egis consulting
Australia

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DIOXIN TESTING AT THE OMEX SITE

Client: **DEPARTMENT OF ENVIRONMENTAL PROTECTION**

Report: **RP-00-004-0**

Dated: **NOVEMBER 1999**

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Mr Bryan Jenkins
Chief Executive Officer
Department of Environmental Protection

Dear Bryan

OMEX REHABILITATION SITE - DIOXIN INVESTIGATION REPORT

Thankyou for referring the Dioxin Investigation Report relating to the Omex Site Remediation.

The Dioxin sampling program was undertaken by the Waste Management division of the Department of Environmental Protection in accordance with the requirements of the Environment Protection Authority. The sampling program was aimed to undertake Polychlorinated dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF) analyses on materials assessed as having the greatest potential of containing elevated concentrations of PCDD and PCDF. The objective of the program was to collect sufficient information to enable an assessment as to whether PCDD or PCDF should be regarded as Contaminants of Concern (COC) for the Omex site. A COC is one that is present in sufficiently high concentrations to warrant further investigation with respect to risks to human health and which may require specific management or remediation.

The analytical program was undertaken by an appropriately qualified laboratory (ESR) in accordance with US EPA method 8290.

The Dioxin Investigation Report indicates that the maximum concentration of PCDD and PCDF fall below values that are commonly used as action levels or remediation criteria for residential land use therefore there should be no implications in regard to the proposed remediation program. Irrespective of the concentration of PCDD and PCDF the remediation program would be expected to utilise environmental controls to limit the generation of dust and sediment in run off during remediation works. As PCDD and PCDF are semi volatile organic compounds, they would be associated with particulates rather than vapours and thus controls on dust and sediments for other non volatile contaminants are also relevant to the control of PCDD and PCDF emissions during site works.

Westralia Square, 141 St Georges Terrace, Perth, Western Australia 6000. Telephone: (08) 9222 7000. Facsimile: (08) 9222 7155.
Postal Address: PO Box K822, Perth, Western Australia 6842.

Based on the outcome of the sampling program undertaken by Egis at the Omex site, the following conclusions can be made:

- The sampling program indicates that the concentrations of PCDD and PCDF in soil are likely to be elevated at the Omex relative to background concentrations for the surrounding area.
- Based on the assumption that the maximum concentration of PCDD and PCDF (49.5 pg/g TEQ) is representative of the higher concentrations present across the Omex site, then PCDD and PCDF would not be present at sufficiently high concentrations to warrant further consideration with respect to risks to human health. This assumption is considered to be reasonable given that the sampling program was biased to locations and depths assessed as having the greatest potential of being affected by elevated concentrations of PCDD and PCDF.

The EPA is satisfied on the advice of the EPA's independent consultant (Woodward-Clyde) and the Health Department of Western Australia who have both reviewed the Dioxin Investigation report related to the Omex Site Remediation that the presence of PCDD and PCDF at the Omex site should have no implications in regard to the proposed remediation program.

Please provide copies of the EPA's advice together with a copy of the Dioxin Investigation Report related to the Omex Site Remediation to all members of the Implementation Consultative Community, Ms J Bremmer and Mr L Bell and notification of its public availability is to be advertised in the EPA's weekly advertisement in Saturday's West Australian.

Kind Regards

Bernard Bowen
CHAIRMAN

CC Woodward-Clyde
Health Department of Western Australia
Appeals Convenor, C/- Office of the Minister for the Environment

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EXECUTIVE SUMMARY

Egis Consulting was commissioned by the Waste Management Division of the Department of Environmental Protection to undertake a dioxin testing programme at the Omex site located on Clayton Road in Bellevue. The investigation was required to comply with a condition of approval of the project as required by the Environmental Protection Authority (EPA). The requirement was to undertake dioxin testing prior to trial excavation work and the full scale remediation.

From 1955 to 1979, the Omex site was used as an oil re-refinery plant where acidic waste sludges and oils were disposed into an unlined clay pit. In the past there have been fires within the pit which may have potentially lead to the formation of dioxins.

Dioxins are chemically classified as halogenated aromatic hydrocarbons. The term dioxin refers specifically to polychlorinated dibenzodioxin (PCDD) and includes polychlorinated dibenzofurans (PCDF).

The dioxin sampling programme was undertaken in accordance with EPA instructions which included the testing of one sludge and one oil sample from the pit, three natural soil samples external to the pit with elevated levels of Polycyclic Aromatic Hydrocarbons and two samples of natural soil from outside of the Omex site but within a 1 km radius.

Samples were tested for all relevant congeners of Polychlorinated dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF) in accordance with US EPA method 8290. Results were expressed both individually and as a total 2,3,7,8 Tetrachlorodibenzo-*p*-dioxin (TCDD) toxicity equivalence (TEQ) which is the standard measure for dioxins.

The observed dioxin TEQ levels at the Omex site including the pit contents were all relatively low ranging from 0 ppt to 49.5 ppt TEQ. The US Agency for Toxic Substances and Registry (ATSDR) proposes a residential action level of 1,000 ppt TEQ. Background levels were at 0 ppt.

Dioxin and dioxin like compounds (TCDDs and TCDFs) have been detected at the Omex site at levels which are well below health based response levels proposed by ATSDR. As such, with regard to dioxins, the material sampled should pose no risk to future users of the site.

The waste sludge and oil from the pit and the surrounding soils sampled in this investigation will be removed to landfill as part of the site clean-up. The levels of dioxin found indicate there is no need for additional management controls beyond those already proposed for the remediation.

1. INTRODUCTION

Egis Consulting was commissioned by the Waste Management Division of the Department of Environmental Protection (DEP) to undertake a dioxin testing programme at the Omex site located on Clayton Road in Bellevue.

The purpose of the investigation is to consider an issue raised in the Environmental Protection Authority (EPA) response to the proponents proposal to remediate contaminated land: *Rehabilitation of the Omex Contaminated Site Bellevue: Consultative Environmental Review*. The EPA have approved the proposal to remediate the Omex site which is detailed in the Bulletin 951, released September 1999. The Bulletin includes a condition to undertake dioxin testing prior to the trial excavation and full scale remediation. To ensure the EPA's conditions are met, the DEP has undertaken testing of the pit sludge and surrounding natural soils for dioxin.

From 1955 to 1979, the Omex site was used as an oil re-refinery plant where acidic waste sludges and oils were disposed into an unlined clay pit. In the past there have been fires within the pit, which may have potentially lead to the formation of dioxins.

Combustion of organic material in the presence of a chlorine source has the potential to produce dioxins. Also some hydraulic oils which may have been reprocessed could have possibly contained Poly Chlorinated Biphenyls (PCBs) as an additive. PCBs can contain very low levels of Polychlorinated dibenzofurans (PCDF) which is a dioxin like compound. Chemical analysis of the waste sludge and oil did not detect any PCBs. However, as a precautionary measure, the EPA requested that the presence of dioxin and dioxin like compounds be investigated prior to remediation.

2. BACKGROUND INFORMATION

2.1 CONTAMINATION OVERVIEW

The Omex site is contains an abandoned clay pit with dimensions of 40 m by 70 m with an average depth of 7 m. This pit has been filled over time with waste acidic oil sludges from an oil re-refinery previously located on the site. The pit contains approximately 15,000 m^3 of oily waste with elevated levels of heavy metals, in particular lead. In addition there are locations with soil contamination both associated and independent of the waste disposal activities that occurred within the pit.

PCBs were not found in either the oil or sludge component above the level of detection which was 0.1 ppm for sludge and 1 ppb for oil (Golder, 1997). PCBs may however exist within the oil and sludge at levels below the laboratory detection limit but at such concentrations they do not represent an environmental or human health issue.

The characteristics of the oil wastes have been thoroughly assessed and are considered to be hazardous to both human health and the environment primarily due to their corrosive nature. Proposed site remediation involves pH treatment and off-site disposal of contaminated material.

Soil has been impacted due to a range of events from waste overflow from the pit to oil spillage from the redrumming facility. Investigations have identified approximately 13,000 m^3 of contaminated soil (excluding pit contents) over an area of 4,500 m^2.

The underlying groundwater in both formations has been impacted by the pit. The principal contaminants are sulphate, hydrocarbons, and the heavy metals nickel and zinc. The Guildford Clay due to its impermeable characteristics is relatively free of contamination. Groundwater in the upper part of the Leederville Formation contains more extensive contamination which has been detected up to 150 m downgradient of the pit. However, the more significant contamination from a human health and environmental perspective is restricted to within 100 m of the pit.

2.2 DIOXIN CHEMISTRY AND SOURCES

Dioxins are chemically classified as halogenated aromatic hydrocarbons. The term dioxin refers specifically to polychlorinated dibenzodioxin (PCDD) and a large group of chemically similar compounds including polychlorinated dibenzofurans (PCDF), brominated dioxins and furans (BDD & BDF), and polychlorinated biphenyls (PCBs-coplanar & mono-ortho coplanar).

The PCDDs and PCDFs are considered to be the primary dioxin like compounds of concern and are therefore routinely tested. BDDs, BDFs and dioxin like PCB's are not currently subject to the same level of consideration.

Dioxin like compounds arise from the four major sources:

- Combustion and incineration;
- Chemical manufacturing and processing;
- Industrial and municpal processes; and
- Redistribution of "accumulated stores".

In Western Australia due to a relatively low level of industrial activity, combustion and redistribution stores are considered to be the principal sources. The burning of wastes, coal, wood and petroleum products, smelting operations and furnaces can all lead to dioxin formation. As dioxins are persistent and hydrophobic, they can accumulate in the environment in sediments and vegetation. Releases back into the environment can occur during events such as bushfires which account for 75% of the dioxin input into the environment in Australia (Environment Australia, 1998).

Background levels of dioxin in soil range significantly between urban and rural environments and between countries as a function of their level of industrialisation. An international comparison of background dioxin levels in soils is provided in the New Zealand Ministry for the Environment Reporting on Persistent Organochlorines in New Zealand, September 1998. In New Zealand, levels in an urban environment range between 0.5 ppt and 6 ppt, 0.1 ppt to 5 ppt in Australia, 2.5 ppt to 20 ppt in the USA, and 4 ppt to >60 ppt in the UK. There are no published background levels for dioxin in Western Australia.

2.3 EPA INSTRUCTIONS

The EPA instructions outlined a specific methodology and approach to undertaking the dioxin investigation (refer Attachment 1), the proponent concurred with the nominated approach which was then submitted to the EPA for endorsement in August 1999 (refer Attachment 2). The EPA endorsed the proponent's sampling programme in late August 1999 and included additional comments relating to the Occupational Health and Safety (OHS) plan (refer Attachment 3).

The dioxin sampling programme was to include testing samples of the following:

- One sludge;
- One lighter oil;
- Three natural soil samples external to the pit with elevated Polycyclic Aromatic Hydrocarbon (PAH) levels;
- Two natural soil samples outside of the Omex site but within 1 km, to be used as background reference results.

The pit was to be drilled in a location considered to represent the worst of the contamination based on the results of previous investigations. Soil external to the pit was sampled at 10 locations considered to exhibit potential PAH contamination based on the results of previous investigations. All 10 locations were tested for PAHs, samples from these locations which contained the three highest levels of PAHs were selected for dioxin analysis. Figure 1 shows the sampling locations on the Omex site.

Background samples were recovered at two local parks located in Bellevue; Goodchild Oval and Elder Park. These locations were considered to have the lowest potential for dioxin contamination as there are no potential domestic sources such as barbeques or garden waste/wood burning.

The forms of dioxin to be tested for include all relevant congeners of Polychlorinated dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF) in accordance with US EPA method 8290. Results are to be expressed both individually and as a total 2,3,7,8 Tetrachlorodibenzo-*p*-dioxin (TCDD) equivalence.

3. INVESTIGATION METHODOLOGY

3.1 INVESTIGATION PROGRAMME

Investigations into the presence of dioxins were undertaken in accordance with the EPA instructions issued to the proponent in July 1999 (refer Attachement 1).

The dioxin investigation was performed concurrently with investigations into the gases that could potentially be generated from the contents of the waste pit. Investigations were undertaken concurrently as both programmes involved drilling into the major pit.

An occupational health and safety plan (OHS) was developed specifcally for the drilling programme. This plan was submitted to the EPA and was approved prior to commencement of drilling activities. The OHS plan detailed safety procedures and necessary protective equipment, handling of the waste and air monitoring requirements. The OHS plan was reviewed and understood by all those involved in the drilling programme. A signed copy of the OHS plan is provided as Attachment 4.

3.2 FIELD INVESTIGATIONS

Field investigations comprised continuous soil sampling with a hollow stem auger drill rig within the major pit and hand augering outside of the pit in natural soils.

The field investigation phase was undertaken on 14 September 1999. All sampling was performed in accordance with the Egis Consulting Quality Assurance Plan, which is attached as Appendix A. Field logs are attached as Appendix B. A photographic record was maintained which is attached as Appendix C. All field investigations were performed under the supervision of a suitably qualified person in the assessment of contaminated sites.

3.2.1 Soil Sampling

Samples from the major pit were recovered continuously in 0.75 m cores and were logged together along with a photographic record. Waste material from two cores (1.5 m depth interval) were equally divided into two large sample containers. Subsamples were then recovered from each 1.5 m depth interval and submitted for dioxin analyses.

Natural soil was recovered with a hand auger with a discrete sample (0.15 m interval) taken where insitu soil was first observed. This occurred at depths ranging from 0.3 m to 0.7 m on-site, and at 0.1 m off-site.

The subsurface conditions encountered in each soil sampling location were logged together with a description of lithology and field ranking of any apparent contamination. The field ranking system is outlined in Section 3.3.2.

The soil/sludge samples were placed into teflon lided laboratory prepared jars and stored in a chilled container. Samples were transported to the laboratory with accompanying chain-of-custody documentation.

3.2.2 Field Contamination Ranking

Each sample was assigned a field rank from 0 to 3 in accordance with the criteria set out in the following table. This is performed to aid in the selection of samples for laboratory testing.

TABLE 1 - FIELD CONTAMINATION RANKING

RANK	DESCRIPTION
0	No odour or visual evidence of contamination
1	Slight visual evidence of contamination and/or slight odour
2	Visual evidence of contamination and/or odour
3	Visual evidence of gross contamination and/or strong odour

3.3 ANALYTICAL VERIFICATION

Laboratory analysis of soil and sludge samples was undertaken on those considered to represent the highest potential for dioxin impact. EPA instructions were to analyse those soil samples with the highest PAH levels and to recover sludge in that part of the pit known to contain the highest concentrations of PAHs.

The rationale for selecting PAHs is not explicit in the EPA instructions but is based on the fact that PAHs are a byproduct of an incomplete combustion process (ie; oil fire in the pit). It should also be noted that PAHs are found in waste oils resulting from the same processes within vehicle engines.

PAH levels in the pit sludge are relatively low ranging between 18 mg/kg and 46 mg/kg compared to the response level of 20 mg/kg (DEP, 1999). PAH levels in soils are also relatively low and are mostly below the response level (DEP, 1999 & Egis, 1999).

3.3.1 Analytical Programme

The dioxin testing program included seven samples in total, one each of oil and sludge and five of soil. The PAH testing programme as a precursor to dioxin analyses included 11 soil samples of which one was a triplicate for Quality Assurance/Quality Control purposes.

The primary laboratory in WA was Analytical Reference Laboratory (ARL), 55 Wittenoom Street, East Perth and the secondary laboratory was Australian Environmental Laboratories (AEL), 52 Murray Road, Welshpool. Both laboratories are NATA (National Association of Testing Authorities) registered.

Samples were submitted to the Institute of Environmental Services and Research Limited (ESR) in New Zealand for dioxin analyses. ESR is accredited by The World Heath Organisation for analyses of dioxins (PCDD's & PCDF's-described in following subsection) in selected matrices.

ESR use a high resolution gas chromatography high resolution mass spectrometry using isotopically labelled surrogate standards based on USEPA Method 8290. This method provides data on all toxic 2,3,7,8-chlorinated PCDD and PCDF isomers as well as totals of non 2,3,7,8-chlorinated PCDDs and PCDFs for each homologue group (tetra to octa). A total of 25 congeners are reported.

3.3.2 Quality Control

Quality control provisions included triplicate testing of one soil sample for PAHs. Both the primary laboratory duplicate and secondary laboratory triplicate reported the same result being below the detection limit. The primary sample is identified as D10.

ESR have an internal QA/QC system which is noted in their Certificate of Analysis. With respect to the dioxin samples, there was a raising of detection limits for the sludge sample (5A) due to hydrocarbon interference. The oil sample and soils D2 and D3 displayed surrogate recovery rates below the method acceptance criteria which may potentially result in minor underestimation of congener results. This is not considered to be significant.

3.4 ACCEPTANCE CRITERIA

In terms of assessing the significance of PCDD and PCDF levels, observed concentrations are converted into a value where toxicity is standardised. Dioxin like compounds are all compared to 2,3,7,8 TCDD or the reference dioxin which has a toxicity equivalence factor (TEF) set at 1 (all other congeners TEF <1). A congener is a group of chemicals which have the same basic structure. Each congener is then converted to a toxicity equivalence (TEQ) by multiplying the observed concentration by the TEF. The significance of dioxin results are then assessed by comparing the total of all TEQs and published levels.

The US Agency for Toxic Substances and Registry (ATSDR, 1997) have nominated a screening, evaluation and action level for dioxin in a residential setting expressed as TEQs. At a level of 50 ppt TEQ or lower, dioxin does not represent a health issue. At concentrations greater than 1,000 ppt TEQ, there exists a potential public health issue which should be considered as an action level requiring a remedial response. At levels between 50 ppt TEQ and 1,000 ppt TEQ, a site specific evaluation should be undertaken which considers bioavailability, ingestion rates, pathway analysis and soil cover should the proposal be to retain soil in an unremediated form. The ATSDR notes that the values nominated are for guidance only and should not be construed to indicate that actual health effects will occur.

The safe level of exposure or minimal risk level (MRL) for dioxins is 1 pg/kg/day for TCDD (ASTDR, 1989). The 1 pg/kg/day exposure limit is approximately two orders of magnitude below the noncancer and cancer health effect levels. The 50 ppt TEQ screening value is at the low end of the range reflecting currently recognized areas of scientific uncertainty; this range is 50-50,000 ppt, which is based on the 1,000 fold uncertainity factor used to derive the MRL (ASTDR, 1997).

The acceptance criteria used in this assessment for dioxin compounds at the Omex site is based on the 1997 ATSDR guidance values which is set at 1,000 ppt TEQ as a response level and 50 ppt TEQ as an investigation or screening level. Section 4 outlines the investigation results.

4. ENVIRONMENTAL SITE ASSESSMENT

4.1 OBJECTIVE

The objective of the environmental investigations was to assess the contents of the pit and surrounding natural soils for dioxin and dioxin-like compounds. The investigation included air monitoring for sulphur dioxide emissions during the drilling programme.

4.2 INVESTIGATION RESULTS

Analytical results are shown on Table 2. Analytical test certificates are included as Appendix D. Soil/sludge sampling locations are shown on Figure 1.

4.3 DISCUSSION OF RESULTS

The observed dioxin TEQ levels were all relatively low ranging from 0 ppt to 49.5 ppt, this compares to the ATSDR residential action level of 1,000 ppt.

Samples D11 and D12 represent the background samples obtained from Goodchild Oval and Elder Park respectively. Both sites exhibited no detectable levels of dioxin.

The oil within the pit exhibited a dioxin TEQ concentration of 0.87 ppt, 2,3,7,8 TCDD was not detected which is considered to be the most hazardous dioxin. The sludge sample from the bottom of the pit was submitted for analyses, a dioxin TEQ of 0 ppt was reported. However, the limit of detection was higher compared to uncontaminated soil samples due to interference from high levels of hydrocarbons in the sludge. Therefore as a conservative interpretive measure, it was assumed that dioxins are present at half the detection limit and this results in a calculated TEQ of 124 ppt. This level is only 12% of the ATSDR action level for residential soils. Applying the full detection limit as real values raises the TEQ to only 24% of the action level.

Dioxin levels detected on-site were elevated compared to local background values but below the 50ppt TEQ investigation screening level. Three insitu soil samples were taken in areas outside of the pit with a higher potential for dioxin as indicated by elevated PAH concentrations. The closest sample location (D3) to the pit exhibited a dioxin TEQ of 49.5ppt, this location is between the major and minor pit No 1. Sample location D6 exhibited a dioxin TEQ of 13.6 ppt and at sample location D2, a dioxin TEQ of 0.622 ppt was reported.

TABLE 2 - ANALYTICAL RESULTS

SAMPLE LOCATION	Total Polcyclic Aromatic Hydrocarbons mg/kg or ppm	Total Dioxin TEQs pg/g or ppt
D1 0.6m	<0.2	NT
D2 0.5m	0.6	0.622
D3 0.6m	0.2	49.5
D4 0.6m	<0.2	NT
D5 0.7m	<0.2	NT
D6 0.3m	<0.2	13.6
D7 0.5m	<0.2	NT
D8 0.6m	<0.2	NT
D9 0.7m	<0.2	NT
D10 0.6m	<0.2	NT
D11 0.1m Background	<0.2	0.0
D12 0.1m Background	<0.2	0.0
Pit Oil	1,790	0.87
Pit Sludge	46	0.0*

Note *Due to high levels of hydrocarbons, interference increased the level of detection from 4ppt for 2,3,7,8 TCDD to 90ppt. Therefore counting half levels of detection raises the TEQ from 0.0ppt to 124ppt.

NT Not Tested

4.4 HUMAN HEALTH IMPLICATIONS

The observed dioxin TEQ levels in the soil are below the ATSDR screening level of 50 ppt. The insitu soil tested in the vicinity of the pit is to be removed as part of the proposed soil excavation programme (Egis, July 1999). The sludge within the pit may contain dioxin TEQ levels anywhere between 0 ppt and 244 ppt. At a worst case theoretical concentration of 244 ppt, the sludge is still well below the ATSDR action level of 1,000 ppt.

It should be noted that the observed dioxin levels found on-site are well below internationally recognised response criteria and would be suitable to remain on-site for residential purposes.

4.5 CONCLUSIONS

Dioxin and dioxin like compounds (TCDDs and TCDFs) have been detected at the Omex site at levels which are well below health based response levels. As such, will regard to dioxins, the material sampled should pose no risk to future users of the site.

The waste sludge and oil from the pit and the surrounding soils sampled in this investigation will be removed to landfill as part of the site clean-up. The levels of dioxin found indicate there is no need for additional management controls beyond those already proposed for the remediation.

4.6 AIR MONITORING RESULTS

The OHS plan for the dioxin investigation included air monitoring for sulphur dioxide. The nominated limit was 2 ppm for occupational exposure immediately downwind of the drill rig within a distance of 10 m. Monitoring was undertaken with a hand held Drager Tube which draws air into a reactor tube. The reactor tube has a concentration scale which changes colour in the present of SO_2. The monitoring results indicate that during the drilling exercise, levels of SO_2 did not exceed either the occupational limit of 2 ppm or the detection limit of 0.25 ppm, results are shown on Table 3.

TABLE 3 - AIR MONITORING RESULTS

Time	Activity	Weather	SO_2 (ppm)
9.45 am	Prior to drilling	Westerly wind, wet and cool.	<0.25
10.05 am	Drilling	Westerly wind, wet and cool.	<0.25
10.45 am	Drilling	Southwesterly wind, wet and cool.	<0.25
11.30 am	Drilling, high sulphur odour noted in sludge sample.	Southwesterly wind, wet and cool.	<0.25
12.10 pm	Finished drilling	Southwesterly wind, wet and cool.	<0.25
12.30 pm	Borehole backfilled	Southwesterly wind, wet and cool.	<0.25

5. REFERENCES

ASTDR (1989). Toxicological profile for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, 1989.

ASTDR (1997). Dioxin and Dioxin-Like Compounds in Soil, Part 1, Interim Policy Guidelines. US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, August 1997.

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Environment Australia (1998). Persistent Organic Pollutants – Dioxin Emission Study, August 1998.

NZME (1998). Reporting on Persistent Organochlorines in New Zealand. NZ Ministry for Environment, September 1998.

USEPA (1994). Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) and Related Compounds. US Environmental Protection Agency, August 1994.

FIGURES

RESIDENCE

RESIDENCE

RESIDENCE

POOL

55

54

53

52

51

50

49

48

56

D8 D9

D6

D7 D10

SHED

OFFICE

SHED

CMC

MAJOR PIT

61

D1

D3

LOT 400

D4

30

D2

D5

TOILETS

SHED

KEY

DIOXINE SAMPLING LOCATION

SCALE

5 0 5 10 m

1 : 500

	INITIALS	SIGNATURE	DATE
DRAWN	AL		
DRG CHKD	DER		
DESIGNED	DER		
SUPERVISOR			
MANAGER			
APPROVED			

CLIENT

DEPARTMENT OF ENVIRONMENTAL PROTECTION

egis consulting Australia
200 Adelaide Terrace
PERTH WA 6000
Tel : 61 9 220 9300
Fax : 61 9 235 9897
A.C.N. 000 912 630

TITLE

OMEX SITE
DIOXIN SAMPLING LOCATIONS

SIZE	PROJECT No	DRAWING No	SHEET No	REV
A3	VW1300	FIGURE 1	OF	

CAD FILE No VW1300-D01 | PLOT INFO XREFS 11:13 25/11/99

JMSTD-05 REV

DEPARTMENT OF
ENVIRONMENTAL
PROTECTION
DIOXIN TESTING AT
THE OMEX SITE

ATTACHMENT 1

Mr Bryan Jenkins
Chief Executive Officer
Department of Environmental Protection
(Waste Management WA)

Dear Bryan

OMEX REHABILITATION SITE - DIOXIN TESTING

Recently I had discussions with an officer from the Health Department of WA on this matter, and was advised that it seemed likely that dioxin in the area would not be a problem in the context of the clean-up of the OMEX site.

However, it is also recognised that specific details regarding dioxins at the OMEX site are unknown and their implication to management can only be inferred by literature results. Additionally, the issue of dioxins has been raised publicly in this assessment and the EPA would need to address this issue within the EPA report. Therefore, it is considered prudent that the proponent undertake sampling for dioxins in order for the EPA to more accurately assess the site-specific risks which the proposal may present to both human health and the environment.

The following information details the requirements of a preliminary/informative dioxin study.

Sampling Locations:

To provide an appropriate indication of the risks associated with dioxins at the OMEX site it is recommended that the study should include samples obtained from:

- waste pit materials;
- surrounding site area (external to the pits); and
- similar residential locations away from the OMEX site.

Westralia Square, 141 St Georges Terrace, Perth, Western Australia 6000. Telephone: (08) 9222 7000. Facsimile: (08) 9222 7155.
Postal Address: PO Box K822, Perth, Western Australia 6842.

Forms of dioxins to be tested for:

The analysis for dioxins shall be according to US EPA method 8290. This includes all relevant congeners of PCDDs and PCDFs. The results are to be reported as concentrations for the individual congeners and as a total 2,3,7,8 TCDD equivalence. Guidelines and health risks are normally expressed on the basis of 2,3,7,8 TCDD Toxicity Equivalence Factors (TEF).

Sampling Methodology:

The proponent is required to provide an appropriate sampling methodology, which will ensure representative results are obtained. By utilising the results of previous site investigations an effective judgemental sampling strategy can be implemented. For example, locations within the major waste pit and surrounding soils, which have returned elevated Polycyclic Aromatic Hydrocarbons (PAH) concentrations, should be targeted for dioxin analysis during this study.

The proponent should consider the following points when preparing their sampling methodology.

Sampling within the major pit should include the viscous heavy fractions ('tar' like materials) and lighter oily sludges, as identified within the CER (Section 4.2.1). Two samples should be obtained for dioxin analysis.

- Soil sampling external to the major pit should be guided by previous laboratory results exhibiting elevated PAH concentrations. It is likely that this will include soil from the areas surrounding the major waste pit which experienced over-flow in 1988/1989. Samples should be screened for PAH with the three highest results being analysed for dioxins.

- Sampling for 'background' dioxin concentrations should be undertaken away from the OMEX site within a similar residential environment (within 1-km radius). Two samples should be obtained for dioxin analysis, one from each material type.

- Composite sampling is not to be undertaken.

- Samples from the major waste pit should be obtained at depth within representative materials. Samples external to the pit should be obtained from greater than 10cm below the surface level.

- Quality field sampling procedures (chain of custody recording, de-contamination, storage, etc.) need to be defined by the proponent.

- Sampling equipment (jars, bottles etc.) should meet laboratory requirements. Use of laboratory supplied materials is preferred.

- Observations made during sampling should be recorded appropriately (field notes, logs, photographs etc.)

Reporting:

The proponent will provide a report to the EPA within two weeks of receiving final laboratory results.

Authority to Proceed with Testing:

Upon review and approval of the proposed sampling approach authority to proceed with dioxin testing will be granted.

Should the sampling program results not be available prior to the EPA completing its report, the EPA is likely to include the sampling program and assessment of analysis results obtained as an environmental condition which will require clearance prior to implementation of the OMEX site clean-up.

Should you wish to further discuss any of the above matters, please contact Mr Ray Claudius on 9222 7188 in the first instance.

Kind regards

Bernard Bowen

Bernard Bowen
CHAIRMAN

20 July 1999

CC: Health Department of WA
Woodward Clyde

egis consulting
Australia

DEPARTMENT OF
ENVIRONMENTAL
PROTECTION
DIOXIN TESTING AT
THE OMEX SITE

ATTACHMENT 2

egis consulting
Australia

PERTH OFFICE

17 August 1999

Department of Environmental Protection
Waste Management Division
4 Floor, Westralia Square
141 St Georges Terrace
PERTH WA 6000

ATTENTION: Ms Catherine Bozanich

SUBJECT: DIOXIN TESTING PROGRAMME

Dear Catherine

In response to the EPA advice on dioxin sampling, letter dated 20/7/99, please find attached the proposed sampling programme which is effectively as what was outlined by the EPA. Attached are also the OH&S and field investigation quality assurance plans which are required prior to drilling.

I will put all drilling work on hold until the EPA and yourselves have endorsed the sampling programme. I trust all is to your satisfaction.

Yours sincerely

DAVID ROSS
SENIOR ENVIRONMENTAL SCIENTIST

200 Adelaide Terrace Perth WA 6000 Australia PO Box 6311 East Perth WA 6892 Tel: Fax:
Egis Consulting Australia Pty Limited A Groupe Egis Company ACN 000 912 630

DIOXIN SAMPLING PROGRAMME

OMEX SITE, BELLEVUE.

SAMPLING METHODOLOGY

The purpose of this investigation is to determine the existence of dioxin compounds in both the waste material and surrounding soil. Concern has been raised regarding the potential for dioxins to be produced during past fire events within the pit.

Samples to be tested include the waste and insitu soil external to the pit. The waste sludges will be tested in the southern half of the pit, this is where the waste was found to contain more significant contamination and free oil. A drill rig with continuous coring will be used to recover samples over the entire pit profile. Based on field observations, a sample of the worst of the solid "tar–like" sludge and "free oil" will be taken.

Soil outside of the pit will be tested in two distinct locations where elevated PAH concentrations above environmental guidelines were detected. These locations are in the vicinity of the 1988 spill onto Lots 51 and 52 Henkin Street, and north of the demolished oil re-refinery site immediately east of the major pit.

A total of 10 samples will be taken from both locations and subjected to a PAH analyses, of these, the three highest results will then be tested for dioxin. Soil samples will be collected with a hand auger from a discrete depth of 0.1 m to 0.2 m.

Outside of the Omex site, two samples will be taken from public open space within a residential environment inside a one kilometre radius of the site. Those locations will both be in Bellevue; Goodchild Oval (south of the site) and Elder Park (east of the site). Samples will be collected by hand auger from a depth of 0.1 m to 0.2 m. No PAH analyses is proposed as they will represent uncontaminated background samples. Both locations will be tested for dioxin.

FIELD SAMPLING PROCEDURES

Sampling will be undertaken in accordance with quality control provisions and in accordance with the advice provided in the EPA letter of the 20/7/99. An occupational health and safety plan has been prepared for the investigation work which details procedures and protective equipment requirements. Emergency responses are also included.

Quality control with regard to field work inclusive of decontamination and sampling protocols will be to a high standard in accordance with the Egis Consulting Quality Assurance Plan. This plan details the collection and storage of samples.

For QA purposes, a triplicate insitu soil sample will be taken from the Omex site at one location and tested for PAH's. Each soil bore will be logged by a person suitably qualified in the assessment of contaminated sites. A photographic record will be maintained of each sample.

Samples will be delivered to the laboratory on ice and with accompanying chain of custody documentation.

ANALYTICAL TESTING

Samples will be stored in laboratory prepared glass jars and tested for either or both; PAHs and dioxin. PAH testing will be performed in Perth at a NATA registered laboratory. The dioxins will need to be tested at ESR laboratories in New Zealand. There are no laboratories in Perth or Australia capable of performing the tests to the same standard. Dioxin testing will be according to US EPA method 8290 for priority congeners of PCDDs and PCDFs. They will be expressed individually and as a total 2,3,7,8 TCDD equivalence. Dioxin will be reported to a detection limit of between 0.1 and 2 pg/g.

REPORTING

The results of the investigation will be reported in an Environmental Site Assessment format with tabular presentation of results and discussion on the outcome of the investigation. The report will be inclusive of field logs and laboratory test certificates.

Any dioxin detected will be assessed against current Health Department and EPA advice regarding toxicity.

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DEPARTMENT OF
ENVIRONMENTAL
PROTECTION
DIOXIN TESTING AT
THE OMEX SITE

ATTACHMENT 3

W:/ENVIRON/JOBS/
VW11001315
RP-00-004-0

Environmental Protection Authority

Mr Bryan Jenkins
Chief Executive Officer
Department of Environmental Protection
(Waste Management WA)

Dear Bryan

OMEX REHABILITATION SITE - DIOXIN TESTING

The Environmental Protection Authority has reviewed the proposed Dioxin sampling strategy (including accompanying details regarding health and safety management) and consider these measures to be satisfactory; conditional to the following issues being addressed prior to implementation.

Comments regarding the sampling plan:

1. Soil sampling undertaken on-site surrounding the major waste pit should ensure that samples are selected from natural ground. (i.e. no sampling within surface fill or similar materials).

Detailed field records should be maintained for each sampling location as per the initial EPA letter dated July 20 1999 (notes, logs, photographic records, change of custody of samples etc.).

Comments regarding the Health and Safety Plan (HASP):

1. On-site personnel involved with activities are required to sign-off on the HASP prior to works commencing.

2. Drums of contaminated drill cuttings, personal protective equipment (PPE) etc. should be disposed of at appropriately designated facilities.

3. Exclusion zones for personnel without higher levels of PPE should be established and maintained during intrusive works.

Westralia Square, 141 St Georges Terrace, Perth, Western Australia 6000. Telephone: (08) 9222 7000. Facsimile: (08) 9222 7155.
Postal Address: PO Box K822, Perth, Western Australia 6842.

4. Samples and associated packaging will require appropriate decontamination prior to final dispatch to the testing laboratory.

5. All operations should be undertaken in a manner so as to reduce dust generation.

Kind regards

Bernard Bowen

Bernard Bowen
CHAIRMAN

26 August 1999

DEPARTMENT OF ENVIRONMENTAL PROTECTION DIOXIN TESTING AT THE OMEX SITE

ATTACHMENT 4

egis consulting

Australia

D.E.R
14/9/99

DOCUMENT NO:VW1100/000/315/RP-00-001-0

OCCUPATIONAL HEALTH & SAFETY PLAN

DIOXIN INVESTIGATION

OMEX PETROLEUM SITE, BELLEVUE

14/9/99

14/9/99.

Peter Thorne
14/9/99.

14/9/99.

Client: DEPARTMENT OF ENVIRONMENTAL PROTECTION

Report: VW1100/315/RP-00-001-0

Dated: 17 August 1999

REV	DATE	REVISION DESCRIPTION	BY EGIS CONSULTING	CHECKED EGIS CONSULTING	APPROVED FOR ISSUE
0	17-08-99	Final Report Issued to Client	DER	PT	

TABLE OF CONTENTS

1. PROJECT DESCRIPTION

The project objective is to assess the presence of dioxin in the waste material within the major pit and in soil contamination that occurs at the Omex site. This contamination is associated with the past disposal of acidic oily wastes from an oil re-refining plant into an abandoned clay pit.

This plan addresses the health and safety issues of the proposed drilling program to collect sludge and oil samples from the pit and contaminated soil samples. Included is the collection of two soil samples from local government land which are considered to be clean background samples. A copy of this plan will be circulated to all site personnel, including the drilling contractors, the Site Supervisor (Egis Consulting) and any authorised government representatives before works proceed.

Project tasks include the:

1. Drilling on the major pit to the base at an approximate depth of 7 m. This will be done with a hollow stem auger drill rig.

2. Collection of soil samples at 10 locations on-site and two off-site with a hand auger.

3. Cuttings from soil bores will be returned to the hole. Where there is excess drill cuttings, these will be placed within sealed drums to be disposed of according to the level of contamination present.

Site activities will be carried out by personnel from:

- Egis Consulting
- Drilling Contractor

Any changes in the scope of works must be amended in writing by the Health & Safety Representative (see Section 3).

2. SITE DESCRIPTION

The study area lies within the Omex site bounded by Henkin Street, Clayton Street and Purton Place, and to the east by the bowling club and service station. The site is shown as Figure 1.

The extent of soil contamination has been the subject of a number of investigations and is shown superficially or at the surface on Figure 2.

The substances of concern from a human health perspective are:

- Acidity in the waste;
- Sulphur Dioxide air emissions from exposed waste;
- Low volatility petroleum hydrocarbons in the waste and soil;
- Heavy metals - particularly lead in the waste and soil; and
- Phenols in the waste and soil.

3. SUPERVISION TEAM & TASKS

The investigation team will comprise Egis staff, the drilling contractor and field hand. Egis staff will manage the investigation and undertake all sampling and monitoring.

During the drilling in the pit, there will be two Egis personnel, one attending to sample collection and logging, with the other providing support and performing air monitoring. A third point of contact will reside in the office during the drilling programme and will be available in the event of any emergency.

The drilling contractor will drill through the pit and collect the samples in the form of a core. Due to the hazardous nature of the pit waste, there will be two persons at all times involved in operating the drill rig.

Supervision Team	Job Function
Field Supervisor	Supervision of drilling, sampling and site health and safety issues. Qualified OH&S officer having completed a recognised course.
Field Scientist	Provide support to the Field Supervisor and perform all hand augering sampling outside of the pit.
Project Manager	Senior supervision of the investigation program and point of contact for any queries relating to site works.

4. NOTIFICATION OF SITE ACTIVITIES

The site activities will be undertaken wholly within property owned by the State and Local Government and Omex, all of whom are aware of the drilling programme.

The OH&S plan will be issued prior to any site activities occurring and a summary review of the main safety considerations will be given to site personnel before any ground disturbing activity takes place.

5. HEALTH & SAFETY ISSUES

Details on potential hazards and the associated protective measures to ensure occupational health and safety issues are managed are outlined below.

5.1 UNDERGROUND SERVICES

Drilling is mostly confined to the Omex site and adjoining properties on Clayton Street with the exception of the two background samples. Underground services to the properties have been disconnected due to the recent demolition activities. There are no services within the Omex site. Underground services off-site will be located prior to hand augering.

5.2 MECHANICAL AND ELECTRICAL HAZARDS

Drilling will be undertaken by a licensed drilling operator in close consultation with the Site Supervisor. As such, it is the responsibility of the contractor to ensure that the machinery to be used is in good working order thus minimising the risk of electrical fire or mechanical failure causing bodily harm. Power for the rig will be sourced from a generator supplied by the drilling contractors.

Overhead hazards may occur where drilling equipment is located in close proximity to power lines. Drill locations have been chosen to minimise potential interference with any overhead lines. It will be the responsibility of all persons on-site to ensure that these hazards are avoided whenever equipment is to be set up or moved.

5.3 CHEMICAL HAZARDS

The following substances may be present in the waste and/or soils encountered during the drilling operation:

- Acidity in the waste;
- Sulphur dioxide air emissions from exposed waste;
- Low volatility petroleum hydrocarbons in the waste and soil;
- Heavy metals - particularly lead in the waste and soil; and

- Phenols in the waste and soil.

Any contamination is likely to be visible.

Exposure is possible by inhalation and dermal contact with contaminated cuttings and soil cores. Suitable protective clothing will be used at all times, the level of which is dependent upon the risk (see Section 7). The possibility of inhalation of dust and airborne particles is considered minor based on previous similar drilling investigations on the Omex site itself.

During drilling within the pit, there exists the potential for exposure to gaseous sulphur dioxide emissions. This is expected to be very low given the small cutting into the waste (<20 cm diameter), however there will be regular monitoring (hourly intervals) for sulphur dioxide with a drager tube immediately downwind of the drill rig.

5.4 HANDLING OF WASTES AND DECONTAMINATION PROCEDURES

Drill cuttings from soil will be returned to the hole. Any excess drill cuttings and decontamination residues from equipment cleaning will be collected upon retrieval and placed in a 200L sealable, lined drums.

Decontamination procedures to remove gross contamination from the drill rig will be initially carried out on a disposable plastic lining placed on the pit cover. Subsequent cleaning will then be carried out on drilling equipment on the concrete washdown pad located at the northern part of the site.

For hand auger soil bores, cleaning compounds such as 5% Decon 90 solution or equivalent will be used for decontamination between bores followed by rinsing with clean water between drill holes. This is described fully in the Egis Field Investigation Quality Assurance Plan.

5.5 MISCELLANEOUS

Drill sites may contain numerous safety hazards such as slippery surfaces, stacking of equipment such as drill rods, heavy machinery in use etc. Site personnel should constantly look out for such potential hazards and avoid them. It is the responsibility of the Field Supervisor to identify, report and rectify any such hazards.

6. SITE CONTROL

All drilling (distinct from hand augering) will be confined to the Omex site. Buildings on the site are either currently being demolished or are vacant. The Omex site has secure perimeter fencing which will be kept closed during the drilling programme.

A warning sign informing that activity is in progress will be shown at the front entrance. Access to the Omex site will be limited to authorised site personnel as dictated by the Project Manager.

7. PERSONAL PROTECTIVE EQUIPMENT

Wearing of personnel protective equipment (PPE) is designed to prevent skin contact and inhalation with the chemicals of concern in the soil and waste. The level of protection required is a function of the hazard posed by the contaminants. As a minimum in soils (as distinct from the pit waste), the following PPE is required where hand augering is used to recover soil samples:

- safety glasses;
- latex gloves;
- steel cap boots; and
- standard Tyvek overalls.

The PPE required for the drilling exercise is of a higher standard due to the hazardous nature of the waste. All personnel working with and in close vicinity to the drill rig will be required to wear the following PPE:

- safety goggles;
- twin respirator for organics and fine dust;
- impermeable Tyvek suit;
- nitrile rubber gloves (two pair-inside and outside of suit);
- nitrile rubber steel cap boots;
- ear plugs; and
- hard hat.

The above mentioned PPE will be required to be worn during the initial cleaning of drilling equipment.

At the completion of all drilling work, the PPE will be removed in the work area and either cleaned, or disposed of (ie Tyvek overalls and gloves) into waste drums.

8. EMERGENCY PROCEDURES

The following pages are to be posted in a prominent location in close proximity to the work area.

SITE EMERGENCY INSTRUCTIONS

Site Evacuation Point:
Front entrance, Clayton Street, Bellevue

Monitored Substances of Concern:

- Sulphur dioxide — 2 ppm occupational limit over 8 hours

Chemical Compounds Present in Waste:

- Acidity
- Metals - Lead, Zinc
- Polycyclic Aromatic Hydrocarbons
- Aliphatic heavy fraction hydrocarbons

Egis Consulting Office Telephone

Project Manager	David Ross 9220 9401
On-site Occupational Health & Safety Representative:	Peter Thorpe (0419 953 024)

SITE EMERGENCY FORM

IN THE EVENT OF ANY EMERGENCY, CONTACT PROJECT MANAGER, OR HEALTH AND SAFETY REPRESENTATIVE

EMERGENCY PHONE NUMBERS

Ambulance	000
Fire	000
Police	000
Project Manager	David Ross 9220 9401
Health and Safety Reps	Peter Thorpe 0419 953 024
Poison Control	131 126 (PMH)
State Agency	Health Department of WA
Hospital Name	Swan District Hospital Eveline Road Middle Swan
Hospital Phone:	9347 5244

FIRST AID FOR SUBSTANCES OF CONCERN

Ingestion: DO NOT INDUCE VOMITING. Call Poison Control; follow instructions. Administer CPR, if necessary. Seek medical attention.

Inhalation: Remove person from contaminated environment. DO NOT ENTER A CONFINED SPACE TO RESCUE SOMEONE WHO HAS BEEN OVERCOME UNLESS PROPERLY EQUIPPED AND A STANDBY PERSON IS PRESENT. Administer CPR if necessary. Seek medical attention.

Skin Contact: Brush off dry material, remove wet or contaminated clothing. Flush skin thoroughly with soap and water. Seek medical attention if irritation persists.

Eye Contact: Flush eyes with water for 15 minutes. Remove contact lenses if present. Seek medical attention.

Contingency Plan: Report incident to Project Manager and Health and Safety Representative after emergency procedures have been implemented.

APPENDIX A
QUALITY ASSURANCE PLAN

APPENDIX A

OMEX SITE INVESTIGATION
QUALITY ASSURANCE PLAN –1999

1. INTRODUCTION

This Quality Assurance Plan documents procedures to be followed by employees of Egis Consulting Australia Environmental, their subconsultants/subcontractors when involved in field investigations designed to assess the nature and extent of ground contamination. This Quality Assurance Plan also applies when providing advice to assist in the remediation of contaminated sites.

The extent of field investigations will be as defined in the relevant proposal/cost estimate for ground contamination assessments. The programme of works associated with site remediation will be developed on a site specific basis, dependent on remediation technique.

All the work performed during this study will be performed under the direction of an experienced field engineer.

All personnel involved in the field investigations will conform with the requirements of a site-specific health and safety plan. Access to the investigation areas will be restricted to personnel directly involved in the investigation.

Underground site services will be located from the available plans, wherever possible, prior to commencement of the field work and relevant data will be assembled on a single plan for use by the field engineer.

2. SAMPLING LOCATIONS AND IDENTIFICATION

All soil gas sample points, hand auger holes and bores will be located by reference to existing ground features, e.g. fences, buildings, etc. with distances being measured by graduated tapes, or pacing.

All soil gas sample points, auger holes and boreholes will be numbered consecutively, and the following prefixes will be assigned:

SGS: Soil-gas probe sampling point

SB: Auger holes

MB: Boreholes (groundwater monitoring)

All depth measured in bores and hand auger holes will be referenced to the ground surface (0 m).

3. AUGER HOLES

An area will be established onsite where all equipment may be cleaned without risk of contaminating areas to be sampled. On arrival onsite, the sampling equipment will be decontaminated in accordance with the procedures outlined in Section 7.

Samples will be recovered from the drill/hand auger, taking care to avoid cross contamination, especially between samples recovered from the same hole but at different depths. All sampling equipment is to be thoroughly cleaned between sampling events, in accordance with the procedures outlined in Section 7.

A log of soil conditions and other observations including evidence of contamination, will be prepared on standard field log sheets.

4. BOREHOLES

- The drilling rig to be used will be in sound working order and free of oil leaks.
- A cleaning pad will be established on the site where the drilling rig and other large equipment can be cleaned without risk of contamination to sampling locations. Power and water will need to be located nearby to enable use of a steam-clean unit. A suitable generator will be required where a power supply is not available.
- On arrival at the site the drilling rig will be cleaned including all drilling equipment which will go into or be used near the borehole. The drilling rig and all drilling equipment will also be cleaned between boreholes.
- Hollow auger equipment will be used to drill each borehole. No petroleum based lubricants are to be used on the drill string or any sampling equipment.
- Samples will be recovered at approximately 1 m intervals to the specified depth of sampling, or at other locations considered appropriate by the field engineer.
- Logs of the soil encountered will be prepared on standard borehole log sheets. The soil will be logged using the Unified Method of Soil Classification and Notes and Abbreviations.
- On completion of drilling the borehole is to be backfilled with clean cuttings. If appropriate, the top of the borehole will be grouted with concrete.

5. PID HEADSPACE MEASUREMENTS

PID headspace readings shall be taken by placing soil cuttings, recovered from the sampling location, in an appropriate glass vial and covered with an aluminium foil seal. The jar shall be filled to approximately 50% of its capacity and stored away from direct sunlight for between 5 and 10 minutes. A headspace reading shall be obtained by piercing the foil seal and inserting the probe of the PID into the vial headspace, with care being taken not to tear the seal such that ambient air may enter. The PID reading shall be observed and the maximum level recorded. Note, the calibration of the PID shall be checked on a regular basis.

6. MONITORING BORE INSTALLATION

Monitoring bores will be installed in accordance with Water & Rivers Commission requirements.

7. SAMPLING AND CLEANING

All sampling equipment will be thoroughly cleaned before use and between samples. This includes the spatulas, trowels, scoops etc. any other equipment that is used. All cleaning will be performed on a clean surface, such as a plastic sheet. The cleaning procedure for all sampling equipment will involve:

- wash in tap water removing gross contamination
- wash in DECON 90 solution (or similar phosphate-free laboratory detergent)
- rinse copiously with tap water
- rinse with de-ionised water

Field blanks will be prepared by running distilled water over the cleaned sampling tools and collecting the water in a clean jar, filling the jar to capacity.

The field engineer is to wear clean vinyl/rubber gloves when handling soil samples and cleaned equipment.

Each soil sample other than BTEX is to be placed in a pre-washed or new glass jar with a tight fitting screw top lid. The pre-washing will be performed in the laboratory using the procedure outlined above. Clean aluminium foil may be used to ensure an air tight seal. BTEX soil samples will be placed into an appropriate vial and crimp sealed.

Each sample jar is to be labelled with the following information:

- Sample identity
- Date of sampling
- Depth of sample

Chain-of-custody documentation is to be completed onsite. This will include the information listed above and if appropriate, the chemical analyses required for each sample. The field engineer is to sign the appropriate section of the chain-of-custody form before handing over the samples to the laboratory.

All samples are to be stored at approximately 4°C, or below, prior to analysis. This includes transportation and onsite storage.

Where samples are to be analysed for monocyclic aromatic hydrocarbons, the sample will be placed in a sealed headspace vial, taking care to minimise the loss of volatiles.

Groundwater samples will be recovered using a suitable bailer, cleaned in accordance with the above procedures. Prior to sampling the monitoring bore will be purged by bailing or otherwise pumping 3 bore volumes or until field parameters have stabilised. Groundwater samples will be transferred from the bailer to the clean sample containers using a bottom-emptying device to minimise the loss of volatile species. Depth to groundwater will be determined after bore development but prior to purging and sampling, after allowing sufficient time for the groundwater levels to re-establish. The depth to groundwater will be measured using a clean water level indicator.

All samples are to be transported to the chemical laboratories by the field engineer, or a designated courier who must be documented in the chain-of-custody documentation (see attached chain-of-custody documentation).

APPENDIX B
FIELD LOGS

Omex Environmental Site assessment Soil Bores
Dioxin Testing Log Sheet
18 September 1999

Soil Bore Number	*Depth Interval*	*Lithology*	*Field Rank*
D1	0.0 – 0.3m	Gravelly SAND; light brown, fine to coarse grained quartz, fill material	0
Photo 1	0.3 – 0.7m	Sandy CLAY; dark grey black, fine to medium grained quartz, low plasticity	3
D2	0.0 – 0.3m	Gravelly SAND; light brown, fine to coarse grained quartz, fill material	0
Photo 2	0.3 – 0.5m	Gravelly CLAY; dark grey, fine to medium grained, low plasticity	2
D3	0.0 – 0.2m	Gravelly SAND; light brown, fine to coarse grained quartz, fill material	0
	0.2 – 0.4m	Sandy CLAY; dark brown, fine to coarse grained quartz, low plasticity	1
Photo 3	0.4 – 0.6m	Silty CLAY; black, fine grained silts, some quartz, low plasticity	2/3
D4	0.0 – 0.3m	Gravelly SAND; light brown, fine to coarse grained quartz, fill material	0
Photo 4	0.3 – 0.6m	Sandy CLAY; dark brown, fine to medium grained quartz, low to medium plasticity	1
D5	0.0 – 0.5m	Silty GRAVEL; light brown, fine to coarse grained, limestone and gravel fill	0
Photo 5	0.5 – 0.7m	Sandy CLAY; light grey grey, fine to medium grained quartz, low plasticity	0
D6	0.0 – 0.2m	Silty SAND; dark grey, fine to medium grained quartz, predominantly fine, low plasticity	0
Photo 6	0.2 – 0.3m	Sandy CLAY; orange brown, fine grained, low to medium plasticity, (Fe staining)	0
D7	0.0 – 0.2m	Silty SAND; dark grey, fine to medium grained quartz, predominantly fine grained	0
Photo 7	0.2 – 0.5m	Sandy CLAY; orange brown, fine grained, low to medium plasticity, (Fe staining)	0
D8	0.0 – 0.2m	Silty SAND; dark grey, fine to medium grained quartz, predominantly fine grained	0
Photo 8	0.2 – 0.5m	Sandy CLAY; orange brown, fine grained, low to medium plasticity, (Fe staining)	0
D9	0.0 – 0.2m	Silty SAND; dark grey, fine to medium grained quartz, predominantly fine grained	0
Photo 9	0.2 – 0.7m	Sandy CLAY; orange brown, fine grained, low to medium plasticity, (Fe staining)	0
D10	0.0 – 0.3m	Silty SAND; dark grey, fine to medium grained quartz, predominantly fine grained	0
Photo 10	0.3 – 0.6m	Sandy CLAY; light brown, fine grained, low to medium plasticity, laterite gravels	0
D11	0.0 – 0.1m	Silty SAND; grey dark grey, fine to medium grained quartz	0
Photo 11	0.1 – 0.7m	Silty SAND; light grey, fine to medium grained quartz	0
D12	0.0 – 0.1m	Silty Clayey SAND; brown, fine to medium grained quartz, low plasticity	0
Photo 12			

- Samples taken from specific locations around the perimeter of the Omex Waste Pit.
- Refer to photographic logs one to twelve in reference to soil types recorded above.

CMPS&F Pty Limited
Environmental Engineers & Scientists
ACN 000 912 630
200 Adelaide Terrace, Perth WA 6000
Tel: (08) 9220 9300 Fax: (08) 9325 9897

Client: DEP
Logged By: P Thorpe
Drill Rig: OZ Drill
Bore Ref: CMC

Project: Omex P M
Date: 14/9/99
Job No: VW1100
Estimated Ground Level: 18.6 mAHD

Depth BGL (m)	Sample Taken	Monitor Well Log	SWL (m)	PID (ppmv)	Lithology	Field Rank	Samples
				FILL: Yellow, medium-coarse grained, poorly sorted quartz sand beneath HDPE cover. Dry no oil.			
1.0							
				CONTAMINATED FILL: Grey clayey sand. Oil-stained in part. Concrete rubble at 1.95 m			Sample 1 (1.2-2.5m)
2.0							
3.0							
				CONTAMINATED FILL: Grey sandy clay & minor laterite gravel. Oil-stained. Soft. Glass bottle fragments			Sample 2 (2.5-4.0m)
4.0							
							Sample 3 (4.0-5.5m)
5.0				CONTAMINATED FILL: Dark grey clayey sand. Bands of black oil staining.			
6.0							
					CONTAMINATED FILL:		Sample 4 (5.5-7.0m)
7.0				Change at 6.0 m to black hard clayey sand with white crystalline material (secondary sulphate crystals) and oil sludge wastes. High astringent odour level.			
				CONTAMINATED FILL: Black hard silty clay with strong sulphur odour. Oil coating grains.			
8.0					SAND:		
				Black oil stained sand from 7.75 m. Probably natural ground infiltrated by oil waste liquor.			Sample 5 (7.0-8.5m)
					SANDY CLAY		
9.0				Yellow/brown sandy clay and clayey sand at 8.5 m. Base of pit fill at 8.5 m. Minor laterite gravel. No visible oil staining.			
							Sample 6 (8.5-9.25m)
10.0							
Note EOH 9.25 m BGL							

Casing : None

Drillhole: Backfilled with cuttings

Wastes : (drill cuttings & PPE) placed in 2 steel 200L drums labelled CMC 1 of 2 and CMC 2 of 2.

Photo 1 - Soil Bore: D1 Depth Drilled: 0.7m

Photo 2 - Soil Bore: D2 Depth Drilled: 0.5m

Photo 3 - Soil Bore: D3 Depth Drilled: 0.6m

Photo 4 - Soil Bore: D4 Depth Drilled: 0.6m

Photo 5 - Soil Bore: D5 Depth Drilled: 0.7m

Photo 6 - Soil Bore: D6 Depth Drilled: 0.3m

Photo 7 - Soil Bore: D7 Depth Drilled: 0.5m

Photo 8 - Soil Bore: D8 Depth Drilled: 0.5m

Photo 9 - Soil Bore: D9 Depth Drilled: 0.7m

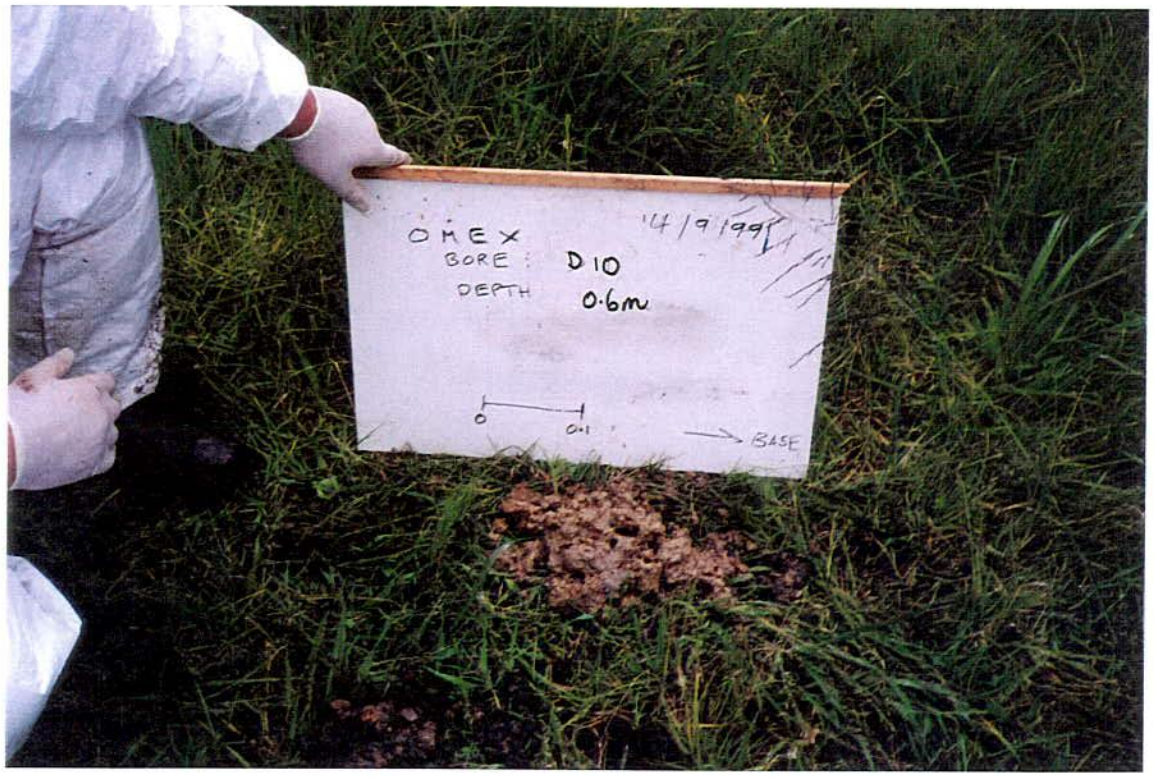

Photo 10 - Soil Bore: D10 Depth Drilled: 0.6m

Photo 11 - Soil Bore: D11 Depth Drilled: 0.1m

Photo 12 - Soil Bore: D12 Depth Drilled: 0.1m

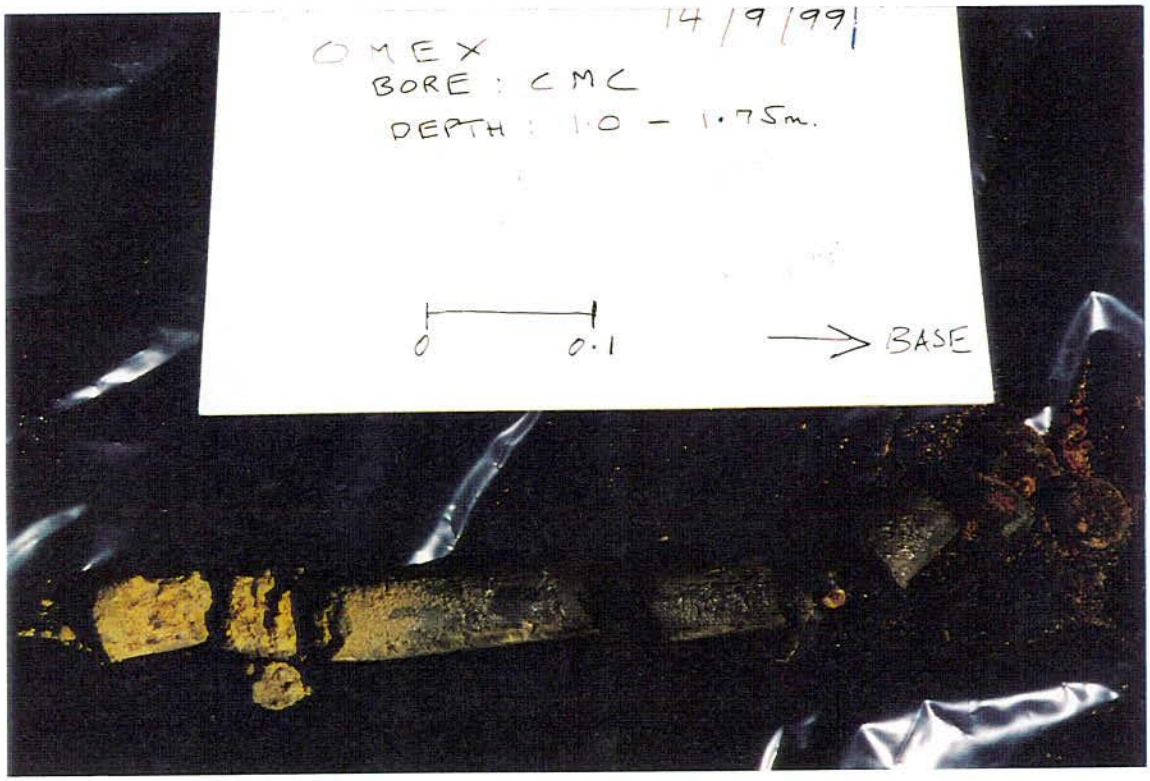

Photo 13 - Bore Hole: CMC Depth: 1.0 – 1.75m

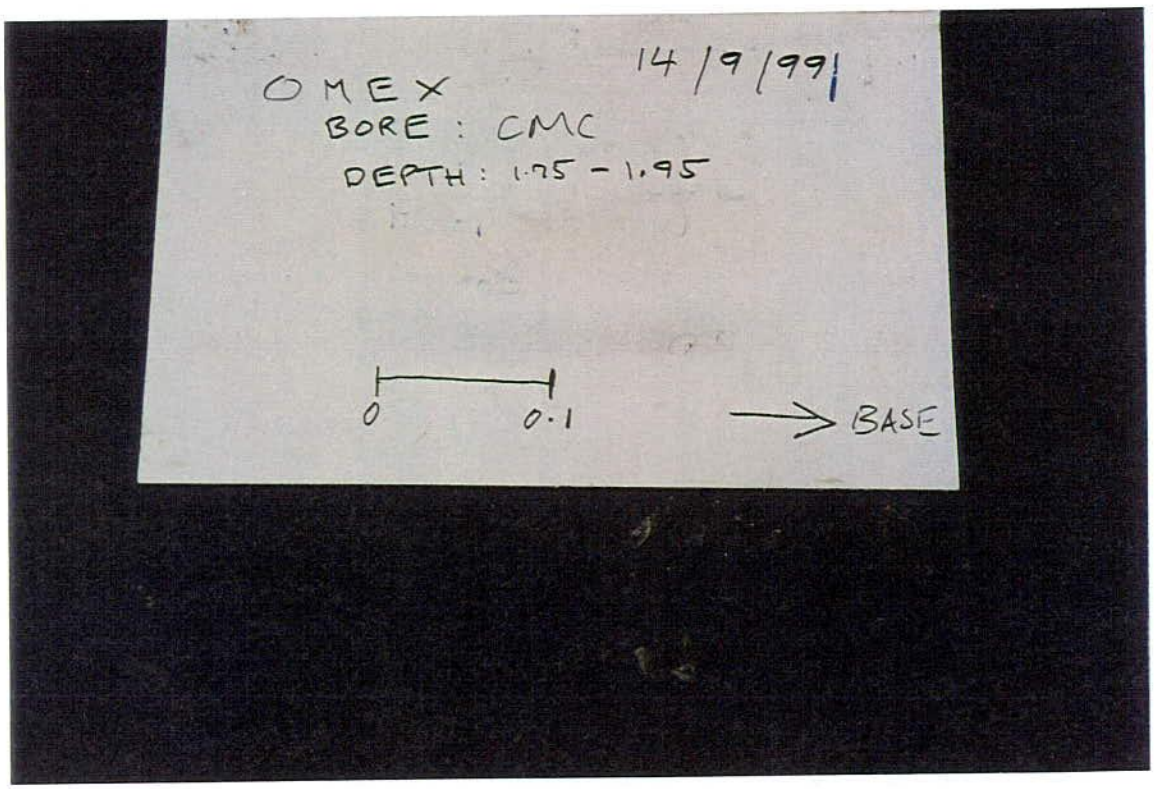

Photo 14 - Bore Hole: CMC Depth: 1.75 – 1.95m

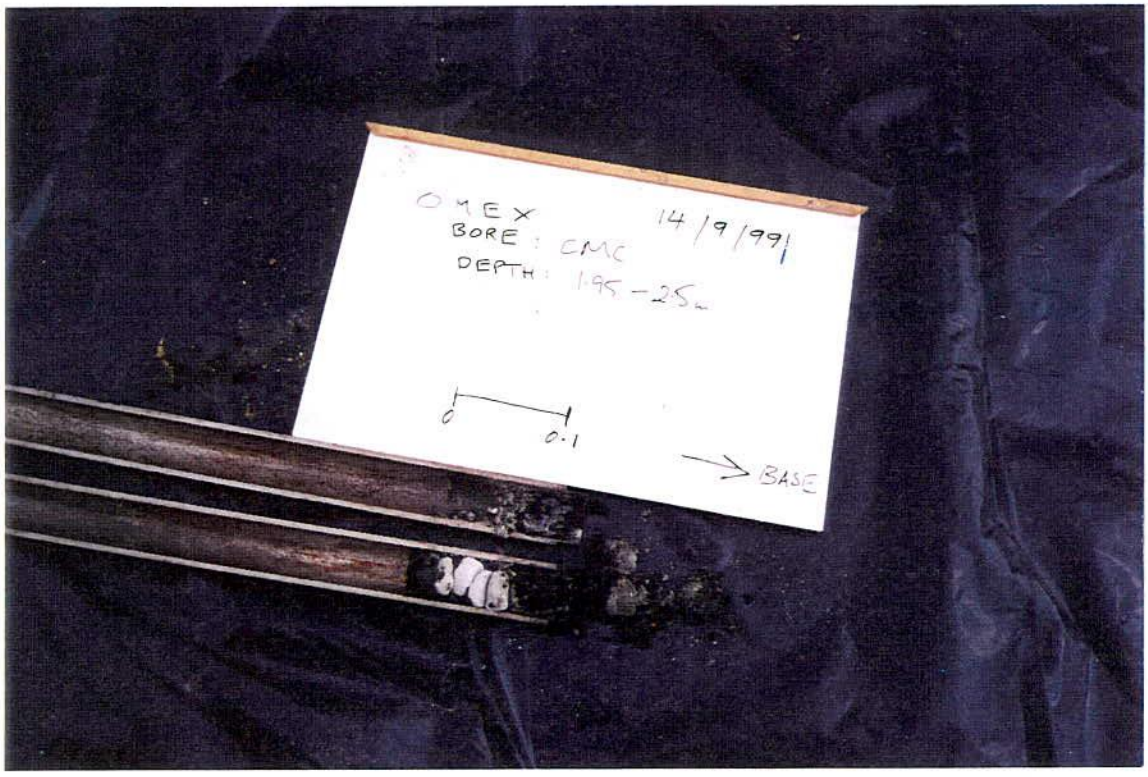

Photo 15 - Bore Hole: CMC Depth: 1.95 – 2.5m

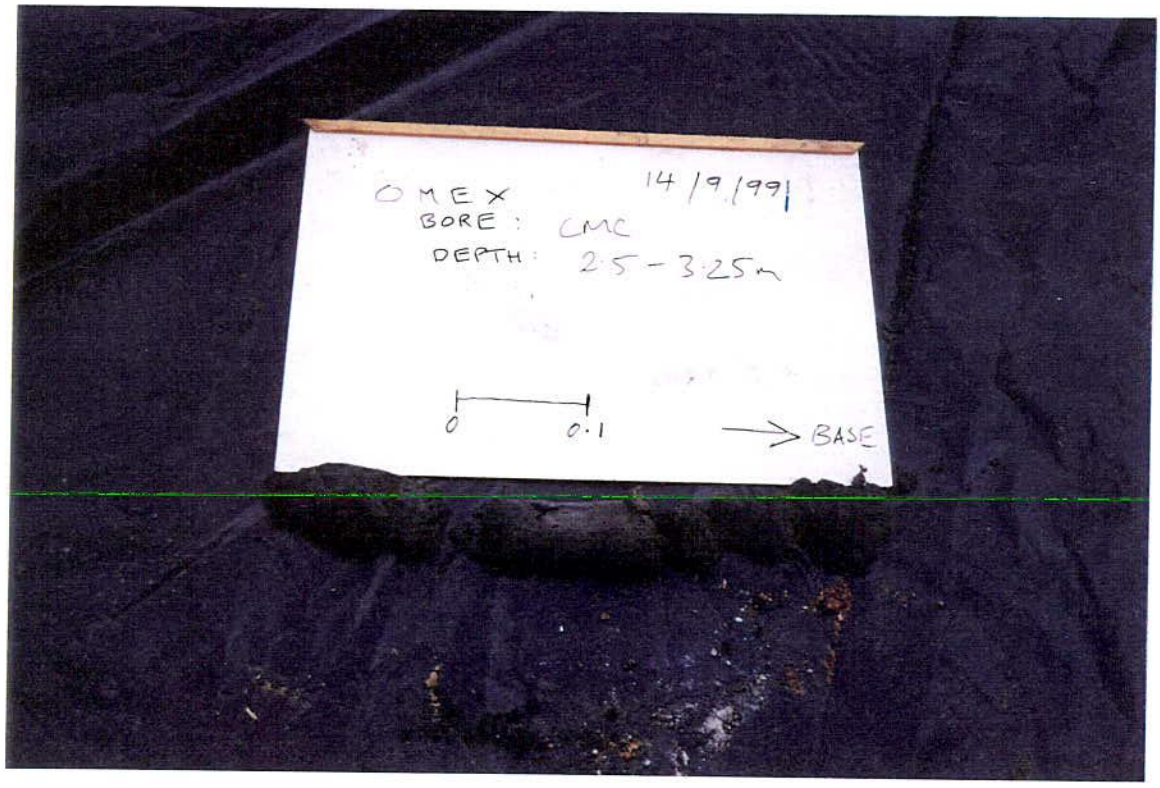

Photo 16 - Bore Hole: CMC Depth: 2.5 – 3.25m

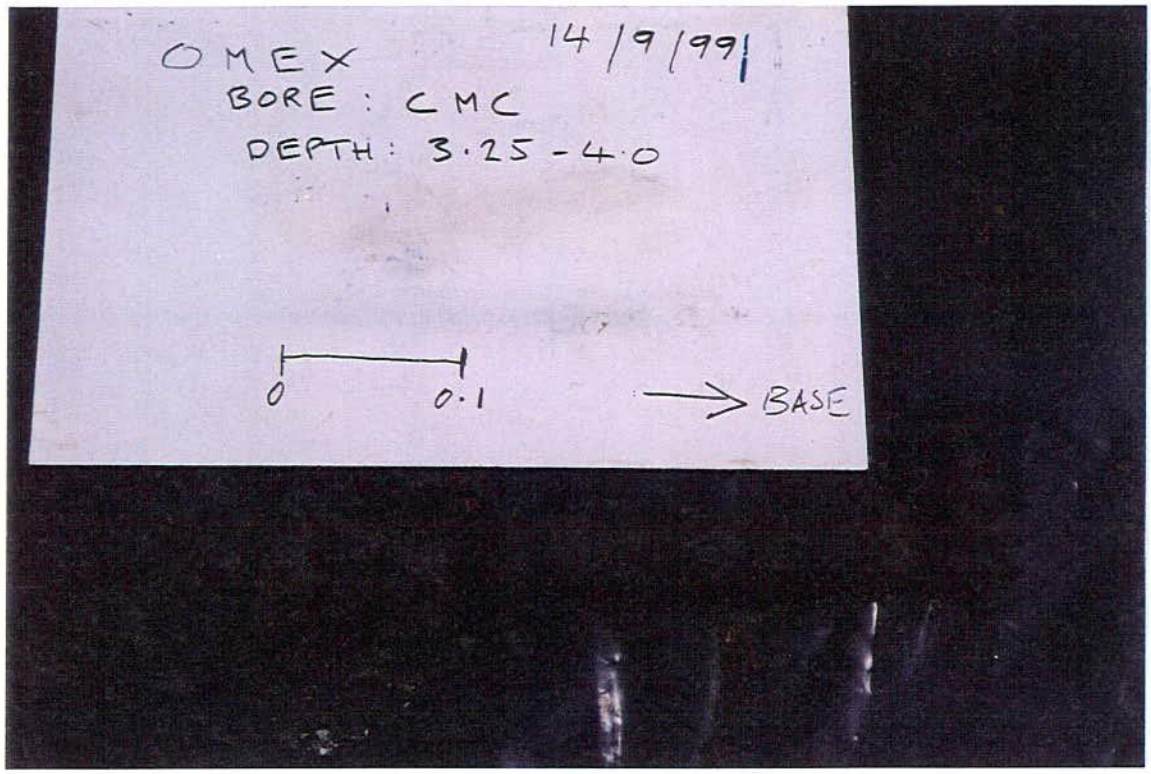

Photo 17 - Bore Hole: CMC Depth: 3.25 – 4.0m

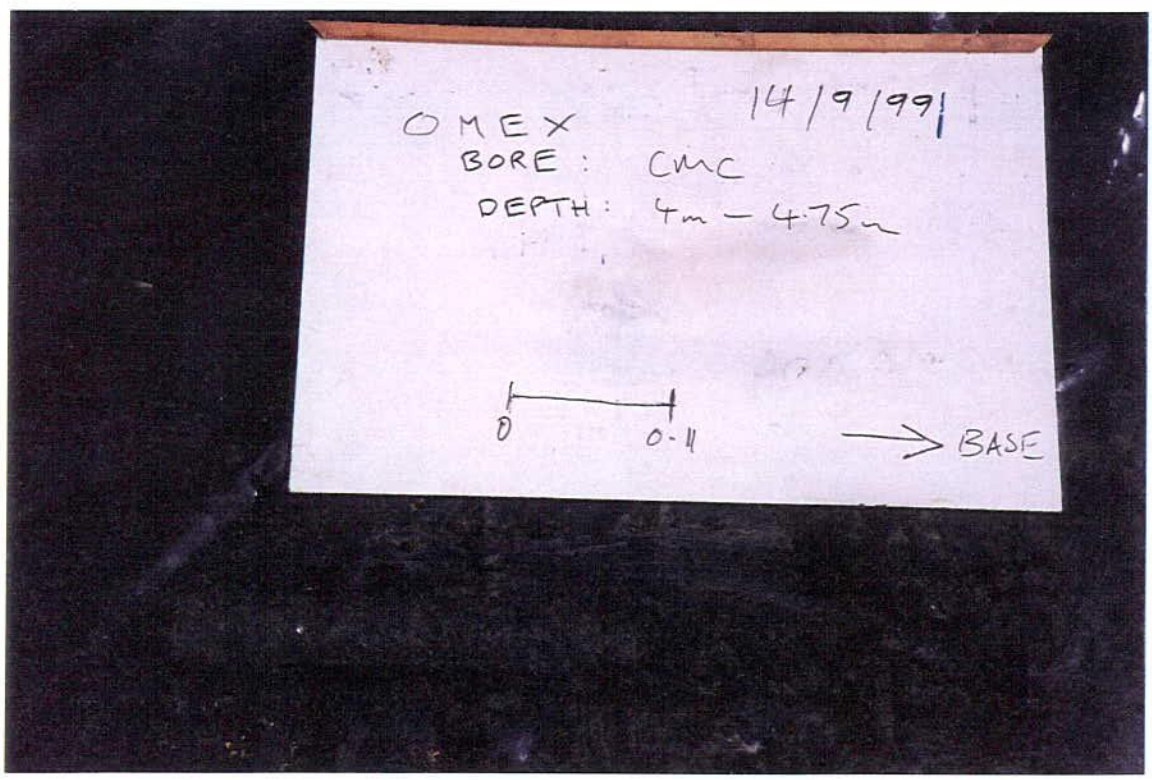

Photo 18 - Bore Hole: CMC Depth: 4.0 – 4.75m

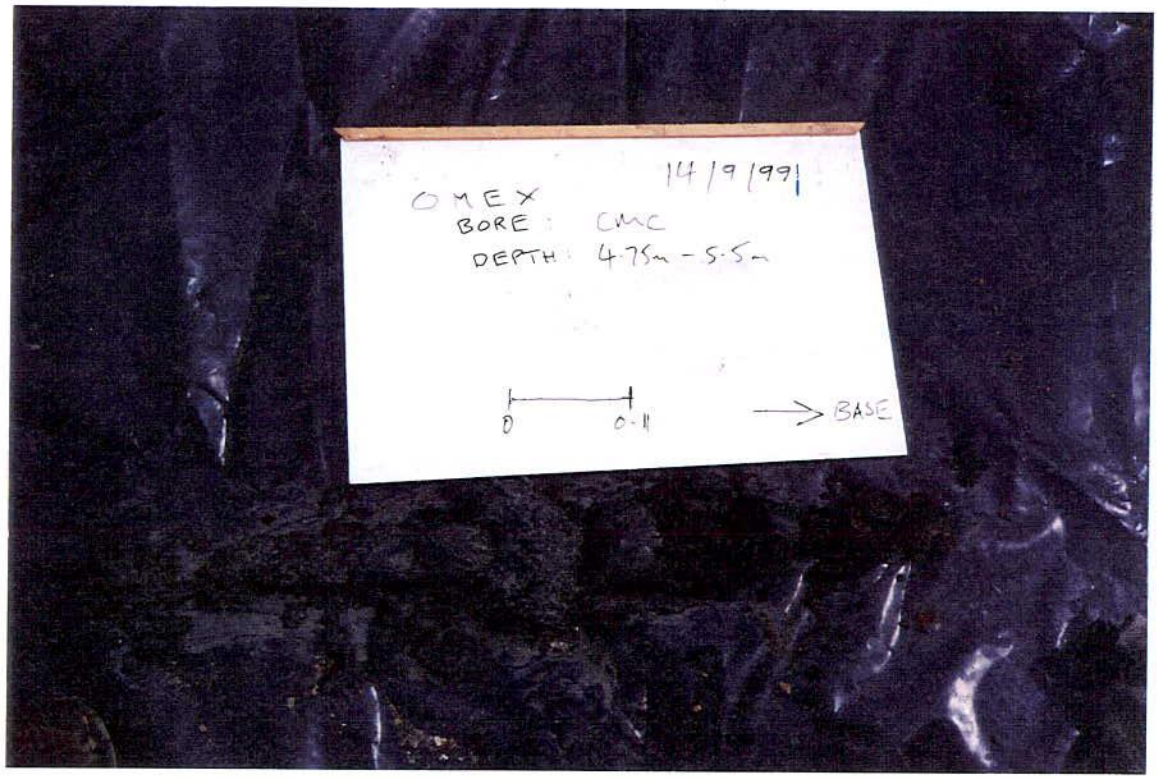

Photo 19 - Bore Hole: CMC Depth: 4.75 – 5.5m

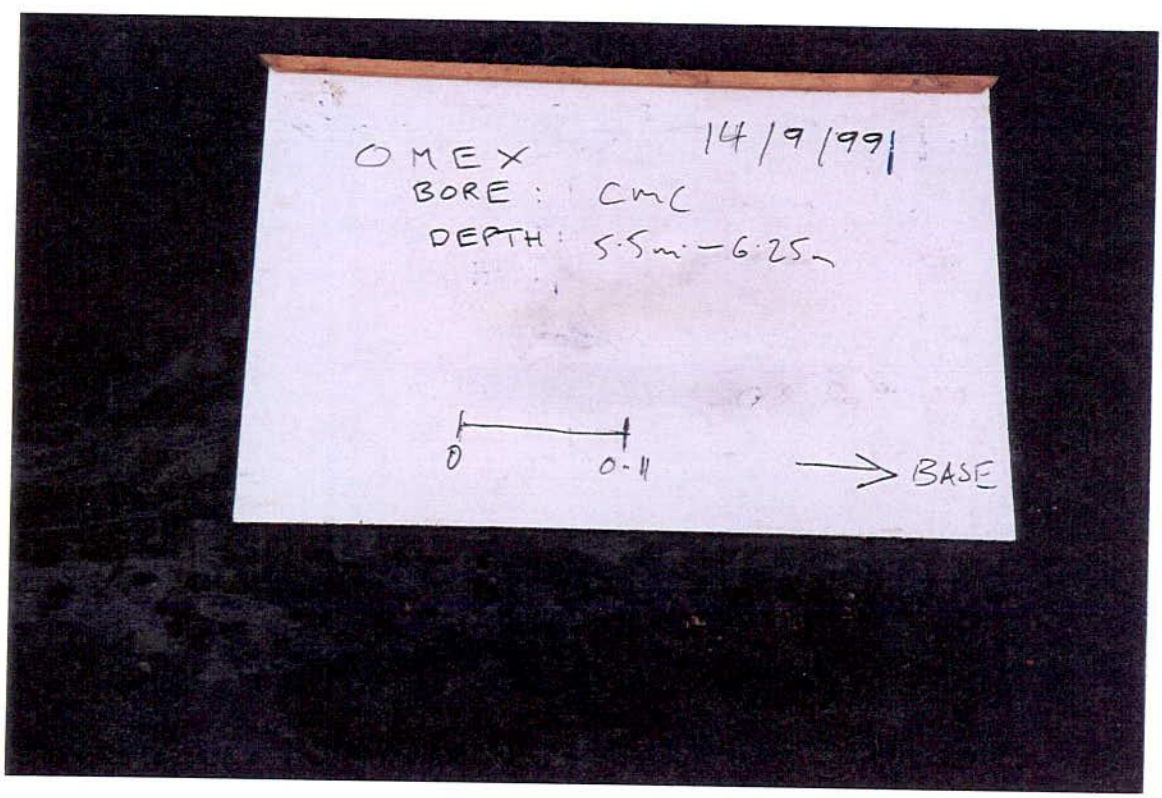

Photo 20 - Bore Hole: CMC Depth: 5.5 – 6.25m

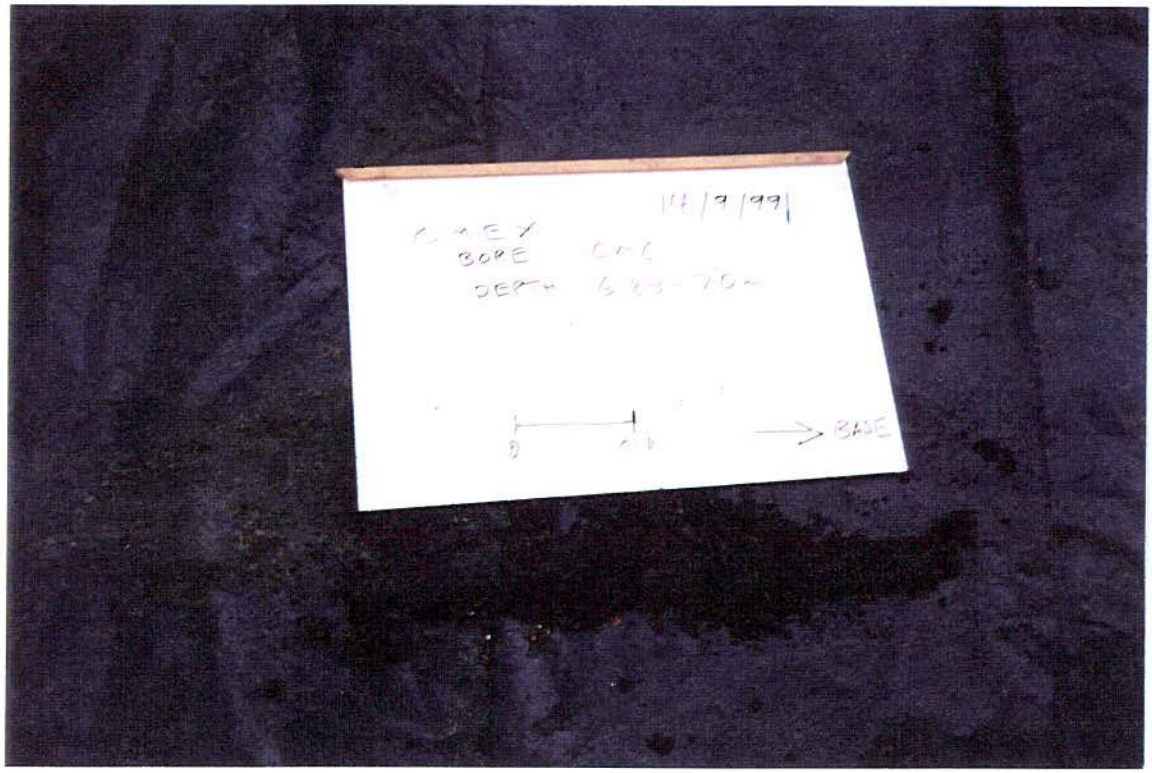

Photo 21 - Bore Hole: CMC Depth: 6.25 – 7.0m

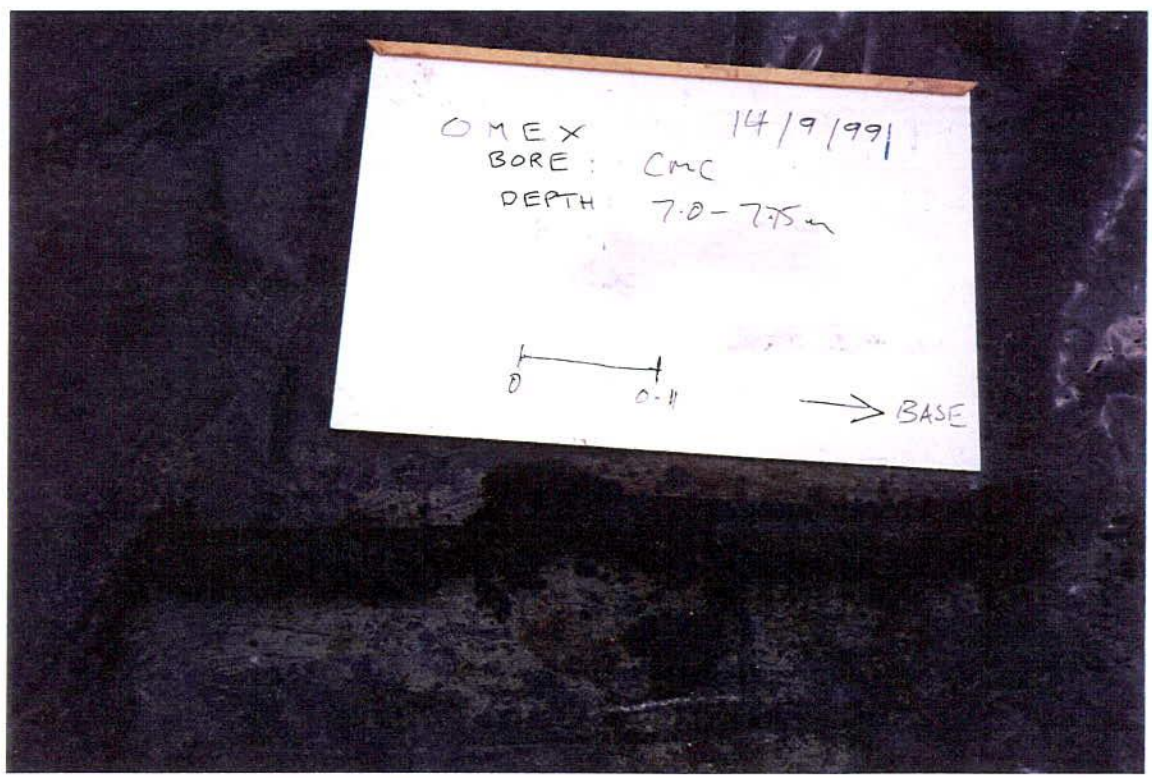

Photo 22 - Bore Hole: CMC Depth: 7.0 – 7.75m

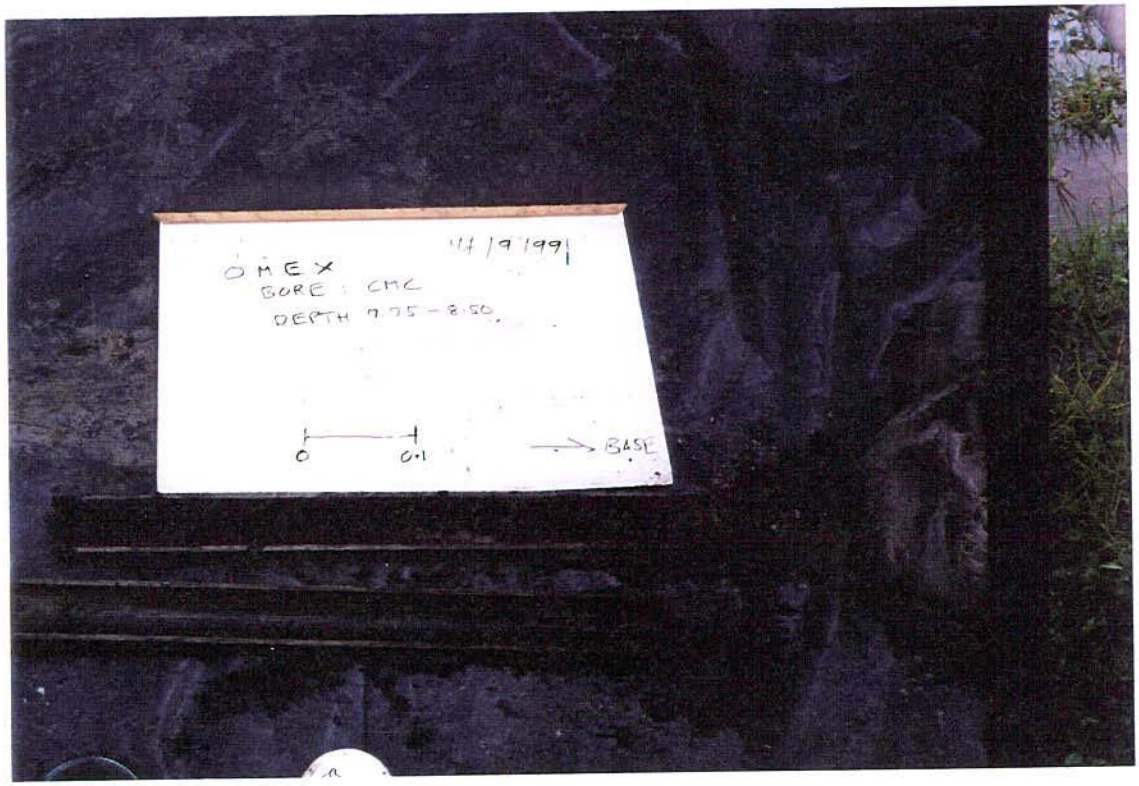

Photo 23 - Bore Hole: CMC Depth: 7.75 – 8.5m

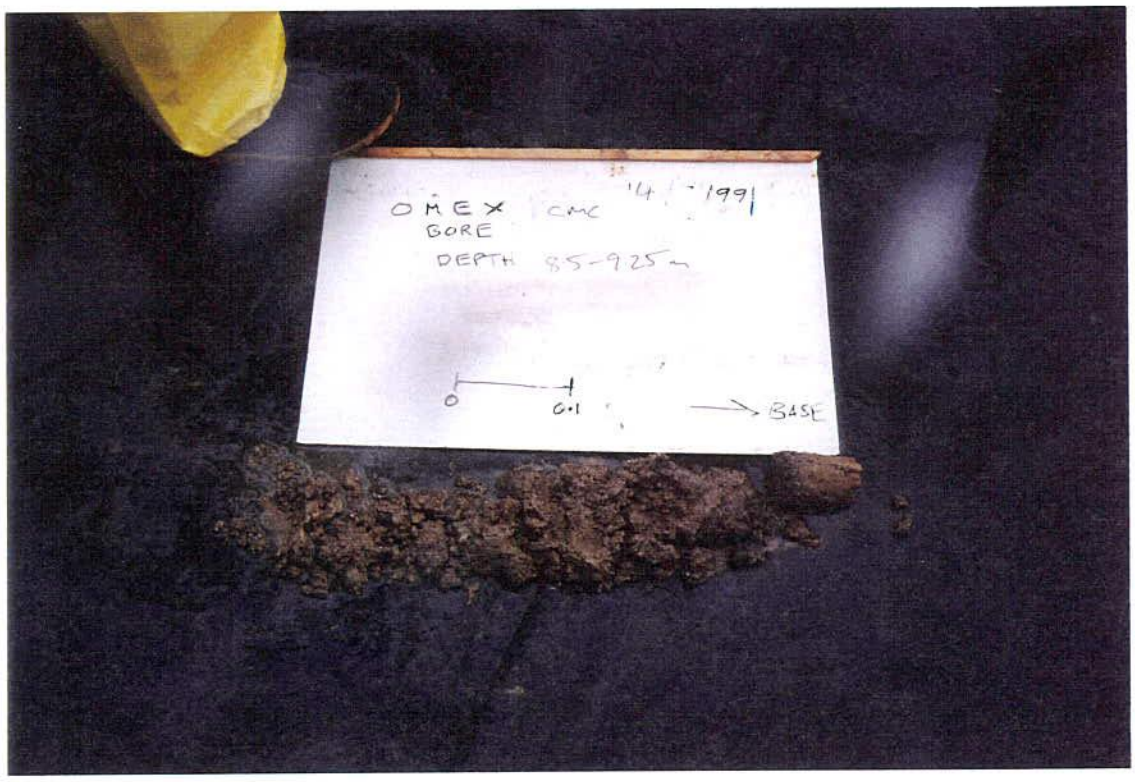

Photo 24 - Bore Hole: CMC Depth: 8.5 – 9.25m

APPENDIX D
ANALYTICAL LABORATORY CERTIFICATES

ESR

23 November 1999

Certificate of Analysis

Client:	EGIS ConsultingAustralia Pty Ltd PO Box 6311 East Perth 6892 WA AUSTRALIA
Attention:	David Ross
Date Received:	27 October 1999
ESR Laboratory Reference:	991888
Sample Type:	Solid
Analysis:	**Polychlorinated dibenzo-*p*-dioxins (PCDDs)** **Polychlorinated dibenzofurans (PCDFs)**
Method:	Isotope Dilution

The samples were spiked with isotopically labelled surrogate standards and extracted with organic solvent. The extracts were purified by chemical treatment and solid phase chromatographic techniques. Measurement was performed using high resolution gas chromatography with high resolution electron impact mass spectrometry. Full details are available on request.

Results are reported in picograms per gram (pg/g), equivalent to ppt, on a dry weight basis to two significant figures. The sum of PCDDs and PCDFs is calculated and reported excluding limit of detection (LOD) values to three significant figures.

The total toxic equivalents (I-TEQ) was calculated for each sample using international toxic equivalency factors (I-TEFs). The total I-TEQ level is reported excluding LOD values values to three significant figures.

IANZ endorsement applies only to the application of an approved analytical method for the determination of PCDDs and PCDFs in these samples.

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

S V Leathem
Organic Chemistry Laboratory
ESR Analytical

J L Allwood
Organic Chemistry Laboratory
ESR Analytical

Supplementary Report
CLAU18\991888 dx

THIS REPORT MUST ONLY BE REPRODUCED IN ITS ENTIRETY

Institute of Environmental Science & Research Limited
Wellington Science Centre
Gracefield Road, PO Box 30-547, Lower Hutt, New Zealand
Telephone: (04) 570-1555, Facsimile: (04) 569-4500

A CROWN RESEARCH INSTITUTE

Sample Details:

Sample Identification	ESR Laboratory Reference	Sample Type	Date Received
D2, 0.5m	991888/1	Solid	27 October 1999
D3, 0.6m	991888/2	Solid	27 October 1999
D6, 0.3m	991888/3	Solid	27 October 1999
D11, 0.1m	991888/4	Solid	27 October 1999
D12, 0.1m	991888/5	Solid	27 October 1999
5A, Omex	991888/6	Solid	27 October 1999

Abbreviations:

CDD	= chlorodibenzo-*p*-dioxin	I-TEF	= International toxic equivalency factor
CDF	= chlorodibenzofuran	I-TEQ	= International toxic equivalent
T	= tetra	$^{13}C_{12}$ RE	= recovery of $^{13}C_{12}$ surrogate standard
Pe	= penta	pg/g	= picograms per gram (equivalent to ppt)
Hx	= hexa	ppt	= parts per trillion
Hp	= hepta	<	= less than limit of detection (LOD)
O	= octa		

Results

ESR Laboratory Reference: 991888/1

Sample Identification: D2, 0.5m

PCDD/PCDF Congener	Level† pg/g	I-TEF	I-TEQ pg/g	$^{13}C_{12}$ RE %	
2378 TCDF	< 10	0.1	0.5	17	⚑
Non 2378 TCDF	< 10	0	0		
2378 TCDD	< 8	1	4	29	
Non 2378 TCDD	< 20	0	0		
12378 PeCDF	< 9	0.05	0.225	63	
23478 PeCDF	< 10	0.5	2.5	46	
Non 2378 PeCDF	< 40	0	0		
12378 PeCDD	< 6	0.5	1.5	65	
Non 2378 PeCDD	61	0	0		
123478 HxCDF	< 10	0.1	0.5	78	
123678 HxCDF	< 8	0.1	0.4	79	
234678 HxCDF	< 5	0.1	0.25	82	
123789 HxCDF	< 3	0.1	0.15	76	
Non 2378 HxCDF	50	0	0		
123478 HxCDD	< 10	0.1	0.5	85	
123678 HxCDD	< 10	0.1	0.5	81	
123789 HxCDD	< 10	0.1	0.5		
Non 2378 HxCDD	62	0	0		
1234678 HpCDF	19	0.01	0.19	81	
1234789 HpCDF	< 7	0.01	0.035	81	
Non 2378 HpCDF	11	0	0		
1234678 HpCDD	40	0.01	0.40	83	
Non 2378 HpCDD	40	0	0		
OCDF	32	0.001	0.032		
OCDD	< 200	0.001	0.1	90	
Sum of PCDD and PCDF congeners:			315	pg/g	
Total I-TEQ:			0.622	pg/g	

† = Results are reported on a dry weight basis.

⚑ = Recovery outside method acceptance criteria (25-125%).

Results

ESR Laboratory Reference: 991888/2

Sample Identification: D3, 0.6m

PCDD/PCDF Congener	Level† pg/g	I-TEF	I-TEQ pg/g	$^{13}C_{12}$ RE %	
2378 TCDF	15	0.1	1.5	9	⚑
Non 2378 TCDF	1100	0	0		
2378 TCDD	< 10	1	5	18	⚑
Non 2378 TCDD	< 10	0	0		
12378 PeCDF	21	0.05	1.05	24	⚑
23478 PeCDF	37	0.5	18.5	12	⚑
Non 2378 PeCDF	1200	0	0		
12378 PeCDD	< 20	0.5	5	24	⚑
Non 2378 PeCDD	< 40	0	0		
123478 HxCDF	64	0.1	6.4	82	
123678 HxCDF	69	0.1	6.9	79	
234678 HxCDF	56	0.1	5.6	75	
123789 HxCDF	< 9	0.1	0.45	77	
Non 2378 HxCDF	890	0	0		
123478 HxCDD	7.9	0.1	0.79	78	
123678 HxCDD	33	0.1	3.3	75	
123789 HxCDD	15	0.1	1.5		
Non 2378 HxCDD	220	0	0		
1234678 HpCDF	150	0.01	1.5	82	
1234789 HpCDF	43	0.01	0.43	84	
Non 2378 HpCDF	100	0	0		
1234678 HpCDD	140	0.01	1.4	85	
Non 2378 HpCDD	140	0	0		
OCDF	190	0.001	0.19		
OCDD	420	0.001	0.42	93	
Sum of PCDD and PCDF congeners:			4910	pg/g	
Total I-TEQ:			49.5	pg/g	

† = Results are reported on a dry weight basis.

⚑ = Recovery outside method acceptance criteria (25-125%).

Results

ESR Laboratory Reference: 991888/3

Sample Identification: D6, 0.3m

PCDD/PCDF Congener	Level† pg/g	I-TEF	I-TEQ pg/g	$^{13}C_{12}$ RE %
2378 TCDF	1.6	0.1	0.16	83
Non 2378 TCDF	62	0	0	
2378 TCDD	7.2	1	7.2	92
Non 2378 TCDD	300	0	0	
12378 PeCDF	< 3	0.05	0.075	88
23478 PeCDF	< 3	0.5	0.75	86
Non 2378 PeCDF	43	0	0	
12378 PeCDD	8.9	0.5	4.45	93
Non 2378 PeCDD	260	0	0	
123478 HxCDF	< 4	0.1	0.2	80
123678 HxCDF	< 3	0.1	0.15	85
234678 HxCDF	< 4	0.1	0.2	86
123789 HxCDF	< 3	0.1	0.15	76
Non 2378 HxCDF	14	0	0	
123478 HxCDD	< 5	0.1	0.25	89
123678 HxCDD	9.2	0.1	0.92	86
123789 HxCDD	6.7	0.1	0.67	
Non 2378 HxCDD	88	0	0	
1234678 HpCDF	< 4	0.01	0.02	88
1234789 HpCDF	< 3	0.01	0.015	78
Non 2378 HpCDF	< 4	0	0	
1234678 HpCDD	18	0.01	0.18	95
Non 2378 HpCDD	20	0	0	
OCDF	< 6	0.001	0.003	
OCDD	< 50	0.001	0.025	98
Sum of PCDD and PCDF congeners:			839	pg/g
Total I-TEQ:			13.6	pg/g

† = Results are reported on a dry weight basis.

Results

ESR Laboratory Reference: 991888/4

Sample Identification: D11, 0.1m

PCDD/PCDF Congener	Level† pg/g	I-TEF	I-TEQ pg/g	$^{13}C_{12}$ RE %
2378 TCDF	< 2	0.1	0.1	80
Non 2378 TCDF	< 2	0	0	
2378 TCDD	< 4	1	2	93
Non 2378 TCDD	< 4	0	0	
12378 PeCDF	< 2	0.05	0.05	87
23478 PeCDF	< 3	0.5	0.75	83
Non 2378 PeCDF	< 2	0	0	
12378 PeCDD	< 4	0.5	1	82
Non 2378 PeCDD	< 4	0	0	
123478 HxCDF	< 3	0.1	0.15	90
123678 HxCDF	< 2	0.1	0.1	99
234678 HxCDF	< 3	0.1	0.15	91
123789 HxCDF	< 4	0.1	0.2	87
Non 2378 HxCDF	< 3	0	0	
123478 HxCDD	< 4	0.1	0.2	84
123678 HxCDD	< 4	0.1	0.2	86
123789 HxCDD	< 4	0.1	0.2	
Non 2378 HxCDD	< 4	0	0	
1234678 HpCDF	< 3	0.01	0.015	95
1234789 HpCDF	< 4	0.01	0.02	95
Non 2378 HpCDF	< 3	0	0	
1234678 HpCDD	< 7	0.01	0.035	99
Non 2378 HpCDD	< 7	0	0	
OCDF	< 10	0.001	0.005	
OCDD	< 30	0.001	0.015	97
Sum of PCDD and PCDF congeners:			0	pg/g
Total I-TEQ:			0	pg/g

† = Results are reported on a dry weight basis.

Results

ESR Laboratory Reference: 991888/5

Sample Identification: D12, 0.1m

PCDD/PCDF Congener	Level† pg/g	I-TEF	I-TEQ pg/g	$^{13}C_{12}$ RE %
2378 TCDF	< 2	0.1	0.1	83
Non 2378 TCDF	< 2	0	0	
2378 TCDD	< 4	1	2	93
Non 2378 TCDD	< 4	0	0	
12378 PeCDF	< 2	0.05	0.05	81
23478 PeCDF	< 2	0.5	0.5	82
Non 2378 PeCDF	< 2	0	0	
12378 PeCDD	< 3	0.5	0.75	81
Non 2378 PeCDD	< 3	0	0	
123478 HxCDF	< 3	0.1	0.15	83
123678 HxCDF	< 2	0.1	0.1	92
234678 HxCDF	< 3	0.1	0.15	89
123789 HxCDF	< 4	0.1	0.2	86
Non 2378 HxCDF	< 3	0	0	
123478 HxCDD	< 4	0.1	0.2	79
123678 HxCDD	< 8	0.1	0.4	81
123789 HxCDD	< 8	0.1	0.4	
Non 2378 HxCDD	< 4	0	0	
1234678 HpCDF	< 3	0.01	0.015	97
1234789 HpCDF	< 4	0.01	0.02	92
Non 2378 HpCDF	< 3	0	0	
1234678 HpCDD	< 8	0.01	0.04	91
Non 2378 HpCDD	< 8	0	0	
OCDF	< 10	0.001	0.005	
OCDD	< 30	0.001	0.015	84
Sum of PCDD and PCDF congeners:			0	pg/g
Total I-TEQ:			0	pg/g

† = Results are reported on a dry weight basis.

Results

ESR Laboratory Reference: 991888/6

Sample Identification: 5A, Omex

PCDD/PCDF Congener	Level† pg/g	I-TEF	I-TEQ pg/g	$^{13}C_{12}$ RE %
2378 TCDF	< 50	0.1	2.5	44
Non 2378 TCDF	< 50	0	0	
2378 TCDD	< 90	1	45	46
Non 2378 TCDD	< 200	0	0	
12378 PeCDF	< 70	0.05	1.75	36
23478 PeCDF	< 70	0.5	17.5	40
Non 2378 PeCDF	< 70	0	0	
12378 PeCDD	< 90	0.5	22.5	41
Non 2378 PeCDD	< 400	0	0	
123478 HxCDF	< 90	0.1	4.5	36
123678 HxCDF	< 80	0.1	4	35
234678 HxCDF	< 90	0.1	4.5	40
123789 HxCDF	< 90	0.1	4.5	43
Non 2378 HxCDF	< 90	0	0	
123478 HxCDD	< 100	0.1	5	37
123678 HxCDD	< 100	0.1	5	38
123789 HxCDD	< 100	0.1	5	
Non 2378 HxCDD	< 200	0	0	
1234678 HpCDF	< 100	0.01	0.5	34
1234789 HpCDF	< 100	0.01	0.5	46
Non 2378 HpCDF	< 100	0	0	
1234678 HpCDD	< 200	0.01	1	43
Non 2378 HpCDD	< 200	0	0	
OCDF	< 300	0.001	0.15	
OCDD	< 700	0.001	0.35	44
Sum of PCDD and PCDF congeners:			0	pg/g
Total I-TEQ:			0	pg/g

† = Results are reported on a dry weight basis.

ESR

24 November 1999

Certificate of Analysis

Client:	EGIS ConsultingAustralia Pty Ltd PO Box 6311 East Perth 6892 WA AUSTRALIA
Attention:	David Ross
Date Received:	27 October 1999
ESR Laboratory Reference:	991888
Sample Type:	Oil
Analysis:	**Polychlorinated dibenzo-*p* -dioxins (PCDDs)** **Polychlorinated dibenzofurans (PCDFs)**
Method:	Isotope Dilution

The samples were spiked with isotopically labelled surrogate standards and extracted with organic solvent. The extracts were purified by chemical treatment and solid phase chromatographic techniques. Measurement was performed using high resolution gas chromatography with high resolution electron impact mass spectrometry. Full details are available on request.

Results are reported in nanograms per gram (ng/g), equivalent to ppb, on an as received basis to two significant figures. The sum of PCDDs and PCDFs is calculated and reported excluding limit of detection (LOD) values to three significant figures.

The total toxic equivalents (I-TEQ) was calculated for each sample using international toxic equivalency factors (I-TEFs). The total I-TEQ level is reported excluding LOD values values to three significant figures.

IANZ endorsement applies only to the application of an approved analytical method for the determination of PCDDs and PCDFs in these samples.

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

S V Leathem
Organic Chemistry Laboratory
ESR Analytical

J L Allwood
Organic Chemistry Laboratory
ESR Analytical

Institute of Environmental Science & Research Limited
Wellington Science Centre
Gracefield Road, PO Box 30-547, Lower Hutt, New Zealand
Telephone: (04) 570-1555, Facsimile: (04) 569-4500

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Sample Details:

Sample Identification	ESR Laboratory Reference	Sample Type	Date Received
Bore	991888/7	Oil	27 October 1999

Abbreviations:

CDD	= chlorodibenzo-*p*-dioxin	I-TEF	= International toxic equivalency factor
CDF	= chlorodibenzofuran	I-TEQ	= International toxic equivalent
T	= tetra	$^{13}C_{12}$ RE	= recovery of $^{13}C_{12}$ surrogate standard
Pe	= penta	ng/g	= nanograms per gram (equivalent to ppb)
Hx	= hexa	ppb	= parts per billion
Hp	= hepta	<	= less than limit of detection (LOD)
O	= octa		

Results

ESR Laboratory Reference: 991888/7

Sample Identification: Bore

PCDD/PCDF Congener	Level† ng/g	I-TEF	I-TEQ ng/g	$^{13}C_{12}$ RE %	
2378 TCDF	< 0.04	0.1	0.002	43	
Non 2378 TCDF	0.17	0	0		
2378 TCDD	< 0.03	1	0.015	39	
Non 2378 TCDD	< 0.2	0	0		
12378 PeCDF	< 0.04	0.05	0.001	23	⚑
23478 PeCDF	< 0.03	0.5	0.0075	33	
Non 2378 PeCDF	< 0.1	0	0		
12378 PeCDD	< 0.04	0.5	0.01	27	
Non 2378 PeCDD	0.38	0	0		
123478 HxCDF	< 0.09	0.1	0.0045	19	⚑
123678 HxCDF	< 0.06	0.1	0.003	20	⚑
234678 HxCDF	< 0.04	0.1	0.002	26	
123789 HxCDF	< 0.05	0.1	0.0025	25	
Non 2378 HxCDF	0.31	0	0		
123478 HxCDD	< 0.05	0.1	0.0025	22	⚑
123678 HxCDD	< 0.09	0.1	0.0045	24	⚑
123789 HxCDD	< 0.1	0.1	0.005		
Non 2378 HxCDD	0.35	0	0		
1234678 HpCDF	< 0.2	0.01	0.001	16	⚑
1234789 HpCDF	< 0.1	0.01	0.0005	25	
Non 2378 HpCDF	< 0.2	0	0		
1234678 HpCDD	< 0.2	0.01	0.001	24	⚑
Non 2378 HpCDD	< 0.2	0	0		
OCDF	< 0.3	0.001	0.00015		
OCDD	0.87	0.001	0.00087	26	

Sum of PCDD and PCDF congeners:	2.08	ng/g
Total I-TEQ:	0.000870	ng/g

† = Results are reported on an as received basis.

⚑ = Recovery outside method acceptance criteria (25-125%).

egis consulting

CHAIN OF CUSTODY RECORD

Project: Omex - Dixon

EGIS CONSULTING AUSTRALIA PTY LIMITED
ACN 000 912 630

■ ■ ■ PERTH OFFICE
Perth Western Australia 6000
Australia

200 Adelaide Terrace
Telephone (09) 220 9300
Facsimile (09) 325 9897

PO Box 6311 East Perth 6892

Job No: VW1100/315. ~~Title:~~

Laboratory: ESR New Zealand. Phone: (644) 560 5576 Page 1 of 1

Sampled By:

Name	Signature
Jason Lyon.	

Analyses Record No: 486.

Purchase Order No: 74074.

Sample Identity	Sample Location	Duplicate Vial	Date	Composite No	Container (Type)	PCOOs	PCOFs	Comments
SA	Omex		14/9		glass.	✓	✓	
D2	0.5m					✓	✓	
D3	0.6m					✓	✓	
D6	0.3m					✓	✓	
D11	0.1m					✓	✓	
D12	0.1m.					✓	✓	
Oil Sample.	Bore					✓	✓	

CMPS&F ENVIRONMENTAL

Relinquished By: Jason Lyon. Signature:

Relinquished By: Signature:

LABORATORY ESR.

Received By: Signature: Date: 8/10/99. Time: 12.00pm.

Received By: Signature: Date: Time:

Method of Shipment: air freight.

Remarks: Samples Relinquished By ESR Labs 5/10/99.

leg co ells

ESR CHAIN OF CUSTODY RECORD

(Please ensure all information is entered legibly and all entries are made with waterproof, permanent ink)

RECEIVED 12 NOV 1999

SAMPLE INFORMATION (to be completed by sender)

COMPANY NAME: EGIS Consulting Aust	CLIENT CONTACT: David Ross
ADDRESS:	PHONE: 0061 8 9220 9401 ~~220 9500~~
	FAX: 0061 8 9325 9897 ~~9325 9897~~
SENT BY (Signature):	DATE SENT:
	METHOD OF SHIPMENT: TNT 248529254

ESR SAMPLE RECEIPT INFORMATION

ESR Job No:	991888
Received By:	
Date Received:	27.10.99
Date Due:	19.11.99
Client Manager:	
Job Manager:	Scott Cranfield
Phone:	(04) 570 1555
Fax:	(04) 560 5573

CLIENT SAMPLE ID	SAMPLE DESCRIPTION/LOCATION/ SITE	SAMPLING DATE	SAMPLE TYPE	TOTAL No. OF ~~Jars~~ BOTTLES	ANALYSIS REQUIRED	ESR SAMPLE NUMBER	COMMENTS
D2	16378	14.9.99	Soil	1	PCDDs/PCDFs	991888 / 1	
D3	16379	✓	Soil	1	-	/ 2	
D6	16382	✓	Soil	1	-	/ 3	
D11	16387		Soil	1	-	/ 4	
D12	16388		Soil	1	-	/ 5	
5A	Omex	14.9.99	Sludge	1	-	/ 6	
	Oil		Waste oil	1	✓	/ 7	

CL_____

ANALYTICAL REFERENCE LABORATORY (W.A.) PTY. LTD.

LABORATORY REPORT

ARL LAB No: 16377-89
DATE: 29 September 1999

CLIENT: EGIS Consulting
PO Box 6311
EAST PERTH WA 6892

ATTENTION: Mr Peter Gell

SAMPLE DESCRIPTION: Thirteen soil samples as received for analysis of polycyclic aromatic hydrocarbons (PAH's).

METHODS: PAH – ARL (WA) Method No: 006

DATE RECEIVED: 15 September 1999

PROJECT ID: VW1100

PROJECT LOCATION: Omex

RESULTS:

ANALYTICAL REFERENCE LABORATORY (W.A.) PTY. LTD.
A.C.N. 050 159 898
55 Wittenoom Street, East Perth, Western Australia 6004
Telephone: (08) 9221 1415. Facsimile: (08) 9325 2398
NATA Registration No. 2377

Mr Peter Gell
EGIS Consultancy
ARL LAB No: 16377-89
29 September 1999-09-28

Polycyclic Aromatic Hydrocarbons

Lab No	16377	16378	16379	16380	16381
Sample ID	D1 0.6m	D2 0.5m	D3 0.6m	D4 0.6m	D5 0.7m
			mg/kg		
Acenaphthene	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	<0.1	<0.1	<0.1	<0.1	<0.1
Benz(*a*)anthracene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(*b*)fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(*k*)fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(*a*)pyrene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo (*g,h,l*)peryklene	<0.2	<0.3	<0.2	<0.2	<0.2
Chrysene	<0.2	0.2	<0.2	<0.2	<0.2
Dibenzo(*a,h*)anthracene	<0.2	<0.2	<0.2	<0.2	<0.2
Fluoranthene	<0.1	0.1	0.1	<0.1	<0.1
Flourene	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(*1,2,3-c,d*)	<0.2	<0.2	<0.2	<0.2	<0.2
2-Methyl-naphathalene	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	<0.1	0.1	<0.1	<0.1	<0.1
Pyrene	<0.1	0.2	0.1	<0.1	<0.1

Mr Peter Gell
EGIS Consultancy
ARL LAB No: 16377-89
29 September 1999-09-28

Polycyclic Aromatic Hydrocarbons

Lab No	16382	16383	16384	16385	16386
Sample ID	D6 0.3m	D7 0.5m	D8 0.6m	D9 0.7m	D10 0.6m
			mg/kg		
Acenaphthene	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	<0.1	<0.1	<0.1	<0.1	<0.1
Benz(*a*)anthracene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(*b*)fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(*k*)fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(*a*)pyrene	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo (*g,h,l*)pyrene	<0.2	<0.2	<0.2	<0.2	<0.2
Chrysene	<0.2	<0.2	<0.2	<0.2	<0.2
Dibenzo(*a,h*)anthracene	<0.2	<0.2	<0.2	<0.2	<0.2
Fluoranthene	<0.1	<0.1	<0.1	<0.1	<0.1
Flourene	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(*1,2,3-c,d*)	<0.2	<0.2	<0.2	<0.2	<0.2
2-Methyl-naphathalene	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	<0.1	<0.1	<0.1	<0.1	<0.1

Mr Peter Gell
EGIS Consultancy
ARL LAB No: 16377-89
29 September 1999-09-28

Polycyclic Aromatic Hydrocarbons

Lab No	16387	16388	16389
Sample ID	D11	D12	Duplicate 1
		mg/kg	
Acenaphthene	<0.1	<0.1	<0.1
Acenaphthylene	<0.1	<0.1	<0.1
Anthracene	<0.1	<0.1	<0.1
Benz(*a*)anthracene	<0.2	<0.2	<0.2
Benzo(*b*)fluoranthene	<0.2	<0.2	<0.2
Benzo(*k*)fluoranthene	<0.2	<0.2	<0.2
Benzo(*a*)pyrene	<0.2	<0.2	<0.2
Benzo (*g,h,l*)pyrene	<0.2	<0.2	<0.2
Chrysene	<0.2	<0.2	<0.2
Dibenzo(*a,h*)anthracene	<0.2	<0.2	<0.2
Fluoranthene	<0.1	<0.1	<0.1
Flourene	<0.1	<0.1	<0.1
Indeno(*1,2,3-c,d*)	<0.2	<0.2	<0.2
2-Methyl-naphathalene	<0.1	<0.1	<0.1
Naphthalene	<0.1	<0.1	<0.1
Phenanthrene	<0.1	<0.1	<0.1
Pyrene	<0.1	<0.1	<0.1

Kim Rodgers
Chemist

Egis consulting

CHAIN OF CUSTODY RECORD

Project: Omex

EGIS CONSULTING AUSTRALIA PTY LIMITED
ACN 000 912 630

■ ■ ■ PERTH OFFICE
Perth Western Australia 6000
Australia

200 Adelaide Terrace
Telephone (09) 220 9300
Facsimile (09) 325 9897

PO Box 6311 East Perth 6892

Job No: VW 1100 Ref: 315.

Laboratory: ARL. Phone: 9301 1415.

Sampled By: Jason Lyon. (Name) (Signature)

(Name) (Signature)

(Name) (Signature)

Analyses Record No: 485.

Sample Identity	Sample Location	Duplicate Vial	Date	Composite No	Container [Type]	PAH's	Purchase Order No: / Comments
D1	0.6m		14/9	Soil	glass.	✓	
D2	0.5m					✓	
D3	0.6m					✓	
D4	0.6m					✓	
D5	0.7m					✓	
D6	0.3m.					✓	
D7	0.5m					✓	
D8	0.6m					✓	
D9	0.7m					✓	
D10.	0.6m					✓	

CMPS&F ENVIRONMENTAL

Relinquished By: Jason Lyon. Signature:

Relinquished By: Trevor Pillans ARL Signature:

LABORATORY ARL.

Received By: D. Wickham. Signature: Date: 14/9/99 Time:

Received By: Jason Lyon. Signature: Date: 5/10/99. Time: 9.00am.

Method of Shipment:

Remarks: Retain Samples. Forward to ERL for Dioxin analysis

egis consulting

CHAIN OF CUSTODY RECORD

Project: Omex

EGIS CONSULTING AUSTRALIA PTY LIMITED
ACN 000 912 630

■ ■ ■ PERTH OFFICE
Perth Western Australia 6000
Australia

200 Adelaide Terrace
Telephone (09) 220 9300
Facsimile (09) 325 9897

PO Box 6311 East Perth 6892

Job No: JW1100 File: 315.

Laboratory: ARL. Phone: 9221 1415.

Sampled By: Jason Lya. (Name / Signature)
Name / Signature
Name / Signature

Analyses Record No: 485

Sample Identity	Sample Location	Duplicate Vial	Date	~~Composite No~~	Container [Type]	DAHs	Purchase Order No: / Comments
87 D11			14/9.	Soil.	glass-	✓	
88 D12.			↓	↓	↓	✓	
89. Duplicate 1			↓	↓	↓	✓	

CMPS&F ENVIRONMENTAL

Relinquished By: Jason Lya
Signature:

Relinquished By: TREVOR PILKEAM ARL
Signature:

LABORATORY ARL.

Received By:
Signature:
Date: 14/9/99 Time:

Received By: Jason Lya.
Signature:
Date: 5/10/99 Time: 9.00am

Method of Shipment:

Remarks: Retain samples. Forward to ERL for Dioxin analysis

Australian
Environmental
Laboratories

Quality System
Quality
Endorsed
Company
ISO 9002 Lic 7007
Standards Australia

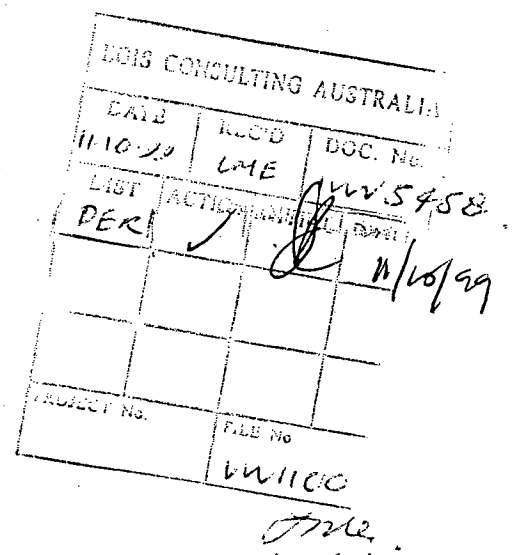
LABORATORY REPORT COVERSHEET

DATE: 7 October 1999

TO: Egis Consulting

PO Box 6311

EAST PERTH WA 6892



ATTENTION: Mr David Ross

YOUR REFERENCE: VW1100, Omex

OUR REFERENCE: 47854

SAMPLES RECEIVED: 14/9/99

SAMPLES/QUANTITY: 1 Soil

The above samples were received intact and analysed according to your accompanying chain of custody form which is returned with this report for your reference.
Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.
PAHs extracts were analysed by our Brisbane laboratory, report No.9400.

Steven Edmett
STEVEN EDMETT
Manager Client Liaison

PETER BAMFORD
Manager Laboratory Services

This report supersedes our preliminary results that were reported by facsimile.
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National Association of Testing Authorities, Australia
NATA Endorsed Test Report
This document may not be reproduced except in full.

(Analabs Pty. Ltd.) ACN 004 591 664
52 Murray Road, Welshpool Western Australia 6106 Australia
Telephone: (61 8) 9458 7278 Facsimile: (61 8) 9451 3505

Australian Environmental Laboratories

CLIENT: Egis Consulting
PROJECT: VW1100, Omex

OUR REFERENCE: 47854

LABORATORY REPORT

Your Reference Our Reference Date Sampled Type of sample	Units	Triplicate 1 47854-1 14/09/99 Soil
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.5
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	<0.1
Pyrene	mg/kg	<0.1
Benzo[*a*]anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo[*b*]fluoranthene	mg/kg	<0.1
Benzo[*k*]fluoranthene	mg/kg	<0.1
Benzo[*a*]pyrene	mg/kg	<0.1
Dibenzo[*ah*]anthracene	mg/kg	<0.1
Benzo[*ghi*]perylene	mg/kg	<0.1
Indeno[*123-cd*]pyrene	mg/kg	<0.1

TEST PARAMETERS	UNITS	LOR	METHOD
PAHs in Soil			
Naphthalene	mg/kg	0.1	PEO-400
Acenaphthylene	mg/kg	0.5	PEO-400
Acenaphthene	mg/kg	0.1	PEO-400
Fluorene	mg/kg	0.1	PEO-400
Phenanthrene	mg/kg	0.1	PEO-400
Anthracene	mg/kg	0.1	PEO-400
Fluoranthene	mg/kg	0.1	PEO-400
Pyrene	mg/kg	0.1	PEO-400
Benzo[*a*]anthracene	mg/kg	0.1	PEO-400
Chrysene	mg/kg	0.1	PEO-400
Benzo[*b*]fluoranthene	mg/kg	0.1	PEO-400
Benzo[*k*]fluoranthene	mg/kg	0.1	PEO-400
Benzo[*a*]pyrene	mg/kg	0.1	PEO-400
Dibenzo[*ah*]anthracene	mg/kg	0.1	PEO-400

CLIENT: Egis Consulting
PROJECT: VW1100, Omex

OUR REFERENCE: 47854

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Benzo[*ghi*]perylene	mg/kg	0.1	PEO-400
Indeno[*123-cd*]pyrene	mg/kg	0.1	PEO-400

Australian Environmental Laboratories

CLIENT: Egis Consulting
PROJECT: VW1100, Omex

OUR REFERENCE: 47854

LABORATORY REPORT

QUALTY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate	Spike Sm#	Matrix Spike
Naphthalene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	106 || 98 || RPD: 8
Acenaphthylene	mg/kg	<0.5	47854-1	<0.5 || <0.5	47854-1	94 || 93 || RPD: 1
Acenaphthene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	110 || 94 || RPD: 16
Fluorene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	110 || 98 || RPD: 12
Phenanthrene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	115 || 91 || RPD: 23
Anthracene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	119 || 108 || RPD: 10
Fluoranthene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	91 || 89 || RPD: 2
Pyrene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	110 || 90 || RPD: 20
Benzo[*a*]anthracene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	109 || 101 || RPD: 8
Chrysene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	110 || 102 || RPD: 8
Benzo[*b*]fluoranthene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	103 || 96 || RPD: 7
Benzo[*k*]fluoranthene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	107 || 102 || RPD: 5
Benzo[*a*]pyrene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	105 || 101 || RPD: 4
Dibenzo[*ah*]anthracene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	116 || 110 || RPD: 5
Benzo[*ghi*]perylene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	108 || 107 || RPD: 1
Indeno[*123-cd*]pyrene	mg/kg	<0.1	47854-1	<0.1 || <0.1	47854-1	87 || 86 || RPD: 1

NOTES:
LOR= Limit of Reporting.

egis consulting

CHAIN OF CUSTODY RECORD

Project: Omex.

EGIS CONSULTING AUSTRALIA PTY LIMITED
ACN 000 912 630

■ ■ ■ PERTH OFFICE
Perth Western Australia 6000
Australia

200 Adelaide Terrace
Telephone (09) 220 9300
Facsimile (09) 325 9897

PO Box 6311 East Perth 6892

Job No: VW1100 File: 315

Laboratory: AEL Phone: 9458 7278.

Page 1 of 1

Sampled By:

Name	Signature
Jason Lyon.	

Job No 47854

Analyses Record No: 485

PAHs

Purchase Order No:

Sample Identity	Sample Location	Duplicate Vial	Date	Composite No	Container [Type]	PAHs	Comments
Implocate 1.			14/9.	soil.	glass.	√	

CMPS&F ENVIRONMENTAL

Relinquished By: Jason Lyon.
Signature:

Relinquished By:
Signature:

LABORATORY AEL.

Received By: Steven Cornett
Signature:
Date: 14/9/99. Time:

Received By:
Signature:
Date: Time:

Method of Shipment:

Remarks: