

SUPPORTING INFORMATION

for

Drivers of Disinfection Byproduct Cytotoxicity in U.S. Drinking Water: Should Other DBPs Be Considered for Regulation?

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Text S1. Unregulated disinfection by-product extraction procedure

Raw (untreated) and distribution system at average detention (Dist. Avg.) samples were extracted in duplicate. The 53 priority, unregulated haloacetonitriles (HANs), haloacetamides (HAMs), halonitromethanes (HNMs), iodinated trihalomethanes (I-THMs), iodinated haloacetic acids (I-HAAs), haloketones (HKs), and tri-haloacetaldehydes (tri-HALs) were extracted in a single method.¹⁻⁵ For this procedure, 100 mL samples were adjusted to pH < 1.0 with concentrated H₂SO₄, spiked with 30 g of sodium sulfate and 5 mL of methyl *tert*-butyl ether (MTBE), and shaken for 15 min on a mechanical shaker. This was done three times, with a 10-minute wait in between each shake for phase separation before removing the organic layer into a separate container. After passing the 15 mL of final extract over dried Na₂SO₄ to remove excess water, the extract was concentrated under nitrogen to a final volume of 200 µL and spiked with internal standard (1,2-dibromopropane). Half of this extract was used for analysis of HANs, HAMs, HNMs, I-THMs, IAAs, HKs, and tri-HALs, and the second 100 µL extract underwent diazomethane derivatization for analysis of the four I-HAAs.

Text S2. Total organic halogen procedure

First, 50 mL of sample was adjusted to pH 2 with concentrated HNO₃ and passed through two activated carbon (AC) columns, then the columns were washed with 10 mL of 5,000 mg/L of KNO₃ adjusted to pH 2. Each AC was then loaded onto a ceramic boat and automatically loaded into a quick furnace (AQF-2100H) using an automatic solid sampler (ASC-240S). The ACs were pyrolyzed inside the furnace at 1000°C, and the produced gasses were bubbled into centrifuge tubes that contained 5 mL of adsorption solution (0.003% H₂O₂, 0.01 mM phosphate) using a gas absorption unit (AU-250). The

adsorption solution was analyzed for chloride, bromide, and iodide with a 1600 ion chromatography (IC) system (Dionex, Sunnyvale, CA). For low iodide concentrations ($<10\text{ }\mu\text{g/L}$), a Finnigan ELEMENT XR double focusing magnetic sector field ICP-MS instrument (Thermo Electron Corporation) instrument was used for quantification.^{4,6}

Text S3. Chinese Hamster Ovary (CHO) cell chronic cytotoxicity assay

After XAD ethyl acetate extracts were solvent-exchanged into dimethyl sulfoxide (DMSO), a 96-well flat-bottomed microplate was used to evaluate a series of concentrations of the concentrated water sample (CWS) for each experimental group. One column of eight microplate wells served as the blank control consisting of 200 μL of F12 + 5% fetal bovine serum (FBS) medium only. The concurrent negative control column consisted of wells with 3×10^3 CHO cells plus F12 + FBS medium. The remaining wells within the experiment contained 3×10^3 CHO cells, F12 + FBS and a known volume of the CWS for a total of 200 μL . The wells were covered with a sheet of sterile Alumna Seal™ to prevent volatile cross contamination of adjacent wells. The microplate was placed on a rocking platform at 37°C for two 5 min-periods (turning the plate 90° after the first 5 min). This step is important to ensure an even distribution of cells across the bottom of the microplate wells. The cells were incubated for 72 h at 37°C under 5% CO_2 .

After the treatment time, the medium from each well was aspirated, the cells fixed in methanol for 5 min and stained for 10 min with a 1% crystal violet solution in 50% methanol. The microplate was washed in tap water and patted dry and 50 μL of dimethyl sulfoxide (DMSO)/methanol (3:1 v/v) was added to each well; the plate was incubated at room temperature for 10 min. The microplate was analyzed at 595 nm with a SpectraMax™ microplate reader. This assay was calibrated and there was a direct

relationship between the absorbance of the crystal violet dye associated with cell density and the number of viable cells.⁷ The averaged absorbance of the blank wells was subtracted from the absorbance data from each microplate well. The mean blank-corrected absorbance value of the negative control was set at 100%. The absorbance for each treatment group well was converted into a percentage of the negative control. This procedure normalized the data, maintained the variance and allowed the combination of data from multiple microplates. For each experiment, a series of concentrations (generally 10 concentration factors) are constructed by diluting the DMSO concentrate, and then mixed with culture medium just prior to the experiment. A median lethal concentration (LC_{50}) \pm standard error (SE) value could be generated, which is the concentration of the water sample, determined from a bootstrap multiple regression analysis of the data,^{8–11} that induced a cell density of 50% as compared to the concurrent negative control. A cytotoxicity index (CTI) could then be found using the LC_{50} , which is defined as the $LC_{50}^{-1}(10^3)$, such that cytotoxic potency could be easily ranked (higher CTI, higher cytotoxicity).

Literature Cited

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Tables and Figures

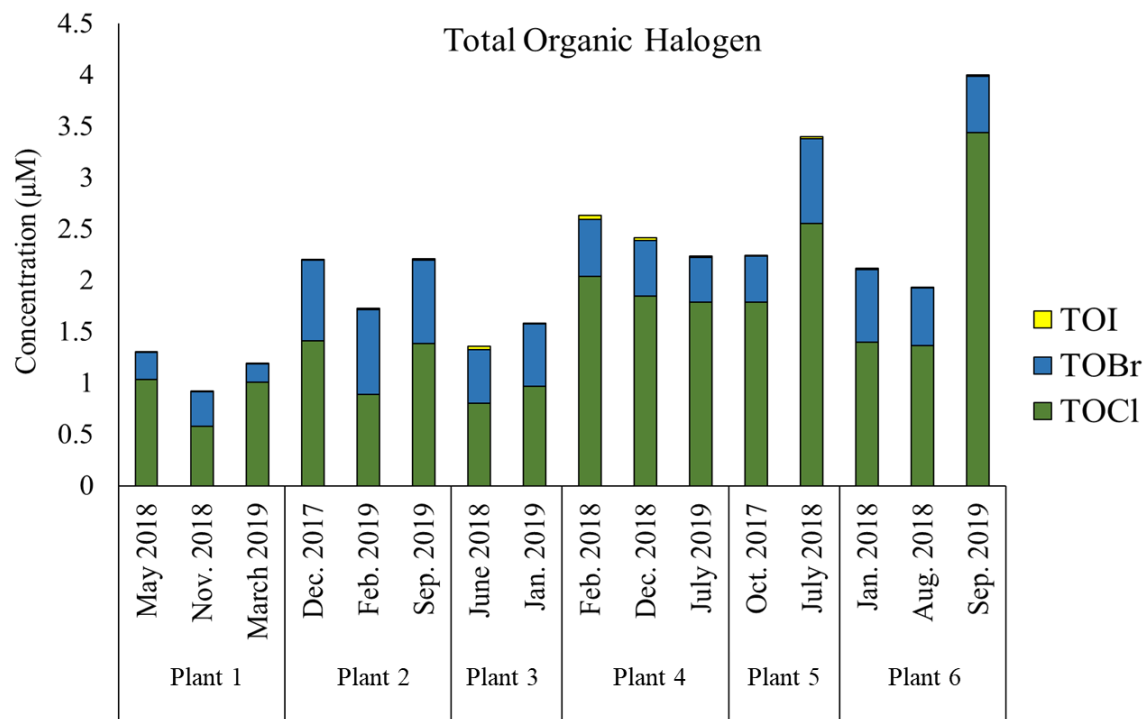


Figure S1. TOX data for all plants (distribution system/average).

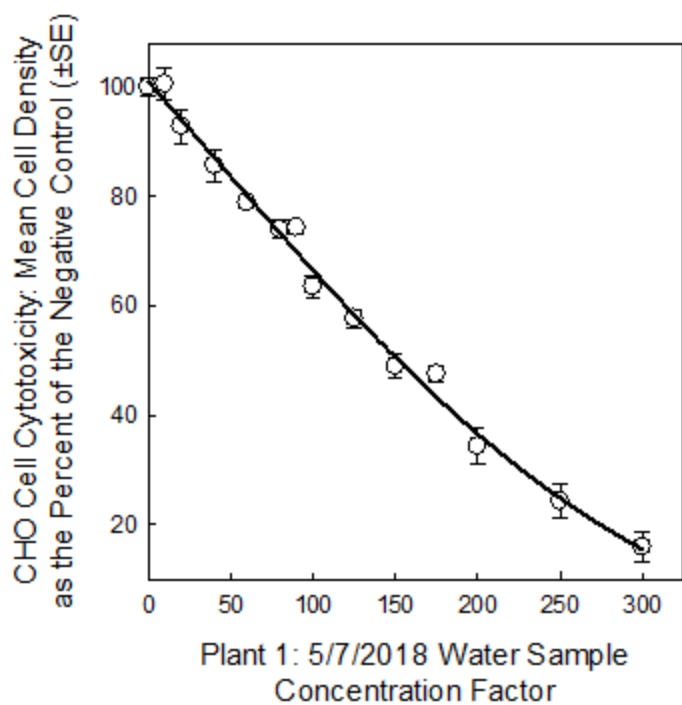


Figure S2. CHO cell cytotoxicity concentration-response curve for Plant 1 sample 5/7/2018.

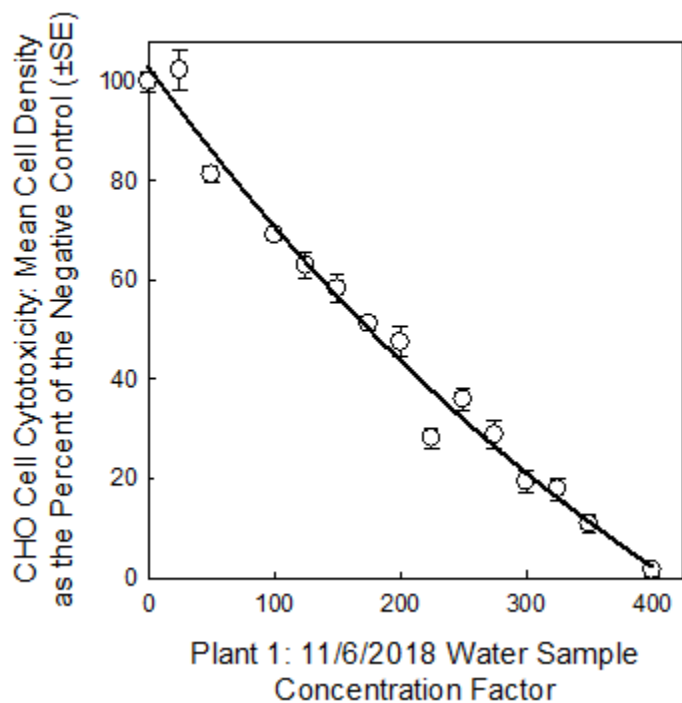


Figure S3. CHO cell cytotoxicity concentration-response curve for Plant 1 sample 11/6/2018.

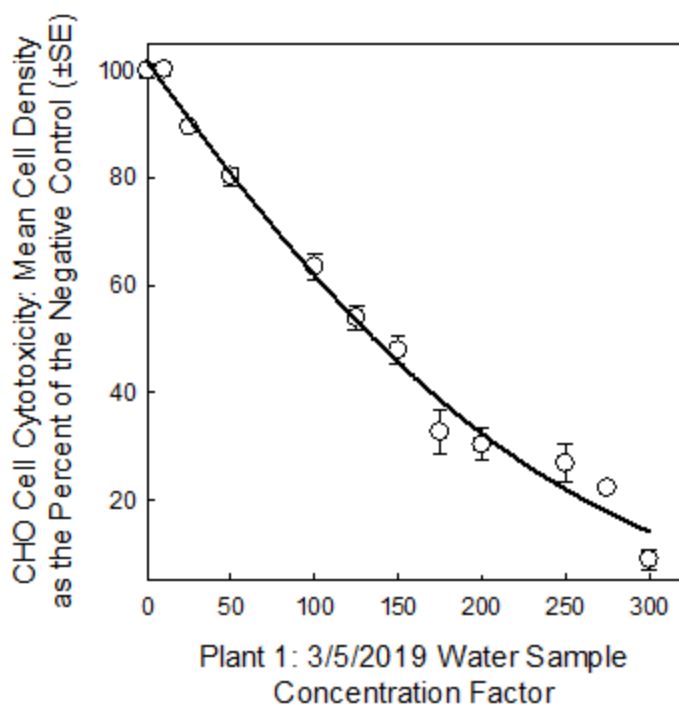


Figure S4. CHO cell cytotoxicity concentration-response curve for Plant 1 sample 3/5/2019.

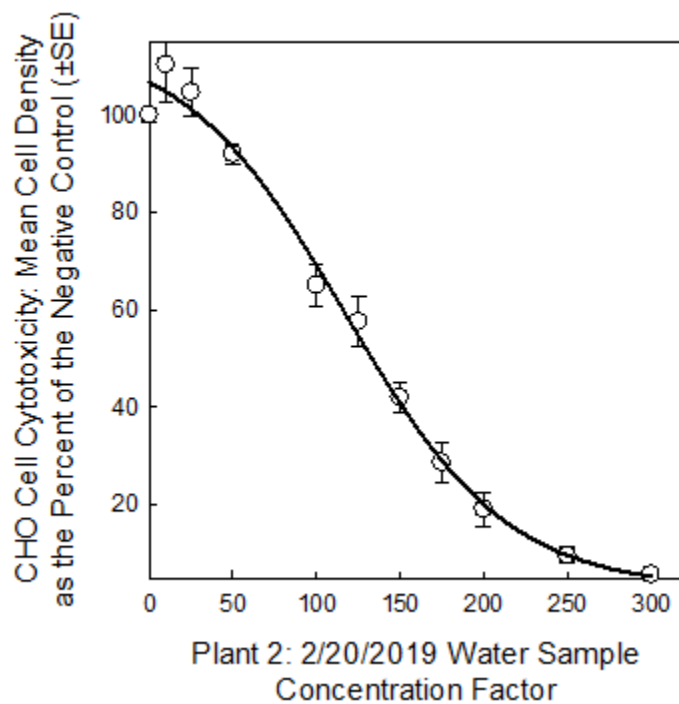


Figure S5. CHO cell cytotoxicity concentration-response curve for Plant 2 sample 12/14/2017.

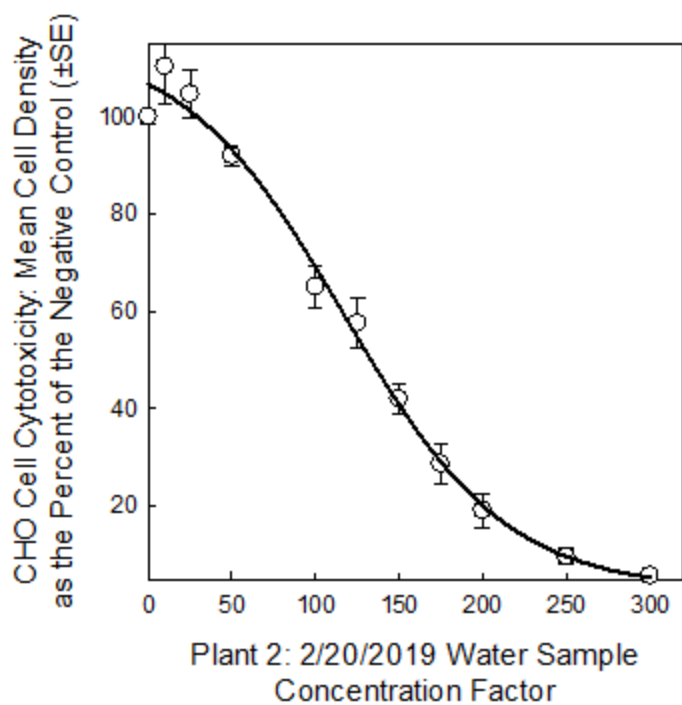


Figure S6. CHO cell cytotoxicity concentration-response curve for Plant 2 sample 2/20/2019.

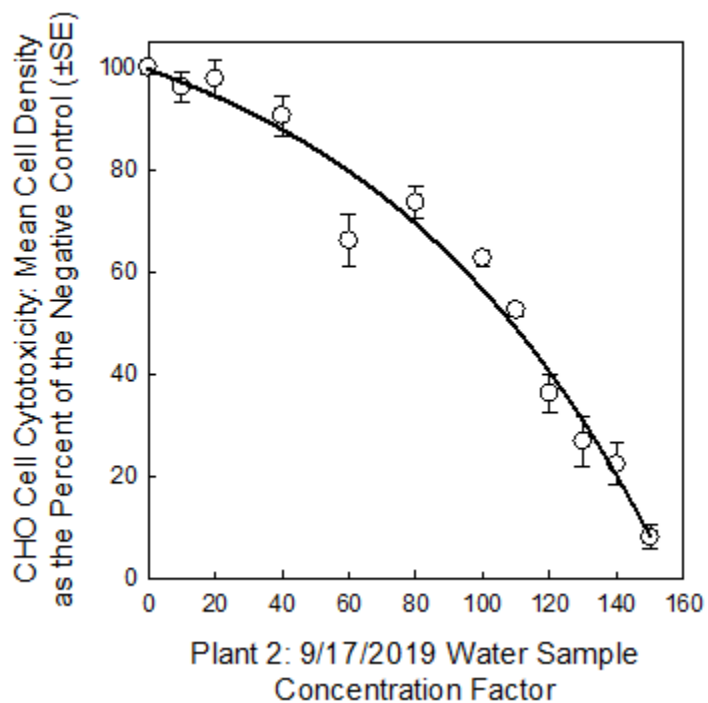


Figure S7. CHO cell cytotoxicity concentration-response curve for Plant 2 sample 9/17/2019.

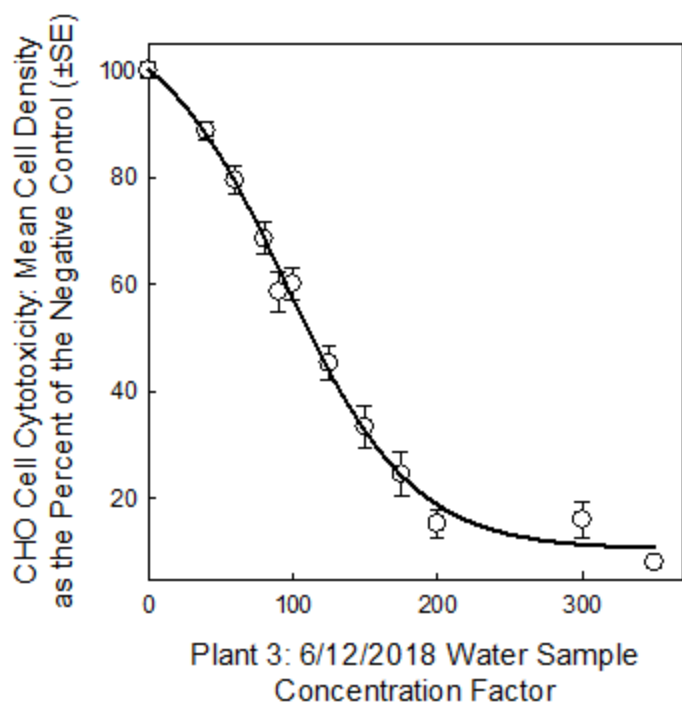


Figure S8. CHO cell cytotoxicity concentration-response curve for Plant 3 sample 6/12/2018.

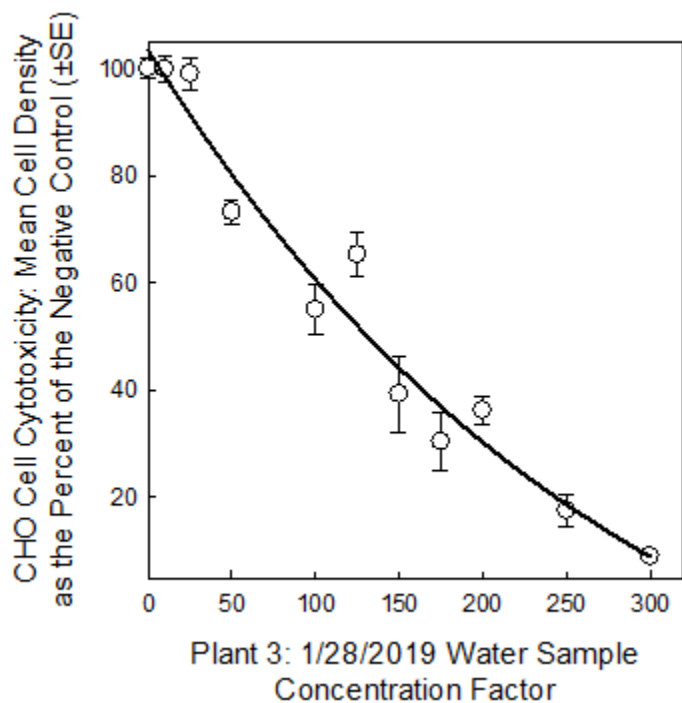


Figure S9. CHO cell cytotoxicity concentration-response curve for Plant 3 sample 1/28/2019.

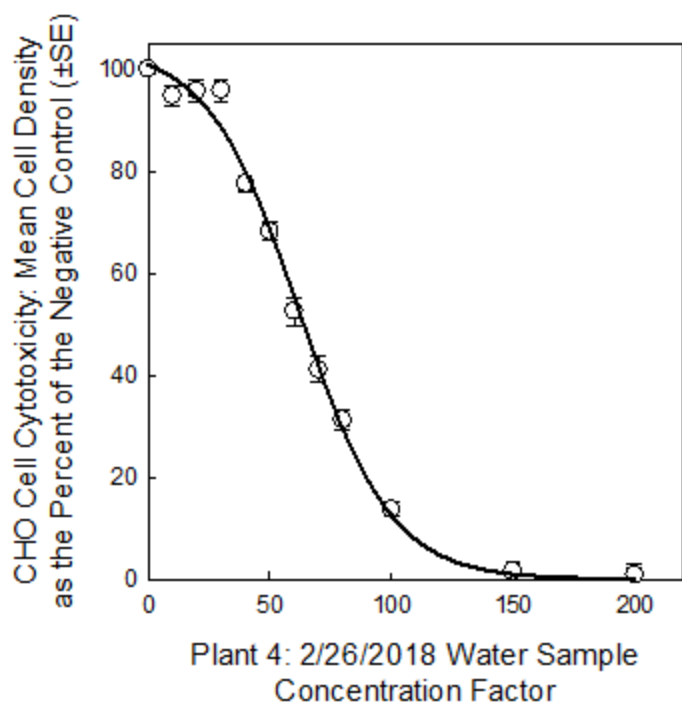


Figure S10. CHO cell cytotoxicity concentration-response curve for Plant 4 sample 2/26/2018.

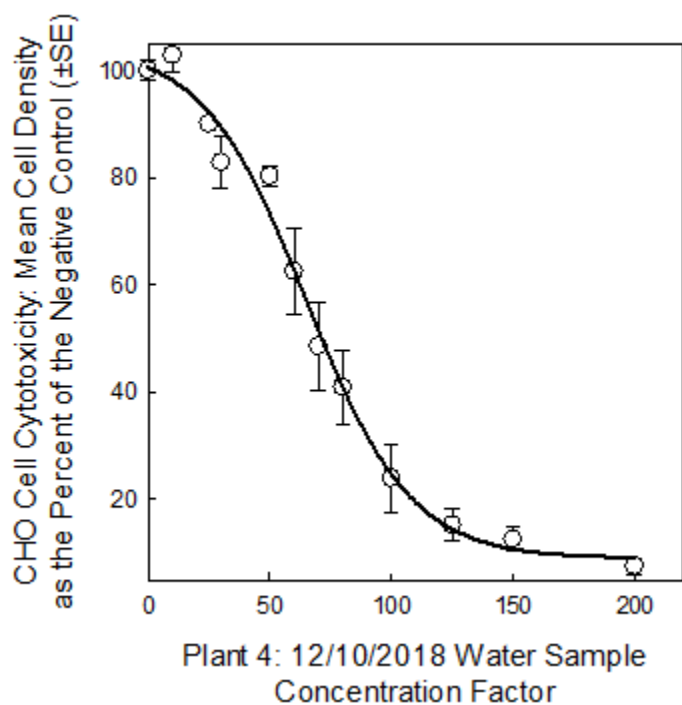


Figure S11. CHO cell cytotoxicity concentration-response curve for Plant 4 sample 12/10/2018.

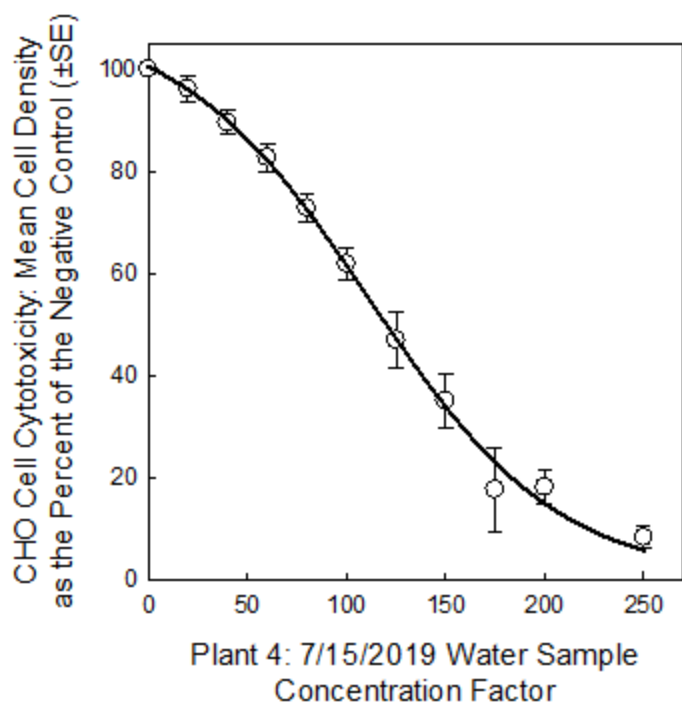


Figure S12. CHO cell cytotoxicity concentration-response curve for Plant 4 sample 7/15/2019.

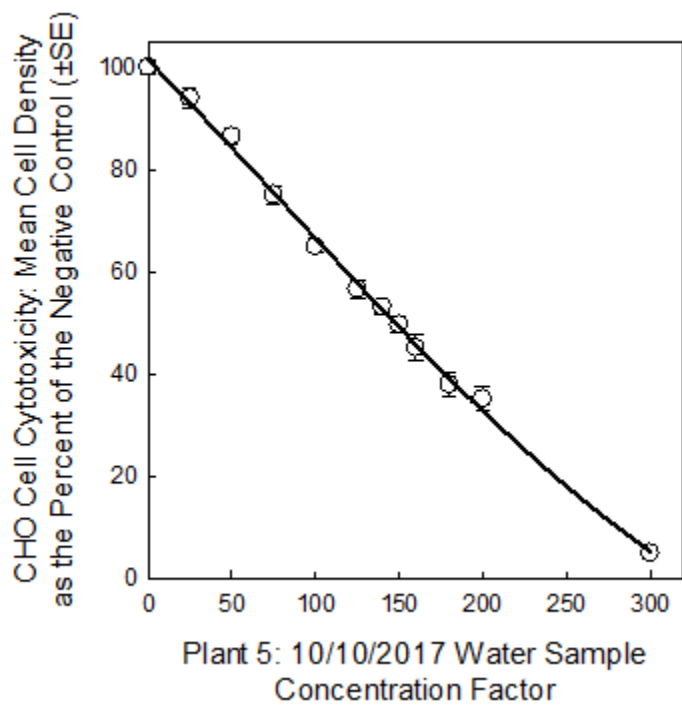


Figure S13. CHO cell cytotoxicity concentration-response curve for Plant 5 sample 10/10/2017.

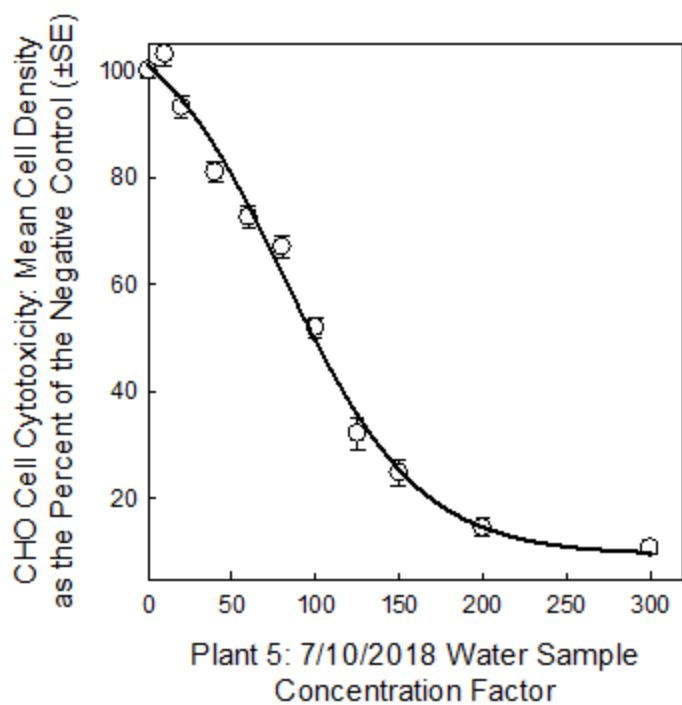


Figure S14. CHO cell cytotoxicity concentration-response curve for Plant 5 sample 7/10/2018.

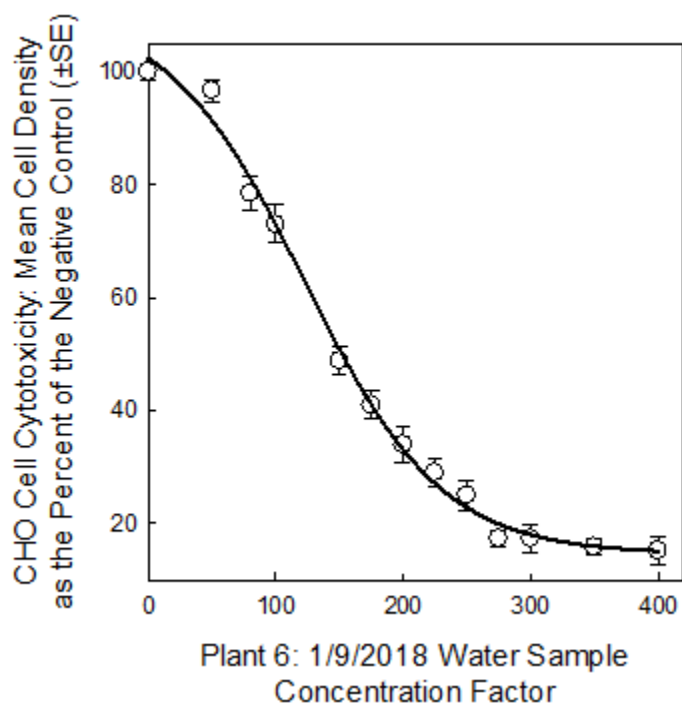


Figure S15. CHO cell cytotoxicity concentration-response curve for Plant 6 sample 1/9/2018.

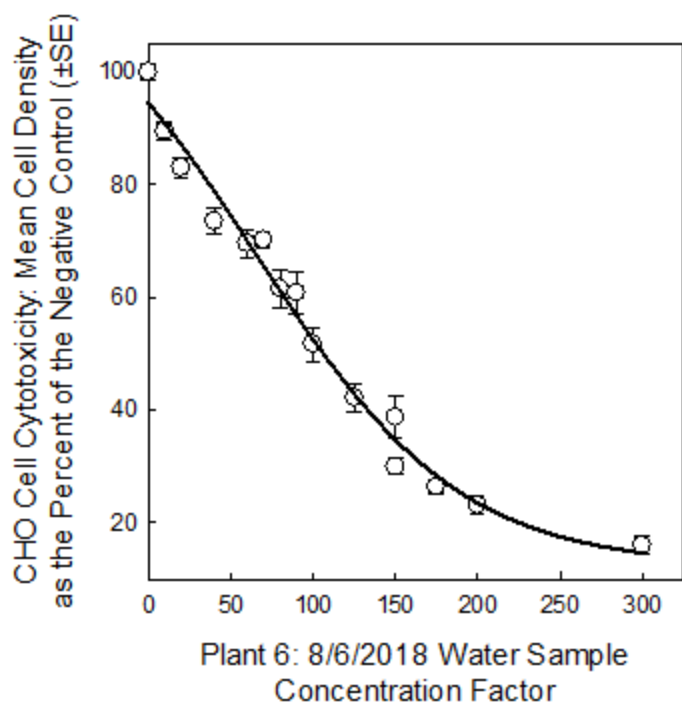


Figure S16. CHO cell cytotoxicity concentration-response curve for Plant 6 sample 8/6/2018.

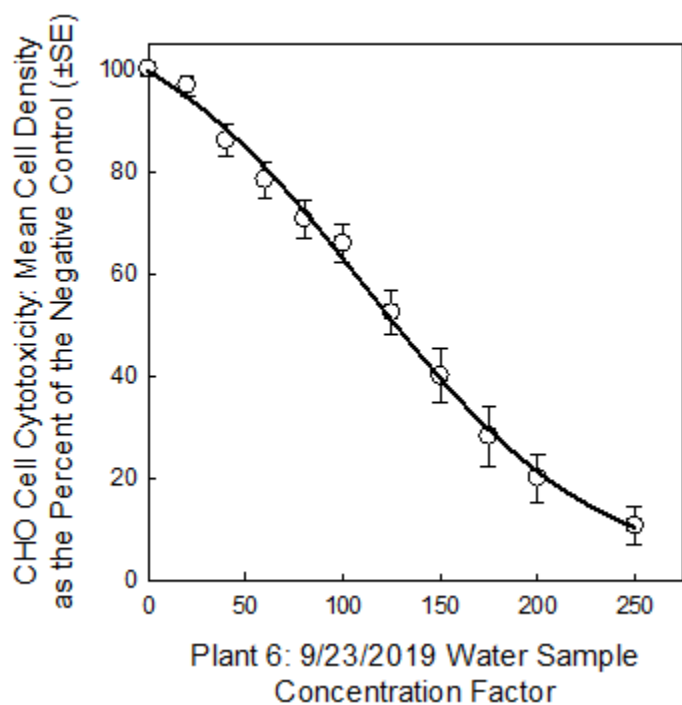


Figure S17. CHO cell cytotoxicity concentration-response curve for Plant 6 sample 9/23/2019.

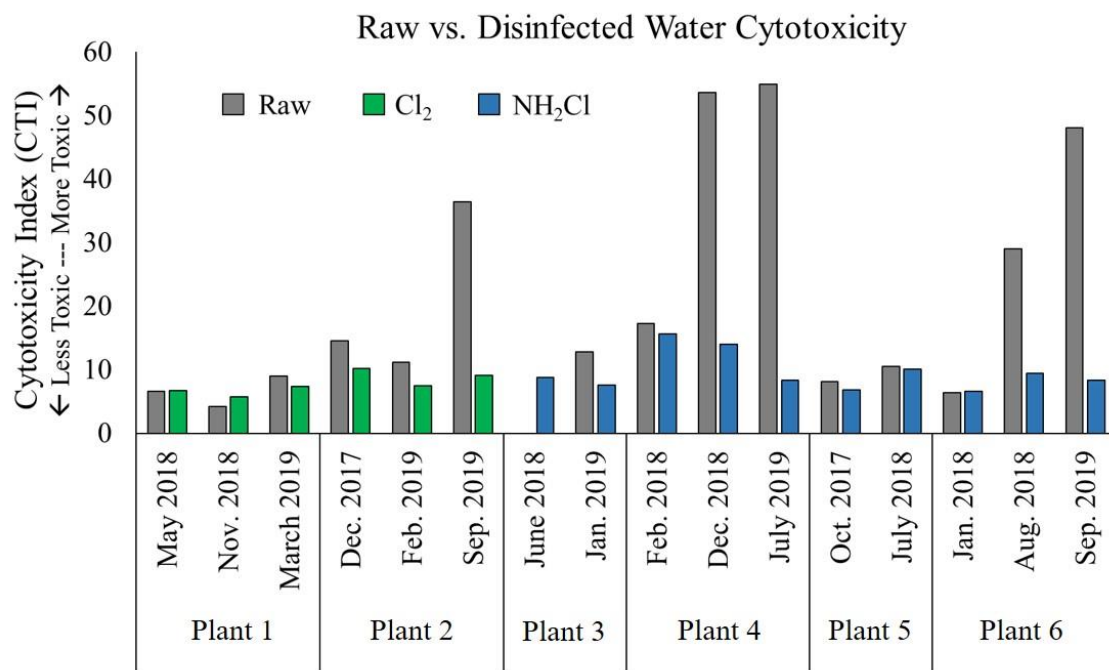


Figure S18. Raw vs. distribution system/average cytotoxicity index values for each plant.

Table S1. Summary of analytical methods.

Parameter	Method
Total organic carbon	Standard Methods ^a
Bromide, iodide	Direct analysis of raw water after 0.45 µm filtration; ion chromatography with conductivity detector
TOCl, TOBr, TOI	GAC sorption, combustion, measurement of Cl ⁻ , Br ⁻ , and I ⁻ with ion chromatography and conductivity detector or inductively coupled plasma MS
THM4	EPA 551.1
HAA9	EPA 552.2
HAMs, HANs, HNMs, HALs, HKs, I-THMs	Liquid-liquid extraction, GC-MS analysis (and PFBHA derivatization for mono- and di-HALs)
IAAs	Liquid-liquid extraction, diazomethane derivatization, GC-MS/MS analysis
Sucralose	Direct injection, LC-MS/MS analysis
Total ammonia	Standard Methods ^a
UV ₂₅₄	Standard Methods ^a

^aAmerican Public Health Association, American Water Works Association, and Water Environment Federation, *Standard Methods for the Examination of Water and Wastewater*, 23rd ed., American Public Health Association, Washington, D.C., 2017.

Table S2. CHO cell cytotoxicity data for all plants.

Sample	Date	LC ₅₀ ^a (CF)	CTI ^b
Plant 1 Raw	May	151.32 ± 3.3	6.64 ± 0.14
Plant 1 Distribution Average	2018	149.43 ± 2.58	6.71 ± 0.12
Plant 1 Raw	Nov.	238.53 ± 8.96	4.25 ± 0.16
Plant 1 Distribution Average	2018	176.75 ± 3.98	5.68 ± 0.13
Plant 1 Raw	March	111.68 ± 0.80	8.96 ± 0.06
Plant 1 Distribution Average	2019	137.41 ± 5.05	7.38 ± 0.27
Plant 2 Raw	Dec.	70.26 ± 3.14	14.50 ± 0.66
Plant 2 Distribution Average	2017	98.48 ± 2.27	10.21 ± 0.26
Plant 2 Raw	Sep.	27.49 ± 0.23	36.4 ± 0.30
Plant 2 Distribution Average	2019	109.90 ± 1.32	9.12 ± 0.11
Plant 2 Raw	Feb.	88.84 ± 1.63	11.30 ± 0.22
Plant 2 Distribution Average	2019	131.68 ± 2.86	7.64 ± 0.18
Plant 3 Raw	June	33.88 ± 1.95	30.58 ± 1.87
Plant 3 Distribution Average	2018	116.33 ± 5.80	8.81 ± 0.43
Plant 3 Raw	Jan.	79.07 ± 2.41	12.79 ± 0.38
Plant 3 Distribution Average	2019	128.48 ± 6.40	8.01 ± 0.39
Plant 4 Raw	Feb.	57.70 ± 0.70	17.36 ± 0.22
Plant 4 Distribution Average	2018	63.79 ± 1.02	15.72 ± 0.25
Plant 4 Raw	Dec.	18.56 ± 0.53	54.43 ± 1.59
Plant 4 Distribution Average	2018	72.35 ± 3.78	14.28 ± 0.75
Plant 4 Raw	July	18.26 ± 0.31	54.96 ± 0.95
Plant 4 Distribution Average	2019	123.67 ± 5.97	8.32 ± 0.42
Plant 5 Raw	Oct.	123.44 ± 3.18	8.15 ± 0.22
Plant 5 Distribution Average	2017	148.01 ± 3.35	6.79 ± 0.15
Plant 5 Raw	July	96.66 ± 1.37	10.37 ± 0.14
Plant 5 Distribution Average	2018	101.29 ± 2.38	9.93 ± 0.24
Plant 6 Raw	Jan.	157.01 ± 4.59	6.42 ± 0.18
Plant 6 Distribution Average	2018	152.97 ± 3.41	6.57 ± 0.15
Plant 6 Raw	Aug.	34.44 ± 0.55	29.12 ± 0.51
Plant 6 Distribution Average	2018	105.25 ± 1.85	9.53 ± 0.17
Plant 6 Raw	Sep.	20.79 ± 0.13	48.13 ± 0.30
Plant 6 Distribution Average	2019	128.41 ± 8.34	8.34 ± 0.64

^a The mean LC₅₀ ± (standard error) SE value is the concentration of the water sample, determined from a bootstrap multiple regression analysis of the data, that induced a cell density of 50% as compared to the concurrent negative controls. ^bCytotoxicity index (CTI) is defined as (LC₅₀⁻¹)(10)³ ± SE; a higher CTI indicates higher cytotoxicity.

Table S3. Pearson Product Moment Correlation statistical analyses for DBP and CHO cell cytotoxicity.

DBP Class	All Sampling Events		No Plant 4	
	Pearson's <i>r</i>	<i>P</i> value	Pearson's <i>r</i>	<i>P</i> value
THM4	0.36	0.17	0.48	0.09
HAA9	0.53	0.03	0.21	0.50
Unregulated HAAs	0.30	0.26	0.16	0.59
HAMs	0.61	0.01	0.25	0.41
HANs	0.08	0.76	0.66	0.01
HNMs	0.37	0.18	0.17	0.60
I-THMs	0.70	0.02	0.31	0.46
I-HAAs	0.88	0.0007	0.23	0.62
HALs	0.05	0.86	0.39	0.19
HKs	0.18	0.53	0.37	0.26
Mono-Halo DBPs	-0.42	0.19		
Di-Halo DBPs	0.64	0.008		
Tri-Halo DBPs	0.22	0.13		
Summed N-DBPs	0.57	0.02		
Summed C-DBPs	0.45	0.09		

*Bold *P* value indicates a significant correlation.

Table S4. Summary of chemical doses applied for each plant.

Plant	Date	O ₃ (mg/L)	UV (mJ/cm ²)	H ₂ O ₂ (mg/L)	Chlorine (mg/L)
Plant 1	5/7/18	NA	~25	NA	1.6
Plant 1	11/6/2018	NA	~25	NA	1.4
Plant 1	3/5/2019	NA	~25	NA	1.3
Plant 2	12/12/17	NA	NA	NA	3.4
Plant 2	2/19/2019	NA	NA	NA	4.0
Plant 2	9/17/2019	NA	NA	NA	3.9
Plant 3	6/11/2018	1.36	NA	NA	3.2
Plant 3	1/28/2019	1.17	NA	NA	3.1
Plant 4	2/26/18	NA	NA	NA	4.2
Plant 4	12/2018	NA	NA	NA	4.1
Plant 4	7/2019	NA	NA	NA	5.0
Plant 5	10/10/17	NA	NA	NA	17.8
Plant 5	7/10/18	NA	NA	NA	14.0
Plant 6	1/9/18	NA	>500	2.5	4.1
Plant 6	8/6/18	NA	>500	1.75	3.3
Plant 6	9/2019	NA	>500	1.60	3.2

*NA = not applicable

Unregulated DBP Abbreviation Key for Quantitative Data Tables:

D = di

T = tri

Te = tetra

C = chloro

B = bromo

I = iodo

AL = aldehyde

P = propanone

NM = nitromethane

AN = acetonitrile

AM = acetamide

M = methane

AA = acetic acid

Table S5. Mean unregulated DBP data for Plant 1.

		Concentration - µg/L (nM)			
Compound	MRL (µg/L)	Raw	Dist. Avg. May 2018	Dist. Avg. Nov. 2018	Dist. Avg. March 2019
HNMs					
BDCNM	0.1	ND	0.2 (1.0)	0.1 (0.3)	0.2 (1.0)
DBCNM	0.1	ND	0.6 (2.6)	0.2 (0.8)	0.2 (0.8)
TBNM	0.1	ND	1.0 (3.5)	0.7 (2.4)	< 0.1
DCNM	0.1	ND	ND	ND	ND
BCNM	0.1	ND	< 0.1	ND	< 0.1
DBNM	0.1	ND	< 0.1	< 0.1	< 0.1
TCNM	0.1	ND	< 0.1	< 0.1	0.2 (1.2)
HALs					
TCAL	0.1	ND	1.5 (10.3)	0.3 (2.4)	1.3 (8.8)
BDCAL	0.1	ND	0.4 (2.0)	0.4 (1.9)	0.8 (4.2)
DBCAL	0.1	ND	< 0.1	0.1 (0.5)	0.3 (1.3)
TBAL	0.1	ND	< 0.1	< 0.1	< 0.1
CAL	0.1	ND	ND	ND	ND
DCAL	0.1	ND	< 0.1	< 0.1	< 0.1
BAL	0.1	ND	ND	ND	ND
BCAL	0.1	ND	< 0.1	< 0.1	< 0.1
IAL	0.1	ND	ND	ND	ND
DBAL	0.1	ND	ND	ND	ND
HANs					
DCAN	0.1	ND	0.3 (2.7)	< 0.1	0.5 (4.5)
BCAN	0.1	ND	0.4 (2.6)	0.4 (2.7)	0.6 (3.9)
TBAN	0.1	ND	0.3 (1.1)	0.4 (1.3)	0.2 (0.7)
TCAN	0.1	ND	< 0.1	ND	< 0.1
CAN	0.25	ND	ND	ND	ND
BAN	0.1	ND	< 0.1	ND	ND
DBAN	0.1	ND	0.3 (1.5)	0.7 (3.3)	0.3 (1.5)
IAN	0.1	ND	ND	ND	ND
BDCAN	0.1	ND	NM	ND	0.1 (0.5)
DBCAN	0.1	ND	NM	< 0.1	ND
HKs					
1,1-DCP	0.1	ND	ND	ND	ND
CP	0.1	ND	ND	ND	ND
1,1,1-TCP	0.1	ND	0.1 (0.6)	< 0.1	0.4 (2.5)
1,1-DBP	0.1	ND	ND	ND	ND
1-B-1,1-DCP	0.1	ND	ND	ND	0.1 (0.8)

1,3-DCP	0.1	ND	< 0.1	ND	ND
1,1,3-TCP	0.1	ND	ND	ND	ND
1,1,3,3-TeCP	0.1	ND	ND	< 0.1	ND
1,1,3,3-TeBP	0.1	ND	ND	ND	ND
I-THMs					
DCIM	0.1	ND	ND	ND	ND
BCIM	0.1	ND	< 0.1	< 0.1	< 0.1
DBIM	0.1	ND	< 0.1	< 0.1	< 0.1
CDIM	0.1	ND	ND	ND	ND
BDIM	0.1	ND	ND	ND	ND
TIM	0.1	ND	ND	ND	ND
HAMs					
CAM	1.0	ND	ND	ND	ND
BAM	1.0	ND	ND	ND	ND
IAM	1.0	ND	ND	ND	ND
BCAM	0.2	ND	0.6 (3.6)	0.6 (3.3)	0.6 (3.5)
TCAM	0.1	ND	ND	ND	< 0.1
DCAM	0.3	ND	0.6 (4.4)	0.3 (2.4)	0.7 (5.5)
DBAM	0.2	ND	0.4 (1.7)	1.1 (4.9)	0.3 (1.4)
CIAM	0.3	ND	ND	ND	ND
BIAM	0.5	ND	ND	ND	ND
DBCAM	0.1	ND	ND	ND	ND
TBAM	0.1	ND	< 0.1	0.1 (0.4)	ND
DIAM	0.1	ND	ND	ND	ND
BDCAM	0.1	ND	< 0.1	ND	< 0.1
IAs					
IAA	.010	ND	< 0.010	< 0.010	ND
CIAA	.025	ND	0.069 (0.3)	< 0.025	ND
BIAA	.025	ND	ND	< 0.025	ND
DIAA	.015	ND	ND	ND	ND

Table S6. Mean THM4 and HAA9 data for Plant 1.

Compound	Concentration - µg/L (nM)					
	Dist. Avg. May 2018	Dist. Max. May 2018	Dist. Avg. Nov. 2018	Dist. Max. Nov. 2018	Dist. Avg. March 2019	Dist. Max. March 2019
THMs						
Trichloromethane	7.0 (58.6)	17 (142)	1.9 (15.9)	0.8 (6.7)	5.5 (46.1)	14 (117)
Bromodichloromethane	6.1 (37.2)	8.6 (52.5)	4.7 (28.7)	1.4 (8.5)	4.4 (26.9)	7.0 (42.7)
Dibromochloromethane	5.4 (25.9)	5.2 (25.0)	8.2 (39.4)	1.9 (9.1)	2.6 (12.5)	3.6 (17.3)
Tribromomethane	1.0 (4.0)	0.7 (2.8)	4.0 (15.8)	0.8 (3.2)	ND	ND
HAAs						
Chloroacetic acid	ND	ND	ND	ND	ND	ND
Bromoacetic acid	ND	ND	ND	ND	ND	ND
Dichloroacetic acid	2.8 (21.7)	5.9 (45.8)	ND	1.7 (13.2)	1.5 (11.6)	4.5 (34.9)
Bromochloroacetic acid	2.1 (12.1)	2.8 (16.1)	1.5 (8.7)	2.1 (12.1)	ND	1.2 (6.9)
Dibromoacetic acid	ND	ND	2.7 (12.4)	3.1 (14.2)	ND	ND
Trichloroacetic acid	1.0 (6.1)	2.5 (15.3)	ND	ND	ND	1.6 (9.8)
Bromodichloroacetic acid	ND	ND	ND	ND	ND	ND
Chlorodibromoacetic acid	ND	ND	ND	ND	ND	ND
Tribromoacetic acid	ND	ND	ND	ND	ND	ND

Table S7. Mean total organic halogen data for Plant 1 - µg/L (µM).

Date	Sample	TOCl (as Cl-)	TOBr (as Br-)	TOI (as I-)
May 2018	Raw	13.4 (0.38)	3.2 (0.04)	0.9 (0.007)
	Effluent	28.2 (0.79)	19.9 (0.25)	0.6 (0.004)
	Dist. Avg.	36.8 (1.04)	20.9 (0.26)	0.7 (0.005)
	Dist. Max	59.6 (1.68)	20.7 (0.26)	0.5 (0.004)
November 2018	Raw	7.0 (0.20)	2.3 (0.03)	1.2 (0.009)
	Effluent	14.6 (0.41)	21.5 (0.27)	0.3 (0.002)
	Dist. Avg.	20.6 (0.58)	26.7 (0.33)	0.4 (0.003)
	Dist. Max.	25.8 (0.73)	31.8 (0.40)	0.3 (0.002)
March 2019	Raw	6.7 (0.19)	1.2 (0.02)	0.4 (0.003)
	Effluent	17.4 (0.49)	10.7 (0.13)	0.3 (0.002)
	Dist. Avg.	35.7 (1.01)	14.4 (0.18)	0.3 (0.002)
	Dist. Max	60.3 (1.70)	16.7 (0.21)	0.3 (0.002)

Table S8. Water quality parameters for Plant 1.

Date	Sample	Sucralose (ug/L)	TOC (mg/L)	UV₂₅₄ (abs/cm)	SUVA (L/mg-m)	Total Ammonia (mg/L)	Br- (µg/L)	I- (µg/L)
May 2018	Raw	0.40	2.5	0.093	3.7	0.08	30	< 10
	Effluent	--	0.8	0.017	2.1	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--
November 2018	Raw	0.80	4.2	0.114	2.7	0.19	44	< 10
	Effluent	--	1.0	0.008	0.8	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--
March 2019	Raw	ND	2.0	0.054	2.8	0.13	20	< 10
	Effluent	--	1.0	0.016	1.6	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--

Table S9. Mean unregulated DBP data for Plant 2.

Compound	MRL (µg/L)	Concentration - µg/L (nM)			
		Raw	Dist. Avg. Dec. 2017	Dist. Avg. Feb. 2019	Dist. Avg. Sept. 2019
HNMs					
BDCNM	0.1	ND	ND	0.2 (1.0)	< 0.1
DBCNM	0.1	ND	ND	0.2 (0.8)	< 0.25
TBNM	0.5	ND	ND	0.5 (1.7)	< 0.5
DCNM	0.1	ND	ND	ND	ND
BCNM	0.1	ND	0.1	ND	ND
DBNM	0.1	ND	0.1	0.3 (1.4)	< 0.1
TCNM	0.1	ND	< 0.1	< 0.1	ND
HALs					
TCAL	0.1	ND	0.4 (2.7)	0.4 (2.7)	0.5 (3.2)
BDCAL	0.1	ND	0.8 (4.2)	1.3 (6.8)	0.7 (3.9)
DBCAL	0.1	ND	1.3 (5.5)	0.7 (3.0)	0.3 (1.2)
TBAL	0.1	ND	0.3 (1.1)	0.3 (1.1)	< 0.1
CAL	0.1	ND	ND	ND	ND
DCAL	0.1	ND	< 0.1	ND	< 0.1
BAL	0.1	ND	ND	ND	ND
BCAL	0.1	ND	< 0.1	< 0.1	< 0.1
IAL	0.1	ND	ND	ND	ND
DBAL	0.1	ND	ND	ND	< 0.1
HANs					
DCAN	0.1	ND	0.4 (3.6)	< 0.1	0.1 (1.0)
BCAN	0.1	ND	1.0 (6.5)	1.1 (7.1)	0.7 (4.8)
TBAN	0.1	ND	0.2 (0.7)	0.2 (0.7)	0.2 (0.8)
TCAN	0.1	ND	ND	ND	ND
CAN	0.25	ND	0.1 (1.3)	ND	ND
BAN	0.1	ND	ND	ND	ND
DBAN	0.1	ND	1.7 (8.5)	2.1 (10.6)	1.6 (8.2)
IAN	0.1	ND	ND	ND	ND
BDCAN	0.1	ND	NM	< 0.1	ND
DBCAN	0.1	ND	NM	0.2 (0.9)	ND
HKs					
1,1-DCP	0.1	ND	0.1 (0.8)	ND	ND
CP	0.1	ND	0.4 (4.3)	ND	ND
1,1,1-TCP	0.1	ND	0.4 (2.5)	< 0.1	< 0.1
1,1-DBP	0.1	ND	0.3 (1.4)	0.3 (1.4)	< 0.1
1-B-1,1-DCP	0.1	ND	ND	ND	ND

1,3-DCP	0.1	ND	ND	ND	ND
1,1,3-TCP	0.1	ND	ND	ND	ND
1,1,3,3-TeCP	0.1	ND	< 0.1	ND	ND
1,1,3,3-TeBP	0.1	ND	ND	0.3 (0.8)	ND
I-THMs					
DCIM	0.1	ND	ND	0.4 (1.9)	< 0.1
BCIM	0.1	ND	0.1 (0.4)	0.3 (1.2)	< 0.1
DBIM	0.1	ND	ND	0.2 (0.7)	< 0.1
CDIM	0.1	ND	ND	ND	ND
BDIM	0.1	ND	ND	ND	ND
TIM	0.1	ND	ND	ND	ND
HAMs					
CAM	1.0	ND	ND	ND	ND
BAM	1.0	ND	ND	ND	ND
IAM	1.0	ND	ND	ND	ND
BCAM	0.2	ND	0.6 (3.5)	1.0 (5.8)	1.0 (5.5)
TCAM	0.1	ND	ND	ND	< 0.1
DCAM	0.3	ND	ND	0.4 (3.1)	0.5 (4.0)
DBAM	0.2	ND	2.7 (12.5)	2.3 (10.6)	2.1 (9.5)
CIAM	0.3	ND	ND	ND	ND
BIAM	0.5	ND	ND	ND	ND
DBCAM	0.1	ND	ND	0.3 (1.2)	0.3 (1.0)
TBAM	0.1	ND	ND	0.5 (1.7)	0.3 (1.1)
DIAM	0.1	ND	ND	ND	ND
BDCAM	0.1	ND	0.4 (1.9)	0.2 (1.0)	< 0.1
IAs					
IAA	.010	ND	ND	ND	0.040 (0.2)
CIAA	.025	ND	ND	ND	ND
BIAA	.025	ND	ND	ND	< 0.025
DIAA	.015	ND	ND	ND	ND

Table S10. Mean THM4 and HAA9 data for Plant 2.

Compound	Concentration - µg/L (nM)					
	Dist. Avg. Dec. 2017	Dist. Max. Dec. 2017	Dist. Avg. Feb. 2019	Dist. Max. Feb. 2019	Dist. Avg. Sep. 2019	Dist. Max. Sep. 2019
THMs						
Trichloromethane	13 (109)	12 (101)	2.8 (23.5)	2.0 (16.8)	11 (92.1)	9.5 (79.6)
Bromodichloromethane	19 (116)	19 (116)	8.2 (50.1)	6.0 (36.6)	17 (104)	16 (97.7)
Dibromochloromethane	16 (76.8)	17 (81.6)	16 (76.8)	12 (57.6)	23 (110)	22 (106)
Tribromomethane	5.8 (22.9)	5.4 (21.4)	12 (47.5)	9.1 (36.0)	13 (51.4)	12 (47.5)
HAAs						
Chloroacetic acid	ND	ND	ND	ND	ND	ND
Bromoacetic acid	ND	ND	ND	ND	ND	1.1 (7.9)
Dichloroacetic acid	2.0 (15.5)	2.7 (20.9)	ND	ND	2.1 (16.3)	2.7 (20.9)
Bromochloroacetic acid	2.4 (13.8)	--	1.8 (10.4)	1.2 (6.9)	4.1 (23.6)	4.6 (26.5)
Dibromoacetic acid	2.4 (11.0)	4.3 (19.7)	3.5 (16.1)	2.2 (10.1)	6.2 (28.5)	6.7 (30.8)
Trichloroacetic acid	ND	1.0 (6.1)	ND	ND	ND	ND
Bromodichloroacetic acid	ND	--	ND	ND	1.1 (5.3)	1.2 (5.8)
Chlorodibromoacetic acid	1.1 (4.4)	--	1.1 (4.4)	ND	2.0 (7.9)	2.2 (8.7)
Tribromoacetic acid	ND	--	ND	ND	ND	ND

Table S11. Mean total organic halogen data for Plant 2 - µg/L (µM).

Date	Sample	TOCl (as Cl-)	TOBr (as Br-)	TOI (as I-)
December 2017	Raw	15.7 (0.44)	8.7 (0.11)	2.2 (0.02)
	Effluent	83.0 (2.34)	24.9 (0.31)	0.8 (0.006)
	Dist. Avg.	50.2 (1.41)	62.7 (0.78)	0.8 (0.006)
	Dist. Max	54.9 (1.55)	66.5 (0.83)	0.6 (0.005)
February 2019	Raw	13.3 (0.37)	8.2 (0.10)	3.9 (0.03)
	Effluent	20.0 (0.56)	20.0 (0.25)	0.7 (0.006)
	Dist. Avg.	31.6 (0.89)	66.2 (0.83)	0.9 (0.007)
	Dist. Max.	27.0 (0.76)	51.3 (0.64)	0.8 (0.006)
September 2019	Raw	38.8 (1.09)	7.9 (0.10)	4.1 (0.03)
	Effluent	50.3 (1.42)	19.8 (0.25)	1.0 (0.008)
	Dist. Avg.	49.2 (1.38)	65.0 (0.81)	1.6 (0.01)
	Dist. Max	81.1 (2.28)	64.9 (0.81)	1.5 (0.01)

Table S12. Water quality parameters for Plant 2.

Date	Sample	Sucralose (ug/L)	TOC (mg/L)	UV₂₅₄ (abs/cm)	SUVA (L/mg-m)	Total Ammonia (mg/L)	Br- (µg/L)	I- (µg/L)
December 2017	Raw	0.79	4.7	0.074	1.6	ND	160	28
	Effluent	ND	1.3	0.010	0.8	--	--	--
	Dist. Avg.	ND	--	--	--	--	--	--
	Dist. Max.	ND	--	--	--	--	--	--
February 2019	Raw	1.06	3.2	0.064	2.0	ND	334	< 10
	Effluent	--	1.0	0.008	0.8	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--
September 2019	Raw	0.60	3.7	0.014	0.4	ND	145	< 10
	Effluent	--	0.9	< 0.004	< 0.5	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--

Table S13. Mean unregulated DBP data for Plant 3.

Compound	MRL µg/L	Concentration - µg/L (nM)		
		Raw	Dist. Avg. June 2018	Dist. Avg. Jan. 2019
HNMs				
BDCNM	0.1	ND	1.0 (5.0)	0.3 (1.4)
DBCNM	0.1	ND	2.6 (10.2)	0.6 (2.4)
TBNM	0.5	ND	2.6 (8.8)	0.7 (2.4)
DCNM	0.1	ND	ND	ND
BCNM	0.1	ND	< 0.1	< 0.1
DBNM	0.1	ND	< 0.1	0.1 (0.5)
TCNM	0.1	ND	< 0.1	0.1 (0.6)
HALs				
TCAL	0.1	ND	< 0.1	0.1 (0.7)
BDCAL	0.1	ND	0.4 (2.0)	ND
DBCAL	0.1	ND	0.7 (3.1)	0.6 (2.5)
TBAL	0.1	ND	0.4 (1.5)	0.4 (1.4)
CAL	0.1	ND	ND	ND
DCAL	0.1	ND	< 0.1	< 0.1
BAL	0.1	ND	ND	ND
BCAL	0.1	ND	0.1 (0.6)	0.2 (1.3)
IAL	0.1	ND	ND	ND
DBAL	0.1	ND	0.2 (1.0)	< 0.1
HANs				
DCAN	0.1	ND	0.2 (2.1)	0.3 (2.7)
BCAN	0.1	ND	0.7 (4.4)	0.5 (3.2)
TBAN	0.1	ND	0.4 (1.6)	0.2 (0.7)
TCAN	0.1	ND	ND	ND
CAN	0.25	ND	1.4 (19.0)	ND
BAN	0.5	ND	ND	ND
DBAN	0.1	ND	0.8 (3.9)	1.1 (5.5)
IAN	0.1	ND	ND	ND
BDCAN	0.1	ND	NM	ND
DBCAN	0.1	ND	NM	ND
HKs				
1,1-DCP	0.1	ND	ND	ND
CP	0.1	ND	1.4 (15.6)	ND
1,1,1-TCP	0.1	ND	< 0.1	0.1 (0.6)
1,1-DBP	0.1	ND	0.3 (1.5)	0.5 (2.3)
1-B-1,1-DCP	0.1	ND	0.1 (0.6)	< 0.1
1,3-DCP	0.1	ND	ND	ND

1,1,3-TCP	0.1	ND	ND	ND
1,1,3,3-TeCP	0.1	ND	0.1 (0.6)	ND
1,1,3,3-TeBP	0.1	ND	0.5 (1.3)	0.2 (0.5)
I-THMs				
DCIM	0.1	ND	< 0.1	ND
BCIM	0.1	ND	0.1 (0.4)	ND
DBIM	0.1	ND	0.2 (0.6)	< 0.1
CDIM	0.1	ND	ND	ND
BDIM	0.1	ND	< 0.1	ND
TIM	0.1	ND	ND	ND
HAMs				
CAM	1.0	ND	ND	ND
BAM	1.0	ND	ND	ND
IAM	1.0	ND	ND	ND
BCAM	0.2	ND	0.7 (3.8)	0.6 (3.5)
TCAM	0.1	ND	< 0.1	ND
DCAM	0.3	ND	ND	ND
DBAM	0.2	ND	1.1 (5.3)	1.0 (4.6)
CIAM	0.3	ND	ND	ND
BIAM	0.5	ND	ND	ND
DBCAM	0.1	ND	0.1 (0.4)	0.3 (1.2)
TBAM	0.1	ND	< 0.1	ND
DIAM	0.1	ND	ND	ND
BDCAM	0.1	ND	< 0.1	ND
IAAs				
IAA	.010	ND	< 0.010	< 0.010
CIAA	.025	ND	ND	ND
BIAA	.025	ND	ND	ND
DIAA	.015	ND	ND	ND

Table S14. Mean THM4 and HAA9 data for Plant 3.

Compound	Concentration - µg/L (nM)			
	Dist. Avg. June 2018	Dist. Max. June 2018	Dist. Avg. Jan. 2019	Dist. Max. Jan. 2019
THMs				
Trichloromethane	ND	0.6 (5.0)	0.8 (6.7)	0.7 (5.9)
Bromodichloromethane	1.7 (10.4)	2.1 (12.8)	2.2 (13.4)	2.2 (13.4)
Dibromochloromethane	4.1 (19.7)	4.6 (22.1)	5.2 (25.0)	5.5 (26.4)
Tribromomethane	4.8 (19.0)	5.0 (19.8)	6.0 (23.7)	6.2 (24.5)
HAAs				
Chloroacetic acid	ND	ND	ND	ND
Bromoacetic acid	ND	ND	ND	ND
Dichloroacetic acid	ND	ND	ND	ND
Bromochloroacetic acid	1.5 (8.7)	1.7 (9.8)	ND	ND
Dibromoacetic acid	3.0 (13.8)	3.1 (14.2)	1.5 (6.9)	1.1 (5.0)
Trichloroacetic acid	ND	ND	ND	ND
Bromodichloroacetic acid	ND	ND	ND	ND
Chlorodibromoacetic acid	ND	ND	ND	ND
Tribromoacetic acid	ND	ND	ND	ND

Table S15. Mean total organic halogen data for Plant 3 - µg/L (µM).

Date	Sample	TOCl (as Cl-)	TOBr (as Br-)	TOI (as I-)
June 2018	Raw	25.2 (0.71)	10.2 (0.13)	5.2 (0.04)
	Effluent	41.0 (1.15)	45.0 (0.56)	3.5 (0.03)
	Dist. Avg.	28.5 (0.80)	42.0 (0.53)	3.9 (0.03)
	Dist. Max	63.1 (1.78)	42.1 (0.53)	2.8 (0.02)
January 2019	Raw	21.3 (0.60)	10.4 (0.13)	2.3 (0.02)
	Effluent	36.3 (1.02)	51.0 (0.64)	1.0 (0.008)
	Dist. Avg.	34.3 (0.97)	48.7 (0.61)	1.3 (0.01)
	Dist. Max.	37.1 (1.05)	47.9 (0.60)	1.4 (0.01)

Table S16. Water quality parameters for Plant 3.

Date	Sample	Sucralose (µg/L)	TOC (mg/L)	UV₂₅₄ (abs/cm)	SUVA (L/mg-m)	Total Ammonia (mg/L)	Br- (µg/L)	I- (µg/L)
June 2018	Raw	0.6	3.0	0.076	2.6	ND	159	27
	Effluent	--	2.2	0.040	1.8	--	--	--
	Dist. Avg.	--	--	--		--	--	--
	Dist. Max.	--	--	--		--	--	--
January 2019	Raw	0.8	2.7	0.062	2.3	ND	184	< 10
	Effluent	--	2.0	0.038	1.9	--	--	--
	Dist. Avg.	--	--	--		--	--	--
	Dist. Max.	--	--	--		--	--	--

Table S17. Mean unregulated DPB data for Plant 4.

Compound	MRL (µg/L)	Concentration - µg/L (nM)			
		Raw	Dist. Avg. Feb. 2018	Dist. Avg. Dec. 2018	Dist. Avg. July 2019
HNMs					
BDCNM	0.1	ND	0.6 (2.9)	0.8 (3.8)	0.3 (1.3)
DBCNM	0.1	ND	1.0 (3.9)	1.5 (5.9)	0.3 (1.1)
TBNM	0.5	ND	1.2 (4.0)	1.4 (4.7)	0.4 (1.2)
DCNM	0.1	ND	ND	ND	ND
BCNM	0.1	ND	ND	ND	ND
DBNM	0.1	ND	< 0.1	< 0.1	< 0.1
TCNM	0.1	ND	ND	0.2 (1.2)	0.1 (0.6)
HALs					
TCAL	0.1	ND	< 0.1	0.1 (0.7)	< 0.1
BDCAL	0.1	ND	ND	< 0.1	< 0.1
DBCAL	0.1	ND	< 0.1	< 0.1	< 0.1
TBAL	0.1	ND	< 0.1	< 0.1	< 0.1
CAL	0.1	ND	ND	ND	ND
DCAL	0.1	ND	< 0.1	0.1 (0.9)	< 0.1
BAL	0.1	ND	ND	ND	ND
BCAL	0.1	ND	< 0.1	ND	ND
IAL	0.1	ND	ND	ND	ND
DBAL	0.1	ND	ND	ND	ND
HANs					
DCAN	0.1	ND	0.2 (1.8)	0.4 (3.6)	0.1 (0.9)
BCAN	0.1	ND	0.3 (1.9)	0.5 (3.2)	0.4 (2.4)
TBAN	0.1	ND	ND	ND	ND
TCAN	0.1	ND	ND	ND	< 0.1
CAN	0.25	ND	0.3 (4.0)	ND	1.2 (16.0)
BAN	0.1	ND	ND	ND	ND
DBAN	0.1	ND	0.3 (1.5)	0.3 (1.5)	0.1 (0.7)
IAN	0.1	ND	ND	ND	< 0.1
BDCAN	0.1	ND	NM	NM	ND
DBCAN	0.1	ND	NM	NM	ND
HKs					
1,1-DCP	0.1	ND	ND	ND	ND
CP	0.1	ND	1.5 (16.2)	ND	0.3 (3.1)
1,1,1-TCP	0.1	ND	< 0.1	ND	ND
1,1-DBP	0.1	ND	0.3 (1.4)	0.2 (0.9)	0.4 (1.9)
1-B-1,1-DCP	0.1	ND	ND	ND	< 0.1

1,3-DCP	0.1	ND	ND	0.7 (5.5)	ND
1,1,3-TCP	0.1	ND	ND	ND	ND
1,1,3,3-TeCP	0.1	ND	0.8 (4.1)	ND	0.3 (1.3)
1,1,3,3-TeBP	0.1	ND	1.0 (2.7)	0.4 (1.1)	0.5 (1.2)
I-THMs					
DCIM	0.1	ND	1.1 (5.2)	1.0 (4.7)	1.1 (5.0)
BCIM	0.1	ND	0.6 (2.4)	0.6 (2.4)	0.4 (1.5)
DBIM	0.1	ND	0.2 (0.7)	0.1 (0.3)	0.1 (0.4)
CDIM	0.1	ND	0.3 (1.0)	0.7 (2.3)	0.2 (0.7)
BDIM	0.1	ND	< 0.1	0.1 (0.3)	< 0.1
TIM	0.1	ND	< 0.3	0.2 (0.5)	< 0.1
HAMs					
CAM	1.0	ND	ND	ND	ND
BAM	1.0	ND	ND	ND	ND
IAM	1.0	ND	ND	ND	ND
BCAM	0.2	ND	1.7 (9.9)	1.7 (9.9)	1.3 (7.7)
TCAM	0.1	ND	ND	ND	ND
DCAM	0.3	ND	2.9 (22.3)	4.1 (32.0)	2.3 (17.9)
DBAM	0.2	ND	1.1 (5.1)	0.9 (4.2)	0.8 (3.6)
CIAM	0.2	ND	ND	ND	0.2 (0.7)
BIAM	0.5	ND	ND	ND	ND
DBCAM	0.1	ND	ND	ND	ND
TBAM	0.1	ND	ND	ND	ND
DIAM	0.1	ND	ND	ND	ND
BDCAM	0.1	ND	< 0.25	< 0.1	< 0.1
IAs					
IAA	.010	ND	0.099 (0.5)	0.128 (0.7)	0.051 (0.3)
CIAA	.025	ND	0.430 (2.0)	0.440 (2.0)	0.152 (0.7)
BIAA	.025	ND	0.072 (0.3)	0.052 (0.2)	0.059 (0.2)
DIAA	.015	ND	0.025 (0.08)	0.030 (0.1)	ND

Table S18. Mean THM4 and HAA9 data for Plant 4.

Compound	Concentration - µg/L (nM)					
	Dist. Avg. Feb. 2018	Dist. Max. Feb. 2018	Dist. Avg. Dec. 2018	Dist. Max. Dec. 2018	Dist. Avg. July 2019	Dist. Max. July 2019
THMs						
Trichloromethane	12 (99.9)	11 (92.1)	15 (126)	17 (142)	19 (159)	18 (151)
Bromodichloromethane	12 (73.0)	10 (61.0)	10 (61.0)	7.2 (43.9)	14 (85.5)	13 (79.4)
Dibromochloromethane	9.1 (43.3)	7.6 (36.5)	4.4 (21.1)	2.8 (13.4)	8.7 (41.8)	8.2 (39.4)
Tribromomethane	1.5 (6.1)	1.4 (5.5)	ND	ND	1.0 (4.0)	1.0 (4.0)
HAAs						
Chloroacetic acid	0.9 (9.0)	0.9 (9.5)	ND	ND	ND	ND
Bromoacetic acid	0.5 (3.4)	0.4 (2.9)	ND	ND	ND	ND
Dichloroacetic acid	11 (84.6)	11 (85.3)	10 (77.6)	14 (109)	11 (85.3)	14 (109)
Bromochloroacetic acid	5.4 (30.9)	5.3 (30.6)	3.6 (20.8)	3.7 (21.3)	4.5 (26.1)	5.9 (34.0)
Dibromoacetic acid	2.9 (13.2)	2.9 (13.3)	ND	ND	1.8 (8.2)	2.3 (10.6)
Trichloroacetic acid	2.3 (14.2)	1.9 (11.6)	3.3 (20.2)	2.5 (15.3)	3.7 (22.5)	3.5 (21.4)
Bromodichloroacetic acid	2.5 (12.2)	1.9 (9.1)	2.0 (9.6)	1.2 (5.8)	2.7 (12.8)	2.5 (12.0)
Chlorodibromoacetic acid	1.9 (7.5)	1.3 (5.2)	ND	ND	1.2 (4.8)	1.1 (4.4)
Tribromoacetic acid	0.13 (0.4)	ND	ND	ND	ND	ND

Table S19. Mean total organic halogen data for Plant 4 - µg/L (µM).

Date	Sample	TOCl (as Cl-)	TOBr (as Br-)	TOI (as I-)
February 2018	Raw	18.5 (0.52)	7.2 (0.09)	4.0 (0.03)
	Effluent	73.6 (2.07)	43.4 (0.54)	3.0 (0.02)
	Dist. Avg.	72.4 (2.04)	44.5 (0.56)	4.7 (0.04)
	Dist. Max	71.2 (2.01)	42.1 (0.53)	3.3 (0.03)
December 2018	Raw	6.7 (0.19)	8.3 (0.10)	4.9 (0.04)
	Effluent	73.4 (2.07)	46.9 (0.59)	3.3 (0.03)
	Dist. Avg.	65.5 (1.85)	43.3 (0.54)	3.5 (0.03)
	Dist. Max.	67.9 (1.91)	23.1 (0.29)	3.5 (0.03)
July 2019	Raw	11.1 (0.31)	10.3 (0.13)	4.2 (0.03)
	Effluent	91.8 (2.59)	39.4 (0.49)	2.3 (0.02)
	Dist. Avg.	63.4 (1.79)	35.0 (0.44)	2.0 (0.02)
	Dist. Max	69.5 (1.96)	53.7 (0.67)	2.3 (0.02)

Table S20. Water quality parameters for Plant 4.

Date	Sample	Sucralose (µg/L)	TOC (mg/L)	UV₂₅₄ (abs/cm)	SUVA (L/mg-m)	Total Ammonia (mg/L)	Br- (µg/L)	I- (µg/L)
February 2018	Raw	ND	4.0	0.067	1.7	ND	146	32
	Effluent	--	2.9	0.051	1.7	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--
December 2018	Raw	ND	4.3	0.107	2.5	0.1	120	22
	Effluent	--	3.4	0.067	2.0	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--
July 2019	Raw	< 0.2	4.2	0.082	2.0	0.03	126	< 10
	Effluent	--	3.0	0.054	1.8	--	--	--
	Dist. Avg.	--	--	--	--	--	--	--
	Dist. Max.	--	--	--	--	--	--	--

Table S21. Mean unregulated DBP data for Plant 5.

Compound	MRL ($\mu\text{g/L}$)	Concentration - $\mu\text{g/L}$ (nM)		
		Raw	Dist. Avg. Oct. 2017	Dist. Avg. July 2018
HNMs				
BDCNM	0.1	ND	0.4 (1.9)	0.3 (1.4)
DBCNM	0.1	ND	0.7 (2.8)	0.5 (2.0)
TBNM	0.5	ND	ND	< 0.5
DCNM	0.1	ND	ND	ND
BCNM	0.1	ND	0.2 (1.1)	< 0.1
DBNM	0.1	ND	< 0.1	< 0.1
TCNM	0.1	ND	0.3 (1.8)	0.1 (0.6)
HALs				
TCAL	0.1	ND	1.9 (12.9)	3.1 (21.0)
BDCAL	0.1	ND	0.8 (4.2)	2.2 (11.5)
DBCAL	0.1	ND	0.2 (0.8)	0.4 (1.7)
TBAL	0.1	ND	< 0.1	< 0.1
CAL	0.1	ND	ND	ND
DCAL	0.1	ND	< 0.1	0.1 (0.9)
BAL	0.1	ND	ND	ND
BCAL	0.1	ND	< 0.1	0.2 (1.3)
IAL	0.1	ND	ND	ND
DBAL	0.1	ND	ND	ND
HANs				
DCAN	0.1	ND	0.6 (5.5)	1.1 (10.0)
BCAN	0.1	ND	1.0 (3.2)	1.1 (7.1)
TBAN	0.1	ND	0.5 (1.8)	0.4 (1.4)
TCAN	0.1	ND	ND	< 0.1
CAN	0.25	ND	0.3 (4.0)	0.4 (5.3)
BAN	0.5	ND	ND	ND
DBAN	0.1	ND	0.3 (1.5)	0.5 (2.5)
IAN	0.1	ND	ND	ND
BDCAN	0.1	NM	NM	NM
DBCAN	0.1	NM	NM	NM
HKs				
1,1-DCP	0.1	ND	ND	0.4 (3.2)
CP	0.1	ND	5.5 (59.4)	1.0 (10.8)
1,1,1-TCP	0.1	ND	0.3 (1.9)	0.2 (1.2)
1,1-DBP	0.1	ND	ND	< 0.1
1-B-1,1-DCP	0.1	ND	ND	0.1 (0.5)
1,3-DCP	0.1	ND	0.8 (6.3)	< 0.1

1,1,3-TCP	0.1	ND	0.1 (0.6)	< 0.1
1,1,3,3-TeCP	0.1	ND	0.1 (0.5)	< 0.1
1,1,3,3-TeBP	0.1	ND	0.1 (0.3)	0.1 (0.3)
I-THMs				
DCIM	0.1	ND	ND	0.1 (0.5)
BCIM	0.1	ND	0.1 (0.4)	0.1 (0.4)
DBIM	0.1	ND	ND	< 0.1
CDIM	0.1	ND	ND	ND
BDIM	0.1	ND	ND	ND
TIM	0.1	ND	ND	ND
HAMs				
CAM	1.0	ND	ND	ND
BAM	1.0	ND	ND	ND
IAM	1.0	ND	ND	ND
BCAM	0.1	ND	1.7 (9.9)	2.6 (14.1)
TCAM	0.1	ND	0.3 (1.8)	0.2 (1.2)
DCAM	0.3	ND	2.7 (21.1)	1.8 (14.1)
DBAM	0.2	ND	0.7 (3.2)	1.7 (7.8)
CIAM	0.3	ND	ND	ND
BIAM	0.5	ND	ND	ND
DBCAM	0.1	ND	0.4 (1.6)	0.3 (1.2)
TBAM	0.1	ND	ND	0.1 (0.3)
DIAM	0.2	ND	ND	ND
BDCAM	0.1	ND	0.4 (1.9)	0.3 (1.5)
IAs				
IAA	.010	ND	0.023 (0.1)	< 0.010
CIAA	.015	ND	0.032 (0.1)	0.120 (0.5)
BIAA	.020	ND	ND	< 0.020
DIAA	.015	ND	ND	ND

Table S22. Mean THM4 and HAA9 data for Plant 5.

Compound	Concentration - µg/L (nM)			
	Dist. Avg. Oct. 2017	Dist. Max. Oct. 2017	Dist. Avg. July 2018	Dist. Max. July 2018
THMs				
Trichloromethane	12 (101)	11 (92.1)	12 (101)	11 (92.1)
Bromodichloromethane	13 (79.4)	12 (73.2)	12 (73.2)	16 (97.7)
Dibromochloromethane	7.3 (35.0)	7.3 (35.0)	9.0 (43.2)	15 (72.0)
Tribromomethane	1.4 (5.5)	1.6 (6.3)	1.9 (7.5)	4.3 (17.0)
HAAs				
Chloroacetic acid	ND	ND	ND	ND
Bromoacetic acid	ND	ND	ND	ND
Dichloroacetic acid	7.6 (58.9)	9.1 (70.6)	8.8 (68.2)	10 (77.6)
Bromochloroacetic acid	4.8 (27.7)	5.7 (32.9)	5.0 (28.8)	8.5 (49.0)
Dibromoacetic acid	1.8 (8.3)	2.3 (10.6)	2.5 (11.5)	4.9 (22.5)
Trichloroacetic acid	4.8 (29.4)	5.5 (33.7)	4.6 (28.2)	6.5 (39.8)
Bromodichloroacetic acid	5.9 (28.4)	3.3 (15.9)	2.9 (14.0)	5.7 (27.4)
Chlorodibromoacetic acid	1.8 (7.1)	ND	ND	3.0 (11.9)
Tribromoacetic acid	ND	ND	ND	ND

Table S23. Mean total organic halogen data for Plant 5 -µg/L (µM).

Date	Sample	TOCl (as Cl-)	TOBr (as Br-)	TOI (as I-)
October 2017	Raw	26.1 (0.74)	10.0 (0.13)	1.6 (0.01)
	Effluent	93.3 (2.63)	45.2 (0.57)	0.8 (0.006)
	Dist. Avg.	63.5 (1.79)	36.1 (0.45)	0.6 (0.005)
	Dist. Max	57.7 (1.63)	30.9 (0.39)	0.5 (0.004)
July 2018	Raw	20.9 (0.59)	9.1 (0.11)	3.9 (0.03)
	Effluent	84.3 (2.37)	77.6 (0.97)	2.4 (0.02)
	Dist. Avg.	90.8 (2.56)	65.8 (0.82)	2.5 (0.02)
	Dist. Max.	70.8 (1.99)	37.7 (0.47)	1.9 (0.01)

Table S24. Water quality parameters for Plant 5.

Date	Sample	Sucralose (µg/L)	TOC (mg/L)	UV₂₅₄ (abs/cm)	SUVA (L/mg-m)	Total Ammonia (mg/L)	Br- (µg/L)	I- (µg/L)
October 2017	Raw	2.8	3.6	0.056	1.5	0.17	92	11
	Effluent	1.2	1.8	0.035	1.9	--	--	--
	Dist. Avg.	1.1	--	--	--	--	--	--
	Dist. Max.	0.9	--	--	--	--	--	--
July 2018	Raw	8.0	5.1	0.072	1.4	0.05	174	< 10
	Effluent	3.1	3.2	0.044	1.4	--	--	--
	Dist. Avg.	2.6	--	--	--	--	--	--
	Dist. Max.	1.2	--	--	--	--	--	--

Table S25. Mean unregulated DBP data for Plant 6.

Compound	MRL µg/L	Concentration - µg/L (nM)				
		Raw A	Raw B	Dist. Avg. Jan. 2018	Dist. Avg. Aug. 2018	Dist. Avg. Sep. 2019
HNMs						
BDCNM	0.1	ND	ND	0.3 (1.4)	0.7 (3.4)	0.2 (1.0)
DBCNM	0.1	ND	ND	0.6 (2.4)	1.4 (5.4)	0.4 (1.6)
TBNM	0.25	ND	ND	ND	1.5 (4.9)	0.5 (1.7)
DCNM	0.1	ND	ND	ND	ND	ND
BCNM	0.1	ND	ND	0.1 (0.6)	ND	ND
DBNM	0.1	ND	ND	0.2 (0.9)	< 0.1	< 0.1
TCNM	0.1	ND	ND	0.1 (0.6)	0.2 (1.0)	< 0.1
HALs						
TCAL	0.1	ND	ND	0.1 (0.7)	0.2 (1.4)	0.3 (2.0)
BDCAL	0.1	ND	ND	ND	0.7 (3.8)	0.6 (3.1)
DBCAL	0.1	ND	ND	1.1 (4.7)	0.4 (1.6)	0.5 (2.1)
TBAL	0.1	ND	ND	0.2 (0.7)	0.1 (0.3)	0.1 (0.4)
CAL	0.1	ND	ND	ND	ND	ND
DCAL	0.1	ND	ND	ND	0.1 (0.9)	< 0.1
BAL	0.1	ND	ND	ND	ND	ND
BCAL	0.1	ND	ND	0.1 (0.6)	0.1 (0.6)	0.3 (1.9)
IAL	0.1	ND	ND	ND	ND	ND
DBAL	0.1	ND	ND	ND	ND	< 0.1
HANs						
DCAN	0.1	ND	ND	0.7 (6.4)	0.6 (5.5)	0.4 (3.6)
BCAN	0.1	ND	ND	1.3 (8.4)	1.4 (8.8)	1.2 (7.8)
TBAN	0.1	ND	ND	0.5 (1.8)	0.6 (2.2)	0.3 (1.1)
TCAN	0.1	ND	ND	ND	< 0.1	ND
CAN	0.1	ND	ND	ND	0.8 (10.8)	ND
BAN	0.1	ND	ND	ND	ND	ND
DBAN	0.25	ND	ND	1.2 (6.0)	1.1 (5.8)	1.7 (8.5)
IAN	0.5	ND	ND	ND	ND	ND
BDCAN	0.1	ND	ND	NM	NM	ND
DBCAN	0.1	ND	ND	NM	NM	0.1 (0.4)
HKs						
1,1-DCP	0.1	ND	ND	0.3 (2.4)	0.3 (2.7)	0.2 (1.6)
CP	0.1	ND	ND	5.9 (63.8)	0.9 (10.0)	0.7 (7.6)
1,1,1-TCP	0.1	ND	ND	0.2 (1.2)	< 0.1	< 0.1
1,1-DBP	0.1	ND	ND	0.1 (0.5)	< 0.1	< 0.1
1-B-1,1-DCP	0.1	ND	ND	0.2 (1.0)	0.2 (0.7)	ND
1,3-DCP	0.1	ND	ND	0.1 (0.8)	ND	ND

1,1,3-TCP	0.1	ND	ND	ND	ND	ND
1,1,3,3-TeCP	0.1	ND	ND	0.1 (0.5)	< 0.1	< 0.1
1,1,3,3-TeBP	0.1	ND	ND	ND	< 0.1	0.2 (0.5)
I-THMs						
DCIM	0.1	ND	ND	0.2 (0.9)	0.3 (1.6)	0.1 (0.5)
BCIM	0.1	ND	ND	0.3 (1.2)	0.2 (0.9)	0.1 (0.5)
DBIM	0.1	ND	ND	0.1 (0.3)	0.1 (0.3)	< 0.1
CDIM	0.1	ND	ND	ND	ND	ND
BDIM	0.1	ND	ND	ND	ND	ND
TIM	0.1	ND	ND	ND	ND	ND
HAMs						
CAM	1.0	ND	ND	ND	ND	ND
BAM	1.0	ND	ND	ND	ND	ND
IAM	1.0	ND	ND	ND	ND	ND
BCAM	0.3	ND	ND	0.6 (3.5)	0.9 (4.5)	0.6 (3.5)
TCAM	0.2	ND	ND	0.2 (1.2)	< 0.2	ND
DCAM	0.3	ND	ND	ND	ND	0.6 (4.7)
DBAM	0.2	ND	ND	1.6 (7.4)	0.9 (4.3)	1.0 (4.6)
CIAM	0.3	ND	ND	ND	ND	ND
BIAM	0.5	ND	ND	ND	ND	ND
DBCAM	0.1	ND	ND	ND	ND	0.1
TBAM	0.1	ND	ND	ND	0.1 (0.5)	< 0.1
DIAM	0.1	ND	ND	ND	ND	ND
BDCAM	0.1	ND	ND	ND	0.2 (0.9)	< 0.1
IAs						
IAA	.025	ND	ND	0.032 (0.2)	< 0.010	0.054 (0.3)
CIAA	.050	ND	ND	0.026 (0.1)	0.111 (0.5)	0.153 (0.7)
BIAA	.020	ND	ND	< 0.020	< 0.020	0.058 (0.2)
DIAA	.025	ND	ND	ND	ND	ND

Table S26. Mean THM4 and HAA9 data for Plant 6.

Compound	Concentration - µg/L (nM)					
	Dist. Avg. Jan. 2018	Dist. Max. Jan. 2018	Dist. Avg. Aug. 2018	Dist. Max. Aug. 2018	Dist. Avg. Sep. 2019	Dist. Max. Sep. 2019
THMs						
Trichloromethane	3.6 (30.5)	3.8 (31.8)	4.8 (40.2)	3.9 (32.7)	2.8 (23.5)	3.8 (31.8)
Bromodichloromethane	7.6 (46.2)	7.6 (46.4)	8.0 (48.8)	7.0 (42.7)	5.5 (33.6)	6.1 (37.2)
Dibromochloromethane	9.0 (43.4)	9.1 (43.7)	8.7 (41.8)	8.0 (38.4)	8.4 (40.3)	8.6 (41.3)
Tribromomethane	3.7 (14.4)	3.9 (15.4)	2.8 (11.1)	2.6 (10.3)	3.8 (15.0)	3.7 (14.6)
HAAs						
Chloroacetic acid	ND	0.4 (4.2)	ND	ND	ND	ND
Bromoacetic acid	0.6 (4.0)	0.5 (3.6)	ND	ND	ND	ND
Dichloroacetic acid	2.3 (18.1)	2.4 (18.6)	1.9 (14.7)	2.0 (15.5)	1.9 (14.7)	4.0 (31.0)
Bromochloroacetic acid	2.8 (15.9)	2.8 (16.1)	2.3 (13.3)	2.1 (12.1)	3.2 (18.5)	4.3 (24.8)
Dibromoacetic acid	2.2 (10.1)	2.2 (10.1)	1.9 (8.7)	1.7 (7.8)	3.2 (14.7)	4.0 (18.4)
Trichloroacetic acid	0.9 (5.8)	0.9 (5.5)	ND	ND	ND	1.2 (7.3)
Bromodichloroacetic acid	2.0 (9.7)	2.1 (10.1)	1.3 (6.3)	ND	2.0 (9.6)	2.3 (11.1)
Chlorodibromoacetic acid	2.0 (7.9)	2.0 (7.9)	1.0 (4.0)	ND	2.8 (11.1)	2.8 (11.1)
Tribromoacetic acid	0.5 (1.7)	0.5 (1.7)	ND	ND	ND	ND

Table S27. Mean total organic halogen data for Plant 6 - µg/L (µM).

Date	Sample	TOCl (as Cl-)	TOBr (as Br-)	TOI (as I-)
January 2018	Plant 6 A Raw	29.8 (0.84)	7.6 (0.10)	4.0 (0.03)
	Plant 6 B Raw	15.7 (0.44)	7.8 (0.10)	1.0 (0.008)
	Combined Effluent	53.8 (1.52)	60.9 (0.76)	0.8 (0.006)
	Dist. Avg.	49.6 (1.40)	56.8 (0.71)	0.9 (0.007)
	Dist. Max.	89.7 (2.53)	53.9 (0.67)	0.9 (0.007)
August 2018	Plant 6 A Raw	28.7 (0.81)	7.4 (0.09)	7.6 (0.06)
	Plant 6 B Raw	11.2 (0.32)	6.8 (0.08)	1.9 (0.01)
	Combined Effluent	46.0 (1.30)	50.7 (0.63)	0.8 (0.006)
	Dist. Avg.	48.4 (1.36)	44.8 (0.56)	0.9 (0.007)
	Dist. Max.	45.1 (1.27)	43.8 (0.55)	0.9 (0.007)
September 2019	Plant 6 A Raw	38.5 (1.08)	7.7 (0.10)	4.1 (0.03)
	Plant 6 B Raw	31.6 (0.89)	6.1 (0.08)	0.9 (0.007)
	Combined Effluent	95.1 (2.70)	50.3 (0.63)	1.1 (0.008)
	Dist. Avg.	122.1 (3.44)	43.6 (0.55)	1.7 (0.01)
	Dist. Max.	75.1 (2.12)	37.8 (0.47)	1.4 (0.01)

Table S28. Water quality parameters for Plant 6.

Date	Sample	Blend	Sucralose (µg/L)	TOC (mg/L)	UV₂₅₄ (abs/cm)	SUVA (L/mg- m)	Total Ammonia (mg/L)	Br- (µg/L)	I- (µg/L)
January 2018	Plant 6 A Raw	36.0 %	12.4	2.6	0.046	1.8	ND	291	22
	Plant 6 A Effluent		2.8	2.1	0.021	1.0	--	--	--
	Plant 6 B Raw	64.0 %	0.2	4.2	0.052	1.2	0.05	59	< 10
	Plant 6 B Effluent		0.2	2.5	0.023	0.9	--	--	--
	Dist. Avg.		1.2	--	--	--	--	--	--
	Dist. Max.		1.0	--	--	--	--	--	--
August 2018	Plant 6 A Raw	31.4%	17.8	2.9	0.058	2.0	0.08	270	< 10
	Plant 6 A Effluent		8.4	2.4	0.031	1.3	--	--	--
	Plant 6 B Raw	68.6 %	0.3	3.6	0.047	1.3	0.09	55	< 10
	Plant 6 B Effluent		0.2	2.1	0.021	1.0	--	--	--
	Dist. Avg.		2.4	--	--	--	--	--	--
	Dist. Max.		2.5	--	--	--	--	--	--
September 2019	Plant 6 A Raw	41.3 %	21	2.8	0.060	2.1	ND	261	< 10
	Plant 6 A Effluent		4.8	1.6	0.021	1.3	--	--	--
	Plant 6 B Raw	58.7 %	0.3	3.0	0.044	1.5	ND	51	< 10
	Plant 6 B Effluent		< 0.2	1.7	0.018	1.1	--	--	--
	Dist. Avg.		1.8	--	--	--	--	--	--
	Dist. Max.		1.9	--	--	--	--	--	--

Table S29. Summary of the CHO cell cytotoxicity statistical analyses of the distribution average water samples.

Water Sample	Lowest Cytotoxic Conc. (CF) ^a	Mean LC ₅₀ Value (CF ± SE) ^b	r^2 ^c	ANOVA Test Statistic ^d	Mean CTI Value ± SE ^e
Plant 1: 5/7/2018	40.0	149.43 ± 6.71	0.98	$F_{14,98} = 132.1; P \leq 0.001$	6.71 ± 0.12
Plant 1: 11/6/2018	50.0	176.75 ± 5.68	0.98	$F_{14,98} = 150.6; P \leq 0.001$	5.68 ± 0.13
Plant 1: 3/5/2018	25.0	137.41 ± 7.38	0.98	$F_{14,95} = 206.4; P \leq 0.001$	7.38 ± 0.27
Plant 2: 12/14/2017	25.0	98.48 ± 10.21	0.99	$F_{12,92} = 85.7; P \leq 0.001$	10.21 ± 0.26
Plant 2: 2/20/2019	100.0	131.68 ± 7.64	0.99	$F_{10,63} = 85.7; P \leq 0.001$	7.64 ± 0.18
Plant 2: 9/17/2019	40.0	109.90 ± 9.12	0.97	$F_{11,99} = 145.2; P \leq 0.001$	9.12 ± 0.11
Plant 3: 6/12/2018	40.0	116.33 ± 8.81	0.99	$F_{11,98} = 132.7; P \leq 0.001$	8.81 ± 0.43
Plant 3: 1/28/2019	50.0	128.48 ± 8.01	0.96	$F_{10,78} = 69.9; P \leq 0.001$	8.01 ± 0.39
Plant 4: 2/26/2018	40.0	63.79 ± 15.72	0.99	$F_{11,99} = 454.1; P \leq 0.001$	15.72 ± 0.25
Plant 4: 12/10/2018	50.0	72.35 ± 14.28	0.99	$F_{11,91} = 58.9; P \leq 0.001$	14.28 ± 0.75
Plant 4: 7/15/2019	40.0	123.67 ± 8.32	0.99	$F_{10,102} = 96.7; P \leq 0.001$	8.32 ± 0.42
Plant 5: 10/10/2017	25.0	148.01 ± 6.79	0.99	$F_{11,97} = 221.6; P \leq 0.001$	6.79 ± 0.15
Plant 5: 7/10/2018	20.0	101.29 ± 9.93	0.99	$F_{10,101} = 339.4; P \leq 0.001$	9.93 ± 0.24
Plant 6: 1/9/2018	80.0	152.97 ± 6.57	0.99	$F_{12,96} = 190.3; P \leq 0.001$	6.57 ± 0.15
Plant 6: 8/6/2018	10.0	105.25 ± 9.53	0.98	$F_{14,97} = 136.8; P \leq 0.001$	9.53 ± 0.17
Plant 6: 9/23/2019	40.0	128.41 ± 8.34	0.99	$F_{10,98} = 76.6; P \leq 0.001$	8.34 ± 0.64

^a Lowest cytotoxic concentration was the lowest concentration factor of the sample that induced a statistically significant reduction in cell density as compared to the negative control. ^b The LC₅₀ value is the concentration factor of the water sample, determined from a regression analysis of the data, that induced a cell density of 50% as compared to the concurrent negative controls. The mean and the standard error (SE) of each LC₅₀ value were derived from multiple regression analyses using bootstrap statistics. ^c The r^2 is the coefficient of determination for the regression analysis of the concentration-response data upon which the LC₅₀ value was calculated. ^d The degrees of freedom for the between-groups and residual associated with the calculated F -test result and the resulting probability value.

^e The Cytotoxicity Index Value is the $(LC_{50}^{-1})(10^3)$. The mean and the standard error (SE) of each CTI value were derived from multiple regression analyses using bootstrap statistics.

