CHEMICALS OF EMERGING CONCERN

Report prepared for Jamesville Reservoir, NY

Submitted by:

Dr. Teng Zeng and Shiru Wang
Syracuse University
151 Link Hall
Syracuse, NY 13244

MaryGail Perkins and Monica Matt
Upstate Freshwater Institute
224 Midler Park Drive
Syracuse, NY 13206

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Background:

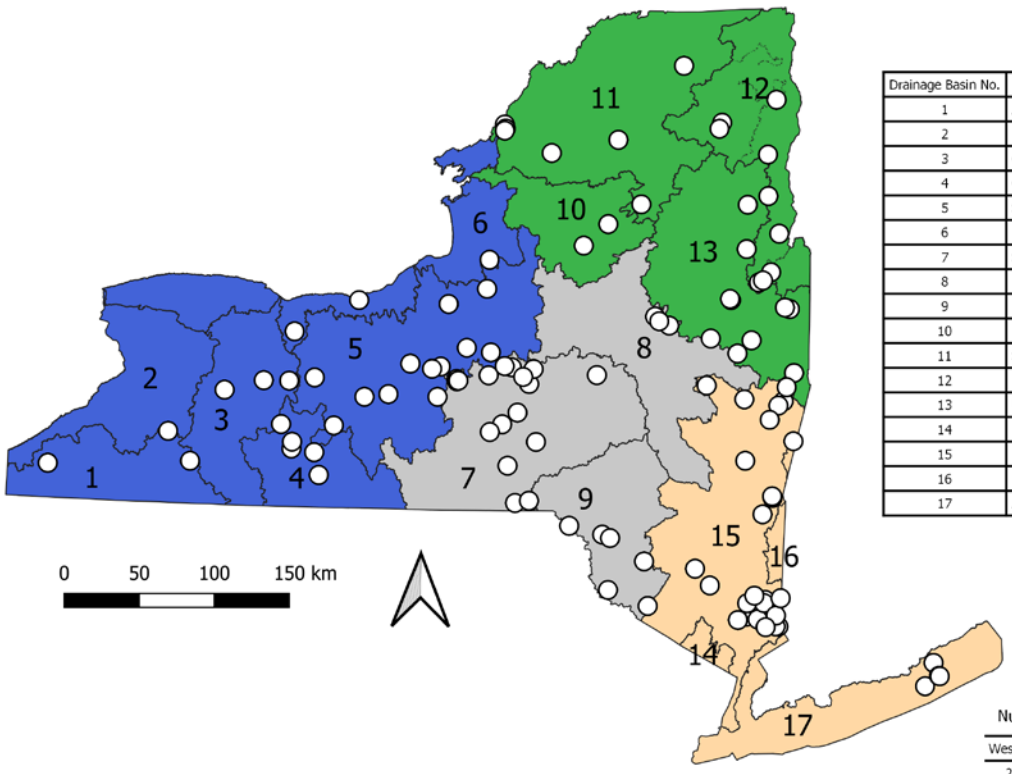
Chemicals of emerging concerns (CECs) are organic contaminants of anthropogenic (human) origin present in the environment. CECs can be traced to commonly used pharmaceuticals, pesticides, household chemicals, and personal care products. Most CECs enter waterbodies via point or non-point sources such as wastewater treatment plant discharges or surface runoff. Although the impact of CECs on humans is currently considered minimal, these trace contaminants may have adverse long-term effects on aquatic organisms, which in turn affects the aquatic ecosystem health and water quality.

CECs present a challenge to lake monitoring and management programs mainly because available data on their occurrence, fate, transport, and ecosystem effects is relatively limited. Further complicating this issue, some CECs, once released into the lakes, may be transformed by natural sunlight or microorganisms into the so-called transformation products that are even less studied. This research was initiated to provide the first survey of CEC occurrence in lakes in New York State. The results of this study will be used by researchers and other stakeholders to evaluate the nature and spatial distribution of these contaminants in NY's surface waters.

CECs are increasingly detected in surface waters worldwide due to advances in modern analytical techniques. Most CECs detected in this study only occurred at concentrations on the order of nanograms per liter (unit: ng/L) or “parts per trillion”, although some concentrations observed were an order of magnitude higher (micrograms per liter or “parts per billion”). A total of 111 lakes participated in this research program during 2018 - 2019. The following is a brief summary of the frequency of detection and range in concentrations of each CEC observed in all participating lakes along with the results specific to your lake.

Salient Findings:

- CECs detected in lake water samples mainly belonged to three major groups: pharmaceuticals (abbreviated as “PHAR” in figures and tables), pesticides (abbreviated as “PEST”) and personal care and household chemicals (abbreviated as “PCHC”). Some transformation products (abbreviated as “TP”) of these CECs were also detected.
- The types and levels of CECs found in participating lakes were similar to those reported for other surface water bodies with recreational usage and potential septic input.
- The occurrence patterns of CECs were similar across different NYS regions but exhibited high inter-lake variability. For example, CEC concentrations varied from lake to lake and often varied from sampling date to sampling date for lakes sampled more than once.
- Every lake had at least one CEC detected in each sample, but not every CEC was found in every lake (this lake specific report lists the CECs found in your lake; Table 2 also lists all CECs found during this study).



Drainage Basin No.	Drainage Basin Name	Region
1	Allegheny River	Western
2	Lake Erie-Niagara	Western
3	Genesee River	Western
4	Chemung River	Western
5	Seneca-Oneida-Oswego River	Western
6	Lake Ontario	Western
7	Susquehanna River	Central
8	Mohawk River	Central
9	Delaware River	Central
10	Black River	Northern
11	St. Lawrence River	Northern
12	Lake Champlain	Northern
13	Upper Hudson River	Northern
14	Ramapo River	Southern
15	Lower Hudson River	Southern
16	Housatonic River	Southern
17	Atlantic Ocean	Southern

Number of Lakes Per Region

Western	Central	Northen	Southern
29	25	27	31

Figure 1: Location of lakes participating in 2018 – 2019 CEC survey.

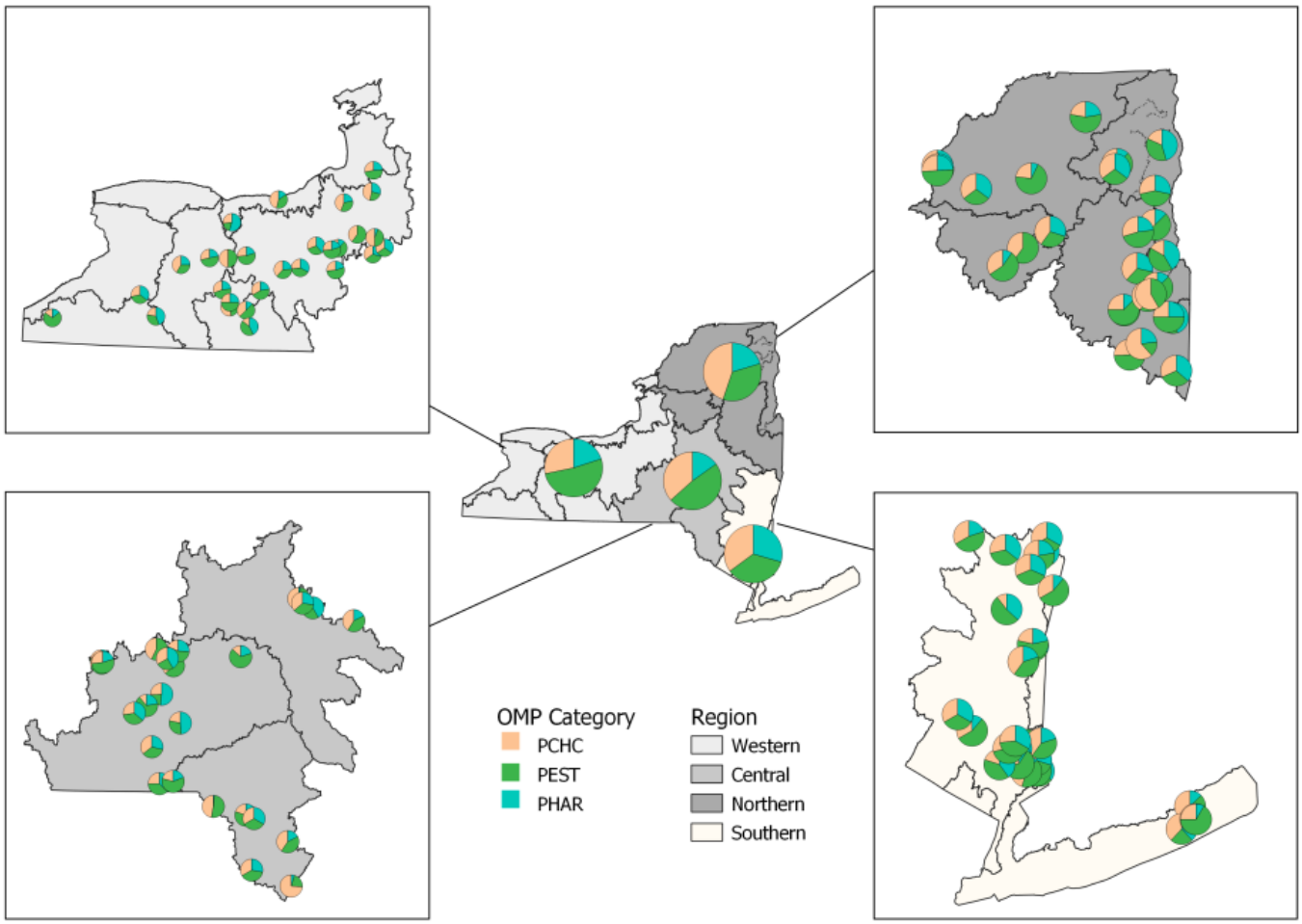


Figure 2: Distribution of CECs in NY lakes according to type and regional location.

Of the 300+ CECs screened for by Syracuse University, 7 were detected in the sample from Jamesville Reservoir collected in 2019. Only pesticides and pesticide transformation products were detected in this sample. Atrazine and Metolachlor OA were two of the most frequently detected CEC throughout the course of the study (Table 2). Table 1 summarizes the concentrations of CECs measured in each sample.

Table 1: Summary of CECs detected in Jamesville Reservoir (2019). Sample analysis was conducted in duplicate on the water sample for all CECs. The limit of quantification (LOQ) is defined as the lowest concentration of a CEC in a sample that can be confidently quantified with acceptable precision and accuracy. Concentrations of CECs are all in "ng/L". Concentrations of CECs below the LOQs are italicized and reported as estimated values with "<LOQ".

Contaminant	Category	LOQ	Date	Average Concentration
Atrazine	Pesticide	13	09/22/19	37.5
Dimethachlor	Pesticide	10	09/22/19	13.5
Metolachlor	Pesticide	11	09/22/19	46.5
Simazine	Pesticide	15	09/22/19	17.5
Atrazine-2-hydroxy	Pesticide transformation product	14	09/22/19	86.5
Atrazine-desethyl	Pesticide transformation product	2	09/22/19	19
Metolachlor Oxanilic Acid (Metolachlor OA)	Pesticide transformation product	24	09/22/19	*21.5* (<LOQ)

For more information on the presence of CECs in surface waters, see the following resources:

Environmental Protection Agency. 2019. Contaminants of Emerging Concern including pharmaceuticals and personal care products. Available at https://www.epa.gov/wqc/contaminants-emerging-concern-including-pharmaceuticals-and-personal-care-products.

Moran E and J Bergere. 2019. Emerging contaminants in New York's drinking water systems: What's in my water? *Report funded by New York Public Interest Research Group*. Available at https://www.nypirg.org/pubs/201905/Whats_in_my_water_2019.pdf.

United States Geological Survey. 2018. Emerging Contaminants. Available at https://www.usgs.gov/mission-areas/water-resources/science/emerging-contaminants?qt-science_center_objects=0#qt-science_center_objects.

Table 2: Chemicals of emerging concern (CECs) detected in NY lakes along with their product type and common use.

Name	Type	Use
Acetaminophen	PHAR	pain reliever
Azelaic Acid	PHAR	topical antiseptic; treats rosacea and severe acne
Caffeine	PHAR	stimulant, world's most widely consumed psychoactive drug
Carbamazepine	PHAR	anticonvulsant
Cetirizine	PHAR	antihistamine; treats hay fever and allergy symptoms, hives, and itching
Clindamycin	PHAR	antibiotic
Cortisone	PHAR	pregnane steroid hormone; used as a pain reliever and anti-inflammatory
Diclofenac	PHAR	NSAID; treats pain, migraines, and arthritis in its oral form
Dopamine	PHAR	organic chemical in supplements to support many brain-related functions, such as mood, motivation and memory
Fexofenadine	PHAR	antihistamine; relieve variety of allergy symptoms
Fluconazole	PHAR	azole antifungal used to prevent and treat a variety of fungal and yeast infections
Fluoxetine	PHAR	Selective Serotonin Reuptake Inhibitor (SSRI) used to treat depression, OCD, bulimia nervosa, and panic disorder.
Gabapentin	PHAR	Nerve pain medication and anticonvulsant
Hydrocortisone	PHAR	used to treat a variety of skin conditions e.g., insect bites, poison oak/ivy, eczema, dermatitis, allergies, rash, itching
Hydroxyprogesterone	PHAR	a progestin medication which is used to prevent preterm birth in pregnant women with a history of the condition
Labetalol	PHAR	beta-blocker used to treat hypertension (high blood pressure).
Lamotrigine	PHAR	treat seizures and bipolar disorder
Levetiracetam	PHAR	medication used to treat epilepsy
Lidocaine	PHAR	topical anesthetic and antiarrhythmic (treat irregular heartbeats)
Losartan	PHAR	used to treat high blood pressure (hypertension) and to help protect the kidneys from damage due to diabetes
Meclofenamic Acid	PHAR	used for joint, muscular pain, arthritis and dysmenorrhea
Metaxalone	PHAR	muscle relaxant; relieve pain caused by injuries
Metformin	PHAR	controls high blood sugar; diabetes medication
Methocarbamol	PHAR	a muscle relaxant
Metoprolol	PHAR	a beta-blocker used to treat angina (chest pain) and hypertension (high blood pressure)
Minoxidil	PHAR	help hair growth in the treatment of male pattern baldness
Norepinephrine	PHAR	used to treat low blood pressure and heart failure
Protriptyline	PHAR	nerve pain medication and antidepressant
Pyridoxine	PHAR	also known as vitamin B_6 commonly in food and used as dietary supplement
Sitagliptin	PHAR	controls high blood sugar; diabetes medication

Name	Type	Use
Sulfamethazine	PHAR	sulfonamide antibacterial medication
Sulfamethoxazole	PHAR	combination of two antibiotics; used to treat a wide variety of bacterial infections
10,11-Dihydro-10-hydroxy Carbamazepine	PHAR TP	anticonvulsant
1-Methylxanthine	PHAR TP	the major metabolites of caffeine in the human
2-Ethyl-2-phenylmalonamide	PHAR TP	an active metabolite of the anticonvulsant drug primidone
Benzoylecgonine	PHAR TP	the compound tested for in most substantive cocaine urinalyses
Paraxanthine	PHAR TP	a psychoactive central nervous system (CNS) stimulan; the preferential path of caffeine metabolism in humans
2,4-Dichlorophenoxyacetic Acid (2,4-D)	PEST	systemic herbicide which selectively kills most broadleaf weeds
Atrazine	PEST	broadleaf herbicide; one of the most widely used herbicides in US
Carbendazim	PEST	aka MBC; widely used, broad-spectrum fungicide used as a casting worm control agent on golf greens & tennis courts
Dimethachlor	PEST	used to control certain broadleaf and annual grassy weeds in agriculture
Diuron	PEST	algicide/herbicide inhibits photosynthesis; control a wide variety of annual and perennial broadleaf and grassy weeds
Fluridone	PEST	organic compound that is used as aquatic herbicide often used to control invasive plants
Imazapyr	PEST	non-selective herbicide; controls broad range of weeds including terrestrial grasses, riparian & emergent aquatic species
Imidacloprid	PEST	insecticide used to control aphids, thrips, whiteflies, scale, termites, turf and soil insects and some beetles.
Metalaxyl	PEST	fungicide; controls Pythium in vegetable crops, and Phytophthora in peas
Metolachlor	PEST	herbicide; highly effective on grasses
Prometon	PEST	herbicide for broad-leaf weed, brush and grass control mainly in non-cropping situations
Simazine	PEST	controls broad-leaved weeds/annual grasses in berry fruit, vegetable & ornamental crops, turfgrass, orchards & vineyards
Trinexapac-ethyl	PEST	manage growth of warm and cool-season turfgrass
Atrazine-2-hydroxy	PEST TP	transformation product of Atrazine
Atrazine-desethyl	PEST TP	transformation product of Atrazine
Atrazine-desisopropyl	PEST TP	transformation product of Atrazine
Metolachlor Ethane Sulfonic Acid (Metolachlor ESA)	PEST TP	the ESA degradates of Metolachlor; can be persistent in soil

Name	Type	Use
Metolachlor Oxanilic Acid (Metolachlor OA)	PEST TP	the *OA* degradates of Metolachlor*;* can be persistent in soil
2-Hydroxybenzothiazole	PCHC	released into wastewaters during the industrial production of a rubber vulcanization accelerator
5-Methyl-1H-benzotriazole	PCHC	corrosion inhibitor in antifreeze, engine oils, brake fluids, protective coatings
1H-Benzotriazole	PCHC	an effective corrosion inhibitor for copper alloys.
Benzophenone	PCHC	used in personal care products such as lip balm and nail polish to protect the products from UV light
Benzophenone-3 (Oxybenzone)	PCHC	benzophenone derivative used as a sunscreen agent; absorbs UVB and UVA II rays
Benzothiazole	PCHC	in many natural plant products; properties include anticancer, antimicrobial, antidiabetic, anticonvulsant, anti-inflammatory
Icaridin	PCHC	aka picaridin, almost colorless & odorless insect repellent with broad efficacy against insects and ticks
Melamine	PCHC	used in production of laminates, glues, plastic dinnerware, adhesives, molding compounds, coatings and flame retardants
N,N-Diethyl-3-methylbenzamide (DEET)	PCHC	most common active ingredient in insect repellents
Sucralose	PCHC	artificial sweetener and sugar substitute; the majority of ingested sucralose is not broken down by the body
Triclosan	PCHC	antibacterial antifungal agent in some toothpaste, soaps, detergents, toys, and surgical cleaning treatments
Galaxolidone	PCHC TP	a synthetic musk component used in fragrances (perfumes, colognes, soaps, detergents, etc)

KEY:

Name: Name of the contaminant

Type: Type of the contaminant:

PHARM: pharmaceutical

PHARM-TP: transformation product of a given pharmaceutical

PEST: pesticide

PEST-TP: transformation product of a given pesticide

PCHC: personal care/household chemical

PHCH-TP: transformation product of a given personal care/household chemical

Use: Contaminant typical use

Table 3: Summary statistics for the occurrence of chemicals of emerging concern (CECs) in NY lakes.

Name	Type	LOQ (ng/L)	Min (ng/L)	Max (ng/L)	Mean (ng/L)	Median (ng/L)	No. Obs
Acetaminophen	PHAR	25	49	291	128	113	3
Azelaic Acid	PHAR	23	< LOQ	716	124	95	66
Caffeine	PHAR	1	3	800	50	30	157
Carbamazepine	PHAR	11	< LOQ	35	11	8	8
Cetirizine	PHAR	11	13	46	22	21	9
Clindamycin	PHAR	32	42	49	45	45	1
Cortisone	PHAR	13	15	23	20	20	10
Diclofenac	PHAR	16	17	79	49	59	3
Dopamine	PHAR	25	77	152	113	111	2
Fexofenadine	PHAR	10	< LOQ	184	45	37	7
Fluconazole	PHAR	2	33	35	34	34	1
Fluoxetine	PHAR	14	< LOQ	< LOQ	< LOQ	< LOQ	3
Gabapentin	PHAR	2	14	185	34	28	63
Hydrocortisone	PHAR	17	79	552	289	261	2
Hydroxyprogesterone	PHAR	11	12	101	28	21	10
Labetalol	PHAR	15	< LOQ	< LOQ	< LOQ	< LOQ	8
Lamotrigine	PHAR	16	< LOQ	57	26	22	22
Levetiracetam	PHAR	10	31	141	81	76	2
Lidocaine	PHAR	10	< LOQ	252	81	10	3
Losartan	PHAR	14	18	40	26	19	3
Meclofenamic Acid	PHAR	10	81	330	132	105	4
Metaxalone	PHAR	12	16	73	34	18	3
Metformin	PHAR	46	< LOQ	438	98	62	27
Methocarbamol	PHAR	10	20	21	20	20	1
Metoprolol	PHAR	10	17	37	27	27	1
Minoxidil	PHAR	10	57	1035	343	79	5
Norepinephrine	PHAR	30	99	420	191	174	17
Protriptyline	PHAR	7	49	1504	124	64	88
Pyridoxine	PHAR	30	101	454	185	165	24
Sitagliptin	PHAR	2	37	73	58	60	8
Sulfamethazine	PHAR	8	13	30	19	16	6
Sulfamethoxazole	PHAR	1	39	46	43	43	1
10,11-Dihydro-10-hydroxy Carbamazepine	PHAR TP	13	< LOQ	54	17	13	6
1-Methylxanthine	PHAR TP	50	78	109	93	93	1
2-Ethyl-2-phenylmalonamide	PHAR TP	11	< LOQ	85	31	18	6
Benzoylecgonine	PHAR TP	1	22	39	28	26	3
Paraxanthine	PHAR TP	28	< LOQ	282	57	32	22

Name	Type	LOQ (ng/L)	Min (ng/L)	Max (ng/L)	Mean (ng/L)	Median (ng/L)	No. Obs
2,4-D	PEST	12	16	1042	328	148	26
Atrazine	PEST	13	< LOQ	302	36	21	295
Carbendazim	PEST	2	112	118	115	115	1
Dimethachlor	PEST	10	< LOQ	20	10	< LOQ	110
Diuron	PEST	11	< LOQ	170	40	12	12
Fluridone	PEST	6	21	4286	645	161	9
Imazapyr	PEST	14	14	33	18	16	9
Imidacloprid	PEST	1	23	99	46	27	3
Metalaxyl	PEST	10	< LOQ	89	20	15	34
Metolachlor	PEST	11	< LOQ	165	29	19	180
Prometon	PEST	1	14	21	16	15	4
Simazine	PEST	15	< LOQ	48	21	18	30
Trinexapac-ethyl	PEST	12	< LOQ	57	24	20	5
Atrazine-2-hydroxy	PEST TP	14	< LOQ	318	63	46	148
Atrazine-desethyl	PEST TP	2	4	82	28	24	105
Atrazine-desisopropyl	PEST TP	14	< LOQ	61	26	25	53
Metolachlor Ethane Sulfonic Acid (Metolachlor ESA)	PEST TP	32	< LOQ	5036	432	250	53
Metolachlor Oxanilic Acid (Metolachlor OA)	PEST TP	24	< LOQ	346	24	< LOQ	301
2-Hydroxybenzothiazole	PCHC	27	< LOQ	254	42	< LOQ	39
5-Methyl-1H-benzotriazole	PCHC	17	18	210	61	52	19
1H-Benzotriazole	PCHC	19	46	63	53	51	6
Benzophenone	PCHC	16	< LOQ	1811	278	190	60
Benzophenone-3 (Oxybenzone)	PCHC	20	< LOQ	4615	137	34	179
Benzothiazole	PCHC	16	37	963	332	305	94
Icaridin	PCHC	7	50	113	60	54	27
Melamine	PCHC	4	13	1912	372	273	60
DEET	PCHC	0.2	1	18986	254	44	256
Sucralose	PCHC	45	< LOQ	5150	273	116	119
Triclosan	PCHC	11	35	57	46	46	2
Galaxolidone	PCHC TP	13	< LOQ	819	55	29	162

KEY Notes:

Name: Name of the contaminant

Type: Pharmaceutical (-transformation product), Pesticide (-transformation product), Personal Care/ Household Chemical (-transformation product)

LOQ: the lowest concentration of a CEC in a sample that can be confidently quantified with acceptable precision and accuracy

Min: minimum concentration observed in NY lakes during this study (2018 – 2019)

Max: maximum concentration observed in NY lakes during this study (2018 – 2019)

Mean: average concentration observed in NY lakes during this study (2018 – 2019). The average was calculated by summing all the observed concentrations for a particular CEC and then dividing by the number of observations for that CEC.

Median: median concentration observed in NY lakes during this study (2018 – 2019). The median concentration is the "middle" concentration where half of the observations have a lower concentration and the other half of the observations have a higher concentration.

For example: A lake has the following concentrations: 1, 2, 7, 12, 21, 57, 193.

The number of observations is 7, the average concentration is 42,

the median concentration is 12 (3 values < 12, and 3 values > 12)

No. Obs.: The total number of times a CEC was detected during 2018 – 2019. The higher the number, the more common the CEC is in NY lakes.