EPA DIVISION

AIR TOXICS MONITORING PROGRAM FOR TASMANIA

ANNUAL REPORT 2008 - 09

Department of Primary Industries, Parks, Water and Environment

Tasmania
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1. EXECUTIVE SUMMARY

The management of air quality in Tasmania is guided by the Tasmanian Air Quality Strategy that was established under the *Environment Protection Policy (Air Quality) 2004.* The Strategy has a strong focus on airborne particles, seen as the primary issue for populated areas of Tasmania, while continuing to address other pollutants of concern, as identified in the National Environment Protection Measures (NEPM) for Ambient Air Quality and Air Toxics.

The Air Toxics NEPM is primarily concerned with the collection of data on ambient (i.e. outdoor) levels of benzene, toluene, xylenes, formaldehyde and benzo[a]pyrene (as a marker for polycyclic aromatic hydrocarbons) at locations where elevated levels are expected to occur and there is a likelihood that significant population exposure could occur.

A detailed Air Toxics Monitoring Program has been planned and is being implemented. The goal of the Program is to implement the Air Toxics NEPM in Tasmania and thereby to improve the information regarding the distribution and concentration of air toxics in residential areas in Tasmania.

Sixteen sites were prioritised for monitoring initially. Monitoring at five of these sites was undertaken in the period 2008 to 2009. Two sites were the existing ambient air quality monitoring stations, New Town in Hobart and Ti Tree Bend in Launceston. Three other sites in Glenorchy, Warrane, and South Launceston were also screened, having been identified as areas with potentially elevated levels of air toxics.

The monitoring undertaken has been for screening purposes and to assess the requirements for the ongoing monitoring program. The preliminary screening monitoring was conducted predominantly using passive samplers. Data collected indicates that NEPM Monitoring Investigation Levels (MIL) would most likely not be exceeded at any of the monitored sites.

In order to make effective use of the relatively limited resources available for Tasmania's ongoing Air Toxics Monitoring Program, more cost effective and less personnel intensive monitoring approaches than those currently specified in the Air Toxics NEPM have been employed. Also, the majority of sampling was conducted in the colder months when the impact of wood smoke is greater, rather than for the complete calendar year.

Results of the toxic pollutants monitored to date indicate that ambient concentrations are seasonal, with higher levels found in winter, coinciding with increased usage of domestic wood heaters. Results indicate that the NEPM Monitoring Investigation Levels are unlikely to be exceeded at the sites monitored to date. The most likely major source of air toxic pollutants at the sites monitored was domestic wood heaters.

When the Air Toxics NEPM was initially being scoped, it was agreed that a phased approach would be adopted to the development of the NEPM, whereby hazardous pollutants not included in the original NEPM could be incorporated at a later date. The outcome was a Tier 2 list of pollutants that are potentially of national concern. Whilst Tier 2 pollutants are not the priority of this program, some data have been collected and presented in this report. For those Tier 2 pollutants measured, concentration levels are below international guideline levels.

A number of recommendations are presented for air toxics monitoring in Tasmania for 2009/10.

2. GLOSSARY AND ACRONYMS

Air Toxic	Means a pollutant selected for assessment in this Measure and listed in Schedule 1 of the Air Toxics NEPM
Ambient Air	Means the external air environment, it does not include the air environment inside buildings or structures
Air NEPM	National Environment Protection (Ambient Air Quality) Measure
Air Shed	Means an area that is defined by natural or topographic features affecting air quality. Once a substance is emitted into an Air Shed, it is contained therein for a reasonable period of time
Air Toxics NEPM	National Environment Protection (Air Toxics) Measure
AQMS	Air Quality Monitoring Station
DRX	Dust Trak optical particulate monitor
EPP	Environment Protection Policy
LVAS	Low Volume Air Sampler. Air NEPM approved methodology for measurement of PM_{10} and $PM_{2.5}$
MIL	Monitoring Investigation Level
Monitoring Investigation Level	Defined in the Air Toxics NEPM as the concentration of an air toxic which if exceeded requires an appropriate form of further investigation and evaluation
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory
OAQC	Ontario Ministry of the Environment Ambient Air Quality Criteria
PAH	Polycyclic aromatic hydrocarbon
PM_{10}	Suspended particulate matter with an equivalent aerodynamic diameter of less than 10µm
$PM_{2.5}$	Suspended particulate matter with an equivalent aerodynamic diameter of less than 2.5µm
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
TCEQ	Texas Commission on Environmental Quality
Tier 2 Air Toxics pollutants	prioritised list of pollutants that are potentially of national concern
µg m^{-3}	Micrograms per cubic meter. The equation for conversion between µg m^{-3} and ppb as presented in Appendix 4.
VOCs	Volatile Organic Compounds, includes benzene, toluene and xylenes
Xylenes	Reported as total of ortho, meta and para isomers

3. INTRODUCTION

The management of air quality in Tasmania is guided by the Tasmanian Air Quality Strategy [1], established under the *Environment Protection Policy (Air Quality) 2004* [2]. The Strategy has a strong focus on airborne particles, seen as the primary issue for populated areas of Tasmania, while continuing to address other pollutants of concern, as identified in the National Environment Protection Measures (NEPM) for Ambient Air Quality [3] and Air Toxics [4].

Tasmania is in the process of implementing a state-wide air quality monitoring program to expand the information base from which to evaluate the state's air quality and to monitor trends. The program includes upgrading the present monitoring system to meet the requirements of both the Ambient Air Quality NEPM and the Air Toxics NEPM. Funding was made available for the implementation of the Air Toxics NEPM in 2008 and the Air Toxics Monitoring Program commenced in July 2008.

Air toxics are pollutants present in the atmosphere in low concentrations that are known or suspected to cause serious health or environmental problems. Information about the sources and health effects of air toxics is available at the National Environment Protection Council (NEPC) web site [4].

The goal of the Air Toxics Monitoring Program is to implement the Air Toxics NEPM in Tasmania and thereby improve the information base regarding the distribution and concentration of Air Toxics in residential areas in Tasmania.

The Air Toxics Monitoring Program focuses on collection of data for the five priority pollutants listed in the Air Toxics NEPM: formaldehyde, toluene, xylenes, benzene and benzo(a)pyrene (as a marker for polycyclic aromatic hydrocarbons, PAH).

The monitoring undertaken has been for screening purposes and to assess the requirements for the ongoing monitoring program. The preliminary screening monitoring was conducted predominantly using passive samplers. Data collected indicates that Air Toxics NEPM Monitoring Investigation Levels would most likely not be exceeded at any of the sites monitored to date.

In order to make effective use of the relatively limited resources available for Tasmania's ongoing Air Toxics Monitoring Program, more cost effective and less personnel intensive monitoring techniques than the Air Toxics NEPM reference methods have been employed. These techniques were validated using Air Toxics NEPM reference methods where possible. The majority of sampling was conducted in the colder months when the impact of wood smoke is greater and the concentration of associated air toxic species is also likely to be greater. Other sources of air toxics, such as vehicle emissions, are not likely to show a seasonal effect.

When the Air Toxics NEPM was initially being scoped, it was agreed that a phased approach would be adopted to develop the NEPM whereby hazardous pollutants not included in the original NEPM could be incorporated at a later date. The outcome was a Tier 2 list of pollutants [5] that are potentially of national concern. Whilst Tier 2 pollutants are not the priority of the program, some data have been collected and presented in this report.

The State of the Environment Report 2009 [6] provides an overview of the recent information on the Ambient Air Quality in Tasmania.

4. AIR TOXICS MONITORING SITES

4.1. Sites

The selection of monitoring sites for the Tasmanian Air Toxics Monitoring Program was guided by the Air Toxics NEPM. It requires that monitoring for air toxics be undertaken at locations where significantly elevated levels are likely to occur and where there is likelihood of significant population exposure. Sources of air toxic pollutants include clusters of industrial sites, heavily trafficked or congested roads and areas affected by wood smoke. Elevated levels are associated with locations that are close to specific sources. Although industrial point sources may contribute to ambient levels in a specific area, the NEPM is not aimed at direct control of industrial emissions.

Fourteen sites were identified in a Desktop Analysis in 2005 that was conducted according to the Air Toxics NEPM Desktop Analysis protocol [7]. These sites are listed in Table 1. The Desktop Analysis used emission information from to the National Pollutant Inventory (NPI) [8] to map the distribution of air toxics over the residential areas of Hobart and Launceston. The Desktop Analysis indicated that formaldehyde and PAH dominate emissions within the Hobart and Launceston air sheds. Higher emissions of all species tend to cluster within central business districts and particular residential suburbs in each air shed.

The occurrence of air toxics (benzene, toluene and xylenes) in Hobart and Launceston has also been confirmed in previous studies (Todd [9], Galbally et al [10]). A study by Jordan et al [11] into air-borne particulate matter in Launceston in winter identified wood smoke as the major contributor to atmospheric carbon pollution.

The locations of the sites monitored during 2008 -2009 are mapped in Appendix 1.

Table 1 Monitoring sites identified in the Desktop Analysis

Suburbs identified in the Desktop Analysis 2005	Sites Monitored 2008/2009	Notes
Greater Hobart area		
Sandy Bay		
South Hobart CBD		
Battery Point		
North Hobart CBD		
Moonah		[4]
Glenorchy, SW Glenorchy	Yes	[3], [4]
New Town	Yes	[1], [4]
Warrane	Yes	[3]
North Hobart		
West Moonah		[4]
Lutana/Moonah/Derwent Park		[4]
Launceston area		
Launceston CBD		[5]
East & South Launceston/Windmill Hill	Yes	[3], [5]
West Launceston		[5]
Other Sites (not identified in the Desktop Analysis)		
Ti Tree Bend AQMS	Yes	[1]
Rowella	Yes	[2]

Notes

[1] Air NEPM air quality monitoring stations (AQMSs). The Air Toxics NEPM notes that significantly elevated levels of the air toxics are unlikely to be detected by the network of Air Quality Monitoring Stations set up under the Ambient Air Quality NEPM, which are used for monitoring general population exposure to the criteria air pollutants.

[2] Independently of the Air Toxics Monitoring Program, the EPA has an air monitoring station in the Tamar Valley at Rowella as part of a major study of baseline air quality associated with the proposed pulp mill at Long Reach. As part of this study high-volume 28-day integrated sampling of polycyclic aromatic hydrocarbons has been undertaken since August 2006.

[3] Identified as possible peak location in Desktop Analysis 2005

[4] Glenorchy site is representative of other indicated sites in the Greater Hobart area *

[5] South Launceston site is representative of other indicated sites in the Launceston area*

* Some of the sites selected could be considered representative of other sites in terms of land use (eg residential), proximity to traffic and geography, and will allow an indicative evaluation of other similar sites. See [3] and [4].

4.2. Sites selected for the 2008/09 Air Toxics Monitoring Program for Tasmania.

Tasmania has adopted a staged approach to the monitoring of air toxics. Preliminary screening monitoring will be undertaken initially. If levels approaching the Air Toxics NEPM Monitoring Investigation Level (MIL) are detected using the screening techniques then additional monitoring using the NEPM reference method will be conducted to confirm the findings. Otherwise the program will progress to other sites that have not yet been monitored.

Monitoring at five of the fourteen sites was undertaken in the period 2008 to 2009. Two of the sites were the existing Ambient Air Quality Monitoring Stations, New Town in Hobart and Ti Tree Bend in Launceston. Sites in Glenorchy, Warrane, and South Launceston were also screened, having been identified as areas with potentially elevated levels of air toxics. PAH monitoring at Rowella, a rural site in the Tamar Valley, was also conducted as a baseline study for another program. Table 2 lists the location, and summarises the site characteristics, the reasons for selecting these sites, pollutants monitored, the monitoring period and the test methodology.

Two types of sites were selected for the 2008/09 preliminary monitoring program:

- Performance monitoring stations as designated under the National Environment Protection (Ambient Air Quality) Measure. Monitoring equipment was sited, as far as practicable, to comply with Australian Standard AS NZS 3580.1.1-2007 Guide to Siting Air Monitoring Equipment, for Performance Monitoring Stations.
- Peak monitoring sites. The monitoring equipment was sited, as far as practicable, to comply with Australian Standard AS NZS 3580.1.1-2007 Guide to Siting Air Monitoring Equipment, for Peak Monitoring Stations.

Table 2 Air Toxics Monitoring Sites for 2008/09 detailed information

Location of Air Toxics Monitoring Sites for 2008/09, site characteristics, reasons for selecting these sites, pollutants monitored, the monitoring period and the test methodology

Site Name	Location		Site description	Reason for Monitoring	Air Toxics Monitored	Period of monitoring	Test Method Name
	MGA Easting (km)	MGA Northing (km)					
Rowella	493,438	5,441,388	Rural	Other program: baseline study	Benzo(a)pyrene	2006 on-going	Based on USEPA TO-13A
Ti Tree Bend	510,440	5,414,887	Light industrial, residential	Air NEPM AQMS Light industrial Residential	Benzene, Toluene, Xylenes, Formaldehyde	22/10/08 - 13/11/09	RAD130, RAD165
New Town	525,762	5,255,281	Urban residential, 1km from major arterial road	Air NEPM AQMS Desktop Analysis: preliminary screening	Benzene, Toluene, Xylenes, Formaldehyde	22/10/08 – 13/11/09	RAD130, RAD145, RAD165, USEPA TO-14A
South Launceston	514,357	5,411,928	Urban residential	Desktop Analysis: preliminary screening; representative of other identified sites	Benzene, Toluene, Xylenes, Formaldehyde	17/06/09 to 04/11/09	RAD130, RAD145, RAD165, USEPA TO-14A
Glenorchy	523,957	5,258,315	Urban residential, 500m from major arterial road	Desktop Analysis: preliminary screening; representative of other identified sites	Benzene, Toluene, Xylenes, Formaldehyde	24/04/09 to 06/11/09	RAD130, RAD165
Warrane	536,784	5,254,216	Urban residential, 200m from major road	Desktop Analysis: preliminary screening	Benzene, Toluene, Xylenes, Formaldehyde	24/04/09 to 06/11/09	RAD130, RAD165

5. METHODOLOGY USED FOR AIR TOXICS MONITORING

5.1. Sampling Techniques

In order to make effective use of the relatively limited resources available for Tasmania's ongoing Air Toxics Monitoring Program, more cost effective and less personnel intensive monitoring approaches than those currently specified in Schedule 3 of the Air Toxics NEPM have been employed.

Table 3 summarises the methods used in the preliminary screening program for 2008/09 and their performance characteristics and the laboratories used for analysis. Where possible an Air Toxics NEPM Schedule 3 reference method was used in conjunction with these alternative techniques for comparison purposes. Figure 1 shows the passive samplers deployed at New Town.

The monitoring technique selected was predominantly passive sampling. Passive sampling refers to the process of allowing air to passively diffuse into the sample collection media without benefit of 'forced air'. This allows for the possibility of longer sampling periods and reduces the concern for overloading the sampling media. As the levels of air toxic pollutants is likely to be low in Tasmania, the extended deployment period associated with passive samplers increases the likelihood of detection of these species. Passive samplers are less resource intensive than Schedule 3 methods and allow a preliminary assessment of air toxic levels, before the implementation of more complex techniques and methodologies listed in Schedule 3.

Passive samplers have been used in other states for similar programs and there is an International Standard [12] associated with their use for sampling volatile organic compounds.

5.2. Benzene, Toluene and Xylenes using RAD130 Passive Samplers

The Radiello sampler RAD130 cartridge is a stainless steel net cylinder, with 100 µm mesh grid opening and 5.8 mm diameter, packed with 530 ± 30 mg of activated charcoal with particle size 35-50 µm mesh. Volatile organic compounds are trapped by adsorption and recovered in the laboratory by carbon disulfide displacement. Analysis is conducted subsequently by gas chromatography - mass spectrometry (GC-MS).

5.3. Benzene, Toluene and Xylenes using RAD145 Passive Samplers

The Radiello sampler RAD145 is used for sampling of benzene, toluene and xylenes. RAD145 is a stainless steel net cylinder, with 3x8 µm mesh grid opening and 4.8 mm diameter, packed with 350 ± 10 mg of graphitised charcoal (Carbograph 4), particle size is 35-50 µm mesh. Volatile organic compounds are trapped by adsorption and recovered in the laboratory by thermal desorption. Analysis is performed by gas chromatography and FID or MS detection. This sampler has lower limits of detection than the RAD130 and was selected as a comparative technique.

5.4. Formaldehyde using RAD165 Passive Samplers

The Radiello sampler RAD165 is a stainless steel net cartridge filled with 2,4-dinitrophenylhydrazine (2,4-DNPH) coated florisil. Aldehydes (and ketones) react with 2,4-DNPH to give the corresponding 2,4-dinitrophenylhydrazones. The 2,4-dinitrophenylhydrazones are then extracted with acetonitrile and analysed in the laboratory by reverse phase HPLC with UV detection.

Figure 1 Radiello passive samplers deployed at New Town

5.5. VOCs by Canister Sampling based on USEPA TO-14A

The canisters used were specifically designed for sampling benzene, toluene and xylenes according to USEPA method TO-14A. This is an Air Toxics NEPM Schedule 3 reference method. These were used in conjunction with RAD130 and RAD145 for method validation.

These treated air sampling canisters regulate the collection and storage of samples. Analysis of the captured sample is performed in the laboratory by gas chromatography – mass spectrometry (GC-MS).

5.6. Polycyclic Aromatic Hydrocarbons Sampling based on USEPA TO-13A using a High Volume PUF/XAD Sampler

The sample pump draws air through the sample media, resulting in a known sample volume of air. The sample media is analysed in a laboratory for PAHs. Benzo(a)pyrene is used as a marker for PAH for the purpose of the Air Toxics NEPM.

For this program samples were collected over a 28 day period, to ensure detectable levels were collected.

Table 3 Details of Methods Used for Preliminary Screening Monitoring

Test Method Name	Source of Method	Samples	Minimum Detection Limit	Measurement Uncertainty	Analyst	NEPM/ non-NEPM methodology	QA/QC
TO-14A	USEPA	24h, 1 day in 6			WA Chem Centre	NEPM	NATA accredited
Benzene			0.2 ppbv	10.0%			
Toluene			0.3 ppbv	10.0%			
Xylene			0.5 ppbv	10.0%			
RAD130		7 day integrated samples			AST, not accredited	non-NEPM	100 %Duplicates, batch blanks
Benzene	Radiello		0.1 µg/m^3	1.8%			
Toluene	Radiello		0.1 µg/m^3	1.5%			
Xylene	Radiello		0.1 µg/m^3	2.5%			
RAD165		7 day integrated samples			AST, not accredited	non-NEPM	100% Duplicates, batch blanks
Formaldehyde	Radiello		0.1 µg/m^3	14.0%			
RAD145		14 day integrated samples			WA Chem Centre,	non-NEPM	NATA accredited 10% Duplicates, batch blanks
Benzene	Radiello		0.05 µg/m^3	7.5%			
Toluene	Radiello		0.01 µg/m^3	8.3%			
Xylene	Radiello		0.01 µg/m^3	11.3%			
TO-13A	USEPA	28 day integrated sample			Asurequality NZ	non-NEPM	Blanks, IANZ accredited
Benzo(a)pyrene			0.24 pg/m^3	21.3%			

Note: Analytical Services Tasmania (AST) is the EPA laboratory. AST has extensive accreditation in many related areas.

6. AIR TOXICS NEPM MONITORING INVESTIGATION LEVELS AND SAMPLING REGIME

6.1. Air Toxics Monitoring Investigation Levels

Monitoring Investigation Levels (MIL) are set in the Air Toxics NEPM. Table 4 lists the averaging periods and MIL for each of the 5 air toxic pollutants. The MIL's are listed in both ppm and µg/m^3 units to enable direct comparison with the graphs in Appendix 2, which are plotted as µg/m^3 versus time.

Table 4 Air Toxics NEPM averaging periods and Monitoring Investigation Levels

Pollutant	Averaging Period	Monitoring Investigation Level
Benzene	Annual average*	0.003 ppm (10 µg/m^3)
Toluene	24 hours	1 ppm (4000 µg/m^3)
	Annual average*	0.1 ppm (400 µg/m^3)
Xylenes	24 hours	0.25 ppm (1200 µg/m^3)
	Annual average*	0.2 ppm (1000 µg/m^3)
Formaldehyde	24 hours	0.04 ppm (50 µg/m^3)
Benzo(a)pyrene	Annual average*	0.3 ng/m^3

* Annual average is the mean of the 24 hour average

6.2. Air Toxics NEPM Sampling Regime

The Air Toxics NEPM prescribes the sampling regime for benzene, toluene, xylenes and PAH as follows:

- One sample every six days over an entire year; or
- 30 samples per season (one day in three is the recommended frequency) for two seasons per year to obtain maximum variability in ambient levels of air toxics as appropriate.

The sampling regime for formaldehyde is as follows:

- One sample every six days over an entire year; or
- 30 samples (one day in three is the recommended frequency) over a sufficient timeframe to include periods when maximum concentrations would be expected (to be conducted within one calendar year).

6.3. Comparison of Air Toxics Monitoring Results with Air Toxics NEPM Monitoring Investigation Levels

The Air Toxics Monitoring Program used more cost effective and less personnel intensive monitoring techniques than those specified in the Air Toxics NEPM. Also, the majority of sampling was conducted in the colder months when the impact of wood smoke is greater, rather than for the complete calendar year. Accordingly the monitoring data collected can only give indicative information about likely exceedence of the Air Toxics NEPM MIL:

- Benzene, toluene and xylenes data was collected using a NEPM reference method (TO-14A, canister sampling), however these were only collected for 6 weeks at each of two sites, whereas the NEPM requires a full year sampling.
- PAH data was collected using a modified NEPM reference method (TO-13A), and these data were collected with a different averaging period (28 days).
- Data for each of the other sampling methods, (results detailed in Table 7) cannot be directly compared to NEPM MIL because of the different averaging periods and different methodologies employed.

7. RESULTS OF PASSIVE SAMPLING MONITORING

7.1. Formaldehyde by RAD165 Passive Sampler

All monitoring for formaldehyde was conducted using the Radiello RAD165 sampler. The formaldehyde data from the five sites is shown in Table 7.

Figure 5, in Appendix 2, shows time series plots of formaldehyde at the five monitoring sites. The NEPM MIL (24 hour average) is included for reference but cannot be used for direct comparison as the averaging times for the RAD165 is seven days.

Formaldehyde levels exhibit seasonal fluctuations at all sites with higher levels detected in winter.

Given the very low levels of formaldehyde reported, it is unlikely that NEPM MIL was exceeded at any of the five sites.

7.2. Benzene, Toluene and Xylenes Sampling

Sampling for benzene, toluene and xylenes was conducted using two types of passive samplers (RAD130 and RAD145) and a NEPM reference method, USEPA TO-14A using canister sampling.

The majority of the data has been collected using RAD130 as the laboratory analysis of the samplers could be conducted at the EPA laboratory.

The RAD145 sampler has the advantage of providing lower detection limits than RAD130 (see Table 3) and can detect an increased range of pollutants, the results of which may be of use in the future. The RAD145 sampler was used to gather sufficient data for comparison with the RAD 130 and USEPA TO-14A. A more limited set of data is available from these samplers as the analysis of the samplers needs to be conducted at an external laboratory.

The USEPA TO-14A canisters were deployed at two sites to enable comparison between the non-NEPM methods and the NEPM reference method. A more limited set of data is available from these samplers as the analysis of the samplers needs to be conducted at an external laboratory.

7.2.1. Benzene, Toluene and Xylenes by RAD130 Passive Samplers

The average weekly benzene, toluene and xylenes concentrations for the full sampling period at each site are presented in Table 7.

Figures 6 to 10 in Appendix 2, show time series plots of benzene, toluene and xylenes weekly average concentrations at the five sites. The NEPM MIL (24 hour average) is included for reference but cannot be used for direct comparison as the averaging times for the RAD130 is seven days.

The benzene, toluene and xylenes levels exhibit seasonal fluctuations at all sites, with higher levels detected in winter.

Given the very low levels of benzene, toluene and xylenes reported, it is unlikely that the NEPM MIL for benzene, toluene and xylenes was exceeded at any of the five sites.

7.2.2. Benzene, Toluene and Xylenes by RAD145 Passive Samplers

The initial screening with RAD130 samplers, conducted from October 08 to February 09, did not detect any benzene, toluene or xylenes. RAD145 samplers were evaluated as an alternative screening method because they have a lower detection limit for these air toxics. They are also capable of detecting some of the Tier 2 air toxic pollutants.

RAD145 sampling and RAD130 sampling was undertaken concurrently at the 5 sites for a limited period between June and October 09. The average results obtained during this time period are tabulated in Table 5. Although the averaging periods are different, there is reasonable agreement between the techniques.

The pollutants measured are at very low concentrations and the measurement uncertainty at such low concentrations can be quite high.

Table 5 Comparison of benzene, toluene and xylenes results from RAD130 and RAD145, June to October 2009

	Average 7-day concentration ppm	Maximum 7 day concentration ppm	Average 14-day concentration ppm	Maximum 14 day concentration ppm
New Town	**RAD 130**	**RAD 130**	**RAD 145**	**RAD 145**
Benzene	0.00020	0.00058	0.00019	0.00026
Toluene	0.00019	0.00060	0.00065	0.00078
Xylenes	0.00007	0.00039	0.00037	0.00055
Ti Tree Bend	**RAD 130**	**RAD 130**	**RAD 145**	**RAD 145**
Benzene	0.00006	0.00030	0.00011	0.00017
Toluene	ND	ND	0.00077	0.0015
Xylenes	ND	ND	0.00040	0.00097
Glenorchy	**RAD 130**	**RAD 130**	**RAD 145**	**RAD 145**
Benzene	0.00006	0.00034	0.00014	0.00020
Toluene	0.0001	0.00039	0.00063	0.00085
Xylenes	0.00003	0.0001	0.00033	0.00047
Warrane	**RAD 130**	**RAD 130**	**RAD 145**	**RAD 145**
Benzene	0.00022	0.00047	0.00030	0.00032
Toluene	0.00039	0.00078	0.00084	0.0011
Xylenes	0.00028	0.00047	0.00051	0.00070
South Launceston	**RAD 130**	**RAD 130**	**RAD 145**	**RAD 145**
Benzene	0.00006	0.00041	0.00016	0.00026
Toluene	0.00004	0.00034	0.00089	0.0015
Xylenes	0.00003	0.00015	0.00046	0.00095

ND: not detected. See Method Detection Limits in Table 3.

7.2.3. Benzene, Toluene and Xylenes based on USEPA Method TO-14A

Air sampling canisters were deployed at New Town and South Launceston over a 24 hour period on a one-in-six day basis for a 7 week period. The methodology used was TO-14A, which is an Air Toxic NEPM Schedule 3 reference method.

The results for New Town, in May to July 09, and South Launceston, in July to August 09, obtained using method TO-14A compared to the results from RAD130 sampling during the same period are summarised in Table 6. Although the averaging periods are different, there is reasonable agreement between the techniques.

These results show that all pollutants were significantly below NEPM MILs.

Table 6 Comparison of benzene, toluene and xylenes results from RAD130 and method TO-14A, May to June 09 for New Town and July to August 09 for South Launceston

	Average 7-day concentration ppm	Maximum 7 day concentration ppm	Average 24 hr concentration ppm	Maximum 24 hr concentration ppm
New Town	**RAD 130**	**RAD 130**	**TO-14A**	**TO-14A**
Benzene	0.00034	0.00052	0.0005	0.00090
Toluene	0.00067	0.00090	0.0010	0.0020
Xylenes	0.00045	0.00072	0.0004	0.0018
South Launceston	**RAD 130**	**RAD 130**	**TO-14A**	**TO-14A**
Benzene	0.00012	0.00041	0.00036	0.00090
Toluene	0.00007	0.00034	0.00088	0.0017
Xylenes	0.00004	0.00015	0.00014	0.00030

Note that the RAD130 sampling and Canister TO-14A sampling comparison presented in Table 6 was undertaken at different date ranges to the RAD130 and RAD145 sampling comparison, presented in Table 5,

Table 7 Summary results of the Air Toxics monitoring program over the period October 2008 to November 2009

	Average concentration ppm	Maximum 7 day concentration ppm	Maximum 24-hour concentration ppm	Maximum 28 day concentration ppm	Monitoring Method	Monitoring dates	Monitoring Period days	No of valid results
New Town								
Benzene	0.00013	0.00067			RAD130	22/10/08 – 13/11/09	7	52
Toluene	0.00020	0.00091			RAD130	22/10/08 - 13/11/09	7	52
Xylenes	0.00011	0.00072			RAD130	22/10/08 - 13/11/09	7	52
Formaldehyde	0.0014	0.0038			RAD165	22/10/08 - 13/11/09	7	52
Benzene	0.00065		0.0009		TO-14A	12/05/09 - 1/07/09	1 in 6	7
Toluene	0.0013		0.002		TO-14A	12/05/09 - 1/07/09	1 in 6	7
Xylene	0.0013		0.0018		TO-14A	12/05/09 - 1/07/09	1 in 6	7
Ti Tree Bend								
Benzene	0.00009	0.00087			RAD130	22/10/08 - 13/11/09	7	52
Toluene	0.00012	0.00076			RAD130	22/10/08 - 13/11/09	7	52
Xylenes	0.00008	0.00059			RAD130	22/10/08 - 13/11/09	7	52
Formaldehyde	0.0013	0.0028			RAD165	22/10/08 - 13/11/09	7	52
Glenorchy								
Benzene	0.00011	0.00031			RAD130	22/10/08 - 13/11/09	7	29
Toluene	0.00028	0.0015			RAD130	22/10/08 - 13/11/09	7	29
Xylenes	0.00014	0.00087			RAD130	22/10/08 - 13/11/09	7	29
Formaldehyde	0.0015	0.0027			RAD165	22/10/08 - 13/11/09	7	29
Warrane								
Benzene	0.00013	0.00062			RAD130	22/10/08 - 13/11/09	7	28
Toluene	0.00016	0.00079			RAD130	22/10/08 - 13/11/09	7	28
Xylenes	0.00011	0.00048			RAD130	22/10/08 - 13/11/09	7	28
Formaldehyde	0.0019	0.0033			RAD165	22/10/08 - 13/11/09	7	28

Table 7 continued. Summary results of the Air Toxics monitoring program over the period October 2008 to November 2009

	Average concentration ppm	Maximum 7 day concentration ppm	Maximum 24-hour concentration ppm	Maximum 28 day concentration	Monitoring Method	Monitoring dates	Monitoring Period days	No of valid results
South Launceston								
Benzene	0.00020	0.00094			RAD130	22/10/08 - 13/11/09	7	22
Toluene	0.00026	0.0018			RAD130	22/10/08 - 13/11/09	7	22
Xylenes	0.00018	0.001			RAD130	22/10/08 - 13/11/09	7	22
Formaldehyde	0.0018	0.0046			RAD165	22/10/08 - 13/11/09	7	22
Benzene	0.00036		0.0009		TO-14A	23/07/09 – 29/08/09	1 in 6	7
Toluene	0.0009		0.0017		TO-14A	23/07/09 – 29/08/09	1 in 6	7
Xylenes	0.00014		0.0003		TO-14A	23/07/09 – 29/08/09	1 in 6	7
Rowella	**ng/m^3**			**ng/m^3**				
Benzo[a]pyrene	0.03			0.1	TO-13A	01/10/08 - 30/09/09	28	13

8. POLYCYCLIC AROMATIC HYDROCARBON MONITORING

Polycyclic aromatic hydrocarbon monitoring has been conducted at Rowella, as part of the proposed pulp mill baseline program, since August 2006. The EPA Division took over the program in November 2007.

The Air Toxics NEPM sets a MIL of 0.3ng/m^3 annual average, for benzo(a)pyrene as a marker for PAH's. The average benzo(a)pyrene level for the year between October 08 and October 09 was 0.03ng/m^3 (see Table 7). Given the very low level of benzo(a)pyrene reported, it is unlikely that the NEPM MIL was exceeded.

Seasonal fluctuations in benzo(a)pyrene are observed with higher levels in the autumn/winter period probably due to planned burns and smoke from domestic wood heaters. There is another peak in summer possibly due to bushfire activity. Figure 11 in Appendix 2 shows the time series plot.

9. SUMMARY OF MONITORING RESULTS FOR TIER 2 POLLUTANTS

When the Air Toxics NEPM was initially being scoped, it was agreed that a phased approach would be adopted to develop the NEPM whereby hazardous pollutants not included in the original NEPM could be incorporated at a later date. The outcome was a Tier 2 list of pollutants that are potentially of national concern.

Whilst the primary focus of the preliminary screening monitoring program is to collect data on the five priority pollutants listed in the Air Toxics NEPM, some of the samplers were capable of detecting some of the Tier 2 pollutants. This data is presented in this section.

There are no Air Toxic NEPM Monitoring Investigation Limits for Tier 2 pollutants, however some guidance is provided by the Ontario Ministry of the Environment Ambient Air Quality Criteria (OAQC) [13] and the Texas Commission on Environmental Quality (TCEQ) [14] screening levels.

9.1. Acetaldehyde and Acetone

The RAD165 passive samplers used to monitor formaldehyde levels was also used to monitor acetaldehyde and acetone. The time series plots of concentrations of acetaldehyde and acetone at the five stations are shown in Figures 12 and 13 of Appendix 2.

Acetaldehyde does not appear to have a winter maximum but exhibits a relatively constant concentration from February to October at both New Town and at Ti Tree Bend where more data has been collected. Acetone concentration does not appear to show seasonal variations.

Table 8 lists the acetaldehyde and acetone results for the five monitoring sites for 2008-09.

The concentrations of acetaldehyde and acetone at all five sites were significantly lower than OAQC criteria and TCEQ screening levels listed in Table 9. Although the averaging times are different, given the very low levels of acetaldehyde and acetone reported, it is unlikely that either the OAQC criteria or the TCEQ screening levels were exceeded at any of the five sites.

Table 8 Acetaldehyde and Acetone Monitoring Results 2008-09

	Average 7 day concentration µg/m^3	Maximum 7 day concentration µg/m^3	Monitoring dates
New Town			
Acetaldehyde	1.3	4.7	22/10/08 – 13/11/09
Acetone	0.6	3.0	22/10/08 - 13/11/09
Ti Tree Bend			
Acetaldehyde	1.2	2.0	22/10/08 - 13/11/09
Acetone	0.43	1.3	22/10/08 - 13/11/09
Glenorchy			
Acetaldehyde	1.1	2.3	22/4/09 - 13/11/09
Acetone	0.64	1.9	22/4/09 - 13/11/09
Warrane			
Acetaldehyde	1.3	2.3	22/4/09 - 13/11/09
Acetone	0.85	1.8	22/4/09 - 13/11/09
South Launceston			
Acetaldehyde	1.37	3.3	17/6/09 - 13/11/09
Acetone	0.8	5.6	17/6/09 - 13/11/09

Table 9 Acetaldehyde and Acetone OAQC criteria and the TCEQ screening levels

	Acetaldehyde µg/m^3	Acetone µg/m^3
OAQC criteria, 24 hr average	500	11880
TCEQ screening level, yearly average	9	590

9.2. Styrene, Tetrachloroethylene, Trichloroethylene and Ethyl Benzene

The RAD145 passive samplers used to monitor benzene, toluene and xylenes, was also used to monitor styrene, tetrachloroethylene, trichloroethylene and ethyl benzene.

TO-14A canister samples also detected ethyl benzene.

There were a limited number of samples collected using these techniques and the results are summarised in Table 10.

The concentrations of styrene, tetrachloroethylene, trichloroethylene and ethyl benzene at all five sites were significantly lower than OAQC criteria and TCEQ screening levels listed in Table 11. Although the averaging times are different, given the very low levels of styrene, tetrachloroethylene, trichloroethylene and ethyl benzene reported, it is unlikely that either the OAQC criteria or the TCEQ screening levels were exceeded at any of the five sites.

Table 10 Monitoring Results for styrene, tetrachloroethylene, trichloroethylene and ethyl benzene

	Average concentration ug/m^3	Maximum concentration ug/m^3	Monitoring method	Monitoring period	No of valid results
New Town					
Styrene	0.2	0.53	RAD145	14 days	6
Tetrachloroethylene	0.06	0.1	RAD145	14 days	6
Trichloroethylene	ND	ND	RAD145	14 days	6
Ethyl Benzene	0.39	0.6	RAD145	14 days	6
Ethyl Benzene	1.82	7.9	TO-14A	24 hours	7
Ti Tree Bend					
Styrene	0.8	2.7	RAD145	14 days	4
Tetrachloroethylene	0.09	0.2	RAD145	14 days	4
Trichloroethylene	0.025	0.03	RAD145	14 days	4
Ethyl Benzene	1.0	2.9	RAD145	14 days	4
Glenorchy					
Styrene	0.5	1.4	RAD145	14 days	5
Tetrachloroethylene	0.15	0.6	RAD145	14 days	5
Trichloroethylene	ND	ND	RAD145	14 days	5
Ethyl Benzene	0.33	0.5	RAD145	14 days	5
Warrane					
Styrene	0.16	0.25	RAD145	14 days	5
Tetrachloroethylene	0.05	0.07	RAD145	14 days	5
Trichloroethylene	ND	ND	RAD145	14 days	5
Ethyl Benzene	0.56	0.77	RAD145	14 days	5
South Launceston					
Styrene	0.62	1.9	RAD145	14 days	5
Tetrachloroethylene	0.11	0.22	RAD145	14 days	5
Trichloroethylene	0.015	0.02	RAD145	14 days	5
Ethyl Benzene	0.87	2.4	RAD145	14 days	5
Ethyl Benzene	0.7	1.4	TO-14A	24 hours	7

ND = Not Detected

Table 11 Styrene, tetrachloroethylene, trichloroethylene and ethyl benzene OAQC criteria and the TCEQ screening levels

	Styrene ug/m^3	Tetrachloroethylene ug/m^3	Trichloroethylene ug/m^3	Ethyl Benzene ug/m^3
OAQC criteria 24 hr average	400	360	12	1000
TCEQ screening level yearly average	140	26	54	200

10. SOURCES OF AIR TOXIC POLLUTANTS

The major sources of the 5 air toxic pollutants listed in the Air Toxics NEPM and also of particulate matter (PM_{10} and $PM_{2.5}$) are motor vehicles and domestic solid fuel burning (largely domestic wood heaters) in the locations monitored.

Studies have been conducted previously in Tasmania confirming a relationship between particulate matter (PM_{10}) from domestic wood heaters and the occurrence of volatile organic compounds (benzene, toluene and xylenes) in Hobart and Launceston [9, 10]. A study by Jordan et al [11] into air-borne particulate matter in Launceston in winter identified wood smoke as the major contributor to atmospheric carbon pollution. This program has identified a seasonal relationship between particulate levels and benzene, toluene and xylenes concentrations but further work is needed to determine the robustness of this relationship.

The contribution of motor vehicles is assumed to be relatively constant throughout the year, whereas the contribution from domestic wood heaters increases during the cooler months of April to October. Winter weather in Tasmania is characterised by cooler, denser air than in summer. Dispersion of pollutants is reduced in these conditions. The combination of the winter weather conditions and increased domestic wood heater usage may be a major factor in the observed seasonal fluctuations of particulate matter and air toxics concentrations. Elevated concentrations observed at other times may be due to fuel reduction, regeneration or agriculture burning or wildfires.

11. CONCLUSIONS

Five of the sixteen prioritised sites have been monitored using screening monitoring techniques. The monitoring dates were between October 2008 and November 2009 for New Town and Ti Tree Bend sites, April 2008 to November 2009 for Glenorchy and Warrane, and from June 2008 to November 2009 for South Launceston. The concentrations of the Air Toxic pollutants determined using the screening techniques described in Table 3 are in the same range as those determined using Air Toxic NEPM reference methods.

The levels of the air toxics measured, whilst not directly comparable to Air Toxic NEPM Monitoring Investigation Levels, due to different averaging periods and methodologies, are very low and are unlikely to exceed the NEPM Monitoring Investigation Levels at any site monitored.

The major sources of air toxics at the locations monitored are motor vehicles and domestic wood heaters. The combination of the winter weather conditions and increased domestic wood heater usage probably results in the observed seasonal fluctuations of air toxics. This trend can be seen in the graphs attached in Appendix 2.

PAH, as benzo(a)pyrene, was monitored at Rowella, a rural location. Benzo(a)pyrene levels tend to exhibit seasonal fluctuations with concentrations tending to be higher in winter. Increased levels at other times may be due to bushfire activity. To date, no PAH monitoring has been conducted in residential locations.

There are no NEPM Monitoring Investigation Levels for Tier 2 pollutants. Given the very low levels of Tier 2 pollutants reported, it is unlikely that either the OAQC criteria or the TCEQ screening levels were exceeded at any of the five sites.

12. RECOMMENDATIONS FOR MONITORING IN 2009/10

As no site monitored in the period October 2008 to November 2009 has been demonstrated to exceed the MILs specified in the Air Toxics NEPM, more intensive monitoring using NEPM Schedule 3 reference methodology is not indicated at these sites.

The recommendations for air toxics monitoring in 2009/10 are:

1. That passive monitoring methodology continues to be used for the preliminary screening monitoring for benzene, toluene, xylenes and formaldehyde.
2. That some repeat screening monitoring be conducted to confirm maximum concentrations occur in winter.
3. That an instrument to continuously measure particulate matter (PM_{10} and $PM_{2.5}$) and meteorological data be installed at one or two additional sites to enable the investigation of a possible correlation between these parameters and air toxic concentrations.
4. That a high volume PUF/XAD sampler be installed at South Launceston and New Town to enable 28-day integrated sampling for polycyclic aromatic hydrocarbons in populated residential areas.
5. That Tier 2 pollutant screening data continue to be collected during winter to confirm low concentrations of pollutants.
6. That New Norfolk and Battery Point be added as two new sites for screening monitoring. New Norfolk because it is likely to be a representative example of a medium sized community that is affected by winter time smoke from domestic wood heaters, and Battery Point because it was identified in the Desktop Analysis.

The proposed 2009/10 Air Toxics Preliminary Screening Program summary is detailed in Table 12.

Table 12 Proposed 2009/10 Air Toxics Monitoring Program summary

Site Name	Proposed Location		Reason for Monitoring	Site description	Proposed Monitoring	Proposed methodology
	MGA Easting (km)	MGA Northing (km)				
Rowella	493,438	5,441,388	Other program	Rural	Benzo(a)pyrene	Based on USEPA TO-13A
New Town	525,762	5,255,281	Air NEPM AQMS Desktop Analysis: preliminary screening	Urban residential, 1km from major arterial road	Benzo(a)pyrene, particulates	Based on USEPA TO-13A LVAS: PM_{10}, $PM_{2.5}$
Ti Tree Bend	510,440	5,414,887	Air NEPM AQMS	Air NEPM AQMS Light industrial Residential	Benzene, toluene, xylenes, formaldehyde, particulates	RAD130, RAD165 LVAS: PM_{10}, $PM_{2.5}$
South Launceston	514,357	5,411,928	Desktop Analysis: Stage 2 site; preliminary screening; representative of other identified sites	Urban residential	Benzene, Toluene, Xylenes, Formaldehyde, Benzo(a)pyrene, Particulates, met data	RAD130, RAD145, RAD165 DRX: PM_{10}, $PM_{2.5}$ Met station Based on USEPA TO-13A
Glenorchy	523,957	5,258,315	Desktop Analysis: Stage 2 site; preliminary screening; representative of other identified sites	Urban residential, 500m from major arterial road	Benzene, toluene, xylenes, formaldehyde	RAD130, RAD145, RAD165
Warrane	536,784	5,254,216	Desktop Analysis: Stage 2 site; preliminary screening;	Urban residential, 200m from major road	Benzene, toluene, xylenes, formaldehyde	RAD130, RAD145, RAD165
New Norfolk	TBD	TBD	Reports of winter smoke entrainment	Urban residential	Benzene, toluene, xylenes, formaldehyde	RAD130, RAD145, RAD165
Battery Point	TBD	TBD	Desktop Analysis: Stage 2 site; preliminary screening;	Urban residential, close proximity to arterial roads	Benzene, toluene, xylenes, formaldehyde, particulates, met data	RAD130, RAD165 DRX: PM_{10}, $PM_{2.5}$ Met station

APPENDIX 1 SITE LOCATIONS

Figure 2 Greater Hobart site locations

Figure 3 Launceston site locations

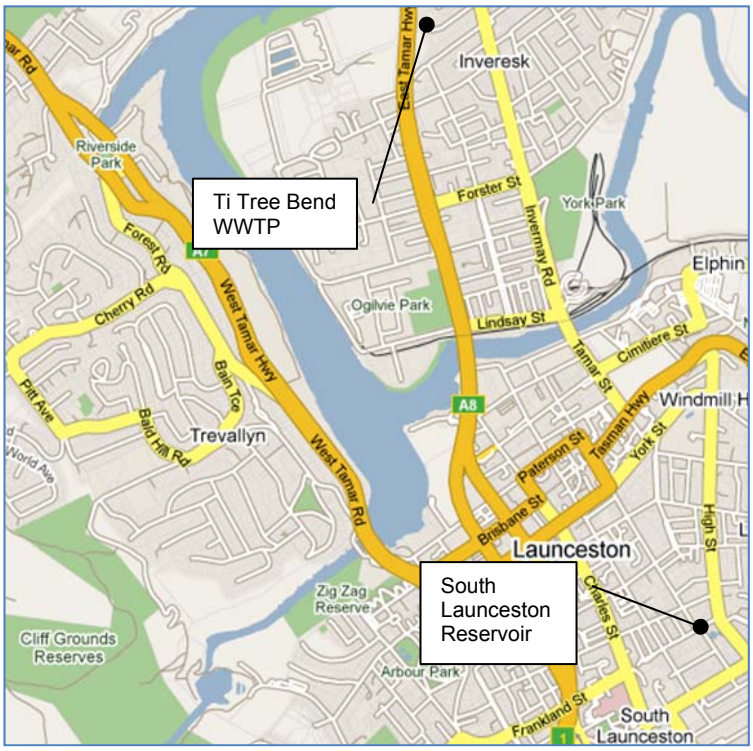
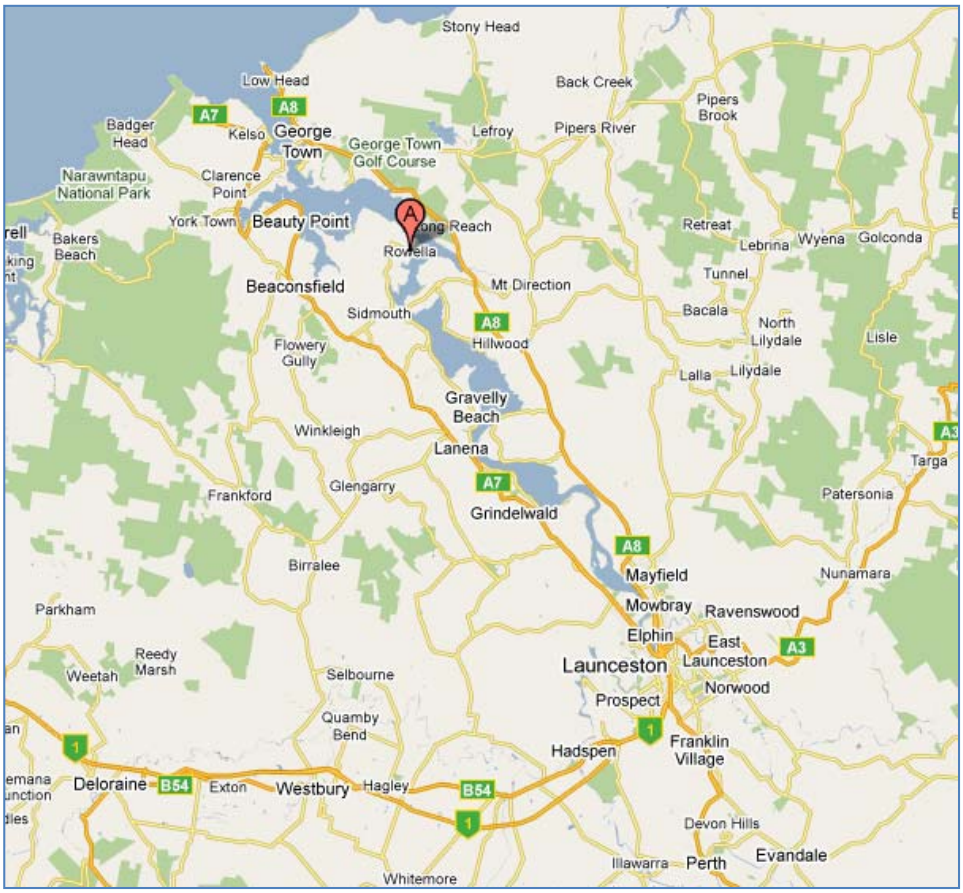
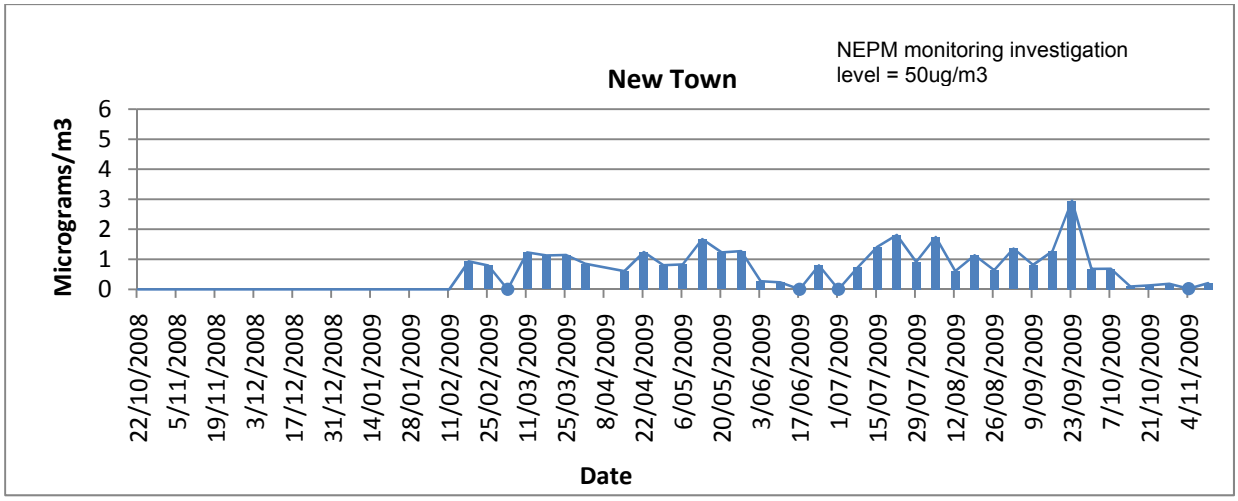


Figure 4 Tamar Valley site location



APPENDIX 2 GRAPHED MONITORING RESULTS

Figure 5 Formaldehyde by RAD165, weekly averages



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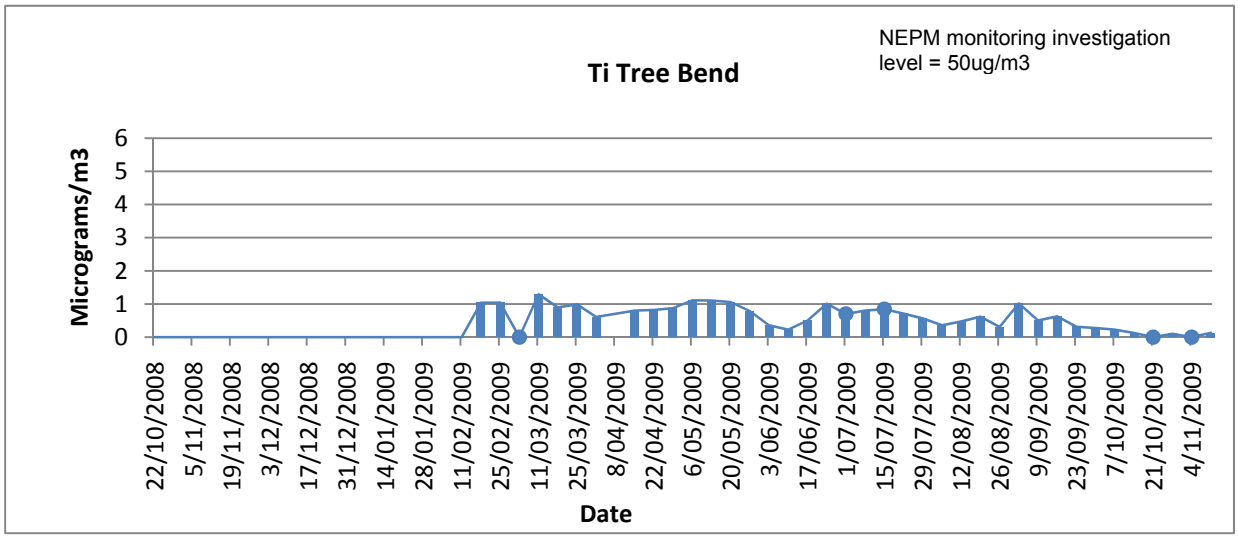
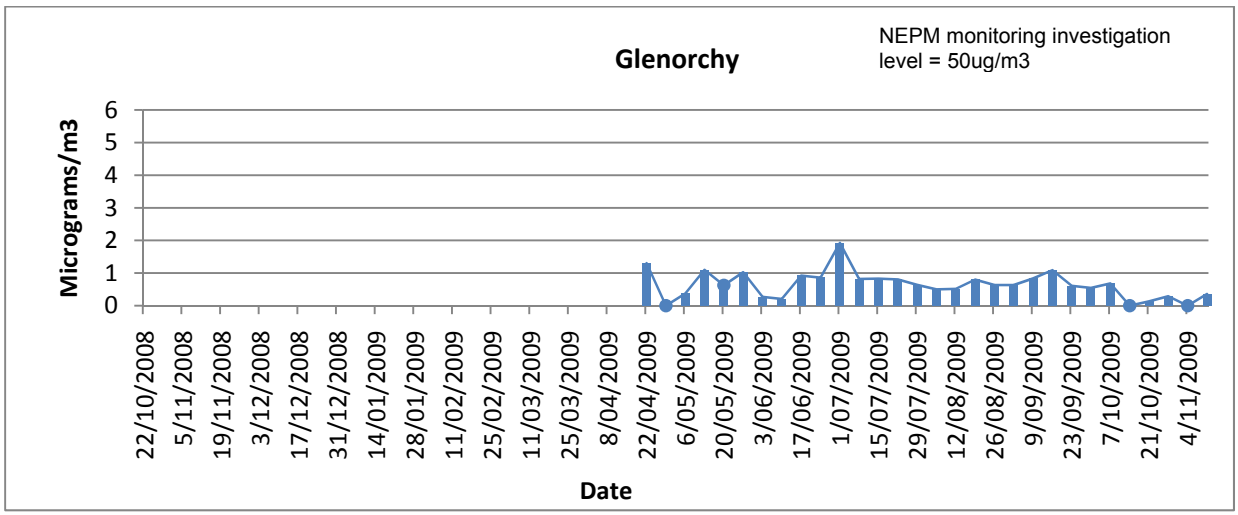
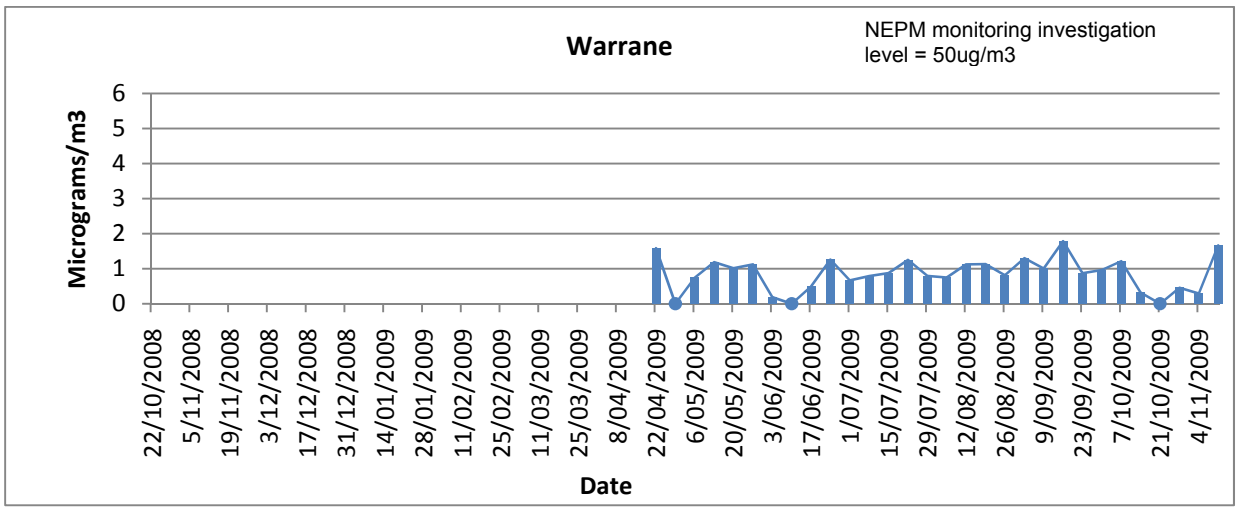


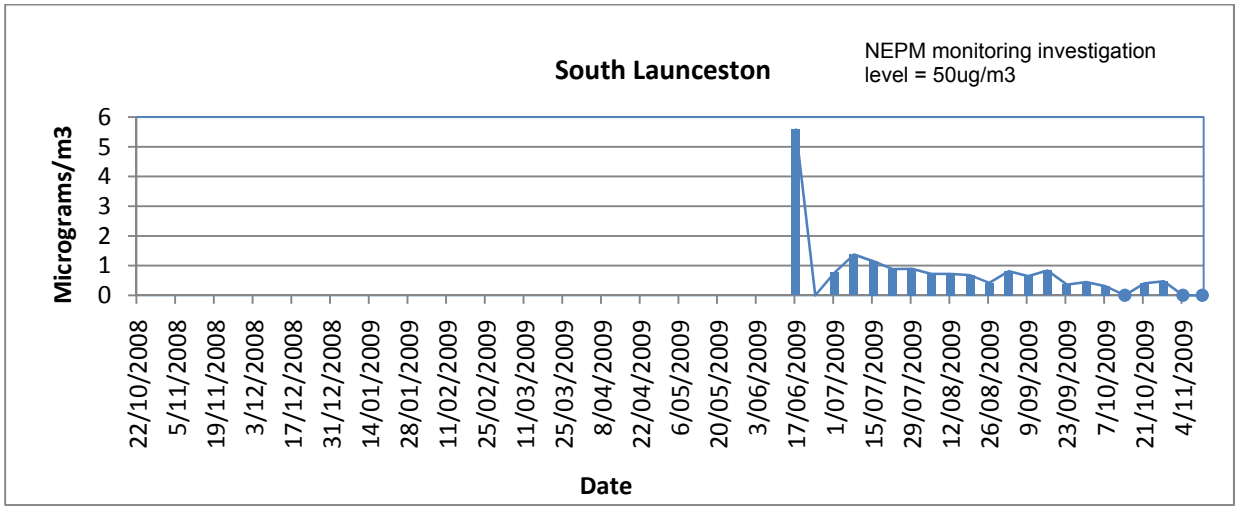
- Not Detected, 31/12/2008 and 8/4/2009 ,missing data points.



- Not Detected, No data collected before 22/4/09

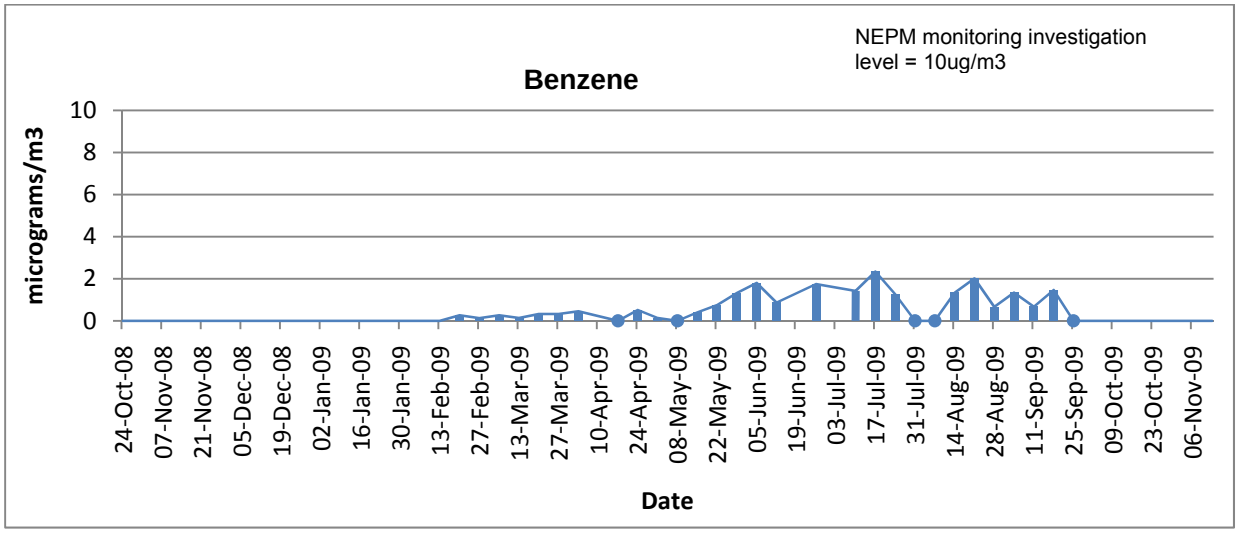


- Not Detected, No data collected before 22/4/09

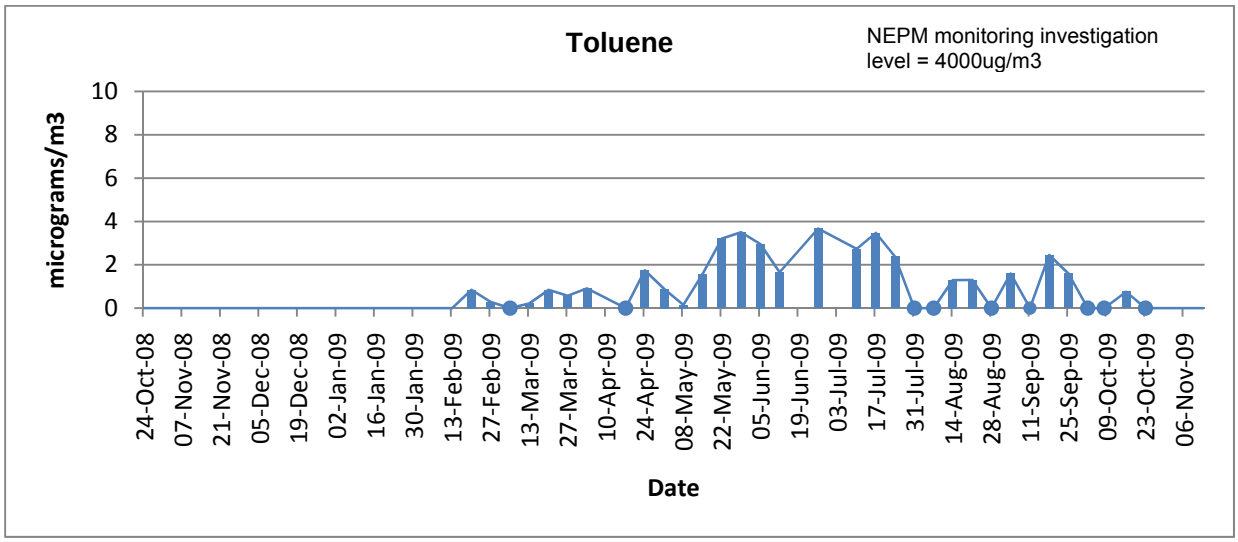


- Not Detected, No data collected before 22/4/09

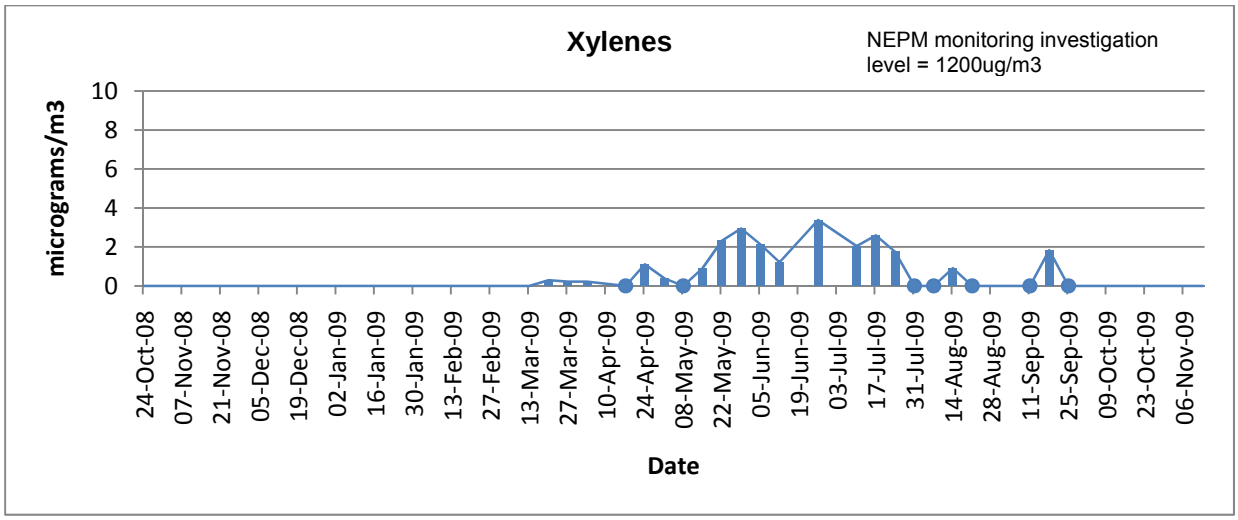
Figure 6 New Town: benzene, toluene and xylenes by RAD130, weekly averages



- Not Detected, not detected before 13/2/09 and after 25/9/09. 10/4/2009, 19/6/09 and 3/7/09 missing data points.

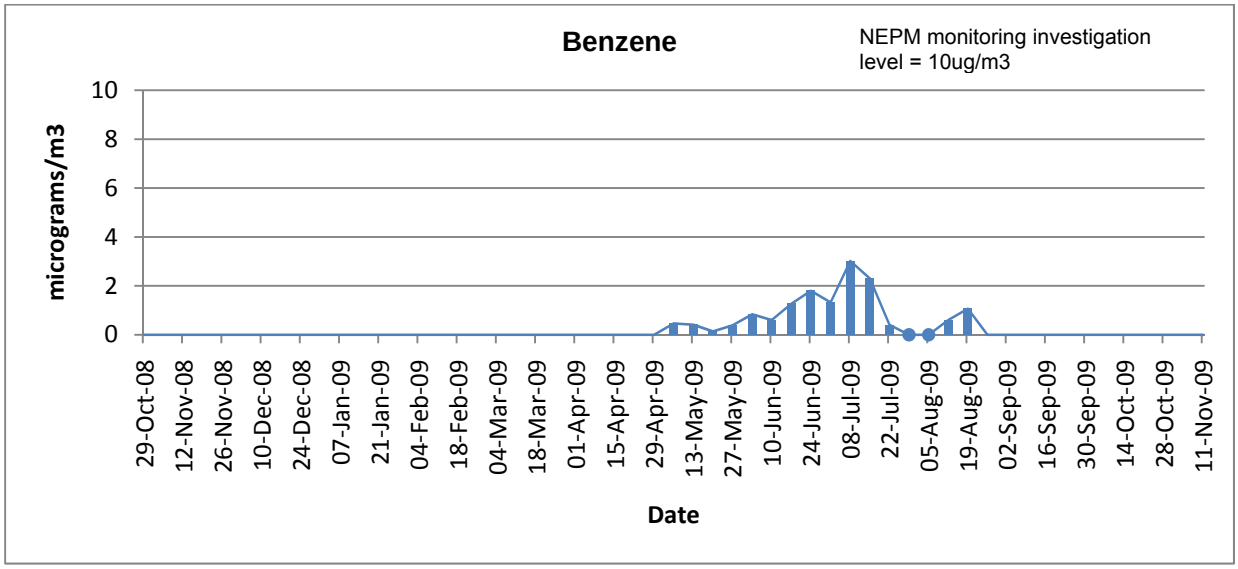


- Not Detected, not detected before 13/2/09 and after 23/10/09. 10/4/2009, 19/6/09 and 3/7/09 missing data points.

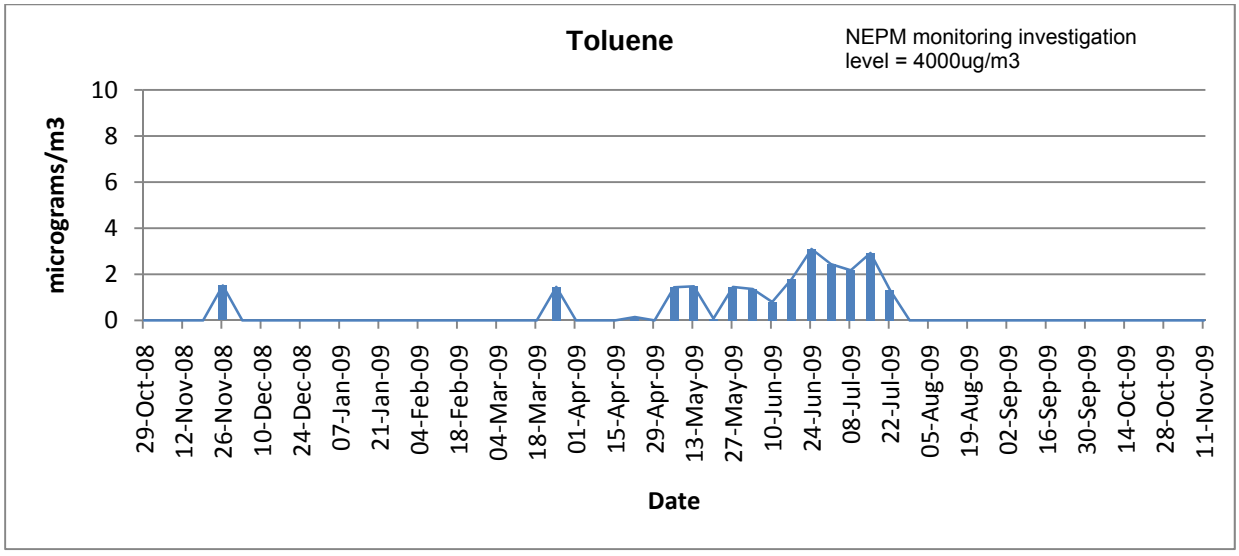


- Not Detected, not detected before 13/3/09 and after 25/9/09. 10/4/2009, 19/6/09 and 3/7/09 missing data points.

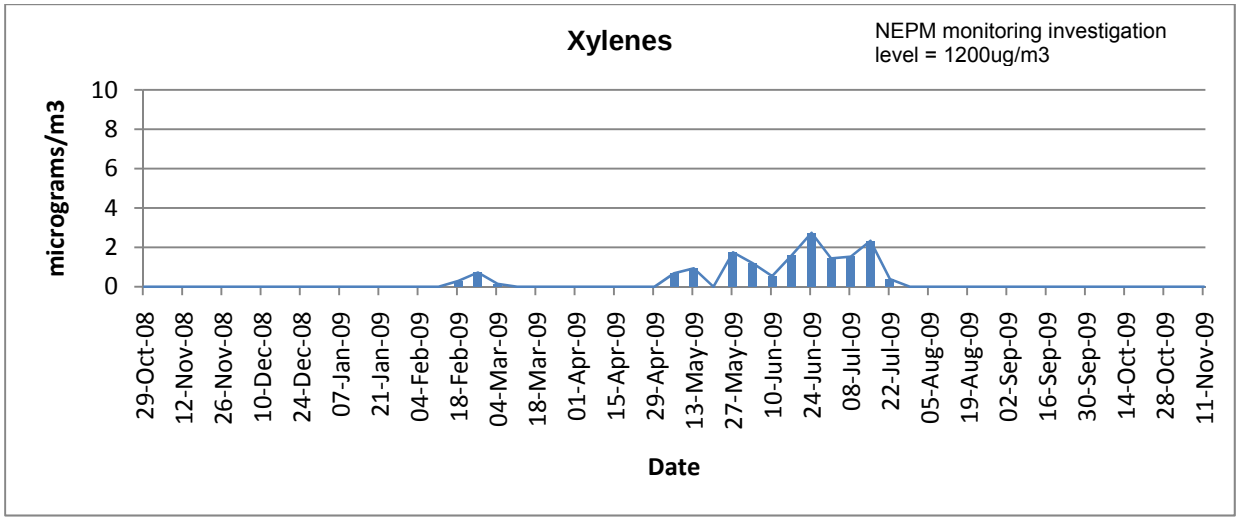
Figure 7 Ti Tree Bend: benzene, toluene and xylenes by RAD130, weekly averages



- Not Detected, not detected before 6/5/09 and after 19/8/09..

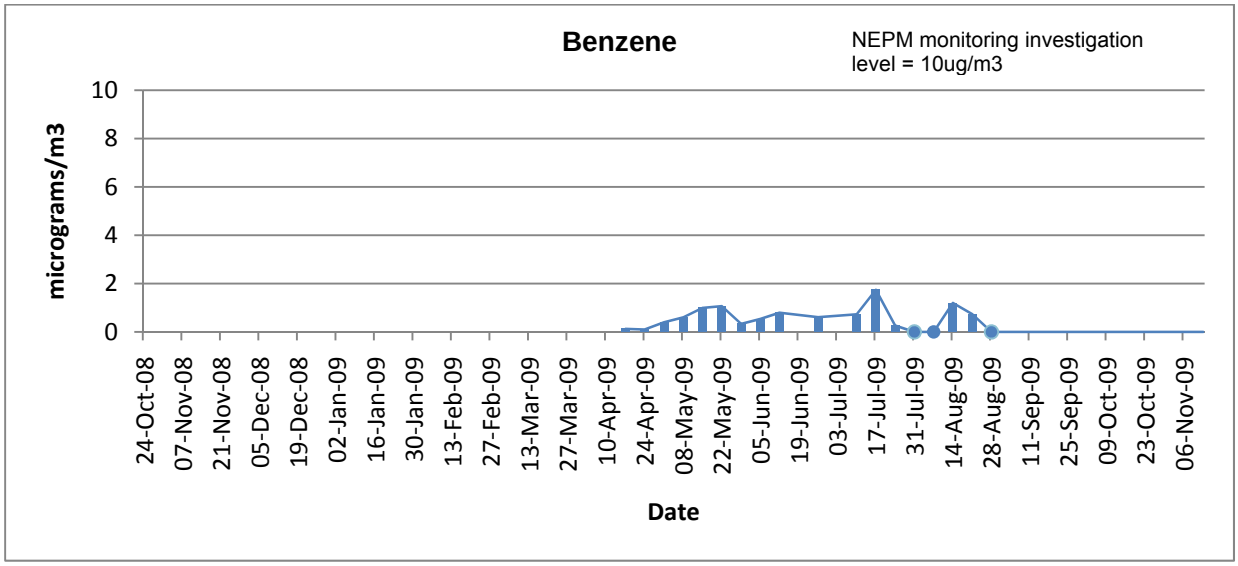


- Not Detected, only one sample detected before 25/3/09. No detection after 22/7/09

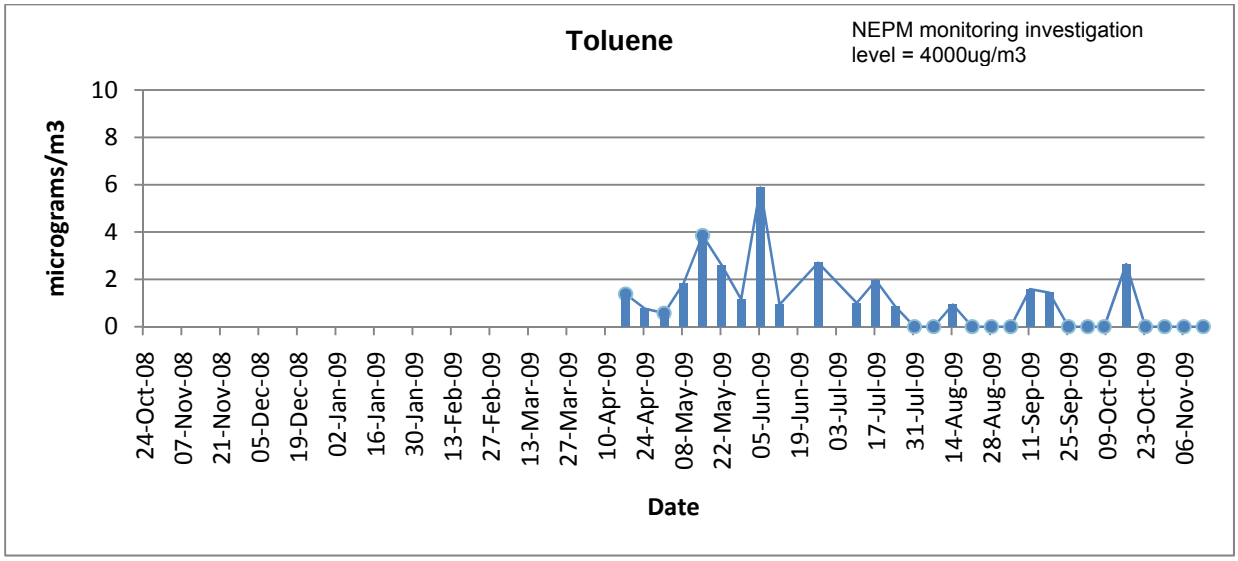


- Not Detected, no detection before 18/2/09 between 4/3/09 and 6/5/08.. No detection after 22/7/09

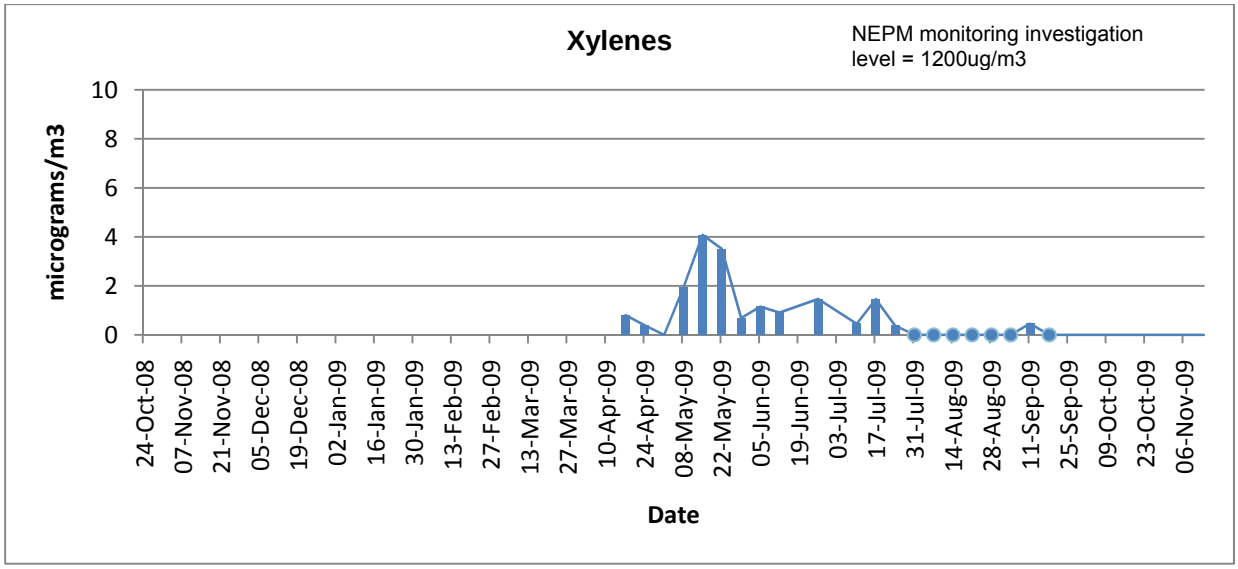
Figure 8 Glenorchy: benzene, toluene and xylenes by RAD130, weekly averages



● Not Detected, no data collected before 17/4/09 Missing data points 19/6/09 and 3/7/09. No detection after 21/8/09

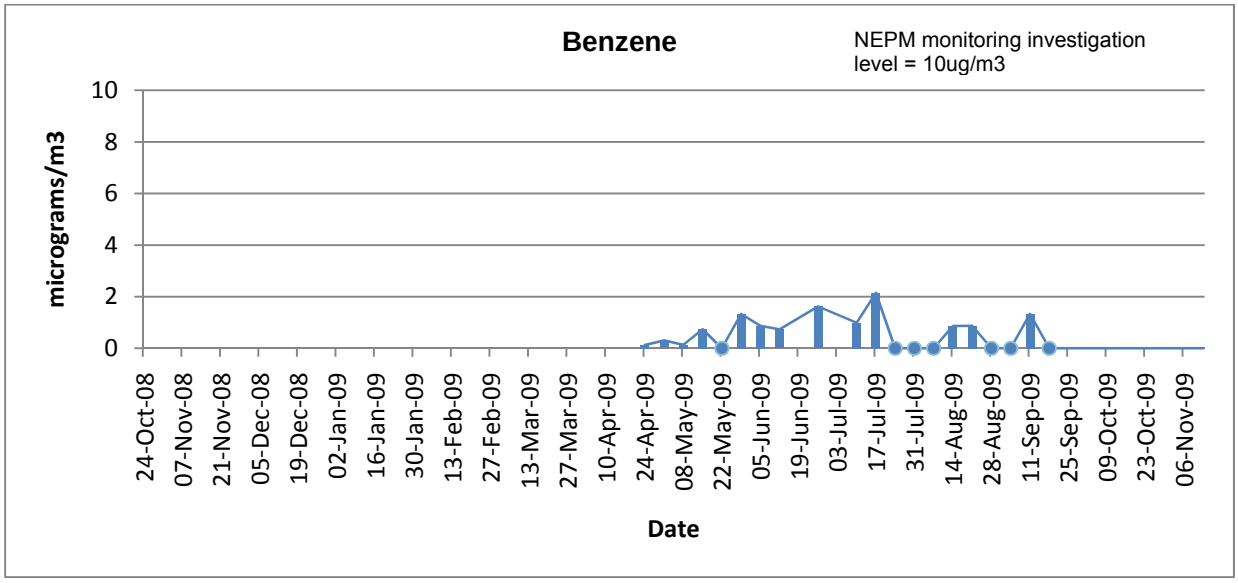


● Not Detected, no data collected before 17/4/09. Missing data points 19/6/09 and 3/7/09.

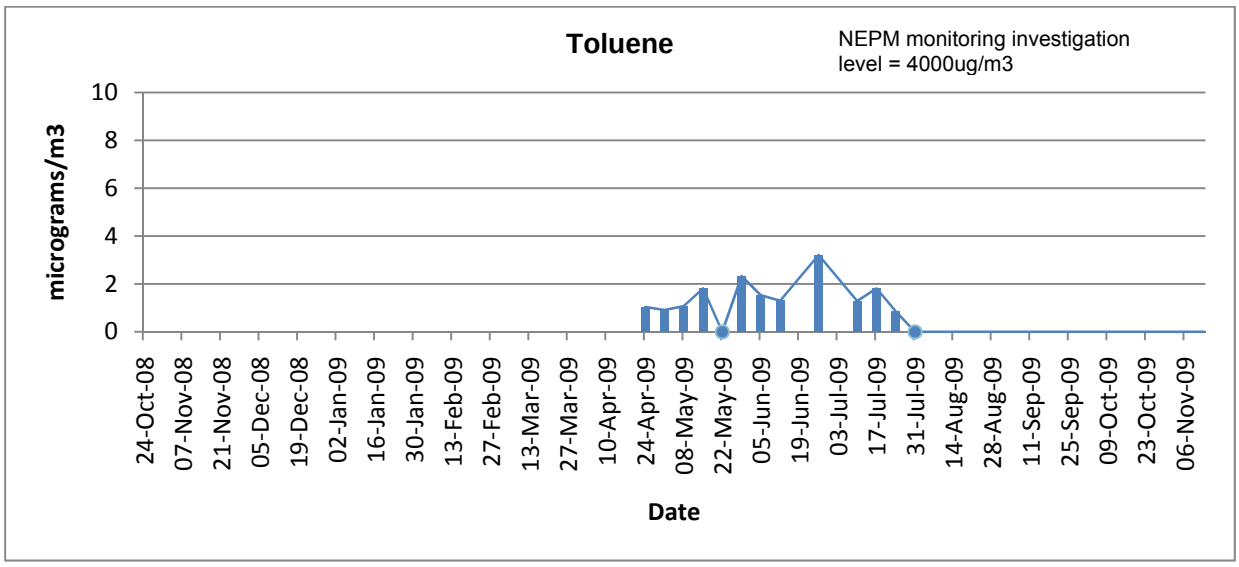


● Not Detected, no data collected before 17/4/09 Missing data points 19/6/09 and 3/7/09. No detection after 11/9/09

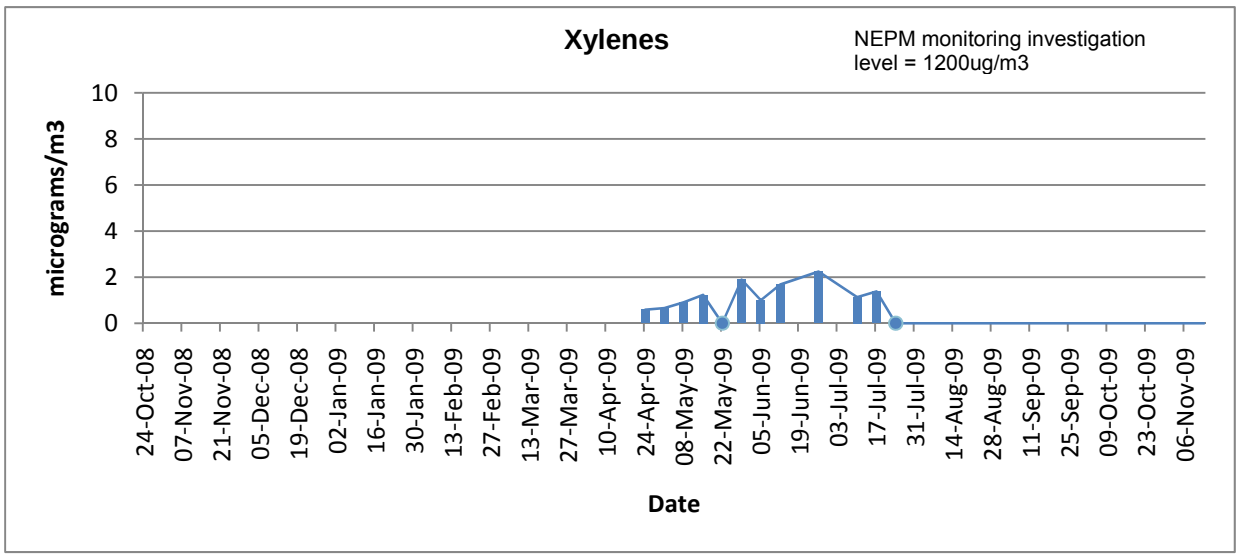
Figure 9 Warrane: benzene, toluene and xylenes by RAD130, weekly averages



● Not Detected, no data collected before 17/4/09 Missing data points 19/6/09 and 3/7/09. No detection after 11/9/09

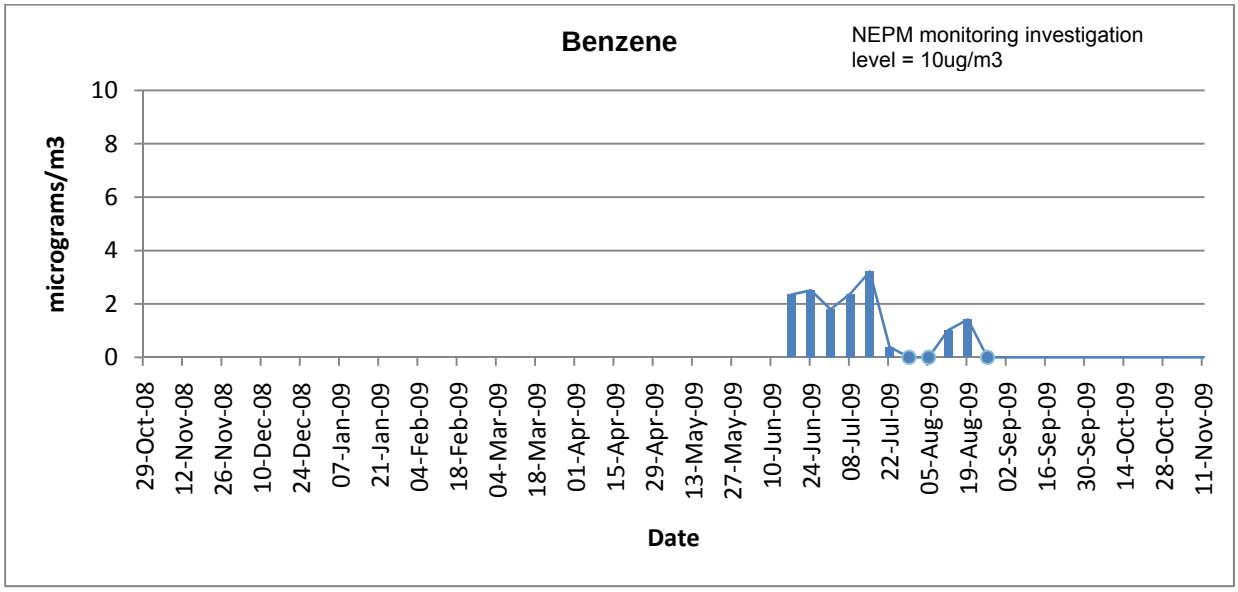


● Not Detected, no data collected before 17/4/09 Missing data points 19/6/09 and 3/7/09. No detection after 24/7/09

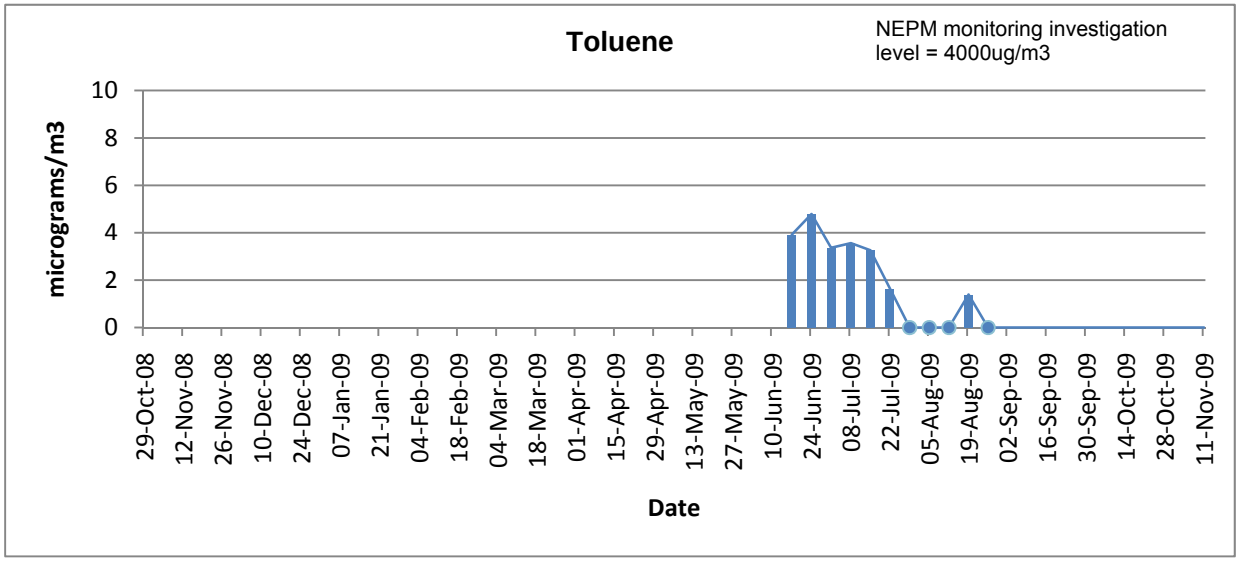


● Not Detected, no data collected before 17/4/09 Missing data points 19/6/09 and 3/7/09. No detection after 17/7/09

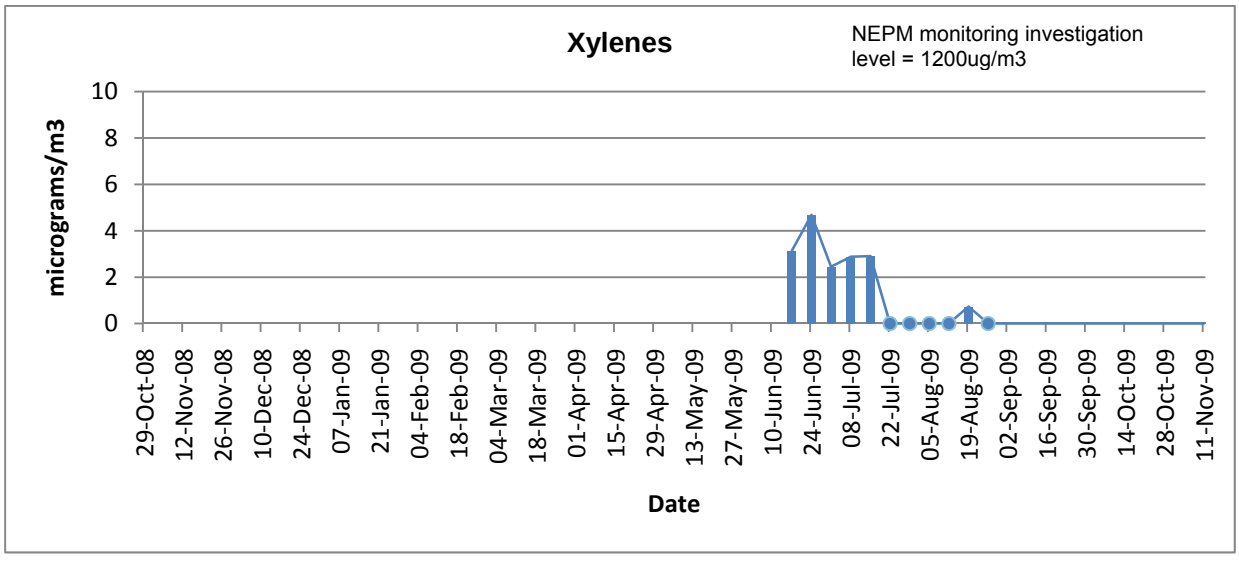
Figure 10 South Launceston: benzene, toluene and xylenes by RAD130, weekly averages



● Not Detected, no data collected before 17/6/09. No detection after 19/8/09



● Not Detected, no data collected before 17/6/09. No detection after 19/8/09



● Not Detected, no data collected before 17/6/09. No detection after 19/8/09

Figure 11 Rowella: benzo(a)pyrene, all data, by USEPA TO-13A, 28 day averages

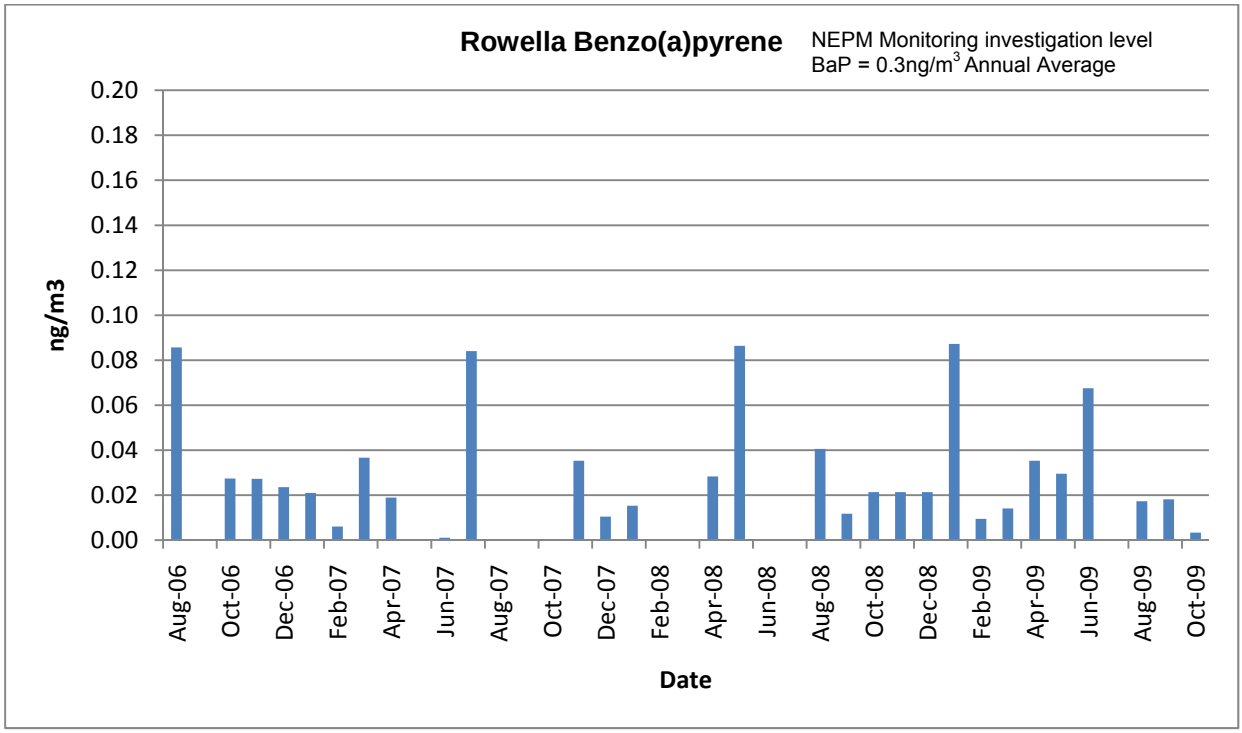
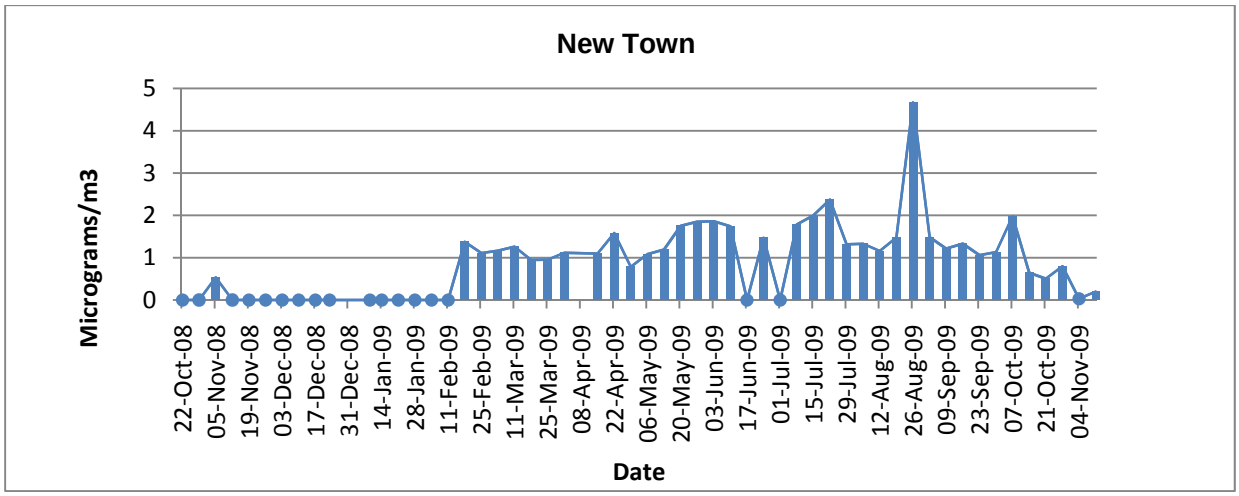
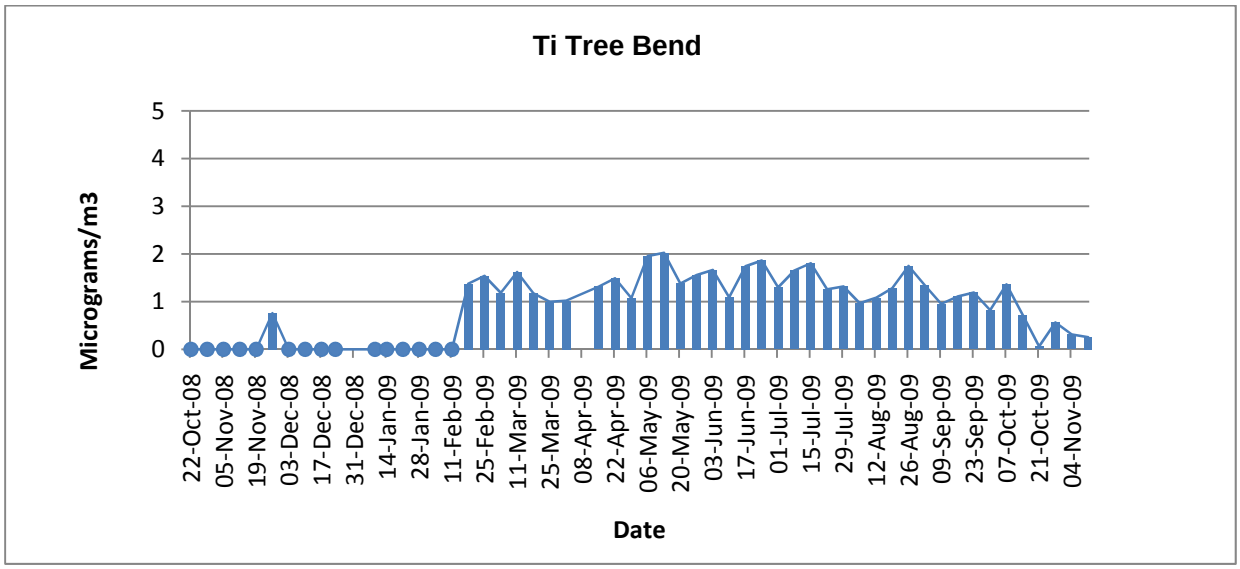


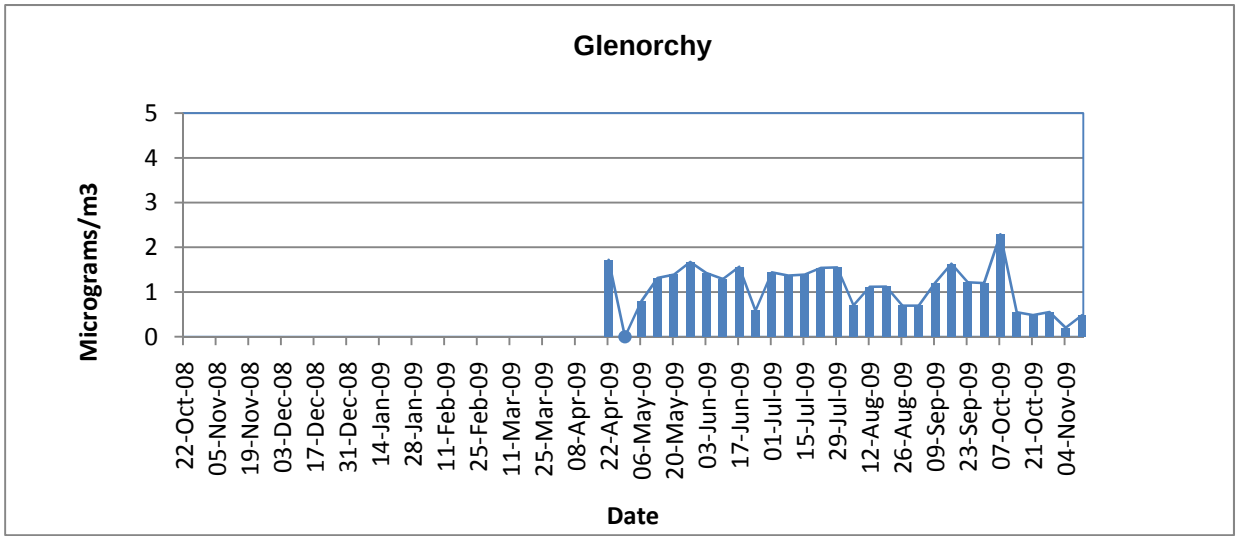
Figure 12 New Town, Ti Tree Bend, Warrane, Glenorchy, South Launceston: acetaldehyde by RAD165, weekly averages



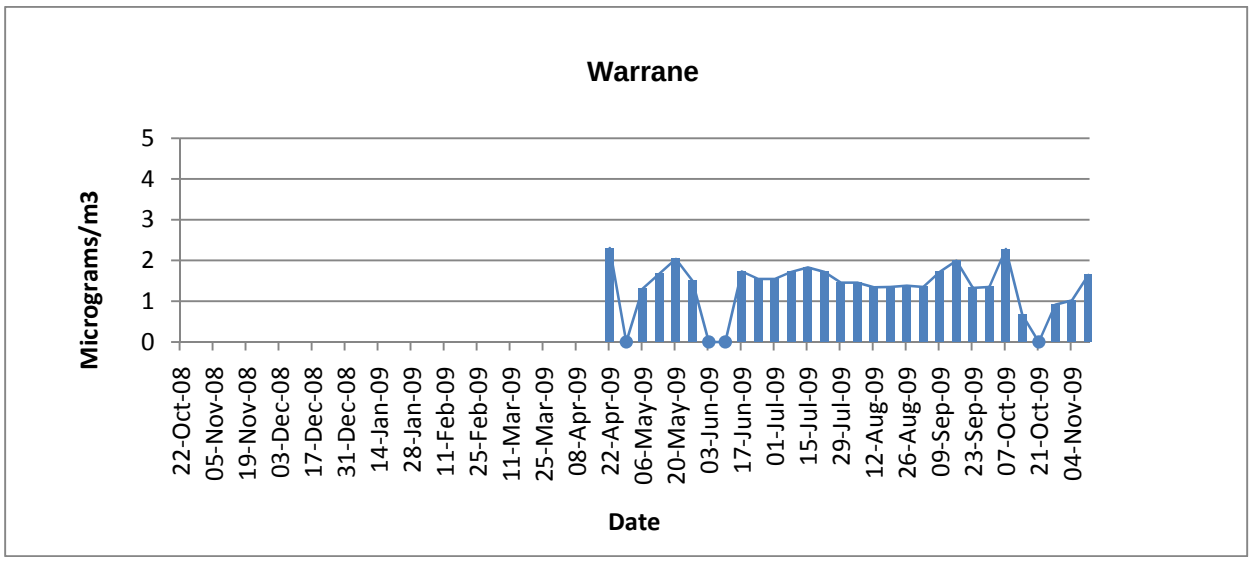
● Not Detected, 31/12/08 and 8/4/09, missing data points



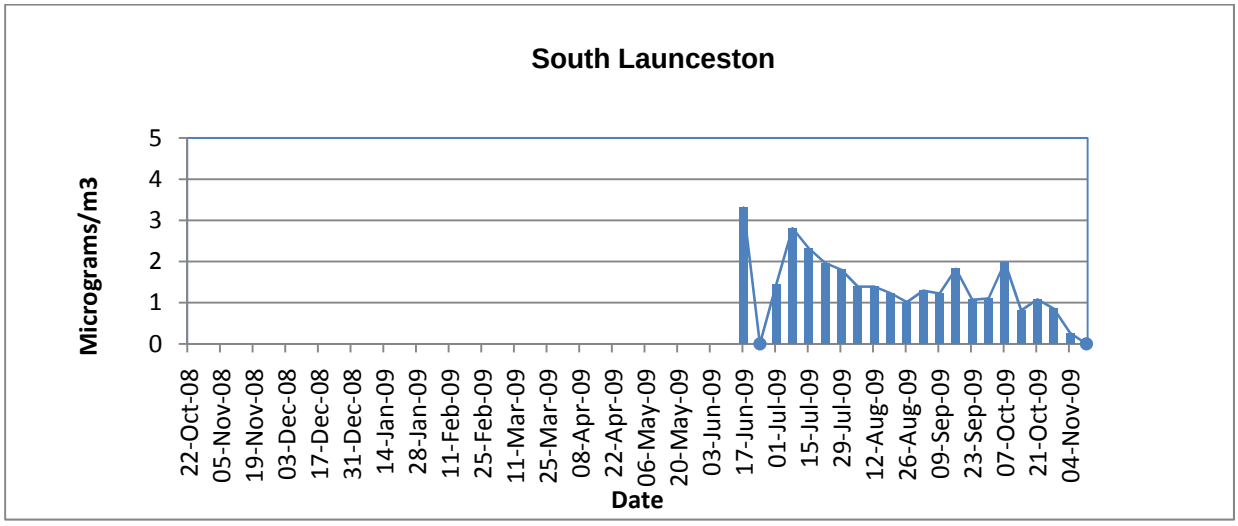
● Not Detected, 31/12/08 and 8/4/09, missing data points



● Not Detected, No data collected before 22/4/09

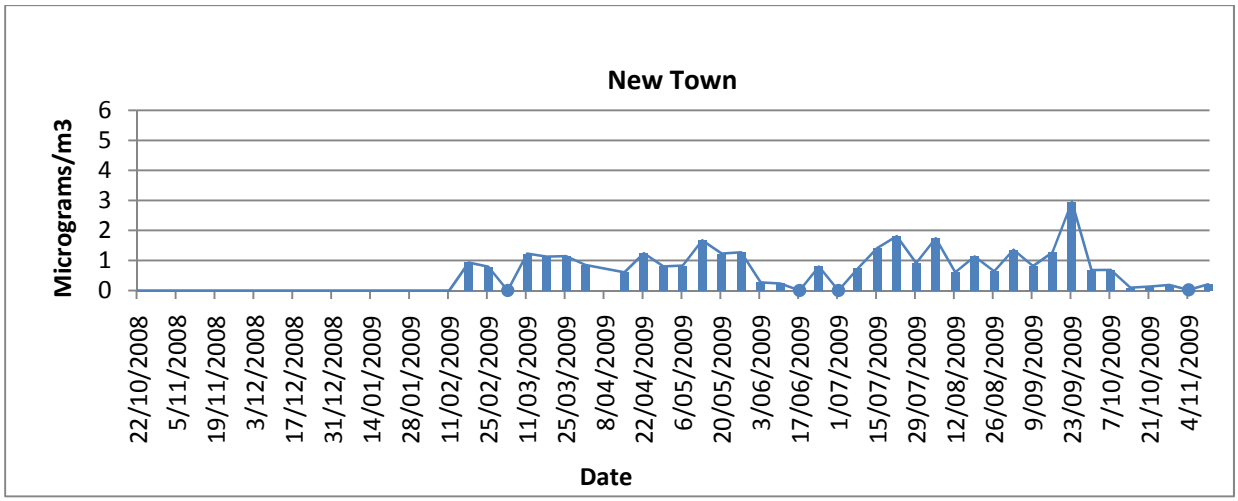


- Not Detected, No data collected before 22/4/09

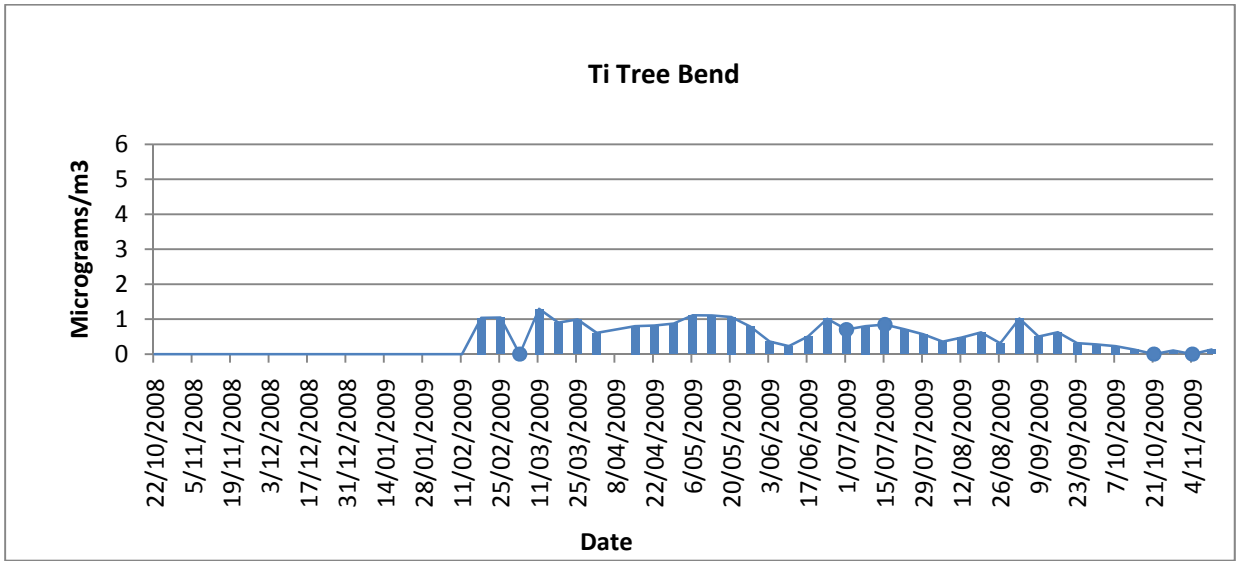


- Not Detected, No data collected before 17/6/09

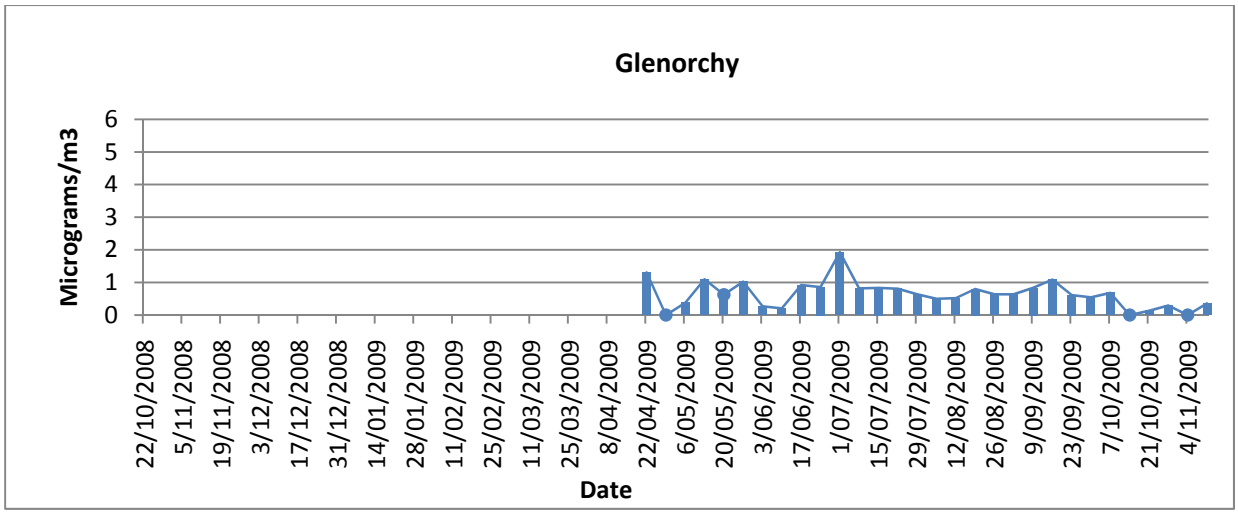
Figure 13 New Town, Ti Tree Bend, Warrane, Glenorchy, South Launceston: acetone by RAD165, weekly averages



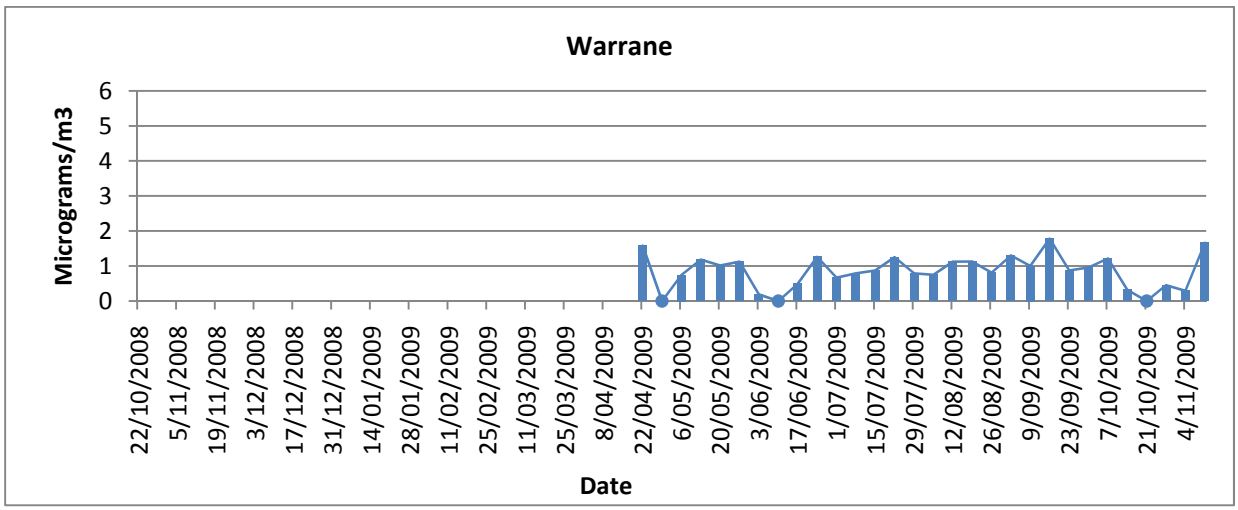
- Not Detected, No sample detected before 11/2/09, 8/4/09 missing data point



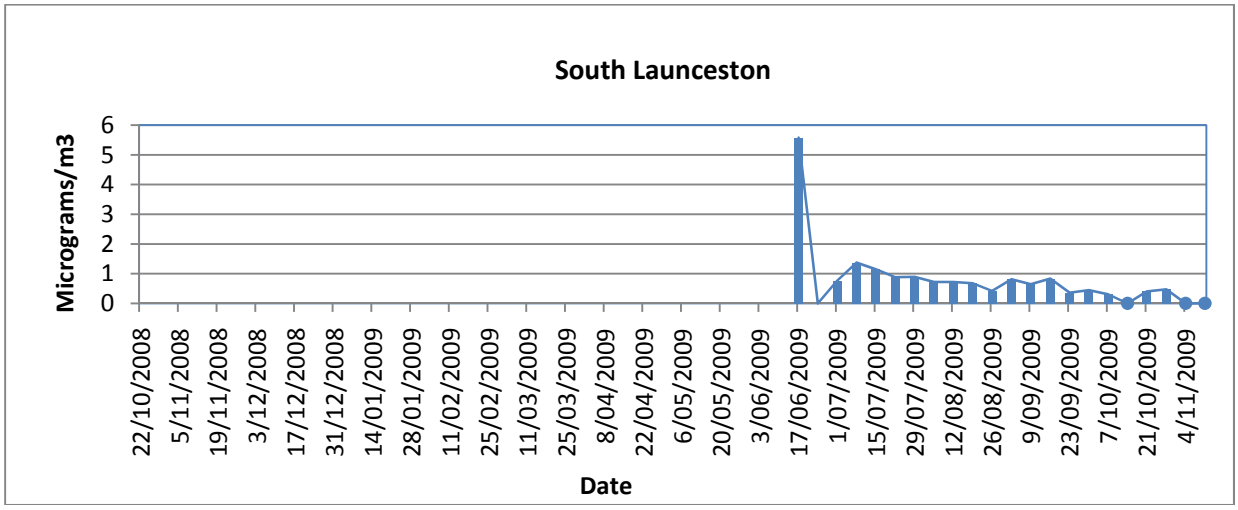
- Not Detected, No sample detected before 11/2/09, 8/4/09 missing data point



- Not Detected, No data collected before 22/4/09



- Not Detected, No data collected before 22/4/09



- Not Detected, No data collected before 17/6/09

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