

# **Bromodichloromethane Levels in Drinking Water 2005 to 2012**

**Phillip Island and Surrounds supplied by  
Westernport Water**



*Bromodichloromethane Hotspots in breach of World Health Organisation Guidelines  
2005-2012 for extended periods of time*

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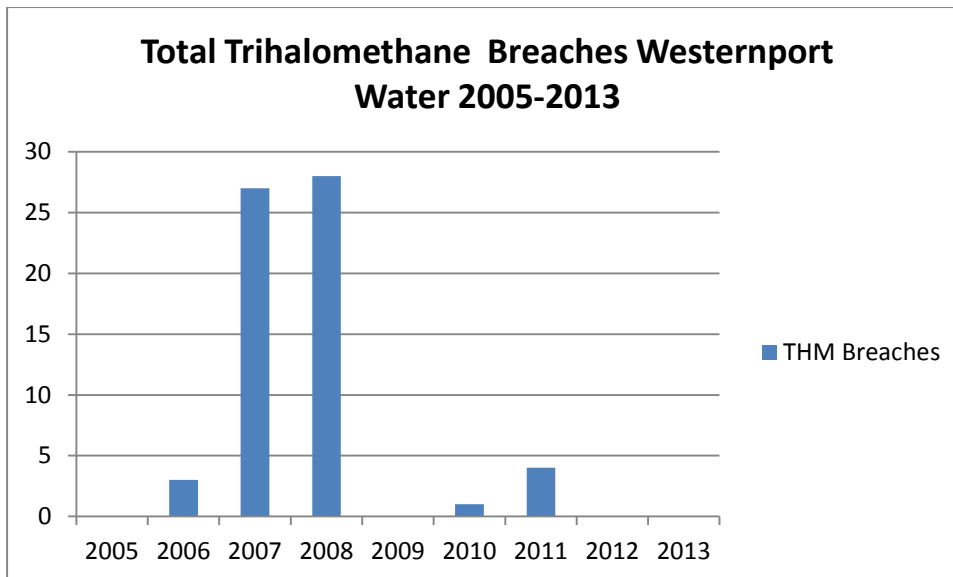
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## Glossary

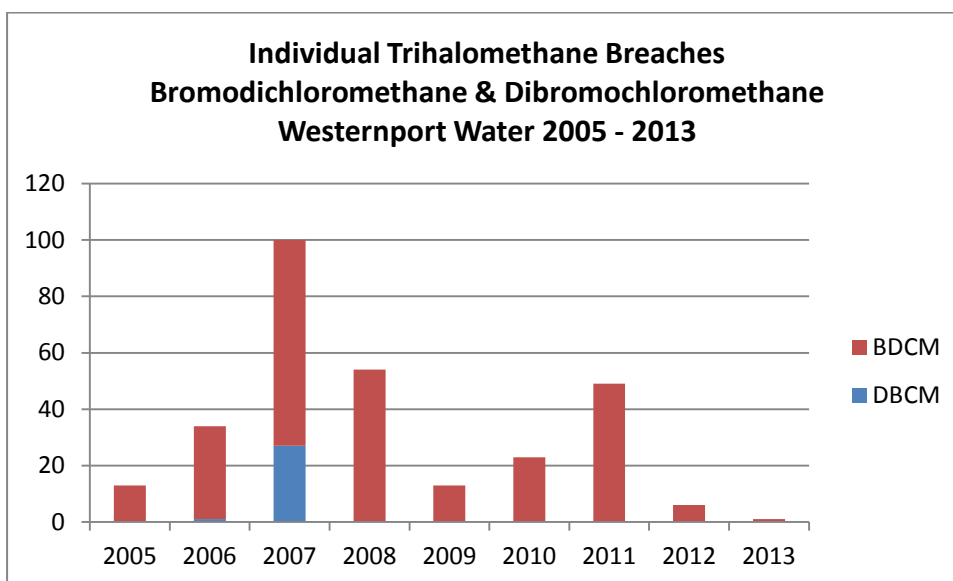
ADWG	Australian Drinking Water Guidelines
BDCM	Bromodichloromethane
DBP	Disinfection Byproduct
IARC	International Agency for Research on Cancer
mg/L	Parts per million (milligrams/litre)
NDMA	N-Nitrosodimethylamine
NHMRC	National Health and Medical Research Centre
NOM	Natural Organic Matter
THM	Trihalomethane
µg/L	Parts per billion (microgram/litre)
WHO	World Health Organisation

# 1. Summary

- In October 2013, Friends of the Earth applied under Freedom of Information legislation for information pertaining to disinfection by-products sampled by Westernport Water between January 2005 and October 2013.
- The information request revealed that the chlorine disinfection byproduct Bromodichloromethane (BDCM), was detected at levels higher than World Health Organisation (WHO) guidelines more than 250 times within the Westernport Water network between the years 2005-12.
- Australian Drinking Water Guideline Breaches also occurred for total trihalomethanes (THM's) and WHO guidelines for Dibromochloromethane at a number of locations up to 2008. Breaches for BDCM continued until 2012.
- The International Agency for Research on Cancer (IARC) has classified BDCM in Group 2B (possibly carcinogenic to humans).
- The BDCM issue appears to have been recently lessened by the use of the chloramination process throughout 99% of the Westernport Water distribution system.
- Several areas of Phillip Island recorded levels of BDCM above WHO guidelines for several years.
- The eight year averages for the following communities were of most concern: Cowes, Ventnor, Sunset Strip and Rhyll.
- The sample locations of most concern, appeared to be – but were not excluded to: Sunset Drive Sunset Strip, School Street Newhaven, Shiloh Ranch Grantville, Harris Road Ventnor, Bella Vista Court Cowes, Marine Parade San Remo, Scenic Drive Cowes, Lock Road Rhyll, Lions Court Cowes, Lantana Road Woolamai Waters, Jansson Road Rhyll, Anderson Street Cowes, Lyall Street Ventnor, Thomson Road Cowes.
- The National Health and Medical Research Council has not reviewed the trihalomethane guideline since 1996 and does not look at individual trihalomethanes, but rather the sum of four trihalomethanes (Chloroform, Bromoform, BDCM and Dibromochloromethane). As such individual trihalomethane levels, such as Bromodichloromethane, are not covered under the Australian Drinking Water Guidelines. Westernport Water were therefore not under any obligation to report the breaches of BDCM to Victorian Health authorities.
- The Australian Drinking Water Guidelines do not take into account exposure to disinfection by-products through the skin or by inhalation. Showering or bathing in water with high levels of disinfection byproducts can be a major source of exposure.
- Australian guidelines for trihalomethanes are set at levels over 3 times higher than equivalent United States guidelines. All areas in the Westernport Water network averaged 8 year THM levels, exceeding similar US guidelines, some by over 2.5 times.



*Breaches of Australian Drinking Water Guidelines for Total Trihalomethanes, occurred 63 times. Under Australian Drinking Water Guidelines (ADWG) therefore, the issue of THM problems was largely resolved by 2008. Victoria's Department of Health would also have been satisfied that these were the only breaches that were required to have been reported.*



**Individual THM breaches to World Health Organisation Guidelines, over the same time period totalled 265 instances and extended well into 2011. None of these breaches are required to be reported. “This was because the current advice in ADWG is that the health significance of THMs only arises when the value of total THMs exceeds 0.25 mg/L. Until the advice in ADWG changes no action is considered necessary where an individual THM exceeds a WHO guideline value.”**

<http://www.westernportwater.com.au/WebFiles/Services/Water%20quality/WPW%20Annual%20Drinking%20Water%20Quality%20Report%202010-11%20Final%20V1.pdf>

## 2. Introduction

For some time Friends of the Earth has been concerned about issues concerning disinfection by-products (DBP's) in drinking water . Since October 2012, Friends of the Earth has produced a number of reports investigating the issue. These reports have included the SA Water, and the Victorian regions of south west victoria, the Grampians Wimmera region and now Westernport Water.

The reports can be found at the following website addresses:

<http://www.foe.org.au/sites/default/files/GWMWaterReportFinal.pdf> (July 2013)

[http://www.foe.org.au/sites/default/files/SWVicWater\\_0.pdf](http://www.foe.org.au/sites/default/files/SWVicWater_0.pdf) (March 2013)

[http://www.foe.org.au/sites/default/files/SAWater2012a\\_0.pdf](http://www.foe.org.au/sites/default/files/SAWater2012a_0.pdf) (October 2012)

It is evident that Westernport Water has been aware about high levels of the Trihalomethane (THM) Bromodichloromethane (BDCM). The issue now appears to be resolved.

Westernport Water has extended the chloramination water treatment process across 99% of its distribution network. Chloramination is a process where ammonia is added to chlorine as a means of keeping the chlorine levels more stable for longer periods of time and also lowering levels of chlorine DBP's. Another range of DBP's can be formed during the chloramination process, most notably monochloramines and NDMA N-Nitrosodimethylamine. Traces of NDMA, a suspected carcinogen have been detected at San Remo. (7 parts per billion in April 2013).

A range of health issues, including respiratory problems have also been reported from Chloramination in the United States. For more information see here:

<http://www.chloramine.org/chloraminefacts.htm>

The current WHO guideline for BDCM is 60 parts per billion. Friends of the Earth is concerned that for extended periods of time, residents mainly living on Phillip Island, have been exposed to levels of BDCM above that which is accepted as being safe by the World Health Organisation (WHO), yet water consumers were not told that these breaches were occurring. How many residents living or visiting Phillip Island were even aware that this problem was occurring? If residents had been informed, they could have taken action to lessen the problem.

Friends of the Earth applied to Westernport Water under the Freedom of Information Act in October 2013, for access to Westernport Water records for levels of DBP's found in the

Westernport Water network since 2005. The information was received in December 2013 and that information has been collated and presented as simply as possible in this report.

Levels of BDCM and other DBP's have guideline levels which are supposedly set with health considerations factored in by the use of "safety margins". The guideline levels are also set so as to take into account a lifetime exposure at the rate specified under the guideline. That is to say that a person drinking water with DBP's at, or above the guideline level may have an increased risk of developing a cancer if those levels are maintained over a lifetime. Because DBP levels rarely are exceeded over a lifetime, health and water authorities remain confident that the risks posed by short term exposure at above guideline levels are negligible.

This scenario may not be as simple as it seems. For example small children may be exposed to high levels for their entire short lives, as several communities on Phillip Island were exposed to high levels for in some cases several years. Exposure of BDCM at high levels for the first five to six years of life may predispose problems for these individuals in later life. Australian guidelines for THM's are set at levels three times higher than those in the United States. Exposure of pregnant women to elevated levels of THM's is also a concern.

*A California study indicates that THMs may be responsible for reproductive problems and miscarriage. The study found a miscarriage rate of 15.7 percent for women who drank five or more glasses of cold water containing more than 0.075 mg/l (75 parts per billion) TTHM, compared to a miscarriage rate of 9.5 percent for women with low TTHM exposure. In addition to these risks, TTHMs are linked to bladder cancer, heart, lungs, kidney, liver, and central nervous system damage."* (<http://water.epa.gov/drink/contaminants/index.cfm>)

The risks may also not take into account problems with compromised immune systems, or people suffering from chemical sensitivity or diseases such as Multiple Chemical Sensitivity. 15,000 rely on drinking water supplied by Westernport Water, how many of these people suffer from chemical sensitivity?

*"Surveys conducted" by the Department of Health in SA in 2002 and 2004 suggest that 0.9 percent of the population may have MCS, while an estimated 16.4 percent may experience some chemical sensitivity. Interstate and overseas research has shown that up to 6 percent of the population may have MCS, with between 10-25 percent experiencing sensitivity to chemicals."*

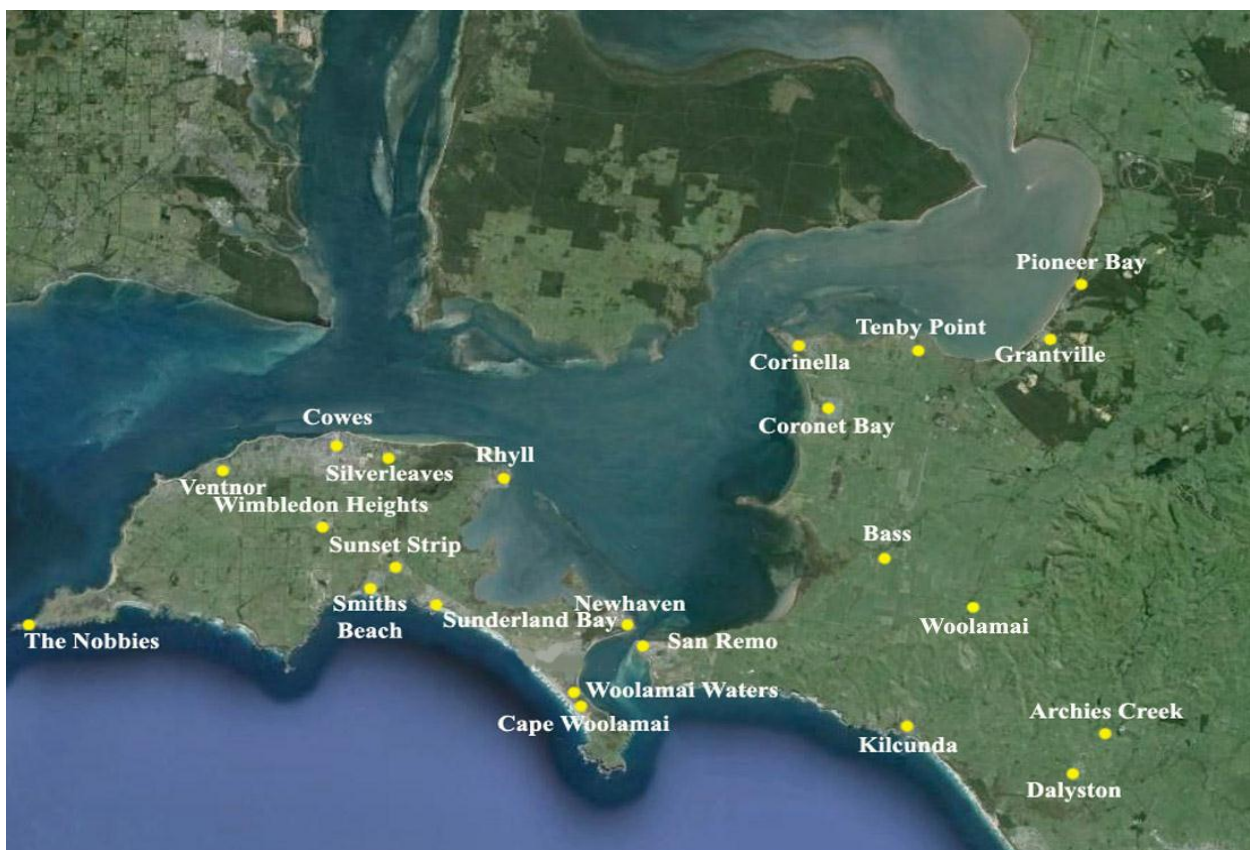
<http://sacfs.asn.au/download/Inquiry%20into%20Multiple%20Chemical%20Sensitivity%20%2822nd%20Report%20of%20the%20Social%20Development%20Committee%29.pdf>

The other concern is that current Australian guidelines do not take into account exposure of DBP's via dermal and inhalation. They only take into account drinking water. Exposure levels from showering, breathing or swimming in water containing high levels of DBP's are simply not factored into Australian guidelines and this has been the case since 1996.

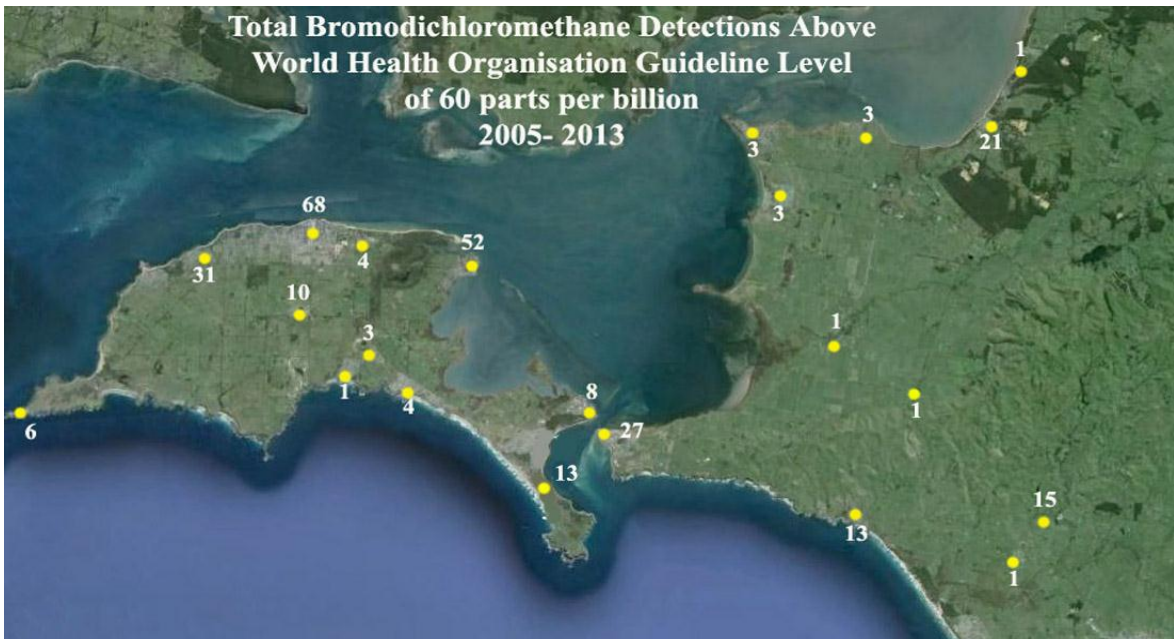
*"Although drinking water studies in laboratory animals might reflect human risks associated with oral exposure, they may not adequately represent risks from dermal or inhalation*



*exposures. The latter exposures lack first-pass liver metabolism and may result in a relatively greater extrahepatic distribution of bromodichloromethane than from oral exposure alone. Indeed, blood levels of trihalomethanes including bromodichloromethane were four to five times higher in people who took 10-minute showers or bathed for 10 minutes than in people who drank one litre from the same tap water source in 10 minutes (Backer et al., 2000). Thus, evaluations of human risk to bromodichloromethane in tap water need to account for all potential routes of exposure, not just oral".* (NTP TECHNICAL REPORT ON THE TOXICOLOGY AND CARCINOGENESIS STUDIES OF BROMODICHLOROMETHANE (CAS NO. 75-27-4) IN MALE F344/N RATS AND FEMALE B6C3F1 MICE (DRINKING WATER STUDIES) NATIONAL TOXICOLOGY PROGRAM P.O. Box 12233 Research Triangle Park, NC 27709 February 2006. NTP TR 532 NIH Publication No. 06-4468. National Institutes of Health Public Health Service. U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES).



***Location map highlighting most communities supplied with drinking water by Westernport Water.***



*Image showing how many times World Health Organisation BMCD levels were surpassed over an eight year period in different locations in the Westernport Water network. Note the predominance of breaches in northern section of Phillip Island – at the “end of the pipe so to speak”.*



### 3. What are Disinfection By-Products?

Chlorine was initially added to drinking water as a means of killing disease causing bacteria including cholera, typhoid, dysentery etc which were responsible for the deaths of millions of people. Its use as a water disinfectant was 'perfected' in the United States in the 1930's. Chlorine however does have its own 'problems', such as those related to Disinfection By-Products (DBP's).

DBP's were first discovered in 1974 when Dutch Scientist, Johannes Rook, found that chloroform was formed when chlorine reacted with organic molecules in drinking water. Chlorine also reacts with fulvic, humic and amino acids in water as well as bromide and iodide ions. Saline water has the potential to produce of high levels brominated DBP's because of levels of bromide usually in salty water which when chlorinated will produce [cause] a variety of Brominated Disinfection Byproducts to be formed in drinking water. Salts in water can increase in extended periods of low rainfall.

Since 1974 over 600 DBP's identified and some have been linked with cancers, adverse birth outcomes and birth defects. If detected, water authorities need to conduct regular air scouring, flushing of the reticulation system and powder activated carbon dosing.

The most commonly detected DBP's are Trihalomethanes (THM's) and Haloacetic Acids. THM's can be present in water as a result of chlorination and to a lesser extent chloramination. Regulated THM's include chloroform, bromodichloromethane, dibromochloromethane and bromoform.

In the United States, the EPA limits the total concentration of the four chief constituents (chloroform, bromoform, bromodichloromethane, and dibromodichloromethane), referred to as total trihalomethanes (TTHM), to 80 parts per million in treated water. In Australian the limit is 250 parts per billion.

The Australian limits have not been revisited by the National Health and Medical Research Council since 1996. No explanation is given to why Australian Guideline levels are three times higher than those in the United States.

*“The Australian trihalomethanes (THM) guideline was developed in 1996 and has not been subject to review since that time. However, in recent years there has been conjecture about the use and significance of trihalomethanes (THM) as indicators for disinfection by-products and associated health implications. This has included debate about the nature of potential health risks and the appropriate guideline value.*

*The National Health and Medical Research Council's Water Quality Advisory Committee is currently considering their work program to 2015 and has identified disinfection-by products as an area for revision as part of this work”* NHMRC Letter to Friends of the Earth 14 January 2013

It would appear that apart from elevated levels of THM/Dibromochloromethane, particularly between 2006-8, the main concern for Westernport Water has been with Bromodichloromethane. The THM issue was tackled in the following manner:

*“The number of THM non-compliances has been an on-going issue over the past few years. With the recent upgrade of the IBWPP, as discussed in section 2.1.1, it is expected that the THM non-compliances will decrease in the future as plant operators are able to control the chlorine dosing more efficiently. A THM reduction strategy was developed to address the elevated THM levels detected at several sites particularly over the summer period. Trials were undertaken to reduce the natural organic matter levels in the treated water. It was found that the combination of regular air scouring, powder activated carbon dosing at the IBWPP and relocation of secondary disinfection sites would deliver improved performance of the system and reduce the THM levels. Powder activated carbon dosing at the IBWPP is maintained all year at 30 mg/L”.*

<http://www.westernportwater.com.au/WebFiles/Services/DHS%20annual%20water%20quality%20report%202007-08.pdf>

## 4. Trihalomethanes

Classical trihalomethanes consist of chloroform (CHCl<sub>3</sub>), dichlorobromoform (CHCl<sub>2</sub>Br), dibromochloroform (CHBr<sub>2</sub>Cl) and bromoform (CHBr<sub>3</sub>).

Why and how are THMs formed?

*“When chlorine is added to water with organic material, such as algae, river weeds, and decaying leaves, THMs are formed. Residual chlorine molecules react with this harmless organic material to form a group of chlorinated chemical compounds, THMs. They are tasteless and odourless, but harmful and potentially toxic. The quantity of by-products formed is determined by several factors, such as the amount and type of organic material present in water, temperature, pH, chlorine dosage, contact time available for chlorine, and bromide concentration in the water.*

*The organic matter in water mainly consists of a) humic substance, which is the organic portion of soil that remains after prolonged microbial decomposition formed by the decay of leaves, wood, and other vegetable matter; and b) fulvic acid, which is a water soluble substance of low molecular weight that is derived from humus”.*

<http://water.epa.gov/drink/contaminants/index.cfm>

*“...Increase in bromide ion concentration increases total THM formation. Fractions of brominated THMs decrease with increasing NOM molecular size. Lower molecular weight NOM forms more brominated THMs than the corresponding higher molecular weight NOM. Increase of bromide to chlorine ratio decreases chloroform and increases brominated THMs. Increase in pH increases chloroform and decreases brominated THMs. This study demonstrates that the distribution of NOM and bromide ion can have important role on the distribution of THMs....distribution of lower and higher molecular weight NOM, can influence THM formation...”* (Trihalomethanes in drinking water: Effect of natural organic matter distribution Water SA Vol. 39 No. 1 January 2013)

*“What are the health effects of THMs?*

*According to a University of Florida report, exposure to THMs may pose an increased risk of cancer. According to Rebekah Grossman, two THMs, chloroform and dibromochloromethane, are carcinogens; and another THM, bromodichloromethane, has been identified as a mutagen, which alters DNA. Mutagens are considered to affect the genetics of future generations in addition to being carcinogenic. A California study indicates that THMs may be responsible for reproductive problems and miscarriage. The study found a miscarriage rate of 15.7 percent for women who drank five or more glasses of cold water containing more than 0.075 mg/l TTHM, compared to a miscarriage rate of 9.5 percent for women with low TTHM exposure. In addition to these risks, TTHMs are linked to bladder cancer, heart, lungs, kidney, liver, and central nervous system damage.”*

<http://water.epa.gov/drink/contaminants/index.cfm>

According to the Australian Drinking Water Guidelines

*“The World Health Organization (WHO) has derived separate guideline values for each compound, but in doing so recognises that the compounds have similar toxicological action. The WHO guideline values for chloroform (0.2 mg/L) and bromodichloromethane (0.06 mg/L) were based on calculations that estimated additional lifetime risks of one fatal cancer per 100,000 people. The use of this approach is questionable because there is evidence that tumours do not occur at low concentrations.... The WHO guideline values for bromoform (0.1 mg/L) and dibromochloromethane (0.1 mg/L) were based on different studies and safety factors from those recommended by the NHMRC Standing Committee on Toxicity, although toxicological effects were similar.”* (Australian Drinking Water Guidelines – National Health and Medical Research Centre)

## **Bromodichloromethane/Dichlorobromoform**

Bromodichloromethane 0.06mg/L (WHO) Guideline Level.

Bromodichloromethane is a Group 2B Possible carcinogen.

The Australian Drinking Water Guidelines do not list Bromodichloromethane.

Bromodichloromethane is a Trihalomethane. The trihalomethane guideline includes the sum of four different substances.

*“The International Agency for Research on Cancer (IARC) has classified BDCM in Group 2B (possibly carcinogenic to humans). BDCM gave both positive and negative results in a variety of in vitro and in vivo genotoxicity assays. In an NTP bioassay, BDCM induced renal adenomas and adenocarcinomas in both sexes of rats and male mice, rare tumours of the large intestine (adenomatous polyps and adenocarcinomas) in both sexes of rats and hepatocellular adenomas and adenocarcinomas in female mice. Exposure to BDCM has also been linked to a possible increase in reproductive effects (increased risk for spontaneous abortion or stillbirth).”*

[http://www.who.int/water\\_sanitation\\_health/dwq/chemicals/trihalomethanes\\_summary\\_statement.pdf](http://www.who.int/water_sanitation_health/dwq/chemicals/trihalomethanes_summary_statement.pdf)

*“Preliminary animal studies indicate that BDCM and other trihalomethanes that contain bromine may be more toxic than chlorinated trihalomethanes such as chloroform. For this reason, and based on the availability of scientific data for BDCM, a separate guideline was also developed for BDCM. BDCM is considered to be a probable carcinogen in humans, with sufficient evidence in animals and inadequate evidence in humans. Animal studies have shown tumours in the large intestine in rats. Among the four trihalomethanes commonly found in drinking water, BDCM appears to be the most potent rodent carcinogen, causing tumours at lower doses and at more target sites than the other three compounds. Exposure to BDCM at levels higher than the guideline value has also been linked to a possible increase in reproductive effects (increased risk for spontaneous abortion or stillbirth) above what can normally be expected. Further studies are required to confirm these effects.”*

<http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/trihalomethanes/guide-eng.php>

## 5. Findings

Westernport Water has acknowledged for at least six years that it has had an issue with Bromodichloromethane. In its 2006/7 Water Quality Report “*Westernport Water exceeded the WHO guideline value of 0.06 mg/L for bromodichloromethane in eight of the nine water sampling localities. As the ADWG only refers to the Total THM value, Westernport Water is still operating in accordance with the relevant regulations and guidelines. Therefore, no action was required other than that noted in Section 3.3.1.1.*”

<http://www.westernportwater.com.au/WebFiles/Services/DHS%20annual%20water%20quality%20report%20006-07.pdf> This response from Westernport Water was essentially the same until 2012.

These levels over 2006-8 also corresponded to very low water levels in Candowie Reservoir due to the Millenium Drought – the worst drought in 100 years of rainfall record keeping.

*“Even though Westernport Water exceeded the WHO guideline value of 0.06 mg/L for bromodichloromethane in six water sampling localities, actions were only taken on one occasion, as outlined in Section 5, when the total THM value exceeded the Safe Drinking Water Regulations 2005 water quality standard of 0.25 mg/L. This was because the current advice in ADWG is that the health significance of THMs only arises when the value of total THMs exceeds 0.25 mg/L. Until the advice in ADWG changes no action is considered necessary where an individual THM exceeds a WHO guideline value.”*

<http://www.westernportwater.com.au/WebFiles/Services/Water%20quality/WPW%20Annual%20Drinking%20Water%20Quality%20Report%202010-11%20Final%20V1.pdf>

By 2012, Chloramination supplies 99% of all Westernport Water customers. Westernport Water installed chloramination systems for all localities except Bass. This appears to have lessened the trihalomethane problem. No information was presented to Friends of the Earth concerning monitoring for monochloramines from Westernport Water.

A range of health issues have also been reported from Chloramination For more information see here: <http://www.chloramine.org/chloraminefacts.htm>

### **What is chloramination?**

Drinking water supplied to Westernport Water customers via Candowie Reservoir comes from intensively-farmed paddocks. Chemical treatment is the only sure way of making drinking water safe.

Chlorine is normally added to water as part of the disinfection process. Chlorine, however, can still leave a slight ‘swimming pool’ taste and odour.

With chloramination, a small amount of ammonia is added to the water just before the chlorine. A reaction takes place that forms a new disinfectant, monochloramine. This lessens the taste and odour of chlorine in the water, and means less treatment by-products in the water. <http://www.westernportwater.com.au/News/Details/?NewsID=174>



**Town by Town Trihalomethane/BDCM breaches –  
Westernport Water 2005-2013.**

Location	Total Samples	Breaches Trihalomethanes >250µg/L	Breaches BDCM >60µg/L	Average THM Trihalomethane 2005-2013 Aust Guideline = 250µg/L U.S. Guideline =80µg/L	Average BDCM 2005-2013 WHO Guideline = 60µg/L
Archies Creek	77	5	15	158µg/L	44µg/L
Bass Cape	64		1	87µg/L	41µg/L
Woolamai	2			175µg/L	58µg/L
Corinella	26	1	5	125µg/L	45µg/L
Coronet Bay	27		3	110µg/L	37µg/L
<b>Cowes</b>	123	20	<b>68</b>	187µg/L	<b>63µg/L</b>
Dalyston	52		1	119µg/L	31µg/L
Grantville	96	8	21	154µg/L	50µg/L
Kilcunda	108	1	13	121µg/L	40µg/L
Newhaven	39	2	8	151µg/L	51µg/L
Nobbies*	50	1	6	93µg/L	21µg/L
Pioneer Bay	12		1	147µg/L	48µg/L
<b>Rhyll</b>	116	9	52	175µg/L	57µg/L
San Remo	86	2	27	157µg/L	53µg/L
<b>Silverleaves</b>	7		<b>4</b>	165µg/L	53µg/L
Smiths Beach	9		1	145µg/L	49µg/L
Sunderland Bay	23	1	4	158µg/L	53µg/L
<b>Sunset Strip</b>	10	1	3	177µg/L	<b>62µg/L</b>
Tenby Point	51		3	111µg/L	37µg/L
<b>Ventnor</b>	56	8	<b>31</b>	184µg/L	<b>61µg/L</b>
Wimbledon Heights	26	2	10	151µg/L	44µg/L
Woolamai	41	0	1	97µg/L	33µg/L
Woolamai Waters	37	3	13	162µg/L	52µg/L

\*Nobbies has used UV disinfection since 2001

## Longest Period Bromodichloromethane above WHO Guideline

**60µg/L = 60 parts per billion**

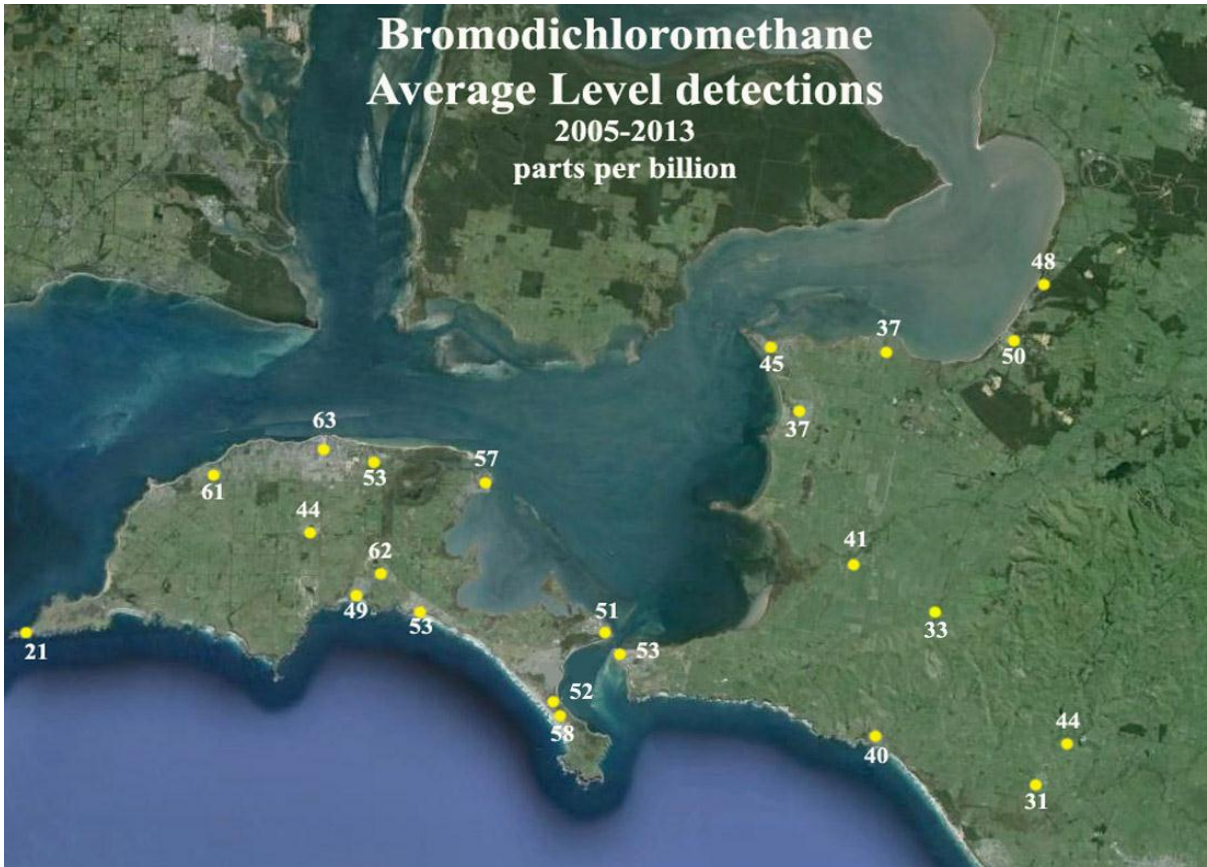
Location	Number of Samples	Breaches THM >250µg/L	Breaches BDCM >60µg/L	Average THM 2005-13 µg/L	Average BDCM 2005-13 µg/L	BDCM Average WHO Guideline >60µg/L	BDCM Possible Months Above WHO Guideline
Sunset Drive Sunset Strip	10	1(10%)	3(30%)	177µg/L	61µg/L	November 9 2005 – January 15 2013 62µg/L	86 months
School St Newhaven	7	2 (28.6%)	4 (57.1%)	193µg/L	64µg/L	November 9 2005 – February 14 2012 64µg/L	75 months
Shiloh Ranch Glen Alvie Rd Grantville	20	6 (30%)	8 (40%)	193µg/L	61µg/L	November 11 2006 – January 2013 68µg/L	74 months
Scenic Drive Cowes	8	1 (12.5%)	8 (62.5%)	159µg/L	60µg/L	July 20 2005 – July 19 2011 0.06mg/L	72 months
Harris Road Ventnor	21	4(19%)	15(71.4%)	195µg/L	66µg/L	February 15 2006 – October 11 2011 73µg/L	68 months
Bella Vista Court Cowes	9		6 (66.7%)	189µg/L	62µg/L	November 9 2005 – June 22 2011 65µg/L	67 months
Marine Parade San Remo	20		7(35%)	166µg/L	54µg/L	December 7 2005 – April 12 2011 (64 months) 59µg/L	64 months
Lock Road Rhyll	26	2 (7.7%)	14 (53.8%)	178µg/L	58µg/L	December 6 2006 – January 17 2012 66µg/L	61 months
Felicia Avenue Rhyll	30	2 (6.7%)	10 (33.3%)	170µg/L	57µg/L	January 31 2007 – February 14 2012 63µg/L	61 months
Lions Court Cowes	13	3 (23%)	8 (61.5%)	208µg/L	69µg/L	May 23 2007 – February 2 2012	57 months

						77µg/L	
Lantana Road Woolamai Waters	15	1 (6.7%)	4(26.7%)	137µg/L	48µg/L	February 14 2007 – October 11 2011 63µg/L	56 months
Jansson Road Rhyll	39	4(10.25%)	17 (43.6%)	176µg/L	56µg/L	June 21 2006 – December 6 2011 58µg/L	54 months
Anderson St Cowes	13	1 (7.7%)	5 (38.5%)	177µg/L	58µg/L	March 14 2007 – August 16 2011 63µg/L	53 months
Lyall Street Ventnor	18		9(50%)	168µg/L	57µg/L	September 12 2007 – November 8 2011 70µg/L	50 months
Thomson Rd Cowes	12	4 (33.3%)	6 (50%)	200µg/L	64µg/L	February 15 2006 – June 16 2009 72µg/L	40 months
Ventnor Road Toilet Block Ventnor	5	1(20%)	4(80%)	200µg/L	65µg/L	July 20 2005 – July 16 2008 65µg/L	37 months
Church St Cowes	6	2 (33.3%)	4 (66.7%)	210µg/L	71µg/L	August 17 2005 – August 12 2008 71µg/L	36 months
Red Rocks Rd Cowes	6		2 (33.3%)	162µg/L	51µg/L	April 12 2006 – April 7 2009 62µg/L	36 months
Cutty Sark Rd Coronet Bay	13		2 (15.38%)	109µg/L	39µg/L	October 18 2006 – September 8 2009 68.5µg/L	35 months
Lots 113/115 Archies Creek Road	19	3 (15.8%)	6 (31.6%)	161µg/L	54µg/L	18-10-06-10/2/09 61µg/L	28 months
Silverleaves Avenue Silverleaves	7		4(57.1%)	164µg/L	53µg/L	December 1 2009 – December 6 2011 69µg/L	24 months
Manly Avenue Woolami	6		3(50%)	172µg/L	55µg/L	December 7 2005 – December 4	24 months

Waters						2007 69µg/L	
The Esplanade Cowes	5	1 (20%)	1 (20%)	184µg/L	61µg/L	November 15 2006 – September 8 2008 78µg/L	22 months
Back Beach Road San Remo	10	2(20%)	5(50%)	192µg/L	65µg/L	April 12 2006 – February 13 2008 79µg/L	22 months
Lot 2 Archies Creek Road	36	2 (5.6%)	9 (25%)	188µg/L	43µg/L	21/6/06-12/2/08 61µg/L	20 months
Ocean Reach Road Wimbleton Heights	16	2(12.5%)	6(37.5%)	182µg/L	55µg/L	June 21 2006 – January 23 2008 76µg/L	19 months
Bowman Road Wimbleton Heights	8	1(25%)	4(50%)	191µg/L	61µg/L	November 15 2006 – May 21 2008 72µg/L	18 months
Settlement Rd Cowes	18	5 (27.8%)	11 (61.1%)	196µg/L	68µg/L	September 13 2006 – February 13 2008 73µg/L	17 months
Cnr Shephard & Agnes Streets Grantville	15	1 (6.7%)	3 (20%)	157µg/L	50µg/L	January 30 2008 – April 7 2009 62µg/L	15 months
Gilbert Road Kilcunda	14	1 (7.1%)	3 (21.4%)	120µg/L	44µg/L	October 18 2006 – January 1 2008 72µg/L	15 months
The Esplanade Corinna (picnic area)	16	1 (6.25%)	3 (18.75%)	128µg/L	46µg/L	November 15 2006 – January 18 2008 74µg/L	14 months
Barkers Road Corinna	10		2 (20%)	129µg/L	43µg/L	December 6 2006 – December 4 2007 74µg/L	12 months
Uringah Court Cowes	4		2 (50%)	160µg/L	59µg/L	October 12 2010 – October 11 2011 78µg/L	12 months

Appely Court Cowes	3		2 (66.7%)	178µg/L	64µg/L	October 12 2010 – October 11 2011 64µg/L	12 months
Bass Highway Grantville Post Office	13		3 (23.1%)	152µg/L	47µg/L	December 6 2006 – December 4 2007 64µg/L	12 months
Phillip Island Road Newhaven	7		2 (28.6%)	164µg/L	56µg/L	March 9 2010 – March 15 2011 69µg/L	12 months
Hill Street Sunderland Bay	7	1(14.3%)	1(14.3%)	168µg/L	53µg/L	March 14 2007 – March 12 2008 63µg/L	12 months
Ventnor Beach Road Wimbledon Heights	13		3(23.1%)	135µg/L	33µg/L	February 16 2011 – February 14 2012 60µg/L	12 months





**Numbers indicate average levels of Bromodichloromethane in communities supplied with drinking water from Westernport Water 2005-2013.**



**Candowie Reservoir, the supply source of most of the water supplied by Westernport Water. Candowie was severely impacted by the Millenium Drought and these problems are likely to have contributed significantly to the high DBP levels recorded.**

## 6. Street Summaries 2005-13

Based on Westernport Water sample locations. Street numbers have been deleted in respect of privacy. Highlighted text indicates problem.

WHO BDCM Guideline = 60µg/L (60 parts per billion)

Highlighted text refers to breaches to Guidelines

Location	Total Samples	THM Breaches 2005-2013	Breaches BDCM 2005-13	Average THM 2005-13 ADWG 250µg/L	Average BDCM 2005-13 WHO Guideline 60µg/L	BDCM Average >WHO Guideline 60µg/L
Lot ** Archies Creek Road	36	2 (5.6%)	9 (25%)	188µg/L	43µg/L	21/6/08-12/2/08 61µg/L
Lots ** Archies Creek Road	19	3 (15.8%)	6 (31.6%)	161µg/L	54µg/L	18-10-06-10/2/09 61µg/L
** Archies Creek Rd	22			108µg/L	38µg/L	
** Hade Avenue Bass (Football Ground)	18			102µg/L	31µg/L	
* Hade Avenue Bass, old school	16		1 (6.25%)	84µg/L	30µg/L	31/1/08
* Hade Avenue Bass	16			80µg/L	28µg/L	
Bass Hwy Giant Worm	14			82µg/L	31µg/L	
* Vista Drive Cape Woolami	2			175µg/L	58µg/L	
The Esplanade Corinella (picnic area)	16	1 (6.25%)	3 (18.75%)	128µg/L	46µg/L	November 15 2006 – January 18 2008 74µg/L
Barkers Road Corinella	10		2 (20%)	129 µg/L	0.043 µg/L	December 6 2006 – December 4 2007 74µg/L
Semaphore Street Coronet Bay	14		1 (7.1%)	111 µg/L	35 µg/L	February 14 2007 74µg/L
Cutty Sark Rd Coronet	13		2 (15.38%)	109 µg/L	39 µg/L	October 18 2006 –

Bay						September 8 2009 68.5µg/L
Thomson Rd Cowes	12	4 (33.3%)	6 (50%)	200 µg/L	64 µg/L	February 15 2006 – June 16 2009 72µg/L
Lions Court Cowes	13	3 (23%)	8 (61.5%)	208 µg/L	69 µg/L	May 23 2007 – February 2 2012 77µg/L
Scenic Drive Cowes	8	1 (12.5%)	8 (62.5%)	159 µg/L	60 µg/L	July 20 2005 – July 19 2011 60µg/L
The Esplanade Cowes	5	1 (20%)	1 (20%)	184 µg/L	61 µg/L	November 15 2006 – September 8 2008 78 µg/L
Church St Cowes	6	2 (33.3%)	4 (66.7%)	210 µg/L	71 µg/L	August 17 2005 – August 12 2008 71 µg/L
Settlement Rd Cowes	18	5 (27.8%)	11 (61.1%)	196 µg/L	68 µg/L	September 13 2006 – February 13 2008 73 µg/L
Bella Vista Court Cowes	9		6 (66.7%)	189 µg/L	62 µg/L	November 9 2005 – June 22 2011 65µg/L
Anderson St Cowes	13	1 (7.7%)	5 (38.5%)	177 µg/L	58 µg/L	March 14 2007 – August 16 2011 63 µg/L
Banksia Court Cowes	3	1 (33.3%)	1 (33.3%)	183 µg/L	62 µg/L	October 18 2006 62 µg/L
Red Rocks Rd Cowes	6		2 (33.3%)	162 µg/L	51 µg/L	April 12 2006 – April 7 2009 62 µg/L
Uringah Court Cowes	4		2 (50%)	160 µg/L	59 µg/L	October 12 2010 – October 11 2011 78 µg/L
Appely Court Cowes	3		2 (66.7%)	177 µg/L	64 µg/L	October 12 2010 – October 11 2011 64 µg/L
Endeavour Court Cowes	4		1 (25%)	144 µg/L	48 µg/L	January 1 2011 75 µg/L
Teddy Bear Lane Cowes	5	1 (20%)	2 (40%)	188 µg/L	60 µg/L	April 2011 (two weeks) 82 µg/L
Outlook Way Cowes	3		1 (33.3%)	126 µg/L	43 µg/L	January 2012 63 µg/L
Woodlands Avenue Cowes	1			100 µg/L	38 µg/L	
Bent Street	23		1 (4.3%)	126 µg/L	43 µg/L	August 15

Dalyston						2007 60 µg/L
Powlett Street Dalyston	11			125 µg/L	39 µg/L	
Tulloch Street Dalyston	14			114 µg/L	32 µg/L	
Walker Street Dalyston	3			86 µg/L	32 µg/L	
Powlett Street Dalyston	1			68 µg/L	21 µg/L	
* Glen Alvie Road Grantville	7			92 µg/L	32 µg/L	
Lot * Glen Alvie Road Grantville	15	1 (6.7%)	3 (20%)	142 µg/L	46 µg/L	September 2 2010 – October 11 2011 55 µg/L
* Pier Road Grantville	15		2 (13.3%)	146 µg/L	49 µg/L	June 16 2009 – January 2010 61 µg/L
Shiloh Ranch Glen Alvie Rd Grantville	20	6 (30%)	8 (40%)	193 µg/L	61 µg/L	November 11 2006 – January 2013 68 µg/L
Cnr Shephard & Agnes Streets Grantville	15	1 (6.7%)	3 (20%)	157 µg/L	50 µg/L	January 30 2008 – April 7 2009 62 µg/L
Bass Highway Grantville Post Office	13		3 (23.1%)	152 µg/L	47 µg/L	December 6 2006 – December 4 2007 64 µg/L
Lot * June Street Grantville	11		2 (18.2%)	149 µg/L	51 µg/L	
Peppermint Road Kilcunda	37*		5 (10.4%)	134 µg/L	45 µg/L	October 10 2005 – December 7 2005 63 µg/L
Mabilla Road Kilcunda	34		1 (3.9%)	110 µg/L	36 µg/L	June 2006 63 µg/L
Carew Road Kilcunda	23		4 (17.4%)	118 µg/L	37 µg/L	
Gilbert Road Kilcunda	14	1 (7.1%)	3 (21.4%)	120 µg/L	44 µg/L	October 18 2006 – January 1 2008 72 µg/L
* Phillip Island Tourist Rd Newhaven	6			140 µg/L	44 µg/L	
Anderson Street Newhaven	3			127 µg/L	43 µg/L	

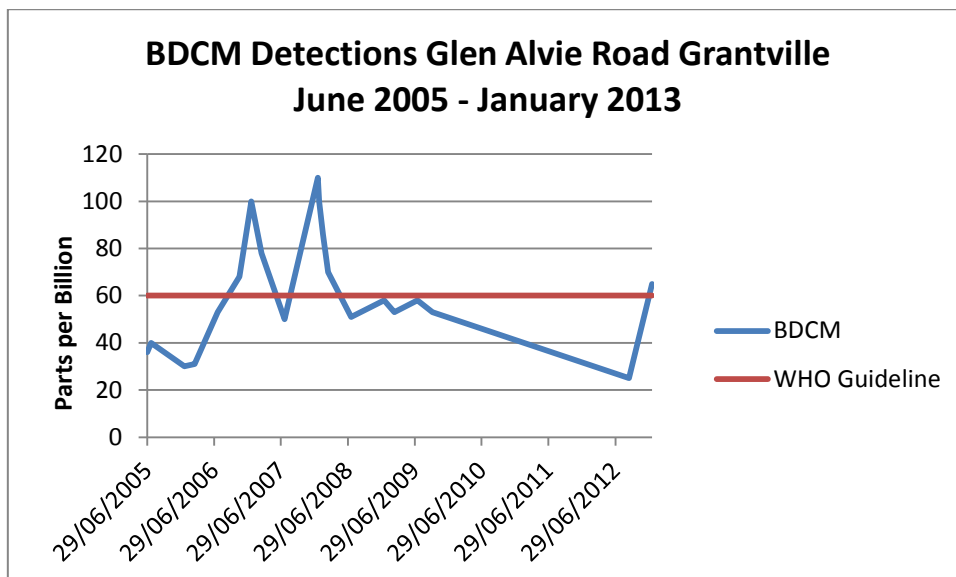
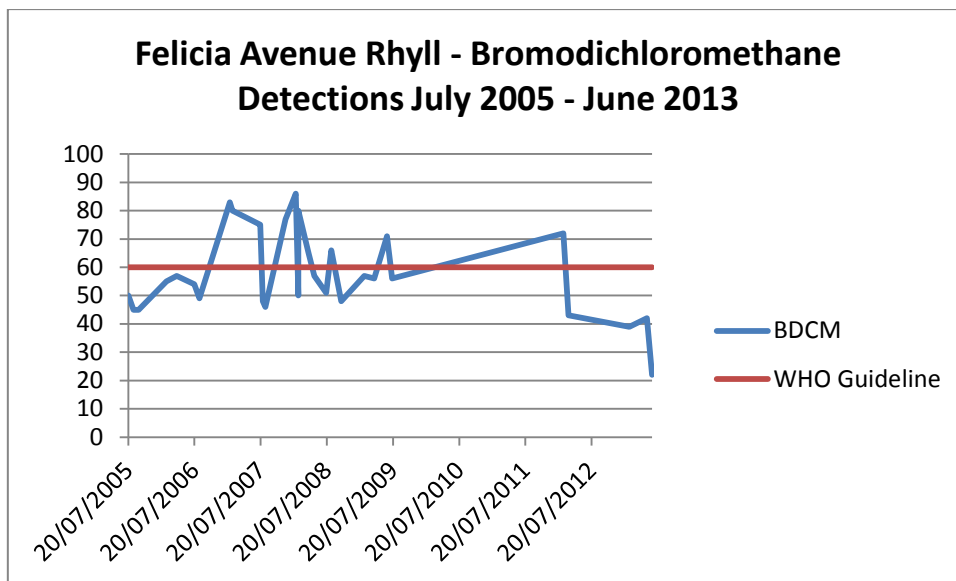
School St Newhaven	7	2 (28.6%)	4 (57.1%)	193 µg/L	64 µg/L	November 9 2005 – February 14 2012 64 µg/L
Phillip Island Road Newhaven	7		2 (28.6%)	164 µg/L	56 µg/L	March 9 2010 – March 15 2011 69 µg/L
Boys Home Road Newhaven	16		2 (12.5%)	136 µg/L	47 µg/L	October 12 2010 – October 11 2011 59 µg/L
Nobbies Road Toilet Block	20		2 (10)	85 µg/L	18 µg/L	June 21 2006 77 µg/L
Phillip Island Penguin Parade	25	1(4%)	3(12%)	102 µg/L	23 µg/L	January 17 2007 – March 14 2007 73µg/L
Ventnor Road Nobbies Toilet Block	5		1(20%)	78 µg/L	18 µg/L	July 14 2009 62 µg/L
Lot * Smith Street Pioneer Bay	5			149 µg/L	48 µg/L	
Lot * Helen Street Pioneer Bay	7		1(14.3%)	146 µg/L	49 µg/L	December 8 2010 – April 12 2011 60µg/L
Lock Road Rhyll	26	2 (7.7%)	14 (53.8%)	178 µg/L	58 µg/L	December 6 2006 – January 17 2012 66 µg/L
Jansson Road Rhyll	39	4(10.25%)	17 (43.6%)	176 µg/L	56 µg/L	June 21 2006 – December 6 2011 58 µg/L
Felicia Avenue Rhyll	30	2 (6.7%)	10 (33.3%)	170 µg/L	57 µg/L	January 31 2007 – February 14 2012 63 µg/L
Beach Street Rhyll	11	1 (9.1%)	3 (27.3%)	150 µg/L	51 µg/L	October 18 2006 – January 17 2007 75 µg/L
Wonthaggi Crescent San Remo	22		3(16.6%)	142 µg/L	48 µg/L	November 15 2006 – September 12 2007 59 µg/L
Marine Parade San Remo	20		7(35%)	166 µg/L	54 µg/L	December 7 2005 – April 12 2011 (64 months) 59 µg/L
Back Beach Road San Remo	10	2(20%)	5(50%)	192 µg/L	65 µg/L	April 12 2006 – February 13 2008 79µg/L
Panorama Drive San	11		4(36.4%)	147 µg/L	50 µg/L	



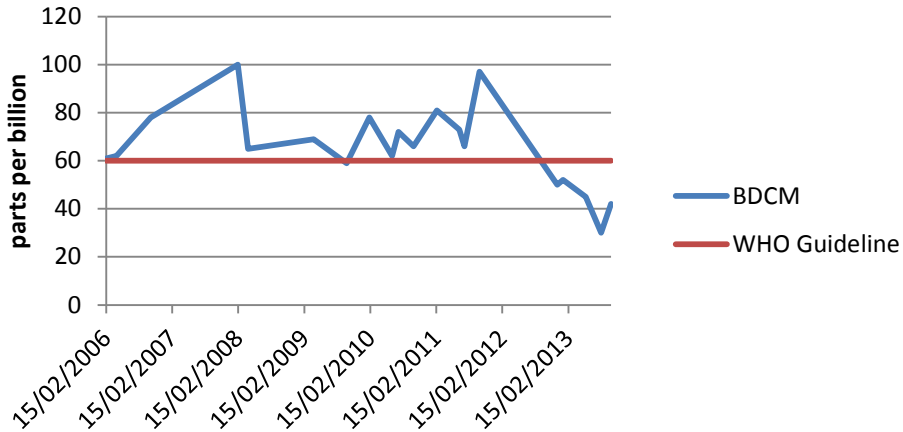
<b>Remo</b>						
<b>Ocean View Drive San Remo</b>	4			82 µg/L	34 µg/L	
<b>Silverleaves Avenue Silverleaves</b>	7		4(57.1%)	164 µg/L	53 µg/L	December 1 2009 – December 6 2011 69 µg/L
<b>Smiths Beach Road Smiths Beach</b>	9		1 (9.1%)	145 µg/L	49 µg/L	October 10 2007 – April 9 2008 62 µg/L
<b>Sinclair Avenue Sunderland Bay</b>	16		3(18.7%)	154 µg/L	52 µg/L	January 18 2011 – November 8 2011 62 µg/L
<b>Hill Street Sunderland Bay</b>	7	1(14.3%)	1(14.3%)	168 µg/L	53 µg/L	March 14 2007 – March 12 2008 63 µg/L
<b>Sunset Drive Sunset Strip</b>	10	1(10%)	3(30%)	177 µg/L	61 µg/L	November 9 2005 – January 15 2013 62 µg/L
<b>Bayview Road Temby Point</b>	40		3 (0.75%)	109 µg/L	36 µg/L	September 12 2007 – January 30 2008 64 µg/L
<b>Marine Parade Temby Point</b>	11			116 µg/L	40 µg/L	
<b>Hayley Avenue Ventnor</b>	12	3(25%)	3(25%)	180 µg/L	59 µg/L	June 20 2007 – February 13 2008 87µg/L
<b>Lyll Street Ventnor</b>	18		9(50%)	168 µg/L	57 µg/L	September 12 2007 – November 8 2011 70 µg/L
<b>Harris Road Ventnor</b>	21	4(19%)	15(71.4%)	195 µg/L	66 µg/L	February 15 2006 – October 11 2011 73 µg/L
<b>Ventnor Road Toilet Block Ventnor</b>	5	1(20%)	4(80%)	200 µg/L	65 µg/L	July 20 2005 – July 16 2008 65 µg/L
<b>Bowman Road Wimbledon Heights</b>	8	1(25%)	4(50%)	191 µg/L	61 µg/L	November 15 2006 – May 21 2008 72 µg/L
<b>Ventnor Beach Road Wimbledon Heights</b>	13		3(23.1%)	135 µg/L	45 µg/L	February 16 2011 – February 14 2012 60 µg/L
<b>Diane Crescent Wimbledon</b>	4			105 µg/L	36 µg/L	

Heights						
Ocean Reach Road Wimbledon Heights	16	2(12.5%)	6(37.5%)	182 µg/L	55 µg/L	June 21 2006 – January 23 2008 76 µg/L
Turnbull - Woolami Road Woolami	19		1(5.3%)	95 µg/L	31 µg/L	October 10 2008 – January 1 2008 60 µg/L
Bass Landing Road Woolami	10			87 µg/L	31 µg/L	
Edward Court Woolami	12			111 µg/L	39 µg/L	
Manly Avenue Woolami	6		3(50%)	172 µg/L	55 µg/L	December 7 2005 – December 4 2007 69 µg/L
Lantana Road Woolami Waters	15	1 (6.7%)	4(26.7%)	137 µg/L	48 µg/L	February 14 2007 – October 11 2011 63µg/L

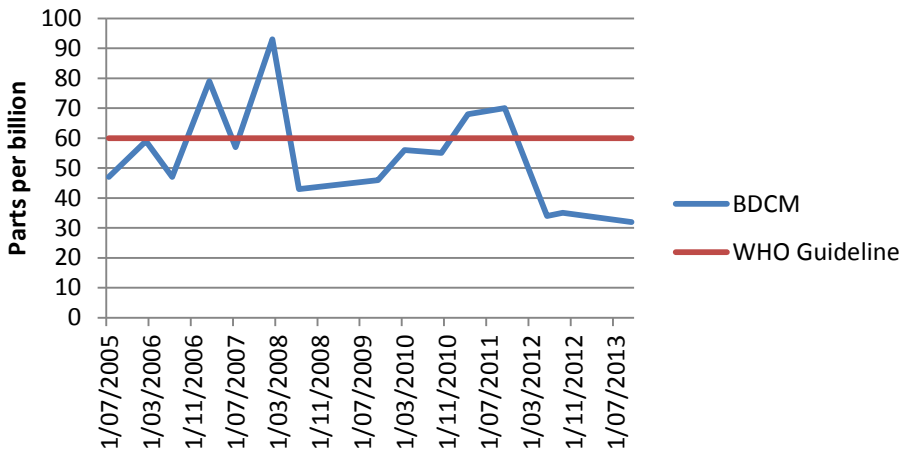
## Graphs showing selected BDCM levels from street sampling locations



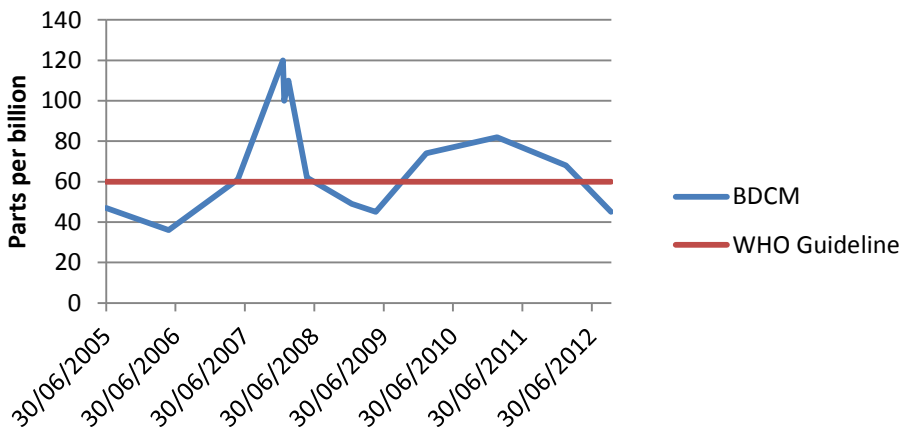
### Harris Road Ventnor Bromodichloromethane Levels Feb 2006- Oct 2013



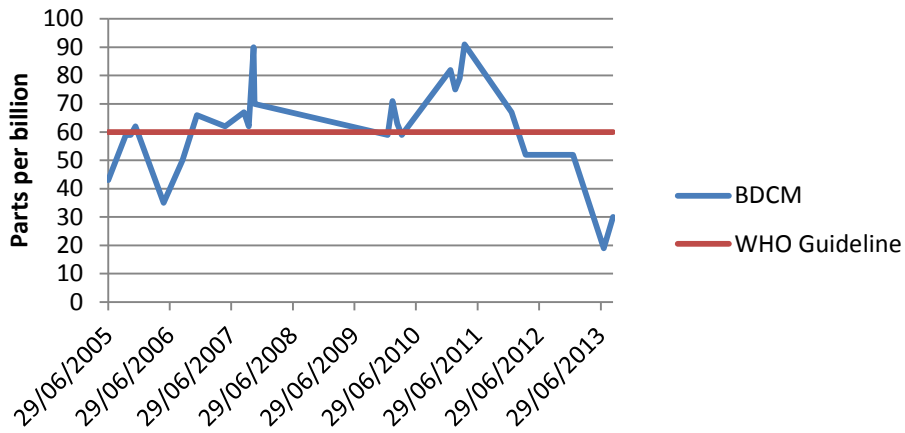
### BDCM detections Lantana Road, Woolamai Waters July 2005 - October 2013



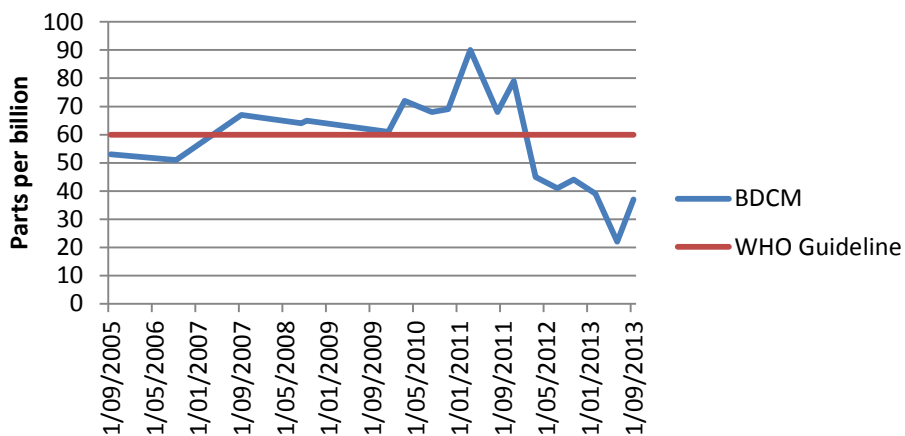
### BDCM detections Lions Court Cowes June 2005 - June 2012



**BDCM detections Lock Road Rhyll June 2005 - September 2013**



**BDCM detections Lyall Street, Ventnor September 2005 - September 2013**



**BDCM detections Panorama Drive San Remo March 2006 - July 2013**

