

# BTEX & COAL SEAM GAS

BTEX is a commonly used abbreviation for four hydrocarbon compounds — benzene, toluene, ethylbenzene and xylenes (BTEX) — that are found in a range of products including tar, crude petroleum, diesel and petrol fuels and a variety of petroleum-related products.

## The origins of BTEX

BTEX compounds are naturally occurring, but are also produced by human activities with people being exposed at low levels by undertaking everyday activities such as smoking cigarettes, driving a car, operating tools such as chainsaws and filling up a car with petrol. Naturally occurring BTEX compounds are typically found in seawater around areas of natural gas and petroleum deposits, coal deposits and in gas emissions from volcanoes and bushfires.

BTEX compounds can enter the environment through motor vehicle emissions, aircraft exhaust, losses and spills during the handling and transfer of large quantities of petroleum, and cigarette smoke. BTEX compounds are also created during the processing of refined petroleum products and coal, and during the production of products such as paints and lacquers, thinners, rubber products, adhesives, inks, cosmetics and pharmaceutical products.

BTEX compounds are among the most abundantly produced chemicals, with worldwide production of 8–10 million tonnes of benzene, 5–10 million tonnes of toluene, 5–10 million tonnes of ethylbenzene and 10–15 million tonnes of xylenes.<sup>1</sup>

Trace amounts of BTEX compounds may also be found in some foods (it has been reported to occur in fruits, fish, vegetables, nuts, dairy products, beverages, and eggs)<sup>2</sup> and — in rare cases — drinking water.

## Exposure to BTEX

In high concentrations, BTEX compounds potentially have adverse effects on human health. Concentrations in the range of 700,000 to 3,000,000 parts per billion may cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion and unconsciousness.<sup>3</sup> In particular, benzene is a known carcinogen (a cancer-causing agent), which is why it is subjected to strict regulation.

People are often exposed to BTEX compounds just by going about their regular activities, as shown in Table 1 (next page). Exposure to BTEX compounds most commonly occurs via exposure to the atmosphere, however it may be found in water in the event of spills or proximity to natural deposits. Overall, BTEX exposure via water represents a very small proportion with the majority of exposure being through breathing and dietary intake.

<sup>1</sup> Leusch, F & Bartkow, M 2010, *A short primer on benzene, toluene, ethylbenzene and xylenes (BTEX) in the environment and in hydraulic fracturing fluids*, Griffith University and Smart Water Research Centre, <<http://www.ehp.qld.gov.au/management/coal-seam-gas/pdf/btex-report.pdf>>, p. 2.

<sup>2</sup> Agency for Toxic Substances and Disease Registry (ATSDR) 2007, *Toxicological profile for Benzene*, ATSDR, US Department of Health and Human Services, Public Health Service, <<http://www.atsdr.cdc.gov/toxprofiles/tp3.pdf>>, p. 271.

<sup>3</sup> Leusch & Bartkow 2010, p. 5

BTEX compounds are typically measured in micrograms per litre ( $\mu\text{g/L}$ ), the equivalent of parts per billion (ppb). One ppb is roughly equivalent to a teaspoon of material in an Olympic-size swimming pool. The various guidelines for BTEX in relation to water are outlined in Table 2.

### BTEX compounds and coal seam gas

In March 2012, the NSW Government banned the use of BTEX compounds as an additive for any coal seam gas (CSG) drilling and hydraulic fracture stimulation (or fracking) activities under the *Petroleum (Onshore) Act 1991* (see Policy Number TI-O-120 *Ban on use of BTEX compounds in CSG activities*, NSW Trade and Investment 2012). This policy also stipulates that all drilling and fracking additives must be tested and demonstrated not to contain BTEX chemicals above the Australian Drinking Water Guidelines, which are detailed in Table 2.

Fracking is the process of pumping high pressure fluids into a coal seam to fracture the seam and

allow gas to flow into the gas well. Fracking fluid consists primarily of water and sand but small amounts of additives are used to thicken the fluid and improve the efficiency of the process.

### BTEX in CSG extracted water

Given that BTEX is naturally occurring, it is possible that flowback and produced water from CSG wells may contain traces of BTEX compounds. Flowback water is the water that returns to the surface after fracking has been completed and will contain traces of the additives that have been added for fracture stimulation. Produced water is the water that is then removed from a coal seam to depressurise the coal seam and release the gas.

The management of this flowback and produced water is regulated by an Environment Protection Licence (EPL), which is issued by the NSW Environment Protection Authority (EPA). The flowback water must be treated at an EPA licensed waste treatment facility before being disposed of in a lawful manner.

**Table 1.** Estimated daily intakes of BTEX. All values are in micrograms per day ( $\mu\text{g/d}$ ).

	Benzene $\mu\text{g/d}$	Toluene $\mu\text{g/d}$	Ethylbenzene $\mu\text{g/d}$	Xylenes $\mu\text{g/d}$
Breathing air	90–1,300	2–12,000	2–3,600	70–2,000
Cigarette smoke	1,800	2,000	40	Up to 190
Food	Up to 250	Up to 64	NA	NA

**Source:** Leusch & Bartkow 2010, p. 4

**Table 2.** Water guidelines for BTEX. All values in micrograms per litre ( $\mu\text{g/L}$ ).

	ADWG <sup>a</sup>	GDWQ <sup>b</sup>	NPDWR <sup>c</sup>
Benzene	1	10	5
Toluene	800	700	1,000
Ethylbenzene	300	300	700
Xylene	600	500	10,000 (total xylenes)

**Source data:**

a From *Australian Drinking Water Guidelines 6* (ADWG), NHMRC & NRMCC 2011, p. 166, p. 170, p. 177, p. 178

b From *Guidelines for Drinking-water Quality* (GDWQ), WHO 2011, p. 322, p. 422, p. 474, p. 475

c From *National Primary Drinking Water Regulations* (NPDWR), USEPA 2009

Similarly, produced water must be collected, treated and disposed of in accordance with various approvals and licences, including an EPL. The management, treatment, transport and disposal of the CSG derived waste water will follow the same legal requirements as any industrial process that generates waste.

## Ensuring compliance

The NSW Government requires that all CSG activities meet strict standards for environmental and resource management. This is achieved by:

- imposing conditions to ensure high standards are required of CSG companies
- monitoring exploration and production activities across the state to ensure compliance programs are deployed and potential breaches are identified in a timely and efficient manner
- investigating alleged breaches of licences or legislation
- taking appropriate action when a breach occurs
- regular review and reporting
- educating the community and CSG exploration companies to promote voluntary compliance.

A range of compliance and enforcement mechanisms are available in accordance with the NSW legislative and policy framework including penalty notices and, if required, prosecution.

## Reporting of environmental incidents

The NSW Government requires CSG companies to report environmental incidents in accordance with the provisions of the EPL and the Pollution Incident Response Management Plan required for all activities that hold an EPL.

If a community member observes an environmental incident associated with CSG operations they can phone the EPA's Environment Line on 131 555.

## Further information

The EPA is responsible for managing environmental issues, responding to pollution incidents and enforcing environmental regulations.

Visit: [www.epa.nsw.gov.au](http://www.epa.nsw.gov.au)

For further information about CSG activities, visit NSW Resources and Energy website <http://www.resourcesandenergy.nsw.gov.au/landholders-and-community/coal-seam-gas>

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## References

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- National Health and Medical Research Council (NHMRC) & National Resource Management Ministerial Council (NRMMC) 2011, *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, Commonwealth of Australia, Canberra, <[https://www.nhmrc.gov.au/\\_files\\_nhmrc/publications/attachments/eh52\\_australian\\_drinking\\_water\\_guidelines\\_150413.pdf](https://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh52_australian_drinking_water_guidelines_150413.pdf)>.
- NSW Trade and Investment 2012, *Policy Number TI-O-120 Ban on use of BTEX compounds in CSG activities*, <<http://www.trade.nsw.gov.au/policies/items/ban-on-use-of-btex-compounds-in-csg-activities>>.
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- World Health Organization (WHO) 2011, *Guidelines for Drinking-water Quality 4th Edition*, WHO, <[http://whqlibdoc.who.int/publications/2011/9789241548151\\_eng.pdf](http://whqlibdoc.who.int/publications/2011/9789241548151_eng.pdf)>.