Fact Sheet

State Water Board Actions on 1,4-Dioxane, a Compound Found in Drinking Water

What is 1,4-dioxane?

1,4-Dioxane is a synthetic chemical historically used as a stabilizer for industrial chlorinated solvents, predominantly 1,1,1- trichloroethane (TCA) [1]. TCA was phased out under the 1995 Montreal Protocol, and the use of 1,4-dioxane as a solvent stabilizer decreased [1]. 1,4-Dioxane is currently used as a solvent in a number of industrial applications [2], [3]. Although not intentionally used in commercial application, 1,4-dioxane is found as a trace contaminant in some foods, pharmaceuticals, cosmetic products, and detergents [2]. Manufacturers generally take extra steps to reduce 1,4-dioxane content in consumer products, as recommended by the Food and Drug Administration. Due to recent advances in analytical techniques, 1,4-dioxane can now be detected in drinking water near a significant risk level.

What are the Water Boards planning regarding 1,4-dioxane?

The State Water Resources Control Board (State Water Board) intends to begin a rulemaking process to set a drinking water standard, known as a maximum contaminant level (MCL), for 1,4-dioxane. In order to set an MCL, California's Office of Environmental Health Hazard Assessment (OEHHA) must first evaluate risk and develop a public health goal. On January 22, 2019, the State Water Board sent a memo to OEHHA requesting the establishment of a public health goal for 1,4-dioxane.

Starting in December 2019, the State Water Board will reconvene an expert panel to consider whether to recommend monitoring for 1,4-dioxane in aquatic ecosystems. The expert panel will provide science-based recommendations for monitoring of constituents of emerging concern in aquatic ecosystems, including oceanic, brackish and fresh waters across the state of California, that receive discharge of treated municipal wastewater effluent and stormwater.

How can 1,4-dioxane affect people's health and what are the risks?

1,4-Dioxane causes cancer in laboratory animals and is reasonably anticipated to be a human carcinogen, and was first listed in the Annual Report on Carcinogens in 1981 [3]. In 1988, OEHHA added 1,4-dioxane to the list of chemical known to the state to cause cancer.

Limited information is available regarding potential reproductive and developmental effects of 1,4-dioxane [2]. Several studies show elevated rates of spontaneous abortion and stillbirths associated with occupational exposure to a combination of chemicals that included 1,4-dioxane; however, the role of 1,4-dioxane, if any, remains unknown [4], [5]. Acute toxic effects from short-term exposure to 1,4-dioxane are not likely to occur at concentrations normally found in the U.S. environment and drinking water [2]. Exposure to high quantities of 1,4-dioxane for a short period time through inhalation causes irritation of the eyes, nose and throat in humans [6]. Exposure to very high amounts of 1,4-dioxane has resulted in severe kidney and liver effects and several deaths in occupational workers [7].

How are people exposed to 1,4-dioxane?

Exposure to 1,4-dioxane primarily occurs through drinking contaminated water, followed by indoor air [8]. Less significant exposures occur through ingestion of contaminated food and handling of contaminated consumer products [8]. Workers may be exposed through inhalation of vapors [2], [9].

How does 1,4-dioxane get into drinking water?

1,4-Dioxane enters wastewater principally from industrial discharges, with low, widespread, and continuous contributions from commercial products that are washed down the drain after use [10]. 1,4-Dioxane is persistent in the environment and highly soluble in water, which allows it to leach into and remain in groundwater [2]. 1,4-Dioxane does not stick to solids such as sludge, sediment, or carbon filters, making it difficult to remove by most wastewater and drinking water treatment processes [11]. Treated wastewater can contribute to 1,4-dioxane contamination of both surface water and groundwater, which may be used to produce drinking water [12].

Is 1,4-dioxane regulated in drinking water?

The State Water Board set a notification level (NL) of 1 microgram per liter (µg/L) in drinking water in November 2010, revising an earlier NL of 3 µg/L set in March 1998 that was based on a risk determination by the United States Environmental Protection Agency (U.S. EPA) and concurrence from OEHHA [13]. In August, 2010, U.S. EPA revised its 1,4-dioxane risk evaluation, lowering the recommended levels in drinking water by nearly 10-fold to 0.35 µg/L. Following U.S. EPA's re-evaluation of risk, the State Water Board revised the NL to 1 µg/L in November 2010, considering analytical limitations at the time.

On January 22, 2019, the State Water Board sent a memo to OEHHA requesting OEHHA establish a public health goal for 1,4-dioxane. OEHHA's public health goal will be used by the State Water Board to set an MCL for 1,4-dioxane in drinking water. MCLs are required to be established at a level as close to its public health goal as is technologically and economically feasible, placing primary emphasis on the protection of public health.

Is 1,4-dioxane monitored in drinking water?

Drinking water systems in California are not currently required to routinely monitor for 1,4-dioxane; however, some systems have either voluntarily sampled or have been directed to sample by the State Water Board pursuant to Health and Safety Code section 116400. Based on State Water Board data from 2009 to 2019, 195 active and standby public water wells (of 1,556 sampled) had at least one detection of 1,4-dioxane above the NL (1 µg/L) [14]. Most detections occurred in Los Angeles (163) and Orange (29) counties. There were also two detections above the NL in Monterey and one in Santa Barbara counties.

From 2013 to 2015, the U.S. EPA, under the Unregulated Contaminant Monitoring Rule (UCMR 3), required all large water systems (i.e., water systems serving over 10,000 people) to collect and analyze more than 12,000 drinking water samples for 1,4-dioxane. This occurrence data identified 23 public water sources in California with detections of 1,4-dioxane. A summary of the findings for California is available on the State Water Board website.

How do I find out if my drinking water contains 1,4-dioxane?

Most Californians receive their drinking water from public water systems. These systems are subject to many state and federal regulations intended to ensure that the water the systems provide to their customers is safe. If you receive water from a public water system, you may be able to find information on contaminants in your drinking water on the Drinking Water Watch Webpage. In order to determine which public water system your water comes from, you can type your zip code or address into the search bar on this interactive map. Since 1,4-dioxane is not monitored statewide, it's possible that you

will not find information on the presence or absence of this contaminant in your drinking water using this database.

If your drinking water comes from a privately owned domestic well, you can test for contaminants, including 1,4-dioxane. When choosing a laboratory to analyze for 1,4-dioxane in water, consider using a laboratory accredited for by California's Environmental Laboratory Accreditation Program (ELAP) for EPA Method 522.

What should I do if I find out that my drinking water is contaminated with 1,4-dioxane?

If 1,4-dioxane is detected above the notification level of 1 µg/L, the public water system is required to notify the governing body of the local agency in which users of the drinking water reside, and is recommended to inform its customers about the presence of the contaminant and associated health concerns. If 1,4-dioxane is detected above the response level of 35 µg/L, the contaminated source may be removed from distribution [15].

If 1,4-dioxane is found in your drinking water above the notification level, you may choose to drink bottled water; however, there is no guarantee that bottled water would not contain 1,4-dioxane, since the Food and Drug Administration and California Department of Public Health's Food and Drug Branch (which regulate bottled water) do not require bottled water manufacturers to monitor for or remove 1,4-dioxane [16]. If considering purchasing a home treatment device to reduce your exposure to 1,4-dioxane from drinking water, you should be aware that there are currently no standards for home water treatment devices that specifically include 1,4-dioxane. The Division of Drinking Water's Residential Water Treatment Devices program does not currently register any devices certified to remove 1,4-dioxane. If choosing to purchase a home water treatment device, be aware that commercial devices vary greatly in performance in the removal of 1,4-dioxane [17]. Reverse osmosis and granular activated carbon filters that are registered for VOCs reduction may be moderately effective at removing 1,4-dioxane [18], [19]. Further information will be provided as it becomes available.

Is 1,4-dioxane monitored in recycled water?

As of January 2017, facilities that produce recycled water for groundwater recharge using subsurface application are required by regulation to demonstrate advanced oxidation processes that achieve a minimum of 0.5-log (69 percent) removal of 1,4-dioxane through their water treatment systems [20]. Additionally, as of April 2019, facilities producing recycled water for groundwater recharge and reservoir water augmentation are required by the Recycled Water Policy to conduct quarterly monitoring of 1,4-dioxane.

Prior to April 2019, several facilities producing recycled water for groundwater recharge began conducting routine monitoring for 1,4-dioxane, including West Coast Basin Barrier Project (Los Angeles County), Alamitos Barrier (Los Angeles County), Orange County Groundwater Replenishment System (Orange County), and Chino Basin Groundwater Recharge (Orange County).

Is 1,4-dioxane monitored in surface water (i.e. lakes, rivers, estuaries and the ocean?)

1,4-Dioxane is monitored in some receiving waters (i.e. rivers, creeks, lagoons, and channels) by wastewater treatment plants on a permit-specific basis. For example, the Los Angeles Regional Water Quality Control Board requires National Pollutant Discharge Elimination System permittees to monitor for 1,4-dioxane in effluent and receiving waters on a semiannual or annual basis. The highest reported daily and monthly discharge recorded between November 1, 2009 and April 30, 2014 for 1,4-dioxane was 3.8 µg/L. Additionally, 1,4-dioxane is monitored in wastewater treatment plant influent and effluent

at multiple locations in Los Angeles County, Orange County, Ventura County, Sacramento County, Imperial County, and San Diego County on a permit-specific basis.

For more information, please visit the State Water Board 1,4-dioxane resource website as well the below scientific references.

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