

1 Supplementary Information

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3 **Total organic halogen (TOX) species formation at different locations in drinking water**

4 **distribution systems**

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17 **Table S1.** Selected water quality parameters of intake waters

	DOC, mg L ⁻¹				SUVA ₂₅₄ , L mg ⁻¹ m ⁻¹				Bromide, µg L ⁻¹				Iodide, µg L ⁻¹				Iodate, µg L ⁻¹				
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	
Plant1	4.4	3.3	3.5	3.6	1.9	2.3	2.2	2.6	128	130	140	97		1.2				1.0			
Plant2	4.7	3.4	3.6	3.7	1.8	2.2	2.3	2.6	126	130	140	92		1.5				ND			
Plant3	4.8	3.3	3.5	3.9	1.7	2.0	1.9	2.6	131	130	153	90		2.6				ND			
Plant4	1.4	0.3	NM	1.0	0.1	1.1	NM	0.6	117	100	NM	89	ND	ND			29.6	28			
Plant5	2.6	1.3	1.6	1.8	1.2	1.0	1.1	1.1	171	150	155	156	5.4	7.1			78.7	37			
Plant6	NM	3.2	4.8	4.1	NM	1.4	0.9	1.1	NM	480	513	444		3.6				9.4			
Plant7	3.8	3.5	5.3	2.2	2.0	4.2	3.9	3.4	13	23	30	18	ND					ND			
Plant8	3.7	2.1	2.6	1.7	1.8	3.3	2.8	2.2	45	70	45	59	ND					1.1			
Plant9	3.4	2.1	2.6	1.6	1.9	3.6	2.8	2.4	33	61	39	57	ND					ND			
Plant10	3.4	3.9	2.9	2.7	1.6	1.6	2.0	1.9	69	58	69	62	ND					1.7			
Plant11	3.4	3.9	2.9	2.7	1.6	1.6	2.0	1.9	69	58	69	62	ND					1.7			

18 NM: not measure, ND: not detected.

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20 **Table S2.** THMs ($\mu\text{g L}^{-1}$) in the samples collected at effluent and in distribution system with average and maximum retention times.

	Spring			Summer			Fall			Winter		
	Effluent	Ave RT	Max RT	Effluent	Ave RT	Max RT	Effluent	Ave RT	Max RT	Effluent	Ave RT	Max RT
Plant1	53.3	46.6	48.0	81.6	71.6	77.9	75.9	78.3	83.9	29.5	25.5	28.0
Plant2	46.2	41.3	42.5	65.9	57.8	49.6	68.2	78.9	66.2	26.5	22.2	22.2
Plant3	53.0	46.2	47.8	59.3	63.6	62.4	63.8	69.9	62.1	29.8	22.7	25.4
Plant4	0.2	15.0	8.0	0.6	18.4	15.9	0.7	14.6	14.1	0.2	6.5	8.4
Plant5	15.4	9.7	4.6	21.0	23.4	17.8	12.9	20.4	17.5	5.2	11.3	4.0
Plant6				32.4	41.4	51.3	28.7	11.4	42.3	16.1	6.7	25.5
Plant7	74.8	75.4	76.1	109	95.3	101.5	54.3	41.2	44.1	11.4	10.8	13.5
Plant8	77.3	75.8	64.7	109.6	94.5	101	46.9	46.2	45.3	10.9	11.5	12.3
Plant9	90.1	74.6	86	77.4	85.2	81.5	34.3	34.3	41.8	8.6	7.8	8.3
Plant1 0	9.2	35.9	33.3	20.2	65.9	97.9	17.2	66.6	87.4	14.1	49.4	55.3
Palnt1 1	15.6	29.7	41.8	27.6	69.7	87.6	24.7	63.5	82.9	16.5	51.4	53.1

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22 **Table S3.** HAAs ($\mu\text{g L}^{-1}$) in the samples collected at effluent and in distribution system with average and maximum retention times.

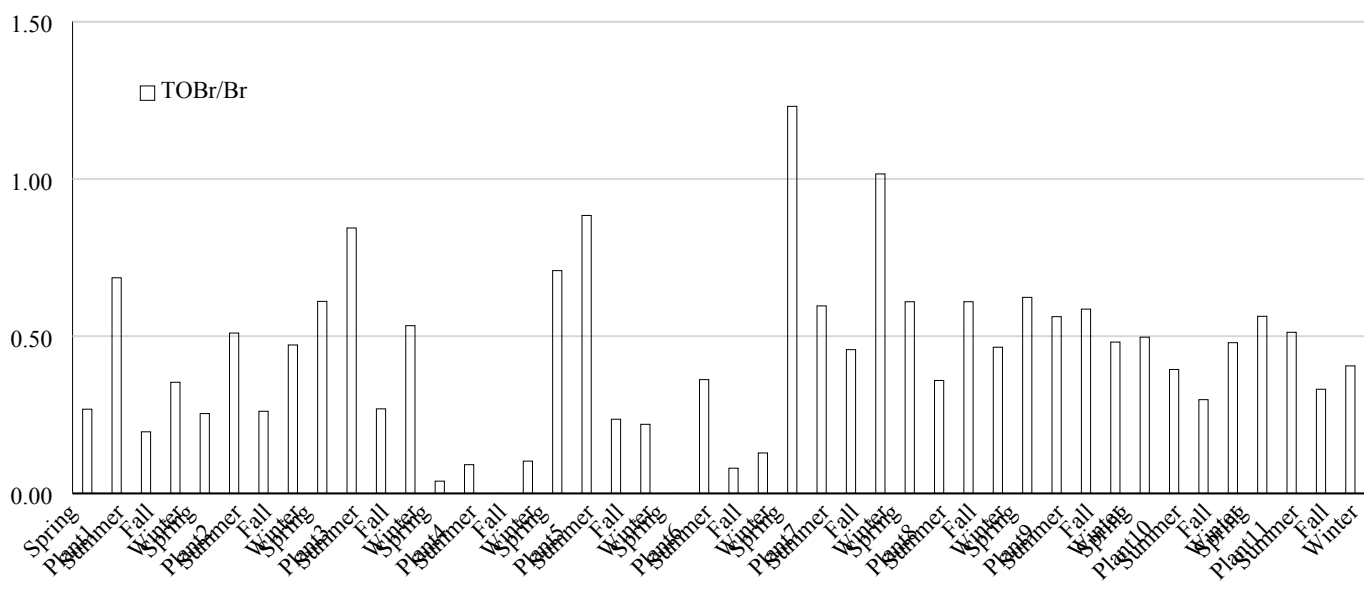
	Spring			Summer			Fall			Winter		
	Effluent	Ave RT	Max RT	Effluent	Ave RT	Max RT	Effluent	Ave RT	Max RT	Effluent	Ave RT	Max RT
Plant1	33.7	34.6	39.2	31.1	24.6	29.7	17.5	13.7	16.5	25.8	21.9	24.5
Plant2	36.5	33.3	33.6	31.1	30.9	21.9	15.7	16.9	15.7	23.2	21.0	21.8
Plant3	35.5	35.5	25.8	31.6	32.1	32.8	14.8	12.8	17.4	23.4	21.7	21.3
Plant4	0.3	21.2	8.2	0.1	17.0	11.6	0.8	8.4	5.2	0.4	3.7	1.8
Plant5	26.1	6.8	2.8	16.6	17.1	15.8	9.4	8.6	7.6	5.2	1.5	2.0
Plant6				17.5	18.1	19.5	5.9	9.5	8.8	2.8	3.4	5.8
Plant7	55.4	43.2	63.0	66.9	46.2	54.8	43.4	40.1	26.0	28.5	26.8	29.8
Plant8	67.4	39.8	53.5	64.0	47.3	57.5	14.9	10.3	8.7	13.5	8.8	21.0
Plant9	56.0	51.5	67.6	44.4	42.8	27.2	17.2	20.4	20.5	14.2	12.8	13.5
Plant10	10.6	25.6	29.4	9.5	21.0	43.2	5.8	20.6	21.9	12.5	31.9	42.0
Plant11	22.2	37.7	51.7	13.9	32.6	43.0	12.9	17.9	15.5	15.4	37.9	54.6

24 Table S4. Average temperature of the months when sampling events occurred in the areas where the
 25 plants are located.

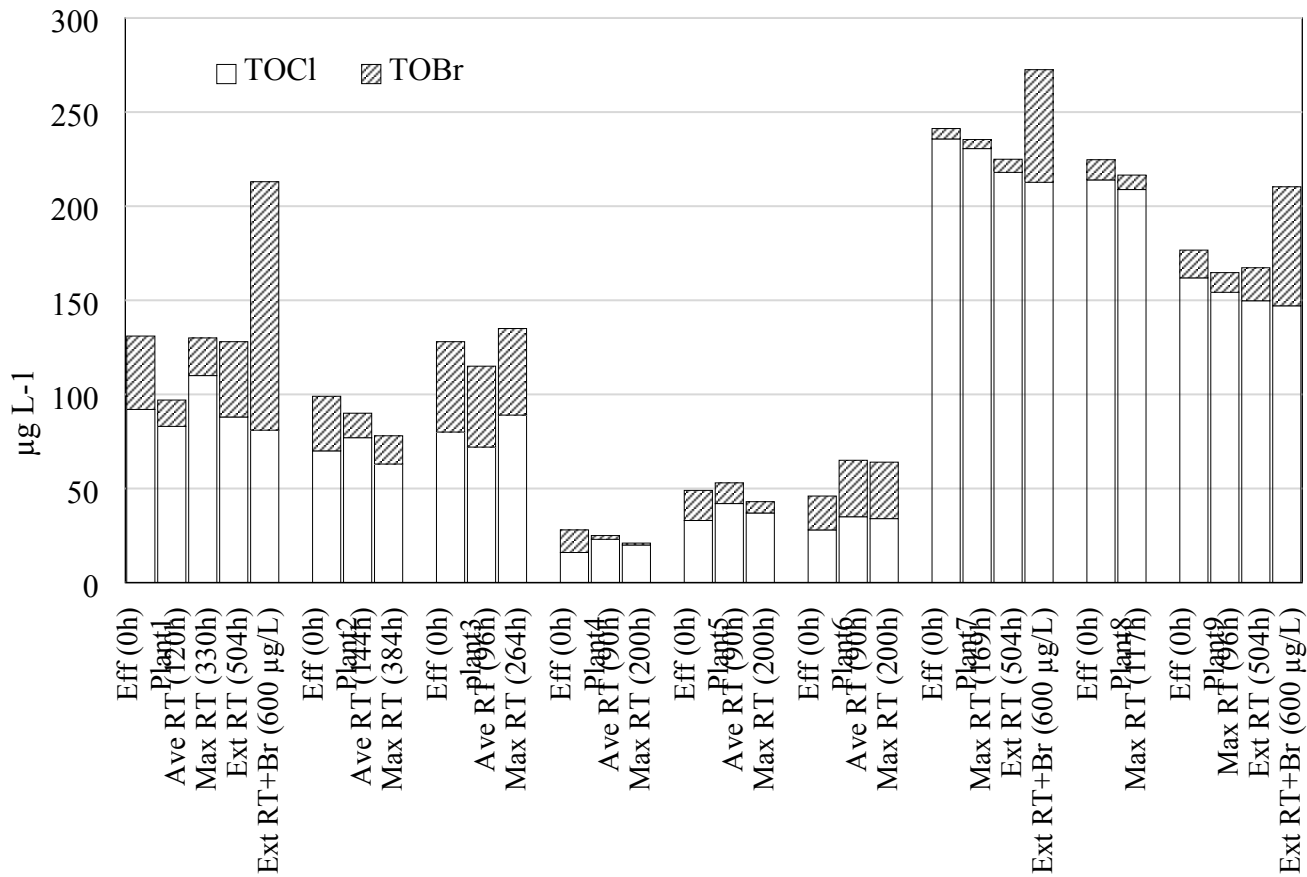
		Spring	Summer	Fall	Winter
Plants 1-3		Apr 2019	Jul 2019	Oct 2019	Jan 2019
	Ave. High (°C)	27.0	36.3	28.7	16.4
	Ave. Low (°C)	14.6	24.2	15.4	5.4
	Ave (°C)	20.8	30.25	22.05	10.9
	Total Precipitation (mm)	185.0	10	106.5	86.1
Plants 4-6		Mar 2019	Jul 2019	Oct 2019	Dec 2018
	Ave. High (°C)	16.6	34.9	21.7	10.9
	Ave. Low (°C)	2.4	20.6	6.3	-1.7
	Ave (°C)	9.5	27.8	14.0	4.6
	Total Precipitation (mm)	28.8	114.6	28.2	36.6
Plants 7-9		Apr 2019	Aug 2019	Oct 2018	Jan 2019
	Ave. High (°C)	20.4	30.1	18.9	4.7
	Ave. Low (°C)	9.6	20.8	11.0	-3.2
	Ave (°C)	15.0	25.5	15.0	0.8
	Total Precipitation (mm)	76.8	70.8	78.3	100.0
Plants 10,11		Mar 2019	Jun 2019	Oct 2019	Jan 2020
	Ave. High (°C)	19.6	36.6	25.2	12.6
	Ave. Low (°C)	3.9	16.5	9.3	-0.3
	Ave (°C)	11.8	26.6	17.3	6.2
	Total Precipitation (mm)	20.0	3.0	11.0	24.0

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 29 **Fig.S1** Seasonal changes of TOBr/Br⁻ of eleven plants. TOBr as Cl⁻ of plant effluent was divided by
 30 influent Br⁻.
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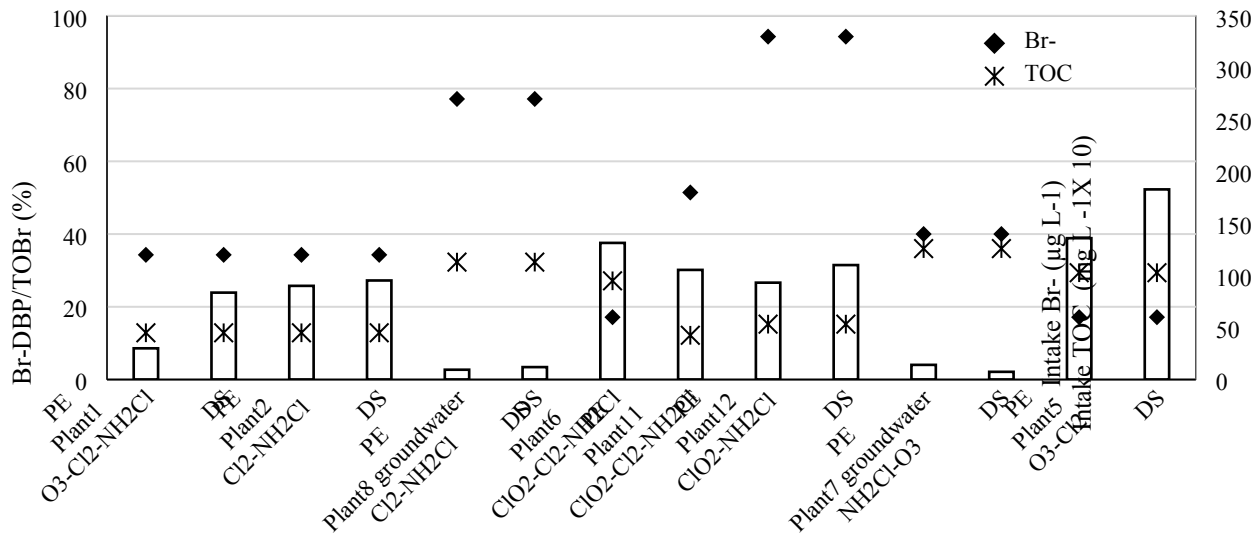


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33 **Fig.S2** The holding experiment results with effluent samples collected from 9 chloraminated plants.

34 Ext RT denotes extended retention time (i.e., 504 h).

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37 **Fig. S3** Calculated ratios of the regulated brominated DBPs to TOBr using the data reported Weinberg
 38 et al., (2002) along with plant configurations, intake DOC (or TOC) and Br- concentrations. PE: plant
 39 effluent, DS: distribution system.

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43 **Reference**

44 H.S. Weinberg, S.W. Krasner, S.D. Richardson and A.D. Thruston, The Occurrence of Disinfection
 45 By-Products (DBPs) of Health Concern in Drinking Water: Results of a Nationwide DBP Occurrence
 46 Study. EPA/600/R-02/068. Athens, GA, 2002.