# Water Quality Survey of the Lower Kaituna Catchment 2007 - 2008

Prepared by Stephen Park, Senior Environmental Scientist

Bay of Plenty Regional Council
Environmental Publication 2010/01
January 2010

5 Quay Street
P O Box 364
Whakatane
NEW ZEALAND

ISSN: 1175 9372 (Print)
ISSN: 1179 9471 (Online)

*Working with our communities for a better environment*
*E mahi ngatahi e pai ake ai te taiao*

# Water Quality survey of the lower Kaituna Catchment 2007 - 2008

Environmental Publication 2010 01
ISSN 1175 9372

January 2010

Bay of Plenty Regional Council
5 Quay Street
PO Box 364
Whakatane 3158
NEW ZEALAND

Prepared by Stephen Park, Senior Environmental Scientist

# Acknowledgements

The assistance of Rob Donald in editing the draft report and Laboratory staff for assistance with sample handling and analysis has been appreciated.

# Executive Summary

An extensive water quality survey of the lower Kaituna River catchment was conducted between May 2007 and June 2008 to provide an assessment of environmental quality and a baseline against which future comparisons could be made. It included;

- Regular baseflow water quality monitoring of the main tributary streams.
- Storm event peak flow water quality sampling.
- Limited sampling of small inflows.
- Water and sediment sampling (for metals and organic contaminants).
- Sediment and shellfish quality sampling in Maketu Estuary.

This information will be used to support the implementation of the Kaituna River and Ongatoro/Maketu Estuary Strategy.

The general water quality results show that the tributaries range from lightly to moderately impacted. Observed trends in declining water quality generally correlate with the percentage of catchment in horticultural, agricultural and urban land cover. This was very apparent in the smallest streams or drains which tend to have high ammonium nitrogen levels. Bacterial contamination ranged from moderate to high with the Kopuaroa and Te Puke streams exceeding the Ministry for the Environment (MfE) contact recreation guideline values for nearly all samples. Overall these two streams had the poorest water quality.

Of the organic contaminants tested for in water, only three Polycyclic Aromatic Hydrocarbon (PAH) compounds were detected. None of these or any of the metal contaminants exceeded guidelines values for human consumption, aluminium (all sites) and zinc at the Te Puke, Kopuaroa and Parawhenuamea Streams exceed the ANZECC trigger levels (95%) for the protection of aquatic life. High zinc values are most likely the result of agricultural and urban land use impacts.

Sediment testing for a similar range of organic and metal contaminants produced similar results but with more PAH compounds and four organochlorine pesticides detected. Three pesticides, DDT and Dieldrin and Endrin, exceeded the ANZECC ISQG-high value for the protection of aquatic life in the Ohineangaanga and Te Puke Stream. These pesticides are all very persistent in the environment and result from historic use. The geothermal influence on the Kaituna River and Maketu Estuary was clearly evident from the elevated levels of arsenic and mercury in the sediments. This resulted in the Kaituna River exceeding the ANZECC low trigger value for mercury. The Te Puke Stream had the highest elevation of metals overall strongly suggesting land use impacts.

The levels of metals and organic contaminants in shellfish from Maketu Estuary were very similar to those found in 1992. Mercury and arsenic are elevated due to the geothermal influence but the levels are below New Zealand guidelines for human consumption. The only organic compounds detected in shellfish were DDT or its break down products and these were below the guideline for consumption.

# Contents

## Tables and Figures

# Part 1: Introduction

## 1.1 Overview

The objective of this study was to provide catchment-wide water quality data for the Kaituna River and tributaries downstream of the Okere outlet from Lake Rotoiti. This involved a number of surveys including;

- Monthly sampling of the general water quality (temperature, turbidity, suspended solids, nutrients and bacterial levels) of seven streams from May 2007 to June 2008. Sampling (twice) of eight additional sites including minor inflows was carried out in June 2007.
- Sampling of water and sediment May 2008 for a range of heavy metals; organochlorines, organonitrogen and organophosphorus pesticides, polycyclic aromatic hydrocarbons (PAH's), polychlorinated biphenyls (PCB's) and chlorinated phenols.
- Storm flow sampling of seven streams around the time of peak flow to assess the impact on sediment and nutrient run-off.
- Sampling of sediment and shellfish for a range of metals and organic contaminants at one site in the Kaituna River Estuary and four sites in the Maketu Estuary.

A key aim of this report is to provide a baseline against which any future change can be accurately assessed. This information will be used to support the implementation of the Kaituna River and Ongatoro/Maketu Estuary Strategy.

## 1.2 Background on the Kaituna River

### 1.2.1 General

The Kaituna River is situated in the central Bay of Plenty and flows from the Okere arm of Lake Rotoiti to the sea at Te Tumu. Historically the river flowed through Maketu Estuary but was diverted directly to the sea in 1958 by engineering works. Re-diversion of restricted flows back to the estuary occurred in 1996 following the granting of consent to the Minister of Conservation.

Lakes Rotorua and Rotoiti form the upper catchment of the Kaituna River and both have experienced long-term deterioration of water quality. This decline has been documented through a number of research projects and therefore there is good information on the source water quality of the Kaituna River. The water quality assessment prepared to support the diversion of the Ohau Channel directly into the top of the Kaituna River is particularly relevant (McIntosh 2005).

The upper regions of the lower Kaituna River catchment (downstream of the lakes) are dominated by pastoral and exotic forestry with some sub-catchments retaining extensive native forest cover. In recent years there has been some conversion of exotic forestry to dairy farms. Much of the mid section of this catchment has had suitable land converted to horticulture with kiwifruit being dominant. The lower regions of the catchment are predominantly productive river-flat plains with extensive drainage schemes and the dominant land use is dairy farming.

A review of the water quality of the lower Kaituna River catchment (Park 2007) found an increasing trend in nitrogen. The review also highlighted the lack of water quality data available for many of the tributaries.

### 1.2.2 The Lower Kaituna Catchment

The total Kaituna catchment area (including the lakes) is approximately 1,218 $km^2$. The catchment feeding directly into the Kaituna River (referred to here as the lower Kaituna catchment) has an area of approximately 580 $km^2$, 47.6% of the total. The sub-catchments in the lower Kaituna are shown in Figure 1 and the area of each is given in Table 2.

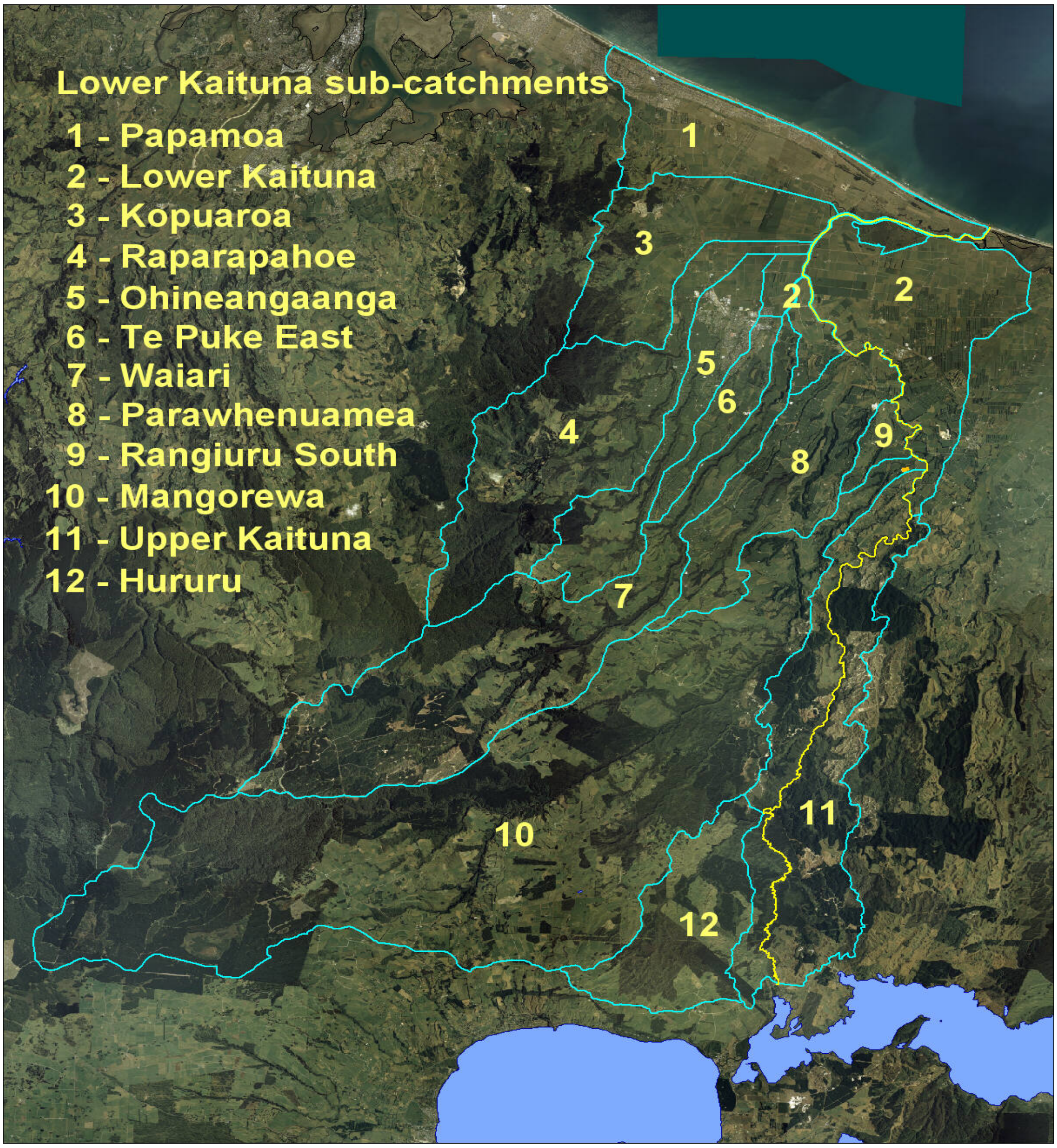



*Figure 1 Sub-catchments of the lower Kaituna catchment.*

Most of the Papamoa sub-catchment (“1” in Figure 1) drains into the Wairakei Stream. This wetland/drainage system flows towards the Kaituna River but then reaches an area where the water soaks away into the ground. A small part of the catchment in the vicinity of Bell Road and the Kopuaroa canal does drain as surface water to the Kaituna River.

The lower Kaituna sub-catchment (“2” in Figure 1) is flat low-lying land which drains to the Kaituna River via a number of small drains. Much of the water is pumped out of the drains in the area near the river mouth.

The upper Kaituna sub-catchment (“11” in Figure 1) consists of a large number of very small rolling to steep catchments which all flow directly into the Kaituna River. Because of their small size, number and similarity they have been grouped together.

The Parawhenuamea Stream which drains sub-catchment 8 has been diverted and now flows into the Kaituna River just above the State Highway 2 Bridge at Waitangi (Te Matai).

### 1.2.3 River and Stream Flows

The Kaituna River is around 53 km in length from Lake Rotoiti (at Okere) to its discharge point at the coast near Maketu. The first 25 km is fast flowing and drops some 260 m through a number of waterfalls and an incised gorge. The remaining 28 km is slower flowing dropping just 20 m in altitude to the sea. The residence time over the whole river from lake to sea is relatively short at approximately one day.

The available flow data for the Kaituna River and tributaries is summarised in Table 1. There are only a few small surface inputs in the lower section of the river for which there are no flow gauging records. A considerable part of the total river flow at Te Matai is attributed to sizable cold water springs between Okere and Te Matai (Freestone 1975, cited in White et. al 1978). Many of the more sizable stream inputs, such as those from the Waiari and Raparapahoe, join the Kaituna River well down towards the sea.

*Table 1 Flow statistics (Litres/second) for the Kaituna River and tributaries.*

| Site | Mean flow | Low flow - mean annual | Maximum flow - mean annual | % of flow at Te Matai |
|---|---|---|---|---|
| Kaituna at Taaheke (Okere)# | 20,687 | 13,008 | 31,377 | 52.3 |
| Mangorewa River | 6124 | 4,557 | 162,794 | 15.5 |
| Waiari Stream* | 4,039 | 3,406 | 34,804 | - |
| Ohineangaanga Stream* | 350 | - | - | - |
| Raparapahoe Stream*^ | 1,852 | 494 | 39,875 | - |
| Kopuaroa Stream* | 88 | - | - | - |
| Other streams and springs | 6,379 | - | - | 32.2 |
| Kaituna at Te Matai | 39,519 | 29,072 | 133,311 | - |

# Data derived from measurements at Okere (before construction of the lake level control structure) and at the Trout Pools at Taaheke (after construction of the lake level control structure).

* Confluence is below Te Matai.

^ The Raparapahoe Stream has recently had a name change to Atuaroa Stream.

### 1.2.4 Land cover

Land cover estimates for the lower Kaituna River catchment are given in Tables 2 and 3 and shown in Figure 2. These estimates are based on the 1995 SPOT satellite remote sensing maps. The horticulture category was updated to 2003 while all other categories are based on the 1995 data with adjustment for horticulture changes.

*Table 2 Land cover ($km^2$) in each of the Lower Kaituna River sub-catchments.*

| | Total Area | Grass | Horti culture | Exotic Forest | Native Forest | Scrub | Urban | Bare |
|---|---|---|---|---|---|---|---|---|
| Lower Kaituna | 45.8 | 28.5 | 15.5 | 0.6 | 0.1 | 0.1 | 0.6 | 0.1 |
| Papamoa | 31.8 | 23.8 | 0.9 | 0.9 | 0.1 | 0.1 | 5.5 | 0.1 |
| Kopuaroa | 30.3 | 20.8 | 1.8 | 1.9 | 5.1 | 0.3 | 0.1 | 0.4 |
| Raparapahoe | 53.6 | 14.0 | 9.4 | 1.6 | 27.8 | 0.7 | 0.1 | 0.0 |
| Ohineangaanga | 24.8 | 11.5 | 6.0 | 0.5 | 3.5 | 0.0 | 3.4 | 0.0 |
| Te Puke East | 9.1 | 1.1 | 6.0 | 0.3 | 0.7 | 0.0 | 1.2 | 0.0 |
| Waiari | 72.0 | 21.1 | 4.6 | 19.1 | 26.4 | 0.1 | 0.1 | 0.0 |
| Parawhenuamea | 31.4 | 10.7 | 14.0 | 2.2 | 1.3 | 3.0 | 0.1 | 0.0 |
| Rangiuru South | 3.9 | 1.6 | 1.9 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 |
| Mangorewa | 189.0 | 72.9 | 2.3 | 46.6 | 64.8 | 1.6 | 0.0 | 0.0 |
| Upper Kaituna | 58.5 | 10.6 | 0.8 | 30.5 | 16.4 | 0.2 | 0.0 | 0.0 |
| Hururu | 27.5 | 14.1 | 0.0 | 9.5 | 4.0 | 0.0 | 0.0 | 0.0 |
| **Total Area ($km^2$)** | **577.7** | **230.7** | **63.1** | **114.5** | **150.4** | **6.0** | **11.3** | **0.6** |

* Note $1km^2$ = 100 hectares

*Table 3 Land cover (%) in each of the lower Kaituna River sub-catchments.*

| | Grass | Horti culture | Exotic Forest | Native Forest | Scrub | Urban | Bare |
|---|---|---|---|---|---|---|---|
| Lower Kaituna | 62.3 | 33.8 | 1.3 | 0.2 | 0.1 | 1.4 | 0.1 |
| Papamoa | 74.7 | 2.9 | 2.8 | 0.3 | 0.2 | 17.1 | 0.3 |
| Kopuaroa | 68.6 | 6.0 | 6.3 | 16.8 | 0.9 | 0.5 | 1.3 |
| Raparapahoe | 26.1 | 17.5 | 3.0 | 51.8 | 1.4 | 0.2 | 0.0 |
| Ohineangaanga | 46.4 | 24.0 | 2.0 | 14.1 | 0.0 | 13.6 | 0.0 |
| Te Puke East | 12.2 | 66.0 | 3.3 | 7.7 | 0.0 | 13.6 | 0.0 |
| Waiari | 29.3 | 6.4 | 26.5 | 36.7 | 0.1 | 0.1 | 0.0 |
| Parawhenuamea | 34.1 | 44.7 | 7.0 | 4.1 | 9.5 | 0.4 | 0.0 |
| Rangiuru South | 40.9 | 49.2 | 3.3 | 5.3 | 0.0 | 0.5 | 0.3 |
| Mangorewa | 38.6 | 1.2 | 24.6 | 34.3 | 0.8 | 0.0 | 0.0 |
| Upper Kaituna | 18.1 | 1.3 | 52.1 | 28.0 | 0.3 | 0.0 | 0.0 |
| Hururu | 51.1 | 0.0 | 34.4 | 14.6 | 0.1 | 0.0 | 0.0 |
| **% of total** | **39.9** | **10.9** | **19.8** | **26** | **1** | **2** | **0.1** |

The largest sub catchment is the Mangorewa River at 189 $km^2$ or 32.7% of the total catchment area. The Waiari Stream at 72 $km^2$ is the next largest.

Table 3 provides the percentage of each land cover category in the sub catchments. In the bottom line of Table 3 the percentage of each land cover type for the whole of the Lower Kaituna catchment is shown. Grass cover comprises around 40% of the area while native forest covers 26% and exotic forest 19.8%. Horticulture comprises 10.9% of the total area while scrub, urban and bare areas are relatively low.

Catchments lower down the Kaituna River generally have the highest grass cover with the Papamoa catchment having nearly 75%. Areas around Te Puke have high levels of horticultural use with Te Puke East at 66%, Rangiuru South at 49% and Parawhenuamea at 45%.

The numerous small catchments along the upper Kaituna River sub-catchment collectively have 52% cover of exotic forest. The Raparapahoe has the highest percentage of native forest cover at 52%. Scrub cover in the Parawhenuamea catchment is proportionately high compared to the other catchments. This catchment has incised stream beds and the numerous steep gulleys host the bulk of the scrub cover.

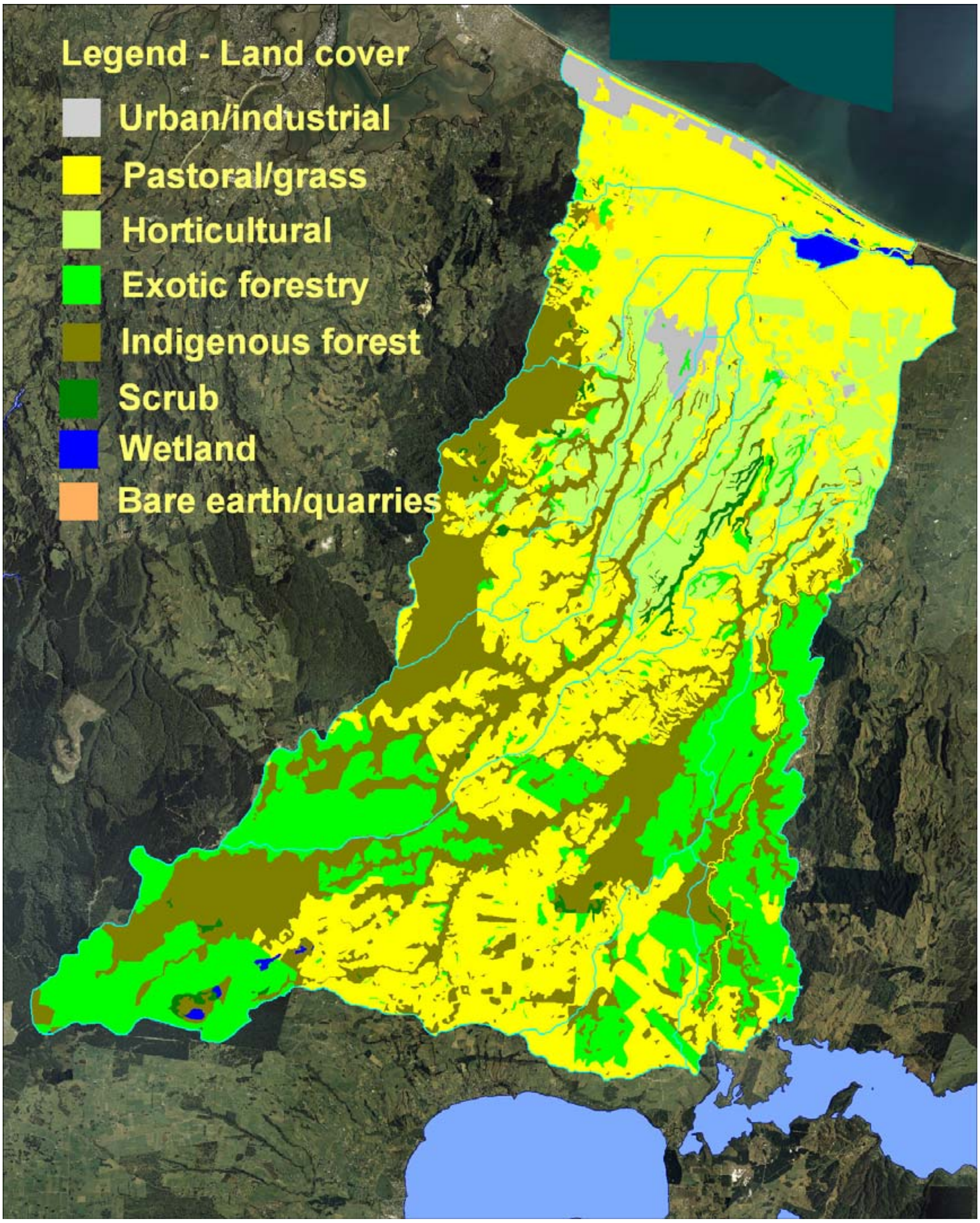



*Figure 2 Land cover in the lower Kaituna Catchment based on 1995 SPOT satellite imagery with horticulture updated to 2003.*

# Part 2: Sampling locations and methods

## 2.1 River and Stream Sites

The locations of the river and stream sampling sites are shown in Figure 3 and described in Table 4.

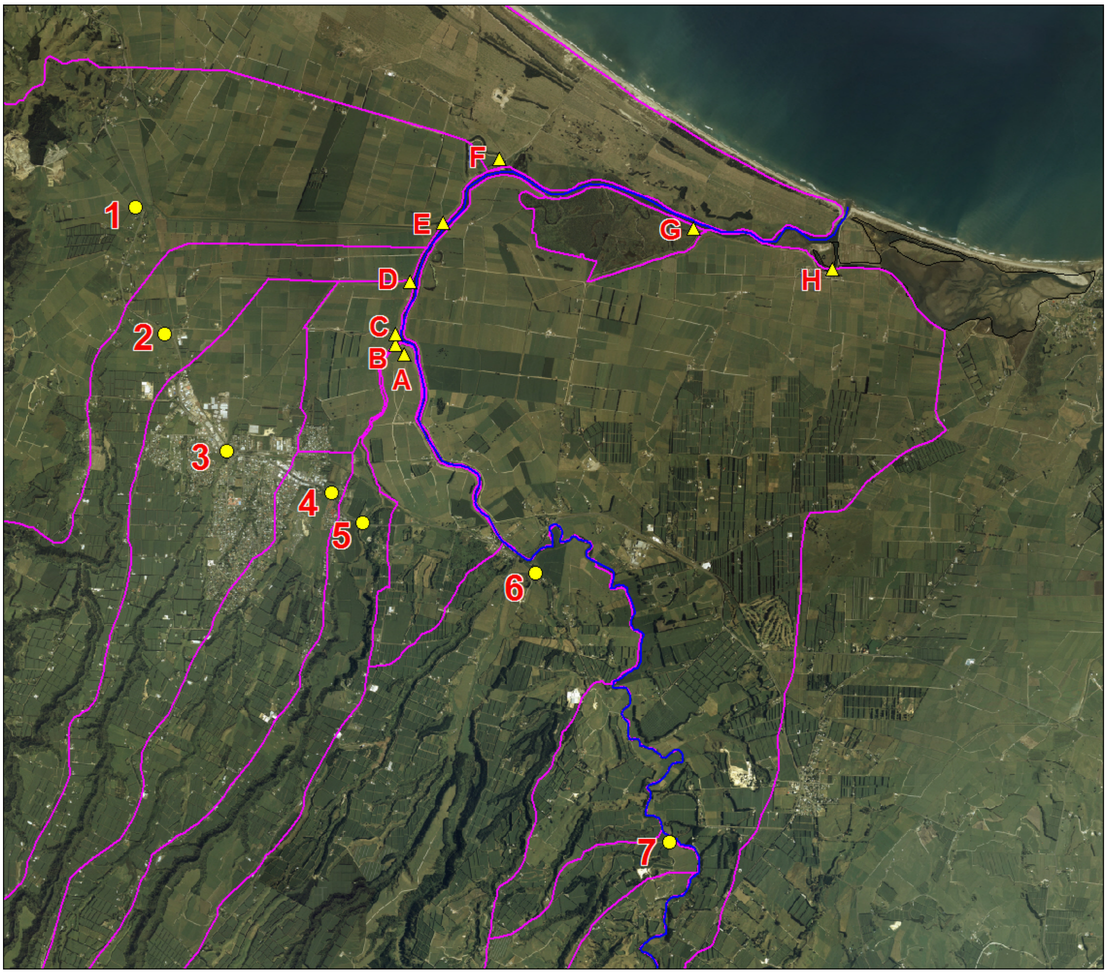



*Figure 3 Locations of the water quality sampling sites in the lower Kaituna catchment.*

### 2.1.1 General water quality

The numbered sites (1-7) cover the major stream and river inflows to the lower Kaituna River. These sites were sampled for water quality once each month from May 2007 to June 2008. When possible sampling was undertaken on or about the same day that permanent monitoring sites on the Kaituna River were sampled to allow better comparison of results. Sites A – H were all sampled twice around June 2007.

The general water quality parameters measured included temperature, conductivity, nutrients (dissolved and totals) and bacteria (*E.coli*, faecal coliforms and enterococci). Chlorophyll-*a* (Chl-*a*) was also measured at the Mangorewa site to give an indication of phytoplankton biomass.

*Table 4 Water quality survey sites in the lower Kaituna River catchment, description and NZ 260 map grid reference.*

| Site # | Site name/location | Lab id | East | North |
|---|---|---|---|---|
| 1 | Kopuaroa Stream, SH2 bridge | 210159 | 2801057 | 6378241 |
| 2 | Raparapahoe (Atuaroa) Stream, SH2 bridge | 210002 | 2801430 | 6376420 |
| 3 | Ohineangaanga Stream, SH2 bridge | 210001 | 2802286 | 6374692 |
| 4 | Te Puke East, SH2 culvert | 210275 | 2803779 | 6374090 |
| 5 | Waiari Stream, SH2 bridge | 210053 | 2804217 | 6373698 |
| 6 | Parawhenuamea Stream, Rangiuru Rd | 210052 | 2806711 | 6372958 |
| 7 | Mangorewa River, at Kaituna River confluence | 210274 | 2808620 | 6369159 |
| | | | | |
| A | Old Parawhenuamea Stream – farmland drain | 210273 | 2804800 | 6376155 |
| B | Waiari Stream, at Kaituna River confluence | 210054 | 2804761 | 6376252 |
| C | North Te puke - farmland drain | 210272 | 2804690 | 6376390 |
| D | Raparapahoe, at Kaituna River confluence | 210058 | 2804930 | 6377160 |
| E | Kopuaroa, at Kaituna River confluence | 210271 | 2805380 | 6377970 |
| F | Papamoa Drain | 210270 | 2806220 | 6378870 |
| G | Kaituna Wetlands level control outlet | 210269 | 2809080 | 6377827 |
| H | Fords Cut pump station farmland drain | 240014 | 2810900 | 6377270 |
| | | | | |
| | Maungarangi Road - Kaituna River | 160128 | 2808527 | 6368170 |
| | | | | |

### 2.1.2 Rainfall events

Sites 1-7 were sampled around the peak of two rainfall events that occurred on 30 June and 17 August 2007. These samples were analysed for suspended solids, turbidity and nutrients.

### 2.1.3 Metal and organic contaminants

Sites 1-7 and Maungarangi Road (Kaituna River) were sampled on 7 May 2008 for a range of metal, pesticide, PAH and PCP contaminants in the surface water and sediments. A water sample was taken at Site H (Fords cut pump station) and analysed for the same range of contaminants.

## 2.2 Estuary Sites

Additional sites were sampled for analysis of contaminants in sediments from the Kaituna River estuary and the Maketu Estuary. Shellfish were also sampled from the Maketu Estuary. The sampling sites are described in Figure 4 and Table 5.

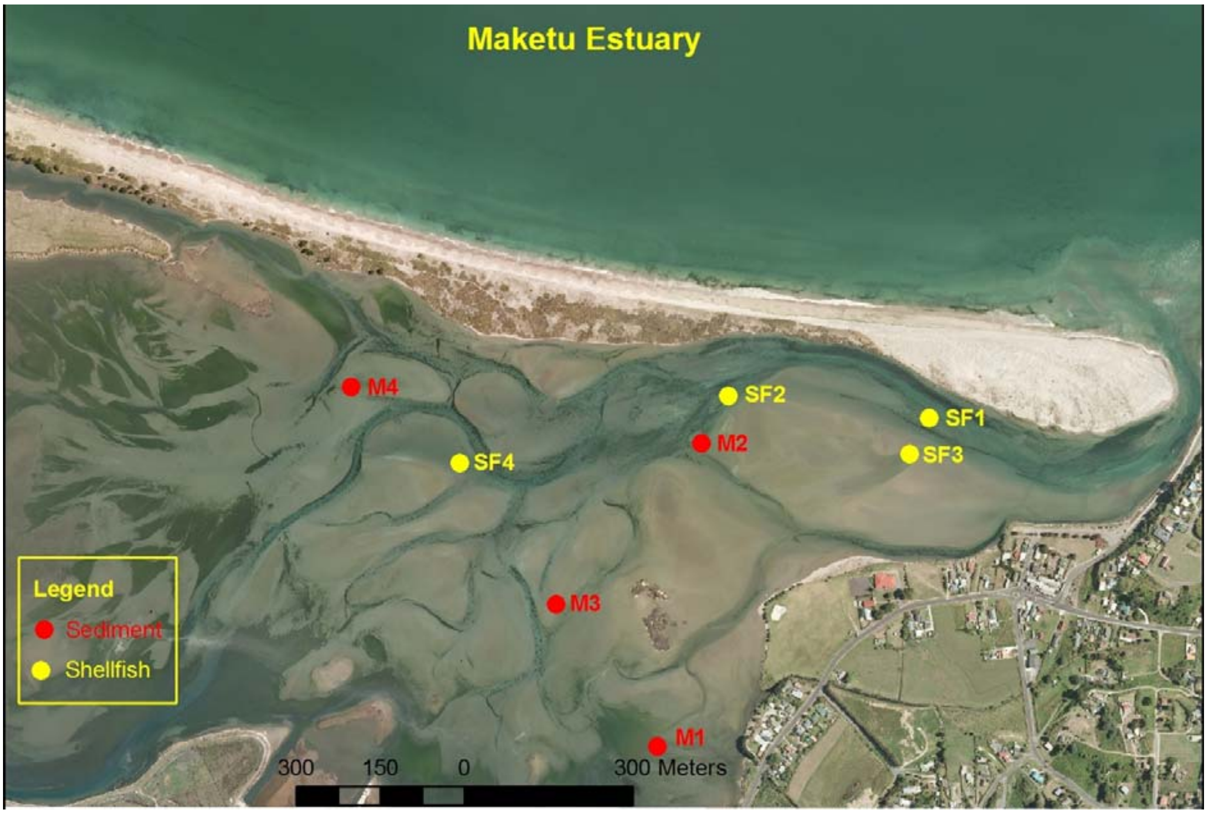



*Figure 4* *Sediment and shellfish sites sampled in Maketu Estuary for analysis of organic and metal contaminants.*

*Table 5* *Description of sites in the Maketu and Kaituna Estuaries sampled for sediment and shellfish contaminants.*

| Site | Description | Sample # | Easting | Northing |
|---|---|---|---|---|
| M1 | Mid Maketu Estuary sediment | 082899 | 2813622 | 6376525 |
| M2 | Mid Maketu Estuary sediment | 082900 | 2813725 | 6377075 |
| M3 | Mid Maketu Estuary sediment | 082901 | 2813467 | 637690 |
| M4 | Mid Maketu Estuary sediment | 082902 | 2813098 | 6377175 |
| K1 | Kaituna Estuary 100m from entrance | 082958 | 2810970 | 6377680 |
| SF1 | Mid Maketu Estuary pipi | 082895 | 2814212 | 6377093 |
| SF2 | Mid Maketu Estuary pipi | 082896 | 2813720 | 6377150 |
| SF3 | Mid Maketu Estuary cockle | 082897 | 2814212 | 6377093 |
| SF4 | Mid Maketu Estuary cockle | 082898 | 2813274 | 6377040 |

## 2.3 Sampling and Analysis Methods

### 2.3.1 Shellfish

The collection of shellfish from Maketu Estuary was carried out using hand gathering with each sample (minimum 50 shellfish) placed in labelled plastic bags on ice in chilly bins. Samples were sent by overnight courier to the laboratory.

Shellfish were shucked and blended to produce a homogenised flesh sample before analysis as below.

- The moisture content of the flesh was determined by drying at 65°C for a minimum of 24 hours.

- Metals analysis was by ICP-MS following digestion of sample by nitric and hydrochloric acid, micro digestion at 85°C for 1 hour.

- Lipid content was determined by gravimetric method.

- Organic contaminants (PCB, PAH and organochlorine pesticides) were determined by sonication extraction, SPE cleanup, GPC cleanup, dual column GC-ECD analysis. Pentachlorophenol trace levels by ASE extraction, acetylation and GC-ECD analysis.

- Dry matter was determined by drying at 103°C and gravimetry.

### 2.3.2 Sediments

Both freshwater and estuarine sediment samples were obtained using a stainless steel trowel to sample the top 2 cm of sediment. A minimum of ten replicates from each site were combined and well mixed to form a composite sample before being placed into a labelled plastic bag and stored on ice. Samples were sent by overnight courier to the laboratory. Samples were then air dried at 35°C and sieved to obtain the fraction less than 2 mm. The analysis methods are outlined below.

- Dry matter was determined by drying at 103°C then gravimetric method.

- Total carbon analysis was by catalytic combustion (900°C, $O_2$), separation, thermal conductivity detector (elementar analyser).

- Metals (total recoverable – trace level) by nitric/hydrochloric acid digestion, ICP-MS, trace level.

- Organochlorine pesticides (trace) by sonication extraction, SPE cleanup, GPC cleanup, dual column GC-ECD analysis.

- Organonitro and phosphorus pesticides (trace) by sonication extraction, GPC cleanup, GC-MS analysis.

- Trace polycyclic aromatic hydrocarbons (PAH's) by sonication extraction, SPE cleanup, GC-MS SIM analysis.

- Pentachlorophenol (PCP) screen determined by solvent extraction, acetylation, GC-ECD analysis.

### 2.3.3 Water

Water samples were collected as mid-stream grab samples in containers washed and provided by the laboratory as appropriate for the analysis being conducted. Stream flows at the time were average base flow levels. The water analysis methods are outlined below.

- Nutrients were determined by the use of standard methods. A summary of these methods is included in the laboratory report included in Appendix II.

- Total anions and cations by calculation of sum as mEquiv/L, total alkalinity using APHA 2320 B (modified for alk <20) 21st ed. 2005, bicarbonate using APHA 4500-CO2 D 21st ed. 2005, total hardness by calculation from Calcium and Magnesium.

- Samples for dissolved metals were filtered using 0.45 micron membrane filters and preservation with nitric acid. APHA 3030 B 21st ed. 2005.

- Total metals (drinking water suite - trace) by nitric acid digestion and ICP-MS APHA 3125 B 21st ed. 2005.

- Dissolved Calcium, Magnesium, Potassium and Sodium (trace) by ICP-MS APHA 3125 B 21st ed. 2005.

- Organochlorine/Organonitro and phosphorus pesticides (ultra trace) determined by solid phase extraction, GPC and GC-MS analysis.

- Trace polycyclic aromatic hydrocarbons (PAH's) by solid phase extraction, SPE, GC-MS SIM analysis.

# Part 3: Results – River and Stream Sites

## 3.1 General Water Quality

### 3.1.1 Kaituna River and main tributaries

The results of the general water quality monitoring are summarised as median values in Tables 6 to 8. Sites on the Kaituna River are listed in order of occurrence from the top of the river (Okere Falls) to the coast (Te Tumu). The results reflect the lake source with increasing influence as the river flows through the lower catchment. Median conductivity values decrease down river with the exception of Te Tumu which has some saline influence. Chlorophyll-*a* concentrations decrease down the river indicating dilution of lake sourced-algae while nutrient concentrations increase.

*Table 6 Median values (n=13) for water quality parameters for samples collected from the Kaituna River and tributaries monthly between May 2007 and June 2008.*

| Site | Temp °C | COND ms/m | SS $g/m^3$ | TURB NTU | pH | Ecoli* | Ent* | FC* |
|---|---|---|---|---|---|---|---|---|
| KR - Okere Falls | 13.6 | 18.9 | 2.2 | 1.2 | 6.9 | 11 | 8 | 10 |
| KR - Maungarangi Road | 14.9 | 16.8 | 4.9 | 1.7 | 6.8 | 30 | 8 | 34 |
| KR - Te Matai | 14.4 | 14.5 | 6.7 | 2.0 | 6.8 | 75 | 16 | 76 |
| KR - Te Tumu | 17.1 | 76.3 | 5.6 | 3.5 | 6.9 | 201 | 23 | 201 |
| Mangorewa River | 13.1 | 7.5 | 2.5 | 0.9 | 6.9 | 58 | 24 | 67 |
| Parawhenuamea Strm | 14.2 | 9.2 | 6.8 | 3.2 | 6.7 | 191 | 87 | 211 |
| Waiari Stream | 13.2 | 7.4 | 5.9 | 1.8 | 7.0 | 188 | 47 | 101 |
| Te Puke Stream | 14.7 | 14.6 | 8.6 | 9.8 | 6.6 | 1301 | 544 | 1601 |
| Ohineangaanga Stream | 14.2 | 9.8 | 5.3 | 2.7 | 6.7 | 389 | 89 | 480 |
| Raparapahoe Stream | 14.2 | 7 | 8.6 | 4.1 | 6.9 | 356 | 57 | 346 |
| Kopuaroa Stream | 13.6 | 13.1 | 16 | 17.5 | 6.8 | 1801 | 633 | 1801 |

* numbers/100 ml

Of all the tributaries sampled the Te Puke and Kopuaroa Streams had the highest conductivity, suspended solids (SS) and turbidity levels. The Kopuaroa Stream stands out as having a particularly high median SS value. These two streams also had very high bacterial loadings while the Ohineangaanga and Raparapahoe Streams have moderate bacterial loadings.

Table 7 below compares the *E.coli* results to the single sample criteria set out in the Microbial Water Quality Guidelines for Recreational areas (MfE 2003). With the exception of the Kaituna River at Okere Falls, all other sites have at least one sample that exceeds the alert mode criteria. The lower Kaituna River (Te Matai - Te Tumu) also has at least one sample that exceeds the action criteria. Nearly all the samples from the Kopuaroa and Te Puke Streams exceed the action criteria.

*Table 7 Comparison of E.coli results (no./100ml) from monthly sampling in 2007/2008 from the Kaituna River and tributaries against the MfE 2003 microbial water quality guidelines for single samples (sample <260-acceptable, >260-alert mode, >550-action mode).*

| | Number of samples | % >260 | % >550 |
|---|---|---|---|
| Okere Falls | 14 | 0.0 | 0.0 |
| Maungarangi Road | 13 | 7.7 | 0.0 |
| Te Matai | 13 | 7.7 | 7.7 |
| Te Tumu | 8 | 25.0 | 12.5 |
| Mangorewa | 13 | 15.4 | 7.7 |
| Parawhenuamea | 12 | 25.0 | 8.3 |
| Waiari | 12 | 41.7 | 25.0 |
| Te Puke | 12 | 91.7 | 91.7 |
| Ohineangaanga | 12 | 75.0 | 33.3 |
| Raparapahoe | 12 | 58.3 | 25.0 |
| Kopuaroa | 12 | 100 | 100 |

The results for nutrients (Table 8) show some interesting values. Nearly all of the phosphorus in the Mangorewa River is in the dissolved reactive phosphorus (DRP) form. This is biologically available and the Mangorewa has the highest median concentration of all the tributaries sampled. Because of its moderate size, the Mangorewa is a significant contributor to the DRP load in the Kaituna River. The Parawhenuamea and Waiari Streams also have moderately high DRP concentrations which accounts for nearly all the total phosphorus measured. In terms of total phosphorus concentrations the Kopuaroa Stream has the highest median values.

Median ammonium nitrogen (NH4) concentrations were high in the Kopuaroa Stream, moderately high in the small Te Puke Stream and very low in the Mangorewa River. All tributaries contribute additional nitrate/nitrite nitrogen (NOx) loading to the Kaituna River. The Parawhenuamea and Ohineangaanga Streams have the highest median concentrations of NOx and total nitrogen (TN).

*Table 8 Median values (n=13) of nutrient parameters (g/m$^3$) and Chlorophyll-a (mg/m$^3$) for samples collected from the Kaituna River and tributaries monthly between May 2007 and June 2008.*

| Site | DRP | NH4-N | NOx-N | TKN | TN | TP | Chl-a |
|---|---|---|---|---|---|---|---|
| KR - Okere Falls | 0.003 | 0.017 | 0.017 | 0.270 | 0.288 | 0.021 | 6.3 |
| KR - Maungarangi Road | 0.017 | 0.014 | 0.238 | 0.291 | 0.521 | 0.033 | 4.5 |
| KR - Te Matai | 0.030 | 0.063 | 0.520 | 0.300 | 0.792 | 0.044 | 3.1 |
| KR - Te Tumu | 0.030 | 0.067 | 0.570 | 0.375 | 0.838 | 0.044 | 2.4 |
| Mangorewa River | 0.054 | 0.007 | 1.065 | 0.168 | 1.223 | 0.050 | 0.2 |
| Parawhenuamea Stream | 0.043 | 0.019 | 1.910 | 0.192 | 2.115 | 0.049 | . |
| Waiari Stream | 0.042 | 0.016 | 1.080 | 0.166 | 1.241 | 0.042 | . |
| Te Puke Stream | 0.022 | 0.091 | 1.355 | 0.550 | 1.869 | 0.036 | . |
| Ohineangaanga Stream | 0.022 | 0.024 | 2.245 | 0.197 | 2.414 | 0.022 | . |
| Raparapahoe Stream | 0.015 | 0.022 | 0.710 | 0.212 | 0.938 | 0.014 | . |
| Kopuaroa Stream | 0.031 | 0.220 | 0.717 | 0.696 | 1.612 | 0.064 | . |

The only tributary in which Chlorophyll-*a* measurements were made is the Mangorewa River. Median concentrations are very low indicating a near absence of phytoplankton which means it effectively dilutes phytoplankton in the Kaituna River. The other tributaries are likely to be similar and this helps explain why algal concentrations in the river decrease down to the sea.

### 3.1.2 Confluence samples

The water quality of samples taken on two days in June 2007 at the confluence of the Kopuaroa, Raparapahoe and Waiari Streams is shown in Tables 9 and 10. When compared to the upstream samples taken around the same time the results tend to be similar with the exception of the Waiari Stream. The nutrient levels recorded at the confluence site for the Waiari Stream were higher than the upstream values.

*Table 9 Mean water quality parameter values (n=2) of samples taken at the confluence of streams with the Kaituna River in June 2007.*

| Site | Temp °C | COND[1] | TURB (NTU) | pH | Ecoli[2] | ENT[2] | FC[2] |
|---|---|---|---|---|---|---|---|
| Kopuaroa | 10.4 | 15 | 13.3 | 6.9 | 220 | 126 | 310 |
| Raparapahoe | 11.1 | 6 | 5.7 | 7 | 405 | 54 | 545 |
| Waiari | 12.3 | 7 | 2.2 | 7.1 | 83 | 24 | 109 |

[1] mS/m @25C, [2] number /100 ml.

*Table 10 Mean suspended sediment and nutrient values ($g/m^3$, n=2) of samples taken at the confluence of streams with the Kaituna River in June 2007.*

| | SS | DRP | NH4-N | NOx-N | TKN | TP |
|---|---|---|---|---|---|---|
| Kopuaroa | 6 | 0.031 | 0.227 | 0.086 | 0.61 | 0.062 |
| Raparapahoe | 10.3 | 0.015 | 0.035 | 1.51 | 0.237 | 0.027 |
| Waiari | 8.7 | 0.08 | 0.038 | 1.23 | 0.208 | 0.075 |

### 3.1.3 Minor inflows

Some of the smaller inflows in the lower reaches of the Kaituna River were sampled on two occasions in June 2007 to provide an indication of the quality of and potential impact on the Kaituna River. The results are shown in Tables 11 and 12 below.

*Table 11 Mean water quality parameter values (n=2) for samples taken in minor inflows to the Kaituna River in June 2007.*

| Site (*) – shown on Fig 3 | Temp | COND[1] | TURB | pH | Ecoli[2] | ENT[2] | FC[2] |
|---|---|---|---|---|---|---|---|
| Kaituna Wetland (G) | 11.2 | 48 | 8.0 | 6.8 | 140 | 31 | 129 |
| Papamoa drain (F) | 11.5 | 30 | 5.9 | 7.0 | 25 | 19 | 31 |
| Small Drain (C) | 9.5 | 20 | 5.4 | 6.6 | 225 | 105 | 265 |
| Old Parawhenuamea (A) | 9.2 | 18 | 21.5 | 6.5 | 2635 | 715 | 4300 |
| Farm drain Fords Cut (H) | 10.7 | 390 | 29.0 | 6.6 | 145 | 82 | 245 |

[1] mS/m @25C , [2] number /100 ml.

*Table 12 Mean suspended sediment and nutrient values ($g/m^3$, n=2) for samples taken in minor inflows to the Kaituna River in June 2007.*

| Sites as shown on Fig 3 | SS | DRP | TP | NH4-N | NOx-N | TKN | TN |
|---|---|---|---|---|---|---|---|
| Kaituna Wetland (G) | 5.5 | 0.033 | 0.079 | 0.314 | 0.481 | 0.689 | 1.170 |
| Papamoa drain (F) | 4.0 | 0.037 | 0.068 | 0.182 | 0.713 | 0.650 | 1.363 |
| Small Drain (C) | 3.6 | 0.034 | 0.067 | 0.449 | 1.850 | 1.090 | 2.940 |
| Old Parawhenuamea (A) | 28.0 | 0.086 | 0.246 | 0.652 | 0.422 | 0.710 | 1.132 |
| Farm drain Fords Cut (H) | 14.5 | 0.004 | 0.045 | 0.632 | 0.492 | 0.855 | 1.347 |

Of these sites one (Site H) has high conductivity. Both sites A and H have high suspended solids and turbidity readings. In terms of bacteria (*E.coli*, enterococi and faecal coliforms) site A has high numbers.

In terms of nutrients, DRP and TP concentrations were high at site A. Concentrations of oxidised forms of nitrogen (NOx) and total nitrogen were reasonably low at sites G, A and H, but moderate at site C. All of these sites show elevated concentrations of ammonium nitrogen, particularly sites A and H.

Site H was sampled on the river side of the discharge point on 7 May 2008 while the drain was discharging large volumes as a result of rainfall on the previous night. Results for nutrients were much higher (NH4 1.3, NOx 0.85, TKN 2.9, TN 3.8 and TP 0.61 $g/m^3$) after rain.

### 3.1.4 Anions and cations

Water samples were collected from a number of sites to determine their anion-cation characteristics. The results are shown in Table 13 below.

*Table 13 Results of analysis of cations and anions on water samples collected on 7 May 2008 from the Kaituna River and tributaries.*

| | Kopuaroa | Rapara pahoe | Ohineanga | Te Puke | Waiari | Parawhenuamea | Mangorewa | Maungarangi | Site H |
|---|---|---|---|---|---|---|---|---|---|
| Anions* | 1.4 | 0.55 | 0.83 | 1.7 | 0.7 | 0.92 | 0.61 | 1.5 | 44 |
| Cations* | 1.3 | 0.49 | 0.75 | 1.5 | 0.64 | 0.83 | 0.54 | 1.4 | 42 |
| pH | 6.4 | 6.8 | 6.6 | 6.5 | 6.8 | 6.6 | 6.9 | 6.8 | 6.3 |
| Alkalinity CaCO3[1] | 24 | 14 | 18 | 34 | 21 | 23 | 18 | 16 | 53 |
| Bicarbonate[1] | 29 | 17 | 21 | 42 | 25 | 28 | 22 | 19 | 65 |
| Hardness[1] | 34 | 9.2 | 14 | 40 | 11 | 16 | 10 | 15 | 540 |
| Conductivity[2] | 15 | 5.7 | 8.9 | 18 | 7.2 | 9.5 | 6.2 | 17 | 470 |
| Ca dissolved[1] | 9 | 2.1 | 3.3 | 10 | 2.6 | 3.6 | 2.3 | 3.3 | 85 |
| Mg dissolved[1] | 2.7 | 0.94 | 1.4 | 3.4 | 1.1 | 1.6 | 1 | 1.7 | 80 |
| Ka dissolved[1] | 4.1 | 1.8 | 2.9 | 6.2 | 2.2 | 3 | 1.9 | 4 | 37 |
| Na dissolved[1] | 11 | 6.1 | 9 | 13 | 8.4 | 10 | 6.8 | 24 | 680 |
| Chloride[1] | 13 | 6.3 | 8.9 | 15 | 5.8 | 8.8 | 5.2 | 22 | 1400 |
| Nitrite-N[1] | 0.0150 | <0.002 | <0.002 | 0.021 | <0.002 | 0.0027 | <0.002 | <0.002 | 0.031 |
| Nitrate-N[1] | 2.1 | 0.59 | 2 | 1.7 | 1.1 | 1.8 | 0.86 | 0.21 | 0.82 |
| Sulphate[1] | 17 | 2.8 | 4 | 21 | 2.5 | 4.2 | 2.1 | 28 | 200 |

Units: * = meq/L, [1] = $g/m^3$, [2] = mS/m

## 3.2 Organic Contaminants

### 3.2.1 Water

Water column samples from the Maungarangi Road site on the Kaituna River and main tributaries in the lower catchment were collected on 7 May 2008 and analysed for a range of organic contaminants. These included organochlorine, organonitrogen and phosphorus based pesticides with the list and detection level provided in Appendix I (lab report in Appendix II). These detection limits are generally well below the mav's (maximum acceptable values) of the New Zealand Drinking Water Standards (MoH 2005). None of the listed pesticides were detected in any of the samples.

Other organic contaminants tested in the water samples included pentachlorophenol (PCP), 2, 3, 4, 6-tetrachlorophenol and polycyclic aromatic hydrocarbons (PAH's). The two chlorophenols were not detected in any samples (detection level of 0.000014 $g/m^3$). PAH's were detected at the Waiari Stream and Mangorewa River sites at concentrations just above the detection limits as listed below.

| | Waiari Stream | Mangorewa River |
|---|---|---|
| Benzo[b,j]fluoranthene ($g/m^3$) | 0.000011 | 0.000013 |
| Benzo[g,h,i]perylene ($g/m^3$) | 0.000009 | 0.000012 |
| Benzo[k]fluoranthene ($g/m^3$) | 0.000013 | <0.000008 |

### 3.2.2 Sediment

Sediment was collected for organics analysis from the Kaituna River at Maungarangi Road and the river entrance along with the tributaries in the lower catchment. The organic contaminants analysis included PAH"s, organochlorine, organonitrogen and phosphorus pesticides.

Many sites had no detectable levels of pesticides. The most common pesticide detected was DDT or its breakdown products, which were detected at three of the nine freshwater sites tested (Table 14).

The Ohineangaanga Stream is the only site where detectable levels of pesticides other than DDT were found. This result is even more significant due to the very low proportion of mud (0.3% by volume) and organic carbon (0.097g/100g) present in the sample collected. The amount of mud and carbon in the sediment are important indicators of the ability of sediment to accumulate both organic and inorganic contaminants as it is these components that bind with chemicals and trap them in the sediment.

*Table 14* *Organochlorine pesticide concentrations (mg/kg dry wt) detected in sediment shown as-sampled and normalised to 1% organic carbon. Samples collected on 7 May 2008.*

| | Ohineangaanga Stream | | Te Puke Stream | | KR - Maungarangi | |
|---|---|---|---|---|---|---|
| | as sampled | normalised | as sampled | normalised | as sampled | normalised |
| 4,4-DDD | 0.0013 | 0.0134 | 0.0015 | 0.0052 | | |
| 4,4-DDE | 0.0013 | 0.0134 | 0.011 | 0.0379 | 0.0021 | 0.0014 |
| 2,4-DDT | | | | | 0.0021 | 0.0014 |
| 4,4-DDT | 0.0014 | 0.0144 | 0.0042 | 0.01448 | 0.014 | 0.0093 |
| Dieldrin | 0.0018 | 0.0186 | | | | |
| Endrin | 0.0014 | 0.0144 | | | | |
| Hexachlorobenzene | 0.0018 | 0.0186 | | | | |

In Table 14 the normalised results have been compared against the ANZECC water quality guidelines for the protection of aquatic life (ANZECC 2000). The yellow shaded results indicate sediment samples that exceed the ISQG-low trigger value (interim sediment quality guideline-low value) which is a level at which further investigation is recommended as sensitive species may be impacted. The red shaded results indicate the ISQG-high value has been exceeded and some impact on species is likely. All three sites in Table 14 have results that exceed the low value while the Te Puke Stream had levels of DDE which exceed the ISQG-high value. Ohineangaanga Stream also has results for Dieldrin and Endrin which exceed the ISQG-high value.

In contrast to the pesticides, none of the individual PAH's (or totals) detected exceeded the ANZECC interim sediment quality guidelines for the protection of aquatic life (Table 15).

*Table 15* *PAH concentrations (mg/kg dry wt) in sediment as collected and normalised to 1% organic carbon for sites recording levels above the limit of detection from samples collected on 7 May 2008.*

| | **Te Puke Stream** | | **Waiari Stream** | | **KR - Maungarangi** | |
|---|---|---|---|---|---|---|
| **PAH mg/kg dry wt** | as sampled | normalised | as sampled | normalised | as sampled | normalised |
| Acenaphthene | <0.0034 | | <0.0025 | | <0.0028 | |
| Acenaphthylene | <0.0034 | | <0.0025 | | <0.0028 | |
| Anthracene | 0.0069 | 0.0238 | <0.0025 | | <0.0028 | |
| Benzo[a]anthracene | 0.023 | 0.079 | <0.0025 | | 0.0074 | 0.0049 |
| Benzo[a]pyrene | 0.033 | 0.114 | <0.0025 | | 0.0076 | 0.0051 |
| Benzo[b,j]fluoranthene | 0.057 | 0.197 | <0.0025 | | <0.0028 | |
| Benzo[g,h,i]perylene | 0.043 | 0.148 | <0.0025 | | 0.0096 | 0.0064 |
| Benzo[k]fluoranthene | 0.036 | 0.124 | <0.0025 | | 0.012 | 0.008 |
| Chrysene | 0.035 | 0.121 | 0.0032 | 0.0011 | 0.0094 | 0.0063 |
| Dibenzo[a,h]anthracene | 0.0068 | 0.0234 | <0.0025 | | <0.0028 | |
| Fluoranthene | 0.069 | 0.238 | 0.0064 | 0.0021 | 0.018 | 0.012 |
| Fluorene | <0.0034 | | <0.0025 | | <0.0028 | |
| Indeno(1,2,3-c,d)pyrene | 0.027 | 0.093 | <0.0025 | | 0.006 | 0.004 |
| Naphthalene | <0.017 | | <0.013 | | <0.014 | |
| Phenanthrene | 0.023 | 0.079 | 0.0055 | 0.0018 | 0.0063 | 0.0042 |
| Pyrene | 0.077 | 0.266 | 0.006 | 0.002 | 0.02 | 0.013 |

| Total detected PAHs | 0.4367 | 1.506 | 0.0211 | 0.007 | 0.0963 | 0.0642 |
|---|---|---|---|---|---|---|

## 3.3 Metals

### 3.3.1 Water

Water column samples from the Maungarangi Road site on the Kaituna River and the main tributaries in the lower catchment were collected on 7 May 2008 and analysed for metals. The results are shown in Table 16 and were all below the relevant drinking water standard values (MoH 2005). The results that came closest to the maximum accepted values were arsenic (mav – 0.01) in the Kaituna River (Maungarangi Road site) and manganese (mav – 0.4) at the Kopuaroa and Te Puke Stream sites.

The Kaituna River results show high concentrations of geothermally derived metals (arsenic, boron, lithium) compared to the tributaries which have little or no geothermal influence. The highest overall metal concentrations were found in the small Te Puke stream indicating possible urban influences while the Kopuaroa Stream with no urban catchment had the next overall highest results.

*Table 16 Results for total metals (g/m$^3$) in water column samples collected from the Kaituna River and the main tributaries on 7 May 2008. Highlighted values exceed the ANZECC 2000 95% protection guideline for aquatic life.*

| | Kopuaroa | Rapahoe | Ohineanga | Te Puke | Waiari | Parawhenu | Mangorewa | Maungrangi |
|---|---|---|---|---|---|---|---|---|
| Aluminium | 0.52 | 0.56 | 0.33 | 0.58 | 0.27 | 0.15 | 0.14 | 0.08 |
| Antimony | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 | 0.00022 |
| Arsenic | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 | 0.0051 |
| Barium | 0.084 | 0.034 | 0.063 | 0.13 | 0.049 | 0.064 | 0.031 | 0.025 |
| Beryllium | 0.00014 | <0.00011 | <0.00011 | 0.00013 | <0.00011 | <0.00011 | <0.00011 | <0.00011 |
| Boron | 0.017 | 0.0091 | 0.015 | 0.02 | 0.0087 | 0.009 | 0.0091 | 0.24 |
| Cadmium | 0.000057 | <0.000053 | <0.000053 | <0.000053 | <0.000053 | <0.000053 | <0.000053 | <0.000053 |
| Calcium | 9.5 | 2.3 | 3.7 | 12 | 2.9 | 3.8 | 2.6 | 3.5 |
| Chromium | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 |
| Copper | 0.00083 | <0.00053 | <0.00053 | 0.001 | <0.00053 | <0.00053 | <0.00053 | <0.00053 |
| Iron | 1.2 | 0.41 | 0.53 | 1.1 | 0.21 | 0.41 | 0.095 | 0.081 |
| Lead | 0.00033 | 0.00039 | 0.00038 | 0.0005 | 0.00016 | 0.00017 | <0.00011 | <0.00011 |
| Lithium | 0.0028 | 0.0017 | 0.0034 | 0.0043 | 0.0041 | 0.0048 | 0.0049 | 0.1 |
| Magnesium | 2.9 | 1.1 | 1.6 | 3.8 | 1.2 | 1.8 | 1.2 | 1.9 |
| Manganese | 0.26 | 0.021 | 0.055 | 0.34 | 0.025 | 0.042 | 0.0077 | 0.022 |
| Mercury | <0.000080 | <0.000080 | <0.000080 | <0.000080 | <0.000080 | <0.000080 | <0.000080 | <0.000080 |
| Molybdenum | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 | <0.00021 |
| Nickel | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 |
| Potassium | 4.3 | 1.9 | 3.2 | 7.2 | 2.4 | 3.2 | 2.1 | 4.2 |
| Selenium | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 |
| Silver | <0.00011 | <0.00011 | <0.00011 | <0.00011 | <0.00011 | <0.00011 | <0.00011 | <0.00011 |
| Sodium | 12 | 6.5 | 10 | 16 | 8.9 | 11 | 7.4 | 26 |
| Tin | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 | <0.00053 |
| Uranium | 0.000055 | 0.000042 | 0.000025 | 0.000067 | 0.000025 | <0.000021 | <0.000021 | <0.000021 |
| Zinc | 0.0087 | 0.0028 | 0.0056 | 0.018 | 0.0034 | 0.0083 | 0.0016 | 0.0038 |

The highlighted results in Table 16 indicate that the ANZECC trigger value for the protection of aquatic life (95% protection level) has been exceeded (ANZECC 2000). The guideline used for aluminium applies at pH >6.5. Both the Kopuaroa and Te Puke Streams had pH <6.5 which increases the toxicity of aluminium. Zinc exceeded the guideline in the Kopuaroa, Te Puke and Parawhenuamea Streams.

### 3.3.2 Sediments

Metal concentrations in the stream bed sediments are shown in Table 17 on an as sampled basis (i.e. not normalised for mud or organic content). The Maungarangi Road site on the Kaituna River shows the influence of geothermal inputs with mercury being just over the ISQG low trigger value for sediments (ANZECC 2000). The site with the highest levels of non-geothermal metals was the Te Puke Stream with cadmium, copper, lead and zinc being higher than other sites.

*Table 17 Sediment parameters and total metal concentrations (mg/kg –dw) measured in streambed samples collected from the lower Kaituna catchment on the 7 May 2008.*

| Site | Kopuaroa | Raparapa | Ohineanga | Te Puke | Waiari | Parawhenu | Mangorew | Maunga | Te Tumu |
|---|---|---|---|---|---|---|---|---|---|
| TOC[1] | 0.72 | 0.25 | 0.097 | 0.29 | 3 | 1.2 | 0.7 | 1.5 | 0.63 |
| Mud[2] | 0.6 | 2.6 | 0.3 | 15.4 | 19.8 | 7.9 | 3.1 | 22.6 | 4.1 |
| Antimony | 0.041 | 0.099 | <0.04 | 0.11 | 0.051 | 0.076 | <0.04 | 0.14 | 0.088 |
| Arsenic | 3.9 | 3.7 | 0.63 | 3.5 | 1.9 | 1.7 | 1.3 | 6.7 | 5.1 |
| Beryllium | 0.36 | 0.33 | 0.12 | 0.55 | 0.78 | 0.59 | 0.31 | 0.36 | 0.23 |
| Cadmium | 0.061 | 0.029 | 0.016 | 0.22 | 0.058 | 0.075 | 0.031 | 0.042 | 0.015 |
| Chromium | 3.1 | 4.1 | 1 | 3.9 | 1.6 | 2.3 | 1.3 | 1.5 | 1.8 |
| Copper | 2.4 | 3 | 0.89 | 8.5 | 3 | 2.9 | 1.7 | 2.5 | 1.4 |
| Lead | 4.4 | 5.7 | 2.6 | 12 | 5.3 | 6.3 | 3.7 | 6.5 | 2.9 |
| Mercury | 0.033 | 0.077 | <0.010 | 0.052 | 0.032 | 0.027 | 0.019 | 0.24 | 0.032 |
| Nickel | 0.92 | 1.3 | 0.24 | 1.5 | 0.65 | 0.7 | 0.45 | 0.69 | 0.74 |
| Silver | 0.023 | 0.027 | <0.02 | 0.068 | 0.048 | 0.032 | 0.024 | 0.038 | <0.02 |
| Thallium | 0.098 | 0.076 | 0.034 | 0.19 | 0.062 | 0.093 | 0.066 | 0.093 | 0.035 |
| Zinc | 30 | 45 | 29 | 70 | 29 | 43 | 29 | 22 | 18 |

[1] g/100g [2] % by volume

## 3.4 Rainfall event monitoring

Sampling of rainfall events occurred three times on 30 June 2007 and twice on 17 August 2007. Sampling effort was around the time of peak flow levels at each of the sites monitored.

To help with interpretation of the water quality data recorded during the two rainfall events hydrological records are provided from three rainfall sites and three stream/river level sites.

### 3.4.1 Rainfall

Rainfall in the Kaituna Catchment at the time of sampling is provided in Figures 5 and 6 for the Kaharoa gauge (uppermost southwest area of the catchment), Saunders Road (mid catchment) and Te Matai (lower catchment). Most of the rainfall on 30 June 2007 fell around the centre of the lower Kaituna River catchment. In contrast most of the rainfall on 17 August 2007 occurred in the upper catchment (Figure 6).

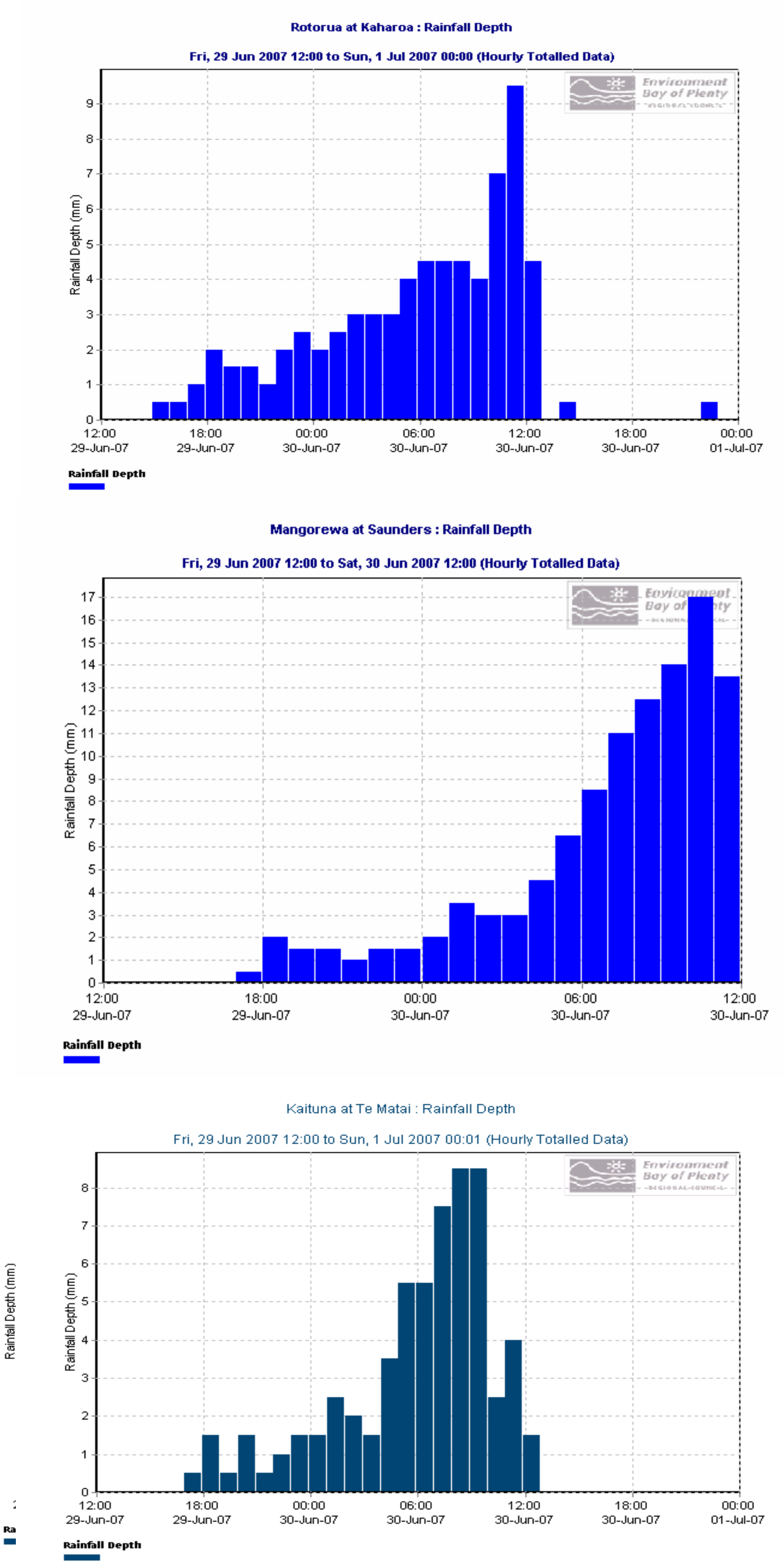



*Figure 5 Rainfall recorded at the Kaharoa, Saunders Road and Te Matai gauges on 30 June 2007.*

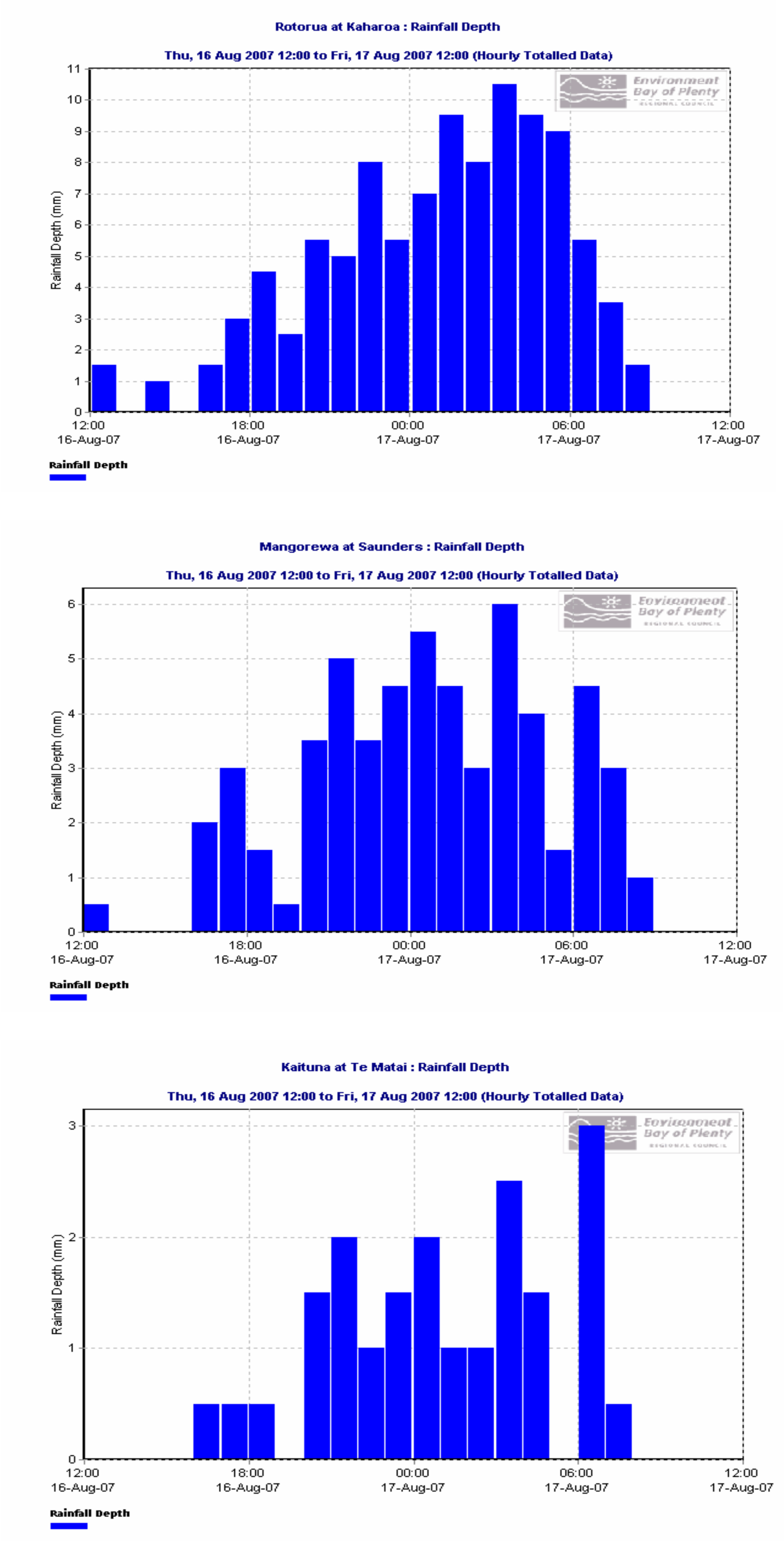
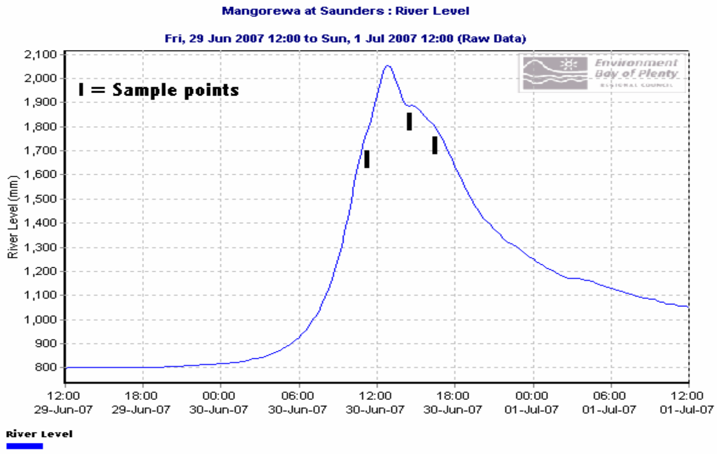
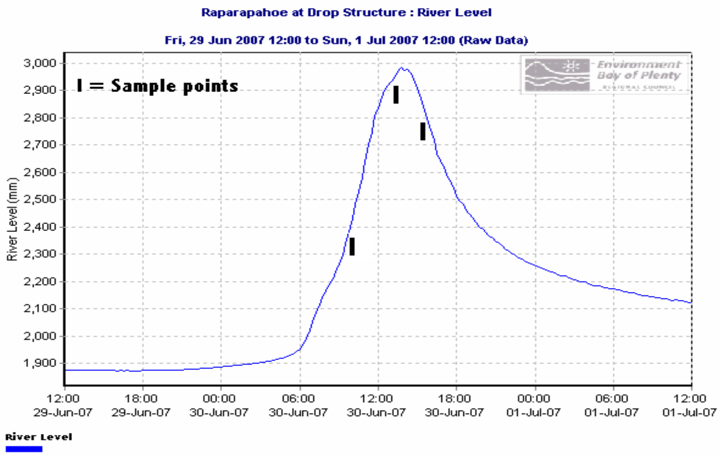



*Figure 6 Rainfall recorded at the Kaharoa, Saunders Road and Te Matai gauges on 17 August 2007.*

## 3.4.2 Stream levels

Stream levels for gauged sites on the Kaituna River (Te Matai), Mangorewa River and Raparapahoe Stream for the two rainfall events in which water sampling took place are shown in Figures 7 and 8.



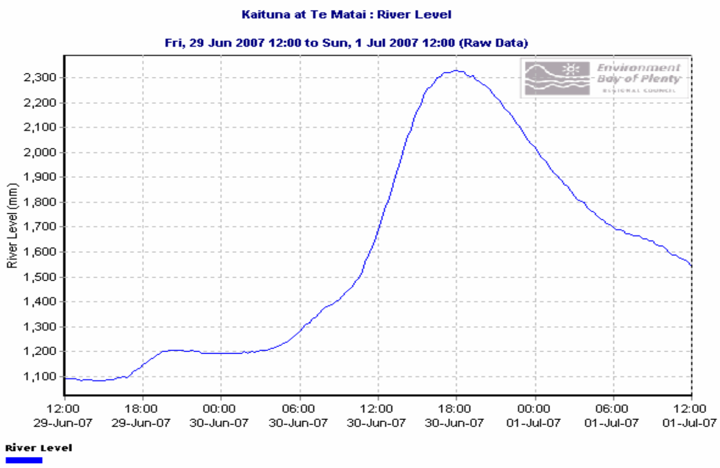




*Figure 7 Water levels recorded on the Mangorewa River, Raparapahoe Stream and the Kaituna River on 30 June 2007.*

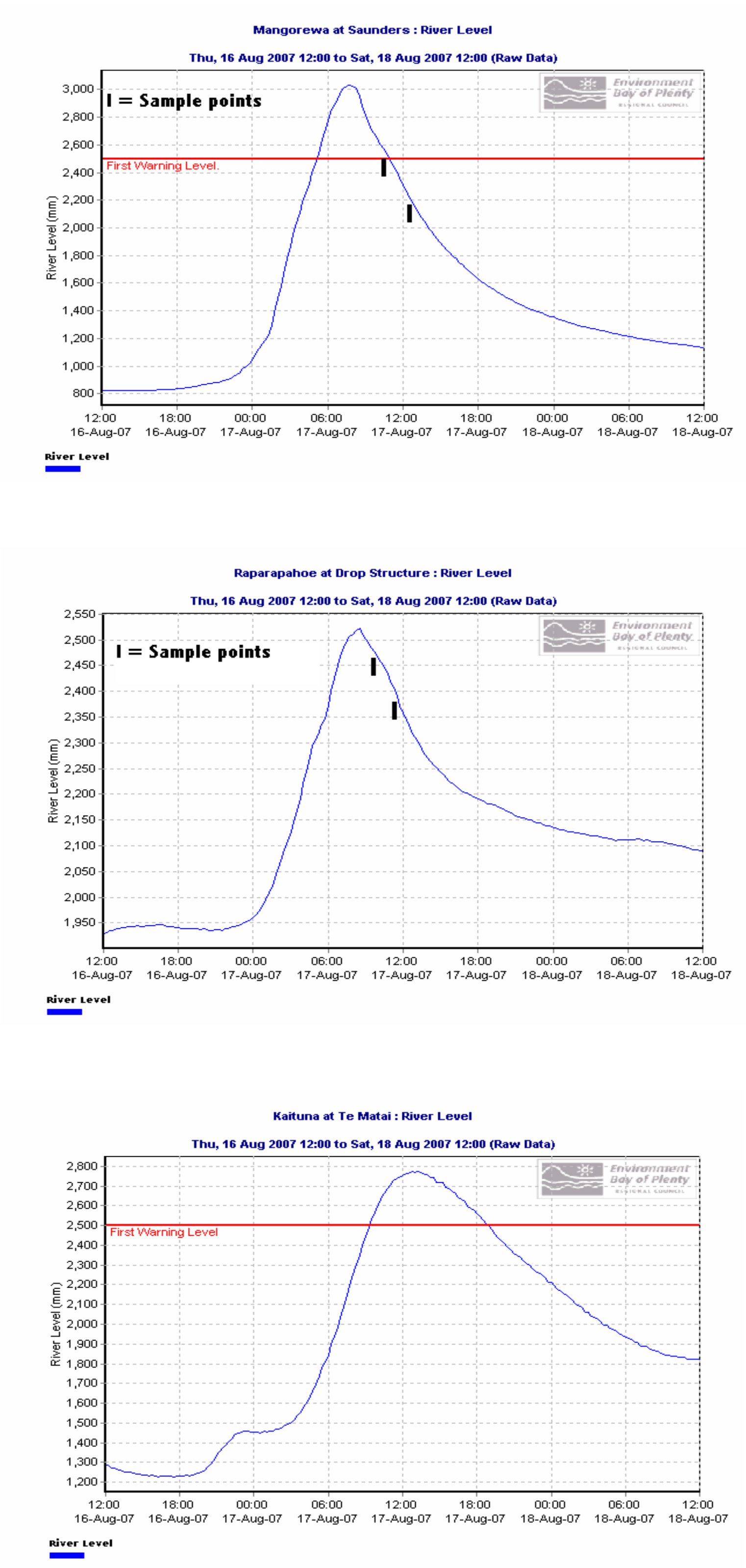



*Figure 8 Water levels recorded on the Mangorewa River, Raparapahoe Stream and Kaituna River on 17 August 2007.*

In line with the rainfall data, the Mangorewa and Kaituna Rivers reached higher levels on 17 August 2007 as a result of heavier rain falling over a greater proportion of their catchments which are further inland. During the 30 June event the Kaharoa rain gauge recorded 70 mm while 102 mm was recorded on 17 August. In contrast, catchments nearer the coast received more rain on 30 June 2007 with 108 mm recorded at Saunders Road and only 57 mm on 17 August 2007. As a result, the smaller streams nearer the coast, such as the Raparapahoe, reached far higher levels during the 30 June event.

The above is also highlighted in Table 18 which shows the peak flow and expresses that flow as a percentage of the mean annual peak flood event. For Raparapahoe Stream the event on 30 June reached close to the mean annual peak flow. It is likely that the similar adjacent catchments of the Kopuaroa, Ohineangaanga, Parawhenuamea and the small Te Puke Streams all came near to their mean annual peak flow levels.

*Table 18 Peak flows for the rainfall events sampled in 30 June and 17 August 2007 expressed as a percentage of the mean annual peak flood flow.*

| River/stream | Date | Peak flow $m^3/s$ | % mean ann. peak flow |
|---|---|---|---|
| Raparapahoe | 30 Jun 2007 | 39.7 | 93.6 |
| Waiari | | 27.7 | 85.2 |
| Mangorewa | | 33.5 | 21.3 |
| Kaituna | | 76.5 | 57.5 |
| Raparapahoe | 17 Aug 2007 | 18.7 | 44.1 |
| Waiari | | 40.5 | 124.6 |
| Mangorewa | | 68.8 | 43.8 |
| Kaituna | | 97.2 | 73.1 |

## 3.4.3 Water quality data for rain events

The results of water quality sampling of the two rainfall events are summarised in Tables 19 and 20 below. The small Te Puke Stream recorded the highest conductivity, suspended solids (SS) and turbidity concentrations. The Waiari and Parawhenuamea Streams had the highest dissolved phosphorus (DRP) levels and the Kopuroa and Parawhenuamea Streams were the highest for dissolved oxidised nitrogen (NOx).

*Table 19 Maximum values for water quality parameters recorded at each of the streams/rivers sampled on 30 June and 17 August 2007 (n=5).*

| SITE | COND | SS[1] | TURB | DRP[1] | NH4-N[1] | NOx-N[1] | TKN[1] | TN[1] | TP[1] |
|---|---|---|---|---|---|---|---|---|---|
| Ohineangaanga | 5.26 | 1100 | 330 | 0.062 | 0.066 | 0.529 | 3.16 | 3.20 | 0.888 |
| Raparapahoe | 5.4 | 540 | 196 | 0.025 | 0.035 | 0.262 | 1.59 | 1.32 | 0.382 |
| Waiari | 6.83 | 980 | 313 | 0.120 | 0.095 | 0.309 | 4.21 | 4.44 | 0.727 |
| Kopuaroa | 12 | 455 | 207 | 0.079 | 0.309 | 0.949 | 3.70 | 2.31 | 0.828 |
| Mangorewa | 6.99 | 240 | 101 | 0.082 | 0.107 | 0.462 | 1.29 | 1.59 | 0.385 |
| Te Puke | 13.8 | 1600 | 1700 | 0.046 | 0.202 | 0.697 | 3.66 | 1.89 | 1.210 |
| Parawhenuamea | 8.6 | 815 | 375 | 0.106 | 0.325 | 0.905 | 3.06 | 1.93 | 0.808 |

[1] $g/m^3$, Turbidity (NTU)

Median values show that the Ohineanagaanga Stream is similar to the Te Puke Stream for suspended solids (Table 20). The much higher median turbidity readings in the Te Puke Stream are likely due to the presence of fine light coloured clay. The Mangorewa River had the highest median concentration of DRP while the Ohineangaanga had the highest total phosphorus (TP) concentrations. The highest median ammonium nitrogen concentrations were recorded in the Kopuaroa Stream and, along with the Parawhenuamea Stream, this site also had the highest median concentration of NOx.

*Table 20 Median values for water quality parameters recorded at each of the streams/rivers sampled on 30 June and 17 August 2007 (n=5).*

| SITE | COND | SS[1] | TURB | DRP[1] | NH4N[1] | NOxN[1] | TKN[1] | TN[1] | TP[1] |
|---|---|---|---|---|---|---|---|---|---|
| Ohineangaanga | 4.96 | 840 | 225 | 0.041 | 0.049 | 0.474 | 2.88 | 2.58 | 0.696 |
| Raparapahoe | 4.97 | 280 | 99 | 0.021 | 0.028 | 0.254 | 1.16 | 1.22 | 0.231 |
| Waiari | 4.06 | 480 | 131 | 0.039 | 0.078 | 0.270 | 2.08 | 3.41 | 0.479 |
| Kopuaroa | 8.20 | 100 | 86 | 0.043 | 0.230 | 0.879 | 1.50 | 2.23 | 0.316 |
| Mangorewa | 4.44 | 125 | 51 | 0.072 | 0.030 | 0.228 | 1.13 | 1.52 | 0.274 |
| Te Puke | 12.77 | 720 | 890 | 0.030 | 0.167 | 0.646 | 1.31 | 1.86 | 0.334 |
| Parawhenuamea | 7.96 | 320 | 127 | 0.058 | 0.120 | 0.894 | 1.96 | 1.88 | 0.566 |

[1] $g/m^3$, Turbidity (NTU)

A comparison of the difference in concentration of suspended sediment and dissolved nutrient during base flow and high flow is given in Table 21. The Ohineangaanga Stream had the greatest increase in SS during rainfall event peak flows while the Kopuaroa Stream had the smallest. It should be noted that although the Kopuaroa had the lowest proportional SS increase during high flow it also has the highest SS levels during base flow.

Most streams show a slightly higher median concentration of DRP during significant rainfall events with the exception of the Waiari Stream which had higher concentrations during base flow. Most streams recorded higher $NH_4$ concentrations during significant rainfall events and the Kopuaroa Stream stood out with the largest increase. The Kopuaroa Stream was also the only stream to show an increase in the concentration of NOx during rainfall events.

*Table 21 Ratio of the median rain event flow/median base flow concentration of key water quality parameters to show change during high flow events.*

| Site | SS | DRP | TP | NH4-N | NOx-N | TN |
|---|---|---|---|---|---|---|
| Ohineangaanga | 158 | 1.86 | 33.1 | 2.0 | 0.21 | 1.1 |
| Raparapahoe | 33 | 1.40 | 16.5 | 1.3 | 0.36 | 1.3 |
| Waiari | 81 | 0.93 | 11.4 | 4.9 | 0.25 | 2.7 |
| Kopuaroa | 6 | 1.39 | 4.9 | 11.5 | 1.23 | 1.4 |
| Mangorewa | 50 | 1.33 | 5.5 | 4.3 | 0.21 | 1.2 |
| Te Puke | 84 | 1.36 | 9.3 | 1.8 | 0.48 | 1.0 |
| Parawhenuamea | 47 | 1.35 | 11.6 | 6.3 | 0.47 | 0.9 |

# Part 4: Results - Maketu Estuary

## 4.1 Sediment quality

### 4.1.1 Organic contaminants

Of the estuary sites sampled only the M3 and M4 sites showed detectable levels of polycyclic aromatic hydrocarbons (PAH's) in the sediments (Table 22). There were no detectable levels of organochlorine, organonitrogen and phosphorus pesticides or chlorophenols. The list of organic contaminants measured is the same as that in section 3.3.2 and full results in Appendix IV.

*Table 22 Concentration of PAH's (mg/kg dry wt) in surface sediment samples collected from Maketu Estuary on 5 May 2008 (detects highlighted).*

| Site | M1 | M2 | M3 | M4 | Kaituna |
|---|---|---|---|---|---|
| Total carbon g/100g | 0.66 | 0.27 | 0.61 | 0.6 | 0.63 |
| Mud - % | 8.4 | 1.7 | 6.4 | 7.1 | 4.1 |
| | | | | | |
| Acenaphthene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Acenaphthylene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Anthracene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Benzo[a]anthracene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Benzo[a]pyrene | <0.0022 | <0.002 | 0.0028 | 0.0022 | <0.002 |
| Benzo[b,j]fluoranthene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Benzo[g,h,i]perylene | <0.0022 | <0.002 | 0.0046 | 0.0022 | <0.002 |
| Benzo[k]fluoranthene | <0.0022 | <0.002 | 0.0057 | <0.0022 | <0.002 |
| Chrysene | <0.0022 | <0.002 | 0.0029 | 0.0035 | <0.002 |
| Dibenzo[a,h]anthracene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Fluoranthene | <0.0022 | <0.002 | 0.0049 | 0.0075 | <0.002 |
| Fluorene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Indeno(1,2,3-c,d)pyrene | <0.0022 | <0.002 | <0.0023 | <0.0022 | <0.002 |
| Naphthalene | <0.011 | <0.010 | <0.012 | <0.011 | <0.010 |
| Phenanthrene | <0.0022 | <0.002 | 0.0035 | 0.0057 | <0.002 |
| Pyrene | <0.0022 | <0.002 | 0.0057 | 0.0068 | <0.002 |
| Total detected PAHs | 0 | 0 | 0.0301 | 0.0279 | 0 |

Comparison of the normalised (to 1% carbon content) results for detectable PAH's with the ANZECC sediment quality guidelines for the protection of aquatic life showed that no results exceed those guidelines.

### 4.1.2 Metals

None of the metals measured in sediments form the estuary sites exceeded the ANZECC sediment quality guidelines for the protection of aquatic life on a whole sample basis (Table 23). If the were normalised to 5% mud content then site M2 would exceed the Canadian sediment quality trigger value for arsenic. If normalised to higher mud content, which is common in more sheltered parts of the estuary, then arsenic, mercury and nickel have the potential to exceed sediment quality guidelines.

*Table 23 Concentration of metals (mg/kg dry wt) in surface sediment samples collected from Maketu Estuary on 5 May 2008.*

| Site | M1 | M2 | M3 | M4 | Kaituna |
|---|---|---|---|---|---|
| Antimony | <0.04 | <0.04 | <0.04 | <0.04 | 0.088 |
| Arsenic | 3.3 | 4.0 | 4.8 | 4.0 | 5.1 |
| Berylllium | 0.14 | 0.17 | 0.2 | 0.19 | 0.23 |
| Cadmium | 0.03 | <0.01 | 0.03 | 0.035 | 0.015 |
| Chromium | 1.7 | 2.9 | 3.1 | 3.0 | 1.8 |
| Copper | 1.1 | 1.2 | 1.6 | 1.4 | 1.4 |
| Lead | 1.7 | 2.1 | 2.2 | 2.1 | 2.9 |
| Mercury | 0.013 | 0.025 | 0.034 | 0.023 | 0.032 |
| Nickel | 0.95 | 1.7 | 1.9 | 1.8 | 0.74 |
| Silver | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Thallium | 0.069 | 0.03 | 0.06 | 0.066 | 0.035 |
| Zinc | 9.8 | 17 | 17 | 18 | 18 |

## 4.2 Shellfish quality

Pipi and cockles collected from Maketu Estuary on 5 May 2008 were analysed for a range of organic and metal contaminants.

The organic contaminants found at detectable concentrations are shown in Table 24 and the full list is given in Appendix III. Contaminants that were not detected in shellfish included PAHs, pentachlorophenol and 2,3,4,6 tetrachlorophenol. Thirty three PCB congeners were tested for but not detected (detection limit <0.0005 mg/kg wet weight).

The only organic compounds detected in the shellfish samples were DDT (used as a pesticide) and its breakdown products. In a 1992 study (Park 1992) only a breakdown product, DDE was detected, as the level of detection (0.0015 mg/kg) was not as low. There is no New Zealand maximum permitted level standard for DDT and its breakdown products, but the recorded levels are well below the Australian standard of 1 mg/kg (all DDT and breakdown products summed). The presence of DDT is due to historic use. It is a very persistent organic compound in the environment which leads to it being banned in most countries.

Total arsenic levels in pipi and cockles were very similar to those found in 1992 (Park 1992) with pipi having slightly lower levels than cockles. In the 1992 study an analysis of the inorganic arsenic showed that it generally comprises around 10% of the total. The New Zealand Department of Health guidelines for human consumption (FSANZ 2010) are set in terms of the inorganic arsenic present and levels in the shellfish are extremely unlikely to exceed the maximum permitted value of 1.0 mg/kg.

Mercury levels are also very similar to the 1992 results and well below the Department of Health maximum permitted value of 0.5 mg/kg for human consumption. The levels of cadmium, copper, lead and zinc in the shellfish samples are low and below their respective permitted values of 2.0, 30, 2.0 and 40 mg/kg.

*Table 24 Metals and organic contaminants found in shellfish samples collected from Maketu Estuary on 5 May 2008.*

| Site - see Figure 4 | **SF1 - Pipi** | **SF2 - Pipi** | **SF3 - Cockles** | **SF4 - Cockles** |
|---|---|---|---|---|
| moisture g/100g | 85 | 85 | 90 | 90 |
| Dry matter g/100g | 19 | 18 | 16 | 15 |
| Lipid g/100g | 1.10 | 1.10 | 0.96 | 0.96 |
| **Metals mg/kg wet wt** | | | | |
| Arsenic | 1.8 | 1.7 | 3.3 | 2.8 |
| Cadmium | 0.033 | 0.030 | 0.028 | 0.028 |
| Chromium | 0.023 | 0.032 | 0.17 | 0.12 |
| Copper | 0.58 | 0.55 | 0.68 | 0.53 |
| Lead | 0.01 | 0.011 | 0.015 | 0.014 |
| Mercury | 0.012 | 0.012 | 0.015 | 0.010 |
| Nickel | 0.081 | 0.079 | 0.950 | 0.800 |
| Zinc | 8.9 | 8.3 | 7.1 | 7.4 |
| **Organic pollutants mg/kg wet wt** | | | | |
| 4,4-DDD | 0.00051 | 0.0017 | 0.0018 | 0.00058 |
| 4,4-DDE | <0.00050 | 0.0028 | 0.0026 | <0.00050 |
| 2,4-DDT | <0.00050 | <0.00050 | 0.00051 | <0.00050 |
| 4,4-DDT | 0.0005 | 0.0018 | 0.0054 | 0.0019 |

# Part 5: Summary

## 5.1 Introduction

An extensive water quality survey of the lower Kaituna River catchment was conducted between May 2007 and June 2008. This was intended to provide an assessment of environmental quality and a baseline against which future comparisons could be made. This information will be used to support the implementation of the Kaituna River and Ongatoro/Maketu Estuary Strategy.

The following summarises the main findings of the study.

## 5.2 Results

### 5.2.1 Water quality

The water quality results for the Kaituna River and tributaries monitored under base flow conditions show a number of important findings. The tributary inflows dilute conductivity and plankton levels and increase dissolved nutrient, suspended solids and bacterial levels in the Kaituna River.

Of the seven tributaries monitored, the Kopuaroa Stream had the highest median suspended solids, turbidity, ammonium-nitrogen and bacterial levels. All *E.coli* bacterial results from the Kopuaroa Stream exceed the MfE recreational water quality guidelines single sample ">550-action mode" value. The Mangorewa River and Parawhenuamea Stream had the lowest bacterial levels being similar to that recorded at the Te Tumu site on the Kaituna River. All tributaries had higher oxidised and total nitrogen concentrations compared to the Kaituna River. The Parawhenuamea and Ohineangaanga Streams had the highest oxidised nitrogen levels. The Mangorewa River had the highest dissolved phosphorus concentrations and this may be sourced from groundwater.

The minor inflows to the Kaituna River monitored in June 2007 generally had poor water quality. Bacterial numbers were reasonable at most sites with the "Site A" drain (former Parawhenuamea Stream) standing out with high numbers. With the exception of the Fords Cut drain all had high phosphorus levels (particularly Site A) and all had ammonium nitrogen concentrations well above the median values recorded from the tributaries.

### 5.2.2 Organic contaminants

The results for a range of organic contaminants on water samples were generally below the limit of detection. The exceptions were the Waiari Stream with three PAH compounds found and the Mangorewa River with two. Analysis for the same organic contaminants in sediments resulted in detectable levels of DDT at three sites (Ohineangaanga Stream, Te Puke Stream and Kaituna River at Maungarangi) and Dieldrin, Endrin and Hexachlorobenzene in the Ohineangaanga Stream.

All of the detected compounds are chlorinated pesticides which are now banned due to their toxicity and persistence in the environment. The levels of 4,4-DDE (a break down product of DDT) recorded at the Te Puke Stream site and Dieldrin and Endrin at the Ohineangaanga Stream site exceed the ANZECC ISQG-high value for the protection of aquatic life. PAH compounds were detected at the Te Puke Stream, Waiari Stream and Kaituna River (at Maungarangi site) but none exceeded the ANZECC guidelines for the protection of aquatic life.

### 5.2.3 Metals

Water from the Kaituna River had the highest concentrations of geothermally derived metals (arsenic, boron, lithium). The Te Puke Stream had the highest concentrations of zinc, copper and lead and these are characteristic of an urban pollutant source. None of the metal results exceeded the New Zealand drinking water standards. However, aluminium concentrations in the Kopuaroa, Raparapahoe, Ohineangaanga, Te Puke and Waiari Streams exceeded the ANZECC trigger values for the protection of aquatic life as did zinc at the Kopuaroa, Te Puke and Parawhenuamea sites.

The sediment metal concentrations also reflected the geothermal influence on the Kaituna River which had the highest levels of arsenic and mercury, just exceeding the ANZECC ISQG-low guideline for the protection of aquatic life. Te Puke Stream had the highest levels of cadmium, copper, lead, nickel, silver, thallium and zinc, but none exceeded the ANZECC guidelines.

### 5.2.4 Storm event sampling

The Te Puke Stream was found to have the highest median suspended solids and turbidity levels at peak flow of the seven tributaries sampled. The Ohineangaanga Stream displayed the highest suspended solids load increase compared to its base flow state.

The concentration of dissolved phosphorus increased slightly for most steams at peak flow while total phosphorus increased more significantly. Ammonium nitrogen concentrations increased during peak flow at all sites while dissolved oxidised nitrogen concentrations decreased in all but the Kopuaroa Stream. Total nitrogen concentrations remained the same for many of the sites with the Waiari Stream being the only one where total nitrogen increased significantly above base flow levels.

### 5.2.5 Maketu Estuary

The levels of organic contaminants and metals in the sediments of Maketu Estuary were found to be at acceptable levels. No pesticides were detected at any of the sites while two sites recorded detectable levels of some PAH compounds at levels well below the ANZECC guidelines for the protection of aquatic life. When normalised to 5% mud content, the sediment concentration of arsenic was found to exceed the Canadian quality trigger value. In this case the arsenic is likely to originate from natural geothermal sources.

The concentrations of metals and organic contaminants in shellfish were similar to those found in a 1992 study. This included low levels of DDT and moderate levels of arsenic and mercury. All contaminants were below the New Zealand Department of Health guidelines for human consumption.

## 5.3 Quality Assessment

In terms of general water quality the Kopuaroa Stream has excessive levels of suspended solids and turbidity. Nutrients are also high with ammonium nitrogen levels suggesting horticulture and/or agriculture sources. The small drains flowing from dairy farmland (sites C, A, H) all had similar high ammonium nitrogen concentrations and generally moderate to poor water quality.

Assessment of bacterial levels against the MfE Guidelines for Recreational Water Quality showed that all tributaries exceeded the criteria for single samples. The best tributaries (Mangorewa River and Parawhenuamea Stream) had results similar to the Te Matai site on the Kaituna River. The Waiari Stream site is used for swimming in summer and 25% of samples exceeded the action mode value. The Kopuaroa and Te Puke Streams have very poor water quality with all samples from the Kopuaroa Stream exceeding the action mode value.

The Kaituna River and Maketu Estuary show the influence of natural geothermal inputs but the metals tend to be at or below levels that would be of any concern.

The results for organic contaminants are generally very good with only the Ohineangaanga and Te Puke streams recording organochlorine pesticides (DDT, Dieldrin, Endrin) above the ANZECC ISQG-high values for the protection of aquatic life. These two stream catchments have a high percentage of horticultural land use and the pesticides have been banned for many years due to their environmental persistence.

The Te Puke stream also has one of the highest percentages of urban land use in its catchment and this may have been a factor in this stream having the highest overall metal levels. High zinc, copper and lead levels are very characteristic of urban influence. However even this stream had sediment metal levels below the ANZECC guidelines and hence must rank as only moderately impacted in respect of metals alone. In conjunction with all other aspects of water quality it would possibly score poorly if a biological assessment of quality were made.

Finally, with the exception of arsenic, organic contaminants and metals in sediments and shellfish from Maketu Estuary were found to be within acceptable levels.

# Part 6: References

ANZECC. 2000: Australian and New Zealand guidelines for fresh and marine water quality. Australian and New Zealand Environment and Conservation Council.

Commission for the Environment. 1984: Maketu Estuary. Environmental Issues and options. Issues and options paper 1984/1. Commission for the Environment, New Zealand.

FSANZ 2010: Food Standards Australia New Zealand; Australia New Zealand Food Standards Code (includes amendments up to 116). NZ office PO Box 10559, Wellington 6036.

McIntosh, J. 2005: Impact of the Ohau Channel diversion on the Okere Arm, Kaituna River and Maketu Estuary. Environmental Report 2005/3. Environment BOP, P.O. Box 364, Whakatane.

MfE. 2003: Microbial Guidelines for Marine and Freshwater Recreational Areas. Published June 2003, Ministry for the Environment, PO Box 10-362 Wellington, New Zealand.

MoH. 2005: Drinking-water Standards for New Zealand 2005. Welington : Ministry of Health. PO Box 5013 Wellington, New Zealand.

Park, S.G. 1992: Maketu Estuary Environmental Baseline Monitoring Project – 1990/91. Technical Report No. 20. Bay of Plenty Regional Council, P.O. Box 364, Whakatane.

Park, S.G. 2003: Kaituna River Diversion to Maketu Estuary. Environmental Report 2003/6. Bay of Plenty Regional Council, P.O. Box 364, Whakatane.

White, E., Don, B., Downes, M.T. & Kemp, L. 1978: Distribution of plant nutrients in the Kaituna River. New Zealand Journal of Marine and Freshwater Research 12(1): 23-27.

# Appendices

# Appendix I – Lists of organic compounds that were tested in water and shellfish

### Organochlorine pesticides – detection limit 0.0000020 g/m$^3$

Aldrin
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
cis-chlordane
trans-chlordane
2,4'-DDD
4,4'-DDD
2,4'-DDE
4,4'-DDE
2,4'-DDT
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin Ketone
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Methoxychlor
Total Chlordane [(cis+trans)*100/42]

### Organonitrogen and phosphorus pesticides – detection limit 0.000050 g/m$^3$ or better

Acetochlor
Alachlor
Atrazine
Atrazine-desethyl
Atrazine-desisopropyl
Azaconazole
Azinphos-methyl
Benalaxyl
Bitertanol
Bromacil
Bromopropylate
Butachlor
Captan
Carbaryl
Carbofuran
Chlorfluazuron
Chlorothalonil
Chlorpyrifos
Chlorpyrifos-methyl
Chlortoluron
Cyanazine
Cyfluthrin
Cyhalothrin
Cypermethrin
Deltamethrin
Diazinon
Dichlofluanid
Dichloran
Dichlorvos
Difenoconazole
Dimethoate
Diphenylamine
Diuron
Fenpropimorph
Fluazifop-butyl
Fluometuron Flusilazole
Fluvalinate
Furalaxyl
Hexaconazole
Hexazinone
IPBC (3-Iodo-2-propynyl-n butylcarbamate)
Iprodione
Kresoxim-methyl
Linuron
Malathion
Metalaxyl
Methamidophos
Metolachlor
Metribuzin
Molinate
Myclobutanil
Naled
Norflurazon
Oxadiazon
Oxyfluorfen
Paclobutrazol
Parathion-ethyl
Parathion-methyl
Pendimethalin
Permethrin
Pirimicarb
Pirimiphos-methyl
Prochloraz
Procymidone
Prometryn
Propachlor
Propanil
Propazine
Propiconazole
Pyriproxyfen
Quizalofop-ethyl
Simazine
Simetryn
Sulfentrazone TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan]
Tebuconazole
Terbacil
Terbufos
Terbumeton
Terbuthylazine
Terbuthylazine-
Terbutryn
Thiabendazole
Thiobencarb
Tolylfluanid
Triazophos
Trifluralin
Vinclozolin

### Persistent organic pollutants tested for in shellfish

Acephate
Acetochlor
Alachlor
Aldrin
Atrazine
Atrazine-desethyl
Atrazine-desisopropyl
Azaconazole
Azinphos-methyl
Azoxystrobin
Benalaxyl
Bendiocarb
Benodanil
Benoxacor
alpha-BHC
beta-BHC
gamma-BHC (Lindane)
delta-BHC
Bifenox
Bifenthrin
Bitertanol
Bromacil
Bromophos-ethyl
Bromopropylate
Bupirimate
Buprofezin
Butachlor
Butamifos
Cadusafos
Captafol
Captan
Carbaryl
Carbofenothion
Carbofuran
Carboxin
cis-chlordane
trans-chlordane
Chlorfenapyr
Chlorfenvinphos
Chlorfluazuron
Chlorobenzilate
Chlorothalonil
Chlorpropham
Chlorpyrifos
Chlorpyrifos-methyl
Chlorthal-dimethyl
Chlortoluron
Chlozolinate
Clomazone
Coumaphos
Cyanazine
Cyanophos
Cyfluthrin
Cyhalcthrin
Cypermethrin
Cyproconazole
Cyprodinil
2,4-DDD
4,4-DDD
2,4-DDE
4,4-DDE
2,4-DDT
4,4-DDT
Deltamethrin
Demeton-S-methyl
Diazinon
Dichlobeil
Dichlofenthion
Dichlofluanid
Dichloran
Dichlorvos
Dicofol
Dicrotophos
Dieldrin
Difenoconazole
Diflufenican
Dimethenamid
Dimethoate
Dimethomorph Dimethylvinphos
Dinocap
Dioxabenzofos
Diphenylamine
Disulfoton
Diuron
Edifenphos
Endosulfan I
Endosulfan II
Endosulfansulphate
Endrin
Endrin aldehyde
Endrin ketone
EPN
Epoxiconazole
EPTC
Esfenvalerate
Esprocarb
Ethion
Ethoprpphos
Etridiazole
Etrimfos
Famphur
Fenamiphos
Fenarimol
Fenchlorphos
Fenitrothion
Fenobucarb
Fenoxaprop-ethyl
Fenpiclonil
Fenpropathrin
Fenpropimorph
Fensulfothion
Fenthion
Fenvalerate
Fluazifop-butyl
Flucythrinate
Fludioxonil
Fluometuron
Flusilazole
Flutriafol
Fluvalinate
Folpet
Fonofos
Furalaxyl
Furathiocarb
Halfenprox
Haloxyfop-methyl
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexaconazole
Hexazinone
Hexythiazox
Imazalil
Indoxacarb
Iodofenphos
Iprobenfos
Iprodione
Isazophos
Isofenphos
Isoprocarb
Kresoxim-methyl
Leptophos
Linuron
Malathion
Mepronil
Metalaxyl
Methacrifos
Methamidophos
Methidathion
Methiocarb
Methoxychlor
Metolachlor
Mevinphos
Metribuzin
Molinate
Monocrotophos
Myclobutanil Naled
Napropamide
Nitrofen
Nitrothal-isopropyl
Norflurazon
Omethoate
Oxadiazon
Oxadixyl
Oxychlordane
Oxyfluorfen
Paclobutrazol
Parathion-ethyl
Parathion-methyl
Penconazole
Pendimethalin
Permethrin
Phenthoate
Phorate
Phosalone
Phosmet
Phosphamidon
Piperonyl-butoxide
Pirimicarb
Pirimiphos-methyl
Prochloraz
Procymidone
Profenofos
Prometryn
Propachlor
Propanil
Propaphos
Propazine
Propetamphos
Propham
Propiconazole
Propoxur
Propyzamide
Prothiofos
Pyraclofos
Pyrazophos
Pyrazoxyfen
Pyrethrin
Pyrifenox
Pyrimethanil
Pyriproxyfen
Quinalphos
Quintozene
Quizalofop-ethyl
Simazine
Simetryn
Sulfentrazone
Sulfotep
Tebuconazole
Tebufenpyrad
Terbacil
Terbufos
Terbumeton
Terbuthylazine
Terbuthylazine-desethyl
Tetrachlorvinphos
Tetradifon
Thenylchlor
Thiobencarb
Thiometon
Tolclofos-methyl
Tolylfluanid
Triadimefon
Tri-allate
Triazophos
Trifloxystrobin
Trifluralin
Vinclozolin

# Appendix II – Lab analysis reports for organics and metals in stream/river water and sediment samples

Kopuaroa; samples numbers 08-2941 & 08-2950, Raparapahoe; 08-2942 & 08-2951, Ohineangaanga; 08-2943 & 08-2952, Te Puke 08-2944 & 08-2953, Waiari; 08-2945 & 08-2954, Parawhenuamea; 08-2946 & 08-2955, Mangorewa; 08-2947 & 08-2956, Maungarangi Kaituna; 08-2948 & 08-2957, Ford rd drain; 08-2949, Te tumu Kaituna; 08-2958.

**Hill Laboratories**
A WORLD LEADER IN ANALYTICAL SERVICES

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

**ANALYSIS REPORT** Page 1 of 16

| | | | |
|---|---|---|---|
| **Client:** | Environment BOP | **Lab No:** | 641657 |
| **Contact:** | Spence, Adrian | **Date Registered:** | 10-May-2008 |
| | c/o Environment BOP | **Date Reported:** | 30-May-2008 |
| | P O Box 384 | **Quote No:** | 32803 |
| | WHAKATANE | **Order No:** | 105551 |
| | | **Client Reference:** | |
| | | **Submitted By:** | Spence, Adrian |

Sample Type: Sediment

| Sample Name: / Lab Number: | | 08-2950 07-May-2008 641657.10 | 08-2951 07-May-2008 641657.11 | 08-2952 07-May-2008 641657.12 | 08-2953 07-May-2008 641657.13 | 08-2954 07-May-2008 641657.14 |
|---|---|---|---|---|---|---|
| **Individual Tests** | | | | | | |
| Total Carbon | g/100g dry wt | 0.72 | 0.25 | 0.097 | 0.29 | 3.0 |
| **USEPA Priority Pollutants - Trace Level, 13 metals** | | | | | | |
| Total Recoverable Antimony | mg/kg dry wt | 0.041 | 0.099 | < 0.040 | 0.11 | 0.051 |
| Total Recoverable Arsenic | mg/kg dry wt | 3.9 | 3.7 | 0.63 | 3.5 | 1.9 |
| Total Recoverable Beryllium | mg/kg dry wt | 0.36 | 0.33 | 0.12 | 0.55 | 0.78 |
| Total Recoverable Cadmium | mg/kg dry wt | 0.061 | 0.029 | 0.016 | 0.22 | 0.058 |
| Total Recoverable Chromium | mg/kg dry wt | 3.1 | 4.1 | 1.0 | 3.9 | 1.6 |
| Total Recoverable Copper | mg/kg dry wt | 2.4 | 3.0 | 0.89 | 8.5 | 3.0 |
| Total Recoverable Lead | mg/kg dry wt | 4.4 | 5.7 | 2.6 | 12 | 5.3 |
| Total Recoverable Mercury | mg/kg dry wt | 0.033 | 0.077 | < 0.010 | 0.052 | 0.032 |
| Total Recoverable Nickel | mg/kg dry wt | 0.92 | 1.3 | 0.24 | 1.5 | 0.65 |
| Total Recoverable Selenium | mg/kg dry wt | < 2.0 | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| Total Recoverable Silver | mg/kg dry wt | 0.023 | 0.027 | < 0.020 | 0.068 | 0.048 |
| Total Recoverable Thallium | mg/kg dry wt | 0.098 | 0.076 | 0.034 | 0.19 | 0.062 |
| Total Recoverable Zinc | mg/kg dry wt | 30 | 45 | 29 | 70 | 29 |
| **Organochlorine Pesticides Trace in Soil** | | | | | | |
| Aldrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| alpha-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| beta-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| delta-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| gamma-BHC (Lindane) | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| cis-chlordane | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| trans-chlordane | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| 2,4'-DDD | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| 4,4'-DDD | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0013 | 0.0015 | < 0.0010 |
| 2,4'-DDE | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| 4,4'-DDE | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0013 | 0.011 | < 0.0010 |
| 2,4'-DDT | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| 4,4'-DDT | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0014 | 0.0042 | < 0.0010 |
| Dieldrin | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0018 | < 0.00099 | < 0.0010 |
| Endosulfan I | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Endosulfan II | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Endosulfan sulphate | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Endrin | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0014 | < 0.00099 | < 0.0010 |
| Endrin aldehyde | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Endrin Ketone | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Heptachlor | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |

| Sample Type: Sediment | | | | | | |
|---|---|---|---|---|---|---|
| | Sample Name: | 08-2950 07-May-2008 | 08-2951 07-May-2008 | 08-2952 07-May-2008 | 08-2953 07-May-2008 | 08-2954 07-May-2008 |
| | Lab Number: | 641657.10 | 641657.11 | 641657.12 | 641657.13 | 641657.14 |
| **Organochlorine Pesticides Trace in Soil** | | | | | | |
| Heptachlor epoxide | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Hexachlorobenzene | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0018 | < 0.00099 | < 0.0010 |
| Methoxychlor | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00099 | < 0.0010 |
| Total Chlordane [(cis+trans)* 100/42] | mg/kg dry wt | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 |
| **Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS** | | | | | | |
| Dry Matter | g/100g as rcvd | 62 | 70 | 75 | 45 | 55 |
| Acetochlor | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Alachlor | mg/kg dry wt | < 0.0060 | < 0.0060 | < 0.0060 | < 0.0074 | < 0.0060 |
| Atrazine | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Atrazine-desethyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Atrazine-desisopropyl | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Azaconazole | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Azinphos-methyl | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Benalaxyl | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Bitertanol | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Bromacil | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Bromopropylate | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Butachlor | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Captan | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Carbaryl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Carbofuran | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Chlorfluazuron | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Chlorothalonil | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Chlorpyrifos | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Chlorpyrifos-methyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Chlortoluron | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Cyanazine | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Cyfluthrin | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Cyhalothrin | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Cypermethrin | mg/kg dry wt | < 0.038 | < 0.034 | < 0.032 | < 0.059 | < 0.043 |
| Deltamethrin | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Diazinon | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Dichlofluanid | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Dichloran | mg/kg dry wt | < 0.030 | < 0.030 | < 0.030 | < 0.037 | < 0.030 |
| Dichlorvos | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Difenoconazole | mg/kg dry wt | < 0.027 | < 0.024 | < 0.023 | < 0.042 | < 0.031 |
| Dimethoate | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Diphenylamine | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Diuron | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Fenpropimorph | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Fluazifop-butyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Fluometuron | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Flusilazole | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Fluvalinate | mg/kg dry wt | < 0.014 | < 0.012 | < 0.012 | < 0.021 | < 0.016 |
| Furalaxyl | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Haloxyfop-methyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Hexaconazole | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Hexazinone | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| IPBC (3-Iodo-2-propynyl-n-butylcarbamate) | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| Iprodione | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Kresoxim-methyl | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Linuron | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Malathion | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |

| Sample Type: Sediment | | | | | | |
|---|---|---|---|---|---|---|
| Sample Name: | | 08-2950 07-May-2008 | 08-2951 07-May-2008 | 08-2952 07-May-2008 | 08-2953 07-May-2008 | 08-2954 07-May-2008 |
| Lab Number: | | 641657.10 | 641657.11 | 641657.12 | 641657.13 | 641657.14 |
| **Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS** | | | | | | |
| Metalaxyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Methamidophos | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| Metolachlor | mg/kg dry wt | < 0.0060 | < 0.0060 | < 0.0060 | < 0.0074 | < 0.0060 |
| Metribuzin | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Molinate | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Myclobutanil | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Naled | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| Norflurazon | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Oxadiazon | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Oxyfluorfen | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Paclobutrazol | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Parathion-ethyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Parathion-methyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Pendimethalin | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Permethrin | mg/kg dry wt | < 0.0068 | < 0.0060 | < 0.0056 | < 0.011 | < 0.0076 |
| Pirimicarb | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Pirimiphos-methyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Prochloraz | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| Procymidone | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Prometryn | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Propachlor | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Propanil | mg/kg dry wt | < 0.030 | < 0.030 | < 0.030 | < 0.030 | < 0.030 |
| Propazine | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Propiconazole | mg/kg dry wt | < 0.014 | < 0.012 | < 0.012 | < 0.021 | < 0.016 |
| Pyriproxyfen | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Quizalofop-ethyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Simazine | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Simetryn | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Sulfentrazone | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan] | mg/kg dry wt | < 0.019 | < 0.017 | < 0.016 | < 0.030 | < 0.022 |
| Tebuconazole | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| Terbacil | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Terbufos | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Terbumeton | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Terbuthylazine | mg/kg dry wt | < 0.0048 | < 0.0043 | < 0.0040 | < 0.0074 | < 0.0054 |
| Terbuthylazine-desethyl | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Terbutryn | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Thiabendazole | mg/kg dry wt | < 0.048 | < 0.043 | < 0.040 | < 0.074 | < 0.054 |
| Thiobencarb | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Tolylfluanid | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Triazophos | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Trifluralin | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| Vinclozolin | mg/kg dry wt | < 0.0095 | < 0.0085 | < 0.0079 | < 0.015 | < 0.011 |
| **Polycyclic Aromatic Hydrocarbons Trace in Soil** | | | | | | |
| Acenaphthene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | < 0.0034 | < 0.0025 |
| Acenaphthylene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | < 0.0034 | < 0.0025 |
| Anthracene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.0069 | < 0.0025 |
| Benzo[a]anthracene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.023 | < 0.0025 |
| Benzo[a]pyrene (BAP) | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.033 | < 0.0025 |
| Benzo[b]fluoranthene + Benzo[j] fluoranthene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.057 | < 0.0025 |
| Benzo[g,h,i]perylene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.043 | < 0.0025 |
| Benzo[k]fluoranthene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.036 | < 0.0025 |
| Chrysene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.035 | 0.0032 |

**Sample Type: Sediment**

| Sample Name: / Lab Number: | | 08-2950 07-May-2008 641657.10 | 08-2951 07-May-2008 641657.11 | 08-2952 07-May-2008 641657.12 | 08-2953 07-May-2008 641657.13 | 08-2954 07-May-2008 641657.14 |
|---|---|---|---|---|---|---|
| **Polycyclic Aromatic Hydrocarbons Trace in Soil** | | | | | | |
| Dibenzo[a,h]anthracene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.0068 | < 0.0025 |
| Fluoranthene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.069 | 0.0064 |
| Fluorene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | < 0.0034 | < 0.0025 |
| Indeno(1,2,3-c,d)pyrene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.027 | < 0.0025 |
| Naphthalene | mg/kg dry wt | < 0.011 | < 0.010 | < 0.010 | < 0.017 | < 0.013 |
| Phenanthrene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.023 | 0.0055 |
| Pyrene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0020 | 0.077 | 0.0060 |
| **Pentachlorophenol Screening in Soil by GC-ECD** | | | | | | |
| Pentachlorophenol (PCP) | mg/kg dry wt | < 0.050 | < 0.050 | < 0.050 | < 0.050 | < 0.050 |
| 2,3,4,6-Tetrachlorophenol | mg/kg dry wt | < 0.050 | < 0.050 | < 0.050 | < 0.050 | < 0.050 |

| Sample Name: / Lab Number: | | 08-2955 07-May-2008 641657.15 | 08-2956 07-May-2008 641657.16 | 08-2957 07-May-2008 641657.17 | 08-2958 07-May-2008 641657.18 | |
|---|---|---|---|---|---|---|
| **Individual Tests** | | | | | | |
| Total Carbon | g/100g dry wt | 1.2 | 0.70 | 1.5 | 0.63 | - |
| **USEPA Priority Pollutants - Trace Level, 13 metals** | | | | | | |
| Total Recoverable Antimony | mg/kg dry wt | 0.076 | < 0.040 | 0.14 | 0.088 | - |
| Total Recoverable Arsenic | mg/kg dry wt | 1.7 | 1.3 | 6.7 | 5.1 | - |
| Total Recoverable Beryllium | mg/kg dry wt | 0.59 | 0.31 | 0.36 | 0.23 | - |
| Total Recoverable Cadmium | mg/kg dry wt | 0.075 | 0.031 | 0.042 | 0.015 | - |
| Total Recoverable Chromium | mg/kg dry wt | 2.3 | 1.3 | 1.5 | 1.8 | - |
| Total Recoverable Copper | mg/kg dry wt | 2.9 | 1.7 | 2.5 | 1.4 | - |
| Total Recoverable Lead | mg/kg dry wt | 6.3 | 3.7 | 6.5 | 2.9 | - |
| Total Recoverable Mercury | mg/kg dry wt | 0.027 | 0.019 | 0.24 | 0.032 | - |
| Total Recoverable Nickel | mg/kg dry wt | 0.70 | 0.45 | 0.69 | 0.74 | - |
| Total Recoverable Selenium | mg/kg dry wt | < 2.0 | < 2.0 | < 2.0 | < 2.0 | - |
| Total Recoverable Silver | mg/kg dry wt | 0.032 | 0.024 | 0.038 | < 0.020 | - |
| Total Recoverable Thallium | mg/kg dry wt | 0.093 | 0.066 | 0.093 | 0.035 | - |
| Total Recoverable Zinc | mg/kg dry wt | 43 | 29 | 22 | 18 | - |
| **Organochlorine Pesticides Trace in Soil** | | | | | | |
| Aldrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| alpha-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| beta-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| delta-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| gamma-BHC (Lindane) | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| cis-chlordane | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| trans-chlordane | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| 2,4'-DDD | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| 4,4'-DDD | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| 2,4'-DDE | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| 4,4'-DDE | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0021 | < 0.00098 | - |
| 2,4'-DDT | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.0021 | < 0.00098 | - |
| 4,4'-DDT | mg/kg dry wt | < 0.0010 | < 0.0010 | 0.014 | < 0.00098 | - |
| Dieldrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Endosulfan I | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Endosulfan II | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Endosulfan sulphate | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Endrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Endrin aldehyde | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Endrin Ketone | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Heptachlor | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Heptachlor epoxide | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Hexachlorobenzene | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |
| Methoxychlor | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.00098 | - |

| Sample Type: Sediment | | | | | | |
|---|---|---|---|---|---|---|
| | Sample Name: | 08-2955 07-May-2008 | 08-2956 07-May-2008 | 08-2957 07-May-2008 | 08-2958 07-May-2008 | |
| | Lab Number: | 641657.15 | 641657.16 | 641657.17 | 641657.18 | |
| Organochlorine Pesticides Trace in Soil | | | | | | |
| Total Chlordane [(cis+trans)* 100/42] | mg/kg dry wt | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | - |
| Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS | | | | | | |
| Dry Matter | g/100g as rcvd | 62 | 58 | 54 | 69 | - |
| Acetochlor | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Alachlor | mg/kg dry wt | < 0.0060 | < 0.0060 | < 0.0061 | < 0.0060 | - |
| Atrazine | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Atrazine-desethyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Atrazine-desisopropyl | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Azaconazole | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Azinphos-methyl | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Benalaxyl | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Bitertanol | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Bromacil | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Bromopropylate | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Butachlor | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Captan | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Carbaryl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Carbofuran | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Chlorfluazuron | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Chlorothalonil | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Chlorpyrifos | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Chlorpyrifos-methyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Chlortoluron | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Cyanazine | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Cyfluthrin | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Cyhalothrin | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Cypermethrin | mg/kg dry wt | < 0.043 | < 0.041 | < 0.049 | < 0.035 | - |
| Deltamethrin | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Diazinon | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Dichlofluanid | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Dichloran | mg/kg dry wt | < 0.030 | < 0.030 | < 0.031 | < 0.030 | - |
| Dichlorvos | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Difenoconazole | mg/kg dry wt | < 0.030 | < 0.029 | < 0.035 | < 0.025 | - |
| Dimethoate | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Diphenylamine | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Diuron | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Fenpropimorph | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Fluazifop-butyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Fluometuron | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Flusilazole | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Fluvalinate | mg/kg dry wt | < 0.015 | < 0.015 | < 0.018 | < 0.013 | - |
| Furalaxyl | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Haloxyfop-methyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Hexaconazole | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Hexazinone | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| IPBC (3-Iodo-2-propynyl-n-butylcarbamate) | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| Iprodione | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Kresoxim-methyl | mg/kg dry wt | < 0.0063 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Linuron | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Malathion | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Metalaxyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Methamidophos | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| Metolachlor | mg/kg dry wt | < 0.0060 | < 0.0060 | < 0.0061 | < 0.0060 | - |

Lab No: 641657 v 2 Hill Laboratories Page 5 of 16

Sample Type: Sediment

| Sample Name: | | 08-2955<br>07-May-2008 | 08-2956<br>07-May-2008 | 08-2957<br>07-May-2008 | 08-2958<br>07-May-2008 | |
|---|---|---|---|---|---|---|
| Lab Number: | | 641657.15 | 641657.16 | 641657.17 | 641657.18 | |
| **Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS** | | | | | | |
| Metribuzin | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Molinate | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Myclobutanil | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Naled | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| Norflurazon | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Oxadiazon | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Oxyfluorfen | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Paclobutrazol | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Parathion-ethyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Parathion-methyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Pendimethalin | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Permethrin | mg/kg dry wt | < 0.0075 | < 0.0073 | < 0.0086 | < 0.0062 | - |
| Pirimicarb | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Pirimiphos-methyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Prochloraz | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| Procymidone | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Prometryn | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Propachlor | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Propanil | mg/kg dry wt | < 0.030 | < 0.030 | < 0.030 | < 0.030 | - |
| Propazine | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Propiconazole | mg/kg dry wt | < 0.015 | < 0.015 | < 0.018 | < 0.013 | - |
| Pyriproxyfen | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Quizalofop-ethyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Simazine | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Simetryn | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Sulfentrazone | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan] | mg/kg dry wt | < 0.022 | < 0.021 | < 0.025 | < 0.018 | - |
| Tebuconazole | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| Terbacil | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Terbufos | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Terbumeton | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Terbuthylazine | mg/kg dry wt | < 0.0053 | < 0.0052 | < 0.0061 | < 0.0044 | - |
| Terbuthylazine-desethyl | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Terbutryn | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Thiabendazole | mg/kg dry wt | < 0.053 | < 0.052 | < 0.061 | < 0.044 | - |
| Thiobencarb | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Tolylfluanid | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Triazophos | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Trifluralin | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| Vinclozolin | mg/kg dry wt | < 0.011 | < 0.011 | < 0.013 | < 0.0087 | - |
| **Polycyclic Aromatic Hydrocarbons Trace in Soil** | | | | | | |
| Acenaphthene | mg/kg dry wt | < 0.0024 | < 0.0023 | < 0.0028 | < 0.0020 | - |
| Acenaphthylene | mg/kg dry wt | < 0.0024 | < 0.0023 | < 0.0028 | < 0.0020 | - |
| Anthracene | mg/kg dry wt | < 0.0024 | < 0.0023 | < 0.0028 | < 0.0020 | - |
| Benzo[a]anthracene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.0074 | < 0.0020 | - |
| Benzo[a]pyrene (BAP) | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.0076 | < 0.0020 | - |
| Benzo[b]fluoranthene + Benzo[j] fluoranthene | mg/kg dry wt | < 0.0024 | < 0.0023 | < 0.0028 | < 0.0020 | - |
| Benzo[g,h,i]perylene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.0096 | < 0.0020 | - |
| Benzo[k]fluoranthene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.012 | < 0.0020 | - |
| Chrysene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.0094 | < 0.0020 | - |
| Dibenzo[a,h]anthracene | mg/kg dry wt | < 0.0024 | < 0.0023 | < 0.0028 | < 0.0020 | - |
| Fluoranthene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.018 | < 0.0020 | - |
| Fluorene | mg/kg dry wt | < 0.0024 | < 0.0023 | < 0.0028 | < 0.0020 | - |

Lab No: 641657 v 2 | Hill Laboratories | Page 6 of 16

| Sample Type: Sediment | | | | | | |
|---|---|---|---|---|---|---|
| | Sample Name: | 08-2955 07-May-2008 | 08-2956 07-May-2008 | 08-2957 07-May-2008 | 08-2958 07-May-2008 | |
| | Lab Number: | 641657.15 | 641657.16 | 641657.17 | 641657.18 | |
| Polycyclic Aromatic Hydrocarbons Trace in Soil | | | | | | |
| Indeno(1,2,3-c,d)pyrene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.0060 | < 0.0020 | - |
| Naphthalene | mg/kg dry wt | < 0.012 | < 0.012 | < 0.014 | < 0.010 | - |
| Phenanthrene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.0063 | < 0.0020 | - |
| Pyrene | mg/kg dry wt | < 0.0024 | < 0.0023 | 0.020 | < 0.0020 | - |
| Pentachlorophenol Screening in Soil by GC-ECD | | | | | | |
| Pentachlorophenol (PCP) | mg/kg dry wt | < 0.050 | < 0.050 | < 0.050 | < 0.050 | - |
| 2,3,4,6-Tetrachlorophenol | mg/kg dry wt | < 0.050 | < 0.050 | < 0.050 | < 0.050 | - |

| Sample Type: Clean waters | | | | | | |
|---|---|---|---|---|---|---|
| | Sample Name: | 08-2941 07-May-2008 | 08-2942 07-May-2008 | 08-2943 07-May-2008 | 08-2944 07-May-2008 | 08-2945 07-May-2008 |
| | Lab Number: | 641657.1 | 641657.2 | 641657.3 | 641657.4 | 641657.5 |
| Individual Tests | | | | | | |
| Reactive Silica | g/m³ as $SiO_2$ | 44 | 31 | 47 | 58 | 48 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.52 | 0.56 | 0.33 | 0.58 | 0.27 |
| Total Antimony | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 |
| Total Barium | g/m³ | 0.084 | 0.034 | 0.063 | 0.13 | 0.049 |
| Total Beryllium | g/m³ | 0.00014 | < 0.00011 | < 0.00011 | 0.00013 | < 0.00011 |
| Total Boron | g/m³ | 0.017 | 0.0091 | 0.015 | 0.020 | 0.0087 |
| Total Cadmium | g/m³ | 0.000057 | < 0.000053 | < 0.000053 | < 0.000053 | < 0.000053 |
| Total Calcium | g/m³ | 9.5 | 2.3 | 3.7 | 12 | 2.9 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.00083 | < 0.00053 | < 0.00053 | 0.0010 | < 0.00053 |
| Total Iron | g/m³ | 1.2 | 0.41 | 0.53 | 1.1 | 0.21 |
| Total Lead | g/m³ | 0.00033 | 0.00039 | 0.00038 | 0.00060 | 0.00016 |
| Total Lithium | g/m³ | 0.0028 | 0.0017 | 0.0034 | 0.0043 | 0.0041 |
| Total Magnesium | g/m³ | 2.9 | 1.1 | 1.6 | 3.8 | 1.2 |
| Total Manganese | g/m³ | 0.26 | 0.021 | 0.055 | 0.34 | 0.025 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | 0.00027 | < 0.00021 |
| Total Nickel | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Potassium | g/m³ | 4.3 | 1.9 | 3.2 | 7.2 | 2.4 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 12 | 6.5 | 10 | 16 | 8.9 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | 0.000055 | 0.000042 | 0.000025 | 0.000067 | 0.000025 |
| Total Zinc | g/m³ | 0.0087 | 0.0028 | 0.0056 | 0.018 | 0.0034 |
| Anion / Cation profile, trace level | | | | | | |
| Sum of Anions | meq/L | 1.4 | 0.55 | 0.83 | 1.7 | 0.70 |
| Sum of Cations | meq/L | 1.3 | 0.49 | 0.75 | 1.5 | 0.64 |
| pH | pH Units | 6.4 | 6.8 | 6.6 | 6.5 | 6.8 |
| Total Alkalinity | g/m³ as $CaCO_3$ | 24 | 14 | 18 | 34 | 21 |
| Bicarbonate | g/m³ at 25°C | 29 | 17 | 21 | 42 | 25 |
| Total Hardness | g/m³ as $CaCO_3$ | 34 | 9.2 | 14 | 40 | 11 |
| Electrical Conductivity (EC) | mS/m | 15 | 5.7 | 8.9 | 18 | 7.2 |
| Dissolved Calcium | g/m³ | 9.0 | 2.1 | 3.3 | 10 | 2.6 |
| Dissolved Magnesium | g/m³ | 2.7 | 0.94 | 1.4 | 3.4 | 1.1 |
| Dissolved Potassium | g/m³ | 4.1 | 1.8 | 2.9 | 6.2 | 2.2 |
| Dissolved Sodium | g/m³ | 11 | 6.1 | 9.0 | 13 | 8.4 |
| Chloride | g/m³ | 13 | 6.3 | 8.9 | 15 | 5.8 |
| Nitrite-N | g/m³ | 0.015 | < 0.0020 | < 0.0020 | 0.021 | < 0.0020 |
| Nitrate-N | g/m³ | 2.1 | 0.59 | 2.0 | 1.7 | 1.1 |

Lab No: 641657 v 2 Hill Laboratories Page 7 of 16

| Sample Type: Clean waters | | | | | | |
|---|---|---|---|---|---|---|
| Sample Name: | | 08-2941<br>07-May-2008 | 08-2942<br>07-May-2008 | 08-2943<br>07-May-2008 | 08-2944<br>07-May-2008 | 08-2945<br>07-May-2008 |
| Lab Number: | | 641657.1 | 641657.2 | 641657.3 | 641657.4 | 641657.5 |
| Anion / Cation profile, trace level | | | | | | |
| Nitrate-N + Nitrite-N | g/m$^3$ | 2.1 | 0.59 | 2.0 | 1.7 | 1.1 |
| Sulphate | g/m$^3$ | 17 | 2.8 | 4.0 | 21 | 2.5 |
| Organochlorine Pesticides UltraTrace in water, By SPE | | | | | | |
| Aldrin | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| alpha-BHC | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| beta-BHC | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| delta-BHC | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| gamma-BHC (Lindane) | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| cis-chlordane | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| trans-chlordane | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| 2,4'-DDD | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| 4,4'-DDD | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| 2,4'-DDE | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| 4,4'-DDE | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| 2,4'-DDT | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| 4,4'-DDT | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Dieldrin | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Endosulfan I | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Endosulfan II | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Endosulfan sulphate | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Endrin | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Endrin aldehyde | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Endrin Ketone | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Heptachlor | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Heptachlor epoxide | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Hexachlorobenzene | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Methoxychlor | g/m$^3$ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000020 |
| Total Chlordane [(cis+trans)*100/42] | g/m$^3$ | < 0.0000029 | < 0.0000029 | < 0.0000029 | < 0.0000029 | < 0.0000029 |
| Organonitro&phosphorus Pesticides Ultratrace in MR Water | | | | | | |
| Acetochlor | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Alachlor | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Atrazine | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Atrazine-desethyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Atrazine-desisopropyl | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Azaconazole | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Azinphos-methyl | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Benalaxyl | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Bitertanol | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Bromacil | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Bromopropylate | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Butachlor | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Captan | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Carbaryl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Carbofuran | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Chlorfluazuron | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Chlorothalonil | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Chlorpyrifos | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Chlorpyrifos-methyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Chlortoluron | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Cyanazine | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Cyfluthrin | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Cyhalothrin | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Cypermethrin | g/m$^3$ | < 0.000040 | < 0.000040 | < 0.000040 | < 0.000040 | < 0.000040 |
| Deltamethrin | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Diazinon | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |

Lab No: 641657 v 2 Hill Laboratories Page 8 of 16

Sample Type: Clean waters

| Sample Name: | | 08-2941 07-May-2008 | 08-2942 07-May-2008 | 08-2943 07-May-2008 | 08-2944 07-May-2008 | 08-2945 07-May-2008 |
|---|---|---|---|---|---|---|
| Lab Number: | | 641657.1 | 641657.2 | 641657.3 | 641657.4 | 641657.5 |
| Organonitro&phosphorus Pesticides Ultratrace in MR Water | | | | | | |
| Dichlofluanid | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Dichloran | g/m$^3$ | < 0.000025 | < 0.000025 | < 0.000025 | < 0.000025 | < 0.000025 |
| Dichlorvos | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Difenoconazole | g/m$^3$ | < 0.000029 | < 0.000029 | < 0.000029 | < 0.000029 | < 0.000029 |
| Dimethoate | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Diphenylamine | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Diuron | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Fenpropimorph | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Fluazifop-butyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Fluometuron | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Flusilazole | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Fluvalinate | g/m$^3$ | < 0.000015 | < 0.000015 | < 0.000015 | < 0.000015 | < 0.000015 |
| Furalaxyl | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Haloxyfop-methyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Hexaconazole | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Hexazinone | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| IPBC (3-Iodo-2-propynyl-n-butylcarbamate) | g/m$^3$ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 |
| Iprodione | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Kresoxim-methyl | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Linuron | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Malathion | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Metalaxyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Metolachlor | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Metribuzin | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Molinate | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Myclobutanil | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Naled | g/m$^3$ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 |
| Norflurazon | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Oxadiazon | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Oxyfluorfen | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Paclobutrazol | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Parathion-ethyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Parathion-methyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Pendimethalin | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Permethrin | g/m$^3$ | < 0.0000071 | < 0.0000071 | < 0.0000071 | < 0.0000071 | < 0.0000071 |
| Pirimicarb | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Pirimiphos-methyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Prochloraz | g/m$^3$ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 |
| Procymidone | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Prometryn | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Propachlor | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Propanil | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Propazine | g/m$^3$ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Propiconazole | g/m$^3$ | < 0.000015 | < 0.000015 | < 0.000015 | < 0.000015 | < 0.000015 |
| Pyriproxyfen | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Quizalofop-ethyl | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Simazine | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Simetryn | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Sulfentrazone | g/m$^3$ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 |
| TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan] | g/m$^3$ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000020 |
| Tebuconazole | g/m$^3$ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 |
| Terbacil | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Terbufos | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Terbumeton | g/m$^3$ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |

Lab No: 641657 v 2 Hill Laboratories Page 9 of 16

**Sample Type: Clean waters**

| Sample Name: / Lab Number: | Unit | 08-2941 07-May-2008 641657.1 | 08-2942 07-May-2008 641657.2 | 08-2943 07-May-2008 641657.3 | 08-2944 07-May-2008 641657.4 | 08-2945 07-May-2008 641657.5 |
|---|---|---|---|---|---|---|
| **Organonitro&phosphorus Pesticides Ultratrace in MR Water** | | | | | | |
| Terbuthylazine | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.0000050 |
| Terbuthylazine-desethyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Terbutryn | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Thiabendazole | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 | < 0.000050 |
| Thiobencarb | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Tolylfluanid | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Triazophos | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Trifluralin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| Vinclozolin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000010 |
| **Polycyclic Aromatic Hydrocarbons Trace in Water, By SPE** | | | | | | |
| Acenaphthene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Acenaphthylene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Anthracene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Benzo[a]anthracene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Benzo[a]pyrene (BAP) | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Benzo[b]fluoranthene + Benzo[j] fluoranthene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | 0.000011 |
| Benzo[g,h,i]perylene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | 0.000008 |
| Benzo[k]fluoranthene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | 0.000009 |
| Chrysene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Dibenzo[a,h]anthracene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Fluoranthene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Fluorene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Indeno(1,2,3-c,d)pyrene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Naphthalene | g/m³ | < 0.000040 | < 0.000040 | < 0.000040 | < 0.000040 | < 0.000040 |
| Phenanthrene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| Pyrene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 |
| **Pentachlorophenol Trace in Water by GC-ECD** | | | | | | |
| Pentachlorophenol (PCP) | g/m³ | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 |
| 2,3,4,6-Tetrachlorophenol | g/m³ | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 |

| Sample Name: / Lab Number: | Unit | 08-2946 07-May-2008 641657.6 | 08-2947 07-May-2008 641657.7 | 08-2948 07-May-2008 641657.8 | 08-2949 07-May-2008 641657.9 | |
|---|---|---|---|---|---|---|
| **Individual Tests** | | | | | | |
| Total Nitrogen | g/m³ | - | - | - | 3.8 | - |
| Total Ammoniacal-N | g/m³ | - | - | - | 1.3 | - |
| Total Kjeldahl Nitrogen (TKN) | g/m³ | - | - | - | 2.9 | - |
| Total Phosphorus | g/m³ | - | - | - | 0.61 | - |
| Reactive Silica | g/m³ as $SiO_2$ | 61 | 40 | 13 | 47 | - |
| **Drinking water metals suite, totals, trace** | | | | | | |
| Total Aluminium | g/m³ | 0.15 | 0.14 | 0.080 | 0.86 | - |
| Total Antimony | g/m³ | < 0.00021 | < 0.00021 | 0.00022 | < 0.0011 | - |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | 0.0051 | < 0.0053 | - |
| Total Barium | g/m³ | 0.064 | 0.031 | 0.025 | 0.17 | - |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00053 | - |
| Total Boron | g/m³ | 0.0090 | 0.0091 | 0.24 | 0.31 | - |
| Total Cadmium | g/m³ | < 0.000053 | < 0.000053 | < 0.000053 | < 0.00027 | - |
| Total Calcium | g/m³ | 3.8 | 2.6 | 3.5 | 85 | - |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.0027 | - |
| Total Copper | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.0027 | - |
| Total Iron | g/m³ | 0.41 | 0.095 | 0.081 | 8.9 | - |
| Total Lead | g/m³ | 0.00017 | < 0.00011 | < 0.00011 | < 0.00053 | - |
| Total Lithium | g/m³ | 0.0048 | 0.0049 | 0.10 | 0.065 | - |
| Total Magnesium | g/m³ | 1.8 | 1.2 | 1.9 | 84 | - |
| Total Manganese | g/m³ | 0.042 | 0.0077 | 0.022 | 1.8 | - |

Lab No: 641657 v 2 Hill Laboratories Page 10 of 16

Sample Type: Clean waters

| Sample Name: | | 08-2946 07-May-2008 | 08-2947 07-May-2008 | 08-2948 07-May-2008 | 08-2949 07-May-2008 | |
|---|---|---|---|---|---|---|
| Lab Number: | | 641657.6 | 641657.7 | 641657.8 | 641657.9 | |
| **Drinking water metals suite, totals, trace** | | | | | | |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | - |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | < 0.0011 | - |
| Total Nickel | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.0027 | - |
| Total Potassium | g/m³ | 3.2 | 2.1 | 4.2 | 39 | - |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0053 | - |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | - |
| Total Sodium | g/m³ | 11 | 7.4 | 26 | 740 | - |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.0027 | - |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | 0.00012 | - |
| Total Zinc | g/m³ | 0.0083 | 0.0016 | 0.0038 | 0.040 | - |
| **Anion / Cation profile, trace level** | | | | | | |
| Sum of Anions | meq/L | 0.92 | 0.61 | 1.5 | 44 | - |
| Sum of Cations | meq/L | 0.83 | 0.54 | 1.4 | 42 | - |
| pH | pH Units | 6.6 | 6.9 | 6.8 | 6.3 | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 23 | 18 | 16 | 53 | - |
| Bicarbonate | g/m³ at 25°C | 28 | 22 | 19 | 65 | - |
| Total Hardness | g/m³ as $CaCO_3$ | 16 | 10 | 15 | 540 | - |
| Electrical Conductivity (EC) | mS/m | 9.5 | 6.2 | 17 | 470 | - |
| Dissolved Calcium | g/m³ | 3.6 | 2.3 | 3.3 | 85 | - |
| Dissolved Magnesium | g/m³ | 1.6 | 1.0 | 1.7 | 80 | - |
| Dissolved Potassium | g/m³ | 3.0 | 1.9 | 4.0 | 37 | - |
| Dissolved Sodium | g/m³ | 10 | 6.8 | 24 | 680 | - |
| Chloride | g/m³ | 8.8 | 5.2 | 22 | 1400 | - |
| Nitrite-N | g/m³ | 0.0027 | < 0.0020 | < 0.0020 | 0.031 | - |
| Nitrate-N | g/m³ | 1.8 | 0.86 | 0.21 | 0.82 | - |
| Nitrate-N + Nitrite-N | g/m³ | 1.8 | 0.86 | 0.21 | 0.85 | - |
| Sulphate | g/m³ | 4.2 | 2.1 | 28 | 200 | - |
| **Organochlorine Pesticides UltraTrace in water, By SPE** | | | | | | |
| Aldrin | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| alpha-BHC | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| beta-BHC | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| delta-BHC | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| gamma-BHC (Lindane) | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| cis-chlordane | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| trans-chlordane | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| 2,4'-DDD | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| 4,4'-DDD | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| 2,4'-DDE | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| 4,4'-DDE | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| 2,4'-DDT | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| 4,4'-DDT | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Dieldrin | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Endosulfan I | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Endosulfan II | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Endosulfan sulphate | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Endrin | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Endrin aldehyde | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Endrin Ketone | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Heptachlor | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Heptachlor epoxide | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Hexachlorobenzene | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Methoxychlor | g/m³ | < 0.0000020 | < 0.0000020 | < 0.0000020 | < 0.0000040 | - |
| Total Chlordane [(cis+trans)*100/42] | g/m³ | < 0.0000029 | < 0.0000029 | < 0.0000029 | < 0.0000057 | - |

Sample Type: Clean waters

| Sample Name: | | 08-2946 07-May-2008 | 08-2947 07-May-2008 | 08-2948 07-May-2008 | 08-2949 07-May-2008 | |
|---|---|---|---|---|---|---|
| Lab Number: | | 641657.6 | 641657.7 | 641657.8 | 641657.9 | |
| **Organonitro&phosphorus Pesticides Ultratrace in MR Water** | | | | | | |
| Acetochlor | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Alachlor | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Atrazine | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Atrazine-desethyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Atrazine-desisopropyl | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Azaconazole | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Azinphos-methyl | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Benalaxyl | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Bitertanol | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Bromacil | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Bromopropylate | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Butachlor | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Captan | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Carbaryl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Carbofuran | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Chlorfluazuron | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Chlorothalonil | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Chlorpyrifos | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Chlorpyrifos-methyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Chlortoluron | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Cyanazine | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Cyfluthrin | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Cyhalothrin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Cypermethrin | g/m³ | < 0.000040 | < 0.000040 | < 0.000040 | < 0.000080 | - |
| Deltamethrin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Diazinon | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Dichlofluanid | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Dichloran | g/m³ | < 0.000025 | < 0.000025 | < 0.000025 | < 0.000050 | - |
| Dichlorvos | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Difenoconazole | g/m³ | < 0.000029 | < 0.000029 | < 0.000029 | < 0.000057 | - |
| Dimethoate | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Diphenylamine | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Diuron | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Fenpropimorph | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Fluazifop-butyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Fluometuron | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Flusilazole | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Fluvalinate | g/m³ | < 0.000015 | < 0.000015 | < 0.000015 | < 0.000029 | - |
| Furalaxyl | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Haloxyfop-methyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Hexaconazole | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Hexazinone | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| IPBC (3-Iodo-2-propynyl-n-butylcarbamate) | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.00010 | - |
| Iprodione | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Kresoxim-methyl | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Linuron | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Malathion | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Metalaxyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Metolachlor | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Metribuzin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Molinate | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Myclobutanil | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Naled | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.00010 | - |
| Norflurazon | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |

Sample Type: Clean waters

| Sample Name: | | 08-2946<br>07-May-2008 | 08-2947<br>07-May-2008 | 08-2948<br>07-May-2008 | 08-2949<br>07-May-2008 | |
|---|---|---|---|---|---|---|
| Lab Number: | | 641657.6 | 641657.7 | 641657.8 | 641657.9 | |
| **Organonitro&phosphorus Pesticides Ultratrace in MR Water** | | | | | | |
| Oxadiazon | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Oxyfluorfen | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Paclobutrazol | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Parathion-ethyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Parathion-methyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Pendimethalin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Permethrin | g/m³ | < 0.0000071 | < 0.0000071 | < 0.0000071 | < 0.000015 | - |
| Pirimicarb | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Pirimiphos-methyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Prochloraz | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.00010 | - |
| Procymidone | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Prometryn | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Propachlor | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Propanil | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Propazine | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Propiconazole | g/m³ | < 0.000015 | < 0.000015 | < 0.000015 | < 0.000029 | - |
| Pyriproxyfen | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Quizalofop-ethyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Simazine | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Simetryn | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Sulfentrazone | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.00010 | - |
| TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan] | g/m³ | < 0.000020 | < 0.000020 | < 0.000020 | < 0.000040 | - |
| Tebuconazole | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.00010 | - |
| Terbacil | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Terbufos | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Terbumeton | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Terbuthylazine | g/m³ | < 0.0000050 | < 0.0000050 | < 0.0000050 | < 0.000010 | - |
| Terbuthylazine-desethyl | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Terbutryn | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Thiabendazole | g/m³ | < 0.000050 | < 0.000050 | < 0.000050 | < 0.00010 | - |
| Thiobencarb | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Tolylfluanid | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Triazophos | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Trifluralin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| Vinclozolin | g/m³ | < 0.000010 | < 0.000010 | < 0.000010 | < 0.000020 | - |
| **Polycyclic Aromatic Hydrocarbons Trace in Water, By SPE** | | | | | | |
| Acenaphthene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Acenaphthylene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Anthracene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Benzo[a]anthracene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Benzo[a]pyrene (BAP) | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Benzo[b]fluoranthene + Benzo[j] fluoranthene | g/m³ | < 0.000008 | 0.000013 | < 0.000008 | < 0.000008 | - |
| Benzo[g,h,i]perylene | g/m³ | < 0.000008 | 0.000012 | < 0.000008 | < 0.000008 | - |
| Benzo[k]fluoranthene | g/m³ | < 0.000008 | 0.000013 | < 0.000008 | < 0.000008 | - |
| Chrysene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Dibenzo[a,h]anthracene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Fluoranthene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Fluorene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Indeno(1,2,3-c,d)pyrene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Naphthalene | g/m³ | < 0.000040 | < 0.000040 | < 0.000040 | < 0.000040 | - |
| Phenanthrene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |
| Pyrene | g/m³ | < 0.000008 | < 0.000008 | < 0.000008 | < 0.000008 | - |

| Sample Type: Clean waters | | | | | | |
|---|---|---|---|---|---|---|
| Sample Name: | | 08-2946 07-May-2008 | 08-2947 07-May-2008 | 08-2948 07-May-2008 | 08-2949 07-May-2008 | |
| Lab Number: | | 641657.6 | 641657.7 | 641657.8 | 641657.9 | |
| Pentachlorophenol Trace in Water by GC-ECD | | | | | | |
| Pentachlorophenol (PCP) | g/m³ | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 | - |
| 2,3,4,6-Tetrachlorophenol | g/m³ | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Sediment**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Individual Tests | | | |
| Environmental Solids Sample Preparation* | Air dried at 35°C and sieved, <2mm fraction. | - | 10-18 |
| Dry Matter (Org) | Dried at 103°C (removes 3-5% more water than air dry), gravimetry. | 0.10 g/100g as rcvd | 10-18 |
| Total Recoverable digestion | Nitric / hydrochloric acid digestion. US EPA 200.2 | - | 10-18 |
| Total Carbon | Catalytic Combustion (900°C, $O_2$), separation, Thermal Conductivity Detector [Elementar Analyser]. | 0.050 g/100g dry wt | 10-18 |
| USEPA Priority Pollutants - Trace Level, 13 metals* | Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level. | - | 10-18 |
| Organochlorine Pesticides Trace in Soil* | Sonication extraction, SPE cleanup, GPC cleanup (if required), dual column GC-ECD analysis | - | 10-18 |
| Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS* | Sonication extraction, GPC cleanup, GC-MS analysis | - | 10-18 |
| Polycyclic Aromatic Hydrocarbons Trace in Soil* | Sonication extraction, SPE cleanup, GC-MS SIM analysis | - | 10-18 |
| Pentachlorophenol Screening in Soil by GC-ECD* | Solvent extraction, acetylation, GC-ECD analysis | - | 10-18 |

**Sample Type: Clean waters**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1-9 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-9 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-9 |
| Total Kjeldahl Digestion | Sulphuric acid digestion with copper sulphate catalyst. | - | 9 |
| Total Phosphorus Digestion | Acid persulphate digestion. | - | 9 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1-9 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1-9 |
| pH | pH meter. APHA 4500-H+ B 21st ed. 2005. | 0.1 pH Units | 1-9 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 g/m³ as $CaCO_3$ | 1-9 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not > 500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 g/m³ at 25°C | 1-9 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 g/m³ as $CaCO_3$ | 1-9 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.10 mS/m | 1-9 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1-9 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-9 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-9 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-9 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-9 |

| Sample Type: Clean waters | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4110 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 $g/m^3$ | 1-9 |
| Total Nitrogen | Calculation: TKN + Nitrate-N + Nitrite-N. | 0.050 $g/m^3$ | 9 |
| Total Ammoniacal-N | Filtered sample. Phenol/hypochlorite colorimetry. Discrete Analyser. ($NH_4$-N = $NH_4^+$-N + $NH_3$-N). APHA 4500-$NH_3$ F (modified from manual analysis) 21st ed. 2005 | 0.010 $g/m^3$ | 9 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 $g/m^3$ | 1-9 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 $g/m^3$ | 1-9 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 $g/m^3$ | 1-9 |
| Total Kjeldahl Nitrogen (TKN) | Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-$N_{org}$ C. (modified) 4500 $NH_3$ F (modified) 21st ed. 2005. | 0.10 $g/m^3$ | 9 |
| Total Phosphorus | Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P E (modified from manual analysis) 21st ed. 2005. | 0.0040 $g/m^3$ | 9 |
| Reactive Silica | Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-$SiO_2$ F (modified from flow injection analysis) 21st ed. 2005. | 0.10 $g/m^3$ as $SiO_2$ | 1-9 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 $g/m^3$ | 1-9 |
| Drinking water metals suite, totals, trace* | | - | 1-9 |
| Anion / Cation profile, trace level* | | - | 1-9 |
| Organochlorine/Organonitro&phos Pest.s Ultratrace in Water* | Solid phase extraction, GPC (if required), GC-MS analysis | - | 1-9 |
| Organochlorine Pesticides UltraTrace in water, By SPE* | Solid phase extraction, SPE cleanup (if required), dual column GC-ECD analysis | - | 1-9 |
| Organonitro&phosphorus Pesticides Ultratrace in MR Water* | Solid phase extraction, GPC (if required), GC-MS analysis | - | 1-9 |
| Polycyclic Aromatic Hydrocarbons Trace in Water, By SPE* | Solid phase extraction, SPE (if required), GC-MS SIM analysis | - | 1-9 |
| Pentachlorophenol Trace in Water by GC-ECD* | Solvent extraction, acetylation, GC-ECD analysis | - | 1-9 |
| Drinking water metals suite, totals, trace | | | |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0032 $g/m^3$ | 1-9 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00021 $g/m^3$ | 1-9 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0011 $g/m^3$ | 1-9 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00021 $g/m^3$ | 1-9 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 $g/m^3$ | 1-9 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 $g/m^3$ | 1-9 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.000053 $g/m^3$ | 1-9 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 $g/m^3$ | 1-9 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 $g/m^3$ | 1-9 |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 $g/m^3$ | 1-9 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 $g/m^3$ | 1-9 |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 $g/m^3$ | 1-9 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 $g/m^3$ | 1-9 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 $g/m^3$ | 1-9 |

| Sample Type: Clean waters | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 $g/m^3$ | 1-9 |
| Total Mercury | Permanganate / Persulphate digestion. Analysis by FIMS. US EPA 245.2 | 0.000080 $g/m^3$ | 1-9 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00021 $g/m^3$ | 1-9 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 $g/m^3$ | 1-9 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 $g/m^3$ | 1-9 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0011 $g/m^3$ | 1-9 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 $g/m^3$ | 1-9 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 $g/m^3$ | 1-9 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 $g/m^3$ | 1-9 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.000021 $g/m^3$ | 1-9 |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0011 $g/m^3$ | 1-9 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

# Appendix - III Lab analysis reports for organics and metals in shellfish samples from Maketū Estuary

**Hill Laboratories**
A WORLD LEADER IN ANALYTICAL SERVICES

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

## ANALYSIS REPORT

Page 1 of 2

| | | | |
|---|---|---|---|
| **Client:** | Environment BOP | **Lab No:** | 641480 |
| **Contact:** | Spence, Adrian | **Date Registered:** | 08-May-2008 |
| | c/o Environment BOP | **Date Reported:** | 03-Jun-2008 |
| | P O Box 364 | **Quote No:** | 32877 |
| | WHAKATANE | **Order No:** | 104425 |
| | | **Client Reference:** | 2008/024 |
| | | **Submitted By:** | Spence, Adrian |

SPv1

Sample Type: Shellfish

| | **Sample Name:** | 08/2895 05-May-2008 | 08/2896 05-May-2008 | 08/2897 05-May-2008 | 08/2898 05-May-2008 | |
|---|---|---|---|---|---|---|
| | **Lab Number:** | 641480.1 | 641480.2 | 641480.3 | 641480.4 | |
| Moisture | g/100g as rcvd | 85 | 85 | 90 | 90 | - |
| Arsenic | mg/kg as rcvd | 1.8 | 1.7 | 3.3 | 2.8 | - |
| Cadmium | mg/kg as rcvd | 0.033 | 0.030 | 0.028 | 0.028 | - |
| Chromium | mg/kg as rcvd | 0.023 | 0.032 | 0.17 | 0.12 | - |
| Copper | mg/kg as rcvd | 0.58 | 0.55 | 0.68 | 0.53 | - |
| Lead | mg/kg as rcvd | 0.010 | 0.011 | 0.015 | 0.014 | - |
| Mercury | mg/kg as rcvd | 0.012 | 0.012 | 0.015 | 0.010 | - |
| Nickel | mg/kg as rcvd | 0.081 | 0.079 | 0.95 | 0.80 | - |
| Zinc | mg/kg as rcvd | 8.9 | 8.3 | 7.1 | 7.4 | - |

## SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Shellfish

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Shucking of Shellfish | Removal of tissue from shell. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. | - | 1-4 |
| Homogenise | Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. | - | 1-4 |
| Moisture | Drying for minimum of 24 hours at 65°C, gravimetry. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. Fact Sheet No 2.3.2-14, A Compendium of Chemical, Physical and Biological Methods for Assessing and Monitoring the Remediation of Contaminated Sediment Sites. 2003. | 0.10 g/100g as rcvd | 1-4 |
| Biological Materials Digestion | Nitric and hydrochloric acid micro digestion, 85°C for 1 hour. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. | - | 1-4 |
| Arsenic | Biological materials digestion, ICP-MS. | 0.020 mg/kg as rcvd | 1-4 |
| Cadmium | Biological materials digestion, ICP-MS. | 0.00040 mg/kg as rcvd | 1-4 |
| Chromium | Biological materials digestion, ICP-MS. | 0.020 mg/kg as rcvd | 1-4 |
| Copper | Biological materials digestion, ICP-MS. | 0.010 mg/kg as rcvd | 1-4 |
| Lead | Biological materials digestion, ICP-MS. | 0.0020 mg/kg as rcvd | 1-4 |
| Mercury | Biological materials digestion, ICP-MS. | 0.0020 mg/kg as rcvd | 1-4 |
| Nickel | Biological materials digestion, ICP-MS. | 0.020 mg/kg as rcvd | 1-4 |
| Zinc | Biological materials digestion, ICP-MS. | 0.010 mg/kg as rcvd | 1-4 |

Lab No: 641480 v 1 Hill Laboratories Page 1 of 2

**Hill Laboratories**
A WORLD LEADER IN ANALYTICAL SERVICES

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | |
|---|---|---|---|
| **Client:** | Environment BOP | **Lab No:** | 641296 |
| **Contact:** | Spence, Adrian | **Date Registered:** | 07-May-2008 |
| | c/o Environment BOP | **Date Reported:** | 10-Jun-2008 |
| | P O Box 364 | **Quote No:** | 32877 |
| | WHAKATANE | **Order No:** | 104425 |
| | | **Client Reference:** | 2008/024 |
| | | **Submitted By:** | Spence, Adrian |

SPv1

**Sample Type: Shellfish**

| Sample Name: | | 08/2895 05-May-2008 | 08/2896 05-May-2008 | 08/2897 05-May-2008 | 08/2898 05-May-2008 | |
|---|---|---|---|---|---|---|
| Lab Number: | | 641296.1 | 641296.2 | 641296.3 | 641296.4 | |
| **Individual Tests** | | | | | | |
| Lipid Content* | g/100g | 1.1 | 1.1 | 0.96 | 0.96 | - |
| Dry Matter | g/100g as rcvd | 19 | 18 | 16 | 15 | - |
| **Organochlorine Pesticides in Biomatter** | | | | | | |
| Aldrin | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| alpha-BHC | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| beta-BHC | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| delta-BHC | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| gamma-BHC (Lindane) | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| cis-chlordane | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| trans-chlordane | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| 2,4'-DDD | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| 4,4'-DDD | mg/kg | 0.00051 | 0.0017 | 0.0018 | 0.00058 | - |
| 2,4'-DDE | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| 4,4'-DDE | mg/kg | < 0.00050 | 0.0028 | 0.0026 | < 0.00050 | - |
| 2,4'-DDT | mg/kg | < 0.00050 | < 0.00050 | 0.00051 | < 0.00050 | - |
| 4,4'-DDT | mg/kg | 0.00050 | 0.0018 | 0.0054 | 0.0019 | - |
| Dieldrin | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Endosulfan I | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Endosulfan II | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Endosulfan sulfate | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Endrin | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Endrin aldehyde | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Endrin Ketone | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Heptachlor | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Heptachlor epoxide | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Hexachlorobenzene | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Methoxychlor | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Total Chlordane [(cis+trans)*100/42] | mg/kg | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | - |
| **Polycyclic Aromatic Hydrocarbons in Biomatter** | | | | | | |
| Acenaphthene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Acenaphthylene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Anthracene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Benzo[a]anthracene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Benzo[a]pyrene (BAP) | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Benzo[b]fluoranthene + Benzo[j] fluoranthene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Benzo[g,h,i]perylene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Benzo[k]fluoranthene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |

**Sample Type: Shellfish**

| | Sample Name: | 08/2895<br>05-May-2008 | 08/2896<br>05-May-2008 | 08/2897<br>05-May-2008 | 08/2898<br>05-May-2008 | |
|---|---|---|---|---|---|---|
| | Lab Number: | 641296.1 | 641296.2 | 641296.3 | 641296.4 | |
| **Polycyclic Aromatic Hydrocarbons in Biomatter** | | | | | | |
| Chrysene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Dibenzo[a,h]anthracene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Fluoranthene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Fluorene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Indeno(1,2,3-c,d)pyrene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Naphthalene | mg/kg as rcvd | < 0.0050 | < 0.0050 | < 0.0085 | < 0.0089 | - |
| Phenanthrene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| Pyrene | mg/kg as rcvd | < 0.00076 | < 0.00079 | < 0.0018 | < 0.0018 | - |
| **Polychlorinated biphenyls in Biomatter** | | | | | | |
| PCB-101 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-105 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-110 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-114 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-118 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-121 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-123 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-126 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-128 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-138 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-141 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-149 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-151 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-153 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-156 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-157 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-159 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-167 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-169 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-170 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-180 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-189 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-194 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-206 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-209 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-28 + PCB-31 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-44 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-49 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-52 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-60 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-77 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-81 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| PCB-86 | mg/kg | < 0.00050 | < 0.00050 | < 0.00050 | < 0.00050 | - |
| Total PCB (Sum of 33 congeners) | mg/kg | < 0.02 | < 0.02 | < 0.02 | < 0.02 | - |
| **Pentachlorophenol Trace in Biota by GC-ECD** | | | | | | |
| Pentachlorophenol (PCP) | mg/kg | < 0.0029 | < 0.0034 | < 0.0033 | < 0.0030 | - |
| 2,3,4,6-Tetrachlorophenol | mg/kg | < 0.0029 | < 0.0034 | < 0.0033 | < 0.0030 | - |

## SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Shellfish**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Lipid Content* | Gravimetric. | 0.10 g/100g | 1-4 |

| Sample Type: Shellfish | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| PCB, PAH And OCP in Biomatter | | - | 1-4 |
| Shucking of Shellfish* | Removal of tissue from shell. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. | - | 1-4 |
| Homogenisation of Biological samples for Organics Tests* | Mincing, chopping, or blending of sample to form homogenous sample fraction. | - | 1-4 |
| Homogenise* | Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. | - | 1-4 |
| Organochlorine Pesticides in Biomatter | Sonication extraction, SPE cleanup, GPC cleanup, dual column GC-ECD analysis | - | 1-4 |
| Polycyclic Aromatic Hydrocarbons in Biomatter | | - | 1-4 |
| Polychlorinated biphenyls in Biomatter | | - | 1-4 |
| Pentachlorophenol Trace in Biota by GC-ECD | ASE extraction, acetylation, GC-ECD analysis | - | 1-4 |
| Dry Matter (Org) | Dried at 103°C (removes 3-5% more water than air dry), gravimetry. | 0.10 g/100g as rcvd | 1-4 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

**Hill Laboratories**
A WORLD LEADER IN ANALYTICAL SERVICES

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | |
|---|---|---|---|
| **Client:** | Environment BOP | **Lab No:** | 641477 |
| **Contact:** | Spence, Adrian | **Date Registered:** | 08-May-2008 |
| | c/o Environment BOP | **Date Reported:** | 20-Jun-2008 |
| | P O Box 364 | **Quote No:** | 32877 |
| | WHAKATANE | **Order No:** | 104425 |
| | | **Client Reference:** | 2008/024 |
| | | **Submitted By:** | Spence, Adrian |

POPv2

**Sample Type: Shellfish**

| **Sample Name:** | 08/2895 05-May-2008 | 08/2896 05-May-2008 | 08/2897 05-May-2008 | 08/2898 05-May-2008 |
|---|---|---|---|---|
| **Lab Number:** | 641477.1 | 641477.2 | 641477.3 | 641477.4 |
| Multiresidue GC Analysis (fresh & dried samples) | | | | |
| **Analytes Detected:** | None | None | None | None |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

## Detection Limits

| Analytes | Detection Limit | Analytes | Detection Limit | Analytes | Detection Limit |
|---|---|---|---|---|---|
| Multiresidue GC Analysis (fresh & dried samples) | | Multiresidue GC Analysis (fresh & dried samples) | | Multiresidue GC Analysis (fresh & dried samples) | |
| Acephate | 0.010 mg/kg | Cyhalothrin | 0.010 mg/kg | Fenobucarb | 0.010 mg/kg |
| Acetochlor | 0.010 mg/kg | Cypermethrin | 0.010 mg/kg | Fenoxaprop-ethyl | 0.010 mg/kg |
| Alachlor | 0.010 mg/kg | Cyproconazole | 0.010 mg/kg | Fenpiclonil | 0.010 mg/kg |
| Aldrin | 0.010 mg/kg | Cyprodinil | 0.010 mg/kg | Fenpropathrin | 0.010 mg/kg |
| Atrazine | 0.010 mg/kg | 2,4'-DDD | 0.010 mg/kg | Fenpropimorph | 0.010 mg/kg |
| Atrazine-desethyl | 0.010 mg/kg | 4,4'-DDD | 0.010 mg/kg | Fensulfothion | 0.010 mg/kg |
| Atrazine-desisopropyl | 0.020 mg/kg | 2,4'-DDE | 0.010 mg/kg | Fenthion | 0.010 mg/kg |
| Azaconazole | 0.010 mg/kg | 4,4'-DDE | 0.010 mg/kg | Fenvalerate | 0.010 mg/kg |
| Azinphos-methyl | 0.010 mg/kg | 2,4'-DDT | 0.010 mg/kg | Fluazifop-butyl | 0.010 mg/kg |
| Azoxystrobin | 0.010 mg/kg | 4,4'-DDT | 0.010 mg/kg | Flucythrinate | 0.010 mg/kg |
| Benalaxyl | 0.010 mg/kg | Deltamethrin (Tralomethrin) | 0.010 mg/kg | Fludioxonil | 0.010 mg/kg |
| Bendiocarb | 0.010 mg/kg | Demeton-S-methyl | 0.010 mg/kg | Fluometuron | 0.010 mg/kg |
| Benodanil | 0.010 mg/kg | Diazinon | 0.010 mg/kg | Flusilazole | 0.010 mg/kg |
| Benoxacor | 0.010 mg/kg | Dichlobenil | 0.010 mg/kg | Flutriafol | 0.010 mg/kg |
| alpha-BHC | 0.010 mg/kg | Dichlofenthion | 0.010 mg/kg | Fluvalinate | 0.010 mg/kg |
| beta-BHC | 0.010 mg/kg | Dichlofluanid | 0.010 mg/kg | Folpet | 0.020 mg/kg |
| gamma-BHC (Lindane) | 0.010 mg/kg | Dichloran | 0.010 mg/kg | Fonofos | 0.010 mg/kg |
| delta-BHC | 0.010 mg/kg | Dichlorvos | 0.010 mg/kg | Furalaxyl | 0.010 mg/kg |
| Bifenox | 0.010 mg/kg | Dicofol | 0.050 mg/kg | Furathiocarb | 0.010 mg/kg |
| Bifenthrin | 0.010 mg/kg | Dicrotophos | 0.010 mg/kg | Halfenprox | 0.010 mg/kg |
| Bitertanol | 0.010 mg/kg | Dieldrin | 0.010 mg/kg | Haloxyfop-methyl | 0.010 mg/kg |
| Bromacil | 0.010 mg/kg | Difenoconazole | 0.020 mg/kg | Heptachlor | 0.010 mg/kg |
| Bromophos-ethyl | 0.010 mg/kg | Diflufenican | 0.010 mg/kg | Heptachlor epoxide | 0.010 mg/kg |
| Bromopropylate | 0.010 mg/kg | Dimethenamid | 0.010 mg/kg | Hexachlorobenzene | 0.010 mg/kg |
| Bupirimate | 0.010 mg/kg | Dimethoate | 0.010 mg/kg | Hexaconazole | 0.010 mg/kg |
| Buprofezin | 0.010 mg/kg | Dimethomorph | 0.010 mg/kg | Hexazinone | 0.010 mg/kg |
| Butachlor | 0.010 mg/kg | Dimethylvinphos | 0.010 mg/kg | Hexythiazox | 0.050 mg/kg |
| Butamifos | 0.010 mg/kg | Dinocap | 0.050 mg/kg | Imazalil | 0.010 mg/kg |
| Cadusafos | 0.010 mg/kg | Dioxabenzofos | 0.010 mg/kg | Indoxacarb | 0.010 mg/kg |
| Captafol | 0.010 mg/kg | Diphenylamine | 0.010 mg/kg | Iodofenphos | 0.010 mg/kg |
| Captan | 0.010 mg/kg | Disulfoton | 0.010 mg/kg | Iprobenfos | 0.010 mg/kg |
| Carbaryl | 0.010 mg/kg | Diuron | 0.010 mg/kg | Iprodione | 0.020 mg/kg |
| Carbofenothion | 0.010 mg/kg | Edifenphos | 0.010 mg/kg | Isazophos | 0.010 mg/kg |
| Carbofuran | 0.010 mg/kg | Endosulfan I | 0.010 mg/kg | Isofenphos | 0.010 mg/kg |
| Carboxin | 0.010 mg/kg | Endosulfan II | 0.010 mg/kg | Isoprocarb | 0.010 mg/kg |
| cis-chlordane | 0.010 mg/kg | Endosulfan sulfate | 0.010 mg/kg | Kresoxim-methyl | 0.010 mg/kg |
| trans-chlordane | 0.010 mg/kg | Endrin | 0.010 mg/kg | Leptophos | 0.010 mg/kg |
| Chlorfenapyr | 0.010 mg/kg | Endrin aldehyde | 0.010 mg/kg | Linuron | 0.020 mg/kg |
| Chlorfenvinphos | 0.010 mg/kg | Endrin Ketone | 0.010 mg/kg | Malathion | 0.010 mg/kg |
| Chlorfluazuron | 0.010 mg/kg | EPN | 0.010 mg/kg | Mepronil | 0.010 mg/kg |
| Chlorobenzilate | 0.010 mg/kg | Epoxiconazole | 0.010 mg/kg | Metalaxyl (Mefenoxam) | 0.010 mg/kg |
| Chlorothalonil | 0.010 mg/kg | EPTC | 0.010 mg/kg | Methacrifos | 0.010 mg/kg |
| Chlorpropham | 0.010 mg/kg | Esfenvalerate | 0.010 mg/kg | Methamidophos | 0.020 mg/kg |
| Chlorpyrifos | 0.010 mg/kg | Esprocarb | 0.010 mg/kg | Methidathion | 0.010 mg/kg |
| Chlorpyrifos-methyl | 0.010 mg/kg | Ethion | 0.010 mg/kg | Methiocarb | 0.010 mg/kg |
| Chlorthal-dimethyl | 0.010 mg/kg | Ethoprophos | 0.010 mg/kg | Methoxychlor | 0.010 mg/kg |
| Chlortoluron | 0.010 mg/kg | Etridiazole | 0.020 mg/kg | Metolachlor | 0.010 mg/kg |
| Chlozolinate | 0.010 mg/kg | Etrimfos | 0.010 mg/kg | Metribuzin | 0.010 mg/kg |
| Clomazone | 0.010 mg/kg | Famphur | 0.010 mg/kg | Mevinphos | 0.010 mg/kg |
| Coumaphos | 0.010 mg/kg | Fenamiphos | 0.010 mg/kg | Molinate | 0.010 mg/kg |
| Cyanazine | 0.010 mg/kg | Fenarimol | 0.010 mg/kg | Monocrotophos | 0.020 mg/kg |
| Cyanophos | 0.010 mg/kg | Fenchlorphos | 0.010 mg/kg | Myclobutanil | 0.010 mg/kg |
| Cyfluthrin | 0.010 mg/kg | Fenitrothion | 0.010 mg/kg | Naled | 0.030 mg/kg |

**Lab No:** 641477 v 2 Hill Laboratories Page 2 of 4

| Analytes | Detection Limit |
|---|---|
| Multiresidue GC Analysis (fresh & dried samples) | |
| Napropamide | 0.010 mg/kg |
| Nitrofen | 0.010 mg/kg |
| Nitrothal-isopropyl | 0.010 mg/kg |
| Norflurazon | 0.020 mg/kg |
| Omethoate | 0.020 mg/kg |
| Oxadiazon | 0.010 mg/kg |
| Oxadixyl | 0.010 mg/kg |
| Oxychlordane | 0.010 mg/kg |
| Oxyfluorfen | 0.010 mg/kg |
| Paclobutrazol | 0.010 mg/kg |
| Parathion-ethyl | 0.020 mg/kg |
| Parathion-methyl | 0.010 mg/kg |
| Penconazole | 0.010 mg/kg |
| Pendimethalin | 0.010 mg/kg |
| Permethrin | 0.010 mg/kg |
| Phenthoate | 0.010 mg/kg |
| Phorate | 0.010 mg/kg |
| Phosalone | 0.010 mg/kg |
| Phosmet | 0.010 mg/kg |
| Phosphamidon | 0.010 mg/kg |
| Piperonyl-butoxide | 0.010 mg/kg |
| Pirimicarb | 0.010 mg/kg |
| Pirimiphos-methyl | 0.010 mg/kg |
| Prochloraz | 0.010 mg/kg |
| Procymidone | 0.010 mg/kg |
| Profenofos | 0.010 mg/kg |
| Prometryn | 0.010 mg/kg |
| Propachlor | 0.010 mg/kg |
| Propanil | 0.020 mg/kg |
| Propaphos | 0.010 mg/kg |
| Propazine | 0.010 mg/kg |
| Propetamphos | 0.010 mg/kg |
| Propham | 0.010 mg/kg |
| Propiconazole | 0.010 mg/kg |
| Propoxur | 0.010 mg/kg |
| Propyzamide | 0.010 mg/kg |
| Prothiofos | 0.010 mg/kg |
| Pyraclofos | 0.020 mg/kg |
| Pyrazophos | 0.010 mg/kg |
| Pyrazoxyfen | 0.020 mg/kg |
| Pyrethrin | 0.030 mg/kg |
| Pyrifenox | 0.010 mg/kg |
| Pyrimethanil | 0.010 mg/kg |
| Pyriproxyfen | 0.010 mg/kg |
| Quinalphos | 0.010 mg/kg |
| Quintozene | 0.010 mg/kg |
| Quizalofop-ethyl | 0.010 mg/kg |
| Simazine | 0.010 mg/kg |
| Simetryn | 0.020 mg/kg |
| Sulfentrazone | 0.010 mg/kg |
| Sulfotep | 0.010 mg/kg |
| Tebuconazole | 0.010 mg/kg |
| Tebufenpyrad | 0.010 mg/kg |
| Terbacil | 0.010 mg/kg |

| Analytes | Detection Limit |
|---|---|
| Multiresidue GC Analysis (fresh & dried samples) | |
| Terbufos | 0.010 mg/kg |
| Terbumeton | 0.010 mg/kg |
| Terbuthylazine | 0.010 mg/kg |
| Terbuthylazine-desethyl | 0.010 mg/kg |
| Terbutryn | 0.010 mg/kg |
| Tetrachlorvinphos | 0.010 mg/kg |
| Tetradifon | 0.010 mg/kg |
| Thenylchlor | 0.010 mg/kg |
| Thiobencarb | 0.010 mg/kg |
| Thiometon | 0.010 mg/kg |
| Tolclofos-methyl | 0.010 mg/kg |
| Tolylfluanid | 0.010 mg/kg |
| Triadimefon | 0.020 mg/kg |
| Tri-allate | 0.010 mg/kg |
| Triazophos | 0.010 mg/kg |
| Trifloxystrobin | 0.010 mg/kg |
| Trifluralin | 0.010 mg/kg |
| Vinclozolin | 0.010 mg/kg |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Shellfish**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Multiresidue GC Analysis (fresh & dried samples) | Ethyl acetate extraction, GPC cleanup, GC-MS SIM analysis, GC-ECD/NPD analysis. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton. | - | 1-4 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Colin Malcolm BSc
Divisional Manager - Food & Bioanalytical Division

# Appendix IV – Lab analysis reports for organics and metals in sediment samples from Maketū Estuary

**Hill Laboratories**
A WORLD LEADER IN ANALYTICAL SERVICES

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

**ANALYSIS REPORT** Page 1 of 4

| | | | |
|---|---|---|---|
| **Client:** | Environment BOP | **Lab No:** | 641486 SPv2 |
| **Contact:** | Spence, Adrian | **Date Registered:** | 08-May-2008 |
| | c/o Environment BOP | **Date Reported:** | 21-May-2008 |
| | P O Box 364 | **Quote No:** | 32803 |
| | WHAKATANE | **Order No:** | 104425 |
| | | **Client Reference:** | 2008/024 |
| | | **Submitted By:** | Spence, Adrian |

**Sample Type: Sediment**

| Sample Name: / Lab Number: | | 08/2899 05-May-2008 641486.1 | 08/2900 05-May-2008 641486.2 | 08/2901 05-May-2008 641486.3 | 08/2902 05-May-2008 641486.4 | |
|---|---|---|---|---|---|---|
| **Individual Tests** | | | | | | |
| Total Organic Carbon | g/100g dry wt | 0.66 | 0.27 | 0.61 | 0.60 | - |
| **USEPA Priority Pollutants - Trace Level, 13 metals** | | | | | | |
| Total Recoverable Antimony | mg/kg dry wt | < 0.040 | < 0.040 | < 0.040 | < 0.040 | - |
| Total Recoverable Arsenic | mg/kg dry wt | 3.3 | 4.0 | 4.8 | 4.0 | - |
| Total Recoverable Beryllium | mg/kg dry wt | 0.14 | 0.17 | 0.20 | 0.19 | - |
| Total Recoverable Cadmium | mg/kg dry wt | 0.030 | < 0.010 | 0.030 | 0.035 | - |
| Total Recoverable Chromium | mg/kg dry wt | 1.7 | 2.9 | 3.1 | 3.0 | - |
| Total Recoverable Copper | mg/kg dry wt | 1.1 | 1.2 | 1.6 | 1.4 | - |
| Total Recoverable Lead | mg/kg dry wt | 1.7 | 2.1 | 2.2 | 2.1 | - |
| Total Recoverable Mercury | mg/kg dry wt | 0.013 | 0.025 | 0.034 | 0.023 | - |
| Total Recoverable Nickel | mg/kg dry wt | 0.95 | 1.7 | 1.9 | 1.8 | - |
| Total Recoverable Selenium | mg/kg dry wt | < 2.0 | < 2.0 | < 2.0 | < 2.0 | - |
| Total Recoverable Silver | mg/kg dry wt | < 0.020 | < 0.020 | < 0.020 | < 0.020 | - |
| Total Recoverable Thallium | mg/kg dry wt | 0.069 | 0.030 | 0.060 | 0.066 | - |
| Total Recoverable Zinc | mg/kg dry wt | 9.8 | 17 | 17 | 18 | - |
| **Organochlorine Pesticides Trace in Soil** | | | | | | |
| Aldrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| alpha-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| beta-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| delta-BHC | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| gamma-BHC (Lindane) | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| cis-chlordane | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| trans-chlordane | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| 2,4'-DDD | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| 4,4'-DDD | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| 2,4'-DDE | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| 4,4'-DDE | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| 2,4'-DDT | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| 4,4'-DDT | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Dieldrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Endosulfan I | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Endosulfan II | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Endosulfan sulphate | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Endrin | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Endrin aldehyde | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Endrin Ketone | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Heptachlor | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |

**Sample Type: Sediment**

| | Sample Name: | 08/2899 05-May-2008 | 08/2900 05-May-2008 | 08/2901 05-May-2008 | 08/2902 05-May-2008 | |
|---|---|---|---|---|---|---|
| | Lab Number: | 641486.1 | 641486.2 | 641486.3 | 641486.4 | |
| **Organochlorine Pesticides Trace in Soil** | | | | | | |
| Heptachlor epoxide | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Hexachlorobenzene | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Methoxychlor | mg/kg dry wt | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0011 | - |
| Total Chlordane [(cis+trans)* 100/42] | mg/kg dry wt | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | - |
| **Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS** | | | | | | |
| Dry Matter | g/100g as rcvd | 63 | 72 | 60 | 62 | - |
| Acetochlor | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Alachlor | mg/kg dry wt | < 0.0060 | < 0.0060 | < 0.0060 | < 0.0060 | - |
| Atrazine | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Atrazine-desethyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Atrazine-desisopropyl | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Azaconazole | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Azinphos-methyl | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Benalaxyl | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Bitertanol | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Bromacil | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Bromopropylate | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Butachlor | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Captan | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Carbaryl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Carbofuran | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Chlorfluazuron | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Chlorothalonil | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Chlorpyrifos | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Chlorpyrifos-methyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Chlortoluron | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Cyanazine | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Cyfluthrin | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Cyhalothrin | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Cypermethrin | mg/kg dry wt | < 0.038 | < 0.034 | < 0.040 | < 0.038 | - |
| Deltamethrin | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Diazinon | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Dichlofluanid | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Dichloran | mg/kg dry wt | < 0.030 | < 0.030 | < 0.030 | < 0.030 | - |
| Dichlorvos | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Difenoconazole | mg/kg dry wt | < 0.027 | < 0.024 | < 0.028 | < 0.027 | - |
| Dimethoate | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Diphenylamine | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Diuron | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Fenpropimorph | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Fluazifop-butyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Fluometuron | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Flusilazole | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Fluvalinate | mg/kg dry wt | < 0.014 | < 0.012 | < 0.014 | < 0.014 | - |
| Furalaxyl | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Haloxyfop-methyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Hexaconazole | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Hexazinone | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| IPBC (3-Iodo-2-propynyl-n-butylcarbamate) | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| Iprodione | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Kresoxim-methyl | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Linuron | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Malathion | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |

| Sample Type: Sediment | | | | | | |
|---|---|---|---|---|---|---|
| | Sample Name: | 08/2899 05-May-2008 | 08/2900 05-May-2008 | 08/2901 05-May-2008 | 08/2902 05-May-2008 | |
| | Lab Number: | 641486.1 | 641486.2 | 641486.3 | 641486.4 | |
| **Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS** | | | | | | |
| Metalaxyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Methamidophos | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| Metolachlor | mg/kg dry wt | < 0.0060 | < 0.0060 | < 0.0060 | < 0.0060 | - |
| Metribuzin | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Molinate | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Myclobutanil | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Naled | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| Norflurazon | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Oxadiazon | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Oxyfluorfen | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Paclobutrazol | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Parathion-ethyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Parathion-methyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Pendimethalin | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Permethrin | mg/kg dry wt | < 0.0067 | < 0.0059 | < 0.0070 | < 0.0067 | - |
| Pirimicarb | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Pirimiphos-methyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Prochloraz | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| Procymidone | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Prometryn | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Propachlor | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Propanil | mg/kg dry wt | < 0.030 | < 0.030 | < 0.030 | < 0.030 | - |
| Propazine | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Propiconazole | mg/kg dry wt | < 0.014 | < 0.012 | < 0.014 | < 0.014 | - |
| Pyriproxyfen | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Quizalofop-ethyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Simazine | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Simetryn | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Sulfentrazone | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan] | mg/kg dry wt | < 0.019 | < 0.017 | < 0.020 | < 0.019 | - |
| Tebuconazole | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| Terbacil | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Terbufos | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Terbumeton | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Terbuthylazine | mg/kg dry wt | < 0.0048 | < 0.0042 | < 0.0050 | < 0.0048 | - |
| Terbuthylazine-desethyl | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Terbutryn | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Thiabendazole | mg/kg dry wt | < 0.048 | < 0.042 | < 0.050 | < 0.048 | - |
| Thiobencarb | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Tolylfluanid | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Triazophos | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Trifluralin | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| Vinclozolin | mg/kg dry wt | < 0.0095 | < 0.0083 | < 0.0099 | < 0.0095 | - |
| **Polycyclic Aromatic Hydrocarbons Trace in Soil** | | | | | | |
| Acenaphthene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Acenaphthylene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Anthracene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Benzo[a]anthracene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Benzo[a]pyrene (BAP) | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0028 | 0.0022 | - |
| Benzo[b]fluoranthene + Benzo[j] fluoranthene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Benzo[g,h,i]perylene | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0046 | 0.0022 | - |
| Benzo[k]fluoranthene | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0057 | < 0.0022 | - |
| Chrysene | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0029 | 0.0035 | - |

Lab No: 641486 v 2 Hill Laboratories Page 3 of 4

| Sample Type: Sediment | | | | | | |
|---|---|---|---|---|---|---|
| | Sample Name: | 08/2899 05-May-2008 | 08/2900 05-May-2008 | 08/2901 05-May-2008 | 08/2902 05-May-2008 | |
| | Lab Number: | 641486.1 | 641486.2 | 641486.3 | 641486.4 | |
| Polycyclic Aromatic Hydrocarbons Trace in Soil | | | | | | |
| Dibenzo[a,h]anthracene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Fluoranthene | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0049 | 0.0075 | - |
| Fluorene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Indeno(1,2,3-c,d)pyrene | mg/kg dry wt | < 0.0022 | < 0.0020 | < 0.0023 | < 0.0022 | - |
| Naphthalene | mg/kg dry wt | < 0.011 | < 0.010 | < 0.012 | < 0.011 | - |
| Phenanthrene | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0035 | 0.0057 | - |
| Pyrene | mg/kg dry wt | < 0.0022 | < 0.0020 | 0.0057 | 0.0068 | - |
| Pentachlorophenol Screening in Soil by GC-ECD | | | | | | |
| Pentachlorophenol (PCP) | mg/kg dry wt | < 0.050 | < 0.050 | < 0.050 | < 0.050 | - |
| 2,3,4,6-Tetrachlorophenol | mg/kg dry wt | < 0.050 | < 0.050 | < 0.050 | < 0.050 | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Sediment

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Environmental Solids Sample Preparation* | Air dried at 35°C and sieved, <2mm fraction. | - | 1-4 |
| USEPA Priority Pollutants - Trace Level, 13 metals* | Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level. | - | 1-4 |
| Organochlorine Pesticides Trace in Soil* | Sonication extraction, SPE cleanup, GPC cleanup (if required), dual column GC-ECD analysis | - | 1-4 |
| Organonitro&phosphorus Pesticides Trace in MR Soil by GCMS* | Sonication extraction, GPC cleanup, GC-MS analysis | - | 1-4 |
| Polycyclic Aromatic Hydrocarbons Trace in Soil* | Sonication extraction, SPE cleanup, GC-MS SIM analysis | - | 1-4 |
| Pentachlorophenol Screening in Soil by GC-ECD* | Solvent extraction, acetylation, GC-ECD analysis | - | 1-4 |
| Dry Matter (Org) | Dried at 103°C (removes 3-5% more water than air dry), gravimetry. | 0.10 g/100g as rcvd | 1-4 |
| Total Recoverable digestion | Nitric / hydrochloric acid digestion, US EPA 200.2 | - | 1-4 |
| Total Organic Carbon | Acid pretreatment to remove carbonates if present, Elementar Combustion Analyser. | 0.050 g/100g dry wt | 1-4 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



Peter Robinson

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division