

### At a glance...

- ❖ Short-lived in atmosphere, may leach from soil to ground water, migrates rapidly in ground water
- ❖ Common exposures include ingestion, inhalation of vapors, and dermal contact
- ❖ Most important route with respect to dose and risk is ingestion
- ❖ Classified as “likely to be carcinogenic to humans”
- ❖ Massachusetts does not currently have an enforceable drinking water standard for 1,4-dioxane but it does have a guideline of 0.3 ug/L that is intended to protect public health.

### Introduction

1,4-Dioxane is a chemical used in the manufacture of many products including paint strippers, varnishes, shampoos, deodorants and pharmaceuticals (EPA, 2006; Mohr, 2001). It dissolves readily in water and has been found to contaminate groundwater throughout the United States. Sources of groundwater contamination include improperly disposed of industrial or municipal waste that may include leachate from landfills and possibly septic systems (Abe, 1999). The behavior of 1,4-dioxane in the environment creates challenges for its characterization and treatment.

### What happens to 1,4-dioxane in the environment?

- ❖ 1,4-dioxane does not stick to soil particles so once in the ground it may move rapidly from soil to groundwater (EPA 2006).
- ❖ It may move rapidly in groundwater, ahead of other contaminants, and does not volatilize rapidly from surface water to air (EPA 2006).
- ❖ If it gets into air it breaks down quickly, with half gone in less than 10 hours (Mohr 2001).
- ❖ It does not bioconcentrate (i.e., concentrate in particular body tissue or fluids) in the food chain (ATSDR 2012; Mohr 2001), nor does it accumulate in people, plants or fish (ATSDR 2012).

### How might I be exposed to 1,4-dioxane?

- ❖ Exposure may occur through ingestion of contaminated water, inhalation of vapors during showering/bathing, or cooking, or dermal (skin) contact during showering/bathing (DHHS 2011).
- ❖ Preliminary studies have found ingestion of contaminated water to be the most significant exposure route, in terms of dose and health risk (MassDEP, 2013).

### What happens to 1,4-dioxane in the human body?

- ❖ Once absorbed into the body through ingestion, inhalation or contact with skin, 1,4-dioxane is distributed rapidly and uniformly in the lung, liver, kidney, spleen, colon, and skeletal muscle tissue (ATSDR 2012).
- ❖ 1,4-dioxane is broken down in the liver and excreted in urine within 1-2 days of exposure.
- ❖ At high concentrations it is shown in animals to damage cells in the liver and kidney.

### What are the health effects of 1,4-dioxane?

- ❖ Short-term exposure to high concentrations may result in irritation of the eyes and throat (ATSDR 2012).
- ❖ Long term exposure to concentrations above the drinking water standard may result in dermatitis, eczema, drying and cracking of skin, and liver and kidney damage (ATSDR 2012; EPA OSW 1996).
- ❖ EPA has classified 1,4-dioxane as “likely to be carcinogenic to humans” (EPA IRIS 2010). This means there is evidence that it is carcinogenic in rats.
- ❖ Reproductive effects of 1,4-dioxane are unknown. One study in rats indicated that early skeletal development and fetal and pregnant body weights were negatively affected at high doses of 1,4-dioxane (ATSDR 2012; EPA IRIS 2010).

## Can I be tested for 1,4-dioxane exposure?

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- ❖ Since 1,4-dioxane does not concentrate in particular body tissue or fluids, and it is rapidly broken down, it is very difficult to measure in the body. 1,4-Dioxane and some of its breakdown products can be measured in blood and urine, but the products are not specific to 1,4-dioxane, and they cannot predict the kind of health effects that might develop from an estimated exposure (ATSDR 2012). Such tests are not readily available by physicians.

## Are there any federal or state water standards for 1,4-Dioxane?

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- ❖ Federal Standards (required to be met):
  - No federal drinking water standards for 1,4-dioxane have been established (EPA 2012).
- ❖ Federal Guidelines (recommendations):
  - Minimal risk levels (MRL) have been established for 1,4-dioxane, which were estimated based on developmental and liver toxicity in animals studies. A MRL of 5,000 µg /kg/day was derived for acute (1 time) oral exposure, 500 µg /kg-day for oral exposure lasting weeks to months, and 100 µg /kg-day for daily exposure over several years (ATSDR 2012).
- ❖ Massachusetts Standards and Guidelines:
  - The MassDEP groundwater standard for groundwater located within a current or potential drinking water source area is currently set at 3.0 ug/L, based on the chronic oral cancer study in rats (MassDEP, 2011). This number is being revised to be consistent with the MassDEP drinking water guideline and will be lowered to 0.3 ug/L in the Fall of 2013.

## Where can I find more information about 1,4-Dioxane?

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- ❖ Agency for Toxic Substances and Disease Registry (ATSDR). 2012. "Toxicological Profile for 1,4-Dioxane." [www.atsdr.cdc.gov/toxprofiles/tp187.pdf](http://www.atsdr.cdc.gov/toxprofiles/tp187.pdf)
- ❖ EPA. 2012. 2012 Edition of Drinking Water Standards and Health Advisories. <http://water.epa.gov/action/advisories/drinking/upload/dwstandards2012.pdf>
- ❖ EPA. 2012. "1,4 Dioxane" [www.clu-in.org/contaminantfocus/default.focus/sec/1,4-Dioxane/cat/Overview/](http://www.clu-in.org/contaminantfocus/default.focus/sec/1,4-Dioxane/cat/Overview/)
- ❖ EPA Integrated Risk Information System (IRIS). 2010. "1,4-Dioxane (CASRN 123-91-1)." [www.epa.gov/iris/subst/0326.htm](http://www.epa.gov/iris/subst/0326.htm)

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## References

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- MassDEP 2013. *Risk Assessment, Toxics & Hazards. Shortforms.* Available from: <http://www.mass.gov/dep/service/compliance/riskasmt.htm#water> Accessed April, 2013.
- MassDEP 2011. *Standards & Guidelines for Contaminants in Massachusetts Drinking Water.* Available from: <http://www.mass.gov/dep/water/drinking/standards/14dioxan.htm> Accessed April, 2013.