of TBT is 13.6 ngSn/L which is very similar to the 95% UCL of the mean concentration of TBT.

It is noted that the occurrence of a single elutriate analysis for TBT above the analytical limit of reporting has resulted in a statistical exceedance of the ANZECC/ARMCANZ (2000) water quality trigger value, and that the statistical reliance on a single elevated concentration of TBT in elutriate samples may be questionable. This is particularly relevant when considering that the concentrations of TBT were below the NAGD Screening Level (9μgSn/kg) in all sediment samples collected in the supplementary sediment assessment in August 2012. While the supplementary sediment sampling of Dredge Area 3 would in itself be sufficient to assess sediments in the entire dredge area (i.e. 95% UCL of the mean concentration of TBT below NAGD Screening Level), the inclusion of the previous sediment geochemical data from 2009 and 2011 results in an exceedance of the Screening Level criterion for TBT.

4.2.3.2 TBT Dilution Calculations

The expected dilution at the disposal site(s) was calculated as recommended in the NAGD (Commonwealth of Australia, 2009) using the "worst-case" contaminant 95% UCL value as a precautionary approach to determine the likely dissolved TBT concentration in waters at the disposal site, and incorporating appropriate particle size parameters of the sediments in the sediment type input. A full report on the dilution modelling is included in **Appendix 5**.

Initial dilution of disposed dredged material in the ocean depends on a number of factors, such as water depth, stratification in the water column, and current velocities and directions. As described in the NAGD, initial dilution can be determined using either of two methods, namely:

- the liquid and suspended particulate phases of the dredged material may be assumed to be evenly distributed after four (4) hours over a column of water bounded on the surface by the release zone and extending to the ocean floor, thermocline or halocline, if one exists, or to a depth of 20 m, whichever is shallower (analytical method); or
- it can be calculated using the US Army Engineers Waterways Research Station STFATE model (numerical method).

The numerical method (STFATE modelling) was adopted in the modelling to predict the initial dilution of TBT for disposal operations at the Sydney Offshore Spoil Ground. The analytical method is overly conservative for application in this case, given that the mixing zone is specified to only extend to a water depth of 20 m in the methodology, when actual water depths at the Sydney Offshore Spoil Ground are about 100 m, where an increased dilution is expected to occur.

The dilution modelling was undertaken using the physical, geochemical and elutriate properties of material from Dredge Area 3, in contrast to the previous modelling undertaken for the 'worst-case' scenario in Dredge Area 1 (refer to Appendix 8 (Dilution Modelling in Dredge Area 1) in **Appendix 1**).

The 95% UCL of the mean of the concentration of TBT in sediments in Dredge Area 3 is substantially lower than in Dredge Area 1 (**Appendix 1**), exemplifying the conservative choice of undertaking

dilution modelling for Dredge Area 3 for the dilution modelling. The dilution modelling also incorporates SEWPAC's previous requirements with regards to the representation of the physical properties of the dredge material (**Appendix 1**).

During the early stages of the project proposal, it was expected that backhoe dredging with overflowing was likely to be the preferred dredging method with disposal from a split hopper. This model has since been refined to exclude overflowing. As such, numerical modelling using STFATE was carried out for one (1) dredging scenario only for sediments in Dredge Area 3, i.e. backhoe loading a split hopper barge (no overflowing).

The results of the numerical modelling for Dredge Area 3 were compared to the ANZECC/ARMCANZ (2000) trigger values for TBT at the 95% and 99% levels of species protection (i.e. 6 ng/L and 0.4 ng/L, respectively).

The results of the numerical modelling indicate that after initial mixing over a four (4) hour period, the maximum concentration of TBT at the Sydney Offshore Spoil Ground for a backhoe loading a split hopper barge (no overflowing) for the Dredge Area 3 sediments would be substantially below the ANZECC/ARMCANZ (2000) trigger values at the 95% and 99% species protection levels for TBT (**Appendix 5**).

Based on the outcomes of the dilution modelling the concentrations of TBT in dredged sediments from Dredge Area 3 are unlikely to adversely affect water quality during the proposed disposal at the Sydney Offshore Spoil Ground.

4.2.4 Phase IV Toxicity Testing

Whole-sediment toxicity testing and elutriate toxicity testing was not required following the interpretation of the analytical data of the NAGD Phase III (elutriate and bioavailability) assessment in **Section 4.2.3**.

With respect to TBT, whole-sediment toxicity testing and elutriate toxicity testing was previously undertaken on three (3) sediment samples from the other Dredge Areas (i.e. Dredge Area 1 (Approaches and Swing Circle) and Dredge Area 2 (Sub-berth)) to determine if there is potential for *in situ* toxicity to benthic organisms following disposal of the dredged material. The results of these toxicity tests indicated that all test sediments were considered to be non-toxic (WorleyParsons, 2012) (**Appendix 1**). Based on the outcomes of the previous toxicity testing, sediments in Dredge Area 3 are also considered to be non-toxic with respect to TBT.

4.3 Additional Interpretation of Geochemical Data From Peat Materials in Dredge Area 3

As noted in **Section 4.1.2** the presence of peat in sediments in Dredge Area 3 is widespread, with peat having been located at all sample locations, except at locations C10 and C12 in the northeastern part of Berth 1 and at location C13 in the southern part of Berth 2 (possibly due to a short core penetration of 0.5 m; a deeper core was not required at that sample location due to a proposed dredge depth of <0.5 m).

Previous sampling in 2009 and 2011 identified peat at several sample locations, but in these previous screening level assessments, the peat samples were not analysed for trace metals. The chemical analyses of sediments in the supplementary sediment assessment in August 2012 have shown that the peat contained elevated concentrations of arsenic that exceed the NAGD Screening Level of 20 mg/kg (arsenic concentration range in peat: 30.6 mg/kg – 72.9 mg/kg).

The consolidated nature of the peat suggests that it is a sedimentary unit that is very old (pre-Holocene/Pleistocene?) and uncontaminated, as demonstrated by the very low concentrations of all other contaminants that were analysed (i.e. trace metals, TBT, TPHs, and previously OCPs, OPPs, and PCBs). An exception is an elevated concentration of TBT in surface sample VC5E_0.0-0.6, which was collected in November 2011 about 20 m adjacent to the jetty. This sample represents a peat sample that contained an elevated TBT concentration of 102 μgSn/kg, which was subsequently reduced to 10.2 μgSn/kg, following a normalization to 1% TOC because of a TOC content of 32% in this sample. The surface exposure of peat in a large part of Berth 1 and Berth 2, with little or no overlying unconsolidated sediment present, makes it possible for anthropogenic contamination, such as particulate-bound TBT from paint flakes, to become incorporated into the upper part of the peat unit, which has shown to be fragmented in several places (e.g. at sample location C18). However, field observations have shown the peat to be generally highly consolidated and completely dry and flaky inside the core barrel upon recovery from the seabed, which demonstrates the natural origin of the material and its generally uncontaminated character.

The scientific argument for natural background concentrations of arsenic in the peat is outlined in **Section 4.2.2.2**, and in accordance with the suggested methodology in the NAGD ("Comparison of Data to Ambient Baseline Concentrations" p 38).

4.3.1 PAHs in Consolidated Peat and Unconsolidated Sediments in Dredge Area 3

The concentrations of total PAHs in sediments in Dredge Area 3 vary between the analytical limit of reporting (<5 μg/kg for individual PAH compounds) and 1,855 μg/kg (normalized to 1% TOC), which is less than 20% of the NAGD Screening Level for total PAHs (10,000 μg/kg). Therefore PAHs do not represent a contaminant group that may be of potential concern in sediments in Dredge Area 3.

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous in the aquatic environment, as they form during incomplete combustion of organic matter and consequently have numerous sources. Sources of anthropogenic combustion include combustion of fossil fuels, coal gasification and liquification processes, waste incineration and production of coke, carbon black, coal tar pitch, asphalt and petroleum cracking (McCready et al., 2000). Apart from combustion processes, another common anthropogenic source of PAHs is spillage of fossil fuels including unrefined (crude oil) and refined products (e.g. petrol). PAHs also stem from natural combustion sources such as forest fires, and certain compounds (perylene and retene) are thought to be produced diagenetically (Wakeham *et al*., 1980).

PAHs are also produced by combustion of wood during bushfires and the widespread distribution of these compounds in lower Hawkesbury–Nepean River sediments north of Sydney suggests that natural contributions from burnt organic matter originating from bushfires over long periods may have

contributed to the presence of these compounds in sediments across the region (Matthai et al., 2009). Although site-specific background concentrations for sediments in the Hawkesbury River are not available at present, mean total PAH concentrations of 55 mg/kg attributable to natural sources have been identified in sediments of freshwater creeks (Costa et al. 2004). In contrast, the natural PAH concentrations in marine sediments are generally substantially lower due to a dilution in the contributions of PAH-bearing combustible particulates with greater distance from terrestrial sources (Ricking & Schulz 2002).

Perylene is the dominant PAH compound present in the peat layer in sediments in Dredge Area 3, which is exemplified in **Figure 8**. Generally more than 50% of the total PAHs present within the peat comprises perylene (range in peat: 74-532 µg/kg). Therefore the perylene in the peat is likely to be of natural (i.e. non-anthropogenic) origin. An increase in concentrations of perylene in deeper and older sediments suggests an *in situ* formation of perylene from biogenic precursors under anaerobic conditions during early diagenesis, as was observed in sediments in San Pablo Bay, San Francisco, USA (Pereira et al., 1999).

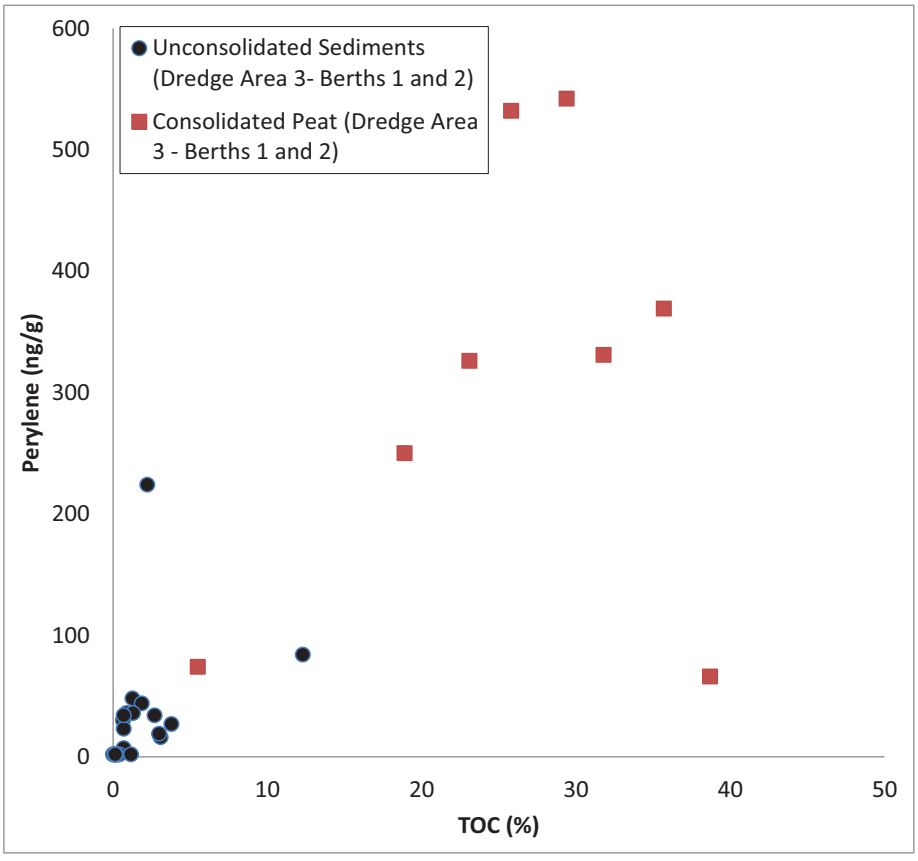


Figure 8. Total organic carbon content vs concentrations of perylene in sediments and peat in Dredge Area 3.

4.3.2 TPHs in Surficial Sediments in Dredge Area 3

In addition to the presence of naturally occurring PAHs in the peat (see **Section 4.3.1**), the concentrations of total petroleum hydrocarbons (TPHs) have previously shown to exceed the analytical limits of reporting in the six (6) sediment samples that were analysed from Dredge Area 3 in the 2009 and 2011 investigations, although the mean concentration of TPHs from these six (6) samples was 51 mg/kg (i.e. <1/10th the NAGD Screening Level). It was decided to include additional TPH analyses of twelve (12) surficial sediment samples from the upper 0.5 m of sediment, including both consolidated peat and unconsolidated muddy sand, to confirm that the concentrations of TPHs (C10-C36 fraction) are generally low in sediments throughout Dredge Area 3. Concentrations of the sum of TPHs (C10-C36 fraction) (normalized to 1%TOC) varied between 8 mg/kg and 138 mg/kg, which is substantially below the NAGD Screening Level concentration of 550 mg/kg.

Therefore TPHs do not represent a contaminant of potential concern in sediments of Dredge Area 3. The analytical results for TPHs are summarized in **Table 9** and in **Appendix 4**.

4.4 Spatial Distribution of TBT in Dredge Area 3

The concentrations of TBT (normalized to 1% TOC) in whole sediments in Dredge Area 3 are generally below the analytical limits of reporting and the NAGD Screening Level (9 μgSn/kg). The NAGD Screening Level for TBT was exceeded in sediments at only three (3) sample locations out of 27 locations across the two berths (i.e. sample locations SS3B and VC5E located within 20 m of each other in the central part of Berth 1 near the jetty, and sample location VC5B (upper 0.8 m of sediments) in the central part of Berth 2 and within 5 m adjacent to the jetty).

4.5 Suitability of Dredge Material From Dredge Area 3 For Sea Disposal

Based on the results of the geochemical analysis of sediments, elutriate testing, dilution modelling and bioavailability testing the following recommendations are made regarding the suitability of the sediments to be dredged from Dredge Area 3 for sea disposal.

Sediments from Dredge Area 3 contained elevated concentrations of TBT. The 95% UCL of the mean TBT concentration in sediments in Dredge Area 3 exceeded the NAGD Screening Level of 9 μgSn/kg (**Table 9**).

Elutriate concentrations of TBT from sediments in Dredge Area 1 exceeded the water quality guideline value of 6 ng/L in only one (1) of eight (8) samples (i.e. 43 ngSn/L in sample VC5B_0.0-0.8 collected in November 2011).

Using numerical dilution modelling for the 95% UCL (i.e. backhoe loading a split hopper barge (no overflowing), it was calculated that the maximum concentration of TBT in the water at the Sydney Offshore Spoil Ground, following initial mixing, would be well below the water quality guideline (WQG) values for 95% species protection for TBT (**Appendix 5**). Continuous exceedance of the WQG for TBT in marine waters near the Sydney Offshore Spoil Ground is therefore unlikely following the offshore disposal of the dredged material from Dredge Area 3.

Toxicity testing for TBT was previously undertaken (Appendix 1) and not required as part of the supplementary assessment of sediments in Dredge Area 3.

Based on the chemical tests, the sediments in Dredge Area 3 (Berths 1 and 2) are considered to be suitable for unconfined ocean disposal at the designated Sydney Offshore Spoil Ground.

4.6 Acid Sulfate Soils

An assessment of acid generating risk was undertaken during the November 2009 and November 2011 investigations and no further assessment was undertaken in the supplementary sediment assessment. Results of the previous acid sulfate soil investigation are provided in WorleyParsons (2012) (**Appendix 1**).

4.7 Data Validation

Tabulated results for field triplicates, split triplicates and duplicates, and field blanks are provided in **Table 11**. Analytical data validation for the previous investigations in 2009 and 2011 are provided in **Appendix 1 (WorleyParsons, 2012)**.

Table 11. Data Validation Summary of the Field QA/QC Results of the Chemical Analyses of Sediments in Dredge Area 3 the 2012 Investigation

			Metals															
	Moisture Content (dried @ 103°C)	TOC	Al	Fe	Sb	As	Cd	Cr	Cu	Co	Pb	Mn	Ni	Se	Ag	V	Zn	Hg
Field Triplicate 1 (Data Quality Objective: <50% RSD)																		
C2_0.0-0.5	27.4	1.27	4090	5870	<0.50	6.59	0.2	26.2	15	1.2	28.3	27	3.9	<0.1	0.3	12.3	102	0.44
T01A	29.5	1.74	4650	7040	<0.50	8.12	0.2	30.3	18.1	1.4	34.6	30	4.3	<0.1	0.3	13.9	128	0.5
T01B	29.1	1.81	5100	7740	<0.50	9.64	0.3	37.9	18.1	1.5	35.2	31	4.8	<0.1	0.4	15.9	130	0.69
Average	28.7	1.61	4613	6883	<LOR	8.12	0.23	31.5	17.1	1.4	32.7	29	4.3	<LOR	0.3	14.0	120	0.54
SD	1.1	0.29	506	945	NA	1.53	0.06	5.9	1.8	0.2	3.8	2	0.5	NA	0.1	1.8	16	0.13
RSD (%)	3.9	18.3	11.0	13.7	NA	18.8	24.7	18.9	10.5	11.2	11.7	7.1	10.4	NA	17.3	12.9	13.0	24.0
Field Triplicate 2 (Data Quality Objective: <50% RSD)																		
C11_0.0-0.35	25.6	3.78	1510	2320	<0.50	3.51	<0.1	5.8	7.8	0.5	12	11	1.6	<0.1	<0.1	5.5	51.6	0.06
T02A	25.5	1.33	1590	2110	<0.50	2.65	<0.1	6.1	4.6	<0.5	8.5	12	1.9	<0.1	<0.1	5.7	31	0.05
T02B	22.9	2.12	1410	1860	<0.50	3.39	<0.1	5.3	3.9	<0.5	7.2	5	1.5	<0.1	<0.1	5.3	26.2	0.05
Average	24.7	2.41	1503	2097	<LOR	3.18	<LOR	5.7	5.4	<LOR	9.2	9	1.7	<LOR	<LOR	5.5	36	0.05
SD	1.5	1.25	90	230	NA	0.47	NA	0.4	2.1	NA	2.5	4	0.2	NA	NA	0.2	13	0.01
RSD (%)	6.2	51.9	6.0	11.0	NA	14.6	NA	7.0	38.3	NA	26.9	40.6	12.5	NA	NA	3.6	37.2	10.8
Split Duplicate (Data Quality Objective: <35% RPD)																		
C6_0.0-0.13	65.8	35.7	8620	5810	0.51	52.3	<0.1	20.1	5.6	3.3	3.2	12	8.7	3.7	<0.1	77.9	7.1	0.08
QC1	63.4	37.4	9050	7480	<0.50	42.9	<0.1	15.6	4.6	2.4	2.8	13	7.4	2.3	<0.1	51.6	7.8	0.05
Mean	64.6	36.6	8835	6645	<LOR	47.6	<LOR	17.9	5.1	2.9	3.0	13	8.1	3.0	<LOR	64.8	7.5	0.07
% RPD	4	-5	-5	-25	NA	20	NA	25	20	32	13	-8	16	47	NA	41	-9	46
Split Duplicate (Data Quality Objective: <35% RPD)																		
C10_0-0.50	23.3	0.65	2060	2730	<0.50	3.36	<0.1	10.2	5.1	0.6	9.8	14	2.2	<0.1	0.1	6.9	25.5	0.14
QC6	22.2	0.58	2210	3120	<0.50	3.75	<0.1	14.1	27.6	0.6	11	15	2.5	<0.1	0.1	6.6	79.6	0.14
Mean	22.8	0.62	2135	2925	<LOR	3.56	<LOR	12.2	16.4	0.6	10.4	15	2.4	<LOR	0.1	6.8	52.6	0.14
% RPD	5	11	-7	-13	NA	-11	NA	-32	-138	0	-12	-7	-13	NA	0	4	-103	0
Field Blanks (DQO: close to LOR)																		
QC3	5.4	NA	480	1350	<0.50	3.62	<0.1	1.6	<1.0	<0.5	<1.0	12	<1.0	<0.1	<0.1	2.8	1.6	<0.01
QC4	5.1	NA	470	1390	<0.50	3.82	<0.1	1.6	<1.0	<0.5	<1.0	14	<1.0	<0.1	<0.1	3	1.6	<0.01
QC10	<1.0	NA	530	1580	<0.50	4.3	<0.1	1.9	<1.0	<0.5	<1.0	14	<1.0	<0.1	<0.1	3.4	2.1	<0.01
Average	ND	ND	493	1440	<LOR	3.9	<LOR	1.7	<LOR	<LOR	<LOR	13.3	<LOR	<LOR	<LOR	3.1	1.8	<LOR
SD	ND	ND	32	123	NA	0.3	NA	0.2	NA	NA	NA	1.2	NA	NA	NA	0.3	0.3	NA
RSD (%)	ND	ND	6.5	9	NA	8.9	NA	10.2	NA	NA	NA	8.7	NA	NA	NA	10.0	16.3	NA
Mean of Split Duplicate/Interlaboratory sample (Data Quality Objective: <35% RPD)																		
Mean C6_0.0-0.13 and QC1	64.6	36.6	8835	6645	<LOR	48	<LOR	18	5.1	2.9	3	13	8.1	3.0	<LOR	65	7.5	0.07
QC2	64.7	42.8	NA	NA	<0.50	35	<0.1	13	4.0	2.5	2	11	6.2	2.3	<0.1	47	6.3	0.06
Average	64.7	39.7	ND	ND	<LOR	41.3	<LOR	15.4	4.6	2.7	2.5	11.8	7.1	2.7	<LOR	55.9	6.9	0.1
% RPD	0	-16	ND	ND	NA	31	NA	31	24	13	40	13	26	26	NA	32	17	8
Mean of Split Duplicate/Interlaboratory sample (Data Quality Objective: <35% RPD)																		
Mean of C10_0-0.50 and QC6	22.8	0.62	2135	2925	<LOR	3.6	<LOR	12.2	16.4	0.60	10.4	15	2.4	<LOR	0.1	6.8	53	0.14
QC7	22.1	0.60	na	na	<0.50	3.8	<0.1	11	5.6	0.59	10.0	16	2.5	0.55	<0.1	7.1	26	0.17
Average	22.4	0.61	ND	ND	<LOR	3.7	<LOR	11.6	11.0	0.60	10.2	15	2.4	<LOR	<LOR	6.9	39	0.16
% RPD	3	2	ND	ND	NA	-7	NA	10	98	2	4	-10	-6	NA	NA	-5	68	-19

	PAHs																					
	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Benzo(g.h.i)perylene	Dibenz(a.h)anthracene	Indeno(1.2.3.cd)pyrene	Coronene	Sum of PAHs	TBT raw
Field Triplicate 1 (Data Quality Objective: <50% RSD)																						
C2_0.0-0.5	<5	<5	28	7	10	82	24	102	94	74	59	90	35	52	82	48	44	<4	28	2.5	859	2.0
T01A	<5	<5	33	14	17	146	26	153	144	129	113	149	39	108	102	38	90	<4	53	28	1380	2.7
T01B	<5	<5	36	15	17	176	33	208	196	148	126	155	38	103	111	38	88	<4	57	27	1570	3.0
Average	<LOR	<LOR	32	12	15	135	28	154	145	117	99	131	37	88	98	41	74	<LOR	46	19	1270	2.6
SD	NA	NA	4	4	4	48	5	53	51	38	36	36	2	31	15	6	26	NA	16	14	368	0.5
RSD (%)	NA	NA	12.5	36.3	27.6	35.7	17.1	34.3	35.3	32.8	35.8	27.4	5.6	35.3	15.1	14.0	35.1	NA	34.2	75.4	29.0	20.0
Field Triplicate 2 (Data Quality Objective: <50% RSD)																						
C11_0.0-0.35	10	<5	5	<4	<4	41	<4	56	52	38	21	49	11	21	35	27	26	<4	26	12	430	5.4
T02A	<5	<5	5	<4	<4	24	4	28	27	19	17	20	6	13	16	14	11	<4	8	<5	212	3.6
T02B	<5	6	<4	<4	<4	21	4	31	31	23	20	29	12	18	25	25	21	<4	14	<5	280	5.1
Average	<LOR	<LOR	<LOR	<LOR	<LOR	29	<LOR	38	37	27	19	33	10	17	25	22	19	<LOR	16	<LOR	307	4.7
SD	NA	NA	NA	NA	NA	11	NA	15	13	10	2	15	3	4	10	7	8	NA	9	NA	112	1.0
RSD (%)	NA	NA	NA	NA	NA	37.6	NA	40.1	36.6	37.6	10.8	45.4	33.3	23.3	37.5	31.8	39.5	NA	57.3	NA	36.3	20.5
Split Duplicate (Data Quality Objective: <35% RPD)																						
C6_0.0-0.13	<5	<5	<5	<5	<5	7	<5	14	<5	6	16	34	13	24	19	369	<5	<5	<5	<5	502	<0.5
QC1	<5	<5	<5	<5	<5	6	<5	13	<5	7	15	32	13	22	16	381	11	<5	10	<5	526	<0.5
Mean	<LOR	<LOR	<LOR	<LOR	<LOR	6.5	<LOR	13.5	<LOR	6.5	15.5	33	13	23	17.5	375	<LOR	<LOR	<LOR	<LOR	514	<LOR
% RPD	NA	NA	NA	NA	NA	15	NA	7	NA	-15	6	6	0	9	17	-3	NA	NA	NA	NA	-5	NA
Split Duplicate (Data Quality Objective: <35% RPD)																						
C10_0-0.50	<5	<5	34	<4	18	129	42	133	112	84	64	108	39	69	85	30	36	7	25	7	1020	2.7
QC6	<5	<5	17	<4	5	42	13	80	72	76	39	66	19	57	42	17	45	<4	19	13	622	2.0
Mean	<LOR	<LOR	26	<LOR	12	86	28	107	92	80	52	87	29	63	64	24	41	<LOR	22	10	821	2.4
% RPD	NA	NA	67	NA	113	102	105	50	43	10	49	48	69	19	68	55	-22	NA	27	-60	48	30
Mean of Split Duplicate/Interlaboratory sample (Data Quality Objective: <35% RPD)																						
Mean C6_0.0-0.13 and QC1	<LOR	<LOR	<LOR	<LOR	<LOR	6.5	<LOR	13.5	<LOR	6.5	16	33	13	23	18	375	<LOR	<LOR	<LOR	<LOR	514	<LOR
QC2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	23	55		22	14	690	14	<10	21	<20	840	1.4
Average	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	19	NA	NA	23	16	533	<LOR	<LOR	<LOR	<LOR	677	<LOR
% RPD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-39	NA	NA	4	22	-59	NA	NA	NA	NA	-48	NA
Mean of Split Duplicate/Interlaboratory sample (Data Quality Objective: <35% RPD)																						
Mean of C10_0-0.50 and QC6	<LOR	<LOR	26	<LOR	11.5	86	28	107	92	80	52	87	29	63	63.5	23.5	40.5	<LOR	22	10	821	2.4
QC7	7	<5.0	7	<5.0	<5.0	16	<5.0	38	39	25	23	58		24	33	20	25	<5.0	20	<10	330	2.4
Average	<LOR	<LOR	16	<LOR	<LOR	51	<LOR	72	66	53	37	NA	NA	44	48	22	33	<LOR	21	<LOR	575.5	2.4
% RPD	NA	NA	114	NA	NA	137	NA	95	81	105	77	NA	NA	90	63	16	47	NA	10	NA	85	-2

4.7.1 Field QA/QC samples

SEDIMENT DUPLICATES AND TRIPLICATES

Two (2) field triplicate samples were collected from two (2) sample locations during the August 2012 investigation to identify any variability of the sediments' chemical characteristics at a particular site. The relative standard deviation (RSD) was calculated for each contaminant (**Table 11**). The NAGD recommends that field replicates should agree within an RSD of +/-50% although the guidelines note "they may not always do so where the sediments are very heterogeneous or greatly differing in grain size". The RSD analysis of the chemical properties of the sample shows that the RSD was within the recommended +/-50% for all analytes in both triplicate samples, except for Coronene in Field Triplicate 1 (75.4% RSD) and TOC (51.9% RSD) and Indeno(1.2.3.cd)pyrene (57.3% RSD) in Field Triplicate 2.

The concentrations of these two organic PAH compounds were generally low and comprised <5% of the overall sum of the concentrations of all PAHs. Therefore the exceedances of the data quality objective (DQO) for Coronene and Indeno(1.2.3.cd)pyrene are unlikely to affect the overall assessment of the concentrations of total PAHs for which there is a NAGD Screening Level value.

Split triplicates were collected at two (2) locations in the August 2012 investigation. The third of the split triplicate samples were sent to a secondary laboratory (AAA) for analysis.

The recommended RPD limits (DQO: <35% RPD) were exceeded in one (1) of the two (2) split samples for total PAHs (i.e. split duplicate pair C10_0.0-0.50 and QC6). An inspection of the core log for sample location C10 indicates that the olive gray-green muddy sand grades into sand at 0.3-0.5 m depth, which despite a thorough homogenization of the sample (which also included an interlaboratory duplicate sample QC7) may indicate that the presence of PAHs within the sediments is inhomogeneous and possibly due to variations in sediment particle size, which could explain the large variability of PAHs in both the split duplicate and the interlaboratory duplicate (**Table 11**).

The split samples C10_0.0-0.50 and QC6 also exceeded the DQO of 35% RPD for Cu and Zn, which is also likely to be the result of the inhomogeneous distribution and particle-size-related nature of the concentrations of these two trace metals in sediments at this sample location, as supported by the field observations and the core log for sample location C10.

In contrast, the recommended RPD limits in the second split duplicate sample pair (C6_0.0-0.13 and QC1) were below 35% RPD for all analytes (i.e. including all PAHs), with the exception of Se (47% RPD), V (41% RPD) and Hg (46% RPD), suggesting a substantially lower degree of sample inhomogeneity and a higher analytical data reproducibility in sediments at sample location C6 compared to sample location C10.

Two (2) interlaboratory split samples were also submitted to AAA (Samples QC2 (Primary sample: C10_0.0-0.13) and QC7 (Primary sample: C10_0.0-0.50). The interlaboratory sample analysis showed that there were exceedances of the DQO (<35% RPD) for the interlaboratory sample from

sample location C10 (i.e. individual PAHs, Zn and Cu), which is likely due to the highly variable sediment texture observed in the upper 0.5 m at that location, and with muddy sand grading into sand below about 0.3 m depth. In contrast, the interlaboratory sample from sample location C6 has shown to provide a substantially better data reproducibility, with RPDs <35% for all analytes, with the exception of Pb (40% RPD), Chrysene (39% RPD), Perylene (59% RPD) and the sum of total PAHs (48% RPD).

SEDIMENT FIELD BLANKS

Daily field blanks were submitted as part of the QA/QC procedures during the August 2012 investigations to detect cross contamination from trace metals during sample handling and transportation. The results showed that all analytes were at or below the analytical LOR, with RSDs for the three triplicate samples collected over the three day sampling period <20% for analytes which were above the LOR in all three blank samples, suggesting that cross-contamination from secondary sources is unlikely in the applied sampling methodology.

ELUTRIATES

A split duplicate sample was also submitted for elutriate TBT testing (sample pair C2_0.0-0.5 and QC5). The RPD for the elutriate TBT (<LOR) results (RPD: 0.8%) were within the 35% RSD criteria (**Table 12**). The seawater used in the elutriate tests was tested for background concentrations of TBT. TBT was not detected in the blank sample, so a correction was not required.

Table 12. Split Duplicate Sample Analyses for Elutriate Samples C2_0.0-0.5 and QC5.

Elutriate QA/QC (DQO: <35% RSD)	
Sample ID	**TBT**
C2_0.0-0.5	<2
QC5	<2
Mean	<2
RPD (%)	nc

4.7.2 Geochemical Laboratory QA/QC

Laboratory quality assurance of the analytical data comprised an analysis of laboratory duplicates, method blanks, laboratory controls samples and matrix spikes as described below. The results of this quality assurance are shown within the laboratory reports (**Appendix 4**).

LABORATORY DUPLICATES

The NAGD recommends that laboratory duplicates should not exceed an RPD of 35%. This range was met for all analytes, with the exception of the following:

- Co and Ni in sample C8_0.0-0.12;
- Se in sample C10_0-0.50;

- Benz(a)anthracene and Sum of PAHs in sample C11_0.0-0.35;
- Co in an anonymous sample; and
- Benz(a)anthracene and Sum of PAHs in an anonymous sample.

The Laboratory QC samples at ALS are randomly picked from a range of samples and an anonymous sample indicate a sample picked from another client batch.

All other RPD results for these samples were within 35%, indicating that the concentrations of Co, Ni, Se and PAHs in sediments at these locations are variable.

MATRIX SPIKES

- Coronene in sample C11_0.0-0.35 greater than recovery limit;
- Tripropyltin in sample C12_0.5-1.0 greater than recovery limit;
- Perylene in sample C13_0-0.50 below the recovery limit;
- TBT, 2-Fluorobiphenyl in sample C18_0.0-0.5 greater than recovery limit; and
- 2-Fluorobiphenyl in sample T02A greater than recovery limit.

Matrix spikes for some individual PAHs and TBT were not determined due to sample matrix interference. Some individual PAHs, TBT and Tripropyltin were reported as less than, or exceeding the recommended recovery limits, indicating matrix interference or sample heterogeneity.

Not determined:

- Individual PAHs in sample C11_0.0-0.35;
- TBT in sample C17_0.0-0.5; and
- Individual PAHs in sample ‘Anonymous’.

Laboratory control spikes were within the recovery limits for all analytes.

INTERLABORATORY DUPLICATES

For the interlaboratory samples that were analysed by Advanced Analytical Australia, the laboratory duplicates were within an RPD of 35%, with the exception of a number of individual PAHs and the total PAHs. This indicates that the concentrations of PAHs in sediments at sample location C10 are variable, as previously indicated in **Section 4.7.1**.

The matrix spikes for the interlaboratory samples for perylene and monobutyl tin were reported as less than or exceeding the recommended recovery limits, indicating matrix interference or sample heterogeneity.

ELUTRIATE DATA LABORATORY QA/QC

Laboratory duplicates and matrix spikes for analyses of TBT have shown to be within the laboratory’s recovery limits for all samples and for TBT. Therefore elutriate data are acceptable for interpretation under the NAGD.

4.7.3 Summary of Field and Laboratory QA/QC

Based on the above interpretation of the field and laboratory QA/QC data, the analytical data are acceptable for interpretation under the NAGD. Although the concentrations of Co, Ni, Se, PAHs, and TBT in laboratory duplicates and matrix spikes have exceeded the stipulated DQOs these analytes have not shown to be contaminants of concern in the current investigation (Note: Concentrations of TBT have shown to be substantially below the NAGD Screening Level in all sediment samples collected in August 2012).

5 KEY FINDINGS

The supplementary sediment sampling and testing program detailed herein was undertaken to characterise the physical and chemical properties of sediment from the modified dredge footprint within Dredge Area 3 (Berths 1 and 2), including an assessment of sediment to the depth of dredging or consolidated sediment (i.e. peat) across the dredge footprint. The three stages of the investigation in 2009, 2011 and 2012 were carried out in accordance with the NAGD (Commonwealth of Australia, 2009) and the relevant SAP's (WorleyParsons, 2009; WorleyParsons, 2011; WorleyParsons, 2012b). Results were compared to relevant guideline values for sea disposal of the maintenance dredge material.

The key findings of the investigation are as follows:

- Sediments within Dredge Area 3 are dominated by unconsolidated muddy sands and sands in the surficial sediments and consolidated peat, which underlies unconsolidated sediments or is present at the surface in the central area of Berth 1 and the northern part of Berth 2. While the overall average fine fraction content (<75 μm) in sediments in Dredge Area 3 is 15%, consolidated peat samples contain in excess of about 30% and up to 47% fine fraction content. Total organic carbon contents are highly variable between the sands and muddy sands (<3% TOC) and peat (~20-40% TOC);
- Comparison of the results to the guidelines for sea disposal, i.e. the Screening Levels provided in Appendix A, Table 2 of the NAGD and the ANZECC ISQG low and high levels indicated:
    - TBT (based principally on elevated concentrations at three (3) sample locations near the jetty sampled in the 2009 and 2011 investigations) exceeded the respective NAGD Screening Level at the 95% UCL of the mean, requiring further testing, including elutriate testing;
    - the 95% UCL of the mean for all other trace metals, total PAHs and total TPHs were below respective NAGD Screening Levels when calculated for the combined sediment data from the 2009, 2011 and 2012 investigations;
- Analytical results for TPHs and PAHs indicate that surface sediments in Dredge Area 3, including consolidated peat, contain concentrations below NAGD Screening Levels in all samples analysed;
- Elutriate TBT concentrations in samples from 2012 were all below analytical limits of reporting, with the 90th percentile of TBT for the total of eight (8) samples (excluding calculated dilutions) exceeding the ANZECC/ARMCANZ (2000) water quality guideline value, due to a single elevated TBT concentration in one (1) sample collected at sample location VC5B in November 2011;

- Dilution modelling for disposal of dredged sediments from Dredge Area 3 at the Sydney Offshore Spoil Ground using the numerical method and results of the elutriate testing for the 95% UCL of Dredge Area 3 indicated that the maximum concentration of TBT in the water following initial mixing for a dredging model that includes backhoe loading a split hopper barge (no overflowing) would be substantially below the water quality guideline (WQG) values for 95% species protection for TBT (**Appendix 5**). Therefore the concentrations of TBT in sediments in Dredge Area 3 are unlikely to adversely affect water quality during disposal at the Sydney Offshore Spoil Ground;
- Whole sediment toxicity testing and elutriate toxicity testing undertaken in 2011 indicated that all test sediments were considered to be non-toxic with respect to TBT (WorleyParsons, 2012) (**Appendix 1**). Additional toxicity testing of sediments sampled in Berths 1 and 2 (Dredge Area 3) in August 2012 is unnecessary, as the concentrations of TBT in all sediment samples obtained in August 2012 were below the NAGD Screening Level of TBT as well as below the ANZECC (2000) water quality guideline value (95% species protection) (i.e. <LOR – 2 ngSn/L in all elutriate samples collected in August 2012); and
- Field and laboratory QA/QC methodology was acceptable.

Based on the chemical and elutriate and bioavailability testing, and supported by the previous sediment toxicity testing and elutriate toxicity testing undertaken in 2011, the sediments in Dredge Area 3 (Berths 1 and 2) are considered to be suitable for unconfined ocean disposal at the designated Sydney Offshore Spoil Ground.

6 REFERENCES

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging.

Costa, H.J., White K.A. and Ruspantini, J.J. (2004). Distinguishing PAH background and MPG residues in sediments of a freshwater creek. *Environmental Forensics* **5**, 171–182.

Matthai, C., Guise, K., Coad, P., McCready, S. and Taylor, S. (2009). Environmental status of sediments in the lower Hawkesbury-Nepean River, New South Wales, *Australian Journal of Earth Sciences* **56**,225-243.

McCready, S., Slee, D.J., Birch, G.F. and Taylor, S.E. (2000). The Distribution of Polycyclic Aromatic Hydrocarbons in Surficial Sediments of Sydney Harbour, Australia. *Marine Pollution Bulletin* **40**, 999-1006.

Simpson, S.L., Batley, G.E. and Chariton, A.A. (2008) Revision of the ANZECC/ARMCANZ sediment quality guidelines. Draft, CSIRO Land and Water Report No. 8/07, August 2008. Prepared for the Commonwealth Department of the Environment, Heritage, Water and the Arts.

Pereira, W.E., Hostettler, F.D., Luoma, S.N., van Geen, A., Fuller, C.C. and Anima, R.J. (1999). Sedimentary record of anthropogenic and biogenic polycyclic aromatic hydrocarbons in San Francisco Bay, California. *Marine Chemistry*, **64**, 99-113.

Ricking M. and Schulz H-M. (2002). PAH-profiles in sediment cores from the Baltic Sea. *Marine Pollution Bulletin* **6**, 565–570.

Wakeham, S.G., Schaffner, C. and Giger, W. (1980). Polycyclic aromatic hydrocarbons in recent lake sediments. II. Compounds derived from biogenic precursors during early diagenesis. *Geochimica et Cosmochimica Acta*, **44**, 415-429.

WorleyParsons (2009) Caltex Maintenance Dredging Sampling and Analysis Plan. Prepared for Caltex Australia Petroleum Australia Pty Ltd, 2009.

WorleyParsons (2010) Caltex Maintenance Dredging Sampling and Analysis Plan. Prepared for Caltex Australia Petroleum Australia Pty Ltd, March 2010.

WorleyParsons (2011) Caltex Dredging Supplementary Sampling and Analysis Plan. Prepared for Caltex Refineries NSW Pty Ltd, September 2011.

WorleyParsons (2012) Caltex Dredging - Sediment Sampling and Analysis Plan Implementation Report – Final Report. Prepared for Caltex Refineries NSW Pty Ltd, June 2012.

WorleyParsons (2012b) Caltex Dredging Supplementary Sampling and Analysis Plan. Prepared for Caltex Refineries NSW Pty Ltd, June 2012.

Appendix 1 WorleyParsons (2012) Caltex Dredging - Sediment Sampling and Analysis Plan Implementation Report – Final Report. Prepared for Caltex Refineries NSW Pty Ltd, June 2012

See Technical Appendix D1

Appendix 2 Botany Bay, Sydney, NSW - Supplementary Sampling and Analysis Plan (Caltex Berths 1 and 2 – Dredge Area 3) (August 2012)

WorleyParsons

resources & energy

EcoNomics

CALTEX REFINERIES NSW PTY LTD

Botany Bay, Sydney, NSW

Supplementary Sampling and Analysis Plan (Caltex Berths 1 and 2 – Dredge Area 3)

301015-02851 – Supplementary SAP_Rev0.doc

6 August 2012

Level 11, 141 Walker Street,
North Sydney NSW 2060
Australia
Telephone: +61 2 8923-6798
Facsimile: +61 2 8923-6877
www.worleyparsons.com
ABN 61 001 279 812

WorleyParsons

resources & energy

EcoNomics

CALTEX REFINERIES NSW PTY LTD
CALTEX DREDGING
SUPPLEMENTARY SAMPLING AND ANALYSIS PLAN

Confidentiality

This document has been prepared for the sole purpose of documenting our Supplementary Sampling and Analysis Plan to undertake sediment sampling in Dredge Area 3 (Berths 1 and 2).

It is expected that this document and its contents will be treated in strict confidence by Caltex Refineries NSW Pty Ltd.

PROJECT 301015-02851 – CALTEX SUPPLEMENTARY SAMPLING

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	CM	VS	DA	26-07-12	N/A	
B	Issued for Caltex Review	CM	BT	DA	03-08-12	CH	06-08-12
0	Issued for SEWPaC review	CM	BT	DA	06-08-12		

CONTENTS

ACRONYMS and ABBREVIATIONS

AAA	Advanced Analytical Australia
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CBD	Central Business District
CD	Chart Datum
DEWHA	Department of Environment, Water, Heritage and the Arts
LOR	Limit of Reporting
MGA 94	Map Grid of Australia (1994)
NAGD	National Assessment Guidelines for Dredging
NATA	National Association of Testing Authorities
OCPs	Organochlorine Pesticides
OPPs	Organophosphorus Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SEWPAC	Department of Sustainability, Environment, Water, Populations and Communities
SPC	Sydney Ports Corporation
TBT	Tributyltin
TOC	Total Organic Carbon
TPHs	Total Petroleum Hydrocarbons
VOCs/SVOCs	Volatile Organic Compounds/Semi Volatile Organic Compounds
UCL	Upper Confidence Limit

1 INTRODUCTION

Caltex Refineries (NSW) Pty Ltd (Caltex) is responsible for the maintenance of their port facilities in Botany Bay in association with their refinery at Kurnell on the southern side of Botany Bay (Sydney, NSW) as well as port facilities within the bay. The facilities comprise the Caltex Wharf located to the west of Sutherland Point, and associated berths and approaches.

1.1 History of Dredge Area

Three recent sediment investigations were undertaken by WorleyParsons in November 2009, March 2010 and November 2011 to determine the suitability of the dredge material for unconfined sea disposal in association with the formerly proposed maintenance dredging in three separate Dredge Areas:

- Dredge Area 1 - Approaches and Swing Basin (to be dredged to -12.8 m relative to Chart Datum (CD));
- Dredge Area 2: Sub-berth (to be dredged to -14.0 m CD); and
- Dredge Area 3: Fixed Berths 1 and 2 (to be dredged to -12.8 m CD).

The testing was undertaken in accordance with the National Assessment Guidelines for Dredging (NAGD) (Commonwealth of Australia, 2009) and indicated that the dredge material in Dredge Areas 1, 2 and 3 was suitable for ocean disposal at the designated Sydney Offshore Spoil Ground (WorleyParsons, 2012) (**Appendix 1**).

A preliminary investigation was undertaken in November 2009 to characterise the physical properties and the types, concentrations and bioavailability of chemicals present in the proposed dredge material. The dredging requirements were determined from the Sydney Ports Corporation (SPC) (2007) hydrographic survey, which was. the most recent hydrographic survey available at the time of sampling.

A Sampling and Analysis Plan (SAP) was prepared for the preliminary investigation in accordance with the NAGD. However, due to the need to fit in with Caltex shipping movements at short notice, the SAP was not submitted to the Department of Environmental, Water, Heritage and the Arts (DEWHA) (now the Department of Sustainability, Environment, Water, Populations and Communities - SEWPAC) for review prior to sampling.

The results of the preliminary investigation indicated that elevated concentrations of tributyltin (TBT) were present in some sediments in the areas sampled. In addition, subsequent discussions with the SPC pilots and review of the SPC (2009) hydrographic survey determined that the required dredge footprint was larger than the footprint investigated in the preliminary investigation.

Therefore, a further investigation was undertaken to:

- Characterise the chemical properties of sediment from within the expanded areas of the dredge footprint; and
- Assess the bioavailability and toxicity of TBT with depth across the dredge footprint.

An SAP (WorleyParsons, 2010) was prepared for the additional investigation and submitted to DEWHA (now SEWPAC) for review in February 2010 and approved on 5 March 2010, following minor requested amendments. Supplementary sediment sampling was undertaken in March 2010 in accordance with the approved SAP. The analytical results indicated that, while elevated concentrations of TBT were observed in elutriates, dilution modelling using the numerical method for material from the combined Dredge Areas 1, 2 and 3 determined that the concentrations of TBT in the dredge material would not be of concern to water quality during disposal at the Sydney Offshore Spoil Ground. In addition, toxicity was not observed by whole sediment or elutriate toxicity testing.

Following the second sediment sampling program in March 2010, it was identified that additional sampling and testing was required in association with the proposal by Caltex to undertake capital dredging in a portion of the dredge footprint to:

- Meet the required minimum number of samples specified in the NAGD, due to the increase in dredge volume since the previous sediment sampling and testing;
- Provide a better spatial and vertical coverage of the three proposed Dredge Areas; and
- Identify whether, following an oily water discharge from the Caltex Refinery in March 2011, any hydrocarbon contamination was present in the surface sediments within the proposed Dredge Areas.

A Supplementary SAP (WorleyParsons, 2011) was prepared for the additional sediment investigation, specifying the program of sampling and testing that would be undertaken in accordance with the NAGD. The Supplementary SAP also provided details on the methodology and results from the two previous investigations. The Supplementary SAP was submitted to SEWPAC for review on 20 September 2011. Comments on the Supplementary SAP were received from SEWPAC on 27 October 2011 and the third sediment sampling and analysis investigation was completed in November 2011 in accordance with the Supplementary SAP (WorleyParsons, 2011) and the review comments that were provided by SEWPAC on 27 October 2011 (**Appendix 1**).

1.2 Purpose and Objectives of SAP

The purpose of this Supplementary Sampling and Analysis Plan (SAP) is to describe and justify the additional sediment sampling and analysis in Dredge Area 3 (Berths 1 and 2). This Supplementary SAP should be considered in association with the SAP Implementation Report for Dredge Areas 1-3 that was prepared following the most recent sediment sampling investigation in November 2011 and

which includes a summary of the three previous sediment investigations (WorleyParsons, 2012) (**Appendix 1**).

Since the completion of the previous sediment investigations, the latest of which was undertaken in November 2011, Caltex has indicated additional dredging of fixed Berths 1 and 2 adjacent to the Caltex jetty as a result of a proposed berth widening of Berth 1 from 35 m to 138 m and a widening of Berth 2 from 35 m to 103 m. Therefore, additional sediment sampling and testing is required to:

- Meet the required minimum number of samples specified in the NAGD, due to the increase in dredge volume since the previous sediment sampling and testing; and
- Provide a better spatial and vertical coverage within the entire dredge footprint of Dredge Area 3 (Berths 1 and 2).

The supplementary sediment sampling and analysis is to be undertaken to provide spatial and vertical coverage of the expanded dredge area in Berths 1 and 2 (Dredge Area 3) and to meet the NAGD sampling requirements for the increased dredge volume. The supplementary sediment sampling and analysis and the previous sediment investigations of Dredge Areas 1-3 reported in WorleyParsons (2012) (**Appendix 1**) will support applications for approvals for dredging and disposal from the relevant government agencies.

This current Supplementary SAP has been prepared in accordance with the NAGD, and it includes the following elements:

- Objectives of the SAP;
- Evaluation of the site history and available data;
- Map showing the proposed sample locations;
- Estimates of the proposed number of sediment samples, including replicates and triplicates;
- Methods and procedures for sampling;
- Details of methods for sample handling, preservation, storage and quality control and quality assurance (QC/QA); and
- List of chemical analyses, detection limits and laboratory QC/QA procedures.

2 COMPILATION AND REVIEW OF EXISTING DATA

2.1 Site Location (Dredge Area 3 – Berths 1 and 2)

The Caltex refinery is located at Kurnell on the southern shore of Botany Bay, south of the Sydney Central Business District CBD (**Figure 1**). The Caltex jetty extends approximately 800 m into Botany Bay to the west of Sutherland Point, terminating in a wharf approximately 300 m long. Fixed Berths 1 and 2 are located either side of the wharf, beyond which are the approaches (including a Swing Basin) and the Sub-berth.

2.2 Existing Geochemical Data

Recent sediment investigations have been undertaken which are relevant to the proposed dredge area in Berths 1 and 2 (Dredge Area 3) including:

- Sediment investigations by GHD in 2007 and 2008 (GHD, 2009) at locations about 0.5 to 1.0 km from the proposed dredge areas; and
- Sediment investigation within the previously proposed dredge area in Berths 1 and 2 (Dredge Area 3; berth width: 35 m) in November 2009 and November 2011 (no sediment sampling was undertaken in Dredge Area 3 in March 2010) (WorleyParsons, 2012) (**Table 1**).

The main findings of the SAP Implementation Report (WorleyParsons, 2012) (**Appendix 1**) are described below, containing the results from the previous investigations in Dredge Area 3 (Berths 1 and 2). The SAP Implementation Report has not yet been reviewed by SEWPAC.

It is envisaged that **Table 1** would be updated following the implementation of this Supplementary SAP, as part of a Supplementary SAP Implementation Report for Dredge Area 3 (Berths 1 and 2) only. The previous SAP Implementation Report (WorleyParsons, 2012) and the Supplementary SAP Implementation Report would be submitted together to form part of the Sea Dumping Permit application, for Caltex to pursue approval for sea disposal of the dredged material.

Figure 1. Overall Site Plan.

Table 1. Summary of Geochemical Data for Dredge Area 3 (Berths 1 and 2) (WorleyParsons, 2012) (Appendix 1)

Analyte			Moisture Content (dried @ 103°C)	Total Organic Carbon	Antimony	Arsenic	Cadmium	Chromium	Copper	Cobalt	Lead	Manganese	Nickel	Selenium	Silver	Vanadium	Zinc	Mercury	BTEX	TPHs					TRHs	Pesticides		PCBs		TBT normalised	VOCs/ SVOCs
																				C6 - C9 Fraction Normalised	C10 - C14 Fraction Normalised	C15 - C28 Fraction Normalised	C29 - C36 Fraction Normalised	Sum TPHs Normalised	C6-C10 Fraction	OC Pesticides	OP Pesticides	Total PCBs normalised	Sum of PAH normalised		
Units			%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µgSn/kg	mg/kg
LOR			1	0.02	0.5	1	0.1	1	1	0.5	1	10	1	0.1	0.1	2	1	0.01	0.2	3	3	3	5	3-5	3	0.5-10	0.5	5	N/A	0.5	0.2-0.5
		NAGD / ANZECC ISQG low	-	-	2	20	1.5	80	65	-	50	-	21	-	1	-	200	0.15	-	-	-	-	-	550	-	0.32-280		23	10000	9	
		NAGD / ANZECC ISQG high	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	NA	-	-		-	-	70*	
Berth	Sampling Month	Sample ID																													
Berth 1	Nov-09	SS3B	47	3.08	<0.50	8.85	0.2	22.8	21.7	1.8	25.5	40	5.7	1	0.2	19.3	95.9	0.2	---	---	---	---	---	---	--	---	--	---	150	46	--
	Nov-09	SS3C	40	1.3	<0.50	5.85	0.1	19.1	15.2	1.4	19.9	33	4.6	0.5	0.1	15.2	64.2	0.15	---	---	---	---	---	---	--	---	--	---	1062	0.2	--
	Nov-09	SS3D	22	1.16	<0.50	1.5	*0.05*	5.3	5.1	*0.25*	4.5	12	1	0.2	*0.05*	3.8	19.1	0.03	---	---	---	---	---	---	--	---	--	---	16	1.0	--
	Nov-11	SS5E	33	2.99	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.50	19	11	31	---	---	---	---	175	0.6	--
	Nov-11	VC5C (0-0.5)	23	2.23	<0.50	1.4	*0.05*	4.4	3.5	*0.25*	5.8		1.3	0.2	*0.05*	*1*	17	0.09	---	<LOR	0.67	22	21	43	<LOR	<LOR	<LOR	<LOR	295	4.8	--
	Nov-11	VC5C (0.5-1)	64	39.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.0	--
	Nov-11	VC5D (0-0.5)	61	34.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	0.2	<LOR
	Nov-11	VC5D (1.8-2.1)	18	0.88	<0.50	17	*0.05*	*0.5*	*0.5*	*0.25*	*0.5*	*5*	*0.5*	0.4	*0.05*	*1*	2.2	*0.01*	<LOR	<LOR	---	---	---	---	<LOR	<LOR	<LOR	<LOR	---	0.3	<LOR
	Nov-11	VC5D (2.1-3.1)	30	4.61	<0.50	4.7	*0.05*	7.3	3.4	1.5	2.2	57	4.2	1.5	*0.05*	11.6	14.6	*0.01*	<LOR	<LOR	0.65	10	26	36	<LOR	<LOR	<LOR	<LOR	---	0.1	<LOR
	Nov-11	VC5E (0-0.6)	56	32.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	10.2	<LOR
	Nov-11	VC5E (0.6-0.8)	28	1.14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	42	--
	Nov-11	VC5E (1-1.6)	41	7.76	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<LOR	---	---	---	---	---	---	<LOR	<LOR	---	---	23	<LOR
Berth 2	Nov-09	VC3A 0-0.6	24	0.69	<0.50	1.98	*0.05*	5	3.1	*0.25*	9	*5*	1.3	0.2	*0.05*	6.4	18.4	0.06	<LOR	<LOR	*2.2*	19	22	86	--	<LOR	--	<LOR	275	7.2	--
	Nov-09	VC3A 0.6-1.3	23	0.19	<0.50	2.34	*0.05*	2.8	1.9	*0.25*	3.4	*5*	*0.05*	0.1	*0.05*	2.5	5.8	0.03	---	---	---	---	---	---	--	---	--	---	45	---	--
	Nov-09	VC3A 1.3-1.9	22	0.25	<0.50	*0.5*	*0.05*	3	2.6	*0.25*	9	*5*	*0.05*	*0.05*	*0.05*	2.1	30.1	0.04	---	---	---	---	---	---	--	---	--	---	60	---	--
	Nov-09	VC3A 1.9-2.4	22	0.14	<0.50	10.1	*0.05*	2.3	*0.5*	*0.25*	1.4	*5*	*0.05*	0.2	*0.05*	3.9	2.3	*0.01*	---	---	---	---	---	---	--	---	--	---	10	---	--
	Nov-09	VC3B 0-0.5	19	0.41	<0.50	*0.5*	*0.05*	2.2	1.3	*0.25*	2.4	*5*	*0.05*	*0.05*	*0.05*	2.5	6.3	0.02	<LOR	<LOR	*3.7*	7.3	3.7	26	--	<LOR	--	<LOR	5	3.7	--
	Nov-09	VC3B 0.5-0.9	24	0.22	<0.50	*0.5*	*0.05*	2.9	2	*0.25*	3.4	*5*	*0.05*	0.1	*0.05*	3.3	9	0.02	---	---	---	---	---	---	--	---	--	---	23	---	--
	Nov-09	SS3A	25	0.14	0.56	1.7	0.2	7.1	33.2	1.5	60.2	14	2	0.2	*0.05*	3.6	460	0.01	---	---	---	---	---	---	--	---	--	---	10	2.5	--
	Nov-11	VC5B (0-0.8)	28	0.69	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.2	48	35	83	---	---	---	---	1855	312	--
	Nov-11	VC5B (0.8-1.3)	33	7.98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.3	--
	Nov-11	VC5B (1.3-1.6)	17	1.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.2	--
COMBINED DREDGE AREA 3 (BERTHS 1 & 2)		Min		0.14	<LOR	0.5	0.05	0.5	0.5	0.25	0.5	5	0.05	0.05	0.05	1	2.2	0.01			0.5	7	4	26					5	0	
		Max		39.6	0.56	17	0.2	22.8	33.2	1.8	60.2	57	5.7	1.5	0.2	19	460	0.2			3.7	48	35	86					1855	312	
		Mean	-	6.5	<LOR	4.4	0.08	6.5	7.2	0.65	11.3	15.1	1.6	0.36	0.07	6	57	0.05	<LOR	<LOR	1.6	21	20	51	<LOR	<LOR	<LOR	<LOR	306	25	<LOR
		SD	-	12.1	N/A	5.0	0.06	6.7	10.0	0.63	16.5	17.1	2.0	0.43	0.04	6	124	0.06	N/A	N/A	1.3	14	11	27	N/A	N/A	N/A	N/A	546	73	N/A
		95% UCL	-	10.8	N/A	6.5	0.11	9.5	11.7	0.96	18.8	22.5	2.5	0.55	0.09	8	114	0.08	<LOR	<LOR	2.7	33	29	73	<LOR	<LOR	<LOR	<LOR	546	54	<LOR

Notes: All organics are normalised to 1% TOC (with 0.2 to 10% TOC); Where results are <LOR, half the LOR has been used in the statistical analyses (*italicised*); SD: Standard Deviation

ANZECC ISQG-low - ANZECC/ARMCANZ (2000) Guidelines for Fresh and Marine Water Quality as updated (in draft) by Simpson et al. (2008); * NAGD maximum level: 70 µgSn/kg (ANZECC ISQG-high: 80 µgSn/kg)

2.2.1 Sediment Sampling Methodology

Vibrocores and surface sediment samples were collected from the two fixed berths (Berth 1 and 2) in Dredge Area 3 during the investigations undertaken in November 2009 and November 2011. No sampling was undertaken in Dredge Area 3 during the March 2010 investigation. A judgmental sampling pattern was used to position sample locations in areas:

- with the greatest sediment accretion within the proposed dredge footprint (based on review of the hydrographic survey and a proposed berth width of 35 m at that time);

- which had high TBT concentrations observed in the preliminary November 2009 investigation (i.e. to ensure retrieval of sufficient sample with TBT concentrations representative of the dredge material for use in elutriate and toxicity testing); and
- not covered in the preliminary investigation (i.e. the additional areas of the broadened dredge footprint).

In total, samples were collected from eleven (11) discrete locations in the November 2009 and November 2011 investigations (i.e. seven (7) sample locations in Berth 1 (SS3B; SS3C; SS3D; SS5E; VC5C; VC5D; VC5E) and four (4) sample locations in Berth 2 (SS3A; VC3A; VC3B; VC5B).

Samples were recovered from vibrocores and surface cores to the proposed depth of dredging at each of the eleven (11) sample locations in Dredge Area 3 (Berths 1 and 2) (refer to Figure 4 in **Appendix 1**) (WorleyParsons, 2012).

2.2.2 Sediment Testing

Sediment Physical Characteristics

Sediments within Dredge Area 3 comprise a mean sand and gravel content of 69% and 16%, respectively, with a greater proportion of fines compared to Dredge Areas 1 and 2 (17% average silt and clay). Several samples from Berths 1 and 2 contained elevated TOC contents of more than 7% up to about 40% (**Table 1**).

During sampling and subsampling of sediment, cores VC5D and VC5E (located in the southern end of Fixed Berth 1 in Dredge Area 3) were found to contain a hard, low density, black material with a chalky texture and a pitted surface. This material was identified at or near the surface to depths of 1.5 m and 0.6 m for each of these two cores, respectively. This equates to approximately -12.5 m below Chart Datum (CD). The material was subjected to testing for Volatile Organic Compounds/Semi Volatile Organic Compounds (VOCs/SVOCs) for consideration of potential hydrocarbon contamination. Subsequently, the results of visual inspections and geochemical analysis identified that the materials consisted of decomposing organic matter, or peat-like material. A review of historic borehole logs that were provided by Caltex (Australian Oil Refinery Limited (1953) Boring Plan AS6201-7 and Plan AA.6653-1), and made available since the preparation of the Supplementary SAP and the completion of the November 2011 investigation, indicated that peat layers had previously been observed in the vicinity of the Caltex berths and approaches. The plans identified peat layers at depths of about -10 to -13 m CD in four boreholes located west of Berths 1 and 2 in Dredge Area 3 and outside of the proposed dredge footprint. The peat layers identified in the most recent investigation were present within this depth range.

SEDIMENT CHEMICAL CHARACTERISTICS

Chemical testing of sediments from Berths 1 and 2 undertaken in November 2009 and in November 2011 included:

- Inorganic contaminants (trace metals): Silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), antimony (Sb), selenium (Se), and vanadium (V);
- Organic contaminants: Polycyclic Aromatic Hydrocarbons (PAHs), Tributyltin (TBT), Polychlorinated Biphenyls (PCBs), Organochlorine Pesticides (OCPs), Organophosphorus Pesticides (OPPs), Total Petroleum Hydrocarbons (TPHs), BTEX; and
- Total Organic Carbon (TOC).

Not all of the analytes above were assessed in all sediment samples from Dredge Area 3 (Berths 1 and 2) (**Table 1**), because the above list of analytes represented a screening assessment to determine if these contaminants may represent contaminants of potential concern.

Previous sediment investigations undertaken by WorleyParsons in November 2009 and November 2011 confirmed the presence of elevated concentrations of TBT in sediments in Berths 1 and 2 (as well as in sediments in Dredge Areas 1 and 2), while the concentrations of all other analytes were below the NAGD Screening Levels in all sediment samples. Exceptions were Pb and Zn at location SS3A in Berth 2 and Hg at location SS3B in Berth 1 (**Table 1**). The 95% upper confidence limit (UCL) of the mean concentration was below the NAGD Screening Level for all analytes, except for TBT (normalized to 1% TOC), for which the 95% UCL of the mean concentration (54 μgSn/kg) exceeded the NAGD Screening Level of 9 μgSn/kg.

The concentrations of TBT in whole sediments are generally elevated in sediments throughout the three Dredge Areas, although normalized TBT concentrations that exceed 9 μgSn/kg in sediments in Dredge Area 3 are mostly limited to the central and southern area of Berths 1 and 2.

Sediments in Berth 1 generally contain greater than 1% TOC, resulting in a reduction of TBT concentrations that are normalized to 1% TOC. While normalized TBT concentrations greater than 9 μgSn/kg are predominantly located in sediments in Dredge Areas 1 and 2, sediments at several sample locations in Dredge Area 3 (Berths 1 and 2) also exceed the NAGD screening level of TBT (WorleyParsons, 2012) (**Appendix 1**).

SEDIMENT ELUTRIATE TESTING

Elutriate testing in all three dredge areas comprised testing of sixteen (16) selected sediment samples, as well as one replicate and one seawater blank. Elutriate TBT concentrations were determined in three (3) sediment samples from Dredge Area 3 (Berths 1 and 2) (i.e. samples SS3B and VC5E_0.6-0.8 from Berth 1 (both <0.1 ng/L) and sample VC5B_0.0-0.8 from Berth 2 (43 ng/L)).

Dilution calculations were undertaken using the results for total sediment TBT concentrations and the elutriate TBT results to determine the potential bioavailability of dissolved TBT concentrations in the water column during sea disposal. The dilution modelling was undertaken using the physical, geochemical and elutriate properties of material from Dredge Area 1 only as a 'worst-case' scenario (**Appendix 1**).

The results of the numerical modelling for the 'worst-case' Dredge Area 1 were compared to the ANZECC/ARMCANZ (2000) trigger values for TBT at the 95% and 99% levels of species protection, i.e. 6 ng/L and 0.4 ng/L, respectively. The results of the numerical modelling indicate that after initial mixing over a four hour period (as allowed for in the NAGD), the maximum concentration of TBT at the Sydney Offshore Spoil Ground for all four dredging scenarios (a. backhoe loading a split hopper barge (with overflowing); b. backhoe loading a split hopper barge (no overflowing); c. trailer suction hopper dredging (with overflowing); d. trailer suction hopper dredging (no overflowing)) for the 'worst-case' Dredge Area 1 sediments would be ≤0.089ng/L, which is substantially below the ANZECC/ARMCANZ (2000) trigger values at the 95% and 99% species protection levels. Based on the outcomes of the dilution modelling the concentrations of TBT in dredged sediments are unlikely to adversely affect water quality during the proposed disposal at the Sydney Offshore Spoil Ground.

A full report on the dilution modelling is included in Appendix 8 of the SAP Implementation Report for Dredge Areas 1-3 (**Appendix 1**).

WHOLE SEDIMENT AND ELUTRIATE TOXICITY TESTING

Following the statistical analysis of analytical results to determine the 95% UCL of the mean concentration of TBT, samples were selected for elutriate and toxicity testing based on a normalised TBT concentration of greater than the NAGD maximum level (70µg Sn/kg) and as close as possible to, or slightly higher than the 95% UCL of the mean TBT concentration (WorleyParsons, 2012) (**Appendix 1**).

The mean concentrations of TBT were substantially greater in Dredge Area 1 and Dredge Area 2 compared to Dredge Area 3 (Berths 1 and 2). Therefore whole sediment toxicity testing and elutriate toxicity testing was undertaken in samples from Dredge Areas 1 and 2 only (i.e. samples from locations VC4B and VC4C from Dredge Area 1 and sample SS4D from Dredge Area 2).

Whole-sediment toxicity testing was undertaken to determine if there is potential for *in situ* toxicity to benthic organisms following disposal of the dredged material. The toxicity testing of whole sediments that was undertaken assessed chronic effects (reproduction) to the epibenthic amphipod *Melita plumulosa*. The results indicated that all test sediments were considered to be non-toxic to the reproduction and survival of *M. plumulosa*.

Elutriate toxicity testing comprised a 48 hour larval development test using the rock oyster *Saccostrea commercialis*. Laboratory results of the elutriate toxicity tests indicated that there was no detectable

toxicity to the bivalve embryos from the elutriate samples tested (WorleyParsons, 2012) (**Appendix 1**).

2.2.3 Main Findings

Based on the previous chemical and ecotoxicological tests, sediments in Dredge Areas 1, 2 and 3 were considered to be suitable for unconfined ocean disposal at the designated Sydney Offshore Spoil Ground (WorleyParsons, 2012) (**Appendix 1**).

3 DESCRIPTION OF DREDGING PROPOSAL

Since the completion of the previous sediment sampling and assessments reported in WorleyParsons (2012) (**Appendix 1**), the proposed berth width of fixed Berths 1 and 2 has been increased from 35 m to 138 m and from 35 m to 103 m, respectively, necessitating consideration for supplementary sediment sampling and analysis of dredged sediments in the berth areas exceeding 35 m berth width. Each berth will be dredged to a declared depth of -12.8 m CD. This will require dredging of both capital and maintenance dredge material.

The most recent hydrographic survey (SPC, 2011) was used to identify the areas, thickness and volume of dredge material in the expanded berth areas to a berth width of 138 m (Berth 1) and 103 m (Berth 2). The depth of dredging required and the areas of greatest sediment accumulation are shown in **Figure 2**.

The proposed widening of Berth 1 from 35 m to 138 m would result in an increase in the dredge sediment volume (including overdredging of 0.3 m) from 13,419 m^3 to 58,918 m^3 (i.e. an additional 45,499 m^3). For Berth 2 an increase in width from 35 m to 103 m would result in an increase in dredge volume from 6,342 m^3 to 14,505 m^3 (i.e. an additional 8,163 m^3). Due to this increase in dredge volume, additional sampling and assessment of sediments is required in Berths 1 and 2.

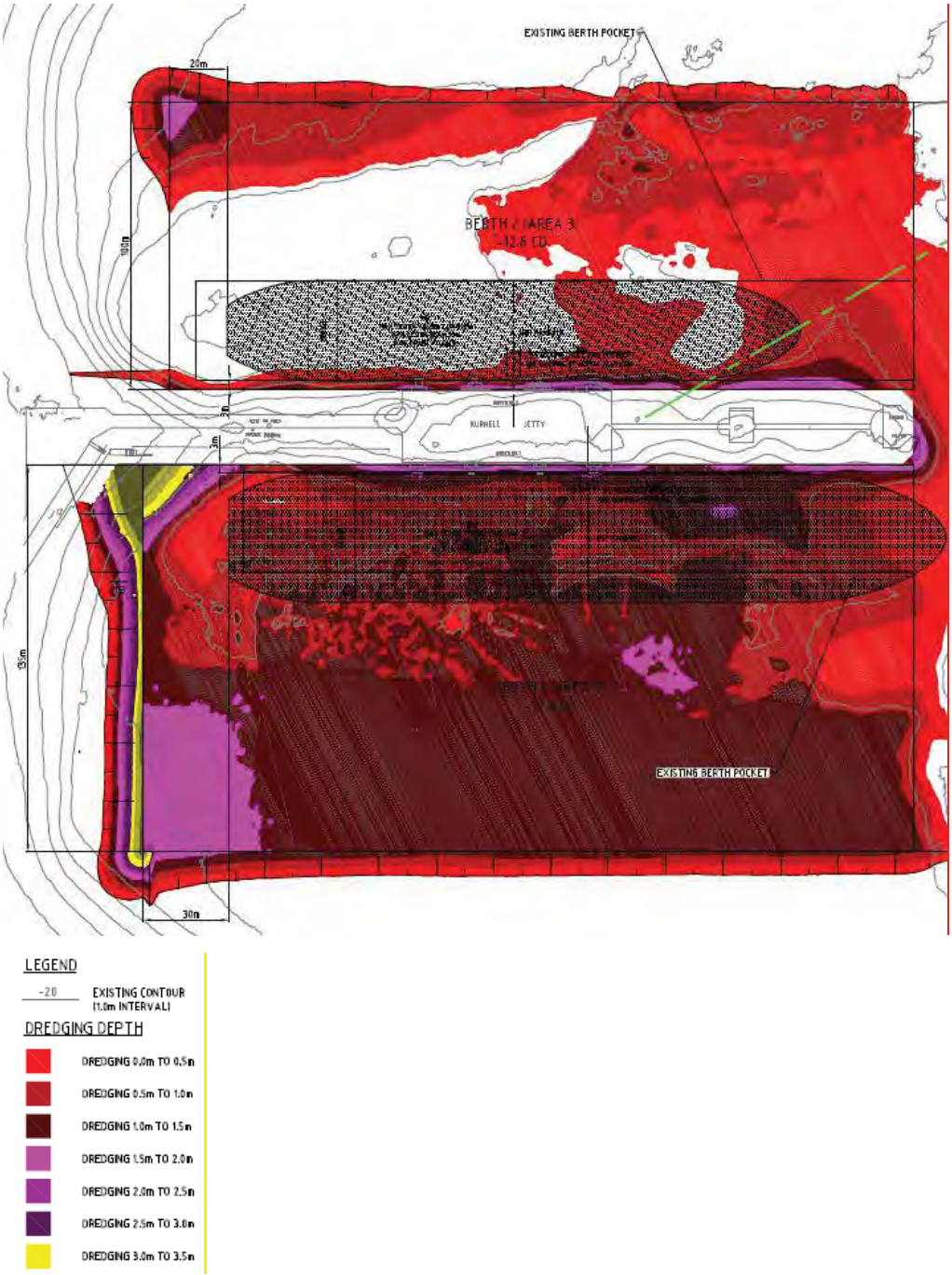


Figure 2. Areas and depths of proposed dredging in Dredge Area 3 (Berths 1 and 2).

4 SUPPLEMENTARY SEDIMENT SAMPLING AND ANALYSIS (DREDGE AREA 3 – BERTHS 1 AND 2)

4.1 Changes in Dredge Volumes in Berths 1 and 2

The proposed berth widening, from 35 m to 138 m for Berth 1 resulted in an increase in dredge material volume of 45,499 m^3, the total being 58,918 m^3 (including overdredging of 0.3 m). Due to this substantial increase in dredge volume, additional sampling and assessment of sediments is required in Berth 1 to assess the entire berth area. The increase in berth width from 35 m to 103 m in Berth 2 increases the dredge volume by 8,163 m^3 to a total dredge volume of 14,505 m^3 (including overdredging of 0.3 m), which is also a substantial increase in dredge volume that necessitates supplementary sediment sampling and assessment of sediments in Berth 2.

Therefore supplementary sediment sampling and analysis at fifteen (15) sample locations, covering a dredge volume of up to 75,000 m^3 to the depth of dredging at -12.8 m CD (Table 6 of NAGD), will be undertaken in Berths 1 and 2. The additional geochemical data will supplement the existing geochemical data from eleven (11) sample locations in Berths 1 and 2 and exceed the minimum sampling requirements of the NAGD if Berths 1 and 2 are assessed as a single dredge area.

4.2 Rationale for Supplementary Sediment Sampling

For the purpose of the sediment assessment for sea disposal under the NAGD, Berths 1 and 2 are assessed as one single dredge area (Dredge Area 3), with a total dredge volume for both berths of 73,423 m^3. This dredge volume requires sediment sampling and analysis at a total of fifteen (15) sample locations according to Table 6 of the NAGD. Previously, sediments from a total of eleven (11) sample locations (seven (7) sample locations in Berth 1 and four (4) sample locations in Berth 2) were sampled and analysed (WorleyParsons, 2012) (**Appendix 1**). Therefore the previous sediment sampling and assessment does not adequately cover the total proposed dredge volume of 73,423 m^3. In addition, the expanded dredge footprint to a berth width of up to 138 m (Berth 1) and up to 103 m (Berth 2) has not been assessed by the previous sediment sampling investigations (WorleyParsons, 2012) (**Appendix 1**).

To allow for coverage of the additional proposed dredge area in Berths 1 and 2 to a berth width of 138 m and 103 m, respectively, sampling at an additional fifteen (15) locations (**Table 2**) will bring the total number of sample locations to twenty-six (26) discrete locations, which substantially exceeds the number required under the NAGD when the entire dredge footprint is considered as one dredge area (Dredge Area 3).

Table 2 shows the existing and additional number of sample locations in the expanded Dredge Area 3, following the proposed widening of the berths. Samples will be collected from twelve (12) additional sample locations in Berth 1 (locations C1 to C12) and from three (3) additional sample

locations in Berth 2 (locations C13 to C15), which is approximately proportional to the respective dredge volumes in Berths 1 and 2 (ratio of about 4:1). Sampling will be undertaken using a piston corer or a vibrocorer, depending on the depth of penetration achieved using the piston corer and the overall coring depth that is required at each sample location.

Unlike in the previous sediment investigations (WorleyParsons, 2012) in which a judgmental sampling pattern was used to assign each sample location, the additional sample locations in Berths 1 and 2 have been assigned using a random sampling pattern that uses a regular grid pattern comprising of 20 m by 20 m squares that overlie the entire dredge area in each berth. Each grid square within the dredge area was numbered (181 grid squares in Berth 1 and 128 grid squares in Berth 2) and the fifteen (15) sample locations were selected using a random number generator. Twelve (12) sample locations were selected in in Berth 1 and three (3) sample locations were selected in Berth 2. Samples will be collected at the centre of each of the selected grid squares or, if the grid square is not entirely located within the dredge area, in the centre of the portion of the grid square that is contained within the dredge area. If sediment sampling cannot be undertaken at a designated sample location (e.g. due to hard or rocky substrate), alternative sample locations have been selected using the same random sample selection procedure. The sample location selection procedure is in accordance with guidance provided on page 61 in the NAGD.

While previously the sample locations in Berths 1 and 2 were chosen to target areas with maximum sediment accumulation above the design dredge levels, the supplementary sampling will ensure that the entire area of the expanded dredge footprint in Berths 1 and 2 is covered.

The proposed sample locations as well as previous sample locations in Berths 1 and 2 are shown in **Figure 3**. The coordinates (in MGA 94 – Zone 56) and the depth of sediment dredging to -12.8 m CD at each sample location is shown in **Table 3**.

Two (2) triplicate sample location will be selected from the fifteen (15) sample locations in Berths 1 and 2.

Table 2. Number of Supplementary (New) and Previous Sample Locations in Dredge Area 3 (Berths 1 and 2)

Dredge Area	Total Estimated Dredge Volume (including 0.3 m overdredge) (m^3)	Total Number of Sample Locations	Minimum Required Sample Locations (Table 6 NAGD)
Combined Berths 1 and 2			
Previously assessed Dredge Area 3 (width: 35 m; -12.8 m CD) (WorleyParsons, 2012)	19,761	11 previous sample locations	8
Proposed Supplementary Sampling Berth 1 width: 138 m; Berth 2 width: 103 m) (-12.8 m CD)	73,423 m^3 (additional 53,662 m^3)	**15 new sample locations (12 in Berth 1; 3 in Berth 2)**	15
Berth 1			
Previously assessed Berth 1 (width: 35 m; -12.8 m CD)	13,419 m^3	7 previous sample locations	7
Proposed Supplementary Sampling Berth 1 width: 138 m (-12.8 m CD)	58,918 m^3 (additional 45,499 m^3)	**12 new sample locations** (covering up to 138 m berth width)	14
Berth 2			
Previously assessed Berth 2 (width: 35 m; -12.8 m CD)	6,342 m^3	4 previous sample locations	6*
Proposed Supplementary Sampling Berth 2 width: 103 m (-12.8 m CD)	14,505 m^3 (additional 8,163 m^3)	**3 new sample locations** (covering up to 103 m berth width	7*

*NAGD requirement if Berth 2 area was to be assessed as a separate dredge area. This is not the case in the current assessment, with Berths 1 and 2 being assessed as a single dredge area (Dredge Area 3).

Table 3. Maximum Dredge Depths and Coordinates of Sample Locations in Berths 1 and 2.

Sample Location	Berth No.	Maximum Dredge Depth (m)	Maximum No. of Subsamples	Easting*	Northing*
C1	1	1.0-1.5	3	334687	6236283
C2	1	1.5-2.0	3	334727	6236262
C3	1	0.5-1.0	2	334681	6236336
C4	1	1.0-1.5	3	334747	6236335
C5	1	1.0-1.5	3	334761	6236328
C6	1	1.0-1.5	3	334748	6236368
C7	1	1.5-2.0	3	334756	6236415
C8	1	1.0-1.5	3	334821	6236414
C9	1	1.0-1.5	3	334796	6236462
C10	1	1.0-1.5	3	334849	6236434
C11	1	0.5-1.0	2	334776	6236488
C12	1	1.0-1.5	3	334836	6236474
C13	2	<0.5	1	334553	6236371
C14	2	0.5-1.0	2	334614	6236457
C15	2	<0.5	1	334681	6236522
Total Sample No			**38**		

*All coordinates are in MGA94 (Zone 56)

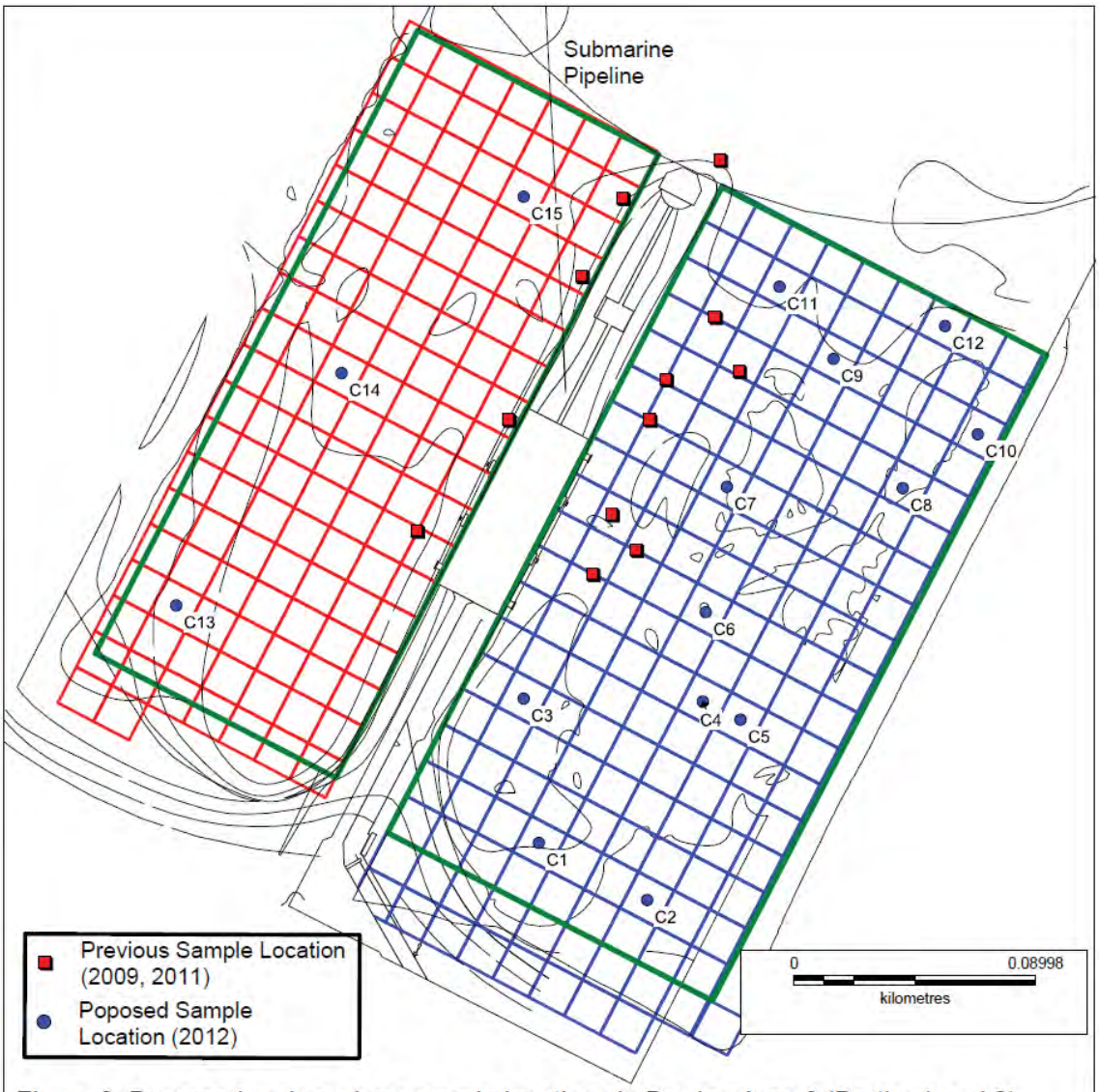


Figure 3. Proposed and previous sample locations in Dredge Area 3 (Berths 1 and 2).

4.3 Sediment Coring

Geochemical Assessments Pty Ltd (GA) will be engaged to collect sediment cores using a vibrocorer and/or a piston push corer. The GA sampling vessel, a purpose built aluminium hull trailer boat (length: 5 m), will be used as a working platform for sediment core sampling and onboard sample processing.

Cores will be collected as close as possible to the proposed sample locations. A handheld GPS with an accuracy of +/-5 m will be used to record each sample location.

A log will be kept by WorleyParsons to record the sampling date, time, water depth, environmental conditions, sample location coordinates, depth of core penetration and other relevant data for each sample location. Prior to sampling, the vessel will be thoroughly inspected and washed down. Any evident sources of contamination will be cleaned and covered in plastic to avoid accidental contamination of sediment samples.

Sediment cores will collected using a custom-fabricated piston push corer with 84 mm outer diameter (OD) polycarbonate core tubes, or a light weight vibrocorer with 50 mm or 84 mm OD steel or polycarbonate core tubes. Core catchers may be used to prevent sediment loss from the core barrel during sample retrieval. Cores will be driven to the depth of dredging (up to 2.5 m) or refusal. Wherever possible, the piston corer will be used to enable a time-efficient collection of sediment cores to the depth of dredging. If piston core refusal occurs in sandy sediment above the depth of dredging, the vibrocorer will be deployed to obtain a core sample to the depth of dredging or core refusal in consolidated clay or rock.

Multiple sediment cores will be collected at each sample location as required to provide sufficient volume of sediment for the required geochemical analyses.

A WorleyParsons environmental scientist (Dr Carsten Matthai) would determine the acceptability of the sediment core following collection. The criteria for acceptance of the core will include:

- No obvious loss of surficial sediment;
- The core must have entered the sediment profile vertically;
- There must be no visible disturbance or gaps in the sediment stratigraphy;
- The core must reach the depth of dredging or refusal at rock or dense sand or clay.

Cores at the fifteen (15) designated sample locations will be collected over two days of field sampling, assuming negligible interference from unscheduled shipping activities or severely adverse weather (see **Section 4.12** - Sampling Contingency Plans).

In addition, field triplicates will be collected at two (2) sample locations, that is, three cores taken at the same sample location and at two separate locations (i.e. four additional cores). The triplicate samples will be used to give an indication of the variability in the chemical properties of the sediment at a sample location. As part of QA/QC procedures there will also be split triplicate samples from one sample location (5% of locations), i.e. a single homogenised sample from each sample interval split into three (3) containers with the third sample being sent to a second laboratory to assess variation associated with subsample handling. This is in accordance with NAGD requirements.

4.4 Sample Processing

All sample handling and processing will be performed to minimise contamination and sample mix-ups. The workspace on the sampling vessel will be washed down regularly with ambient seawater to clean all surfaces and minimize dust contamination of samples. New powder-free nitrile gloves will be worn by the sampler for the processing of each sample from each location. Subsampling will be undertaken using stainless steel implements that will be decontaminated between each sample using Decon90, followed by an ambient seawater rinse.

Piston cores and/or vibrocores will be extruded from the core tube and placed on a sampling tray for subsequent logging, photographing and subsampling.

A subsample will be collected at 0.5 m depth intervals in the top 1.0 m (i.e. 0.0-0.5 m and 0.5-1.0 m), followed by a composite sample from 1.0 m to the end of the core.

Sediment subsamples of entire cores, collected at 0.5 m intervals in the top 1.0 m and from 1.0 m to the end of the core will be collected and stored appropriately for elutriate and bioavailability testing, if required.

Samples for chemical analysis and possible elutriate testing will be homogenised and placed with zero headspace in appropriate sampling containers that are provided by the analytical laboratory. Samples for physical testing (Particle Size Distributions (PSD) analysis) will be placed in plastic ziplock bags.

Sample identifiers will include the sample location and the depth interval. For example, C1_0.0-0.5 indicates that the sediment sample was collected from sample location C1 over the interval from 0.0 m to 0.5 m. Triplicate samples will be labelled with the prefix “T” and suffix A, B, or C (e.g. T01A). QA/QC samples will be numbered consecutively (i.e. QC1, QC2, etc.) with the type of the QA/QC sample and the key for the primary sample it relates to being recorded on a separate QA/QC identification log sheet that will not be revealed to the analytical laboratory.

The following sediment volumes will be retained from each subsample, where relevant, for the different analyses required:

- One 500 ml, one 250 ml, and one 150 ml glass jar for analysis of metals, PAHs, TPHs, TBT, TOC (all samples) and possible elutriate and bioavailability analysis; and
- One 250 ml ziplock bag for PSD analysis (50% of primary samples only).

4.5 Sample Preservation, Shipment and Analysis

Samples for geochemical analysis will be packed in ice in an esky immediately after sampling to maintain the temperature below 4°C. Samples for physical analysis will be stored at ambient temperatures. Samples will then be submitted to the following NATA-accredited analytical laboratories on the same day, or the following morning, under WorleyParsons Chain-of-Custody (CoC) protocols:

- ALS Laboratory Group (ALS) for primary physical and chemical testing; and
- Advanced Analytical Australia (AAA) for secondary chemical testing of split duplicates (via ALS under CoC protocol).

WorleyParsons will coordinate the analysis of the samples. Samples for possible elutriate and bioavailability analyses will be archived in refrigerated storage by the analytical laboratory. Elutriate and bioavailability analyses (including 20% replicate samples), if required, would be undertaken by ALS.

Given that the analytical holding times for sediment and elutriate samples, as specified in the NAGD, are 14 days or longer for all chemical analytes included in the supplementary sediment investigation, a submission of sediment samples within 24 hours of sampling is not critical, provided the samples are chilled and kept in the dark.

4.6 Analysis Schedule

The primary laboratory selected to undertake the chemical testing is the NATA registered ALS Laboratory Group (ALS). Split triplicate inter-laboratory samples will be submitted to a secondary laboratory, the NATA registered Advanced Analytical Australia (AAA) laboratory. The contaminants and the detection limit of the proposed analytical methods are outlined in the following sections and summarized in **Table 4**.

Table 4. Chemical Analytes for Supplementary Sediment Sampling

Test Parameter	PQL	units	Lab Method	NAGD Screening Level
Silver (Ag)	0.1	mg/kg	USEPA 6020	1
Cadmium (Cd)	0.1	mg/kg	USEPA 6020	1.5
Selenium (Se)	0.1	mg/kg	USEPA 6020	--
Cobalt (Co)	0.5	mg/kg	USEPA 6020	--
Antimony (Sb)	0.5	mg/kg	USEPA 6020	2
Copper (Cu)	1	mg/kg	USEPA 6020	65
Lead (Pb)	1	mg/kg	USEPA 6020	50
Zinc (Zn)	1	mg/kg	USEPA 6020	200
Chromium (Cr)	1	mg/kg	USEPA 6020	80
Nickel (Ni)	1	mg/kg	USEPA 6020	21
Arsenic (As)	1	mg/kg	USEPA 6020	20
Vanadium (V)	2	mg/kg	USEPA 6020	--
Manganese (Mn)	10	mg/kg	USEPA 6020	--
Mercury (Hg)	0.01	mg/kg	APHA 3112 Hg-B	0.15
PAHs (each individual species)	4-5[1]	µg/kg	USEPA 3640/8270	10,000
TBT	0.5	µg/kg	In-House GC/MS	9
TOC	0.02%		In house/Leco	--

Notes
1. The laboratory will strive to reach this PQL but previous sampling and testing indicates that matrix interference may prevent the laboratory reaching this very low detection limit.
2. All primary and QA/QC sediment samples will be analysed for all analytes.

4.6.1 Chemical Analysis

TBT has been identified as a contaminant of potential concern based on a review of recent geochemical data for Dredge Area 3 (Berths 1 and 2) (**Section 2.2**) and the surrounding Dredge Areas 1 and 2 (WorleyParsons, 2012) (**Appendix 1**). Therefore TBT is also a contaminant of potential concern for the sampling of sediments in the expanded berth area to a width of 138 m in Berth 1 and up to 103 m in Berth 2. TBT analyses will be undertaken for all sediment samples to be collected in the supplementary sediment sampling program in Dredge Area 3 (Berths 1 and 2), including QA/QC samples.

In addition, there were exceedances of NAGD Screening levels for Hg, Pb and Zn in at least one sediment sample collected previously in Dredge Area 3 (Berths 1 and 2) (**Table 1**). Therefore trace metals (Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn) will be included in the analysis of all sediment samples, including QA/QC samples to be collected in the supplementary sampling of sediments in Dredge Area 3 (Berths 1 and 2).

While the concentrations of PAHs in sediments in Dredge Area 3 (Berths 1 and 2) were below the NAGD Screening Levels in all sediment samples analysed, PAHs were present at concentrations above the analytical limits of reporting (LOR) in all sediment samples that were analysed for PAHs in Berths 1 and 2. Therefore an analysis of PAHs will be undertaken for all sediment samples collected in the expanded dredge area of Berth 1, including QA/QC samples.

In contrast, the concentrations of, BTEX, TPHs, OCPs, OPPs and PCB's in sediment samples collected previously in Berths 1 and 2 were generally low or below the LOR (WorleyParsons, 2012) (**Appendix 1**). Therefore these analytes are not included in the supplementary sediment sampling program outlined in this Supplementary SAP.

Total organic carbon (TOC) contents in all sediment samples will be determined to enable a normalization of the organic contaminant concentrations (i.e. TBT, PAHs) to 1% TOC, in accordance with the guidance provided by the NAGD.

The analytes and their detection limits in the supplementary sediment sampling and analysis program are listed in **Table 4**.

The results of the chemical analysis will be combined with data obtained from the previous sediment sampling and analysis programs (WorleyParsons, 2012). The 95% UCL of the mean concentration of each contaminant will be calculated and compared to the NAGD screening levels to assess the requirement for further testing (i.e. elutriate and bioavailability).

4.6.2 Physical Analysis

Fifty per cent of primary sediment samples (i.e. up to nineteen (19) samples from the fifteen (15) sample locations) obtained in Berths 1 and 2 will be analysed for particle size distributions (PSD) to provide an indication of the physical characteristics of the proposed dredge material in the expanded berth area. Physical testing will comprise a determination of PSD by wet sieving, using geological size fractions (including a 75 μm cut-off to enable comparison with previous PSD data), and a determination of the fine fraction content in accordance with Table 1 of NAGD (hydrometer) to determine clay (<4 μm) and silt (4 to 63 μm) fraction contents. Particle size analyses will be undertaken by the ALS Environmental laboratory in Newcastle.

4.7 Total Number of Supplementary Samples in Dredge Area 3

The number of subsamples per core, from the fifteen (15) sample locations in Dredge Area 1 (Berths 1 and 2) (including two triplicate sample locations), will be up to three (3), with sample intervals of 0.0-0.5 m, 0.5-1.0 m and 1.0 m to the end of the core (less than 2.5 m core length). The maximum number of sediment subsamples, including QA/QC samples, is up to 54 (**Table 5**).

Sediment samples will not be analysed for volatile contaminants (i.e. BTEX) and the field blank sample, which comprises clean sand, will be analysed for trace metals only.

Table 5. Maximum Number of Sediment Samples in Supplementary Sediment Sampling and Analysis of Dredge Area 3 (Berths 1 and 2)

Sample Type	Number of Subsamples
Dredge Area 3 (Berths 1 and 2): Primary piston push core or vibrocore subsamples (21 core locations with up to 3 subsamples per core)	up to 38
Two Field Triplicates (10% of locations - 2 core locations: 4 additional cores with up to two samples per core)	up to 8
Split Triplicate and Interlaboratory samples (5% of locations – 1 location; up to 2 subsamples x 3 triplicates)	up to 6 (including 2 interlaboratory samples)
Interbatch samples (1 batch only)	Nil
Daily Field Blank (metals analyses only)	2
Total*	**up to 54***

*Excludes elutriate and bioavailability sample analyses (to be confirmed following Phase II sediment testing)

4.8 Requirements for Additional Sampling and Testing

The results of the chemical analyses of sediments would be combined with the geochemical data obtained in the previous investigations of Dredge Area 3 (Berths 1 and 2) (WorleyParsons, 2012) (**Table 1**). The 95% UCL of the mean concentration of each chemical in the combined data for Dredge Area 3 (Berths 1 and 2) would be calculated and compared to the NAGD screening levels.

Elutriate, bioavailability and toxicity testing was previously undertaken in accordance with the NAGD decision-tree approach for assessing potential contaminants. Results from the three previous sediment investigations are documented in the SAP Implementation Report (WorleyParsons, 2012) (**Appendix 1**).

4.8.1 Elutriate and Bioavailability Testing

Provided that the 95% UCL of the mean concentration of the combined data, is consistent with the results from the previous investigations, it may not be required to undertake further elutriate or bioavailability testing in Dredge Area 3. However, TBT has shown to be a contaminant of potential concern for which elutriate testing was previously required (WorleyParsons, 2012). The results of the combined data for TBT elutriate concentrations from the three previous investigations indicated that the concentration of elutriate TBT exceed the ANZECC/ARMCANZ (2000) water quality guideline value of 6 ng/L.

It is therefore recommended to obtain additional sediment samples to undertake up to four (4) elutriate and bioavailability analyses (plus one replicate sample analysis) for contaminants of potential concern, if required. Elutriate analysis will be required if the 95% UCL of the mean concentrations of TBT in sediments in Dredge Area 3 exceed the NAGD Screening Level, using the combined data for the previous and the supplementary sediment investigations.

Ambient seawater from Dredge Area 3 for possible use in elutriate analysis will be collected in a triple-rinsed 20 L plastic carboy at the time of sediment sampling.

4.8.2 Toxicity Testing

Whole sediment toxicity testing and elutriate toxicity testing undertaken during the previous sediment investigation (WorleyParsons, 2012) are considered to be the most sensitive tests currently available, and indicated that the sediments in the Dredge Areas were non-toxic. Therefore it is not recommended that further ecotoxicological tests be undertaken in the proposed supplementary sediment investigation.

4.8.3 Acid Sulfate Soil Testing

Acid sulfate soils testing in previous sediment investigations indicated that the net acidity of some samples in Dredge Areas 2 and 3 exceeded the action criteria provided in the Acid Sulfate Soils Manual (ASSM). Previous sediment investigations have identified low net acidity in four sediment samples collected from Dredge Area 1 (WorleyParsons, 2012). If the ASSM action criteria are exceeded, an Acid Sulfate Soil Management Plan (ASSMP) will be required if the proposed works are expected to result in the oxidation of this dredged material during removal, transportation, reuse or disposal. Oxidation will only occur if the material is disposed of on land and for the proposed offshore disposal an ASSMP will therefore not be required. As the proposed disposal method (offshore disposal in the Sydney Offshore Spoil Ground) will not trigger a requirement for an ASSMP, no additional acid sulphate soil testing will be undertaken.

4.8.4 Other NAGD Phase IV Testing

Additional elements of testing that may be required under the NAGD, such bioaccumulation testing (Phase IV in NAGD), have not been included in the proposed sediment sampling and assessment outlined in this Supplementary SAP, as they are subject to the analysis of results from elutriate contaminant concentration testing. Additional testing requirements would be assessed as part of an additional Phase IV sampling and analysis program, if required.

4.8.5 Additional Sampling of Sediments in Dredge Area 1 (Swing Basin)

A northeastward moving of the Swing Basin by about 50 m, additional dredging to the east of the swing basin as part of Caltex' planned berth development, and a resulting readjustment of the

boundary for Dredge Area 1 resulted in a slight change in the dredge volume from the previously assessed 58,450 m^3 to 58,812 m^3 (i.e. an additional 362 m^3). This does not require additional sampling and assessment of sediments in Dredge Area 1, as previous sampling and assessment was undertaken at nineteen (19) sample locations within Dredge Area 1. This substantially exceeds the minimum sampling requirement for the assessment of the dredge volume for this area (i.e. only 14 sample locations are required for a dredge volume of 58,812 m^3).

4.9 Data Management Procedure

Statistical analysis and tabulation of data will be undertaken following data validation. Data management of the analysis results will be in accordance with the requirements of the NAGD. Validation of data will include evaluating the results from laboratory blanks, standard samples, field triplicate samples and split triplicate samples.

4.10 Equipment List

The following equipment will be required to undertake the supplementary sediment sampling program:

- Handheld differential GPS;
- Sampling vessel (length: 5 m) (owned and operated by Geochemical Assessments);
- Light-weight vibrocorer;
- 50 mm stainless steel core tubes (vibrocoring) and 84 mm polycarbonate core tubes (piston coring), with stainless steel core catcher (if required);
- Tray table for subsampling;
- Stainless steel piston push corer (custom-fabricated);
- Core extrusion devices;
- Core catchers and core caps;
- Digital camera;
- Measuring tape;
- Deck wash;
- Eskies and ice;
- Decontamination equipment (Decon 90, brushes, buckets);
- Laboratory-supplied sample containers and zip-lock bags;
- Sampling trays, stainless steel mixing bowls and subsampling equipment, spoons;
- Permanent markers and other stationary;
- Chain-of-Custody (CoC) forms;

- Log book and logging sheets; and
- Personal protection equipment (weather protection, hats, nitrile powder-free gloves, steel capped boots, appropriate work clothes).

An experienced environmental scientist, Dr Carsten Matthai, from WorleyParsons will coordinate the sampling program and assist GA in carrying out the sampling. GA personnel will operate the sampling vessel, vibrocorer and piston push corer and undertake the core extraction with the assistance of GA technical staff.

4.11 Health and Safety Precautions

The sampling program will adhere to HSE systems of WorleyParsons, Caltex and Geochemical Assessments and Safe Work Method Statements (SWMS) for the proposed works prepared by GA.

Prior to the commencement of fieldwork involving coring, Caltex would provide authorization to undertake the proposed sampling and analysis program to confirm that no underwater services are present at the proposed sample locations.

4.12 Sampling Contingency Plans

4.12.1 Adverse Weather

The proposed sampling would be undertaken in the relatively protected waters of Botany Bay. In the case of predicted severe weather, sampling would be discontinued and rescheduled. The sampling program will be completed over two days, however a longer sampling period may result from inclement weather. WorleyParsons believe that there are no unacceptable OH&S risks to personnel working in rain and they anticipate continue working during calm, wet weather. If adverse weather makes sampling unacceptable due to high winds or waves, the sampling team, coring subcontractor and vessel operator would remain on stand-by.

4.12.2 Equipment Failure

Equipment used on the sampling program is highly specialized but many replacement parts for the vibrocorer and piston push corer would be provided on standby by the subcontractor. Repairs to critical equipment would be undertaken as soon as practicable, although equipment failure would result in a delay to sample collection.

4.12.3 Shipping Operations

Sampling may be delayed due to operational requirements of the Caltex berths, including shipping movements during the period of sampling or during the mobilization period.

In the event of delays due to the above issues, the sampling would be recommenced following the provision of access to the berths and access channel, improvement in the weather or fixing of the equipment.

5 QA/QC PROCEDURES

5.1 Field QA/QC Procedures

Field QA/QC procedures will include the following:

- Sample Location: A handheld GPS position fixing system with an accuracy of +/-5 m will be used to locate each sample location;
- Decontamination of Sampling Equipment: Prior to use, the survey vessel will be thoroughly inspected and washed down. Any evident sources of contamination will be cleaned and covered in plastic to avoid accidental contamination of any samples. All surfaces used for sample handling will also be covered in plastic sheeting prior to subsampling. All sampling equipment that may come into contact with the sediment samples will be decontaminated using Decon 90 prior to each sampling event;
- Field triplicates: Triplicate samples will be analysed and used to assess the variability in the chemical analytes in the sediment at two (2) sample locations (comprising up to three core subsamples per core taken from two triplicate sample locations – i.e. 2 locations x 3 cores x up to 2 samples = up to 12 samples);
- Field Documentation: Each sample location will be numbered on a sampling plan in the field logbook. All other observations including weather, time, date of sampling, water depth, and depth of core penetration will be noted in the field logbook. Time, date, and appearance of the sediments (e.g. texture, colour, odour) will also be reported in the field logbook during sub-sampling;
- Cross Contamination: Each sample jar will be washed with seawater following subsampling to remove sediment on the outside of the sample containers and to minimize cross-contamination;
- Split triplicates: At one sample location three split triplicate samples will be taken (i.e. up to 2 subsamples x 3 triplicates = up to 6 samples) with two of each of the core subsamples submitted to the primary laboratory, and a third of the core subsamples submitted to the secondary laboratory for geochemical analysis. The split results will be analysed to assess variability in sub-sampling; and
- Sample Control: Each sample will have a unique identification number that will be recorded in the field log book, and the Chain-of-Custody (CoC) form. A CoC form will accompany the sediment samples at all times, and will include the analysis required for each sample and each laboratory.

5.2 Laboratory QA/QC Procedures

Laboratory QA/QC procedures for the geochemical analyses will include the following:

- Analysis Blanks: One per analytical run or one in every 20 samples, whichever is the smaller;
- Laboratory Duplicate: One in every 10 samples or batch, whichever is the smaller;
- Laboratory Control Standard: One per analytical run or one in every 20 samples, whichever is the smaller;
- Laboratory Matrix Spike: One in every 20 samples or batch, whichever is the smaller;
- Surrogate Spike: For determinations that are appropriate, surrogate spikes will be added to all samples for analysis; and
- Calibration Blank: One per analytical run or one in every 20 samples, whichever is the smaller.

6 REPORTING (SUPPLEMENTARY SAP IMPLEMENTATION REPORT)

The findings of the supplementary sediment sampling and analysis investigation will be in accordance with the Supplementary SAP and documented in a Supplementary SAP Implementation Report, which will include a synthesis of the analytical data obtained for Dredge Area 3 (Berths 1 and 2) from the previous sediment investigations in 2009 and 2011 (WorleyParsons, 2012) (**Appendix 1**) and the supplementary sediment investigation. The SAP Implementation Report will assess sediments to be dredged in the expanded Dredge Area 3 (138 m berth width in Berth 1 and 103 m berth width in Berth 2) against the criteria set out in the NAGD.

The Supplementary SAP Implementation Report will provide a summary of the total sampling and analysis work undertaken in Dredge Area 3, and provide a classification of the suitability of sediments in Dredge Area 3 for offshore disposal under the NAGD. The Report will also detail the sampling and analysis work completed and present an assessment of the results, including the following:

- Summary of the Supplementary SAP, or Supplementary SAP appended to report;
- A description of the sampling carried out, along with the actual sample locations, sample numbers (including replicate and QA samples), completed CoC forms, field logs and descriptions of the sediments;
- A description of any problems encountered or deviations from the procedures set out in the SAP (including justifications for deviations);
- Normalization of results for organic analytes to 1% TOC (within a range of 0.2-10%);
- Comparison of the 95% UCL of mean chemical concentrations of sediment in Dredge Area 3 with NAGD Screening Levels;
- Reporting of all QA/QC data;
- Presentation and review of the results, including QA/QC assessment of field and laboratory data, comparison to data quality objectives and data validation;
- Conclusions as to the acceptability or unacceptability of the dredge material in Dredge Area 3 for open water disposal and/or recommendations as to further work required;
- Classification of sediment in Dredge Area 3 as acceptable (or otherwise) for unconfined ocean disposal, based on the previous and supplementary sediment assessments;
- Assessment of sediment toxicity may be recommended and separately reported, as it is not included in the supplementary sediment assessment, and if sediment is classified unsuitable for unconfined sea disposal, following NAGD Phase III assessments; and

- Appendices, including all laboratory and field data.

7 REFERENCES

ANZECC/ARMCANZ, (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand, October 2000.

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging, Commonwealth of Australia, Canberra, 2009.

GHD (2009) Caltex Port Facilities, Botany Bay Geotechnical & Geochemical Investigations Desk Study.

Simpson, S., Batley, G. and Chariton, A. (2008) Revision of the ANZECC/ARMCANZ sediment quality guidelines. Draft, CSIRO Land and Water. Technical report No. 8/07, August 2008. Prepared for the Commonwealth Department of the Environment, Heritage, Water and the Arts.

WorleyParsons (2010). Caltex Maintenance Dredging. Sampling And Analysis Plan, Report to Caltex Refineries NSW, March 2010.

WorleyParsons (2011). Caltex Dredging. Supplementary Sampling And Analysis Plan, Report to Caltex Refineries NSW, September 2011.

WorleyParsons (2012). Caltex Dredging. Sediment Sampling And Analysis Plan Implementation Report – Final Report. (Dredge Areas 1-3), Report to Caltex Refineries NSW, June 2012.

Appendix 3 Core Logs

CORE LOG

WorleyParsons
resources & energy

CORE ID: C1
SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	15/08/2012 10.40am
PROJECT:	Caltex Dredging	**DATE LOGGED**	15/08/2012 10.50am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334687
Equipment:	SDI Lightweight Vibrocorer	**(ID):**	46	**Northing:**	6236283

Water depth: 11.9m
Datum: WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Vibrocoring	0.5			dark olive muddy gravel, grading into muddy sand; abundant shell fragments and worm tubes; core refusal into stiff, hard dark olive-gray peat; large angular peat fragments (5 cm diameter) present in upper 25 cm of core; barnacles and shell fragments (3-4 cm length present in upper 25 cm	100% (depth: 0.55m; recovery: 0.55m)	S	PSD	metals, PAHs, TBT, TOC				
	1			Core terminated at 0.55m - core refusal in consolidated peat		VSt						
	1.5											Depth of dredge design approximately 1.5m
	2											

CORE LOG

WorleyParsons resources & energy

CORE ID: C2

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	15/08/2012 8.30am
PROJECT:	Caltex Dredging	**DATE LOGGED**	15/08/2012 9.25am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor: Geochemical Assessments **Core diameter (OD):** 50 **Easting:** 334727 **Water depth:** 11.4m

Equipment: SDI Lightweight Vibrocorer **(ID):** 46 **Northing:** 6236262 **Datum:** WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Vibrocoring	0.5			dark olive gray to brown muddy sand (<10% visual mud content) overlying peat at about 0.7 m depth; increaing mud content with depth in core to about 30% visual mud content core loss of 0.5-0.7 m section	83% (depth: 0.7m; recovery: 0.5m)	S	PSD	metals, PAHs, TBT, TOC				Field Triplicate sample location (T01A and T01B); loss of 50-70 section of primary core C2; penetration of 0.8 m for field triplicate core T01B prior to refusal in hard/stiff peat layer and loss of bottom 0.3 m of core; sampled 0.0-0.5 m depth intervals in all three fielf triplicate cores C2, T01A and T01B; Sample QC5 (replicate elutriate sample)
	1			Core terminated at 0.7m - core refusal in consolidated peat		VSt						
	1.5											
	2											Depth of dredge design approximately 2.0m

CORE LOG

WorleyParsons resources & energy

CORE ID: C3

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	14/08/2012 12.05pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	14/08/2012 12.15pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334681	**Water depth:**	12.3m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236336	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
				very stiff dark brown peat, flaky and dry in situ		VSt						required collection of three cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis; insufficient sample material for elutriate analysis
Piston coring	0.5			Core terminated at 0.1m - core refusal in consolidated peat	100% (depth: 0.1m; recovery: 0.1m)			metals, PAHs, TBT, TOC				
	1											Depth of dredge design approximately 1.0m

CORE LOG

WorleyParsons
resources & energy

CORE ID: C4
SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	14/08/2012 1.00pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	14/08/2012 1.15pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334747	**Water depth:**	11.9m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236335	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
				very stiff dark brown peat, flaky and dry in situ; friable when wet; no odour		VSt						required collection of three cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis; insufficient sample material for elutriate analysis
Piston coring	0.5 1 1.5			Core terminated at 0.1m - core refusal in consolidated peat	100% (depth: 0.1m; recovery: 0.1m)			metals, PAHs, TBT, TOC				
												Depth of dredge design approximately 1.5m

CORE LOG

WorleyParsons resources & energy

CORE ID: C5

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	14/08/2012 1.20pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	14/08/2012 1.35pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334761	**Water depth:**	11.9m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236328	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
				Very stiff dark brown peat, flaky and dry in situ; friable when wet; thin veneer of light brown sand (<1cm); no odour		VSt						required collection of three cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis;
Piston coring	0.5			Core terminated at 0.15m - core refusal in consolidated peat	100% (depth: 0.15m; recovery: 0.15m)		PSD	metals, PAHs, TBT, TOC				
	1											
	1.5											Depth of dredge design approximately 1.5m

CORE LOG

WorleyParsons resources & energy

CORE ID: C6

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	14/08/2012 2.25pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	14/08/2012 2.40pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334748	**Water depth:**	12.1m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236368	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
				very stiff dark brown peat, flaky and dry in situ; friable when wet; organic-rich; no odour		VSt						required collection of four cores and compositing of upper 0.13 m of sediments to obtain sufficient material for chemical analysis; insufficient sample material for elutriate analysis; sample QC1 (split triplicate and QC2 (interlaboratory sample)
Piston coring	0.5			Core terminated at 0.13m - core refusal in consolidated peat	100% (depth: 0.13m; recovery: 0.13m)			metals, PAHs, TBT, TOC				
	1											
	1.5											Depth of dredge design approximately 1.5m

CORE LOG

WorleyParsons resources & energy

CORE ID: C7

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	14/08/2012 3.30pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	14/08/2012 3.45pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334756	**Water depth:**	12.9m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236415	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
				dark brown to black organic-rich peat; some light olive-gray sand at surface (<1 cm depth)		VSt						required collection of two cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis; insufficient sample material for elutriate analysis
Piston coring	0.5 1 1.5			Core terminated at 0.1m - core refusal in consolidated peat	100% (depth: 0.1m; recovery: 0.1m)		PSD	metals, PAHs, TBT, TOC				
	2											Depth of dredge design approximately 2.0m

CORE LOG

WorleyParsons resources & energy

CORE ID: C8

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	15/08/2012 2.10pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	15/08/2012 2.30pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334821	**Water depth:**	11.9m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236414	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
				dark brown to black organic-rich peat; no overlying sand, very hard and stiff		VSt						required collection of two cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis; insufficient sample material for elutriate analysis
Piston coring	0.5 1 1.5			Core terminated at 0.12m - core refusal in consolidated peat	100% (depth: 0.1m; recovery: 0.1m)		PSD	metals, PAHs, TBT, TOC				Depth of dredge design approximately 1.5m

CORE LOG

WorleyParsons resources & energy

CORE ID: C9

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	15/08/2012 3.30pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	15/08/2012 3.45pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334796
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236462

Water depth: 12.3m

Datum: WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Piston coring				light brown to olive-gray quartzose sand in upper 30 cm overlying peat at about 30-40cm, very hard and stiff peat at 0.3 m	100% (depth: 0.45m; recovery	S-Med / VSt		metals, PAHs, TBT, TOC				required collection of two cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis;
	0.5 / 1			Core terminated at 0.45m - core refusal in consolidated peat		Vst						
	1.5											Depth of dredge design approximately 1.5m

CORE LOG

WorleyParsons
resources & energy

CORE ID: C10
SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	15/08/2012 11.40am
PROJECT:	Caltex Dredging	**DATE LOGGED**	15/08/2012 11.50am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor: Geochemical Assessments **Core diameter (OD):** 50 **Easting:** 334849 **Water depth:** 11.3m
Equipment: SDI Lightweight Vibrocorer **(ID):** 46 **Northing:** 6236434 **Datum:** WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Vibrocoring	0.5			olive gray-green muddy sand; thin (<2 cm) olive muddy surface layer; muddy sand grades into sand at 30-50 cm depth	100% (depth: 2.00m; recovery: 2.00m)	S	PSD	metals, PAHs, TBT, TOC				C10_0.0-0.5: split triplicate sample (QC6); interlaboratory sample (QC7)
	1			well sorted light brown clean (<1% fine fraction content) quartzose sand		S		metals, PAHs, TBT, TOC				
	1.5			well sorted light brown clean (<1% fine fraction content) quartzose sand		S	PSD	metals, PAHs, TBT, TOC				Depth of dredge design approximately 1.5m
	2			Core terminated at 2.00m - core ends in unconsolidated clean quartzose sand								

CORE LOG

WorleyParsons
resources & energy

CORE ID: C11
SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	16/08/2012 8.50am
PROJECT:	Caltex Dredging	**DATE LOGGED**	16/08/2012 9.05am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor: Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334776	**Water depth:** 12.0m
Equipment: Piston push corer	**(ID):**	46	**Northing:**	6236488	**Datum:** WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Piston coring				olive gray-green slightly muddy sand overlying dark brown very stiff peat at 0.3 m depth, some shell fragments (<10% visual fine fraction content)	100% (depth: 0.35m; recovery: 0.3	S-Med		metals, PAHs, TBT, TOC				required collection of two cores and compositing of upper 0.1 m of sediments to obtain sufficient material for chemical analysis; Filed Triplicate core sample location (Cores T02A and T02B - sampled 0.0-0.35 m intervals in all three triplicate cores
						VSt						
	0.5			Core terminated at 0.35m - core refusal in consolidated peat		Vst						
	1											Depth of dredge design approximately 1.0m
	1.5											

CORE LOG

WorleyParsons resources & energy

CORE ID: C12

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	15/08/2012 1.10pm
PROJECT:	Caltex Dredging	**DATE LOGGED**	15/08/2012 1.25pm
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor: Geochemical Assessments **Core diameter (OD):** 50 **Easting:** 334836 **Water depth:** 11.9m

Equipment: SDI Lightweight Vibrocorer **(ID):** 46 **Northing:** 6236474 **Datum:** WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Vibrocoring	0.5			thin muddy dark olive gray surface layer (<5 cm thickness); quartzose light brown well sorted medium sized sand (<2% visual fine fraction content); minor shell fragments	86% (depth: 1.75m; recovery: 1.5m)	S		metals, PAHs, TBT, TOC				
	1			homogeneous light brown well sorted quartzose sand; <1% visual fine fraction content		S	PSD	metals, PAHs, TBT, TOC				
	1.5			homogeneous light brown well sorted quartzose sand; <1% visual fine fraction content; thin clay layer (~3cm thickness) at 1.00-1.03 m depth		S		metals, PAHs, TBT, TOC				Depth of dredge design approximately 1.5m
	2			Core terminated at 1.70m - lost bottom 20 cm of core (1.50-1.70 m segment); core ends in unconsolidated clean quartzose sand								

CORE LOG

WorleyParsons resources & energy

CORE ID: C18

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	16/08/2012 9.30am
PROJECT:	Caltex Dredging	**DATE LOGGED**	16/08/2012 9.45am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334840
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236380

Water depth: 12.9m

Datum: WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Piston coring	0.5			dark olive gray-green slightly muddy sand, grading into brown to dark brown fragmented peaty layers at ~0.3-0.5 m depth	100% (depth: 0.9m; recovery: 0.9m)	S	PSD	metals, PAHs, TBT, TOC				
				dark brown peat, organic-rich, fragmented angular blocks, appearing more weathered than at other locations		VSt (fragmented peaat)		metals, PAHs, TBT, TOC				
	1			Core terminated at 0.90m - core refusal in consolidated peat								
	1.5											Depth of dredge design approximately 1.5m

CORE LOG

WorleyParsons
resources & energy

CORE ID: C13
SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	14/08/2012 10.30am
PROJECT:	Caltex Dredging	**DATE LOGGED**	14/08/2012 10.45am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334553	**Water depth:**	12.7m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236371	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Piston coring				dark olive-gray slightly muddy sand (<5% visual fine fraction content); organic-rich at depth of 0.5 m	100% (depth: 0.5m; recovery: 0.5	S-Med	PSD	metals, PAHs, TBT, TOC				
	0.5											Depth of dredge design approximately 0.5m
	1.0			Core terminated at 0.5m - bottom 0.5 m of core lost; core endds in uconsolidated slightly muddy sand								

CORE LOG

WorleyParsons
resources & energy

CORE ID: C14
SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	16/08/2012 10.20am
PROJECT:	Caltex Dredging	**DATE LOGGED**	16/08/2012 10.35am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor: Geochemical Assessments **Core diameter (OD):** 50 **Easting:** 334614 **Water depth:** 12.8m
Equipment: Piston push corer **(ID):** 46 **Northing:** 6236457 **Datum:** WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Piston coring				dark brown to black organic-rich peat, no overlying sand, very hard and stiff; some shell fragments at surface	100% (depth: 0.1m; recovery: 0	VSt	PSD	metals, PAHs, TBT, TOC				required collection of two cores and compositing of upper 0.15 m of sediments to obtain sufficient material for chemical analysis
	0.5			Core terminated at 0.15m - core refusal in consolidated peat								
	1											Depth of dredge design approximately 1.0m
	1.5											

CORE LOG

WorleyParsons resources & energy

CORE ID: C15

SHEET 1 of 1

CLIENT:	Caltex Refineries NSW Pty Ltd	**DATE COLLECTED:**	16/08/2012 11.45am
PROJECT:	Caltex Dredging	**DATE LOGGED**	16/08/2012 11.55am
LOCATION:	Caltex Berths 1 and 2 (Dredge Area 3)	**LOGGED BY:**	CM
JOB NUMBER:	301015-03041	**CHECKED BY:**	

Contractor:	Geochemical Assessments	**Core diameter (OD):**	50	**Easting:**	334668	**Water depth:**	12.9m
Equipment:	Piston push corer	**(ID):**	46	**Northing:**	6236496	**Datum:**	WGS84

Method	Depth below bed level (m)	Geological Unit	Classification Symbol	Material Description	% Recovery	Density/ Consistency	Sample/ Test: PSD	Sample/ Test: Geochem	Lab Results: % Fines (< 75µm)	Lab Results: % Sand (>75µm)	Lab Results: % Gravel (> 2mm)	Field Records/Comments
Piston coring	0			dark olive to gray-green slighlty muddy sand; about 20% visual mud content; grading into sandy mud below 30 cm depth; some shell fragments; strong H2S odour;	100% (depth: 0.5m; recovery: 0.5	S-Med	PSD	metals, PAHs, TBT, TOC				required repeat coring attempts (three unsuccessful coring attempts in hard peat surface; patchy distribution of unconsolidated sediments at this location, with surface appearance of peat layer common
	0.5			Core terminated at 0.5m - core refusal in consolidated peat		VSt						Depth of dredge design approximately 0.5m
	1											

Appendix 4 Laboratory Results

PARTICLE SIZE DISTRIBUTION RESULTS

Certificate of Analysis

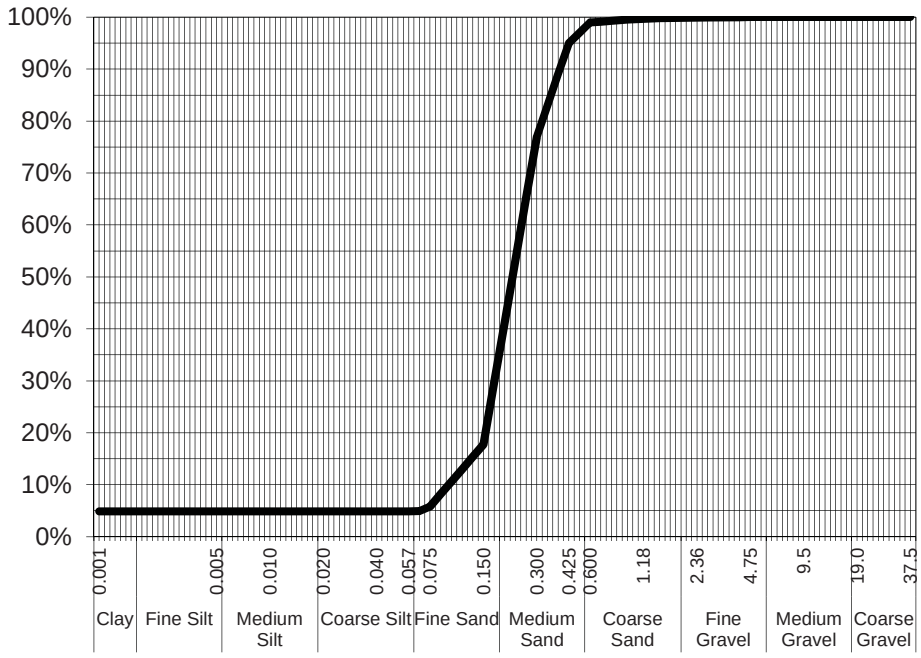
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-001 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C13_0.0-0.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	95%
0.300	77%
0.150	18%
0.075	6%
Particle Size (microns)	
57	5%
40	5%
20	5%
10	5%
5	5%
4	5%
1	5%

Median Particle Size (mm)	0.150

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

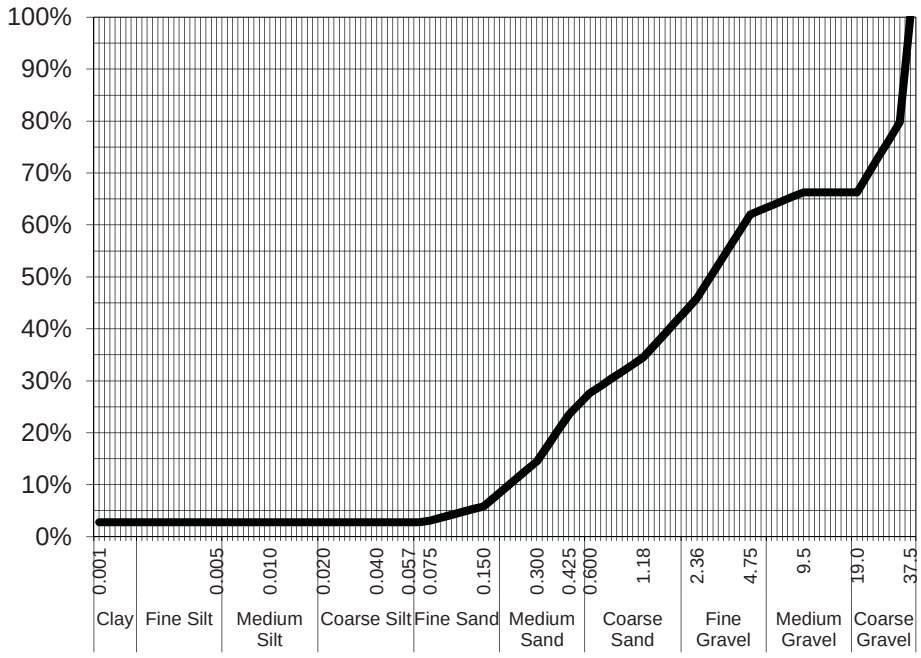
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-002 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C5_0.0-0.15

Particle Size Distribution



Particle Size (mm)	Percent Passing
37.5	100%
19.0	66%
9.5	66%
4.75	62%
2.36	46%
1.18	35%
0.600	28%
0.425	23%
0.300	14%
0.150	6%
0.075	3%
Particle Size (microns)	
57	3%
40	3%
20	3%
10	3%
5	3%
4	3%
1	3%

Median Particle Size (mm)	2.360

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Gravel and sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

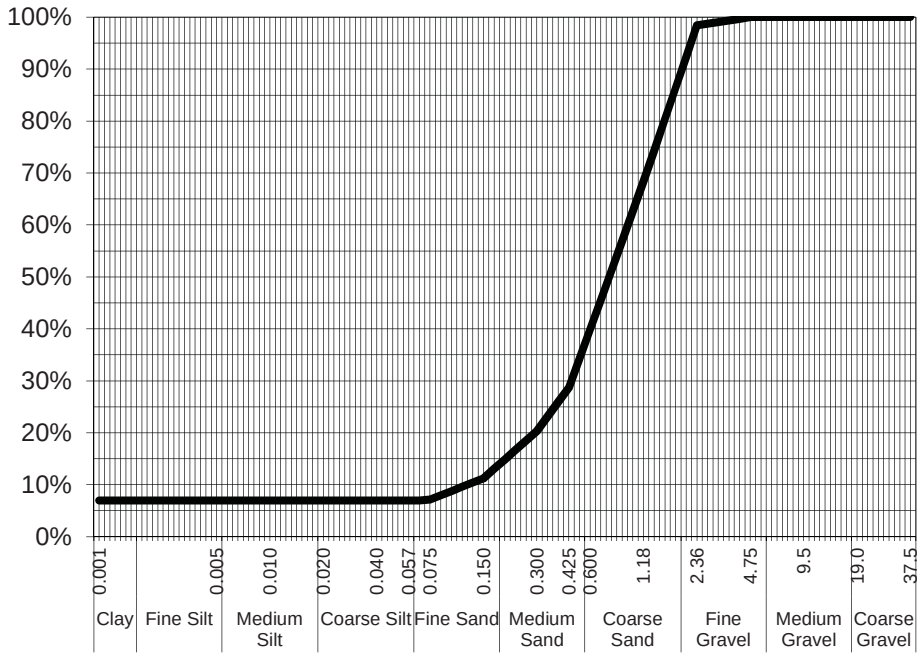
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-003 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C7_0.0-0.10

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	98%
1.18	68%
0.600	40%
0.425	29%
0.300	20%
0.150	11%
0.075	7%
Particle Size (microns)	
57	7%
40	7%
20	7%
10	7%
5	7%
4	7%
1	7%

Median Particle Size (mm)	0.600

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

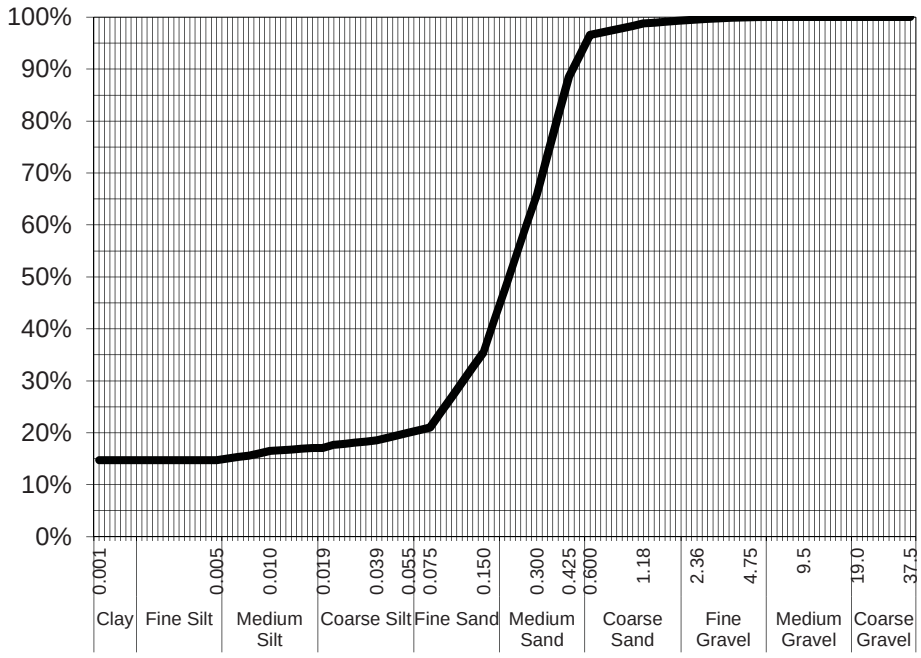
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-004 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C2_0.0-0.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	97%
0.425	88%
0.300	66%
0.150	35%
0.075	21%
Particle Size (microns)	
55	20%
39	19%
19	17%
10	16%
5	15%
3	15%
1	15%

Median Particle Size (mm)	0.150

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

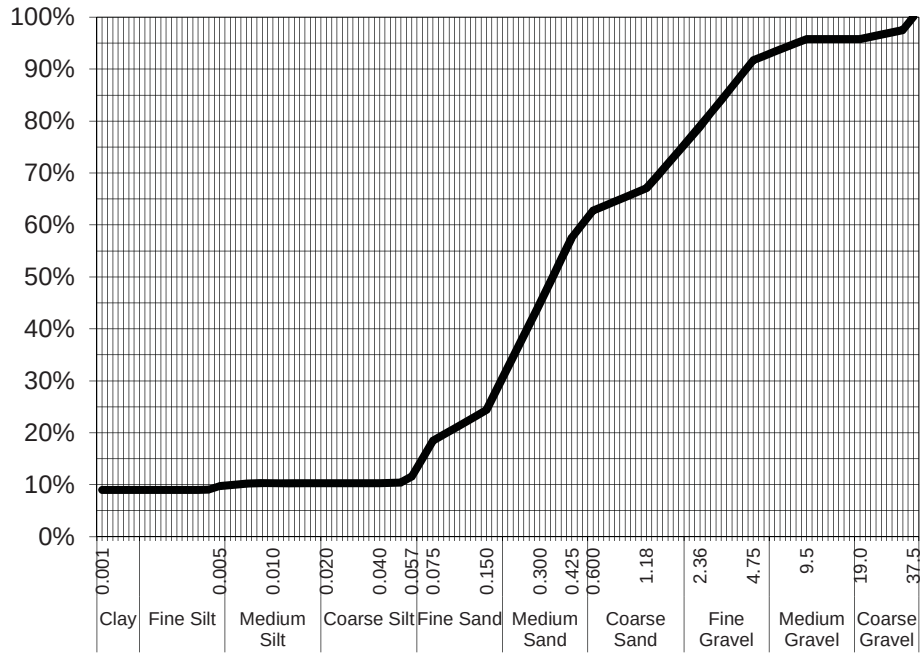
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-005 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C1_0-0.55

Particle Size Distribution



Particle Size (mm)	Percent Passing
37.5	100%
19.0	96%
9.5	96%
4.75	92%
2.36	79%
1.18	67%
0.600	63%
0.425	58%
0.300	45%
0.150	24%
0.075	18%
Particle Size (microns)	
57	12%
40	10%
20	10%
10	10%
5	10%
4	9%
1	9%

Median Particle Size (mm)	0.300

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:		**Analysed:**	20-Aug-12
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand, gravel and silty clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.1/AS1289.3.6.3	**Hydrometer Type**	ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

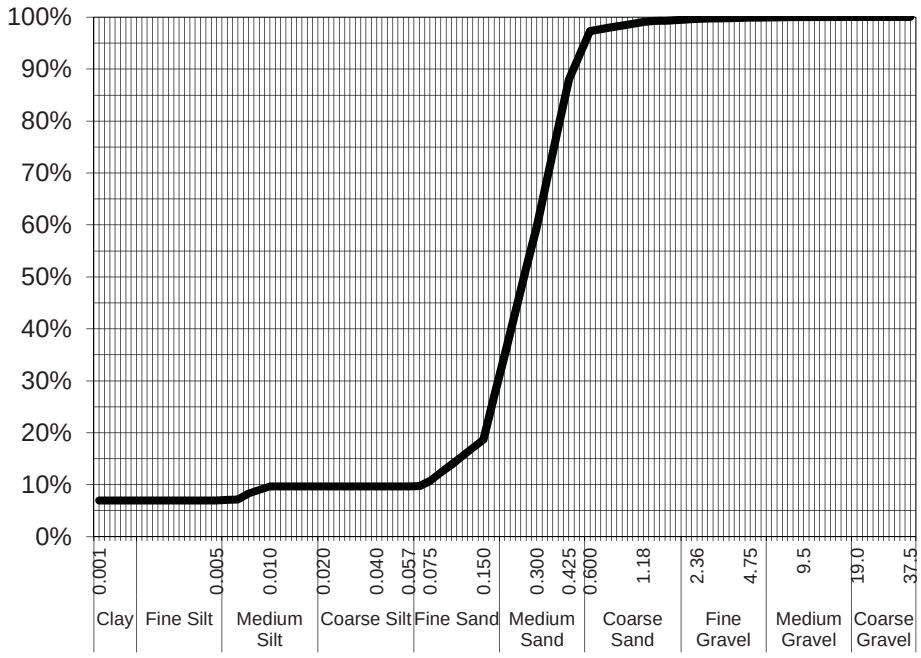
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-006 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C10_0-0.50

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	97%
0.425	88%
0.300	60%
0.150	19%
0.075	11%
Particle Size (microns)	
57	10%
40	10%
20	10%
10	10%
5	7%
4	7%
1	7%

Median Particle Size (mm)	0.150

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

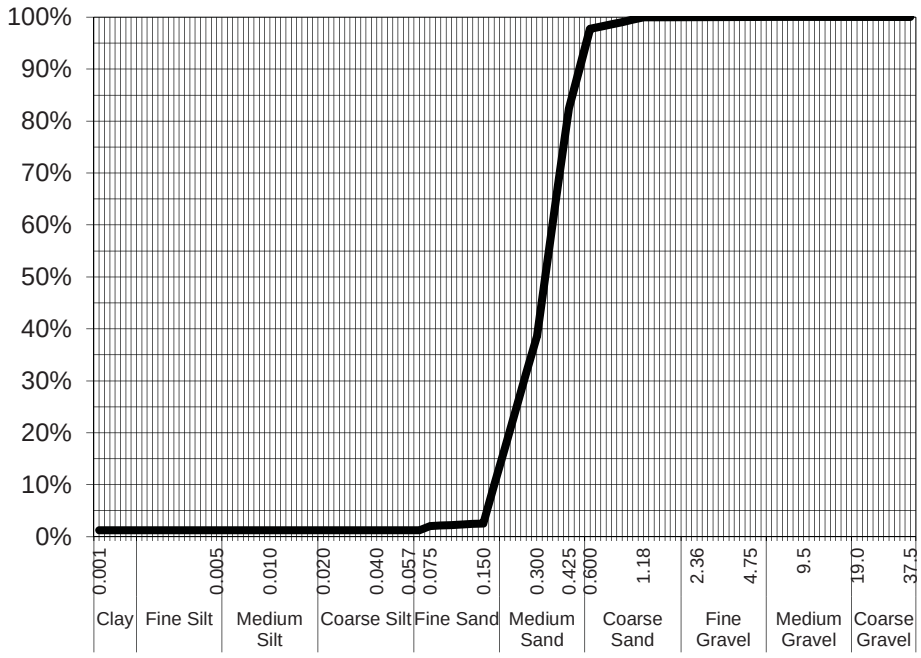
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-007 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C10_1.0-1.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	98%
0.425	82%
0.300	38%
0.150	3%
0.075	2%
Particle Size (microns)	
57	1%
40	1%
20	1%
10	1%
5	1%
4	1%
1	1%

Median Particle Size (mm)	0.300

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

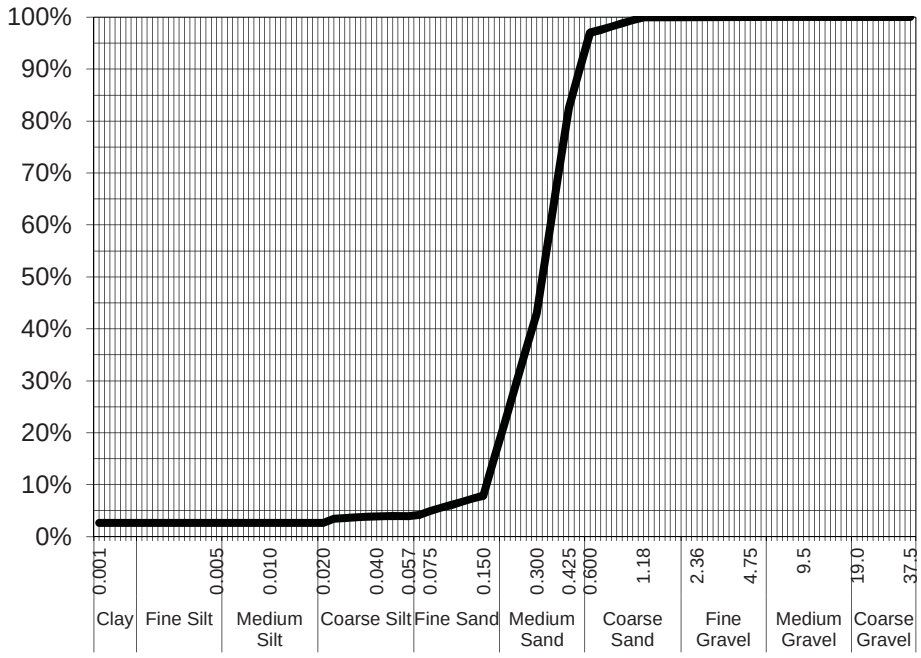
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-008 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C12_0.5-1.0

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	97%
0.425	83%
0.300	43%
0.150	8%
0.075	5%
Particle Size (microns)	
57	4%
40	4%
20	3%
10	3%
5	3%
4	3%
1	3%

Median Particle Size (mm)	0.300

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

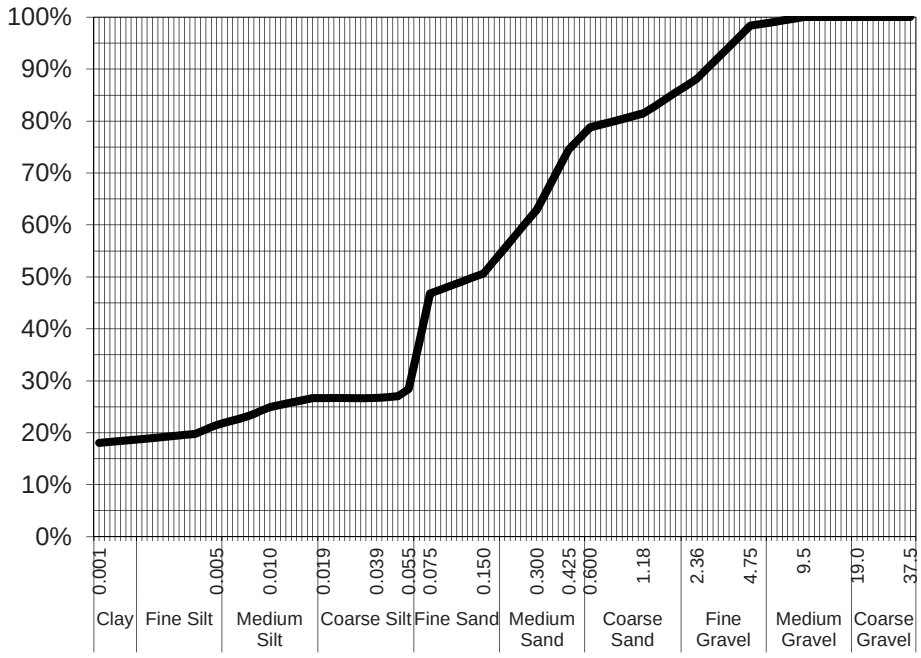
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-009 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C8_0.0-0.12

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	98%
2.36	88%
1.18	81%
0.600	79%
0.425	75%
0.300	63%
0.150	51%
0.075	47%
Particle Size (microns)	
55	28%
39	27%
19	27%
10	25%
5	21%
3	20%
1	18%

Median Particle Size (mm)	0.113

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay, sand and gravel

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

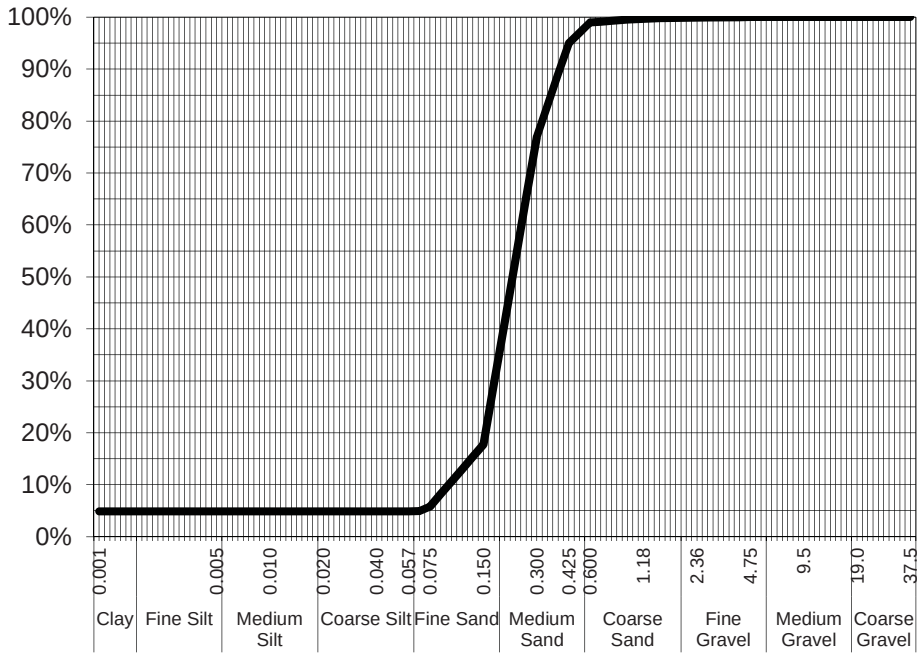
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-001 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C13_0.0-0.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	95%
0.300	77%
0.150	18%
0.075	6%
Particle Size (microns)	
57	5%
40	5%
20	5%
10	5%
5	5%
4	5%
1	5%

Median Particle Size (mm)	0.150

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

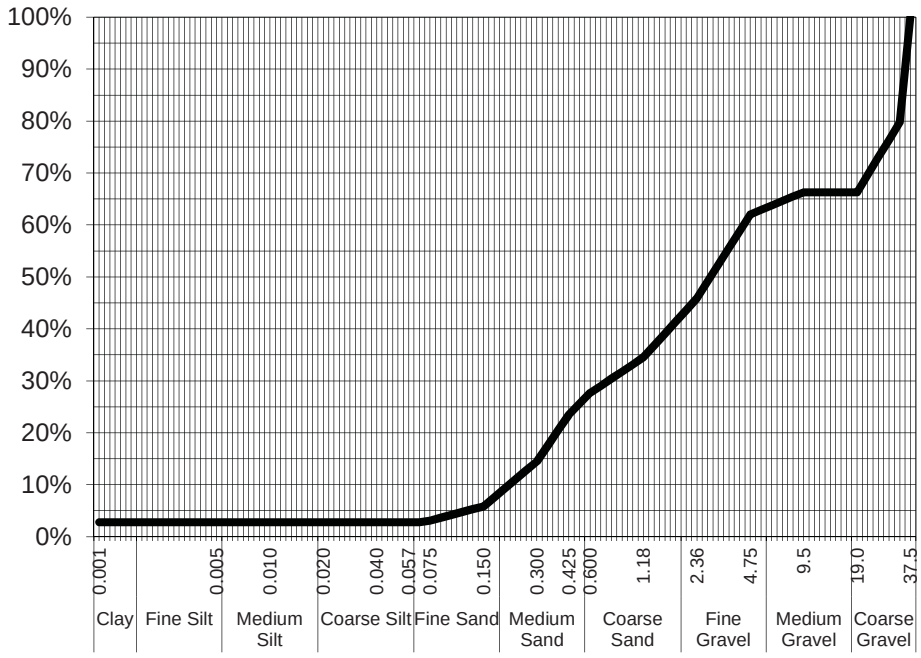
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-002 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C5_0.0-0.15

Particle Size Distribution



Particle Size (mm)	Percent Passing
37.5	100%
19.0	66%
9.5	66%
4.75	62%
2.36	46%
1.18	35%
0.600	28%
0.425	23%
0.300	14%
0.150	6%
0.075	3%
Particle Size (microns)	
57	3%
40	3%
20	3%
10	3%
5	3%
4	3%
1	3%

Median Particle Size (mm)	2.360

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Gravel and sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

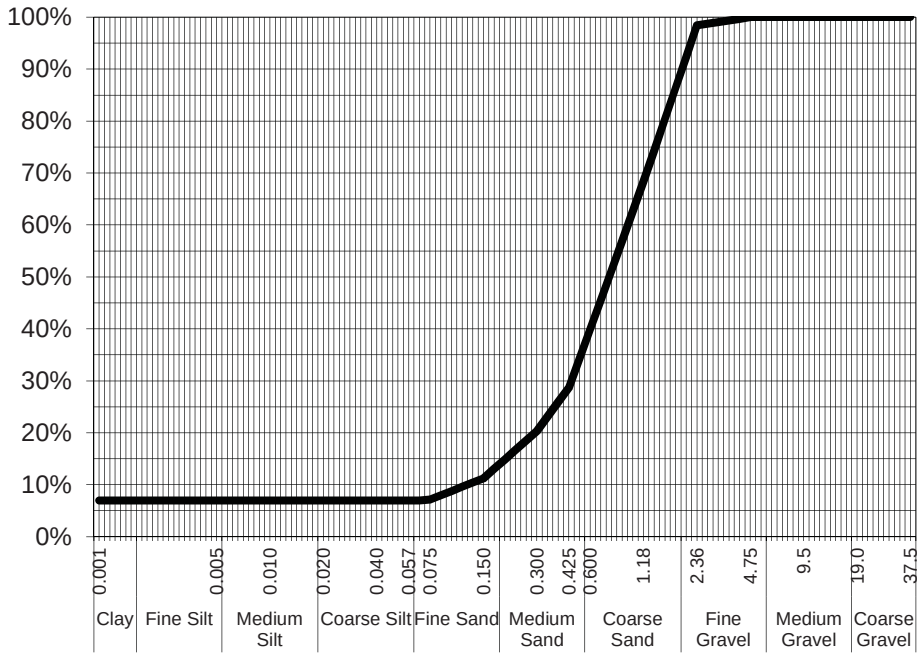
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-003 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C7_0.0-0.10

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	98%
1.18	68%
0.600	40%
0.425	29%
0.300	20%
0.150	11%
0.075	7%
Particle Size (microns)	
57	7%
40	7%
20	7%
10	7%
5	7%
4	7%
1	7%

Median Particle Size (mm)	0.600

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

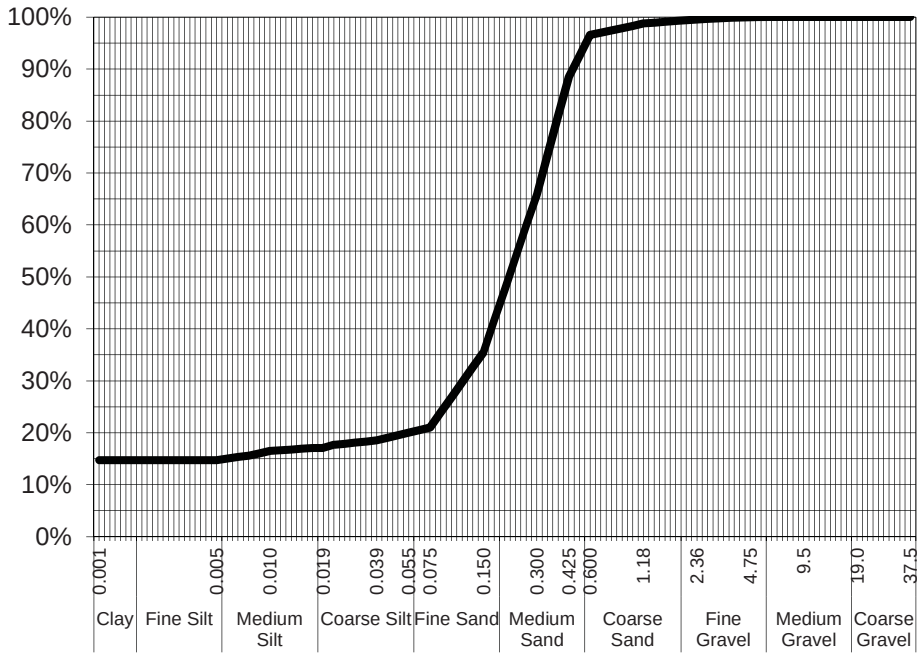
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-004 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C2_0.0-0.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	97%
0.425	88%
0.300	66%
0.150	35%
0.075	21%
Particle Size (microns)	
55	20%
39	19%
19	17%
10	16%
5	15%
3	15%
1	15%

Median Particle Size (mm)	0.150

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

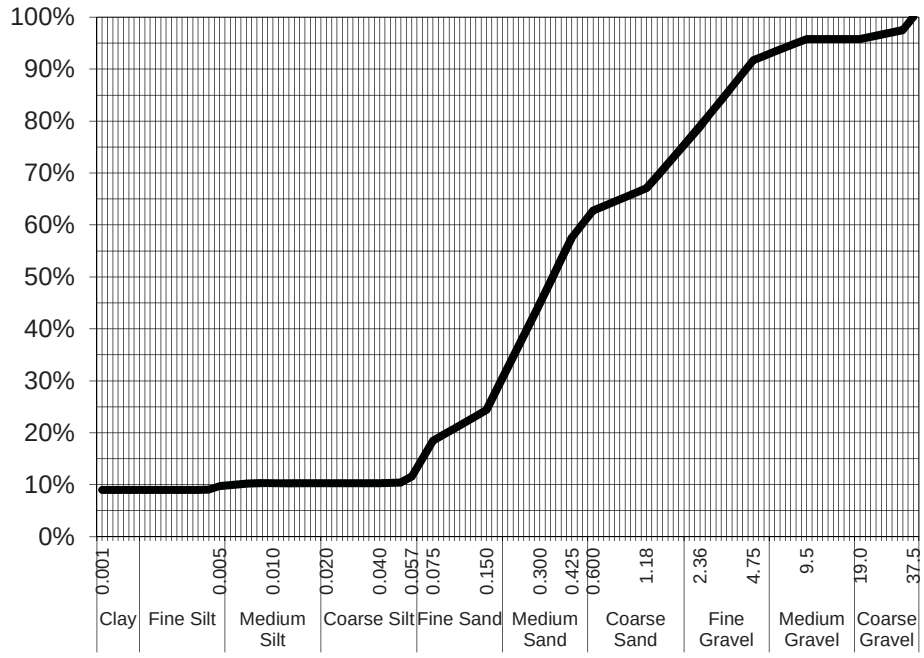
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-005 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C1_0-0.55

Particle Size Distribution



Particle Size (mm)	Percent Passing
37.5	100%
19.0	96%
9.5	96%
4.75	92%
2.36	79%
1.18	67%
0.600	63%
0.425	58%
0.300	45%
0.150	24%
0.075	18%
Particle Size (microns)	
57	12%
40	10%
20	10%
10	10%
5	10%
4	9%
1	9%

Median Particle Size (mm)	0.300

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:		**Analysed:**	20-Aug-12
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand, gravel and silty clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.1/AS1289.3.6.3	**Hydrometer Type**	ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

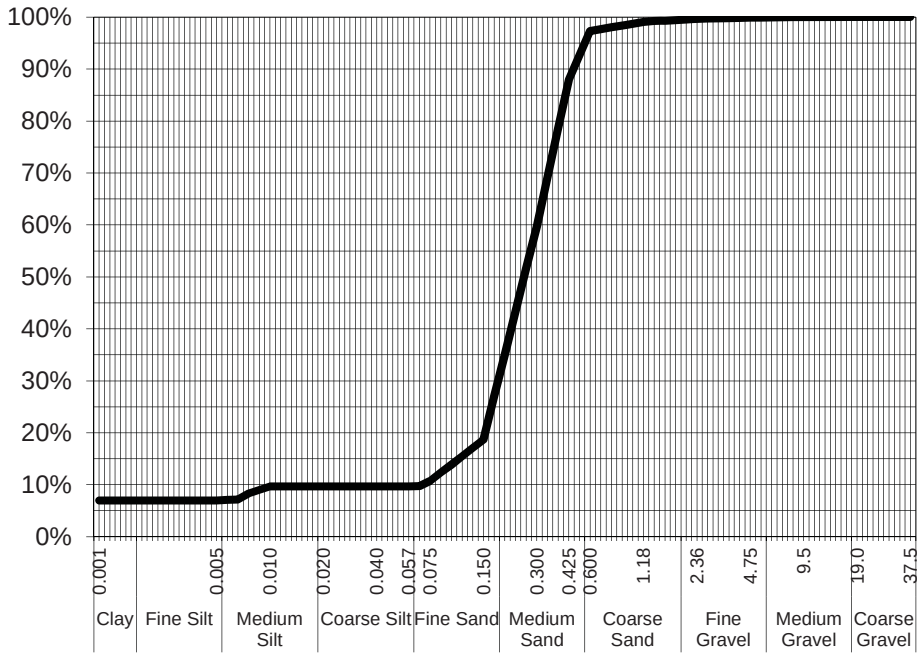
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-006 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C10_0-0.50

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	97%
0.425	88%
0.300	60%
0.150	19%
0.075	11%
Particle Size (microns)	
57	10%
40	10%
20	10%
10	10%
5	7%
4	7%
1	7%

Median Particle Size (mm)	0.150

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

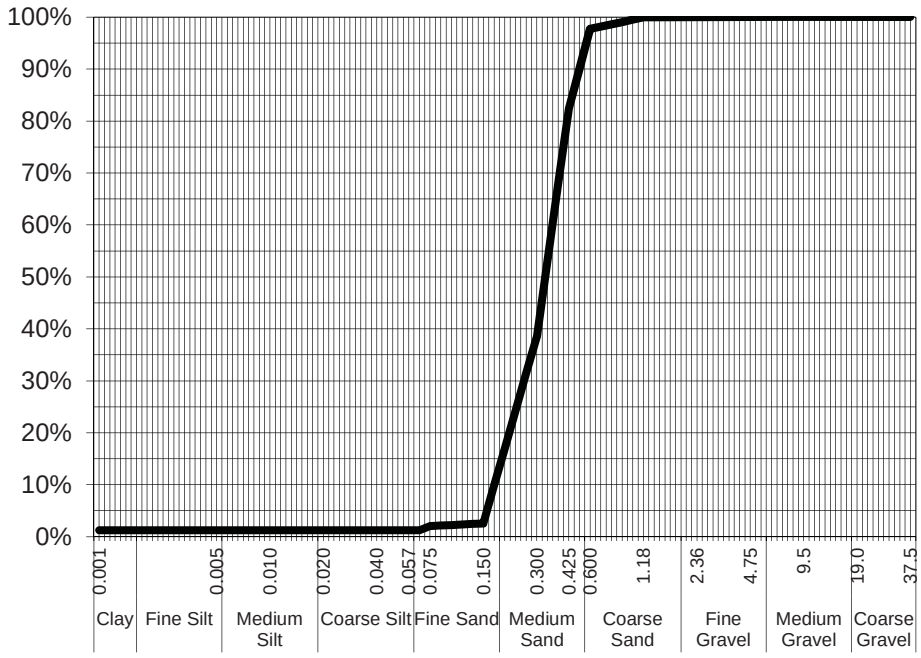
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-007 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C10_1.0-1.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	98%
0.425	82%
0.300	38%
0.150	3%
0.075	2%
Particle Size (microns)	
57	1%
40	1%
20	1%
10	1%
5	1%
4	1%
1	1%

Median Particle Size (mm)	0.300

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

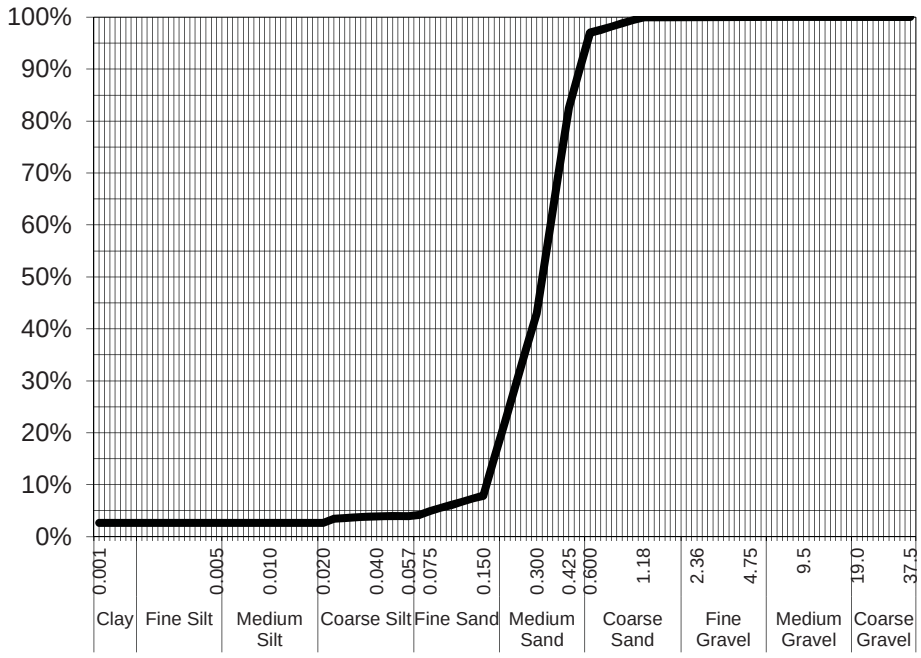
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-008 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C12_0.5-1.0

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	97%
0.425	83%
0.300	43%
0.150	8%
0.075	5%
Particle Size (microns)	
57	4%
40	4%
20	3%
10	3%
5	3%
4	3%
1	3%

Median Particle Size (mm)	0.300

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

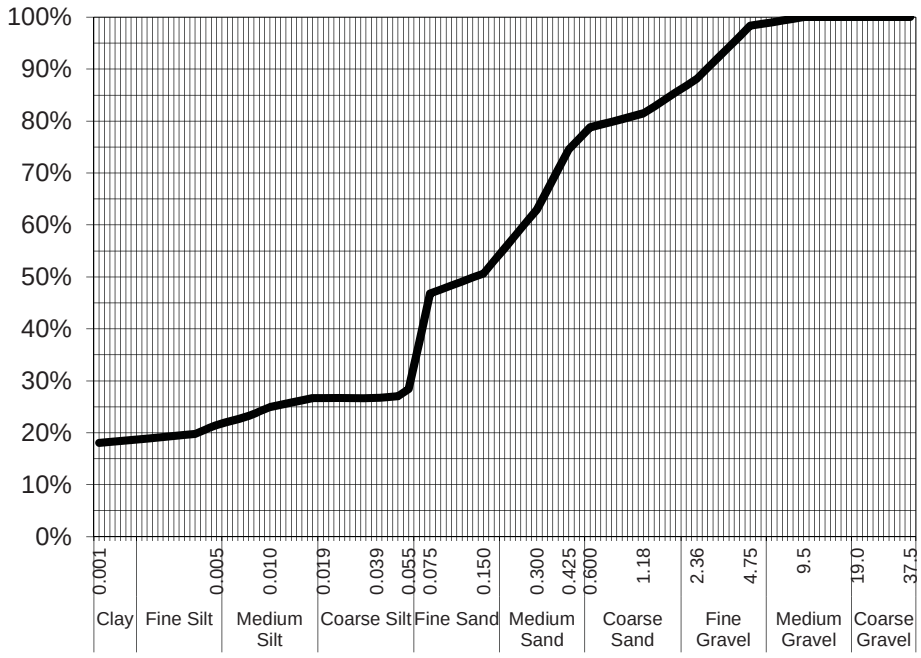
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Carsten Matthai	**DATE REPORTED:**	22-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	15-Aug-2012
ADDRESS:	141 Walker St North Sydney, NSW 2060	**REPORT NO:**	ES1219873-009 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C8_0.0-0.12

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	98%
2.36	88%
1.18	81%
0.600	79%
0.425	75%
0.300	63%
0.150	51%
0.075	47%
Particle Size (microns)	
55	28%
39	27%
19	27%
10	25%
5	21%
3	20%
1	18%

Median Particle Size (mm)	0.113

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 20-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay, sand and gravel

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1219873**	Page	: 1 of 4
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 301015-03041		
C-O-C number	: ----	Date Samples Received	: 15-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Site	: ----		
		No. of samples received	: 12
Quote number	: SY/389/12 V2	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
		Newcastle

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: C13_0.0-0.5	C5_0.0-0.15	C7_0.0-0.10	C2_0.0-0.5	C1_0-0.55
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1219873-001	ES1219873-002	ES1219873-003	ES1219873-004	ES1219873-005
EA150: Particle Sizing								
+75µm	----	1	%	94	97	93	79	82
+150µm	----	1	%	82	94	89	64	76
+300µm	----	1	%	23	86	80	34	55
+425µm	----	1	%	5	77	71	12	42
+600µm	----	1	%	1	72	60	3	37
+1180µm	----	1	%	<1	66	32	1	33
+2.36mm	----	1	%	<1	54	2	<1	21
+4.75mm	----	1	%	<1	38	<1	<1	8
+9.5mm	----	1	%	<1	34	<1	<1	4
+19.0mm	----	1	%	<1	34	<1	<1	4
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	5	3	7	15	9
Silt (2-60 µm)	----	1	%	1	<1	<1	6	8
Sand (0.06-2.00 mm)	----	1	%	94	43	91	79	62
Gravel (>2mm)	----	1	%	<1	54	2	<1	21
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C10_0-0.50	C10_1.0-1.5	C12_0.5-1.0	C8_0.0-0.12	----
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	----
Compound	CAS Number	LOR	Unit		ES1219873-006	ES1219873-007	ES1219873-008	ES1219873-009	----
EA150: Particle Sizing									
+75µm	----	1	%		89	98	95	53	----
+150µm	----	1	%		81	98	92	49	----
+300µm	----	1	%		40	62	57	37	----
+425µm	----	1	%		12	18	18	26	----
+600µm	----	1	%		3	2	3	21	----
+1180µm	----	1	%		<1	<1	<1	18	----
+2.36mm	----	1	%		<1	<1	<1	12	----
+4.75mm	----	1	%		<1	<1	<1	2	----
+9.5mm	----	1	%		<1	<1	<1	<1	----
+19.0mm	----	1	%		<1	<1	<1	<1	----
+37.5mm	----	1	%		<1	<1	<1	<1	----
+75.0mm	----	1	%		<1	<1	<1	<1	----
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		7	1	3	18	----
Silt (2-60 µm)	----	1	%		4	1	2	27	----
Sand (0.06-2.00 mm)	----	1	%		89	98	95	43	----
Gravel (>2mm)	----	1	%		<1	<1	<1	12	----
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	----

Client - Ma SOIL		Sample Type:	REG	REG	REG	REG	REG	REG	REG	REG	REG
Workgrou ES1219873		ALS Sample number:	ES1219873001	ES1219873002	ES1219873003	ES1219873004	ES1219873005	ES1219873006	ES1219873007	ES1219873008	ES1219873009
Project nar CALTEX DREDGING		Sample date:	14/08/2012	14/08/2012	14/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012
		Client sample ID (Primary):	C13_0.0-0.5	C5_0.0-0.15	C7_0.0-0.10	C2_0.0-0.5	C1_0-0.55	C10_0-0.50	C10_1.0-1.5	C12_0.5-1.0	C8_0.0-0.12
		Client sample ID (Secondary):									
		Sample Site:									
		Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte gr	CAS Numb	Units	LOR								
EA150: Particle Sizing											
+75µm		%	1	94	97	93	79	82	89	98	95	53
+150µm		%	1	82	94	89	64	76	81	98	92	49
+300µm		%	1	23	86	80	34	55	40	62	57	37
+425µm		%	1	5	77	71	12	42	12	18	18	26
+600µm		%	1	1	72	60	3	37	3	2	3	21
+1180µm		%	1	<1	66	32	1	33	<1	<1	<1	18
+2.36mm		%	1	<1	54	2	<1	21	<1	<1	<1	12
+4.75mm		%	1	<1	38	<1	<1	8	<1	<1	<1	2
+9.5mm		%	1	<1	34	<1	<1	4	<1	<1	<1	<1
+19.0mm		%	1	<1	34	<1	<1	4	<1	<1	<1	<1
+37.5mm		%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
+75.0mm		%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size												
Clay (<2 µm)		%	1	5	3	7	15	9	7	1	3	18
Silt (2-60 µm)		%	1	1	<1	<1	6	8	4	1	2	27
Sand (0.06-2.00 mm)		%	1	94	43	91	79	62	89	98	95	43
Gravel (>2mm)		%	1	<1	54	2	<1	21	<1	<1	<1	12
Cobbles (>6cm)		%	1	<1	<1	<1	<1	<1	<1	<1	<1	<1

QC - Matrix:	Sample Type:	
Workgrou ES1219873	ALS Sample number:	
	Sample date:	

Analyte gr	CAS Numb	Units	LOR

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order : **ES1219873**

Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS DEBORAH LAM	Contact	: Client Services
Address	: 141 Walker st North Sydney NSW 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: deborah.lam@WorleyParsons.com	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	Page	: 1 of 3
Order number	: 301015-03041		
C-O-C number	: ----	Quote number	: ES2012CALREFNSW0182 (SY/389/12 V2)
Site	: ----		
Sampler	: CM	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 15-AUG-2012	Issue Date	: 16-AUG-2012 11:17
Client Requested Due Date	: 23-AUG-2012	Scheduled Reporting Date	: **23-AUG-2012**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 3.3'C - Ice present
No. of coolers/boxes	: 3 HARD	No. of samples received	: 12
Security Seal	: Not intact.	No. of samples analysed	: 9

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **PSD analysis will be conducted by ALS Newcastle.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample C14_0.0-0.12 received extra and placed on hold, Please confirm.**
- **Sample #8 id is C12_0.5-1.0 on the jar, but received labelled as C12_1.0-1.5, Please confirm which is the correct ID.**
- **THIS BATCH IS FOR PSD AND SPLIT INTO ES1219839.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

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

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

Summary of Sample(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 the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) SOIL No analysis requested	SOIL - EA150H Particle Size Analysis by Hydrometer
ES1219873-001	14-AUG-2012 15:00	C13_0.0-0.5		✓
ES1219873-002	14-AUG-2012 15:00	C5_0.0-0.15		✓
ES1219873-003	14-AUG-2012 15:00	C7_0.0-0.10		✓
ES1219873-004	15-AUG-2012 15:00	C2_0.0-0.5		✓
ES1219873-005	15-AUG-2012 15:00	C1_0-0.55		✓
ES1219873-006	15-AUG-2012 15:00	C10_0-0.50		✓
ES1219873-007	15-AUG-2012 15:00	C10_1.0-1.5		✓
ES1219873-008	15-AUG-2012 15:00	C12_1.0-1.5		✓
ES1219873-009	15-AUG-2012 15:00	C8_0.0-0.12		✓
ES1219873-010	14-AUG-2012 15:00	C3_0.0-0.1	✓	
ES1219873-011	14-AUG-2012 15:00	C4_0.0-0.1	✓	
ES1219873-012	14-AUG-2012 15:00	C14_0.0-0.12	✓	

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

MR CARSTEN MATTHAI

- *AU Certificate of Analysis - NATA (COA)	Email	carsten.matthai@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	carsten.matthai@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	carsten.matthai@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	carsten.matthai@WorleyParsons.com
- Attachment - Report (SUBCO)	Email	carsten.matthai@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	carsten.matthai@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	carsten.matthai@WorleyParsons.com

MR SIMON CAPLES

- *AU Certificate of Analysis - NATA (COA)	Email	scaples@caltex.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	scaples@caltex.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	scaples@caltex.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	scaples@caltex.com.au
- A4 - AU Tax Invoice (INV)	Email	scaples@caltex.com.au
- Attachment - Report (SUBCO)	Email	scaples@caltex.com.au
- Chain of Custody (CoC) (COC)	Email	scaples@caltex.com.au
- EDI Format - ENMRG (ENMRG)	Email	scaples@caltex.com.au

MS CHRISTINA HALIM

- A4 - AU Tax Invoice (INV)	Email	CHalim@caltex.com.au

MS DEBORAH LAM

- *AU Certificate of Analysis - NATA (COA)	Email	deborah.lam@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	deborah.lam@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	deborah.lam@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	deborah.lam@WorleyParsons.com
- Attachment - Report (SUBCO)	Email	deborah.lam@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	deborah.lam@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	deborah.lam@WorleyParsons.com

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor — CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai — SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No — EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHallm@caltex.com.au

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

☑ 3 DAY TAT REQUIRED

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)

COC: (1) 2 3 4 5 6 7

OF: 1 2 (3) 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: °C

Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	Frank ALS		
DATE/TIME: 15/8/12 4:30pm	DATE/TIME: 15-8-12 1800	DATE/TIME:	DATE/TIME:

Environmental Division Sydney

Work Order

ES1219873

Telephone : +61-2-8784 8555

ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price. Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).

ALS USE	SAMPLE DETAILS — MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ALS SYDNEY					ALS Newcastle		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing	
1	C13_0.0-0.5	14/8/12	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓	Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
(10)	C3_0.0-0.1	"	Sediment	Various	2 jars	✓	✓		✓	✓		✓	
(11)	C4_0.0-0.1	"	Sediment	Various	2 jars	✓	✓		✓	✓		✓	
2	C5_0.0-0.15	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓	small volume in PSD bag and one "hold" jar (elutriate
	C6_0.0-0.13	"	Sediment	Various	2 jars	✓	✓		✓	✓		✓	
3	C7_0.0-0.10	"	Sediment	Various	2 jars 1 bag	✓	✓		✓	✓	✓	✓	
	QC1	"	Sediment	Various	2 jars	✓	✓		✓	✓			
	~~QC2~~ QC3	"	Sediment	Various	1 jar		✓						
			Sediment	Various									
				TOTAL	22								

Subcon / Forward Lab / Split WO

Lab / Analysis: ALS Newcastle / PSD

Organised By / Date: _____

Relinquished By / Date: _____

Courier: _____

SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS

WO #: _____

Attach My PO / Internal Sheet: _____

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5630 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com

WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor — CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai — SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No — EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

☑ 3 DAY TAT REQUIRED

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)

COC: 1 (2) 3 4 5 6 7

OF: 1 2 (3) 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: °C

Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	Frank ALS		
DATE/TIME: 15-8-12 4:30pm	DATE/TIME: 15-8-12 1800	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER/INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
						ALS SYDNEY					ALS Newcastle			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
4	C2_0.0-0.5	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
5	C1_0-0.55	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		
6	C10_0-0.50	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		
	C10_0.5-1.0	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		
7	C10_1.0-1.5	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		
	QC6	15-8-12	Sediment	Various	2jars	✓	✓		✓	✓				
	QC4	15-8-12	Sediment	Various	1jar		✓							
	QC5	15-8-12	Sediment	Various	2jars							✓		
	TO1A	15-8-12	Sediment	Various	4jars	✓	✓		✓	✓		✓		
	TO1B	15-8-12	Solid		4jars	✓	✓		✓	✓		✓		SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	37									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic

V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unproserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor — CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai — SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No — EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)

☑ 3 DAY TAT REQUIRED

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)

COC: 1 2 3 4 5 6 7

OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle):

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: °C

Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	FRANK ALS		
DATE/TIME: 15-8-12 4:30pm	DATE/TIME: 15-8-12 18:00	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
						ALS SYDNEY					ALS Newcastle			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		
	C12_0.0-0.5	15-8-12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
8	C12_0.5-1.0 + 1.0-1.5 OVERLAP	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
	C12-1.0-1.5	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
9	C8_0.0-0.12	"	Sediment	Various	2 jars 1 bag	✓	✓		✓	✓	✓	✓		insufficient material for elutriate
	C9_0.0-0.45	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
			Sediment	Various										
(12)	C14_0.0-0.12		Sediment	Various										
	↑ Extra sample		Sediment	Various										
			Sediment	Various										
	Elutriate blank	15-8-12	Water		1 x 1L container	(x1)						✓		SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	21 (incl. 1 x 1L container)									

*Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order	: **ES1219873**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CARSTEN MATTHAI	Contact	: Client Services
Address	: 141 Walker st North Sydney NSW 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: carsten.matthai@WorleyParsons.com	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	Page	: 1 of 3
Order number	: 301015-03041		
C-O-C number	: ----	Quote number	: ES2012CALREFNSW0182 (SY/389/12 V2)
Site	: ----		
Sampler	: CM	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 15-AUG-2012	Issue Date	: 17-AUG-2012 12:25
Client Requested Due Date	: 23-AUG-2012	Scheduled Reporting Date	: **23-AUG-2012**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 3.3'C - Ice present
No. of coolers/boxes	: 3 HARD	No. of samples received	: 12
Security Seal	: Not intact.	No. of samples analysed	: 9

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **PSD analysis will be conducted by ALS Newcastle.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample C14_0.0-0.12 received extra and placed on hold, Please confirm.**
- **Sample #8 id is C12_0.5-1.0 on the jar, but received labelled as C12_1.0-1.5, Please confirm which is the correct ID.**
- **THIS BATCH IS FOR PSD AND SPLIT INTO ES1219839.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

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

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

Summary of Sample(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 the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) SOIL No analysis requested	SOIL - EA150H Particle Size Analysis by Hydrometer
ES1219873-001	14-AUG-2012 15:00	C13_0.0-0.5		✓
ES1219873-002	14-AUG-2012 15:00	C5_0.0-0.15		✓
ES1219873-003	14-AUG-2012 15:00	C7_0.0-0.10		✓
ES1219873-004	15-AUG-2012 15:00	C2_0.0-0.5		✓
ES1219873-005	15-AUG-2012 15:00	C1_0-0.55		✓
ES1219873-006	15-AUG-2012 15:00	C10_0-0.50		✓
ES1219873-007	15-AUG-2012 15:00	C10_1.0-1.5		✓
ES1219873-008	15-AUG-2012 15:00	C12_0.5-1.0		✓
ES1219873-009	15-AUG-2012 15:00	C8_0.0-0.12		✓
ES1219873-010	14-AUG-2012 15:00	C3_0.0-0.1	✓	
ES1219873-011	14-AUG-2012 15:00	C4_0.0-0.1	✓	
ES1219873-012	14-AUG-2012 15:00	C14_0.0-0.12	✓	

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

MR CARSTEN MATTHAI

- *AU Certificate of Analysis - NATA (COA)	Email	carsten.matthai@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	carsten.matthai@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	carsten.matthai@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	carsten.matthai@WorleyParsons.com
- Attachment - Report (SUBCO)	Email	carsten.matthai@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	carsten.matthai@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	carsten.matthai@WorleyParsons.com

MR SIMON CAPLES

- *AU Certificate of Analysis - NATA (COA)	Email	scaples@caltex.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	scaples@caltex.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	scaples@caltex.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	scaples@caltex.com.au
- A4 - AU Tax Invoice (INV)	Email	scaples@caltex.com.au
- Attachment - Report (SUBCO)	Email	scaples@caltex.com.au
- Chain of Custody (CoC) (COC)	Email	scaples@caltex.com.au
- EDI Format - ENMRG (ENMRG)	Email	scaples@caltex.com.au

MS CHRISTINA HALIM

- A4 - AU Tax Invoice (INV)	Email	CHalim@caltex.com.au

MS DEBORAH LAM

- *AU Certificate of Analysis - NATA (COA)	Email	deborah.lam@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	deborah.lam@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	deborah.lam@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	deborah.lam@WorleyParsons.com
- Attachment - Report (SUBCO)	Email	deborah.lam@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	deborah.lam@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	deborah.lam@WorleyParsons.com

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1219873**	Page	: 1 of 5
Client	: CALTEX REFINERIES(NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 15-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 12
Quote number	: SY/389/12 V2	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

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

Analysis Holding Time Compliance

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 precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA150: Particle Sizing							
Snap Lock Bag (EA150H) C13_0.0-0.5, C5_0.0-0.15, C7_0.0-0.10	**14-AUG-2012**	**---**	10-FEB-2013	----	**21-AUG-2012**	10-FEB-2013	✓
Snap Lock Bag (EA150H) C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_1.0-1.5, C12_0.5-1.0, C8_0.0-0.12	**15-AUG-2012**	**---**	11-FEB-2013	----	**21-AUG-2012**	11-FEB-2013	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag (EA150H) C13_0.0-0.5, C5_0.0-0.15, C7_0.0-0.10	**14-AUG-2012**	**---**	10-FEB-2013	----	**21-AUG-2012**	10-FEB-2013	✓
Snap Lock Bag (EA150H) C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_1.0-1.5, C12_0.5-1.0, C8_0.0-0.12	**15-AUG-2012**	**---**	11-FEB-2013	----	**21-AUG-2012**	11-FEB-2013	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix:

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	

Brief Method Summaries

The analytical procedures used by the Environmental Division 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 in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

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

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1219873**	Page	: 1 of 4
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 15-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 12
Quote number	: SY/389/12 V2	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
		Newcastle

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

- **No Laboratory Duplicate (DUP) Results are required to be reported.**

Method Blank (MB) and Laboratory Control Spike (LCS) Report

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

- **No Method Blank (MB) or Laboratory Control Spike (SCS) Results are required to be reported.**

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) Results are required to be reported.**

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Certificate of Analysis

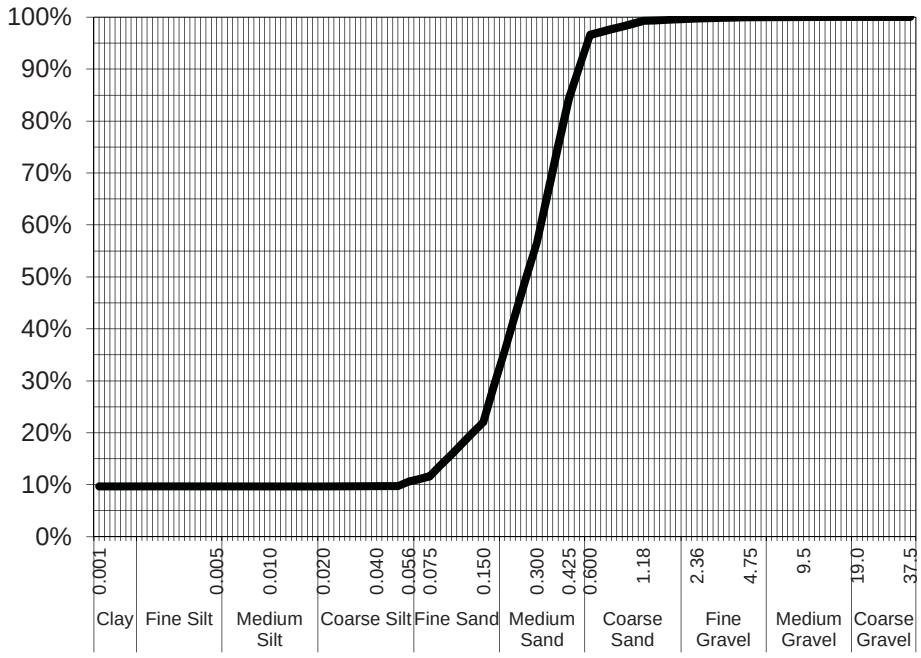
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Simon Caples	**DATE REPORTED:**	23-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	16-Aug-2012
ADDRESS:	2 Solander St Kurnell, NSW, Australia 2231	**REPORT NO:**	ES1220010-001 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C18_0.0-0.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	97%
0.425	84%
0.300	57%
0.150	22%
0.075	12%
Particle Size (microns)	
56	11%
40	10%
20	10%
10	10%
5	10%
4	10%
1	10%

Median Particle Size (mm)	0.225

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 21-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

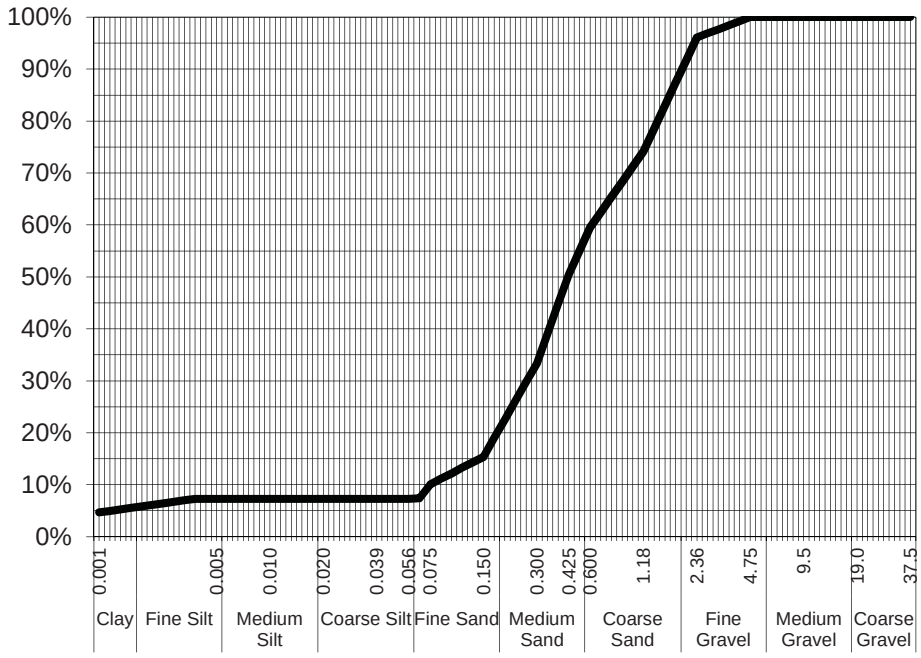
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Simon Caples	**DATE REPORTED:**	23-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	16-Aug-2012
ADDRESS:	2 Solander St Kurnell, NSW, Australia 2231	**REPORT NO:**	ES1220010-002 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C14_0.0-0.15

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	96%
1.18	74%
0.600	60%
0.425	50%
0.300	33%
0.150	15%
0.075	10%
Particle Size (microns)	
56	7%
39	7%
20	7%
10	7%
5	7%
4	7%
1	5%

Median Particle Size (mm)	0.363

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 21-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

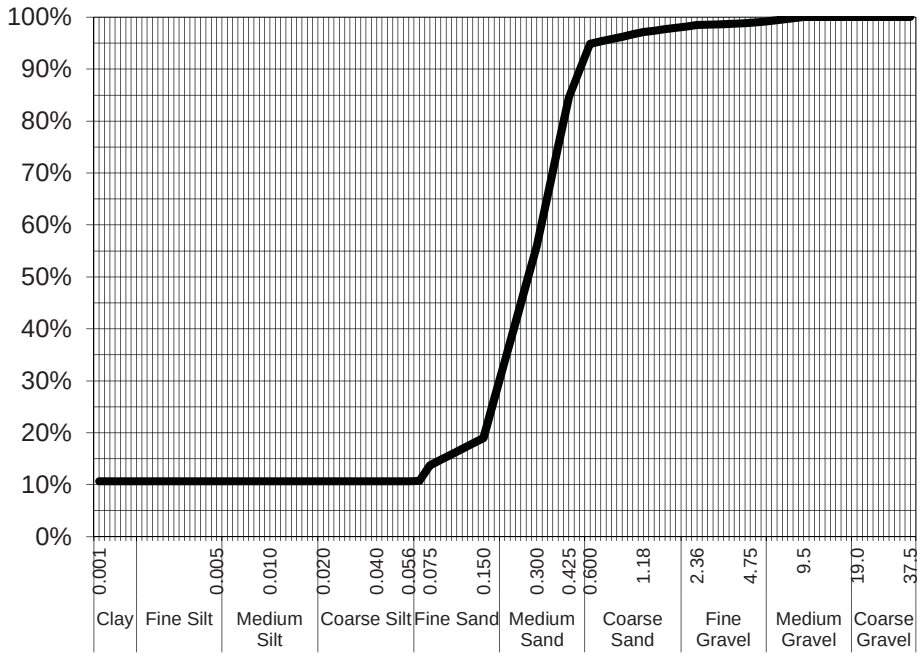
ALS Laboratory Group Pty Ltd
5 Rosegum Road
Warabrook, NSW 2304
pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Simon Caples	**DATE REPORTED:**	23-Aug-2012
COMPANY:	Caltex Refineries(NSW) Pty Ltd	**DATE RECEIVED:**	16-Aug-2012
ADDRESS:	2 Solander St Kurnell, NSW, Australia 2231	**REPORT NO:**	ES1220010-003 / PSD
PROJECT:	Caltex Dredging	**SAMPLE ID:**	C15_0.0-0.5

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	99%
2.36	98%
1.18	97%
0.600	95%
0.425	85%
0.300	56%
0.150	19%
0.075	14%
Particle Size (microns)	
56	11%
40	11%
20	11%
10	11%
5	11%
4	11%
1	11%

Median Particle Size (mm)	0.225

Samples analysed as received.

Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 21-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Client - Matrix:	SOIL		Sample Type:	REG	REG	REG
Workgroup:	ES1220010		ALS Sample number:	ES1220010001	ES1220010002	ES1220010003
Project name/number:	CALTEX DREDGING		Sample date:	16/08/2012	16/08/2012	16/08/2012
			Client sample ID (Primary):	C18_0.0-0.5	C14_0.0-0.15	C15_0.0-0.5
			Client sample ID (Secondary):			
			Sample Site:			
			Purchase Order:	301015-03041	301015-03041	301015-03041

Analyte grouping/Analyte	CAS Number	Units	LOR			
EA150: Particle Sizing						
+75µm		%	1	88	90	86
+150µm		%	1	78	85	81
+300µm		%	1	43	67	44
+425µm		%	1	16	50	16
+600µm		%	1	3	40	5
+1180µm		%	1	<1	26	3
+2.36mm		%	1	<1	4	2
+4.75mm		%	1	<1	<1	1
+9.5mm		%	1	<1	<1	<1
+19.0mm		%	1	<1	<1	<1
+37.5mm		%	1	<1	<1	<1
+75.0mm		%	1	<1	<1	<1
EA150: Soil Classification based on Particle Size						
Clay (<2 µm)		%	1	10	5	11
Silt (2-60 µm)		%	1	1	2	1
Sand (0.06-2.00 mm)		%	1	89	89	86
Gravel (>2mm)		%	1	<1	4	2
Cobbles (>6cm)		%	1	<1	<1	<1

QC - Matrix:		Sample Type:	
Workgroup:	ES1220010	ALS Sample number:	
		Sample date:	

Analyte grouping/Analyte	CAS Number	Units	LOR

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 48 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5800 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
NUDGEE 27 Sydney Road Nudgee NSW 2850 Ph: 02 6372 6735 E: nudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor — CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai — SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No — EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics) — **3 DAY TAT REQUIRED**

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)
COC: (1) 2 3 4 5 6 7
OF: (1) 2 3 4 5 6 7

RELINQUISHED BY: Carsten Matthai — DATE/TIME: 16-8-12 3:30pm

RECEIVED BY: Frank ALS — DATE/TIME: 16-8-12 1710

RELINQUISHED BY: — DATE/TIME:

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free Ice / frozen ice brick receipt? N/A
Random Sample Temperature
Other comment:

Environmental Division Sydney
Work Order
ES1220010

Telephone : +61-2-8784 8555

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price. Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								
						ALS SYDNEY					ALS Newcastle			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	C11_0.0-0.35	16/8/12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
1	C18-0.0-0.5	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
	C18-0.5-0.9	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
2	C14_0.0-0.15	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		Elutriate jar half full
	QC10	"	Sediment	Various	1 jar		✓							
3	C15_0.0-0.5	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
	T02A	"	Sediment	Various	2 jars	✓	✓		✓	✓				
	T02B	"	Sediment	Various	2 jars	✓	✓		✓	✓				
			Sediment	Various		PSD ONLY								
														SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	28									

Subcon / Forward Lab / Split WO
Lab / Analysis:
Organised By / Date:
Relinquished By / Date:

ALSO: ESP / AP / Material Sheet

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order	: **ES1220010**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CARSTEN MATTHAI	Contact	: Client Services
Address	: 141 Walker st North Sydney NSW 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: carsten.matthai@WorleyParsons.com	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	Page	: 1 of 2
Order number	: 301015-03041		
C-O-C number	: ----	Quote number	: ES2012CALREFNSW0182 (SY/389/12 V2)
Site	: ----		
Sampler	: CM	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 16-AUG-2012	Issue Date	: 20-AUG-2012 09:30
Client Requested Due Date	: 24-AUG-2012	Scheduled Reporting Date	: **24-AUG-2012**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 4.5'C - Ice present
No. of coolers/boxes	: 3 HARD	No. of samples received	: 3
Security Seal	: Not intact.	No. of samples analysed	: 3

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **PSD analysis will be conducted by ALS Newcastle.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **THIS BATCH IS FOR PSD AND SPLIT INTO ES1220011.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

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

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

Summary of Sample(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 the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA150H Particle Size Analysis by Hydrometer
ES1220010-001	[16-AUG-2012]	C18_0.0-0.5	✓
ES1220010-002	[16-AUG-2012]	C14_0.0-0.15	✓
ES1220010-003	[16-AUG-2012]	C15_0.0-0.5	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

MR CARSTEN MATTHAI

- *AU Certificate of Analysis - NATA (COA)	Email	carsten.matthai@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	carsten.matthai@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	carsten.matthai@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	carsten.matthai@WorleyParsons.com
- Attachment - Report (SUBCO)	Email	carsten.matthai@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	carsten.matthai@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	carsten.matthai@WorleyParsons.com

MR SIMON CAPLES

- *AU Certificate of Analysis - NATA (COA)	Email	scaples@caltex.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	scaples@caltex.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	scaples@caltex.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	scaples@caltex.com.au
- A4 - AU Tax Invoice (INV)	Email	scaples@caltex.com.au
- Attachment - Report (SUBCO)	Email	scaples@caltex.com.au
- Chain of Custody (CoC) (COC)	Email	scaples@caltex.com.au
- EDI Format - ENMRG (ENMRG)	Email	scaples@caltex.com.au

MS CHRISTINA HALIM

- A4 - AU Tax Invoice (INV)	Email	CHalim@caltex.com.au

MS DEBORAH LAM

- *AU Certificate of Analysis - NATA (COA)	Email	deborah.lam@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	deborah.lam@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	deborah.lam@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	deborah.lam@WorleyParsons.com
- Attachment - Report (SUBCO)	Email	deborah.lam@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	deborah.lam@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	deborah.lam@WorleyParsons.com

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220010**	Page	: 1 of 5
Client	: CALTEX REFINERIES(NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 16-AUG-2012
Sampler	: CM	Issue Date	: 23-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 3
Quote number	: SY/389/12 V2	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

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

Analysis Holding Time Compliance

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 precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA150: Particle Sizing							
Snap Lock Bag (EA150H) C18_0.0-0.5, C15_0.0-0.5, C14_0.0-0.15,	**16-AUG-2012**	**---**	12-FEB-2013	----	**22-AUG-2012**	12-FEB-2013	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag (EA150H) C18_0.0-0.5, C15_0.0-0.5, C14_0.0-0.15,	**16-AUG-2012**	**---**	12-FEB-2013	----	**22-AUG-2012**	12-FEB-2013	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix:

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	

Brief Method Summaries

The analytical procedures used by the Environmental Division 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 in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Particle Size Analysis (Sieving)	EA150	SOIL	Particle Size Analysis by Sieving according to AS1289.3.6.1 - 1995
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

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

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1220010**	Page	: 1 of 4
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 16-AUG-2012
Sampler	: CM	Issue Date	: 23-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 3
Quote number	: SY/389/12 V2	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
		Newcastle

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

- **No Laboratory Duplicate (DUP) Results are required to be reported.**

Method Blank (MB) and Laboratory Control Spike (LCS) Report

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

- **No Method Blank (MB) or Laboratory Control Spike (SCS) Results are required to be reported.**

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) Results are required to be reported.**

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220010**	Page	: 1 of 3
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 301015-03041		
C-O-C number	: ----	Date Samples Received	: 16-AUG-2012
Sampler	: CM	Issue Date	: 23-AUG-2012
Site	: ----		
		No. of samples received	: 3
Quote number	: SY/389/12 V2	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
		Newcastle

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C18_0.0-0.5	C14_0.0-0.15	C15_0.0-0.5	----	----
				Client sampling date / time	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	----	----
Compound	CAS Number	LOR	Unit		ES1220010-001	ES1220010-002	ES1220010-003	----	----
EA150: Particle Sizing									
+75µm	----	1	%		88	90	86	----	----
+150µm	----	1	%		78	85	81	----	----
+300µm	----	1	%		43	67	44	----	----
+425µm	----	1	%		16	50	16	----	----
+600µm	----	1	%		3	40	5	----	----
+1180µm	----	1	%		<1	26	3	----	----
+2.36mm	----	1	%		<1	4	2	----	----
+4.75mm	----	1	%		<1	<1	1	----	----
+9.5mm	----	1	%		<1	<1	<1	----	----
+19.0mm	----	1	%		<1	<1	<1	----	----
+37.5mm	----	1	%		<1	<1	<1	----	----
+75.0mm	----	1	%		<1	<1	<1	----	----
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		10	5	11	----	----
Silt (2-60 µm)	----	1	%		1	2	1	----	----
Sand (0.06-2.00 mm)	----	1	%		89	89	86	----	----
Gravel (>2mm)	----	1	%		<1	4	2	----	----
Cobbles (>6cm)	----	1	%		<1	<1	<1	----	----

GEOCHEMISTRY LABORATORY RESULTS

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1219839**	Page	: 1 of 13
Amendment	: **1**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 301015-03041		
C-O-C number	: ----	Date Samples Received	: 15-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Site	: ----		
		No. of samples received	: 24
Quote number	: SY/389/12 V2	No. of samples analysed	: 22

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Stephen Hislop	Senior Inorganic Chemist	Stafford Minerals - AY

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C13_0.0-0.5	C3_0.0-0.1	C4_0.0-0.1	C5_0.0-0.15	C6_0.0-0.13
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-001	ES1219839-002	ES1219839-003	ES1219839-004	ES1219839-005
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	---	1.0	%		20.7	63.6	57.7	60.8	65.8
EG005-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		880	9980	8100	5360	8620
Iron	7439-89-6	50	mg/kg		960	15700	9710	13500	5810
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	0.51
Arsenic	7440-38-2	1.00	mg/kg		2.52	72.9	49.8	49.5	52.3
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg		2.3	22.7	19.9	16.2	20.1
Copper	7440-50-8	1.0	mg/kg		<1.0	12.8	4.6	5.7	5.6
Cobalt	7440-48-4	0.5	mg/kg		<0.5	4.1	1.7	3.0	3.3
Lead	7439-92-1	1.0	mg/kg		1.9	5.0	2.2	7.9	3.2
Manganese	7439-96-5	10	mg/kg		<10	11	<10	17	12
Nickel	7440-02-0	1.0	mg/kg		<1.0	8.7	6.7	6.5	8.7
Selenium	7782-49-2	0.1	mg/kg		<0.1	1.3	4.1	2.2	3.7
Silver	7440-22-4	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	7440-62-2	2.0	mg/kg		2.7	68.6	50.6	46.2	77.9
Zinc	7440-66-6	1.0	mg/kg		5.0	38.1	6.2	33.8	7.1
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.02	0.05	0.05	0.04	0.08
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	---	0.02	%		0.88	31.8	29.4	23.1	35.7
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		0.7	3.5	<0.5	2.2	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		<5	<5	<5	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	<5	<5	<5	<5
Acenaphthylene	208-96-8	4	µg/kg		<4	<5	<5	<5	<5
Acenaphthene	83-32-9	4	µg/kg		<4	<5	<5	<5	<5
Fluorene	86-73-7	4	µg/kg		<4	<5	<5	<5	<5
Phenanthrene	85-01-8	4	µg/kg		<4	7	6	9	7
Anthracene	120-12-7	4	µg/kg		<4	<5	<5	<5	<5
Fluoranthene	206-44-0	4	µg/kg		6	30	15	12	14
Pyrene	129-00-0	4	µg/kg		6	36	30	23	<5
Benz(a)anthracene	56-55-3	4	µg/kg		4	9	<5	5	6
Chrysene	218-01-9	4	µg/kg		<4	15	10	9	16

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C13_0.0-0.5	C3_0.0-0.1	C4_0.0-0.1	C5_0.0-0.15	C6_0.0-0.13
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-001	ES1219839-002	ES1219839-003	ES1219839-004	ES1219839-005
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		6	18	35	24	34
Benzo(k)fluoranthene	207-08-9	4	µg/kg		<4	6	16	6	13
Benzo(e)pyrene	192-97-2	4	µg/kg		4	13	22	13	24
Benzo(a)pyrene	50-32-8	4	µg/kg		5	6	8	14	19
Perylene	198-55-0	4	µg/kg		36	331	542	326	369
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		<4	<5	<5	<5	<5
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<4	<5	<5	<5	<5
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		<4	<5	<5	10	<5
Coronene	191-07-1	5	µg/kg		<5	<5	<5	<5	<5
^ Sum of PAHs	---	4	µg/kg		67	471	684	451	502
EP090S: Organotin Surrogate									
Tripropyltin	---	0.1	%		110	108	81.7	104	88.4
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		110	103	113	84.4	92.6
Anthracene-d10	1719-06-8	0.1	%		116	99.1	110	112	115
4-Terphenyl-d14	1718-51-0	0.1	%		93.7	79.5	85.1	89.0	106

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C7_0.0-0.10	QC1	QC3	C2_0.0-0.5	C1_0-0.55
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-006	ES1219839-007	ES1219839-008	ES1219839-009	ES1219839-010
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		67.2	63.4	5.4	27.4	38.4
EG005-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		3740	9050	480	4090	3130
Iron	7439-89-6	50	mg/kg		4150	7480	1350	5870	5490
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg		34.2	42.9	3.62	6.59	13.9
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	0.2	0.1
Chromium	7440-47-3	1.0	mg/kg		8.2	15.6	1.6	26.2	12.8
Copper	7440-50-8	1.0	mg/kg		3.7	4.6	<1.0	15.0	13.5
Cobalt	7440-48-4	0.5	mg/kg		2.2	2.4	<0.5	1.2	1.0
Lead	7439-92-1	1.0	mg/kg		3.0	2.8	<1.0	28.3	22.7
Manganese	7439-96-5	10	mg/kg		<10	13	12	27	15
Nickel	7440-02-0	1.0	mg/kg		3.6	7.4	<1.0	3.9	3.6
Selenium	7782-49-2	0.1	mg/kg		1.4	2.3	<0.1	<0.1	0.7
Silver	7440-22-4	0.1	mg/kg		<0.1	<0.1	<0.1	0.3	0.1
Vanadium	7440-62-2	2.0	mg/kg		17.4	51.6	2.8	12.3	13.9
Zinc	7440-66-6	1.0	mg/kg		16.0	7.8	1.6	102	112
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.04	0.05	<0.01	0.44	0.12
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		38.7	37.4	----	1.27	12.3
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		0.5	<0.5	----	2.0	15.9
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		<5	<5	----	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	<5	----	<5	<5
Acenaphthylene	208-96-8	4	µg/kg		<5	<5	----	28	14
Acenaphthene	83-32-9	4	µg/kg		<5	<5	----	7	23
Fluorene	86-73-7	4	µg/kg		<5	<5	----	10	20
Phenanthrene	85-01-8	4	µg/kg		10	6	----	82	160
Anthracene	120-12-7	4	µg/kg		<5	<5	----	24	22
Fluoranthene	206-44-0	4	µg/kg		63	13	----	102	156
Pyrene	129-00-0	4	µg/kg		69	<5	----	94	134
Benz(a)anthracene	56-55-3	4	µg/kg		9	7	----	74	100
Chrysene	218-01-9	4	µg/kg		14	15	----	59	90

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C7_0.0-0.10	QC1	QC3	C2_0.0-0.5	C1_0-0.55
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-006	ES1219839-007	ES1219839-008	ES1219839-009	ES1219839-010
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		11	32	----	90	120
Benzo(k)fluoranthene	207-08-9	4	µg/kg		<5	13	----	35	40
Benzo(e)pyrene	192-97-2	4	µg/kg		11	22	----	52	63
Benzo(a)pyrene	50-32-8	4	µg/kg		6	16	----	82	100
Perylene	198-55-0	4	µg/kg		66	381	----	48	84
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		<5	11	----	44	39
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<5	<5	----	<4	17
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		<5	10	----	28	38
Coronene	191-07-1	5	µg/kg		<5	<5	----	<5	7
^ Sum of PAHs	----	4	µg/kg		259	526	----	859	1230
EP090S: Organotin Surrogate									
Tripropyltin	----	0.1	%		57.0	73.4	----	110	120
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		102	93.1	----	101	85.0
Anthracene-d10	1719-06-8	0.1	%		114	99.7	----	99.4	92.9
4-Terphenyl-d14	1718-51-0	0.1	%		104	80.5	----	81.9	93.7

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: C10_0-0.50	C10_0.5-1.0	C10_1.0-1.5	QC6	QC4
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1219839-011	ES1219839-012	ES1219839-013	ES1219839-014	ES1219839-015
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	23.3	15.9	17.3	22.2	5.1
EG005-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2060	450	500	2210	470
Iron	7439-89-6	50	mg/kg	2730	260	60	3120	1390
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	3.36	<1.00	<1.00	3.75	3.82
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	10.2	2.0	1.6	14.1	1.6
Copper	7440-50-8	1.0	mg/kg	5.1	<1.0	<1.0	27.6	<1.0
Cobalt	7440-48-4	0.5	mg/kg	0.6	<0.5	<0.5	0.6	<0.5
Lead	7439-92-1	1.0	mg/kg	9.8	<1.0	<1.0	11.0	<1.0
Manganese	7439-96-5	10	mg/kg	14	<10	<10	15	14
Nickel	7440-02-0	1.0	mg/kg	2.2	<1.0	<1.0	2.5	<1.0
Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Silver	7440-22-4	0.1	mg/kg	0.1	<0.1	<0.1	0.1	<0.1
Vanadium	7440-62-2	2.0	mg/kg	6.9	<2.0	<2.0	6.6	3.0
Zinc	7440-66-6	1.0	mg/kg	25.5	1.9	<1.0	79.6	1.6
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	0.14	0.01	<0.01	0.14	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.65	0.19	<0.02	0.58	----
EP090: Organotin Compounds								
Tributyltin	56573-85-4	0.5	µgSn/kg	2.7	<0.5	<0.5	2.0	----
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	<5	<5	<5	<5	----
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	<5	<5	----
Acenaphthylene	208-96-8	4	µg/kg	34	<4	<4	17	----
Acenaphthene	83-32-9	4	µg/kg	<4	<4	<4	<4	----
Fluorene	86-73-7	4	µg/kg	18	<4	<4	5	----
Phenanthrene	85-01-8	4	µg/kg	129	5	<4	42	----
Anthracene	120-12-7	4	µg/kg	42	<4	<4	13	----
Fluoranthene	206-44-0	4	µg/kg	133	6	<4	80	----
Pyrene	129-00-0	4	µg/kg	112	5	<4	72	----
Benz(a)anthracene	56-55-3	4	µg/kg	84	<4	<4	76	----
Chrysene	218-01-9	4	µg/kg	64	4	<4	39	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C10_0-0.50	C10_0.5-1.0	C10_1.0-1.5	QC6	QC4
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-011	ES1219839-012	ES1219839-013	ES1219839-014	ES1219839-015
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		108	<4	<4	66	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		39	<4	<4	19	----
Benzo(e)pyrene	192-97-2	4	µg/kg		69	<4	<4	57	----
Benzo(a)pyrene	50-32-8	4	µg/kg		85	<4	<4	42	----
Perylene	198-55-0	4	µg/kg		30	<4	<4	17	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		36	<4	<4	45	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		7	<4	<4	<4	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		25	<4	<4	19	----
Coronene	191-07-1	5	µg/kg		7	<5	<5	13	----
^ Sum of PAHs	----	4	µg/kg		1020	20	<4	622	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.1	%		122	119	122	112	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		97.6	94.0	108	112	----
Anthracene-d10	1719-06-8	0.1	%		96.1	118	101	98.5	----
4-Terphenyl-d14	1718-51-0	0.1	%		83.7	92.0	79.7	99.3	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	T01A	T01B	C12_0.0-0.5	C12_0.5-1.0	C12_1-1.5
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-017	ES1219839-018	ES1219839-019	ES1219839-020	ES1219839-021
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	---	1.0	%		29.5	29.1	17.5	17.3	16.8
EG005-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		4650	5100	860	640	600
Iron	7439-89-6	50	mg/kg		7040	7740	1800	550	1590
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg		8.12	9.64	4.45	1.16	3.10
Cadmium	7440-43-9	0.1	mg/kg		0.2	0.3	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg		30.3	37.9	4.1	1.2	1.1
Copper	7440-50-8	1.0	mg/kg		18.1	18.1	1.6	<1.0	<1.0
Cobalt	7440-48-4	0.5	mg/kg		1.4	1.5	<0.5	<0.5	<0.5
Lead	7439-92-1	1.0	mg/kg		34.6	35.2	2.7	<1.0	<1.0
Manganese	7439-96-5	10	mg/kg		30	31	<10	<10	<10
Nickel	7440-02-0	1.0	mg/kg		4.3	4.8	1.0	<1.0	<1.0
Selenium	7782-49-2	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Silver	7440-22-4	0.1	mg/kg		0.3	0.4	<0.1	<0.1	<0.1
Vanadium	7440-62-2	2.0	mg/kg		13.9	15.9	3.1	<2.0	<2.0
Zinc	7440-66-6	1.0	mg/kg		128	130	6.1	<1.0	<1.0
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.50	0.69	0.07	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	---	0.02	%		1.74	1.81	0.12	0.35	<0.02
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		2.7	3.0	<0.5	<0.5	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		<5	<5	<5	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	<5	<5	<5	<5
Acenaphthylene	208-96-8	4	µg/kg		33	36	4	<4	<4
Acenaphthene	83-32-9	4	µg/kg		14	15	<4	<4	<4
Fluorene	86-73-7	4	µg/kg		17	17	<4	<4	<4
Phenanthrene	85-01-8	4	µg/kg		146	176	8	<4	<4
Anthracene	120-12-7	4	µg/kg		26	33	<4	<4	<4
Fluoranthene	206-44-0	4	µg/kg		153	208	13	<4	<4
Pyrene	129-00-0	4	µg/kg		144	196	14	<4	<4
Benz(a)anthracene	56-55-3	4	µg/kg		129	148	11	<4	<4
Chrysene	218-01-9	4	µg/kg		113	126	10	<4	<4

Analytical Results

Sub-Matrix: SOIL				Client sample ID	T01A	T01B	C12_0.0-0.5	C12_0.5-1.0	C12_1-1.5
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1219839-017	ES1219839-018	ES1219839-019	ES1219839-020	ES1219839-021
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		149	155	10	<4	<4
Benzo(k)fluoranthene	207-08-9	4	µg/kg		39	38	4	<4	<4
Benzo(e)pyrene	192-97-2	4	µg/kg		108	103	9	<4	<4
Benzo(a)pyrene	50-32-8	4	µg/kg		102	111	5	<4	<4
Perylene	198-55-0	4	µg/kg		38	38	<4	<4	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		90	88	6	<4	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<4	<4	<4	<4	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		53	57	<4	<4	<4
Coronene	191-07-1	5	µg/kg		28	27	<5	<5	<5
^ Sum of PAHs	---	4	µg/kg		1380	1570	94	<4	<4
EP090S: Organotin Surrogate									
Tripropyltin	---	0.1	%		108	109	118	136	124
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		103	96.0	103	106	101
Anthracene-d10	1719-06-8	0.1	%		98.5	93.6	103	97.8	95.3
4-Terphenyl-d14	1718-51-0	0.1	%		93.6	97.5	85.4	87.7	87.0

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C8_0.0-0.12	C9_0.0-0.45	----	----	----
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1219839-022	ES1219839-023	----	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		57.7	18.7	----	----	----
EG005-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		9300	2350	----	----	----
Iron	7439-89-6	50	mg/kg		15700	1760	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	----	----	----
Arsenic	7440-38-2	1.00	mg/kg		50.6	3.74	----	----	----
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	----	----	----
Chromium	7440-47-3	1.0	mg/kg		23.6	4.7	----	----	----
Copper	7440-50-8	1.0	mg/kg		7.8	1.2	----	----	----
Cobalt	7440-48-4	0.5	mg/kg		2.0	<0.5	----	----	----
Lead	7439-92-1	1.0	mg/kg		4.0	1.8	----	----	----
Manganese	7439-96-5	10	mg/kg		12	<10	----	----	----
Nickel	7440-02-0	1.0	mg/kg		7.5	<1.0	----	----	----
Selenium	7782-49-2	0.1	mg/kg		4.5	0.6	----	----	----
Silver	7440-22-4	0.1	mg/kg		<0.1	<0.1	----	----	----
Vanadium	7440-62-2	2.0	mg/kg		38.7	7.2	----	----	----
Zinc	7440-66-6	1.0	mg/kg		8.2	1.6	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.08	0.01	----	----	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		18.9	2.69	----	----	----
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		<0.5	<0.5	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		<5	<5	----	----	----
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	<5	----	----	----
Acenaphthylene	208-96-8	4	µg/kg		<5	<4	----	----	----
Acenaphthene	83-32-9	4	µg/kg		<5	<4	----	----	----
Fluorene	86-73-7	4	µg/kg		<5	<4	----	----	----
Phenanthrene	85-01-8	4	µg/kg		6	<4	----	----	----
Anthracene	120-12-7	4	µg/kg		<5	<4	----	----	----
Fluoranthene	206-44-0	4	µg/kg		18	<4	----	----	----
Pyrene	129-00-0	4	µg/kg		<5	<4	----	----	----
Benz(a)anthracene	56-55-3	4	µg/kg		<5	<4	----	----	----
Chrysene	218-01-9	4	µg/kg		8	<4	----	----	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C8_0.0-0.12	C9_0.0-0.45	----	----	----
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1219839-022	ES1219839-023	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		57	19	----	----	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		21	8	----	----	----
Benzo(e)pyrene	192-97-2	4	µg/kg		19	5	----	----	----
Benzo(a)pyrene	50-32-8	4	µg/kg		15	5	----	----	----
Perylene	198-55-0	4	µg/kg		250	34	----	----	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		42	<4	----	----	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<5	<4	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		36	6	----	----	----
Coronene	191-07-1	5	µg/kg		<5	<5	----	----	----
^ Sum of PAHs	----	4	µg/kg		472	77	----	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.1	%		96.6	114	----	----	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		106	96.2	----	----	----
Anthracene-d10	1719-06-8	0.1	%		110	114	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		109	92.6	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	30	115
Anthracene-d10	1719-06-8	27	133
4-Terphenyl-d14	1718-51-0	18	137

Client - Matrix: SOIL
Workgroup: ES1219839
Project name/number: CALTEX DREDGING

Analyte grouping/Analyte	CAS Number	Units	LOR	ES1219839001	ES1219839002	ES1219839003	ES1219839004	ES1219839005	ES1219839006	ES1219839007	ES1219839008	ES1219839009	ES1219839010	ES1219839011
Sample Type:				REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG
Sample date:				14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	15/08/2012	15/08/2012	15/08/2012
Client sample ID (Primary):				C13_0.0-0.5	C3_0.0-0.1	C4_0.0-0.1	C5_0.0-0.15	C6_0.0-0.13	C7_0.0-0.10	QC1	QC3	C2_0.0-0.5	C1_0.0-0.55	C10_0.0-0.50
Client sample ID (Secondary):														
Sample Site:														
Purchase Order:				301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
EA055: Moisture Content														
Moisture Content (dried @ 103°C)		%	1	20.7	63.6	57.7	60.8	65.8	67.2	63.4	5.4	27.4	38.4	23.3
EG005-SD: Total Metals in Sediments by ICP-AES														
Aluminium	7429-90-5	mg/kg	50	880	9980	8100	5360	8620	3740	9050	480	4090	3130	2060
Iron	7439-89-6	mg/kg	50	960	15700	9710	13500	5810	4150	7480	1350	5870	5490	2730
EG020-SD: Total Metals in Sediments by ICPMS														
Antimony	7440-36-0	mg/kg	0.5	<0.50	<0.50	<0.50	<0.50	0.51	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	mg/kg	1	2.52	72.9	49.8	49.5	52.3	34.2	42.9	3.62	6.59	13.9	3.36
Cadmium	7440-43-9	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1	<0.1
Chromium	7440-47-3	mg/kg	1	2.3	22.7	19.9	16.2	20.1	8.2	15.6	1.6	26.2	12.8	10.2
Copper	7440-50-8	mg/kg	1	<1.0	12.8	4.6	5.7	5.6	3.7	4.6	<1.0	15	13.5	5.1
Cobalt	7440-48-4	mg/kg	0.5	<0.5	4.1	1.7	3	3.3	2.2	2.4	<0.5	1.2	1	0.6
Lead	7439-92-1	mg/kg	1	1.9	5	2.2	7.9	3.2	3	2.8	<1.0	28.3	22.7	9.8
Manganese	7439-96-5	mg/kg	10	<10	11	<10	17	12	<10	13	12	27	15	14
Nickel	7440-02-0	mg/kg	1	<1.0	8.7	6.7	6.5	8.7	3.6	7.4	<1.0	3.9	3.6	2.2
Selenium	7782-49-2	mg/kg	0.1	<0.1	1.3	4.1	2.2	3.7	1.4	2.3	<0.1	<0.1	0.7	<0.1
Silver	7440-22-4	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.1	0.1
Vanadium	7440-62-2	mg/kg	2	2.7	68.6	50.6	46.2	77.9	17.4	51.6	2.8	12.3	13.9	6.9
Zinc	7440-66-6	mg/kg	1	5	38.1	6.2	33.8	7.1	16	7.8	1.6	102	112	25.5
EG035T: Total Recoverable Mercury by FIMS														
Mercury	7439-97-6	mg/kg	0.01	0.02	0.05	0.05	0.04	0.08	0.04	0.05	<0.01	0.44	0.12	0.14
EP008: Total Organic Carbon (TOC) in Soil														
Total Organic Carbon		%	0.02	0.88	31.8	29.4	23.1	35.7	38.7	37.4		1.27	12.3	0.65
EP090: Organotin Compounds														
Tributyltin	56573-85-4	µgSn/kg	0.5	0.7	3.5	<0.5	2.2	<0.5	0.5	<0.5		2	15.9	2.7
EP090S: Organotin Surrogate														
Tripropyltin		%	0.1	110	108	81.7	104	88.4	57	73.4		110	120	122
EP132B: Polynuclear Aromatic Hydrocarbons														
Naphthalene	91-20-3	µg/kg	5	<5	<5	<5	<5	<5	<5	<5		<5	<5	<5
2-Methylnaphthalene	91-57-6	µg/kg	5	<5	<5	<5	<5	<5	<5	<5		<5	<5	<5
Acenaphthylene	208-96-8	µg/kg	4	<4	<5	<5	<5	<5	<5	<5		28	14	34
Acenaphthene	83-32-9	µg/kg	4	<4	<5	<5	<5	<5	<5	<5		7	23	<4
Fluorene	86-73-7	µg/kg	4	<4	<5	<5	<5	<5	<5	<5		10	20	18
Phenanthrene	85-01-8	µg/kg	4	<4	7	6	9	7	10	6		82	160	129
Anthracene	120-12-7	µg/kg	4	<4	<5	<5	<5	<5	<5	<5		24	22	42
Fluoranthene	206-44-0	µg/kg	4	6	30	15	12	14	63	13		102	156	133
Pyrene	129-00-0	µg/kg	4	6	36	30	23	<5	69	<5		94	134	112
Benz(a)anthracene	56-55-3	µg/kg	4	4	9	<5	5	6	9	7		74	100	84
Chrysene	218-01-9	µg/kg	4	<4	15	10	9	16	14	15		59	90	64
Benzo(b)fluoranthene	205-99-2	µg/kg	4	6	18	35	24	34	11	32		90	120	108
Benzo(k)fluoranthene	207-08-9	µg/kg	4	<4	6	16	6	13	<5	13		35	40	39
Benzo(e)pyrene	192-97-2	µg/kg	4	4	13	22	13	24	11	22		52	63	69
Benzo(a)pyrene	50-32-8	µg/kg	4	5	6	8	14	19	6	16		82	100	85
Perylene	198-55-0	µg/kg	4	36	331	542	326	369	66	381		48	84	30
Benzo(g.h.i)perylene	191-24-2	µg/kg	4	<4	<5	<5	<5	<5	<5	11		44	39	36
Dibenz(a.h)anthracene	53-70-3	µg/kg	4	<4	<5	<5	<5	<5	<5	<5		<4	17	7
Indeno(1.2.3.cd)pyrene	193-39-5	µg/kg	4	<4	<5	<5	10	<5	<5	10		28	38	25
Coronene	191-07-1	µg/kg	5	<5	<5	<5	<5	<5	<5	<5		<5	7	7
Sum of PAHs		µg/kg	4	67	471	684	451	502	259	526		859	1230	1020
EP132T: Base/Neutral Extractable Surrogates														
2-Fluorobiphenyl	321-60-8	%	0.1	110	103	113	84.4	92.6	102	93.1		101	85	97.6
Anthracene-d10	1719-06-8	%	0.1	116	99.1	110	112	115	114	99.7		99.4	92.9	96.1
4-Terphenyl-d14	1718-51-0	%	0.1	93.7	79.5	85.1	89	106	104	80.5		81.9	93.7	83.7

Analyte grouping/Analyte	CAS Number	Units	LOR	ES1219839012	ES1219839013	ES1219839014	ES1219839015	ES1219839017	ES1219839018	ES1219839019	ES1219839020	ES1219839021	ES1219839022	ES1219839023
Sample Type:				REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG
Sample date:				15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012	15/08/2012
Client sample ID (Primary):				C10_0.5-1.0	C10_1.0-1.5	QC6	QC4	T01A	T01B	C12_0.0-0.5	C12_0.5-1.0	C12_1-1.5	C8_0.0-0.12	C9_0.0-0.45
Client sample ID (Secondary):														
Sample Site:														
Purchase Order:				301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
EA055: Moisture Content														
Moisture Content (dried @ 103°C)		%	1	15.9	17.3	22.2	5.1	29.5	29.1	17.5	17.3	16.8	57.7	18.7
EG005-SD: Total Metals in Sediments by ICP-AES														
Aluminium	7429-90-5	mg/kg	50	450	500	2210	470	4650	5100	860	640	600	9300	2350
Iron	7439-89-6	mg/kg	50	280	60	3120	1390	7040	7740	1800	550	1590	15900	1760
EG020-SD: Total Metals in Sediments by ICPMS														
Antimony	7440-36-0	mg/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
Arsenic	7440-38-2	mg/kg	1	<1.00	<1.00	3.75	3.82	8.12	9.64	4.45	1.16	3.1	50.6	3.74
Cadmium	7440-43-9	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	mg/kg	1	2	1.6	14.1	1.6	30.3	37.9	4.1	1.2	1.1	23.6	4.7
Copper	7440-50-8	mg/kg	1	<1.0	<1.0	27.6	<1.0	18.1	18.1	1.6	<1.0	<1.0	7.8	1.2
Cobalt	7440-48-4	mg/kg	0.5	<0.5	<0.5	0.6	<0.5	1.4	1.5	<0.5	<0.5	<0.5	2	<0.5
Lead	7439-92-1	mg/kg	1	<1.0	<1.0	11	<1.0	34.6	35.2	2.7	<1.0	<1.0	4	1.8
Manganese	7439-96-5	mg/kg	10	<10	<10	15	14	30	31	<10	<10	<10	12	<10
Nickel	7440-02-0	mg/kg	1	<1.0	<1.0	2.5	<1.0	4.3	4.8	1	<1.0	<1.0	7.5	<1.0
Selenium	7782-49-2	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	4.5	0.6
Silver	7440-22-4	mg/kg	0.1	<0.1	<0.1	0.1	<0.1	0.3	0.4	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	7440-62-2	mg/kg	2	<2.0	<2.0	6.6	3	13.9	15.9	3.1	<2.0	<2.0	38.7	7.2
Zinc	7440-66-6	mg/kg	1	1.9	<1.0	79.6	1.6	128	130	6.1	<1.0	<1.0	8.2	1.6
EG035T: Total Recoverable Mercury by FIMS														
Mercury	7439-97-6	mg/kg	0.01	0.01	<0.01	0.14	<0.01	0.5	0.69	0.07	<0.01	<0.01	0.08	0.01
EP008: Total Organic Carbon (TOC) in Soil														
Total Organic Carbon		%	0.02	0.19	<0.02	0.58		1.74	1.81	0.12	0.35	<0.02	18.9	2.69
EP090: Organotin Compounds														
Tributyltin	56573-85-4	µgSn/kg	0.5	<0.5	<0.5	2		2.7	3	<0.5	<0.5	<0.5	<0.5	<0.5
EP090S: Organotin Surrogate														
Tripropyltin		%	0.1	119	122	112		108	109	118	136	124	96.6	114
EP132B: Polynuclear Aromatic Hydrocarbons														
Naphthalene	91-20-3	µg/kg	5	<5	<5	<5		<5	<5	<5	<5	<5	<5	<5
2-Methylnaphthalene	91-57-6	µg/kg	5	<5	<5	<5		<5	<5	<5	<5	<5	<5	<5
Acenaphthylene	208-96-8	µg/kg	4	<4	<4	17		33	36	4	<4	<4	<5	<4
Acenaphthene	83-32-9	µg/kg	4	<4	<4	<4		14	15	<4	<4	<4	<5	<4
Fluorene	86-73-7	µg/kg	4	<4	<4	5		17	17	<4	<4	<4	<5	<4
Phenanthrene	85-01-8	µg/kg	4	5	<4	42		146	176	8	<4	<4	6	<4
Anthracene	120-12-7	µg/kg	4	<4	<4	13		26	33	<4	<4	<4	<5	<4
Fluoranthene	206-44-0	µg/kg	4	6	<4	80		153	208	13	<4	<4	18	<4
Pyrene	129-00-0	µg/kg	4	5	<4	72		144	196	14	<4	<4	<5	<4
Benz(a)anthracene	56-55-3	µg/kg	4	<4	<4	76		129	148	11	<4	<4	<5	<4
Chrysene	218-01-9	µg/kg	4	4	<4	39		113	126	10	<4	<4	8	<4
Benzo(b)fluoranthene	205-99-2	µg/kg	4	<4	<4	66		149	155	10	<4	<4	57	19
Benzo(k)fluoranthene	207-08-9	µg/kg	4	<4	<4	19		39	38	4	<4	<4	21	8
Benzo(e)pyrene	192-97-2	µg/kg	4	<4	<4	57		108	103	9	<4	<4	19	5
Benzo(a)pyrene	50-32-8	µg/kg	4	<4	<4	42		102	111	5	<4	<4	15	5
Perylene	198-55-0	µg/kg	4	<4	<4	17		38	38	<4	<4	<4	250	34
Benzo(g.h.i)perylene	191-24-2	µg/kg	4	<4	<4	45		90	88	6	<4	<4	42	<4
Dibenz(a.h)anthracene	53-70-3	µg/kg	4	<4	<4	<4		<4	<4	<4	<4	<4	<5	<4
Indeno(1.2.3.cd)pyrene	193-39-5	µg/kg	4	<4	<4	19		53	57	<4	<4	<4	36	6
Coronene	191-07-1	µg/kg	5	<5	<5	13		28	27	<5	<5	<5	<5	<5
Sum of PAHs		µg/kg	4	20	<4	622		1380	1570	94	<4	<4	472	77
EP132T: Base/Neutral Extractable Surrogates														
2-Fluorobiphenyl	321-60-8	%	0.1	94	108	112		103	96	103	106	101	106	96.2
Anthracene-d10	1719-06-8	%	0.1	118	101	98.5		98.5	93.6	103	97.8	95.3	110	114
4-Terphenyl-d14	1718-51-0	%	0.1	92	79.7	99.3		93.6	97.5	85.4	87.7	87	109	92.6

Client - Matrix: WATER
Workgroup: ES1219839
Project name/number: CALTEX DREDGING

Sample Type:
ALS Sample number:
Sample date:
Client sample ID (Primary):
Client sample ID (Secondary):
Sample Site:
Purchase Order:

Analyte grouping/Analyte | CAS Number | Units | LOR

QC - Matrix: SOIL
Workgroup: ES1219839

Analyte grouping/Analyte	CAS Number	Units	LOR	2905192-001	2905192-002	2905192-004	2905192-005	2905192-016	2906119-026	2906119-038	2906119-048	2907571-002	2907571-004	2907571-005
Sample Type:				MB	LCS	DUP	MS	DUP	DUP	DUP	DUP	LCS	DUP	MS
Sample date:				16/08/2012	16/08/2012	14/08/2012	14/08/2012	15/08/2012	14/08/2012	14/08/2012	15/08/2012	17/08/2012	14/08/2012	14/08/2012
EA055: Moisture Content														
Moisture Content (dried @ 103°C)		%	1						9.2	63.5	29.4			
EG005-SD: Total Metals in Sediments by ICP-AES														
Aluminium	7429-90-5	mg/kg	50										830	
Iron	7439-89-6	mg/kg	50										1060	
EG020-SD: Total Metals in Sediments by ICPMS														
Antimony	7440-36-0	mg/kg	0.5										<0.50	
Arsenic	7440-38-2	mg/kg	1										2.56	
Cadmium	7440-43-9	mg/kg	0.1										<0.1	
Chromium	7440-47-3	mg/kg	1										2.1	
Copper	7440-50-8	mg/kg	1										<1.0	
Cobalt	7440-48-4	mg/kg	0.5										<0.5	
Lead	7439-92-1	mg/kg	1										1.9	
Manganese	7439-96-5	mg/kg	10										<10	
Nickel	7440-02-0	mg/kg	1										<1.0	
Selenium	7782-49-2	mg/kg	0.1										<0.1	
Silver	7440-22-4	mg/kg	0.1										<0.1	
Vanadium	7440-62-2	mg/kg	2										2.4	
Zinc	7440-66-6	mg/kg	1										4.4	
EG035T: Total Recoverable Mercury by FIMS														
Mercury	7439-97-6	%										91.8	0.01	83.9
EP008: Total Organic Carbon (TOC) in Soil														
Total Organic Carbon		%	0.02											
EP090: Organotin Compounds														
Tributyltin	56573-85-4	µgSn/kg	0.5											
EP090S: Organotin Surrogate														
Tripropyltin		%	0.1											
EP132B: Polynuclear Aromatic Hydrocarbons														
Naphthalene	91-20-3	µg/kg	5	<5	118	<5	114	<5						
2-Methylnaphthalene	91-57-6	µg/kg	5	<5	85.2	<5	95.6	<5						
Acenaphthylene	208-96-8	µg/kg	4	<4	101	<4	104	<4						
Acenaphthene	83-32-9	µg/kg	4	<4	100	<4	95.6	<4						
Fluorene	86-73-7	µg/kg	4	<4	96.8	<4	97.6	<4						
Phenanthrene	85-01-8	µg/kg	4	<4	102	<4	95.4	4						
Anthracene	120-12-7	µg/kg	4	<4	106	<4	88.8	<4						
Fluoranthene	206-44-0	µg/kg	4	<4	91.7	6	81.4	5						
Pyrene	129-00-0	µg/kg	4	<4	91.5	6	80.8	5						
Benz(a)anthracene	56-55-3	µg/kg	4	<4	93.3	<4	112	4						
Chrysene	218-01-9	µg/kg	4	<4	106	<4	80.8	5						
Benzo(b)fluoranthene	205-99-2	µg/kg	4	<4	99.2	6	100	<4						
Benzo(k)fluoranthene	207-08-9	µg/kg	4	<4	106	<4	82.1	<4						
Benzo(e)pyrene	192-97-2	µg/kg	4	<4	102	<4	91	<4						
Benzo(a)pyrene	50-32-8	µg/kg	4	<4	91.8	<4	95.5	<4						
Perylene	198-55-0	µg/kg	4	<4	102	39	62.5	<4						
Benzo(g.h.i)perylene	191-24-2	µg/kg	4	<4	104	<4	83	<4						
Dibenz(a.h)anthracene	53-70-3	µg/kg	4	<4	101	<4	91.3	<4						
Indeno(1.2.3.cd)pyrene	193-39-5	µg/kg	4	<4	101	<4	88.2	<4						
Coronene	191-07-1	µg/kg	5	<5	98.5	<5	92.8	<5						
Sum of PAHs		µg/kg	4	<4		57		23						
EP132T: Base/Neutral Extractable Surrogates														
2-Fluorobiphenyl	321-60-8	%	0.1	110	87.3	101	91.5	119						
Anthracene-d10	1719-06-8	%	0.1	94.3	110	111	106	112						
4-Terphenyl-d14	1718-51-0	%	0.1	92.7	102	89.6	88.7	89.8						

Analyte grouping/Analyte	CAS Number	Units	LOR	2907571-007	2907571-008	2907571-015	2907571-026	2907571-039	2907571-041	2907571-042	2907571-044	2907571-045	2907571-052	2907571-063
Sample Type:				MB	LCS	MS	DUP	LCS	DUP	MS	MB	LCS	MS	DUP
Sample date:				17/08/2012	17/08/2012	14/08/2012	15/08/2012	17/08/2012	15/08/2012	15/08/2012	17/08/2012	17/08/2012	15/08/2012	16/08/2012
Moisture Content (dried @ 103°C)		%	1											
Aluminium	7429-90-5	mg/kg	50	<50			2090		9880		<50			850
Iron	7439-89-6	mg/kg	50	<50			2890		14200		<50			940
Antimony	7440-36-0	mg/kg	0.5	<0.50	53.9		<0.50		<0.50		<0.50	55.6		<0.50
Arsenic	7440-38-2	mg/kg	1	<1.00	112	125	3.09		43		<1.00	138	110	1.28
Cadmium	7440-43-9	mg/kg	0.1	<0.1	104	98.2	<0.1		<0.1		<0.1	107	104	<0.1
Chromium	7440-47-3	mg/kg	1	<1.0	93.8	95	10.1		28.2		<1.0	94.9	103	4.3
Copper	7440-50-8	mg/kg	1	<1.0	110	98.6	5		9.6		<1.0	106	109	1.6
Cobalt	7440-48-4	mg/kg	0.5	<10.0	99.9		0.6		1.4		<10.0	98.9		<0.5
Lead	7439-92-1	mg/kg	1	<1.0	103	95.4	9		3.7		<1.0	104	103	3.6
Manganese	7439-96-5	mg/kg	10	<10	103		12		<10		<10	101		<10
Nickel	7440-02-0	mg/kg	1	<1.0	98.5	90.5	2.2		4.4		<1.0	100	97.2	<1.0
Selenium	7782-49-2	mg/kg	0.1	<0.1	99		0.6		4.5		<0.1	99		<0.1
Silver	7440-22-4	mg/kg	0.1	<0.1	123		<0.1		<0.1		<0.1	128		<0.1
Vanadium	7440-62-2	mg/kg	2	<2.0	108		6.7		38.4		<2.0	107		2.8
Zinc	7440-66-6	mg/kg	1	<1.0	118	102	25.6		6.8		<1.0	114	111	7.4
Mercury	7439-97-6	%		<0.01			0.14	102	0.07	90.4	<0.01			0.09

Analyte grouping/Analyte	CAS Number	Units	LOR	2907805-001	2907805-002	2907805-004	2907805-006	2907805-016	2907920-001	2907920-002	2907920-004	2907920-015	ES1219767002	ES1220015001
Sample Type:				MB	LCS	DUP	MS	DUP	MB	LCS	DUP	DUP	REG	REG
Sample date:				17/08/2012	17/08/2012	14/08/2012	14/08/2012	15/08/2012	17/08/2012	17/08/2012	14/08/2012	15/08/2012	14/08/2012	16/08/2012
Moisture Content (dried @ 103°C)		%	1										9.9	
Aluminium	7429-90-5	mg/kg	50											880
Iron	7439-89-6	mg/kg	50											1000
Antimony	7440-36-0	mg/kg	0.5											<0.50
Arsenic	7440-38-2	mg/kg	1											1.25
Cadmium	7440-43-9	mg/kg	0.1											<0.1
Chromium	7440-47-3	mg/kg	1											4.7
Copper	7440-50-8	mg/kg	1											1.6
Cobalt	7440-48-4	mg/kg	0.5											<0.5
Lead	7439-92-1	mg/kg	1											3.6
Manganese	7439-96-5	mg/kg	10											<10
Nickel	7440-02-0	mg/kg	1											<1.0
Selenium	7782-49-2	mg/kg	0.1											<0.1
Silver	7440-22-4	mg/kg	0.1											<0.1
Vanadium	7440-62-2	mg/kg	2											2.8
Zinc	7440-66-6	mg/kg	1											7.7
Mercury	7439-97-6	%												0.09
Total Organic Carbon		%	0.02						<0.02	99.8	0.89	0.2		
Tributyltin	56573-85-4	µgSn/kg	0.5	<0.5	113	<0.5	94.5	<0.5						
Tripropyltin		%	0.1	170	130	39	144	136						

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☑ 3 DAY TAT REQUIRED ☐ Non Standard or urgent TAT (List due date):
OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)	ALS QUOTE NO.: SY/389/12 V2
PROJECT: Caltex Dredging	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7
ORDER NUMBER: 301015-03041	
PROJECT MANAGER: Ben Taylor	CONTACT PH: 0402 406624
SAMPLER: Carsten Matthai	SAMPLER MOBILE: 0411 331112
COC emailed to ALS? (YES / NO) No	EDD FORMAT (or default):
Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com	
Email Invoice to (will default to PM if no other addresses are listed): CHallm@caltex.com.au	

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Freeze/ frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comments:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	France ALS		
DATE/TIME: 15/8/12 4:30pm	DATE/TIME: 16-8-12 1800	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

Environmental Division Sydney
Work Order
ES1219839

Telephone : +61-2-8784 8555

ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price. Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ALS SYDNEY					ALS Newcastle		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS [EP132-SD]	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing	
1	C13_0.0-0.5	14/8/12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	Hold at primary samples for possible elutriate analysis and weak acid extraction and analysis
2	C3_0.0-0.1	"	Sediment	Various	2jars	✓	✓		✓	✓		✓	
3	C4_0.0-0.1	"	Sediment	Various	2jars	✓	✓		✓	✓		✓	
4	C5_0.0-0.15	"	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	small volume in PSD bag and one "hold" jar (elutriate
5	C6_0.0-0.13	"	Sediment	Various	2jars	✓	✓		✓	✓		✓	
6	C7_0.0-0.10	"	Sediment	Various	2jars 1bag	✓	✓		✓	✓	✓	✓	
7	QC1	"	Sediment	Various	2jars	✓	✓		✓	✓			
8	~~QC2~~ QC3	"	Sediment	Various	1jar		✓						PSD
			Sediment	Various									
				TOTAL	22								

Subcon / Forward Lab / Split WO ES1219873
Lab / Analysis:
Organised By / Date:
Relinquished By / Date:
Courier:
WO No.: ES1219839
Attach By PO / Internal Sheet:

SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07-3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobe.com

WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: c/o WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor

CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai

SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No

EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

☑ 3 DAY TAT REQUIRED

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)

COC: 1 (2) 3 4 5 6 7

OF: 1 2 (3) 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt °C

Other comments:

RELINQUISHED BY: Carsten Matthai

DATE/TIME: 15-8-12 4.30pm

RECEIVED BY: Frame ALS

DATE/TIME: 15-8-12 1800

RELINQUISHED BY:

DATE/TIME:

RECEIVED BY:

DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
						ALS Brisbane					ALS Newcastle			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHs (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP096)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
9	C2_0.0-0.5	15-8-12	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
10	C1_0-0.55	15-8-12	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
11	C10_0-0.50	15-8-12	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
12	C10_0.5-1.0	15-8-12	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
13	C10_1.0-1.5	15-8-12	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
14	QC6	15-8-12	Sediment	Various	2 jars	✓	✓		✓	✓				
15	QC4	15-8-12	Sediment	Various	1 jar		✓							
16	QC5	15-8-12	Sediment	Various	2 jars							✓		
17	TO1A	15-8-12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
18	TO1B	15-8-12	Sediment		4 jars	✓	✓		✓	✓		✓		SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	37									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5800 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: parkinmela@alsglobal.com

CLIENT: CALTEX	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☑ 3 DAY TAT REQUIRED ☐ Non Standard or urgent TAT (List due date):
OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)	ALS QUOTE NO.: SY/389/12 V2	
PROJECT: Caltex Dredging		
ORDER NUMBER: 301015-03041		
PROJECT MANAGER: Ben Taylor	CONTACT PH: 0402 406624	
SAMPLER: Carsten Matthai	SAMPLER MOBILE: 0411 331112	
COC emailed to ALS? (YES / NO) No	EDD FORMAT (or default):	
Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com		
Email Invoice to (will default to PM if no other addresses are listed): CHatim@caltex.com.au		

COC SEQUENCE NUMBER (Circle)

COC:	1	2	(3)	4	5	6	7
OF:	1	2	(3)	4	5	6	7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt		°C	
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	Frame ALS		
DATE/TIME: 15-8-12 4:30pm	DATE/TIME: 15-8-12 1800	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
						ALS SYDNEY					ALS Newcastle			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		
19	C12_0.0-0.5	15-8-12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		Hold as primary samples for possible elutriate analysis and weak acid extraction and analysis
20	C12_0.5_1.0	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
21	C12-1.0-1.5	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
22	C8_0.0-0.12	"	Sediment	Various	2 jars 1 bag	✓	✓		✓	✓	✓	✓		insufficient material for elutriate
23	C9_0.0-0.45	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
			Sediment	Various										
			Sediment	Various										
			Sediment	Various										
			Sediment	Various										
24	Elutriate blank	15-8-12	Water	10L container	(X1)							✓		
				TOTAL	21 (incl. 1oL container)									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial; SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formate; ZA = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1219839**	Page	: 1 of 7
Amendment	: **1**		
Client	: CALTEX REFINERIES(NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 15-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 24
Quote number	: SY/389/12 V2	No. of samples analysed	: 22

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

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

Analysis Holding Time Compliance

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 precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103)							
C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1, QC3	**14-AUG-2012**	**----**	----	----	**16-AUG-2012**	28-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA055-103)							
C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, QC4, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**----**	----	----	**16-AUG-2012**	29-AUG-2012	✓
EG005-SD: Total Metals in Sediments by ICP-AES							
Soil Glass Jar - Unpreserved (EG005-SD)							
C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1, QC3	**14-AUG-2012**	**17-AUG-2012**	10-FEB-2013	✓	**20-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005-SD)							
C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, QC4, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**17-AUG-2012**	11-FEB-2013	✓	**20-AUG-2012**	11-FEB-2013	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020-SD: Total Metals in Sediments by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SD)							
C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1, QC3	**14-AUG-2012**	**17-AUG-2012**	10-FEB-2013	✓	**18-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG020-SD)							
C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, QC4, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**17-AUG-2012**	11-FEB-2013	✓	**18-AUG-2012**	11-FEB-2013	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T-LL)							
C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1, QC3	**14-AUG-2012**	**17-AUG-2012**	11-SEP-2012	✓	**17-AUG-2012**	11-SEP-2012	✓
Soil Glass Jar - Unpreserved (EG035T-LL)							
C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, QC4, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**17-AUG-2012**	12-SEP-2012	✓	**17-AUG-2012**	12-SEP-2012	✓
EP003: Total Organic Carbon (TOC) in Soil							
Pulp Bag (EP003)							
C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1	**14-AUG-2012**	**17-AUG-2012**	21-AUG-2012	✓	**17-AUG-2012**	14-SEP-2012	✓
Pulp Bag (EP003)							
C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**17-AUG-2012**	22-AUG-2012	✓	**17-AUG-2012**	14-SEP-2012	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP090: Organotin Compounds							
Soil Glass Jar - Unpreserved (EP090) C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1	**14-AUG-2012**	**17-AUG-2012**	28-AUG-2012	✓	**20-AUG-2012**	26-SEP-2012	✓
Soil Glass Jar - Unpreserved (EP090) C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**17-AUG-2012**	29-AUG-2012	✓	**20-AUG-2012**	26-SEP-2012	✓
EP132B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP132B-SD) C13_0.0-0.5, C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1	**14-AUG-2012**	**16-AUG-2012**	28-AUG-2012	✓	**17-AUG-2012**	25-SEP-2012	✓
Soil Glass Jar - Unpreserved (EP132B-SD) C2_0.0-0.5, C1_0-0.55, C10_0-0.50, C10_0.5-1.0, C10_1.0-1.5, QC6, T01A, T01B, C12_0.0-0.5, C12_0.5-1.0, C12_1-1.5, C8_0.0-0.12, C9_0.0-0.45	**15-AUG-2012**	**16-AUG-2012**	29-AUG-2012	✓	**17-AUG-2012**	25-SEP-2012	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	3	29	**10.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Organotin Analysis	EP090	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Fe and Al in Sediments by ICPAES	EG005-SD	4	33	**12.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	4	33	**12.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	4	33	**12.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Organotin Analysis	EP090	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Organotin Analysis	EP090	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Fe and Al in Sediments by ICPAES	EG005-SD	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Organotin Analysis	EP090	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	2	33	**6.1**	**5.0**	✓	ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	2	33	**6.1**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division 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 in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Fe and Al in Sediments by ICPAES	EG005-SD	SOIL	(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). LORs per NODG
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	(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. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(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 SnCl2 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)
Total Organic Carbon	EP003	SOIL	In-house C-IR17. 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.
Organotin Analysis	EP090	SOIL	(USEPA SW 846 - 8270D) Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.
PAHs in Sediments by GCMS(SIM)	EP132B-SD	SOIL	8270 GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.

Preparation Methods	Method	Matrix	Method Descriptions
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na2SO4 and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.
Organotin Sample Preparation	ORG35	SOIL	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.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP132B: Polynuclear Aromatic Hydrocarbons	ES1219839-001	C13_0.0-0.5	**Perylene**	198-55-0	62.5 %	70-130%	**Recovery less than lower data quality objective**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**

Regular Sample Surrogates

Sub-Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Samples Submitted							
EP090S: Organotin Surrogate	ES1219839-020	C12_0.5-1.0	**Tripropyltin**	----	136 %	35-130 %	**Recovery greater than upper data quality objective**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1219839**	Page	: 1 of 11
Amendment	: **1**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 15-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 24
Quote number	: SY/389/12 V2	No. of samples analysed	: 22

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Stephen Hislop	Senior Inorganic Chemist	Stafford Minerals - AY

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 2452356)									
ES1219767-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	9.9	9.2	7.9	No Limit
ES1219839-007	QC1	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	63.4	63.5	0.0	0% - 20%
EA055: Moisture Content (QC Lot: 2452357)									
ES1219839-017	T01A	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	29.5	29.4	0.0	0% - 20%
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2453557)									
ES1219839-001	C13_0.0-0.5	EG005-SD: Aluminium	7429-90-5	50	mg/kg	880	830	4.9	0% - 50%
		EG005-SD: Iron	7439-89-6	50	mg/kg	960	1060	9.4	0% - 20%
ES1219839-011	C10_0-0.50	EG005-SD: Aluminium	7429-90-5	50	mg/kg	2060	2090	1.3	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	2730	2890	5.8	0% - 20%
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2453560)									
ES1219839-022	C8_0.0-0.12	EG005-SD: Aluminium	7429-90-5	50	mg/kg	9300	9880	6.0	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	15700	14200	9.8	0% - 20%
ES1220015-001	Anonymous	EG005-SD: Aluminium	7429-90-5	50	mg/kg	880	850	3.4	0% - 50%
		EG005-SD: Iron	7439-89-6	50	mg/kg	1000	940	5.9	0% - 50%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2453556)									
ES1219839-001	C13_0.0-0.5	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EG020-SD: Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.0	No Limit
		EG020-SD: Chromium	7440-47-3	1.0	mg/kg	2.3	2.1	8.4	No Limit
		EG020-SD: Copper	7440-50-8	1.0	mg/kg	<1.0	<1.0	0.0	No Limit
		EG020-SD: Lead	7439-92-1	1.0	mg/kg	1.9	1.9	0.0	No Limit
		EG020-SD: Nickel	7440-02-0	1.0	mg/kg	<1.0	<1.0	0.0	No Limit
		EG020-SD: Zinc	7440-66-6	1.0	mg/kg	5.0	4.4	13.0	No Limit
		EG020-SD: Arsenic	7440-38-2	1.00	mg/kg	2.52	2.56	1.4	No Limit
		EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	<10	0.0	No Limit
		EG020-SD: Vanadium	7440-62-2	2.0	mg/kg	2.7	2.4	9.3	No Limit
ES1219839-011	C10_0-0.50	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	0.6	146	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	0.1	<0.1	0.0	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	0.6	0.6	0.0	No Limit
		EG020-SD: Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.0	No Limit
		EG020-SD: Chromium	7440-47-3	1.0	mg/kg	10.2	10.1	0.0	0% - 50%
		EG020-SD: Copper	7440-50-8	1.0	mg/kg	5.1	5.0	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2453556) - continued									
ES1219839-011	C10_0-0.50	EG020-SD: Lead	7439-92-1	1.0	mg/kg	9.8	9.0	8.0	No Limit
		EG020-SD: Nickel	7440-02-0	1.0	mg/kg	2.2	2.2	0.0	No Limit
		EG020-SD: Zinc	7440-66-6	1.0	mg/kg	25.5	25.6	0.5	0% - 20%
		EG020-SD: Arsenic	7440-38-2	1.00	mg/kg	3.36	3.09	8.6	No Limit
		EG020-SD: Manganese	7439-96-5	10	mg/kg	14	12	16.1	No Limit
		EG020-SD: Vanadium	7440-62-2	2.0	mg/kg	6.9	6.7	3.0	No Limit
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2453559)									
ES1219839-022	C8_0.0-0.12	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	4.5	4.5	0.0	0% - 20%
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	2.0	1.4	37.4	No Limit
		EG020-SD: Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.0	No Limit
		EG020-SD: Chromium	7440-47-3	1.0	mg/kg	23.6	28.2	17.6	0% - 20%
		EG020-SD: Copper	7440-50-8	1.0	mg/kg	7.8	9.6	21.4	No Limit
		EG020-SD: Lead	7439-92-1	1.0	mg/kg	4.0	3.7	6.2	No Limit
		EG020-SD: Nickel	7440-02-0	1.0	mg/kg	7.5	4.4	51.8	No Limit
		EG020-SD: Zinc	7440-66-6	1.0	mg/kg	8.2	6.8	19.0	No Limit
		EG020-SD: Arsenic	7440-38-2	1.00	mg/kg	50.6	43.0	16.3	0% - 20%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	12	<10	22.7	No Limit
		EG020-SD: Vanadium	7440-62-2	2.0	mg/kg	38.7	38.4	0.6	0% - 50%
ES1220015-001	Anonymous	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EG020-SD: Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.0	No Limit
		EG020-SD: Chromium	7440-47-3	1.0	mg/kg	4.7	4.3	7.8	No Limit
		EG020-SD: Copper	7440-50-8	1.0	mg/kg	1.6	1.6	0.0	No Limit
		EG020-SD: Lead	7439-92-1	1.0	mg/kg	3.6	3.6	0.0	No Limit
		EG020-SD: Nickel	7440-02-0	1.0	mg/kg	<1.0	<1.0	0.0	No Limit
		EG020-SD: Zinc	7440-66-6	1.0	mg/kg	7.7	7.4	4.8	No Limit
		EG020-SD: Arsenic	7440-38-2	1.00	mg/kg	1.25	1.28	2.3	No Limit
		EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	<10	0.0	No Limit
		EG020-SD: Vanadium	7440-62-2	2.0	mg/kg	2.8	2.8	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2453555)									
ES1219839-001	C13_0.0-0.5	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.02	0.01	0.0	No Limit
ES1219839-011	C10_0-0.50	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.14	0.14	0.0	0% - 50%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2453558)									
ES1219839-022	C8_0.0-0.12	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.08	0.07	17.6	No Limit
ES1220015-001	Anonymous	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.09	0.09	0.0	No Limit
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 2453884)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 2453884) - continued									
ES1219839-001	C13_0.0-0.5	EP003: Total Organic Carbon	---	0.02	%	0.88	0.89	1.5	0% - 20%
ES1219839-012	C10_0.5-1.0	EP003: Total Organic Carbon	---	0.02	%	0.19	0.20	0.0	0% - 50%
EP090: Organotin Compounds (QC Lot: 2453775)									
ES1219839-001	C13_0.0-0.5	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	0.7	<0.5	28.4	No Limit
ES1219839-012	C10_0.5-1.0	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.0	No Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2451591)									
ES1219839-001	C13_0.0-0.5	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	6	6	0.0	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	6	6	0.0	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	4	<4	0.0	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	4	µg/kg	6	6	0.0	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	4	<4	0.0	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	5	<4	26.9	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	36	39	6.0	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Sum of PAHs	---	4	µg/kg	67	57	16.1	0% - 50%
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.0	No Limit
ES1219839-012	C10_0.5-1.0	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	5	4	0.0	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	6	5	0.0	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	5	5	0.0	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	4	0.0	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	4	5	0.0	No Limit
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2451591) - continued									
ES1219839-012	C10_0.5-1.0	EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Sum of PAHs	---	4	µg/kg	20	23	14.0	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2453557)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2453560)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453556)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	6.19 mg/kg	53.9	----	----
EG020-SD: Arsenic	7440-38-2	1.0	mg/kg	<1.00	21.7 mg/kg	112	----	----
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.64 mg/kg	104	----	----
EG020-SD: Chromium	7440-47-3	1.0	mg/kg	<1.0	43.9 mg/kg	93.8	----	----
EG020-SD: Copper	7440-50-8	1.0	mg/kg	<1.0	32 mg/kg	110	----	----
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	----	16 mg/kg	99.9	----	----
		10	mg/kg	<10.0	----	----	----	----
EG020-SD: Lead	7439-92-1	1.0	mg/kg	<1.0	40 mg/kg	103	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	130 mg/kg	103	----	----
EG020-SD: Nickel	7440-02-0	1.0	mg/kg	<1.0	55 mg/kg	98.5	----	----
EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	5.37 mg/kg	99.0	----	----
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	2.10 mg/kg	123	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	29.6 mg/kg	108	----	----
EG020-SD: Zinc	7440-66-6	1.0	mg/kg	<1.0	60.8 mg/kg	118	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	6.19 mg/kg	55.6	----	----
EG020-SD: Arsenic	7440-38-2	1.0	mg/kg	<1.00	21.7 mg/kg	138	----	----
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.64 mg/kg	107	----	----
EG020-SD: Chromium	7440-47-3	1.0	mg/kg	<1.0	43.9 mg/kg	94.9	----	----
EG020-SD: Copper	7440-50-8	1.0	mg/kg	<1.0	32 mg/kg	106	----	----
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	----	16 mg/kg	98.9	----	----
		10	mg/kg	<10.0	----	----	----	----
EG020-SD: Lead	7439-92-1	1.0	mg/kg	<1.0	40 mg/kg	104	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	130 mg/kg	101	----	----
EG020-SD: Nickel	7440-02-0	1.0	mg/kg	<1.0	55 mg/kg	100	----	----
EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	5.37 mg/kg	99.0	----	----
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	2.10 mg/kg	128	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	29.6 mg/kg	107	----	----

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559) - continued								
EG020-SD: Zinc	7440-66-6	1.0	mg/kg	<1.0	60.8 mg/kg	114	----	----
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453555)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.11 mg/kg	91.8	74.2	126
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453558)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.11 mg/kg	102	74.2	126
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 2453884)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	100 %	99.8	70	130
EP090: Organotin Compounds (QCLot: 2453775)								
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	113	45	134
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451591)								
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	118	----	----
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	25 µg/kg	85.2	----	----
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	101	----	----
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	100	----	----
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	96.8	----	----
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	102	----	----
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	106	----	----
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	91.7	----	----
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	91.5	----	----
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	93.3	----	----
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	106	----	----
EP132B-SD: Benzo(b)fluoranthene	205-99-2	4	µg/kg	<4	25 µg/kg	99.2	----	----
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	106	----	----
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	25 µg/kg	102	----	----
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	91.8	----	----
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	25 µg/kg	102	----	----
EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	104	----	----
EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	101	----	----
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	101	----	----
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	25 µg/kg	98.5	----	----
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

	Matrix Spike (MS) Report		
	Spike	Spike Recovery (%)	Recovery Limits (%)

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%) MS	Recovery Limits (%) Low	High
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453556)							
ES1219839-002	C3_0.0-0.1	EG020-SD: Arsenic	7440-38-2	50 mg/kg	125	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	98.2	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	95.0	70	130
		EG020-SD: Copper	7440-50-8	250 mg/kg	98.6	70	130
		EG020-SD: Lead	7439-92-1	250 mg/kg	95.4	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	90.5	70	130
		EG020-SD: Zinc	7440-66-6	250 mg/kg	102	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559)							
ES1219839-023	C9_0.0-0.45	EG020-SD: Arsenic	7440-38-2	50 mg/kg	110	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	104	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	103	70	130
		EG020-SD: Copper	7440-50-8	250 mg/kg	109	70	130
		EG020-SD: Lead	7439-92-1	250 mg/kg	103	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	97.2	70	130
		EG020-SD: Zinc	7440-66-6	250 mg/kg	111	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453555)							
ES1219839-001	C13_0.0-0.5	EG035T-LL: Mercury	7439-97-6	0.050 mg/kg	83.9	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453558)							
ES1219839-022	C8_0.0-0.12	EG035T-LL: Mercury	7439-97-6	0.050 mg/kg	90.4	70	130
EP090: Organotin Compounds (QCLot: 2453775)							
ES1219839-002	C3_0.0-0.1	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	94.5	20	130
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451591)							
ES1219839-001	C13_0.0-0.5	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	114	70	130
		EP132B-SD: 2-Methylnaphthalene	91-57-6	25 µg/kg	95.6	70	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	104	70	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	95.6	70	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	97.6	70	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	95.4	70	130
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	88.8	70	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	81.4	70	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	80.8	70	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	112	70	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	80.8	70	130
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	25 µg/kg	100	70	130
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	82.1	70	130
		EP132B-SD: Benzo(e)pyrene	192-97-2	25 µg/kg	91.0	70	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	95.5	70	130
		EP132B-SD: Perylene	198-55-0	25 µg/kg	# 62.5	70	130

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Spike Recovery (%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451591) - continued							
ES1219839-001	C13_0.0-0.5	EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	83.0	70	130
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	91.3	70	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	88.2	70	130
		EP132B-SD: Coronene	191-07-1	25 µg/kg	92.8	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report: Spike Concentration	Spike Recovery (%): MS	Spike Recovery (%): MSD	Recovery Limits (%): Low	Recovery Limits (%): High	RPDs (%): Value	RPDs (%): Control Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451591)										
ES1219839-001	C13_0.0-0.5	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	114	----	70	130	----	----
		EP132B-SD: 2-Methylnaphthalene	91-57-6	25 µg/kg	95.6	----	70	130	----	----
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	104	----	70	130	----	----
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	95.6	----	70	130	----	----
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	97.6	----	70	130	----	----
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	95.4	----	70	130	----	----
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	88.8	----	70	130	----	----
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	81.4	----	70	130	----	----
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	80.8	----	70	130	----	----
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	112	----	70	130	----	----
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	80.8	----	70	130	----	----
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	25 µg/kg	100	----	70	130	----	----
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	82.1	----	70	130	----	----
		EP132B-SD: Benzo(e)pyrene	192-97-2	25 µg/kg	91.0	----	70	130	----	----
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	95.5	----	70	130	----	----
		EP132B-SD: Perylene	198-55-0	25 µg/kg	# 62.5	----	70	130	----	----
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	83.0	----	70	130	----	----
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	91.3	----	70	130	----	----
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	88.2	----	70	130	----	----
		EP132B-SD: Coronene	191-07-1	25 µg/kg	92.8	----	70	130	----	----
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453555)										
ES1219839-001	C13_0.0-0.5	EG035T-LL: Mercury	7439-97-6	0.050 mg/kg	83.9	----	70	130	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453556)										
ES1219839-002	C3_0.0-0.1	EG020-SD: Arsenic	7440-38-2	50 mg/kg	125	----	70	130	----	----
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	98.2	----	70	130	----	----
		EG020-SD: Chromium	7440-47-3	50 mg/kg	95.0	----	70	130	----	----

Sub-Matrix: **SOIL**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453556) - continued										
ES1219839-002	C3_0.0-0.1	EG020-SD: Copper	7440-50-8	250 mg/kg	98.6	----	70	130	----	----
		EG020-SD: Lead	7439-92-1	250 mg/kg	95.4	----	70	130	----	----
		EG020-SD: Nickel	7440-02-0	50 mg/kg	90.5	----	70	130	----	----
		EG020-SD: Zinc	7440-66-6	250 mg/kg	102	----	70	130	----	----
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453558)										
ES1219839-022	C8_0.0-0.12	EG035T-LL: Mercury	7439-97-6	0.050 mg/kg	90.4	----	70	130	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559)										
ES1219839-023	C9_0.0-0.45	EG020-SD: Arsenic	7440-38-2	50 mg/kg	110	----	70	130	----	----
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	104	----	70	130	----	----
		EG020-SD: Chromium	7440-47-3	50 mg/kg	103	----	70	130	----	----
		EG020-SD: Copper	7440-50-8	250 mg/kg	109	----	70	130	----	----
		EG020-SD: Lead	7439-92-1	250 mg/kg	103	----	70	130	----	----
		EG020-SD: Nickel	7440-02-0	50 mg/kg	97.2	----	70	130	----	----
		EG020-SD: Zinc	7440-66-6	250 mg/kg	111	----	70	130	----	----
EP090: Organotin Compounds (QCLot: 2453775)										
ES1219839-002	C3_0.0-0.1	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	94.5	----	20	130	----	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220011**	Page	: 1 of 7
Amendment	: **1**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 301015-03041		
C-O-C number	: ----	Date Samples Received	: 16-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Site	: ----		
		No. of samples received	: 8
Quote number	: SY/389/12 V2	No. of samples analysed	: 8

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY
Matt Frost	Senior Organic Chemist	Brisbane Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics
Pabi Subba	Senior Organic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EP132B-SD : Poor duplicate precision due to sample heterogeneity. Confirmed by re-extraction and re-analysis.**
- **EP132B-SD : Poor matrix spike recovery due to sample heterogeneity. Confirmed by re-extraction and re-analysis.**
- **TBT: Sample C18_0.0-0.5 shows high matrix spike recovery due to sample heterogeneity. Confirmed by re-extraction and re-analysis.**

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C11_0.0-0.35	C18_0.0-0.5	C18_0.5-0.9	C14_0.0-0.15	QC10
				Client sampling date / time	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]
Compound	CAS Number	LOR	Unit		ES1220011-001	ES1220011-002	ES1220011-003	ES1220011-004	ES1220011-005
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		25.6	23.4	34.7	56.8	<1.0
EG005-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1510	2790	6860	5320	530
Iron	7439-89-6	50	mg/kg		2320	4140	7920	10000	1580
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg		3.51	5.44	19.8	30.6	4.30
Cadmium	7440-43-9	0.1	mg/kg		<0.1	0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg		5.8	19.0	17.8	13.5	1.9
Copper	7440-50-8	1.0	mg/kg		7.8	7.3	6.8	4.4	<1.0
Cobalt	7440-48-4	0.5	mg/kg		0.5	0.7	0.7	1.6	<0.5
Lead	7439-92-1	1.0	mg/kg		12.0	14.5	3.3	4.1	<1.0
Manganese	7439-96-5	10	mg/kg		11	20	<10	12	14
Nickel	7440-02-0	1.0	mg/kg		1.6	2.5	3.2	6.6	<1.0
Selenium	7782-49-2	0.1	mg/kg		<0.1	0.6	5.1	1.1	<0.1
Silver	7440-22-4	0.1	mg/kg		<0.1	0.2	<0.1	<0.1	<0.1
Vanadium	7440-62-2	2.0	mg/kg		5.5	9.0	29.4	49.0	3.4
Zinc	7440-66-6	1.0	mg/kg		51.6	39.6	6.2	19.5	2.1
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.06	0.38	0.07	0.04	<0.01
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		3.78	0.70	5.50	25.8	----
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		5.4	0.9	<0.5	1.1	----
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		10	47	<5	<5	----
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	16	<5	12	----
Acenaphthylene	208-96-8	4	µg/kg		5	22	<4	<5	----
Acenaphthene	83-32-9	4	µg/kg		<4	<4	6	<5	----
Fluorene	86-73-7	4	µg/kg		<4	12	<4	<5	----
Phenanthrene	85-01-8	4	µg/kg		41	85	<4	27	----
Anthracene	120-12-7	4	µg/kg		<4	18	<4	9	----
Fluoranthene	206-44-0	4	µg/kg		56	118	8	67	----
Pyrene	129-00-0	4	µg/kg		52	100	8	85	----
Benz(a)anthracene	56-55-3	4	µg/kg		38	59	<4	20	----
Chrysene	218-01-9	4	µg/kg		21	51	<4	24	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C11_0.0-0.35	C18_0.0-0.5	C18_0.5-0.9	C14_0.0-0.15	QC10
				Client sampling date / time	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]
Compound	CAS Number	LOR	Unit		ES1220011-001	ES1220011-002	ES1220011-003	ES1220011-004	ES1220011-005
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		49	79	40	28	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		11	19	11	12	----
Benzo(e)pyrene	192-97-2	4	µg/kg		21	42	10	19	----
Benzo(a)pyrene	50-32-8	4	µg/kg		35	65	15	18	----
Perylene	198-55-0	4	µg/kg		27	23	74	532	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		26	53	<4	<5	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<4	12	<4	<5	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		26	41	<4	<5	----
Coronene	191-07-1	5	µg/kg		12	15	<5	<5	----
^ Sum of PAHs	----	4	µg/kg		430	877	172	853	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.1	%		126	115	68.7	60.8	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		111	117	117	108	----
Anthracene-d10	1719-06-8	0.1	%		98.7	92.9	112	99.6	----
4-Terphenyl-d14	1718-51-0	0.1	%		105	90.3	118	116	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C15_0.0-0.5	T02A	T02B	----	----
				Client sampling date / time	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	----	----
Compound	CAS Number	LOR	Unit		ES1220011-006	ES1220011-007	ES1220011-008	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		28.6	25.5	22.9	----	----
EG005-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		3000	1590	1410	----	----
Iron	7439-89-6	50	mg/kg		4220	2110	1860	----	----
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	----	----
Arsenic	7440-38-2	1.00	mg/kg		5.22	2.65	3.39	----	----
Cadmium	7440-43-9	0.1	mg/kg		0.2	<0.1	<0.1	----	----
Chromium	7440-47-3	1.0	mg/kg		17.5	6.1	5.3	----	----
Copper	7440-50-8	1.0	mg/kg		8.5	4.6	3.9	----	----
Cobalt	7440-48-4	0.5	mg/kg		0.8	<0.5	<0.5	----	----
Lead	7439-92-1	1.0	mg/kg		14.2	8.5	7.2	----	----
Manganese	7439-96-5	10	mg/kg		21	12	<10	----	----
Nickel	7440-02-0	1.0	mg/kg		2.9	1.9	1.5	----	----
Selenium	7782-49-2	0.1	mg/kg		<0.1	<0.1	<0.1	----	----
Silver	7440-22-4	0.1	mg/kg		0.2	<0.1	<0.1	----	----
Vanadium	7440-62-2	2.0	mg/kg		8.9	5.7	5.3	----	----
Zinc	7440-66-6	1.0	mg/kg		41.0	31.0	26.2	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.26	0.05	0.05	----	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		1.86	1.33	2.12	----	----
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		2.3	3.6	5.1	----	----
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		83	<5	<5	----	----
2-Methylnaphthalene	91-57-6	5	µg/kg		24	<5	6	----	----
Acenaphthylene	208-96-8	4	µg/kg		25	5	<4	----	----
Acenaphthene	83-32-9	4	µg/kg		4	<4	<4	----	----
Fluorene	86-73-7	4	µg/kg		11	<4	<4	----	----
Phenanthrene	85-01-8	4	µg/kg		60	24	21	----	----
Anthracene	120-12-7	4	µg/kg		26	4	4	----	----
Fluoranthene	206-44-0	4	µg/kg		97	28	31	----	----
Pyrene	129-00-0	4	µg/kg		97	27	31	----	----
Benz(a)anthracene	56-55-3	4	µg/kg		63	19	23	----	----
Chrysene	218-01-9	4	µg/kg		52	17	20	----	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	C15_0.0-0.5	T02A	T02B	----	----
				Client sampling date / time	[16-AUG-2012]	[16-AUG-2012]	[16-AUG-2012]	----	----
Compound	CAS Number	LOR	Unit		ES1220011-006	ES1220011-007	ES1220011-008	----	----
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(b)fluoranthene	205-99-2	4	µg/kg		68	20	29	----	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		24	6	12	----	----
Benzo(e)pyrene	192-97-2	4	µg/kg		44	13	18	----	----
Benzo(a)pyrene	50-32-8	4	µg/kg		65	16	25	----	----
Perylene	198-55-0	4	µg/kg		44	14	25	----	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		46	11	21	----	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		8	<4	<4	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		33	8	14	----	----
Coronene	191-07-1	5	µg/kg		10	<5	<5	----	----
^ Sum of PAHs	----	4	µg/kg		884	212	280	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.1	%		97.3	78.6	100	----	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		107	119	108	----	----
Anthracene-d10	1719-06-8	0.1	%		96.2	97.3	96.1	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		85.8	83.1	84.8	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	30	115
Anthracene-d10	1719-06-8	27	133
4-Terphenyl-d14	1718-51-0	18	137

Client - Matrix:	SOIL			Sample Type:	REG	REG	REG	REG	REG	REG	REG	REG
Workgroup:	ES1220011			ALS Sample number:	ES1220011001	ES1220011002	ES1220011003	ES1220011004	ES1220011005	ES1220011006	ES1220011007	ES1220011008
Project name/number:	CALTEX DREDGING			Sample date:	16/08/2012	16/08/2012	16/08/2012	16/08/2012	16/08/2012	16/08/2012	16/08/2012	16/08/2012
				Client sample ID (Primary):	C11_0.0-0.35	C18_0.0-0.5	C18_0.5-0.9	C14_0.0-0.15	QC10	C15_0.0-0.5	T02A	T02B
				Client sample ID (Secondary):								
				Sample Site:								
				Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte grouping/Analyte	CAS Number	Units	LOR									
EA055: Moisture Content												
Moisture Content (dried @103°C)		%	1		25.6	23.4	34.7	56.8	<1.0	28.6	25.5	22.9
EG005-SD: Total Metals in Sediments by ICP-AES												
Aluminium	7429-90-5	mg/kg	50		1510	2790	6860	5120	530	3000	1590	1410
Iron	7439-89-6	mg/kg	50		2320	4140	7920	10000	1580	4220	2110	1860
EG020-SD: Total Metals in Sediments by ICPMS												
Antimony	7440-36-0	mg/kg	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	mg/kg	1		3.51	5.44	19.8	30.6	4.3	5.22	2.65	3.39
Cadmium	7440-43-9	mg/kg	0.1		<0.1	0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Chromium	7440-47-3	mg/kg	1		5.8	19	17.8	13.5	1.9	17.5	6.1	5.3
Copper	7440-50-8	mg/kg	1		7.8	7.3	6.8	4.4	<1.0	8.5	4.6	3.9
Cobalt	7440-48-4	mg/kg	0.5		0.5	0.7	0.7	1.6	<0.5	0.8	<0.5	<0.5
Lead	7439-92-1	mg/kg	1		12	14.5	3.3	4.1	<1.0	14.2	8.5	7.2
Manganese	7439-96-5	mg/kg	10		11	20	<10	12	14	21	12	<10
Nickel	7440-02-0	mg/kg	1		1.6	2.5	3.2	6.6	<1.0	2.9	1.9	1.5
Selenium	7782-49-2	mg/kg	0.1		<0.1	0.6	5.1	1.1	<0.1	<0.1	<0.1	<0.1
Silver	7440-22-4	mg/kg	0.1		<0.1	0.2	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Vanadium	7440-62-2	mg/kg	2		5.5	9	29.4	49	3.4	8.9	5.7	5.3
Zinc	7440-66-6	mg/kg	1		51.6	39.6	6.2	19.5	2.1	41	31	26.2
EG035T: Total Recoverable Mercury by FIMS												
Mercury	7439-97-6	mg/kg	0.01		0.06	0.38	0.07	0.04	<0.01	0.26	0.05	0.05
EP003: Total Organic Carbon (TOC) in Soil												
Total Organic Carbon		%	0.02		3.78	0.7	5.5	25.8		1.86	1.33	2.12
EP090: Organotin Compounds												
Tributyltin	5673-85-4	µgSn/kg	0.5		5.4	0.9	<0.5	1.1		2.3	3.6	5.1
EP090S: Organotin Surrogate												
Tripropyltin		%	0.1		126	115	68.7	60.8		97.3	78.6	100
EP132B: Polynuclear Aromatic Hydrocarbons												
Naphthalene	91-20-3	µg/kg	5		10	47	<5	<5		83	<5	<5
2-Methylnaphthalene	91-57-6	µg/kg	5		<5	16	<5	12		24	<5	6
Acenaphthylene	208-96-8	µg/kg	4		5	22	<4	<5		25	5	<4
Acenaphthene	83-32-9	µg/kg	4		<4	<4	6	<5		4	<4	<4
Fluorene	86-73-7	µg/kg	4		<4	12	<4	<5		11	<4	<4
Phenanthrene	85-01-8	µg/kg	4		41	85	<4	27		60	24	21
Anthracene	120-12-7	µg/kg	4		<4	18	<4	9		26	4	4
Fluoranthene	206-44-0	µg/kg	4		56	118	8	67		97	28	31
Pyrene	129-00-0	µg/kg	4		52	100	8	85		97	27	31
Benz(a)anthracene	56-55-3	µg/kg	4		38	59	<4	20		63	19	23
Chrysene	218-01-9	µg/kg	4		21	51	<4	24		52	17	20
Benzo(b)fluoranthene	205-99-2	µg/kg	4		49	79	40	28		68	20	29
Benzo(k)fluoranthene	207-08-9	µg/kg	4		11	19	11	12		24	6	12
Benzo(e)pyrene	192-97-2	µg/kg	4		21	42	10	19		44	13	18
Benzo(a)pyrene	50-32-8	µg/kg	4		35	65	15	18		65	16	25
Perylene	198-55-0	µg/kg	4		27	23	74	532		44	14	25
Benzo(g.h.i)perylene	191-24-2	µg/kg	4		26	53	<4	<5		46	11	21
Dibenz(a.h)anthracene	53-70-3	µg/kg	4		<4	12	<4	<5		8	<4	<4
Indeno(1.2.3.cd)pyrene	193-39-5	µg/kg	4		26	41	<4	<5		33	8	14
Coronene	191-07-1	µg/kg	5		12	15	<5	<5		10	<5	<5
Sum of PAHs		µg/kg	4		430	877	172	853		884	212	280
EP132T: Base/Neutral Extractable Surrogates												
2-Fluorobiphenyl	321-60-8	%	0.1		111	117	117	108		107	119	108
Anthracene-d10	1719-06-8	%	0.1		98.7	92.9	112	99.6		96.2	97.3	96.1
4-Terphenyl-d14	1718-51-0	%	0.1		105	90.3	118	116		85.8	83.1	84.8

QC - Matrix:	SOIL			Sample Type:	LCS	DUP	MS	MB	LCS	MS	DUP	MB	LCS	DUP	MS	MB	LCS	DUP	MS	MB	LCS	DUP	DUP	DUP	REG	REG	REG	REG
Workgroup:	ES1220011			ALS Sample number:	2907571-039	2907571-041	2907571-042	2907571-044	2907571-045	2907571-052	2907571-063	2907807-001	2907807-002	2907807-004	2907807-005	2907891-001	2907891-002	2907891-004	2907891-006	2914604-001	2914604-002	2914604-004	2914797-026	2914797-038	ES1219839022	ES1219839023	ES1219950085	ES1220015001
				Sample date:	17/08/2012	15/08/2012	15/08/2012	17/08/2012	17/08/2012	15/08/2012	16/08/2012	17/08/2012	17/08/2012	16/08/2012	16/08/2012	17/08/2012	17/08/2012	16/08/2012	16/08/2012	21/08/2012	21/08/2012	16/08/2012	15/08/2012	16/08/2012	15/08/2012	15/08/2012	15/08/2012	16/08/2012
Analyte grouping/Analyte	CAS Number	Units	LOR																									
EA055: Moisture Content																												
Moisture Content (dried @103°C)		%	1																				19.3	19.1		19.1	19.2	
EG005-SD: Total Metals in Sediments by ICP-AES																												
Aluminium	7429-90-5	mg/kg	50			9880		<50			850														9100			880
Iron	7439-89-6	mg/kg	50			14200		<50			940														15700			1000
EG020-SD: Total Metals in Sediments by ICPMS																												
Antimony	7440-36-0	mg/kg	0.5			<0.50		<0.50	55.6		<0.50														<0.50			<0.50
Arsenic	7440-38-2	mg/kg	1			43		<1.00	138	110	1.28														50.6	3.74		1.23
Cadmium	7440-43-9	mg/kg	0.1			<0.1		<0.1	107	104	<0.1														<0.1	<0.1		<0.1
Chromium	7440-47-3	mg/kg	1			28.2		<1.0	94.9	103	4.3														23.6	4.7		4.7
Copper	7440-50-8	mg/kg	1			9.6		<1.0	106	109	1.6														7.8	1.2		1.6
Cobalt	7440-48-4	mg/kg	0.5			1.4		<10.0	98.9		<0.5														2			<0.5
Lead	7439-92-1	mg/kg	1			3.7		<1.0	104	103	3.6														4	1.8		3.6
Manganese	7439-96-5	mg/kg	10			<10		<10	101		<10														12			<10
Nickel	7440-02-0	mg/kg	1			4.4		<1.0	100	97.2	<1.0														7.5	<1.0		<1.0
Selenium	7782-49-2	mg/kg	0.1			4.5		<0.1	99		<0.1														4.5			<0.1
Silver	7440-22-4	mg/kg	0.1			<0.1		<0.1	128		<0.1														<0.1			<0.1
Vanadium	7440-62-2	mg/kg	2			38.4		<2.0	107		2.8														38.7			2.8
Zinc	7440-66-6	mg/kg	1			6.8		<1.0	114	111	7.4														8.2	1.6		7.7
EG035T: Total Recoverable Mercury by FIMS																												
Mercury	7439-97-6	%			102	0.07	90.4	<0.01			0.09														0.08			0.09
EP003: Total Organic Carbon (TOC) in Soil																												
Total Organic Carbon		%	0.02																	<0.02	98.5	3.76						
EP090: Organotin Compounds																												
Tributyltin	5673-85-4	µgSn/kg	0.5													<0.5	124	5.2	168									
EP090S: Organotin Surrogate																												
Tripropyltin		%	0.1													88.7	106	126	127									
EP132B: Polynuclear Aromatic Hydrocarbons																												
Naphthalene	91-20-3	µg/kg	5									<5	86.6	13	107													
2-Methylnaphthalene	91-57-6	µg/kg	5									<5	93.7	<5	92.6													
Acenaphthylene	208-96-8	µg/kg	4									<4	83.9	<4	134													
Acenaphthene	83-32-9	µg/kg	4									<4	88.6	<4	106													
Fluorene	86-73-7	µg/kg	4									<4	87.3	<4	102													
Phenanthrene	85-01-8	µg/kg	4									<4	89.4	48	ND													
Anthracene	120-12-7	µg/kg	4									<4	92.3	7	114													
Fluoranthene	206-44-0	µg/kg	4									<4	91.7	72	ND													
Pyrene	129-00-0	µg/kg	4									<4	92.2	76	ND													
Benz(a)anthracene	56-55-3	µg/kg	4									<4	82.7	64	ND													
Chrysene	218-01-9	µg/kg	4									<4	93.8	28	ND													
Benzo(b)fluoranthene	205-99-2	µg/kg	4									<4	95	53	ND													
Benzo(k)fluoranthene	207-08-9	µg/kg	4									<4	80.6	17	122													
Benzo(e)pyrene	192-97-2	µg/kg	4									<4	93.6	28	ND													
Benzo(a)pyrene	50-32-8	µg/kg	4									<4	86.8	46	ND													
Perylene	198-55-0	µg/kg	4									<4	88.5	20	104													
Benzo(g.h.i)perylene	191-24-2	µg/kg	4									<4	95.1	26	ND													
Dibenz(a.h)anthracene	53-70-3	µg/kg	4									<4	91.8	<4	121													
Indeno(1.2.3.cd)pyrene	193-39-5	µg/kg	4									<4	91.7	27	ND													
Coronene	191-07-1	µg/kg	5									<5	94.3	8	134													
Sum of PAHs		µg/kg	4									<4		533														
EP132T: Base/Neutral Extractable Surrogates																												
2-Fluorobiphenyl	321-60-8	%	0.1									90.2	89.9	111	111													
Anthracene-d10	1719-06-8	%	0.1									94.4	87.7	82.9	110													
4-Terphenyl-d14	1718-51-0	%	0.1									99.2	99.5	115	118													

EB Copy.

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 5735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 8433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX	TURNAROUND REQUIREMENTS: 3 DAY TAT REQUIRED (Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):
OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)	
PROJECT: Caltex Dredging	ALS QUOTE NO.: SY/389/12 V2
ORDER NUMBER: 301015-03041	
PROJECT MANAGER: Ben Taylor	CONTACT PH: 0402 406824
SAMPLER: Carsten Matthai	SAMPLER MOBILE: 0411 331112
COC emailed to ALS? (YES / NO) No	EDD FORMAT (or default):
Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com	
Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au	

COC SEQUENCE NUMBER (Circle): COC: (1) 2 3 4 5 6 7 SOF: (1) 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle): Custody Seal Intact? Yes / No / N/A; Freeze / Frozen / Ice Bricks present upon receipt? Yes / No; Random Samples Received Broken / Leaking? Yes / No; Other comments:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:
Carsten Matthai	Frank ALS	
DATE/TIME: 16-8-12 3:30pm	DATE/TIME: 16-8-12 1710	DATE/TIME:

Environmental Division Sydney

Work Order

ES1220011

Telephone : +61-2-8784 8555

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract su... Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field fil... required).								
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	C11_0.0-0.35	16/8/12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
2	C18-0.0-0.5	"	Sediment	Various	4 jars + bag	✓	✓		✓	✓	✓	✓		
3	C18-0.5-0.9	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
4	C14_0.0-0.15	"	Sediment	Various	4 jars + bag	✓	✓		✓	✓	✓	✓		1 elutriate jar half full
5	QC10	"	Sediment	Various	1 jar		✓							
6	C15_0.0-0.5	"	Sediment	Various	4 jars + bag	✓	✓		✓	✓	✓	✓		
7	T02A	"	Sediment	Various	2 jars	✓	✓		✓	✓				
8	T02B	"	Sediment	Various	2 jars	✓	✓		✓	✓				
			Sediment	Various										
			Sediment	Various										
				TOTAL	28									SEDIMENTS TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0690 E: adelaide@alsglobal.com

☐BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com

☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com

☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com

☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com

☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics) — 3 DAY TAT REQUIRED ☐ Non Standard or urgent TAT (List due date):
OFFICE: via WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)	
PROJECT: Caltex Dredging	ALS QUOTE NO.: SY/389/12 V2
ORDER NUMBER: 301015-03041	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7
PROJECT MANAGER: Ben Taylor	CONTACT PH: 0402 406624 — SP: 1 2 3 4 5 6 7
SAMPLER: Carsten Matthai	SAMPLER MOBILE: 0411 331112
COC emailed to ALS? (YES / NO) No	EDD FORMAT (or default):
Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com	
Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au	

RELINQUISHED BY: Carsten Matthai — DATE/TIME: 16-8-12 3:30pm

RECEIVED BY: Frank ALS — DATE/TIME: 16-8-12 1710

RELINQUISHED BY: — DATE/TIME:

FOR LABORATORY USE ONLY (Circle): Custody Seal Intact? / Free Ice / frozen ice on receipt? / Random Sample? / Other comments:

Environmental Division Sydney

Work Order

ES1220011

Telephone : +61-2-8784 8555

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract su... Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
						ALS Newcastle								
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	C11_0.0-0.35	16/8/12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
2	C18-0.0-0.5	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
3	C18-0.5-0.9	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
4	C14_0.0-0.15	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		elutriate jar half full
5	QC10	"	Sediment	Various	1 jar		✓							
6	C15_0.0-0.5	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
7	T02A	"	Sediment	Various	2 jars	✓	✓		✓	✓				
8	T02B	"	Sediment	Various	2 jars	✓	✓		✓	✓				
			Sediment	Various										
														SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	28									

Analysis Required By / Date: ES1220011 (PSD) 16/8/12

Received By / Date: ES1220011 16/8/12

Temperature / Cooler / Container: Ice / Frozen / Ambient

Received By / Date: [illegible]

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220011**	Page	: 1 of 7
Amendment	: **1**		
Client	: CALTEX REFINERIES(NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 16-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 8
Quote number	: SY/389/12 V2	No. of samples analysed	: 8

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

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

Analysis Holding Time Compliance

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 precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, QC10, C15_0.0-0.5	**16-AUG-2012**	**----**	----	----	**21-AUG-2012**	30-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA055-103)							
T02A, T02B	**16-AUG-2012**	**----**	----	----	**22-AUG-2012**	30-AUG-2012	✓
EG005-SD: Total Metals in Sediments by ICP-AES							
Soil Glass Jar - Unpreserved (EG005-SD)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, QC10, C15_0.0-0.5, T02A, T02B	**16-AUG-2012**	**17-AUG-2012**	12-FEB-2013	✓	**20-AUG-2012**	12-FEB-2013	✓
EG020-SD: Total Metals in Sediments by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SD)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, QC10, C15_0.0-0.5, T02A, T02B	**16-AUG-2012**	**17-AUG-2012**	12-FEB-2013	✓	**18-AUG-2012**	12-FEB-2013	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T-LL)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, QC10, C15_0.0-0.5, T02A, T02B	**16-AUG-2012**	**17-AUG-2012**	13-SEP-2012	✓	**17-AUG-2012**	13-SEP-2012	✓
EP003: Total Organic Carbon (TOC) in Soil							
Pulp Bag (EP003)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, C15_0.0-0.5, T02A, T02B	**16-AUG-2012**	**21-AUG-2012**	23-AUG-2012	✓	**21-AUG-2012**	18-SEP-2012	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP090: Organotin Compounds							
Soil Glass Jar - Unpreserved (EP090)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, C15_0.0-0.5, T02A, T02B	**16-AUG-2012**	**17-AUG-2012**	30-AUG-2012	✓	**20-AUG-2012**	26-SEP-2012	✓
EP132B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP132B-SD)							
C11_0.0-0.35, C18_0.0-0.5, C18_0.5-0.9, C14_0.0-0.15, C15_0.0-0.5, T02A, T02B	**16-AUG-2012**	**17-AUG-2012**	30-AUG-2012	✓	**20-AUG-2012**	26-SEP-2012	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Organotin Analysis	EP090	1	5	**20.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	10	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Fe and Al in Sediments by ICPAES	EG005-SD	2	13	**15.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	2	13	**15.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	2	13	**15.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	10	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Organotin Analysis	EP090	1	5	**20.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	10	**10.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	10	**10.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Organotin Analysis	EP090	1	5	**20.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	10	**10.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	10	**10.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Organotin Analysis	EP090	1	5	**20.0**	**5.0**	✓	ALS QCS3 requirement
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	10	**10.0**	**5.0**	✓	ALS QCS3 requirement
Total Mercury by FIMS (Low Level)	EG035T-LL	1	13	**7.7**	**5.0**	✓	ALS QCS3 requirement
Total Metals in Sediments by ICPMS	EG020-SD	1	13	**7.7**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division 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 in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Fe and Al in Sediments by ICPAES	EG005-SD	SOIL	(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). LORs per NODG
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	(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. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(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 SnCl2 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)
Total Organic Carbon	EP003	SOIL	In-house C-IR17. 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.
Organotin Analysis	EP090	SOIL	(USEPA SW 846 - 8270D) Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.
PAHs in Sediments by GCMS(SIM)	EP132B-SD	SOIL	8270 GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.

Preparation Methods	Method	Matrix	Method Descriptions
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na2SO4 and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.
Organotin Sample Preparation	ORG35	SOIL	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.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Benz(a)anthracene**	56-55-3	50.6 %	0-50%	**RPD exceeds LOR based limits**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Sum of PAHs**	----	21.4 %	0-20%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EP090: Organotin Compounds	ES1220011-002	C18_0.0-0.5	**Tributyltin**	56573-85-4	168 %	20-130%	**Recovery greater than upper data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Phenanthrene**	85-01-8	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Fluoranthene**	206-44-0	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Pyrene**	129-00-0	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Benz(a)anthracene**	56-55-3	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Chrysene**	218-01-9	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Benzo(b)fluoranthene**	205-99-2	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Benzo(e)pyrene**	192-97-2	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Benzo(a)pyrene**	50-32-8	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Benzo(g.h.i)perylene**	191-24-2	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Indeno(1.2.3.cd)pyrene**	193-39-5	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**
EP132B: Polynuclear Aromatic Hydrocarbons	ES1220011-001	C11_0.0-0.35	**Coronene**	191-07-1	134 %	70-130%	**Recovery greater than upper data quality objective**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**

Regular Sample Surrogates

Sub-Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment

Sub-Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Samples Submitted							
EP132T: Base/Neutral Extractable Surrogates	ES1220011-002	C18_0.0-0.5	**2-Fluorobiphenyl**	321-60-8	117 %	30-115 %	**Recovery greater than upper data quality objective**
EP132T: Base/Neutral Extractable Surrogates	ES1220011-003	C18_0.5-0.9	**2-Fluorobiphenyl**	321-60-8	117 %	30-115 %	**Recovery greater than upper data quality objective**
EP132T: Base/Neutral Extractable Surrogates	ES1220011-007	T02A	**2-Fluorobiphenyl**	321-60-8	119 %	30-115 %	**Recovery greater than upper data quality objective**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1220011**	Page	: 1 of 8
Amendment	: **1**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 16-AUG-2012
Sampler	: CM	Issue Date	: 22-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 8
Quote number	: SY/389/12 V2	No. of samples analysed	: 8

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY
Matt Frost	Senior Organic Chemist	Brisbane Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics
Pabi Subba	Senior Organic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 2459970)									
ES1219950-085	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	19.1	19.3	1.1	0% - 50%
ES1220015-001	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	19.2	19.1	0.0	0% - 50%
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2453560)									
ES1219839-022	Anonymous	EG005-SD: Aluminium	7429-90-5	50	mg/kg	9300	9880	6.0	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	15700	14200	9.8	0% - 20%
ES1220015-001	Anonymous	EG005-SD: Aluminium	7429-90-5	50	mg/kg	880	850	3.4	0% - 50%
		EG005-SD: Iron	7439-89-6	50	mg/kg	1000	940	5.9	0% - 50%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2453559)									
ES1219839-022	Anonymous	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	4.5	4.5	0.0	0% - 20%
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	2.0	1.4	37.4	No Limit
		EG020-SD: Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.0	No Limit
		EG020-SD: Chromium	7440-47-3	1.0	mg/kg	23.6	28.2	17.6	0% - 20%
		EG020-SD: Copper	7440-50-8	1.0	mg/kg	7.8	9.6	21.4	No Limit
		EG020-SD: Lead	7439-92-1	1.0	mg/kg	4.0	3.7	6.2	No Limit
		EG020-SD: Nickel	7440-02-0	1.0	mg/kg	7.5	4.4	51.8	No Limit
		EG020-SD: Zinc	7440-66-6	1.0	mg/kg	8.2	6.8	19.0	No Limit
		EG020-SD: Arsenic	7440-38-2	1.00	mg/kg	50.6	43.0	16.3	0% - 20%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	12	<10	22.7	No Limit
		EG020-SD: Vanadium	7440-62-2	2.0	mg/kg	38.7	38.4	0.6	0% - 50%
ES1220015-001	Anonymous	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EG020-SD: Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.0	No Limit
		EG020-SD: Chromium	7440-47-3	1.0	mg/kg	4.7	4.3	7.8	No Limit
		EG020-SD: Copper	7440-50-8	1.0	mg/kg	1.6	1.6	0.0	No Limit
		EG020-SD: Lead	7439-92-1	1.0	mg/kg	3.6	3.6	0.0	No Limit
		EG020-SD: Nickel	7440-02-0	1.0	mg/kg	<1.0	<1.0	0.0	No Limit
		EG020-SD: Zinc	7440-66-6	1.0	mg/kg	7.7	7.4	4.8	No Limit
		EG020-SD: Arsenic	7440-38-2	1.00	mg/kg	1.25	1.28	2.3	No Limit
		EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	<10	0.0	No Limit
		EG020-SD: Vanadium	7440-62-2	2.0	mg/kg	2.8	2.8	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2453558)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2453558) - continued									
ES1219839-022	Anonymous	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.08	0.07	17.6	No Limit
ES1220015-001	Anonymous	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.09	0.09	0.0	No Limit
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 2459848)									
ES1220011-001	C11_0.0-0.35	EP003: Total Organic Carbon	---	0.02	%	3.78	3.76	0.8	0% - 20%
EP090: Organotin Compounds (QC Lot: 2453870)									
ES1220011-001	C11_0.0-0.35	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	5.4	5.2	2.3	0% - 50%
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2453777)									
ES1220011-001	C11_0.0-0.35	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	5	<4	0.0	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	41	48	17.1	0% - 50%
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	7	60.2	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	56	72	24.2	0% - 50%
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	52	76	37.7	0% - 50%
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	38	64	# 50.6	0% - 50%
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	21	28	28.4	No Limit
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	4	µg/kg	49	53	8.8	0% - 50%
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	11	17	45.6	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	21	28	25.6	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	35	46	29.0	0% - 50%
		EP132B-SD: Perylene	198-55-0	4	µg/kg	27	20	27.0	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	26	26	0.0	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	26	27	0.0	No Limit
		EP132B-SD: Sum of PAHs	---	4	µg/kg	430	533	# 21.4	0% - 20%
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	10	13	30.4	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	12	8	32.7	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2453560)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	6.19 mg/kg	55.6	----	----
EG020-SD: Arsenic	7440-38-2	1.0	mg/kg	<1.00	21.7 mg/kg	138	----	----
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.64 mg/kg	107	----	----
EG020-SD: Chromium	7440-47-3	1.0	mg/kg	<1.0	43.9 mg/kg	94.9	----	----
EG020-SD: Copper	7440-50-8	1.0	mg/kg	<1.0	32 mg/kg	106	----	----
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	----	16 mg/kg	98.9	----	----
		10	mg/kg	<10.0	----	----	----	----
EG020-SD: Lead	7439-92-1	1.0	mg/kg	<1.0	40 mg/kg	104	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	130 mg/kg	101	----	----
EG020-SD: Nickel	7440-02-0	1.0	mg/kg	<1.0	55 mg/kg	100	----	----
EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	5.37 mg/kg	99.0	----	----
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	2.10 mg/kg	128	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	29.6 mg/kg	107	----	----
EG020-SD: Zinc	7440-66-6	1.0	mg/kg	<1.0	60.8 mg/kg	114	----	----
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453558)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.11 mg/kg	102	74.2	126
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 2459848)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	100 %	98.5	70	130
EP090: Organotin Compounds (QCLot: 2453870)								
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	124	45	134
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2453777)								
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	86.6	----	----
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	25 µg/kg	93.7	----	----
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	83.9	----	----
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	88.6	----	----
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	87.3	----	----
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	89.4	----	----
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	92.3	----	----
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	91.7	----	----
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	92.2	----	----
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	82.7	----	----

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	LCS: Spike Recovery (%)	Recovery Limits (%): Low	Recovery Limits (%): High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2453777) - continued								
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	93.8	----	----
EP132B-SD: Benzo(b)fluoranthene	205-99-2	4	µg/kg	<4	25 µg/kg	95.0	----	----
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	80.6	----	----
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	25 µg/kg	93.6	----	----
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	86.8	----	----
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	25 µg/kg	88.5	----	----
EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	95.1	----	----
EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	91.8	----	----
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	91.7	----	----
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	25 µg/kg	94.3	----	----
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Spike Recovery (%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559)							
ES1219839-023	Anonymous	EG020-SD: Arsenic	7440-38-2	50 mg/kg	110	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	104	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	103	70	130
		EG020-SD: Copper	7440-50-8	250 mg/kg	109	70	130
		EG020-SD: Lead	7439-92-1	250 mg/kg	103	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	97.2	70	130
		EG020-SD: Zinc	7440-66-6	250 mg/kg	111	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453558)							
ES1219839-022	Anonymous	EG035T-LL: Mercury	7439-97-6	0.050 mg/kg	90.4	70	130
EP090: Organotin Compounds (QCLot: 2453870)							
ES1220011-002	C18_0.0-0.5	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	# 168	20	130
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2453777)							
ES1220011-001	C11_0.0-0.35	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	107	70	130
		EP132B-SD: 2-Methylnaphthalene	91-57-6	25 µg/kg	92.6	70	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	114	70	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	106	70	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	102	70	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	# Not Determined	70	130

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Spike Recovery (%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2453777) - continued							
ES1220011-001	C11_0.0-0.35	EP132B-SD: Anthracene	120-12-7	25 µg/kg	114	70	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	122	70	130
		EP132B-SD: Benzo(e)pyrene	192-97-2	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Perylene	198-55-0	25 µg/kg	104	70	130
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	121	70	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	# Not Determined	70	130
		EP132B-SD: Coronene	191-07-1	25 µg/kg	# 134	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report: Spike Concentration	Spike Recovery (%): MS	Spike Recovery (%): MSD	Recovery Limits (%): Low	Recovery Limits (%): High	RPDs (%): Value	RPDs (%): Control Limit
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2453558)										
ES1219839-022	Anonymous	EG035T-LL: Mercury	7439-97-6	0.050 mg/kg	90.4	----	70	130	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2453559)										
ES1219839-023	Anonymous	EG020-SD: Arsenic	7440-38-2	50 mg/kg	110	----	70	130	----	----
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	104	----	70	130	----	----
		EG020-SD: Chromium	7440-47-3	50 mg/kg	103	----	70	130	----	----
		EG020-SD: Copper	7440-50-8	250 mg/kg	109	----	70	130	----	----
		EG020-SD: Lead	7439-92-1	250 mg/kg	103	----	70	130	----	----
		EG020-SD: Nickel	7440-02-0	50 mg/kg	97.2	----	70	130	----	----
		EG020-SD: Zinc	7440-66-6	250 mg/kg	111	----	70	130	----	----
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2453777)										
ES1220011-001	C11_0.0-0.35	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	107	----	70	130	----	----
		EP132B-SD: 2-Methylnaphthalene	91-57-6	25 µg/kg	92.6	----	70	130	----	----
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	114	----	70	130	----	----
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	106	----	70	130	----	----
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	102	----	70	130	----	----
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	# Not Determined	----	70	130	----	----

Sub-Matrix: **SOIL**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2453777) - continued										
ES1220011-001	C11_0.0-0.35	EP132B-SD: Anthracene	120-12-7	25 µg/kg	114	----	70	130	----	----
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Benzo(b)fluoranthene	205-99-2	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	122	----	70	130	----	----
		EP132B-SD: Benzo(e)pyrene	192-97-2	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Perylene	198-55-0	25 µg/kg	104	----	70	130	----	----
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	121	----	70	130	----	----
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	# Not Determined	----	70	130	----	----
		EP132B-SD: Coronene	191-07-1	25 µg/kg	# 134	----	70	130	----	----
EP090: Organotin Compounds (QCLot: 2453870)										
ES1220011-002	C18_0.0-0.5	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	# 168	----	20	130	----	----

ELUTRIATE LABORATORY RESULTS

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order	: **ES1220556**		
Amendment	: **3**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING REBATCH OF ES1219839 ES1220011	Page	: 1 of 3
Order number	: 301015-03041		
C-O-C number	: ----	Quote number	: ES2012CALREFNSW0182 (SY/389/12 V2)
Site	: ----		
Sampler	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 23-AUG-2012	Issue Date	: 15-NOV-2012 15:59
Client Requested Due Date	: 16-NOV-2012	Scheduled Reporting Date	: **16-NOV-2012**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 4.1'C - Ice present
No. of coolers/boxes	: REBATCH	No. of samples received	: 7
Security Seal	: Intact.	No. of samples analysed	: 7

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **TBT analysis will be conducted by ALS Brisbane**
- **Breaches in recommended extraction / analysis holding times may occur. Please refer to the 'Proactive Holding Time Report' below for further details. Please contact ALS if further information is required.**
- **This is a rebatch of ES1219839 & ES1220011**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

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

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

Summary of Sample(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 the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA055-103 Moisture Content	SOIL - EP090S Organotins
ES1220556-001	14-AUG-2012 15:00	C5_0.0-0.15	✓	
	28-AUG-2012 12:00	C5_0.0-0.15		✓
ES1220556-002	15-AUG-2012 15:00	C2_0.0-0.5	✓	
	28-AUG-2012 12:00	C2_0.0-0.5		✓
ES1220556-003	15-AUG-2012 15:00	QC5	✓	
	28-AUG-2012 12:00	QC5		✓
ES1220556-004	28-AUG-2012 12:00	ELUTRIATE BLANK		✓
ES1220556-005	16-AUG-2012 15:00	C14_0.0-0.15	✓	
	28-AUG-2012 12:00	C14_0.0-0.15		✓
ES1220556-006	16-AUG-2012 15:00	C15_0.0-0.5	✓	
	28-AUG-2012 12:00	C15_0.0-0.5		✓
ES1220556-007	16-AUG-2012 15:00	C18_0.0-0.5	✓	
	28-AUG-2012 12:00	C18_0.0-0.5		✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

MR CARSTEN MATTHAI

- *AU Certificate of Analysis - NATA (COA)	Email	carsten.matthai@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	carsten.matthai@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	carsten.matthai@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental Abridged (SRN Abridged)	Email	carsten.matthai@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	carsten.matthai@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	carsten.matthai@WorleyParsons.com

MR SIMON CAPLES

- *AU Certificate of Analysis - NATA (COA)	Email	scaples@caltex.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	scaples@caltex.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	scaples@caltex.com.au
- A4 - AU Sample Receipt Notification - Environmental Abridged (SRN Abridged)	Email	scaples@caltex.com.au
- A4 - AU Tax Invoice (INV)	Email	scaples@caltex.com.au
- Chain of Custody (CoC) (COC)	Email	scaples@caltex.com.au
- EDI Format - ENMRG (ENMRG)	Email	scaples@caltex.com.au

MS CHRISTINA HALIM

- A4 - AU Tax Invoice (INV)	Email	CHalim@caltex.com.au

MS DEBORAH LAM

- *AU Certificate of Analysis - NATA (COA)	Email	deborah.lam@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	deborah.lam@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	deborah.lam@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental Abridged (SRN Abridged)	Email	deborah.lam@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	deborah.lam@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	deborah.lam@WorleyParsons.com

Client - Matrix:	ELUTRIATE			Sample Type:	REG	REG	REG	REG	REG	REG	REG
Workgroup:	ES1220556			ALS Sample number:	ES1220556001	ES1220556002	ES1220556003	ES1220556004	ES1220556005	ES1220556006	ES1220556007
Project name/number:	CALTEX DREDGING REBATCH OF ES1219839 ES1220011			Sample date:	28/08/2012	28/08/2012	28/08/2012	28/08/2012	28/08/2012	28/08/2012	28/08/2012
				Client sample ID (Primary):	C5_0.0-0.15	C2_0.0-0.5	QC5	ELUTRIATE BLANK	C14_0.0-0.15	C15_0.0-0.5	C18_0.0-0.5
				Client sample ID (Secondary):							
				Sample Site:							
				Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte grouping/Analyte	CAS Number	Units	LOR								
EP090: Organotin Compounds (Soluble)											
Tributyltin	56573-85-4	ngSn/L	2		<2	<2	<2	<2	<2	<2	<2
EP090S: Organotin Surrogate											
Tripropyltin		%	0.1		67.7	71.8	64.5	75.2	47.9	67.8	65.2

Client - Matrix:	SEAWATER			Sample Type:
Workgroup:	ES1220556			ALS Sample number:
Project name/number:	CALTEX DREDGING REBATCH OF ES1219839 ES1220011			Sample date:
				Client sample ID (Primary):
				Client sample ID (Secondary):
				Sample Site:
				Purchase Order:
Analyte grouping/Analyte	CAS Number	Units	LOR	

Client - Matrix:	SOIL			Sample Type:	REG	REG	REG	REG	REG	REG	REG
Workgroup:	ES1220556			ALS Sample number:	ES1220556001	ES1220556002	ES1220556003	ES1220556004	ES1220556005	ES1220556006	ES1220556007
Project name/number:	CALTEX DREDGING REBATCH OF ES1219839 ES1220011			Sample date:	14/08/2012	15/08/2012	15/08/2012	15/08/2012	16/08/2012	16/08/2012	16/08/2012
				Client sample ID (Primary):	C5_0.0-0.15	C2_0.0-0.5	QC5	ELUTRIATE BLANK	C14_0.0-0.15	C15_0.0-0.5	C18_0.0-0.5
				Client sample ID (Secondary):							
				Sample Site:							
				Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte grouping/Analyte	CAS Number	Units	LOR								
EA055: Moisture Content											
Moisture Content (dried @ 103°C)		%	1		60.8	27.4	26.9		56.8	28.6	23.4
EN68: Seawater Elutriate Testing Procedure											
Seawater Sampling Date		-	0.1		27/08/2012	27/08/2012	27/08/2012	27/08/2012	27/08/2012	27/08/2012	27/08/2012

QC - Matrix:	SOIL			Sample Type:	DUP
Workgroup:	ES1220556			ALS Sample number:	2927697-004
				Sample date:	15/08/2012
Analyte grouping/Analyte	CAS Number	Units	LOR		
EA055: Moisture Content					
Moisture Content (dried @ 103°C)		%	1		27.2

QC - Matrix:	WATER			Sample Type:	MB	LCS	DUP	MS
Workgroup:	ES1220556			ALS Sample number:	2926967-001	2926967-002	2926967-004	2926967-006
				Sample date:	28/08/2012	28/08/2012	14/08/2012	15/08/2012
Analyte grouping/Analyte	CAS Number	Units	LOR					
EP090: Organotin Compounds (Soluble)								
Tributyltin	56573-85-4	ngSn/L	2		<2	88.5	<2	92.1
EP090S: Organotin Surrogate								
Tripropyltin		%	0.1		59.2	66.7	69.4	57.4

Due - Wed (Loren) 29/8/12

Received by Lasintha 23/8 17:10

Loren Schiavon

From: Matthai, Carsten (Sydney) <Carsten.Matthai@WorleyParsons.com>
Sent: Thursday, 23 August 2012 4:07 PM
To: Loren Schiavon
Cc: Taylor, Ben (Sydney)
Subject: RE: Results ES1219839
Attachments: image001.jpg

Hi Loren,

I would like to order the analysis of **elutriate and bioavailability analyses**, as per NAGD requirements for a total of six samples (including one replicate sample) plus one elutriate blank sample (i.e. the seawater blank submitted in the large carboy). The analyses are required for As, TBT and Se, with Se reported on a separate CoA.

The samples to be analysed using a fast TAT, and for which there should be sufficient material for elutriate analyses, are as follows (**please confirm sufficient sample availability for the analyses and the approximate reporting date, preferably within 5 business days**):

#4 (1) #9 (2) #16 (3) #24 (4)

Batch ES1219839: Sample IDs: **C5_0.0-0.15; C2_0.0-0.5; QC5; Elutriate Blank** (4 samples) — tray SG10-612

Batch ES1220011: Sample IDs: **C14_0.0-0.15; C15_0.0-0.5; C18_0.0-0.5** (3 samples) — tray SG18-619

#4 (5) #6 (6) #2 (7)

The above seven samples should be analysed for bioavailability (i.e. 1 M HCl extracts) for As and Se and for elutriates (TBT, As and Se) (Note: Se to be reported on a different CoA).

Invoicing should be directly to Simon Caples at Caltex. - CALREFNSW.

Please confirm the above at your earliest convenience. Many thanks to you and your team who are doing a fantastic job on this project (and you can quote me on that to Geoff Anderson).

Regards,
Carsten

Carsten Matthai, BSc(Hons), PhD
Environmental Scientist
Ports and Marine Terminals, Coastal and Ocean Engineering
WorleyParsons
Tel: +61 2 89236798 (direct)
Mob: +61 4 1133 1112
Fax: +61 2 8923 6877
Level 12, 141 Walker St., North Sydney, NSW, 2060
PO Box 1812 North Sydney NSW 2059

From: Loren Schiavon [mailto:loren.schiavon@alsglobal.com]
Sent: Wednesday, 22 August 2012 10:44 AM
To: Matthai, Carsten (Sydney)
Subject: RE: Results ES1219839

Hi Carsten,

I have asked sample receipt to find the samples you mentioned to prepare them for elutriate analysis.

The minimum volume we have for these samples is approximately 50g.

Submit / Forward Lab / Split WO
Lab / Analysis: ALS Brisbane/
Organised By / Date: TBT on
Relinquished By / Date: elutriates
Connote / Courier:
WO No:
Attach By PO / Internal Sheet:

Loren Schiavon

Received by Rasvilla 23/8 17:40

From: Matthai, Carsten (Sydney) <Carsten.Matthai@WorleyParsons.com>
Sent: Thursday, 23 August 2012 4:07 PM
To: Loren Schiavon
Cc: Taylor, Ben (Sydney)
Subject: RE: Results ES1219839
Attachments: image001.jpg

Hi Loren,

I would like to order the analysis of **elutriate and bioavailability analyses**, as per NAGD requirements for a total of six samples (including one replicate sample) plus one elutriate blank sample (i.e. the seawater blank submitted in the large carboy). The analyses are required for As, TBT and Se, with Se reported on a separate CoA.

The samples to be analysed using a fast TAT, and for which there should be sufficient material for elutriate analyses, are as follows (**please confirm sufficient sample availability for the analyses and the approximate reporting date, preferably within 5 business days**):

#4 #9 #16 #24

Batch ES1219839: Sample IDs: **C5_0.0-0.15; C2_0.0-0.5; QC5; Elutriate Blank** (4 samples) — tray SG10-612

Batch ES1220011: Sample IDs: **C14_0.0-0.15; C15_0.0-0.5; C18_0.0-0.5** (3 samples) — tray SG18-619

#4 #6 #2

The above seven samples should be analysed for bioavailability (i.e. 1 M HCl extracts) for As and Se and for elutriates (TBT, As and Se) (~~Note: Se to be reported on a different CoA~~).

Invoicing should be directly to Simon Caples at Caltex.

Please confirm the above at your earliest convenience. Many thanks to you and your team who are doing a fantastic job on this project (and you can quote me on that to Geoff Anderson).

Regards,
Carsten

Carsten Matthai, BSc(Hons), PhD
Environmental Scientist
Ports and Marine Terminals, Coastal and Ocean Engineering
WorleyParsons
Tel: +61 2 89236798 (direct)
Mob: +61 4 1133 1112
Fax: +61 2 8923 6877
Level 12, 141 Walker St., North Sydney, NSW, 2060
PO Box 1812 North Sydney NSW 2059

Ignore this comment. Se can be reported in the same batch as discussed between Loren & the client J.Lo

From: Loren Schiavon [mailto:loren.schiavon@alsglobal.com]
Sent: Wednesday, 22 August 2012 10:44 AM
To: Matthai, Carsten (Sydney)
Subject: RE: Results ES1219839

Hi Carsten,

I have asked sample receipt to find the samples you mentioned to prepare them for elutriate analysis.

The minimum volume we have for these samples is approximately 50g.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics) :3 DAY TAT REQUIRED ☑ Non Standard or urgent TAT (List due date):
OFFICE: c/o WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)	
PROJECT: Caltex Dredging	ALS QUOTE NO.: SY/389/12 V2
ORDER NUMBER: 301015-03041	COC SEQUENCE NUMBER (Circle): COC: 1 2 3 4 5 6 7; OF: 1 2 3 4 5 6 7
PROJECT MANAGER: Ben Taylor	CONTACT PH: 0402 406624
SAMPLER: Carsten Matthai	SAMPLER MOBILE: 0411 331112
COC emailed to ALS? (YES / NO) No	EDD FORMAT (or default):
Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com	
Email Invoice to (will default to PM if no other addresses are listed): CHalim@caltex.com.au	

FOR LABORATORY USE ONLY (Circle)
Custody seal intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comments:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	Frame ALS		
DATE/TIME: 15/8/12 4:30pm	DATE/TIME: 16-8-12 1800	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

Environmental Division Sydney
Work Order
ES1219839

Telephone : +61-2-8784 8555

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price. Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								
						ALS SYDNEY					ALS (Newcastle)			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-7) - As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP080)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		
1	C13_0.0-0.5	14/8/12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
2	C3_0.0-0.1	"	Sediment	Various	2jars	✓	✓		✓	✓		✓		
3	C4_0.0-0.1	"	Sediment	Various	2jars	✓	✓		✓	✓		✓		
4	C5_0.0-0.15	"	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓		small volume in PSD bag and one "hold" jar for elutriate
5	C6_0.0-0.13	"	Sediment	Various	2jars	✓	✓		✓	✓		✓		
6	C7_0.0-0.10	"	Sediment	Various	2jars 1bag	✓	✓		✓	✓	✓	✓		
7	QC1	"	Sediment	Various	2jars	✓	✓		✓	✓				
8	~~QC2~~ QC3	"	Sediment	Various	1jar		✓							PSD
			Sediment	Various										
														SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	22									

Subcon / Forward Lab / Split WO ES1219873
Lab / Analysis:
Organised By / Date:
Relinquished By / Date:
Courier / Carrier:
WO No.: ES1219839
Attach By PO / Internal Sheet:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: c/o WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor — CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai — SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No — EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHallm@caltex.com.au

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

☑ 3 DAY TAT REQUIRED

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)

COC: 1 (2) 3 4 5 6 7

OF: 1 2 (3) 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? YES NO N/A

Free ice / frozen ice bricks present upon receipt? YES NO N/A

Random Sample Temperature on Receipt: °C

Other comments:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	Frank MS		
DATE/TIME: 15-8-12 4.30pm	DATE/TIME: 15-8-12 1800	DATE/TIME:	DATE/TIME:

ALS USE	SAMPLE DETAILS (MATRIX: SOLID(S) WATER (W))			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information
						ALS SYDNEY					ALS Newcastle		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing	
9	C2_0.0-0.5	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
10	C1_0-0.55	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	Hold all primary samples for possible elutriate analysis and weak acid extraction and analysis
11	C10_0-0.50	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	
12	C10_0.5-1.0	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	
13	C10_1.0-1.5	15-8-12	Sediment	Various	4jars 1bag	✓	✓		✓	✓	✓	✓	
14	QC6	15-8-12	Sediment	Various	2jars	✓	✓		✓	✓			
15	QC4	15-8-12	Sediment	Various	1jar		✓						
16	QC5	15-8-12	Sediment	Various	2jars								
17	TOIA	15-8-12	Sediment	Various	4jars	✓	✓		✓	✓		✓	
18	TOIB	15-8-12	Solid		4jars	✓	✓		✓	✓		✓	SEAWATER TO BE PLACED ON HOLD FOR POSSIBLE ELUTRIATE ANALYSIS
				TOTAL	37								

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5800 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: CALTEX

OFFICE: c/o WorleyParsons Office (141 Walker ST, North Sydney NSW 2060)

PROJECT: Caltex Dredging

ORDER NUMBER: 301015-03041

PROJECT MANAGER: Ben Taylor — CONTACT PH: 0402 406624

SAMPLER: Carsten Matthai — SAMPLER MOBILE: 0411 331112

COC emailed to ALS? (YES / NO) No — EDD FORMAT (or default):

Email Reports to: Carsten.Matthai@WorleyParsons.com and Deborah.Lam@WorleyParsons.com

Email Invoice to (will default to PM if no other addresses are listed): CHallm@caltex.com.au

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

☑ 3 DAY TAT REQUIRED

Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/389/12 V2

COC SEQUENCE NUMBER (Circle)

COC: 1 2 3 4 5 6 7

OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: °C

Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Carsten Matthai	Frame ALS		
DATE/TIME: 15-8-12 4:30pm	DATE/TIME: 15-8-12 1800	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
						ALS SYDNEY					ALS Newcastle			
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Super Ultratrace PAHS (EP132-SD)	Trace Metals (Suite SD-3) - Ag, As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, V, Zn	HCL Extractable Metals (SD-4)	TOC (LECO) (EP003)	TBT (EP090)	Particle Size (Hydrometer) (EA150-H)	HOLD for potential elutriate testing		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
19	C12_0.0-0.5	15-8-12	Sediment	Various	4 jars	✓	✓		✓	✓		✓		Hold all primary samples for possible elutriate testing and weak acid extraction and analysis
20	C12_0.5_1.0	"	Sediment	Various	4 jars 1 bag	✓	✓		✓	✓	✓	✓		
21	C12-1.0-1.5	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
22	C8_0.0-0.12	"	Sediment	Various	2 jars 1 bag	✓	✓		✓	✓	✓	✓		insufficient sediment for elutriate
23	C9_0.0-0.45	"	Sediment	Various	4 jars	✓	✓		✓	✓		✓		
			Sediment	Various										
			Sediment	Various										
			Sediment	Various										
			Sediment	Various										
24	Elutriate blank	15-8-12	Water	40L container	(X1)							✓		
				TOTAL	21 (incl. 40L container)									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220556**	Page	: 1 of 5
Amendment	: **3**		
Client	: CALTEX REFINERIES(NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING REBATCH OF ES1219839 ES1220011	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 23-AUG-2012
Sampler	: ----	Issue Date	: 15-NOV-2012
Order number	: 301015-03041		
		No. of samples received	: 7
Quote number	: SY/389/12 V2	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

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

Analysis Holding Time Compliance

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 precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content								
Soil Glass Jar - Unpreserved (EA055-103)								
C5_0.0-0.15		**14-AUG-2012**	**----**	----	----	**28-AUG-2012**	28-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA055-103)								
C2_0.0-0.5,	QC5	**15-AUG-2012**	**----**	----	----	**28-AUG-2012**	29-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA055-103)								
C14_0.0-0.15,	C15_0.0-0.5,	**16-AUG-2012**	**----**	----	----	**28-AUG-2012**	30-AUG-2012	✓
C18_0.0-0.5								
EN68: Seawater Elutriate Testing Procedure								
LabSplit: Leach for organics and other tests (EN68a)								
C5_0.0-0.15		**14-AUG-2012**	**---**	28-AUG-2012	----	**28-AUG-2012**	28-AUG-2012	✓
LabSplit: Leach for organics and other tests (EN68a)								
C2_0.0-0.5,	QC5,	**15-AUG-2012**	**---**	29-AUG-2012	----	**28-AUG-2012**	29-AUG-2012	✓
ELUTRIATE BLANK								
LabSplit: Leach for organics and other tests (EN68a)								
C14_0.0-0.15,	C15_0.0-0.5,	**16-AUG-2012**	**---**	30-AUG-2012	----	**28-AUG-2012**	30-AUG-2012	✓
C18_0.0-0.5								
EP090: Organotin Compounds (Soluble)								
Amber Glass Bottle - Unpreserved (EP090S)								
C5_0.0-0.15,	C2_0.0-0.5,	**28-AUG-2012**	**28-AUG-2012**	04-SEP-2012	✓	**28-AUG-2012**	07-OCT-2012	✓
QC5,	ELUTRIATE BLANK,							
C14_0.0-0.15,	C15_0.0-0.5,							
C18_0.0-0.5								

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	1	6	**16.7**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Organotin Compounds (Soluble)	EP090S	1	7	**14.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Organotin Compounds (Soluble)	EP090S	1	7	**14.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Organotin Compounds (Soluble)	EP090S	1	7	**14.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Organotin Compounds (Soluble)	EP090S	1	7	**14.3**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division 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 in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
1M HCl Extractable Metals	EG005-SDH	SOIL	APHA 21st ed., 3120; USEPA SW 846 - 6010. Metals are determined via ICPAES following weak acid extraction. 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). LORs per NAGD.
1M HCl Extractable Metals by ICPMS	EG020-SDH	SOIL	APHA 21st ed., 3125; USEPA SW846 - 6020. Metals are determined via ICPMS following weak acid extraction. 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. Analyte list and LORs per NAGD.
Total Metals in Saline Water Suite A by ORC-ICPMS	EG093A-T	SOIL	APHA 21st ed., 3125; USEPA SW846 - 6020 Samples are 0.45 um filtered prior to analysis. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Metals in Saline Water -Suite B by ORC-ICPMS	EG093B-T	SOIL	APHA 21st ed., 3125; USEPA SW846 - 6020 Samples are 0.45 um filtered prior to analysis. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Organotin Compounds (Soluble)	EP090S	SOIL	USEPA SW 846 - 8270D Sample extracts are analysed by GC/MS coupled with high volume injection and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals - ORC	EN25-ORC	SOIL	Modified USEPA SW846-3005. This is an Ultrapure Nitric acid digestion procedure used to prepare surface and ground water samples for analysis by ORC- ICPMS. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Seawater Elutriate Testing Procedure	* EN68a	SOIL	USEPA Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Guide, 1991, EPA-503/8-91/001, USEPA and US Army Corps of Engineers. ANZECC Interim Ocean Disposal Guidelines, December, 1998 This Procedure outlines the preparation of leachate designed to simulate release of contaminants from sediment during the disposal of dredged material. Release can occur by physical processes or a variety of chemical changes such as oxidation of metal sulphides and release of contaminants adsorbed to particles or organic matter.
1M HCl Extraction for Metals in Sediments (1 hour)	EN71	SOIL	In house, Allen (1993) Mod. 1g of sample is leached at room temperature for 1 hour in 10% hydrochloric acid. The resultant extract is filtered and bulked for analysis of extracted metals.
Organotin Sample Preparation	ORG34	SOIL	In-house. A specified volume of sample is spiked with surrogate, acidified and vacuum filtered. Reagents and solvent are added and the mixture tumbled. The butyltin compounds is derivitisated, extracted and the subtitution reaction completed. The extract is transferred to a separatory funnel and further extracted two times with petroleum ether. The resultant extracts are combined and concentrated for analysis.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

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

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1220556**	Page	: 1 of 4
Amendment	: **3**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING REBATCH OF ES1219839 ES1220011	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 23-AUG-2012
Sampler	: ----	Issue Date	: 15-NOV-2012
Order number	: 301015-03041		
		No. of samples received	: 7
Quote number	: SY/389/12 V2	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 2470708)									
ES1220556-003	QC5	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	26.9	27.2	1.3	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP090: Organotin Compounds (Soluble) (QC Lot: 2470025)									
ES1220556-001	C5_0.0-0.15	EP090S: Tributyltin	56573-85-4	2	ngSn/L	<2	<2	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP090: Organotin Compounds (Soluble) (QCLot: 2470025)								
EP090S: Tributyltin	56573-85-4	2	ngSn/L	<2	147 ngSn/L	88.5	24	120

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP090: Organotin Compounds (Soluble) (QCLot: 2470025)							
ES1220556-002	C2_0.0-0.5	EP090S: Tributyltin	56573-85-4	147 ngSn/L	92.1	20	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EP090: Organotin Compounds (Soluble) (QCLot: 2470025)										
ES1220556-002	C2_0.0-0.5	EP090S: Tributyltin	56573-85-4	147 ngSn/L	92.1	----	20	130	----	----

Client - Matrix:	ELUTRIATE			Sample Type:	REG	REG	REG	REG	REG	REG	REG
Workgroup:	ES1220556			ALS Sample number:	ES1220556001	ES1220556002	ES1220556003	ES1220556004	ES1220556005	ES1220556006	ES1220556007
Project name/number:	CALTEX DREDGING REBATCH OF ES1219839 ES1220011			Sample date:	28/08/2012	28/08/2012	28/08/2012	28/08/2012	28/08/2012	28/08/2012	28/08/2012
				Client sample ID (Primary):	C5_0.0-0.15	C2_0.0-0.5	QC5	ELUTRIATE BLANK	C14_0.0-0.15	C15_0.0-0.5	C18_0.0-0.5
				Client sample ID (Secondary):							
				Sample Site:							
				Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte grouping/Analyte	CAS Number	Units	LOR								
EP090: Organotin Compounds (Soluble)											
Tributyltin	56573-85-4	ngSn/L	2		<2	<2	<2	<2	<2	<2	<2
EP090S: Organotin Surrogate											
Tripropyltin		%	0.1		67.7	71.8	64.5	75.2	47.9	67.8	65.2

Client - Matrix:	SEAWATER			Sample Type:
Workgroup:	ES1220556			ALS Sample number:
Project name/number:	CALTEX DREDGING REBATCH OF ES1219839 ES1220011			Sample date:
				Client sample ID (Primary):
				Client sample ID (Secondary):
				Sample Site:
				Purchase Order:
Analyte grouping/Analyte	CAS Number	Units	LOR	

Client - Matrix:	SOIL			Sample Type:	REG	REG	REG	REG	REG	REG	REG
Workgroup:	ES1220556			ALS Sample number:	ES1220556001	ES1220556002	ES1220556003	ES1220556004	ES1220556005	ES1220556006	ES1220556007
Project name/number:	CALTEX DREDGING REBATCH OF ES1219839 ES1220011			Sample date:	14/08/2012	15/08/2012	15/08/2012	15/08/2012	16/08/2012	16/08/2012	16/08/2012
				Client sample ID (Primary):	C5_0.0-0.15	C2_0.0-0.5	QC5	ELUTRIATE BLANK	C14_0.0-0.15	C15_0.0-0.5	C18_0.0-0.5
				Client sample ID (Secondary):							
				Sample Site:							
				Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte grouping/Analyte	CAS Number	Units	LOR								
EA055: Moisture Content											
Moisture Content (dried @ 103°C)		%	1		60.8	27.4	26.9		56.8	28.6	23.4
EN68: Seawater Elutriate Testing Procedure											
Seawater Sampling Date		-	0.1		27/08/2012	27/08/2012	27/08/2012	27/08/2012	27/08/2012	27/08/2012	27/08/2012

QC - Matrix:	SOIL			Sample Type:	DUP
Workgroup:	ES1220556			ALS Sample number:	2927697-004
				Sample date:	15/08/2012
Analyte grouping/Analyte	CAS Number	Units	LOR		
EA055: Moisture Content					
Moisture Content (dried @ 103°C)		%	1		27.2

QC - Matrix:	WATER			Sample Type:	MB	LCS	DUP	MS
Workgroup:	ES1220556			ALS Sample number:	2926967-001	2926967-002	2926967-004	2926967-006
				Sample date:	28/08/2012	28/08/2012	14/08/2012	15/08/2012
Analyte grouping/Analyte	CAS Number	Units	LOR					
EP090: Organotin Compounds (Soluble)								
Tributyltin	56573-85-4	ngSn/L	2		<2	88.5	<2	92.1
EP090S: Organotin Surrogate								
Tripropyltin		%	0.1		59.2	66.7	69.4	57.4

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220765**	Page	: 1 of 5
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9668 1557	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9668 1920	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING REBATCH OF ES1220011 ES1219839	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 301015-03041		
C-O-C number	: ----	Date Samples Received	: 28-AUG-2012
Sampler	: ----	Issue Date	: 31-AUG-2012
Site	: ----		
		No. of samples received	: 15
Quote number	: SY/389/12 V2	No. of samples analysed	: 15

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: **SEDIMENT**				Client sample ID	C2_0.0-0.5	C3_0.0-0.1	C4_0.0-0.1	C5_0.0-0.15	C6_0.0-0.13
				Client sampling date / time	15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
Compound	*CAS Number*	*LOR*	*Unit*		ES1220765-001	ES1220765-002	ES1220765-003	ES1220765-004	ES1220765-005
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	**----**	1.0	%		**25.7**	**63.7**	**60.5**	**47.6**	**66.2**
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C10 - C14 Fraction	**----**	3	mg/kg		**4**	<3	<3	<3	<3
C15 - C28 Fraction	**----**	3	mg/kg		**72**	**626**	**397**	**278**	**593**
C29 - C36 Fraction	**----**	5	mg/kg		**58**	**650**	**527**	**307**	**782**
^ **C10 - C36 Fraction (sum)**	**----**	3	mg/kg		**134**	**1280**	**924**	**585**	**1380**

Analytical Results

Sub-Matrix: SEDIMENT				Client sample ID	C7_0.0-0.10	C8_0.0-0.12	C10_0-0.50	C10_0.5-1.0	C14_0.0-0.15
				Client sampling date / time	14-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1220765-006	ES1220765-007	ES1220765-008	ES1220765-009	ES1220765-010
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		68.4	57.5	22.7	15.9	60.6
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C10 - C14 Fraction	----	3	mg/kg		<3	<3	<3	<3	<3
C15 - C28 Fraction	----	3	mg/kg		409	355	25	<3	211
C29 - C36 Fraction	----	5	mg/kg		517	500	24	<5	287
^ C10 - C36 Fraction (sum)	----	3	mg/kg		926	855	49	<3	498

Analytical Results

Sub-Matrix: SEDIMENT				Client sample ID	C15_0.0-0.5	C18_0.0-0.5	T01A	T01B	QC1
				Client sampling date / time	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	14-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		ES1220765-011	ES1220765-012	ES1220765-013	ES1220765-014	ES1220765-015
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		28.7	21.8	31.4	28.0	65.7
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C10 - C14 Fraction	----	3	mg/kg		4	3	6	7	<3
C15 - C28 Fraction	----	3	mg/kg		63	62	116	116	321
C29 - C36 Fraction	----	5	mg/kg		52	52	119	99	439
^ C10 - C36 Fraction (sum)	----	3	mg/kg		119	117	241	222	760

Client - Matrix:	SEDIMENT			Sample Type:	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG	REG
Workgroup:	ES1220765			ALS Sample number:	ES1220765001	ES1220765002	ES1220765003	ES1220765004	ES1220765005	ES1220765006	ES1220765007	ES1220765008	ES1220765009	ES1220765010	ES1220765011	ES1220765012	ES1220765013	ES1220765014	ES1220765015
Project name/number:	CALTEX DREDGING REBATCH OF ES1220011 ES1219839			Sample date:	15/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	15/08/2012	15/08/2012	15/08/2012	16/08/2012	16/08/2012	16/08/2012	15/08/2012	15/08/2012	14/08/2012
				Client sample ID (Primary):	C2_0.0-0.5	C3_0.0-0.1	C4_0.0-0.1	C5_0.0-0.15	C6_0.0-0.13	C7_0.0-0.10	C8_0.0-0.12	C10_0-0.50	C10_0.5-1.0	C14_0.0-0.15	C15_0.0-0.5	C18_0.0-0.5	T01A	T01B	QC1
				Client sample ID (Secondary):															
				Sample Site:															
				Purchase Order:	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041	301015-03041
Analyte grouping/Analyte	CAS Number	Units	LOR																
EA055: Moisture Content																			
Moisture Content (dried @ 103°C)		%	1		25.7	63.7	60.5	47.6	66.2	68.4	57.5	22.7	15.9	60.6	28.7	21.8	31.4	28	65.7
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons																			
C10 - C14 Fraction		mg/kg	3		4	<3	<3	<3	<3	<3	<3	<3	<3		4	3	6	7	<3
C15 - C28 Fraction		mg/kg	3		72	626	397	278	593	409	355	25	<3	211	63	62	116	116	321
C29 - C36 Fraction		mg/kg	5		58	650	527	307	782	517	500	24	<5	287	52	52	119	99	439
C10 - C36 Fraction (sum)		mg/kg	3		134	1280	924	585	1380	926	855	49	<3	498	119	117	241	222	760

QC - Matrix:	SOIL			Sample Type:	MB	LCS	DUP	MS	DUP	DUP	DUP	DUP	REG
Workgroup:	ES1220765			ALS Sample number:	2928371-001	2928371-002	2928371-004	2928371-005	2928371-016	2928790-004	2928790-016	2929009-004	ES1220653002
				Sample date:	28/08/2012	28/08/2012	15/08/2012	15/08/2012	16/08/2012	27/08/2012	15/08/2012	16/08/2012	27/08/2012
Analyte grouping/Analyte	CAS Number	Units	LOR										
EA055: Moisture Content													
Moisture Content (dried @ 103°C)		%	1							26.1	16	27.2	25.2
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons													
C10 - C14 Fraction		mg/kg	3		<3	98	<3	81.5	4				
C15 - C28 Fraction		mg/kg	3		<3	95.3	<3	83.4	56				
C29 - C36 Fraction		mg/kg	5		<5	89	<5	111	46				

Fadi Soro

28/8/12
4:15pm

From: Loren Schiavon
Sent: Tuesday, 28 August 2012 3:49 PM
To: Fadi Soro
Subject: FW: URGENT - RE: Caltex sediment analyses

Importance: High

Hi Fadi,

Can you please arrange this urgent re-batch below? I have indicated sample numbers from the original work orders below. Samples go out of holding time today so this is urgent. Samples are in tray S610-612 and trays S618-619.

Thanks.

Kind regards,

Loren Schiavon
CLIENT SERVICES CO-ORDINATOR

ALS | Environmental Division

Address
277-289 Woodpark Road
Smithfield, NSW, 2164

PHONE +61 2 8784 8555
DIRECT +61 2 8784 8503
FAX +61 2 8784 8500

Environmental Division
Sydney
Work Order
ES1220765

Telephone : +61-2-8784 8555

TAT

HT

URGENT

Winner of the inaugural CARE Award 2011 - Sustainable Technology & Innovation:
Reduction in Sample Volumes - Improving quality, safety, efficiency and sustainability in environmental practices

www.alsglobal.com

Please consider the environment before printing this email.

From: Matthai, Carsten (Sydney) [mailto:Carsten.Matthai@WorleyParsons.com]
Sent: Tuesday, 28 August 2012 3:26 PM
To: Loren Schiavon
Cc: scaples@cAlTeX.com.au
Subject: URGENT - RE: Caltex sediment analyses

Loren,

Please proceed with the additional non-volatile TPH (C10-C40) analyses for the following **fifteen (15) samples** from the two batches (**including QC samples T01A, T01B and QC1**) at a cost of $37 per sample. Note that sample holding times expire at the end of today, so please proceed with the extractions asap.

C2_0.0-0.5	1	ES1219839-009 (additional sample arriving from Brisbane tonight)
C3_0.0-0.1	2	ES1219839-002
C4_0.0-0.1	3	ES1219839-003
C5_0.0-0.15	4	ES1219839-004 (additional sample arriving from Brisbane tonight)
C6_0.0-0.13	5	ES1219839-005
C7_0.0-0.10	6	ES1219839-006
C8_0.0-0.12	7	ES1219839-022
C10_0-0.50	8	ES1219839-011
C10_0.5-1.0	9	ES1219839-012
C14_0.0-0.15	10	ES1220011-004 (additional sample arriving from Brisbane tonight)
C15_0.0-0.5	11	ES1220011-006 (additional sample arriving from Brisbane tonight)
C18_0.0-0.5	12	ES1220011-002 (additional sample arriving from Brisbane tonight)
T01A	13	ES1219839-017
T01B	14	ES1219839-018
QC1	15	ES1219839-007

5610-612

5618-619

5610-612

Thanks.

Regards,
Carsten
Carsten Matthai, BSc(Hons), PhD
Environmental Scientist
Ports and Marine Terminals, Coastal and Ocean Engineering
WorleyParsons
Tel: +61 2 89236798 (direct)
Mob: +61 4 1133 1112
Fax: +61 2 8923 6877
Level 12, 141 Walker St., North Sydney, NSW, 2060
PO Box 1812 North Sydney NSW 2059

From: Loren Schiavon [mailto:loren.schiavon@alsglobal.com]
Sent: Tuesday, 28 August 2012 11:24 AM
To: Matthai, Carsten (Sydney)
Subject: RE: Caltex sediment analyses

Hi Carsten,

As the volatile would be compromised, I am assuming it is just the TPH C10-C40 that you are after. I will have to confirm pricing with Geoff Anderson (as he may offer a further discount to Caltex), but a ball park figure for this analysis will be as follows-

TRH (C10-C40) - Ultra trace including sum of C10-C40	EP071-SD	USEPA 3510/8015	3 - 5 per fraction	37.00

As soon as you know which samples may require TPH analysis, let me know so that I can get the testing started within holding time this evening.

Cheers.
How was your customer experience? Please send us your feedback

Kind regards,

Loren Schiavon
CLIENT SERVICES CO-ORDINATOR

ALS | Environmental Division

Address
277-289 Woodpark Road
Smithfield, NSW, 2164

PHONE +61 2 8784 8555
DIRECT +61 2 8784 8503
FAX +61 2 8784 8500

Winner of the inaugural CARE Award 2011 – Sustainable Technology & Innovation:
Reduction in Sample Volumes – Improving quality, safety, efficiency and sustainability in environmental practices

www.alsglobal.com

P Please consider the environment before printing this email.

From: Matthai, Carsten (Sydney) [mailto:Carsten.Matthai@WorleyParsons.com]
Sent: Tuesday, 28 August 2012 11:15 AM
To: Loren Schiavon
Subject: Caltex sediment analyses

Hi Loren,

Could you please provide an estimate of costs for possible additional TPH analyses of some of the sediment samples from the recent Caltex sample batches?

I understand that there may be insufficient sample volume left for TPH analyses to be undertaken, however, could you please confirm for which of the samples there would be sufficient material and what the cost per analysis would be? I would have to obtain approval from Caltex prior to authorization of TPH analyses, in addition to the analytical holding time being 14 days (i.e. samples from 14 August would expire by the end of today – i.e. urgent).

Thanks for your quick reply. Please do not undertake any TPH analyses until authorization.

Regards,
Carsten

Carsten Matthai, BSc(Hons), PhD
Environmental Scientist
Ports and Marine Terminals, Coastal and Ocean Engineering
WorleyParsons
Tel: +61 2 89236798 (direct)
Mob: +61 4 1133 1112
Fax: +61 2 8923 6877
Level 12, 141 Walker St., North Sydney, NSW, 2060
PO Box 1812 North Sydney NSW 2059

*** WORLEYPARSONS GROUP NOTICE *** "This email is confidential. If you are not the intended recipient, you must not disclose or use the information contained in it. If you have received this email in error, please notify us immediately by return email and delete the email and any attachments. Any personal views or opinions expressed by the writer may not necessarily reflect the views or opinions of any company in the WorleyParsons Group of Companies."

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order	: **ES1220765**		
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9668 1557	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9668 1920	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING	Page	: 1 of 3
Order number	: REBATCH OF ES1220011 ES1219839		
C-O-C number	: ----	Quote number	: ES2012CALREFNSW0182 (SY/389/12 V2)
Site	: ----		
Sampler	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 28-AUG-2012	Issue Date	: 28-AUG-2012 17:45
Client Requested Due Date	: 31-AUG-2012	Scheduled Reporting Date	: **31-AUG-2012**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 4.1'C - Ice present
No. of coolers/boxes	: REBATCH	No. of samples received	: 15
Security Seal	: N/A	No. of samples analysed	: 15

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Samples received in appropriately pretreated and preserved containers.
- This is a rebatch of ES1219839 and ES1220011.
- **Samples received in appropriately pretreated and preserved containers.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

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

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

Summary of Sample(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 the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA055-103 Moisture Content	SOIL - EP071 - SD TPH ultra trace in sediments
ES1220765-001	15-AUG-2012 15:00	C2_0.0-0.5	✓	✓
ES1220765-002	14-AUG-2012 15:00	C3_0.0-0.1	✓	✓
ES1220765-003	14-AUG-2012 15:00	C4_0.0-0.1	✓	✓
ES1220765-004	14-AUG-2012 15:00	C5_0.0-0.15	✓	✓
ES1220765-005	14-AUG-2012 15:00	C6_0.0-0.13	✓	✓
ES1220765-006	14-AUG-2012 15:00	C7_0.0-0.10	✓	✓
ES1220765-007	15-AUG-2012 15:00	C8_0.0-0.12	✓	✓
ES1220765-008	15-AUG-2012 15:00	C10_0-0.50	✓	✓
ES1220765-009	15-AUG-2012 15:00	C10_0.5-1.0	✓	✓
ES1220765-010	16-AUG-2012 15:00	C14_0.0-0.15	✓	✓
ES1220765-011	16-AUG-2012 15:00	C15_0.0-0.5	✓	✓
ES1220765-012	16-AUG-2012 15:00	C18_0.0-0.5	✓	✓
ES1220765-013	15-AUG-2012 15:00	T01A	✓	✓
ES1220765-014	15-AUG-2012 15:00	T01B	✓	✓
ES1220765-015	14-AUG-2012 15:00	QC1	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

MR CARSTEN MATTHAI

- *AU Certificate of Analysis - NATA (COA)	Email	carsten.matthai@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	carsten.matthai@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	carsten.matthai@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	carsten.matthai@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	carsten.matthai@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	carsten.matthai@WorleyParsons.com

MR SIMON CAPLES

- *AU Certificate of Analysis - NATA (COA)	Email	scaples@caltex.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	scaples@caltex.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	scaples@caltex.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	scaples@caltex.com.au
- A4 - AU Tax Invoice (INV)	Email	scaples@caltex.com.au
- Chain of Custody (CoC) (COC)	Email	scaples@caltex.com.au
- EDI Format - ENMRG (ENMRG)	Email	scaples@caltex.com.au

MS CHRISTINA HALIM

- A4 - AU Tax Invoice (INV)	Email	CHalim@caltex.com.au

MS DEBORAH LAM

- *AU Certificate of Analysis - NATA (COA)	Email	deborah.lam@WorleyParsons.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	deborah.lam@WorleyParsons.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	deborah.lam@WorleyParsons.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	deborah.lam@WorleyParsons.com
- Chain of Custody (CoC) (COC)	Email	deborah.lam@WorleyParsons.com
- EDI Format - ENMRG (ENMRG)	Email	deborah.lam@WorleyParsons.com

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220765**	Page	: 1 of 5
Client	: CALTEX REFINERIES(NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9668 1557	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9668 1920	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING REBATCH OF ES1220011 ES1219839	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 28-AUG-2012
Sampler	: ----	Issue Date	: 31-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 15
Quote number	: SY/389/12 V2	No. of samples analysed	: 15

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

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

Analysis Holding Time Compliance

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 precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Lab Split: Managed Moisture for Dry Weight Det. (EA055-103) C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1	**14-AUG-2012**	**----**	----	----	**28-AUG-2012**	10-FEB-2013	✓
Lab Split: Managed Moisture for Dry Weight Det. (EA055-103) C2_0.0-0.5, C8_0.0-0.12, C10_0-0.50, C10_0.5-1.0, T01A, T01B	**15-AUG-2012**	**----**	----	----	**28-AUG-2012**	11-FEB-2013	✓
Lab Split: Managed Moisture for Dry Weight Det. (EA055-103) C14_0.0-0.15, C15_0.0-0.5, C18_0.0-0.5	**16-AUG-2012**	**----**	----	----	**28-AUG-2012**	12-FEB-2013	✓
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP071-SD) C3_0.0-0.1, C4_0.0-0.1, C5_0.0-0.15, C6_0.0-0.13, C7_0.0-0.10, QC1	**14-AUG-2012**	**28-AUG-2012**	28-AUG-2012	✓	**29-AUG-2012**	07-OCT-2012	✓
Soil Glass Jar - Unpreserved (EP071-SD) C2_0.0-0.5, C8_0.0-0.12, C10_0-0.50, C10_0.5-1.0, T01A, T01B	**15-AUG-2012**	**28-AUG-2012**	29-AUG-2012	✓	**29-AUG-2012**	07-OCT-2012	✓
Soil Glass Jar - Unpreserved (EP071-SD) C14_0.0-0.15, C15_0.0-0.5, C18_0.0-0.5	**16-AUG-2012**	**28-AUG-2012**	30-AUG-2012	✓	**29-AUG-2012**	07-OCT-2012	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	3	20	**15.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071-SD	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
TPH - Semivolatile Fraction	EP071-SD	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
TPH - Semivolatile Fraction	EP071-SD	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
TPH - Semivolatile Fraction	EP071-SD	1	15	**6.7**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division 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 in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
TPH - Semivolatile Fraction	EP071-SD	SOIL	(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)

Preparation Methods	Method	Matrix	Method Descriptions
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na2SO4 and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

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

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1220765**	Page	: 1 of 4
Client	: **CALTEX REFINERIES(NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR SIMON CAPLES	Contact	: Client Services
Address	: 2 SOLANDER ST KURNELL NSW, AUSTRALIA 2231	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scaples@caltex.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9668 1557	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9668 1920	Facsimile	: +61-2-8784 8500
Project	: CALTEX DREDGING REBATCH OF ES1220011 ES1219839	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 28-AUG-2012
Sampler	: ----	Issue Date	: 31-AUG-2012
Order number	: 301015-03041		
		No. of samples received	: 15
Quote number	: SY/389/12 V2	No. of samples analysed	: 15

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 2471617)									
ES1220653-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	25.2	26.1	3.7	0% - 20%
ES1220765-009	C10_0.5-1.0	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	15.9	16.0	0.0	0% - 50%
EA055: Moisture Content (QC Lot: 2471747)									
ES1220765-011	C15_0.0-0.5	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	28.7	27.2	5.4	0% - 20%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2471332)									
ES1220765-009	C10_0.5-1.0	EP071-SD: C10 - C14 Fraction	---	3	mg/kg	<3	<3	0.0	No Limit
		EP071-SD: C15 - C28 Fraction	---	3	mg/kg	<3	<3	0.0	No Limit
		EP071-SD: C29 - C36 Fraction	---	5	mg/kg	<5	<5	0.0	No Limit
ES1220765-011	C15_0.0-0.5	EP071-SD: C10 - C14 Fraction	---	3	mg/kg	4	4	0.0	No Limit
		EP071-SD: C15 - C28 Fraction	---	3	mg/kg	63	56	12.1	0% - 50%
		EP071-SD: C29 - C36 Fraction	---	5	mg/kg	52	46	11.6	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2471332)								
EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	5 mg/kg	98.0	75.2	116
EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	7.5 mg/kg	95.3	75.3	113
EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	5 mg/kg	89.0	72.6	117

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2471332)							
ES1220765-009	C10_0.5-1.0	EP071-SD: C10 - C14 Fraction	----	19.75 mg/kg	81.5	70	130
		EP071-SD: C15 - C28 Fraction	----	87.25 mg/kg	83.4	70	130
		EP071-SD: C29 - C36 Fraction	----	60 mg/kg	111	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2471332)										
ES1220765-009	C10_0.5-1.0	EP071-SD: C10 - C14 Fraction	----	19.75 mg/kg	81.5	----	70	130	----	----
		EP071-SD: C15 - C28 Fraction	----	87.25 mg/kg	83.4	----	70	130	----	----
		EP071-SD: C29 - C36 Fraction	----	60 mg/kg	111	----	70	130	----	----

Appendix 5 Dilution Modelling of Elutriate TBT at the Sydney Offshore Spoil Ground (Dredge Area 3 (Berths 1 and 2)

CONTENTS

A1 INTRODUCTION

A split hopper barge is proposed to be used for dredge material disposal operations as part of the Caltex maintenance dredging project. In this vessel, doors in the bottom of the ship's hull (or the hull itself) would be opened, and the entire hopper contents (a mixture of water and solids) would be emptied within the Sydney Offshore Spoil Ground.

In the National Assessment Guidelines for Dredging (Commonwealth of Australia, 2009), hereafter denoted as NAGD, it is recommended that the applicable ANZECC/ARMCANZ (2000) marine water quality guidelines not be exceeded after allowing for initial mixing, defined as mixing which occurs within four hours of dumping.

Initial dilution of disposed dredged material in the ocean depends on a number of factors, such as water depth, stratification in the water column, and current velocities and directions. As described in Appendix A of the NAGD (refer page 59), initial dilution can be determined using either of two methods, namely:

- the liquid and suspended particulate phases of the waste may be assumed to be evenly distributed after four hours over a column of water bounded on the surface by the release zone and extending to the ocean floor, thermocline or halocline, if one exists, or to a depth of 20 m, whichever is shallower (this methodology is denoted herein as the *analytical method*); or
- it can be calculated using the US Army Engineers Waterways Research Station STFATE model (this methodology is denoted herein as the *numerical method*).

The critical contaminant relative to screening levels for the subject dredging is tributyltin (TBT), and it is this contaminant that is considered herein. The more accurate numerical method (STFATE modelling) has been adopted herein to predict the initial dilution of TBT for disposal operations at the Sydney Offshore Spoil Ground. The analytical method is overly conservative for application in this case, given that the mixing zone is specified to only extend to a depth of 20 m in the methodology, when actual depths are about 100m.

Background information is provided in Section A2, and the STFATE modelling is described in Section A3.

A2 BACKGROUND INFORMATION

A2.1 TBT Concentrations

A summary of elutriate testing results for TBTin Dredge Area 3 (Berths 1 and 2) is provided in **Table A1**.

Table A1: Elutriate testing results for TBT (95% UCL mean concentrations)

Dredge Area	TBT in Sediment (µg/kg)[1]	TBT in Elutriate (µg/L)[2]
3 (Berths 1 and 2)	25	0.0162

Disposal of only Area 1 (Berths 1 and 2) sediments has been simulated herein. The ANZECC/ARMCANZ (2000) trigger values for TBT at the 95% and 99% levels of protection are 0.006µg/L and 0.0004 µg/L respectively.

A2.2 Dredged Sediment Properties

The sediment to be dredged varies in properties depending on location. The approximate proportions of various sediment types are provided in **Table A2**.

Table A2: Proportions (%) of various sediments to be dredged (by mass)

Area	Proportion (%)				
	Clay	Silt	Sand	Gravel	Total
Dredge Area 3 (Berths 1 and 2)	7	4	80	10	101

The proportions of sediments in the dredging vessel hopper prior to disposal would vary depending on the dredging methodology, but in this case only a backhoe loading a split hopper barge without overflowing is assumed. Approximate proportions of *in situ* sediment (by volume)[3] that would be located in the hopper are provided in
Table A3.

Table A3: Proportions of in *situ* sediment (by volume) for single dredging scenario

Case	Dredging Operation	Proportion of *in situ* sediment (by volume) in hopper (%)
Case 1	backhoe loading a split hopper barge (no overflowing)	30

[1] Normalised to 1% TOC.
[2] Remaining in the supernatant after the elutriate test.
[3] With the remainder of material in the hopper generally being water, and noting that this *in situ* sediment also contains water filling the voids.

For Dredge Area 3 (Berths 1 and 2) location, approximate hopper volumetric fractions (proportion of each sediment type by volume, expressed as a decimal) for each of the sediment types were determined as listed in **Table A4**, based on an *in situ* solids proportion of 78% by mass (43% porosity) and a bulking factor of 3.33 for the dredging scenario[4].

Table A4: Volumetric fractions of each sediment type in hopper for four dredging cases, for Area 1

Sediment Type	Volumetric Fraction
	Case 1
Gravel	0.017
Medium Sand	0.137
Silt	0.007
Clay	0.012

Volumetric fractions for other areas have not been listed herein as simulations were only undertaken for the critical Dredge Area 3 (Berths 1 and 2) location.

[4] As recommended by Dr Paul Schroeder, Research Civil Engineer and dredging expert, Environmental Laboratory, US Army Corps of Engineers.

A3 STFATE MODELLING

A3.1 Model Background

In STFATE, the behaviour of the material during disposal is assumed to be separated into three phases, namely:

- convective descent, during which the disposal cloud falls under the influence of gravity and its initial momentum is imparted by gravity;
- dynamic collapse, occurring when the descending cloud either impacts the bottom or arrives at a level of neutral buoyancy where descent is retarded and horizontal spreading dominates; and,
- passive transport-dispersion, commencing when the material transport and spreading are determined more by ambient currents and turbulence than by the dynamics of the disposal operation (USEPA, 1998).

Note that, given the size of the disposal area and time between disposal episodes, it can be assumed that subsequent disposal operations from the same dredging campaign would not interact in the water column. That is, only a single disposal operation has been simulated in each STFATE run.

A3.2 Cases Simulated

One simulation was undertaken based on dredging of Area 3 (Berths 1 and 2) sediments, which is for the following dredging case:

1. backhoe loading a split hopper barge (no overflowing);

The inputs used in this modelling are described in Section A3.3, while the results are provided in Section A3.4.

A3.3 Modelling Inputs

The values selected as input variables into the STFATE model for Case 1 are summarised in **Table A5**. Note that in selecting default STFATE material properties, sand was treated as “medium sand”. Also, it is recommended that the elutriate concentration be used as input for the type of modelling selected in STFATE, as adopted. This is reasonable since the ratio of solids (with voids) to water in the hopper is similar to the equivalent ratio in the elutriate.

Table A5: Input variables used in STFATE modelling for Case 1

Variable		Units	Selection
Type of analysis			Section 404(b)(1) Regulatory Analysis for US Navigable Waters
Method of disposal			Split-hull barge
Program Options	Simulation type		Descent, collapse and diffusion (default coefficients)
	Evaluation type		Tier II, Compare Water Quality
	Initial TBT concentration in fluid fraction	mg/L	1.62×10^{-5}(TBT)
	Background concentration at disposal site	mg/L	0 (TBT)
Output Options	Depths for which output desired	m	10, 20, 25, 50, 75, 100
	Duration of the simulation	hours	4
	Long-term time step for diffusion	s	600
Site Description	Grid points		96 x 96
	Grid spacing	m	18 x 18
	Roughness height	m	1.5×10^{-3}
	Slope of bottom	degrees	0
	Constant water depth	m	100
	Water density	g/cm^3	1.025 constant
Material Description	Layers in vessel		1
	Volume of hopper	m^3	500
	Velocity of vessel	m/s	1.03
	Material type		Four types, see Table A4
	Dredge material specific gravity		2.65
	Volumetric fraction (proportion of solids by volume)	m^3/m^3	Four fractions, see Table A4
	Solid fraction fall velocity	mm/s	STFATE default for each material type
	Void ratio after deposition		STFATE default for each material type
	Critical shear stress	N/m^2	STFATE default for each material type
	Cohesive		STFATE default for each material type
	Stripped during descent		STFATE default for each material type
Velocity Data	Ambient velocity profile type		Single depth averaged velocity
	Depth averaged velocity	m/s	0.1
Disposal operation	Length of disposal vessel bin	m	31.2
	Width of disposal vessel bin	m	7.5
	Pre-disposal draft of vessel	m	3.5
	Post-disposal draft of vessel	m	1.3
	Time needed to empty the disposal vessel	s	10
	Dumping over a depression		No

A3.4 Modelling Results

The STFATE (numerical) modelling results for the four cases simulated are summarised in **Table A6**. The results were compared to the ANZECC/ARMCANZ (2000) marine water quality guidelines for TBT at the 95% protection level (i.e. 0.006 µg/L) and at the 99% level of protection (i.e. 0.0004 µg/L). The multiplier required for each result to exceed the relevant guidelines is also provided.

Table A6: Summary of STFATE modelling results

Case	Maximum concentration of TBT in the water column after four hours (µg/L)	Multiplier that TBT concentration is less than	
		95% protection level	99% protection level
1 - backhoe loading a split hopper barge (no overflowing)	2.86×10^{-10}	20979	1399

It is evident from the STFATE (numerical) method that after initial mixing (that is after four hours), TBT concentrations at the Sydney Offshore Spoil Ground would be less than the ANZECC/ARMCANZ (2000) trigger values at both the 95% and 99% protection levels for TBT.

Therefore, the concentrations of TBT in material from Dredge Area 3 (Berths 1 and 2) are not of concern to water quality during disposal at the Sydney Offshore Spoil Ground.

A4 REFERENCES

ANZECC/ARMCANZ (2000) *National Water Quality Management Strategy, Paper No. 4*, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, October, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), ISBN 09578245 0 5 (set), ISSN 1038 7072

Commonwealth of Australia (2009) *National Assessment Guidelines for Dredging*

United States Environmental Protection Agency [USEPA] (1998) *Evaluation of Dredged Material Proposed for Discharge in Waters of the US*, *Testing Manual, Inland Testing Manual*, EPA 823-B-98-004, USEPA and US Army Corps of Engineers, February