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Emerging Contaminant Surveillance in Surface Water and Fish: Results from Cape Cod Pilot Study

November 2, 2021

This data brief provides an overview of the laboratory analyses of surface water and freshwater fish samples collected by the Massachusetts Department of Public Health (DPH) in May 2021. The analyses of these data were conducted by the DPH Environmental Toxicology Program to determine if sampled waterbodies require a waterbody-specific risk assessment or a fish consumption advisory.

Sampling Methods

On May 14 and 15, 2021, DPH contractors conducted surface water sampling at 16 public or semi-public bathing beaches on Cape Cod. One sample was collected from most waterbodies. For larger waterbodies, two samples were collected from multiple beach access points. Samples were collected where exposure to the most vulnerable populations is most likely to occur (e.g., at wading depths).

From May 24 to 26, 2021, DPH contractors sampled fish from five of the 16 waterbodies sampled for surface water. For each waterbody, three to five individual fish from each of three to five species were targeted, for a minimum of 9 fish and a maximum of 18 fish. To demonstrate the overall integrity of the samples and sampling process, the sampling team collected quality control samples and implemented strict sample handling practices.

SGS AXYS Analytical Services (SGS AXYS) (British Columbia, Canada) conducted the laboratory analysis for surface water and fish, using SGS AXYS Method MLA-110 Rev. 02 Ver. 08, which targets all 40 PFAS from EPA Methods 537.1 and 533.

Data Evaluation

Surface water concentrations were evaluated using DPH's candidate Surface Water Action Level (cSWAL) for PFAS. DPH recommends a cSWAL of 23 nanograms (ng) of PFAS, per Liter (L) of water (also known as parts per trillion or ppt) for surface water bodies that are intended for swimming (e.g., permitted bathing beaches). Consistent with ATSDR recommendations for evaluating PFAS compounds individually, this value was applied to individual measurements of

perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and perfluorooctane sulfonate (PFOS). If any of these compounds (individually) exceed the cSWAL of 23 ng/L, a water-body specific risk assessment would be required.

Fish tissue concentrations were evaluated using DPH's candidate Fish Action Level (cFAL) for PFAS. DPH recommends a cFAL of 22 µg of PFAS, per kilogram (kg) of fish (also known as parts per billion or ppb). Consistent with ATSDR recommendations for evaluating PFAS compounds individually, this value was applied to individual measurements of PFOA, PFNA, PFHxS, and PFOS. If the concentration for any of these compounds exceeds a cFAL of 0.22 µg/kg a waterbody-specific analyses would be required. When a site-specific assessment is required following an exceedance of the DPH PFAS fish action level (0.22 ppb), threshold values that account for different individual sensitivities and consumption patterns will be used to develop more refined waterbody-specific recommendations. This location-specific assessment will also trigger local public health notification, as to allow consideration of non-recreational activities (e.g. subsistence fishing) at a specific waterbody that may result in greater potential PFAS exposure than evaluated in typical recreational use exposure scenarios (e.g., > 1 meal/day).

Surface Water Results

All waterbodies sampled contained some detectable amount of one or more PFAS compounds (Tables 1a, 1b). However, samples from only one waterbody, Johns Pond, had PFAS concentrations that exceeded the cSWAL of 23 nanograms per liter (ng/L), where average concentrations of PFNA, PFHxS, and PFOS were 24.6, 54.0, and 55.4 ng/L, respectively. Of the forty PFAS compounds tested, PFOS had the highest maximum and average concentration (across all waterbodies) at 64.3 and 6.27 ng/L, respectively. Concentrations of PFHxS were the second highest, with a maximum and average concentration of 55.3 ng/L and 5.43 ng/L, respectively. DPH determined that all sampled waterbodies are safe for recreational activities such as wading, boating, and catch-and-release fishing.

Fish Results

All five waterbodies had at least one fish species with PFOS levels above the lowest threshold for the general population (0.71 ppb; Tables 2a, 2b, 2c, 2d). All fish samples exceeded the cFAL of 0.22 µg/kg. Similar to the surface water results, PFOS had the highest average and maximum concentration of all 40 PFAS tested in fish tissues. PFOS concentrations were highest in fish from John's Pond with an average PFOS tissue concentration of 97.76 ppb. Although PFOS concentrations were lower in the four remaining waterbodies, they were still high enough to trigger fish consumption advisories.

Table 1a: PFAS Concentrations in Surface Water (Bolded Concentrations Exceed cSWAL)

Waterbody	Crooked Pond	Flax Pond	Grews Pond	Hen Cove	Jenkins Pond (N)	Jenkins Pond (NE)		Johns Pond (NE)	Johns Pond (SE)		Mares Pond	Mashpee-Wakeby Pond (S)
Sample collection date	5/15	5/15	5/15	5/14	5/15	5/15	5/15	5/15	5/15	5/15	5/15	5/14
PFBA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	5.3	5.17	5.28	<MRL	<MRL
PFPeA	1.06	<MRL	0.943	<MRL	0.817	<MRL	<MRL	12.7	12.4	12.9	<MRL	1.08
PFHxA	1.2	0.48	0.891	0.457	1.14	1.1	0.994	15.7	17	16.1	0.458	1.15
PFHpA	0.744	<MRL	1.08	<MRL	0.554	0.736	0.742	9.57	8.9	8.82	0.568	0.703
PFOA	1.25	0.622	2.12	<MRL	1.45	1.19	1.56	17.4	18.4	15.5	<MRL	0.757
PFNA	<MRL	<MRL	0.621	<MRL	<MRL	<MRL	<MRL	**24.9**	**24.2**	**24.4**	<MRL	<MRL
PFDA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFUnA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFDoA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFTrDA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFTeDA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFBS	1.4	0.576	0.562	<MRL	0.905	0.959	0.915	5.48	5.44	5.41	<MRL	0.958
PFPeS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	5.73	6.06	5.66	<MRL	<MRL
PFHxS	0.461	0.626	<MRL	1.08	0.497	0.499	0.561	**55.3**	**52.4**	**52.9**	<MRL	0.711
PFHpS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	1.02	1.02	1.08	<MRL	<MRL
PFOS	<MRL	<MRL	0.538	3.48	0.51	0.624	0.676	**51.8**	**64.3**	**53.7**	<MRL	0.591
PFNS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFDS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFDoS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
4:2FTS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
6:2FT	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
8:2 FTS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFOSA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-MeFOSA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-EtFOSA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
MeFOSAA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
EtFOSAA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-MeFOSE	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-EtFOSE	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
HFPO-DA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
ADONA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
9Cl-PF3ONS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
11Cl-PF3OUdS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
3:3 FTCA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
5:3 FTCA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
7:3 FTCA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFEESA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFMPA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFMBA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
NFDHA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL

Table 1b: PFAS Concentrations in Surface Water

Waterbody	Mashpee-Wakeby Pond (SW)	Peters Pond (N)	Peters Pond (S)		Picture Lake (Flax Pond)	Round Pond	Santuit Pond	Shubael Pond	Snake Pond	Squeteague Harbor		Triangle Pond
Sample collection date	5/14	5/14	5/14	5/14	5/14	5/15	5/14	5/14	5/14	5/14	5/14	5/14
PFBA	<MRL	1.91	1.75	1.92	1.78	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	1.97
PFPeA	1.11	2.76	2.88	2.73	2.72	<MRL	1.43	1.32	<MRL	<MRL	<MRL	4.39
PFHxA	1.04	2.43	2.31	2.81	3.38	0.836	1.54	1.35	0.479	0.876	0.922	2.89
PFHpA	0.732	1.54	1.63	1.71	1.88	0.725	0.562	0.916	0.68	0.723	0.568	3.46
PFOA	0.943	2.17	2.13	2.63	4.29	1.26	1.46	1.79	0.72	2.62	2.79	2.25
PFNA	<MRL	<MRL	0.49	0.468	<MRL	<MRL	<MRL	<MRL	<MRL	0.959	1.03	0.421
PFDA	<MRL	<MRL	0.418	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.46	0.411	<MRL
PFUnA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFDoA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFTrDA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFTeDA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFBS	0.867	0.697	0.746	0.713	2.23	0.8	1.76	0.972	<MRL	1.16	1.16	0.466
PFPeS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFHxS	0.897	0.636	0.795	0.971	1.64	0.599	0.947	0.733	<MRL	0.748	0.727	<MRL
PFHpS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFOS	0.537	0.578	1.95	1.8	1.66	0.616	0.542	0.484	<MRL	7.67	8.55	<MRL
PFNS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFDS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFDoS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
4:2FTS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
6:2FTS	3.14	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
8:2 FTS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFOSA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.45	0.53	<MRL
N-MeFOSA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-EtFOSA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
MeFOSAA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
EtFOSAA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-MeFOSE	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
N-EtFOSE	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
HFPO-DA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
ADONA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
9Cl-PF3ONS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
11Cl-PF3OUdS	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
3:3 FTCA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
5:3 FTCA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
7:3 FTCA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFEESA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFMPA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
PFMBA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
NFDHA	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL

Table 2a: Average Fish Tissue Results for All PFAS Tested

Waterbody	Species	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA	PFTrDA	PFTeDA
Flax Pond (Picture Lake)	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	0.07	0.25	0.45	0.28	0.37	0.21
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.23	0.43	0.28	0.36	0.21
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	0.28	0.41	0.64	0.30	0.47	0.20
Grews Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	0.07	0.25	0.61	0.44	0.91	0.34
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	0.07	0.25	0.61	0.44	0.91	0.34
Jenkins Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.22	0.84	0.88	1.58	0.60
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.21	0.76	0.68	1.34	0.51
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.39	1.45	1.45	2.45	1.03
	Yellow bullhead	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.37	0.72	1.59	0.49
Johns Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	0.08	1.65	0.33	0.28	0.36	0.62	0.31
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	0.93	0.35	0.38	0.45	0.83	0.42
	Chain pickerel	<MRL	<MRL	<MRL	<MRL	<MRL	1.78	0.24	0.14	0.25	0.41	0.24
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	0.18	0.26	0.29	0.41	0.77	0.36
	Pumpkinseed	<MRL	<MRL	<MRL	<MRL	0.22	2.06	0.33	0.18	0.16	0.22	0.16
	White perch	<MRL	<MRL	<MRL	<MRL	<MRL	1.29	0.40	0.37	0.49	0.85	0.39
	Yellow perch	<MRL	<MRL	<MRL	<MRL	0.07	3.89	0.33	0.22	0.26	0.41	0.22
Mashpee-Wakeby Pond	Waterbody average	<MRL	<MRL	0.06	<MRL	0.06	0.06	0.07	0.27	0.15	0.25	0.14
	Chain pickerel	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.09	<MRL	0.11	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.35	0.23	0.35	0.18
	Pumpkinseed	<MRL	<MRL	0.08	<MRL	0.09	0.1	0.08	0.23	0.15	0.23	0.17
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.09	0.46	0.27	0.41	0.22
	White perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.24	0.13	0.20	<MRL
	White sucker	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.15	0.47	0.31	0.42	0.29
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.17	0.07	0.18	0.08

Values reported as µg/kg (parts per billion, ppb)

Max concentration used if fewer than three fish collected per species; average concentration calculated if three or more species collected per species

Table 2b: Fish Tissue Results for All PFAS Tested

Waterbody	Species	PFBS	PFHxS	PFHpS	PFPeS	PFOS	PFNS	PFDS	PFDoS	4:2 FTS	6:2 FTS	8:2 FTS
Flax Pond (Picture Lake)	Waterbody average	<MRL	<MRL	<MRL	<MRL	2.64	<MRL	<MRL	<MRL	<MRL	0.35	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	2.54	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	3.44	<MRL	<MRL	<MRL	<MRL	1.72	<MRL
Grews Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	0.97	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	0.97	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Jenkins Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	2.80	<MRL	0.05	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	2.71	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	4.68	<MRL	0.15	<MRL	<MRL	<MRL	<MRL
	Yellow bullhead	<MRL	<MRL	<MRL	<MRL	0.34	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Johns Pond	Waterbody average	<MRL	0.58	0.18	<MRL	97.76	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	0.32	0.18	<MRL	144.33	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Chain pickerel	<MRL	0.83	0.21	<MRL	86.10	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	0.16	<MRL	<MRL	73.37	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Pumpkinseed	<MRL	1.38	0.12	<MRL	45.70	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White perch	<MRL	0.13	0.24	<MRL	140.25	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	1.01	0.30	<MRL	74.90	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Mashpee-Wakeby Pond	Waterbody average	<MRL	0.06	<MRL	<MRL	0.67	<MRL	<MRL	<MRL	<MRL	1.73	<MRL
	Chain pickerel	<MRL	<MRL	<MRL	<MRL	0.40	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	0.91	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Pumpkinseed	<MRL	<MRL	<MRL	<MRL	0.62	<MRL	<MRL	<MRL	<MRL	1.65	<MRL
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	1.02	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White perch	<MRL	<MRL	<MRL	<MRL	0.87	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White sucker	<MRL	0.16	<MRL	<MRL	0.69	<MRL	<MRL	<MRL	<MRL	17.1	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	0.55	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL

Values reported as µg/kg (parts per billion, ppb)

Max concentration used if fewer than three fish collected per species; average concentration calculated if three or more species collected per species

Table 2c: Fish Tissue Results for All PFAS Tested

Waterbody	Species	PFOSA	N-MeFOSA	N-EtFOSA	MeFOSAA	EtFOSAA	N-MeFOSE	N-EtFOSE	HFPO-DA	ADONA	9Cl-PF3ONS	11Cl-PF3OUdS
Flax Pond (Picture Lake)	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Grews Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Jenkins Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow bullhead	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Johns Pond	Waterbody average	0.14	<MRL	<MRL	<MRL	<MRL	<MRL	0.39	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.51	<MRL	<MRL	<MRL	<MRL
	Chain pickerel	0.60	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Pumpkinseed	0.15	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White perch	0.09	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	0.21	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Mashpee-Wakeby Pond	Waterbody average	0.10	<MRL	<MRL	<MRL	<MRL	<MRL	0.62	<MRL	<MRL	<MRL	<MRL
	Chain pickerel	0.30	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Pumpkinseed	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	0.54	<MRL	<MRL	<MRL	<MRL
	White perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White sucker	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	3.30	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL

Values reported as µg/kg (parts per billion, ppb)

Max concentration used if fewer than three fish collected per species; average concentration calculated if three or more species collected per species

Table 2d: Fish Tissue Results for All PFAS Tested

Waterbody	Species	3:3 FTCA	5:3 FTCA	7:3 FTCA	PFMPA	PFEESA	NFDHA	PFMBA
Flax Pond (Picture Lake)	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Grews Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Jenkins Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow bullhead	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Johns Pond	Waterbody average	<MRL	1.81	1.69	<MRL	<MRL	<MRL	<MRL
	Bluegill	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Chain pickerel	<MRL	<MRL	9.09	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Pumpkinseed	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White perch	<MRL	3.71	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
Mashpee-Wakeby Pond	Waterbody average	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Chain pickerel	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Largemouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Pumpkinseed	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Smallmouth bass	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	White sucker	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL
	Yellow perch	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL	<MRL

Values reported as µg/kg (parts per billion, ppb)

Max concentration used if fewer than three fish collected per species; average concentration calculated if three or more species collected per species