



1,4-Dioxane: Regional Overview & Concerns or, Where to Find it and How to Regulate it

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NEWMOA 1,4-Dioxane Assessment & Remediation Workshop
Lebanon, NH



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1,4-DIOXANE REGIONAL OVERVIEW

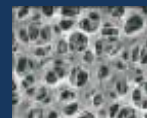
- How was it used and where to find it?
- How to regulate it?
- Is it in drinking water supplies?
 - Private Wells
 - Public Water Systems
- What about Industrial & Municipal waste water discharges?



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USES OF 1,4-DIOXANE

- **Solvent Stabilizer for 111-TCA**
- **As the Main Ingredient**
 - Cellulose Acetate Membrane Production
 - Scintillation Counting Cocktails/Bray's Solution
- **Synthesis of other products**
 - Brominated flame retardants
 - Pharmaceutical industry
 - Paper industry (coated paper)



Source: T. Mohr, Midwest GeoSciences Webinar, March 19 & 21, 2013.



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USES OF 1,4-DIOXANE (cont.)

- **As a Minor Ingredient**

- Magnetic tape production
- Tissue preservative in histology
- Inks and printing operations
- Painting, coating and stripping
- Polyurethane medical devices
- Brake cleaning sprays and fluids
- Wood glue and contact cement
- Loosening agent for hardware



Source: T. Mohr, Midwest GeoSciences Webinar, March 19 & 21, 2013.



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USES OF 1,4-DIOXANE (cont.)

- **Produced as By-Product**

- Photographic film recycling (dimethyl terephthalate, DMT)
- Aircraft deicing fluid
- Ethoxylated surfactant production
- Personal care products, Cosmetics, Shampoos
- Resin production
- PET plastic production
- Antifreeze production



Source: T. Mohr, Midwest GeoSciences Webinar, March 19 & 21, 2013.



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FACILITIES / OPERATIONS

Where 1,4-Dioxane Could Be Found

Degreasing operations	Electroplating/polishing
Paints, varnishes, lacquers, strippers	Inks, dyes, coatings, and adhesives
Pharmaceutical mfg. plants & laboratories	Polymers, plastics, and rubber
Petrochemical processing	Explosives mfg.
Semiconductors, electronic components	Commercial printing and photographic equipment



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FACILITIES / OPERATIONS

Where 1,4-Dioxane Could Be Found

Military Installations/DoD sites	NPL sites
RCRA CA sites	University and other landfills
Airports with de-icing fluids	Agricultural & veterinary products
Cotton, textiles	Pulp, paper, fiber manufacture
Personal care products (cosmetics, detergents, shampoos)	<i>Many places!</i>



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WHERE ARE NEWMOA STATES FINDING IT?

- Industrial sites that used solvents
 - Often with TCA and/or TCE & breakdown products
- Superfund sites
- LANDFILLS – *“in the soup”*
- Potable wells
- Car washes (NH)
- Waste water effluent & wells near large septic (NH)



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OTHER CONSIDERATIONS

- Why co-location with TCE?
- Leading edge of plume
- Can penetrate mineral structure of clay LF liners (T. Mohr)
- Retained in unsaturated silts/clays at 10-100x concentration as in adjacent sands (T. Mohr)
- Don't use polyethylene Passive-Diffusion Bag samplers
- Liquinox – present in trace amounts



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HOW TO REGULATE IT?

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EPA Risk Levels

Media	Regional Screening Levels (RSLs) for Superfund Sites (TR=10 ⁻⁶ , HQ=1), 6/2015	Removal Management Levels (RMLs) (TR=10 ⁻⁴ , HQ=3), 7/2015
Tap Water	0.46 µg/L	46 µg/L
Resident Soil	5.3 mg/kg	530 mg/kg
Industrial Soil	24 mg/kg	2,400 mg/kg
Resident Air	0.56 µg/m ³	---
Industrial Air	2.5 µg/m ³	---

But note...

RSLs are NOT cleanup levels! Used to determine which contaminants should be carried forward through Risk Assessment.

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EPA Risk Levels (cont.)

- 2012 Edition of the Drinking Water Standards and Health Advisories, April 2012 update
 - 35 µg/L – 10^{-4} cancer risk
 - Translates to 0.35 µg/L – 10^{-6} cancer risk
 - Likely to be carcinogenic to humans
- Used as UCMR3 Reference Concentrations



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STATE GROUNDWATER STANDARDS

State	Groundwater Standards
Connecticut <small>(1) DPH Advisory Level (2) Preliminary Draft</small>	3 µg/L ⁽¹⁾ – Private wells - drinking water 50 µg/L ⁽¹⁾ – Bathing/Showering 3 µg/L ⁽²⁾ – Groundwater Protection 960 µg/L ⁽²⁾ – Surface Water Protection
Massachusetts	0.3 µg/L - Drinking water supplies 0.3 µg/L - GW-1 areas (water supply zones) 6,000 µg/L - GW-2 areas (vol. risk near bldgs) 50,000 µg/L - GW-3 areas
Vermont	3 µg/L
New Hampshire	3 µg/L



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STATE GW STANDARDS (cont.)

State	Groundwater Standards
Rhode Island	Not established; tested at Superfund sites
Maine	4 µg/L – drinking water 72,000 µg/L – worker exposure
New York	50 µg/L for unspecified organics Future rule making?
New Jersey	10 µg/L Interim GW Quality Standard 3 µg/L for publicly funded actions 0.4 µg/L – proposed IGWQS



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STATE SOIL STANDARDS

State	Soil Standards
Connecticut *Preliminary Draft	6.1 mg/kg – Residential Direct Exposure 57 mg/kg – Industrial/Commercial DEC 0.1 mg/kg – GA Pollutant Mobility 0.6 mg/kg – GB Pollutant Mobility
Massachusetts	0.2 mg/kg – GW-1 areas 6 mg/kg – GW-2 20 mg/kg – S-1/GW-3 areas 90 mg/kg – S-2/GW-3 areas 500 mg/kg – S-3/GW-3 areas



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STATE SOIL STANDARDS (cont. 2)

State	Soil Standards
New Hampshire	5 mg/kg soil – leaching to GW 13 mg/kg – S-1 – direct contact 41 mg/kg – S-2 432 mg/kg – S-3
Vermont	2.69 mg/kg – Residential 17 mg/kg – Industrial
Maine	110 mg/kg – Residential 180 mg/kg – Park User 290 mg/kg – Commercial Worker 3,300 mg/kg – Construction Worker



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STATE SOIL STANDARDS (cont. 3)

State	Soil Standards
New York	9.8 mg/kg – Residential soil 13 mg/kg – Restricted Residential 130 mg/kg – Commercial 250 mg/kg – Industrial 0.1 mg/kg – Protection of GW and Eco resources



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OTHER STATE STANDARDS

State	Indoor Air/Volatilization
Vermont	0.32 $\mu\text{g}/\text{m}^3$ – Indoor air 3.2 $\mu\text{g}/\text{m}^3$ – Shallow soil gas 32 $\mu\text{g}/\text{m}^3$ - Deep soil gas >5' from structure



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1,4-DIOXANE IN PRIVATE WELLS?

- **Yes!** CT, NH, MA, RI, NJ

Solutions:

- ✓ Granular Activated Carbon (GAC) filters – but can be unreliable
- ✓ GAC and bottled water (CT, MA, NH)

- ✓ **Water Main Extension**



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1,4-DIOXANE IN PUBLIC WATER?

EPA's UCMR 3 Program

- Unregulated Contaminant Monitoring Rule 3
- 2013-2015 sampling, on-going thru Dec. 2015
- EPA Method 522, 0.07 µg/L MRL
- Preliminary results through June 2015
- **Yes!** But not everywhere.
- Primarily in groundwater sources.



Source: EPA UCMR3 webpage, accessed 9/1/2015

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1,4-DIOXANE IN PUBLIC WATER?

Nationwide Results – as of June 2015

- 28,702 samples analyzed from 4,394 PWS
- Detected above MRL in 3,350 samples from 943 PWS
 - 11.7% of samples, 21.5% of PWS
 - > **0.35 µg/L** : 882 samples from 294 systems
 - 3.1% of all samples
 - 6.7% of all PWS
 - > **35 µg/L** : **None**

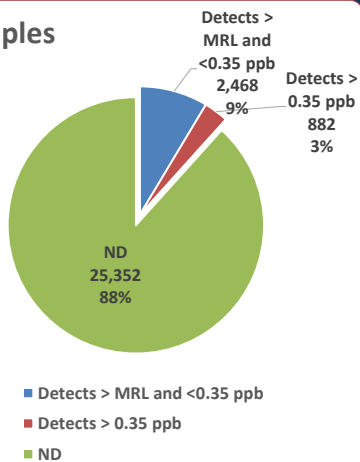


Source: EPA, June 2015. UCMR3: Data Summary. EPA 815-S-15-002.

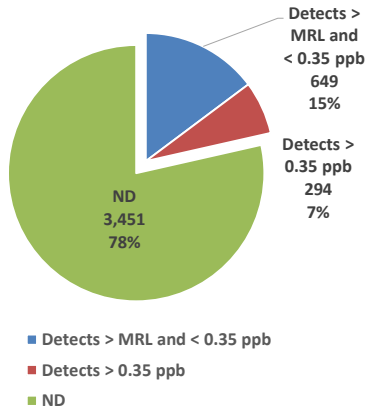
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NATIONWIDE DETECTIONS

Samples



Public Water Systems



Source: EPA, June 2015. UCMR3: Data Summary. EPA 815-S-15-002.



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1,4-DIOXANE IN PUBLIC WATER?

Public Water Systems in the Northeast

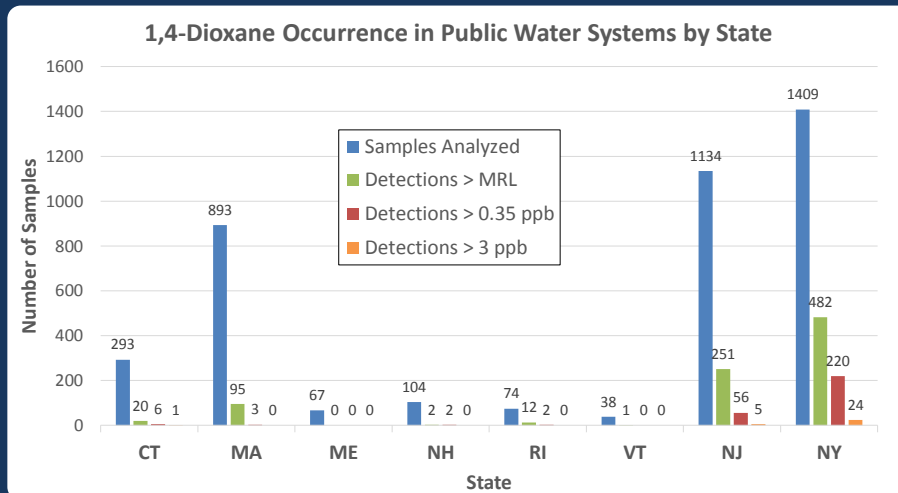
State	# Samples	# Detects	Range (µg/L)	Average (µg/L)	# Detects > 0.35 µg/L	# Detects > 3 µg/L
CT	293	20	0.077 – 3.6	0.42	6	1
MA	893	95	0.07 – 0.41	0.13	3	0
ME	67	0	---	---	---	---
NH	104	2	0.43 – 2.75	1.59	2	0
RI	74	12	0.074 -0.72	0.20	2	0
VT	38	1	0.11	---	0	0
NJ	1134	251	0.07 – 5.83	0.39	56	5
NY	1409	482	0.07 – 33	0.75	220	24

Source: EPA UCMR3 webpage and database, June 2015 data, accessed 9/1/2015



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OCCURRENCE IN PWS BY STATE



Source: EPA UCMR3 webpage and database, June 2015 data, accessed 9/1/2015

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INDUSTRIAL DISCHARGES

- CT - 1 site where 1,4-dioxane was known present, criteria set at 5 mg/L AML. Max. reported was 0.41 mg/L.
- RI requires monitoring, but no standard.
- No discharge limits set: MA, NJ, NY, NH, VT, ME
- Nothing uniform in the Northeast.



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POTW DISCHARGES

- 1,4-Dioxane not easily removed thru aerobic wastewater treatment (T. Mohr)
- Ann Arbor WWTP example – not treated
- No standards exist in Northeast
 - RI – requires annual monitoring, but no stds.
 - NH – 2 samples collected, 1-3 $\mu\text{g/L}$
 - MA – Tested at 1 WWTP, 0.7 $\mu\text{g/L}$
 - CT – Starting to look
 - Not looking – NJ, NY, ME, VT



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• **Future needs:**

- More looking, more sampling
- Continued toxicological research
- Consistent drinking water standard, MCL?
- Evaluate need for establishing discharge limits



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Questions?

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