

Lake Bonney SE dioxins

Information Sheet

Dioxins and dioxin-like organic contaminants (dioxins, furans and polychlorinated biphenyls) in Lake Bonney, South East

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EPA 887/10: This information sheet is intended to provide technical information on the occurrence and risks posed by dioxins in Lake Bonney, SE.

Summary

Dioxins are a group of potentially dangerous environmental pollutants that include some very persistent and toxic chemicals that can accumulate in the environment and humans. They are unintentionally formed by a wide range of industries but can also form naturally during bushfires.

Lake Bonney SE is a large lake near Millicent in the South East that has received wastewater from paper and pulp mills for over 50 years. In the past, the mills used chlorine to whiten paper and tissues, a process that had the potential to create dioxins. However, this practice ended in 1991 when the mills were upgraded and they no longer use chemicals likely to produce dioxins.

Studies of dioxins in fish, sediments and water taken from the lake in 2005–08 have confirmed that the amounts in the environment are very low, similar to levels found elsewhere in the state, and that they pose no risk to humans or the environment.

Introduction

'Dioxins' are a group of environmental pollutants that are of particular concern to the environment and humans because of their persistence and high potential toxicity. They are stable chemicals that are stored in the fatty body tissues of animals. Their half-life (the time needed for the body to rid itself of half the chemicals) in the body is estimated to range from 5-14 years. Similar ranges have also been reported from lakes and soils. In the environment, dioxins tend to accumulate in the food chain, so high level predators tend to have higher concentrations than animals that eat plant material.

The chemical name for dioxin is 2,3,7,8-tetrachlorodibenzo para dioxin (TCDD), which describes the chemical structure of the most potent and toxic dioxin. The name 'dioxins' is generally used for the group of other structurally and chemically related polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Certain dioxin-like polychlorinated biphenyls (PCBs) with similar toxic properties are also typically included under the term 'dioxins'. In total there are several hundred types of these chemicals but only 29 are considered to have significant toxicity and pose a risk to the environment and humans.

Dioxins occur in the environment as a complex mixture of different chemicals. In an attempt to address this complexity, the concept of toxicity equivalency factors (TEFs) has been developed to provide an estimate of the toxicity of mixtures in

comparison to the most potent and toxic dioxin (TCDD). Different chemicals have been assigned an 'order of magnitude' estimate of relative toxicity compared to TCDD, which are multiplied by their concentrations and then added together to give what are called the total toxic equivalence quotient (TEQ) for the mixture.

The World Health Organization (WHO) has described, assigned and published TEFs for the 29 most toxic chemicals (comprising seven PCDDs, 10 PCDFs and 12 dioxin-like PCBs) and committed to continue and update the science that underpins this approach at least every five years <www.who.int/ipcs/assessment/tef_update/en/>. The most recently updated TEFs from 2005 (Van den Berg *et al* 2006) are being used by the EPA in evaluating the risks for the aquatic life in the state, including the work conducted on the fish, sediments and water in Lake Bonney SE.

How are they formed?

Dioxins and dioxin-like compounds are formed and released to the environment from a number of sources such as combustion (including bushfires), metal processing, and some chemical manufacturing and processing industries; there are both natural and industrial sources.

Dioxins and furans are not deliberately produced in industrial processes and have no known use but are formed as unintended by-products of certain industrial (eg waste incineration, chlorine bleaching of paper pulp, metal refining and the manufacture of some pesticides) and incomplete combustion activities (eg burning fossil fuels, wood and garbage).

PCBs are commercial products used widely throughout the world in a range of industrial applications due to their thermal stability, insulating properties and non-flammability among other features. They have commonly been used in some industrial oils (eg heat transfer fluids, hydraulic fluids and dielectric fluids in the electricity, mining, manufacturing and other industries using oils) as well as some solvent extenders and fire retardants.

How are people exposed to dioxins?

Dioxins are generally found at very low levels throughout the world in the air, water, sediment, soils and in foods such as meat, fish, shellfish and dairy products; they are globally distributed. The general public is mainly exposed to dioxins through the food they eat, drinking water, inhaling the air and to some extent through the skin (eg Rappe 1994).

Understanding the actual risks from dioxins: is there a source and exposure pathway that indicates an environmental risk?

Like many chemicals present in the environment, the presence of low levels of dioxins in the water, sediments, soil, air and living organisms is likely to cause concern to some people in the community. However, the fact is that many chemicals, including dioxins, are found everywhere in the world. The most critical questions are really whether they occur in large enough amounts or concentrations to cause adverse effects and whether there is an exposure pathway that can lead to an adverse effect to the environment and/or people.

Governments around the world have been aware of these issues for some time and indeed Australia was among the first countries to commit to the Stockholm Convention on Persistent Organic Pollutants (POPs) in 2001 <http://en.wikipedia.org/wiki/Stockholm_Convention_on_Persistent_Organic_Pollutants>.

This international treaty aims to eliminate or restrict the production and use of specific POPs which includes PCDDs, PCDFs and PCBs. See Australia's commitments to meeting its obligations at <www.environment.gov.au/settlements/chemicals/international/pop.html#obligations>.

There are also additional national approving bodies responsible for chemical use in Australia (eg Australian Pesticides and Veterinary Medicines Authority, National Industrial Chemicals Notification and Assessment Scheme, and Food Standards Australia and New Zealand) in addition to federal and state government agencies with responsibility for reducing and where possible eliminating POPs and in some cases monitoring and assessing their risk to the environment and people living in Australia.

Sources and risks for Lake Bonney SE and nearby communities?

The pulp and paper mill that discharges into Lake Bonney SE ceased using chlorine bleaching in 1991, when it changed to a hydrogen peroxide bleaching method. This effectively eliminated the only major source of dioxins entering the lake. Minor contributions were also expected to be contributed from the discharge to drain 44 from the Millicent Wastewater Treatment Plant that now only discharges into the drain network for about six months of the year.

Monitoring various aspects of water quality, sediment chemistry and biological communities in Lake Bonney SE showed that a number of significant improvements had occurred over the period from the 1990's to the mid 2000's. Importantly, at least eight species of fish have been collected and most are regularly breeding in the lake, which shows that chemicals are not interfering with the successful reproduction of a wide range of native fish species. This is significant because growth in juvenile fish may be affected at dioxin concentrations of 1000 pg/L (ie 0.000001 mg/L) and eggs may be affected at even lower concentrations (ANZECC & ARMCANZ 2000).

Dioxin levels in fish, sediments and water in Lake Bonney SE

The EPA has evaluated the potential for dioxins to impact on living organisms in the lake based on samples taken from 2005–07. This was to confirm that levels of dioxin were, as expected with the cessation of chlorine bleaching by the mills, low and comparable to background levels found elsewhere in Australia.

A summary of the samples taken from the lake include the following:

- One water sample taken from the lake by the EPA had a WHO TEQ for dioxins and furans (middle bound) of 3.5 pg/L (ie 0.000000035 mg/L). The term middle bound is a technical term that refers to the way in which concentrations are added together; middle bound values are calculated by including half the level of detection for those chemicals that are less than the level of detection for the sample being analysed.
- Various sediment samples taken from the lake in 2007 by the EPA and Department for Environment and Heritage had WHO TEQs for dioxins, furans and PCBs (middle bound) ranging from 0.27–1.3 pg/g. Samples of sediment taken from the lake by a community group in 2005-2006 had TEQs for dioxins and furans (middle bound) ranging from 2.9–5.9 pg/g. They also sampled Bucks Lake (a nearby small freshwater wetland) and the TEQ (middle bound) of one sample was 0.83 pg/g.
- Two species of *whole fish* were sampled from 2 sites and the WHO TEQs results for dioxins, furans and PCBs (upper bound) ranged from 3.87–4 pg/g fresh weight for Yellow-eyed Mullet and 1.58–1.73 pg/g fresh weight for Common Galaxias. The upper bound values are presented here as the worse case results, and were calculated by including the level of detection for those chemicals that are less than the level of detection for the sample being analysed.

None of these results are exceptional or at levels that would cause harm to the environment or people. All values are in a similar order of magnitude and there is no evidence that any bio-concentration is occurring in the environment. Similar findings have been reported from Canada and elsewhere in the world, whenever pulp and paper mills have reduced or eliminated using chlorine bleaches (Hewitt & Servos 2001).

The water result for the lake falls within the 'clean' water range of 0–5 pg/L described in the National Water Quality Management Strategy (ANZECC & ARMCANZ 2000). The sediment results were similar to the median concentration of 2.3 pg/g from other estuarine habitats reported in Australia in the National Dioxins Study and obviously much lower than the highest concentrations that were recorded from contaminated sediments of Homebush Bay in Sydney (eg 78–520 pg/g) (Commonwealth of Australia 2004).

The fish results are below the levels used in many countries for issuing fish advisories to limit the consumption of affected fish. For example, the European Union's maximum level for fish and fish products is 8 pg/g (fresh weight), for the combined amounts of dioxins, furans and PCBs (EUSC 2001). Australian States have used 6 pg/g (fresh weight) as a temporary action level in relation to dioxin contamination in Port Jackson and tributaries in NSW and the Yarra and Maribyrnong estuaries in Victoria (EPA Victoria 2007). It is important to note that these fish advisory levels apply to fish fillets whereas whole fish from Lake Bonney SE were processed to provide a worse-case assessment of risk from eating fish from the lake.

While the issues surrounding human health risks posed by dioxins is complicated by many factors, in Australia the recommended tolerable monthly intake that should be protective for humans is 70 pg TEQ per kg bodyweight, from all sources combined, in recognition of the risk posed by a life-time of exposure to dioxins <[www.nhmrc.gov.au/ files_nhmrc/file/publications/synopses/eh26.pdf](http://www.nhmrc.gov.au/files_nhmrc/file/publications/synopses/eh26.pdf)>.

A more detailed discussion on these and other data collected from Lake Bonney SE are expected be available in a technical report on the EPA's website in late 2010.

Risks for the aquatic environment and people in Lake Bonney SE and nearby communities

The EPA and Department of Health have assessed the risks to the environment and humans recreating and living near the lake as negligible, and no different from other parts of the state.

References

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Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

Further information

Legislation

Legislation may be viewed on <www.legislation.sa.gov.au>

Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet
Adelaide Service SA Centre
108 North Terrace
Adelaide SA 5000

Telephone: 13 23 24
Fax: (08) 8204 1909
Website: <shop.service.sa.gov.au>

For general information please contact:

Environment Protection Authority
GPO Box 2607
Adelaide SA 5001

Telephone: (08) 8204 2004
Facsimile: (08) 8124 4670
Freecall (country): 1800 623 445
Website: <www.epa.sa.gov.au>
Email: <epainfo@epa.sa.gov.au>
