SARAH LAWRENCE COLLEGE
CENTER FOR THE URBAN RIVER AT BECZAK

SAW MILL RIVER

Water Quality Summary Report

2020/2021

Data provided in this report has been collected as part of the NYS DEC PEERS (Professional External Evaluation of Rivers and Streams) program and reviewed by the Sarah Lawrence College Center for the Urban River at Beczak.

LETTER TO THE READER

Thank you for your interest in the Saw Mill River and this water quality report. A bulk of the data presented were collected as part of the NYS DEC Professional External Evaluation of Rivers and Streams (PEERS) Program. The PEERS program allows "professional external evaluators" such as CURB staff to collect water quality data that DEC will use in their official Clean Water Act reporting to US EPA.

Every two years NYS delivers a Water Quality Report to EPA, often called the 305(b) report based on the section of the Clean Water Act, that reports on the condition of all water resources in the state and whether these waters meet the criteria based on that waters designated use. In addition, the state reports on known impaired waters and identifies specific pollutants of concern, often called the 303(d) list.

A major impetus of our research was to collect current data on the Saw Mill, which had not been fully sampled by DEC in quite some time, and is classified as an impaired water on the 303(d) list for dissolved oxygen, fecal coliform, and phosphorus impairments. Of particular interest were current nitrogen and phosphorus levels. As of this writing, DEC is working to develop *numerical* nutrient standards to replace the long-standing *narrative* standard of "none in amounts that result in the growths of algae, weeds and slimes that will impair the waters for their best usages".

We believe, based on our data collected and EPA guidance for our ecoregion, it is likely that once those numeric nutrient standards are adopted the Saw Mill River will exceed the standard. Under the Clean Water Act, DEC will be required to develop a Total Maximum Daily Load (TMDL) in an effort to reduce pollution and meet the standard. In addition, other Clean Water Plans, such as the development of a Watershed Management Plan (which the Saw Mill has never had), should be explored. Our hope is that our research will help catalyze those efforts and leverage funding from sources like the NYS Department of State Local Waterfront Revitalization Program.

As you can imagine this whole process will take some time to develop so please stay in touch, join our mailing list at www.slccurb.org, and feel free to reach out with any questions or concerns. Thanks again for your interest!

Sincerely,

Ryan Palmer, Director

Katie Lamboy, Science Coordinator

TABLE OF CONTENT

We acknowledge that the Center for the Urban River at Beczak is located on land in Yonkers with a rich cultural, natural, and political history that long predates colonization by Europeans, traditionally inhabited by the Munsee Lenape and Wappinger tribes. We recognize the land we inhabit as stolen land, taken forcibly from these nations and their related bands, and that it does not rightfully belong to us. We respect the indigenous people of this land as leaders in our field and advocates for environmental justice. We have much to learn from these communities and will strive to listen to and support them through progressive, responsible, and inclusive partnership.

INTRODUCTION

This educational report provides local stakeholders of Westchester County, the Saw Mill River, and its watershed with essential knowledge and data on numerous water quality (wq) monitoring parameters and their importance in indicating overall environmental health. Data depicted throughout this report were analyzed by the ELAP-certified (Environmental Laboratory Accreditation Program) ALS Laboratories (Rochester) as part of the NYS DEC Professional External Evaluation of Rivers and Streams (PEERS) Program in the years 2020 and 2021. All samples analyzed were collected by trained staff of the Sarah Lawrence College Center for the Urban River at Beczak (SLC CURB) under a reviewed Quality Assurance Project Plan (QAPP) and audited by staff of the New York State Department of Environmental Conservation (NYS DEC) Division of Water.

Please Note: Gridlines and scales are altered to best showcase visual data from 8 sampling dates corresponding with 6 sampling sites. Data collected in the year 2020 is indicated with a triangular shape and data collected in the year 2021 is indicated with a star shape in each graph (please refer to graph key for additional information). Sampling dates impacted by rain/weather are indicated by the letter R in the key aside corresponding date. All site names have corresponding codes that associate with their river mile expressed in the map key on page 4.

The addendum to follow this primary data report includes additional data not collected as part of the aforementioned NYS DEC PEERS sampling program; however, it provides additional data which contributes to the understanding of overall health of the Saw Mill River. Samples collected in projects highlighted in this section were collected by participants of the SLC CURB community science program and analyzed in either of the Sarah Lawrence College laboratories by staff and by partnering organizations.

For additional information pertaining to the SLC CURB water quality sampling research programs and education, please visit www.centerfortheurbanriver.org.

SAW MILL RIVER

Site Information and Map

13-SAW-18.4: Pleasantville

(41.13632, -73.7947) River Mile 18.4
Land Use: Residential
Pleasant Ave. and Grant St.

13-SAW-10.8: Elmsford

(41.05516, -73.82071) River Mile 10.8
Land Use: Commercial
Before water enters bridge at Rte 119

13-SAW-7.9: Ardsley

(41.02055, -73.84565) River Mile 7.9
Land Use: Recreational
Behind Ballfields/ WAVE site

13-SAW-4.8: Hastings

(40.98295, -73.86553) River Mile 4.8
Land Use: Recreational/Commercial
S. County Trail Parking Lot

13-SAW-1.11: Yonkers

(40.93709, -73.88854) River Mile 1.11
Land Use: Urban/Recreational
Walsh Rd. and Archer St.

13-SAW-0.2: Yonkers

(40.93534, -73.90025) River Mile 0.2
Land Use: Urban/Recreational
Van Der Donck Park

PEERS WQ PARAMETERS REVIEW

ALKALINITY

This indicator of water quality acts as a buffer against rapid pH changes in natural aquatic environments. The measurement of alkalinity indicates how much acid can be added to a liquid without causing a large change in pH. Higher alkalinity will indicate a more stable aquatic system.

Vocabulary

Buffer: A solution that resists changes in pH

Acid: Having a pH of less than 7

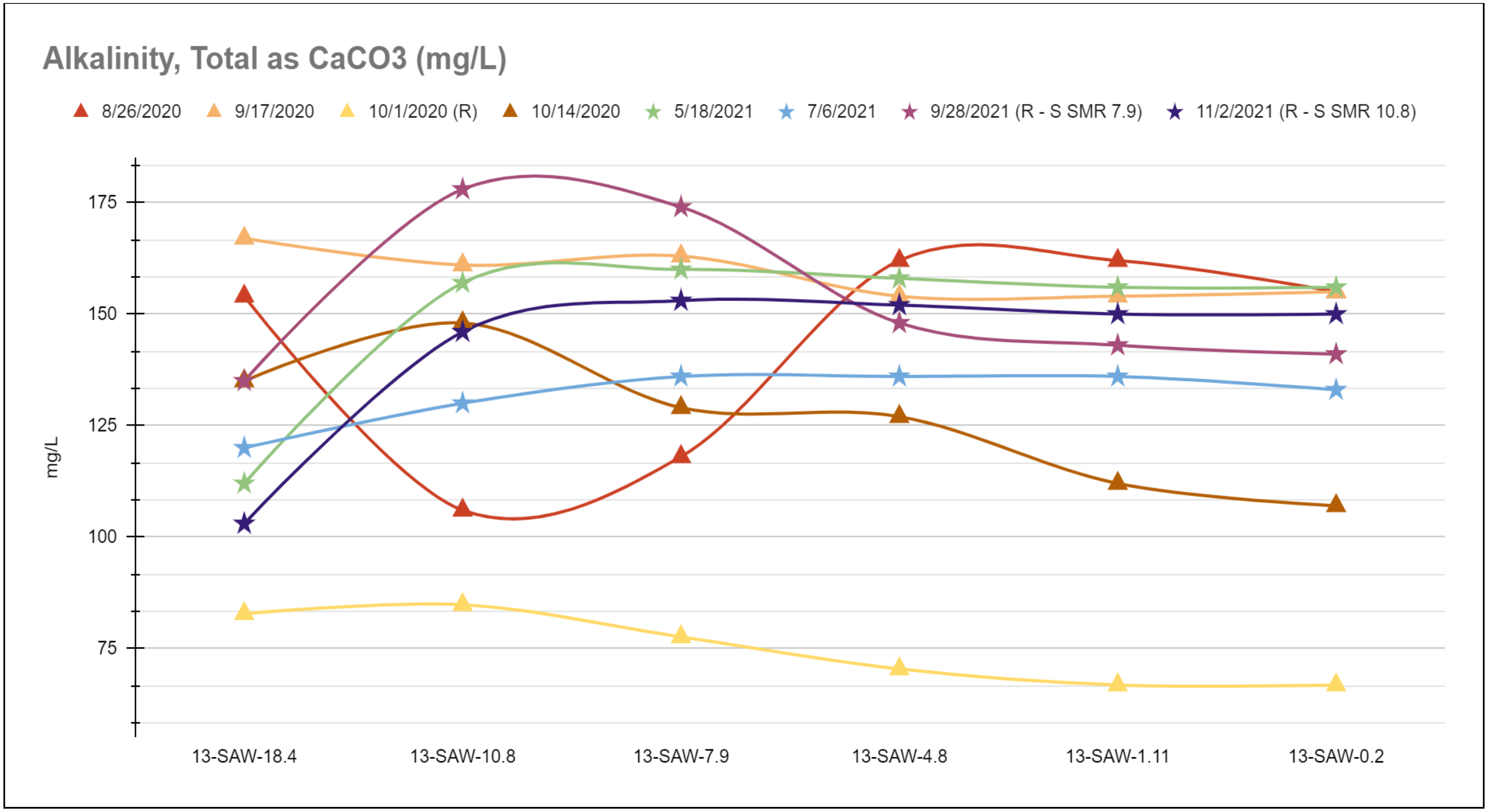
pH: A figure expressing the acidity or alkalinity on a logarithmic scale of 0-14 with 7 being neutral

ALKALINITY

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Alkalinity is a property of water that is dependent on the presence of other chemical factors. Sudden changes in pH can create an unstable environment and pose dangerous living conditions for vulnerable creatures. Creatures with higher "pollution tolerance" are often not impacted by these rapid changes. Higher alkalinity values provide safer environments for creatures with greater sensitivities.



CHLORIDE

In nature, chloride comes from different natural salts and is critical to the survival of life. Chlorides are present in both fresh and salt water systems. Excess chlorides can enter a system through road salt used in winter and CSO discharges. Natural spikes can also happen in times of excess evaporation. Once present in a system it is nearly impossible to get rid of.

Vocabulary

Chloride: Result of salt from the combination of gas chlorine with a metal such as sodium

CSO: Combined Sewer Overflow - Systems that are designed to collect both rainwater runoff, domestic sewage, and industrial wastewater in the same pipe that operate with a overflow valve which releases the mixture into rivers and oceans in times of elevated storms

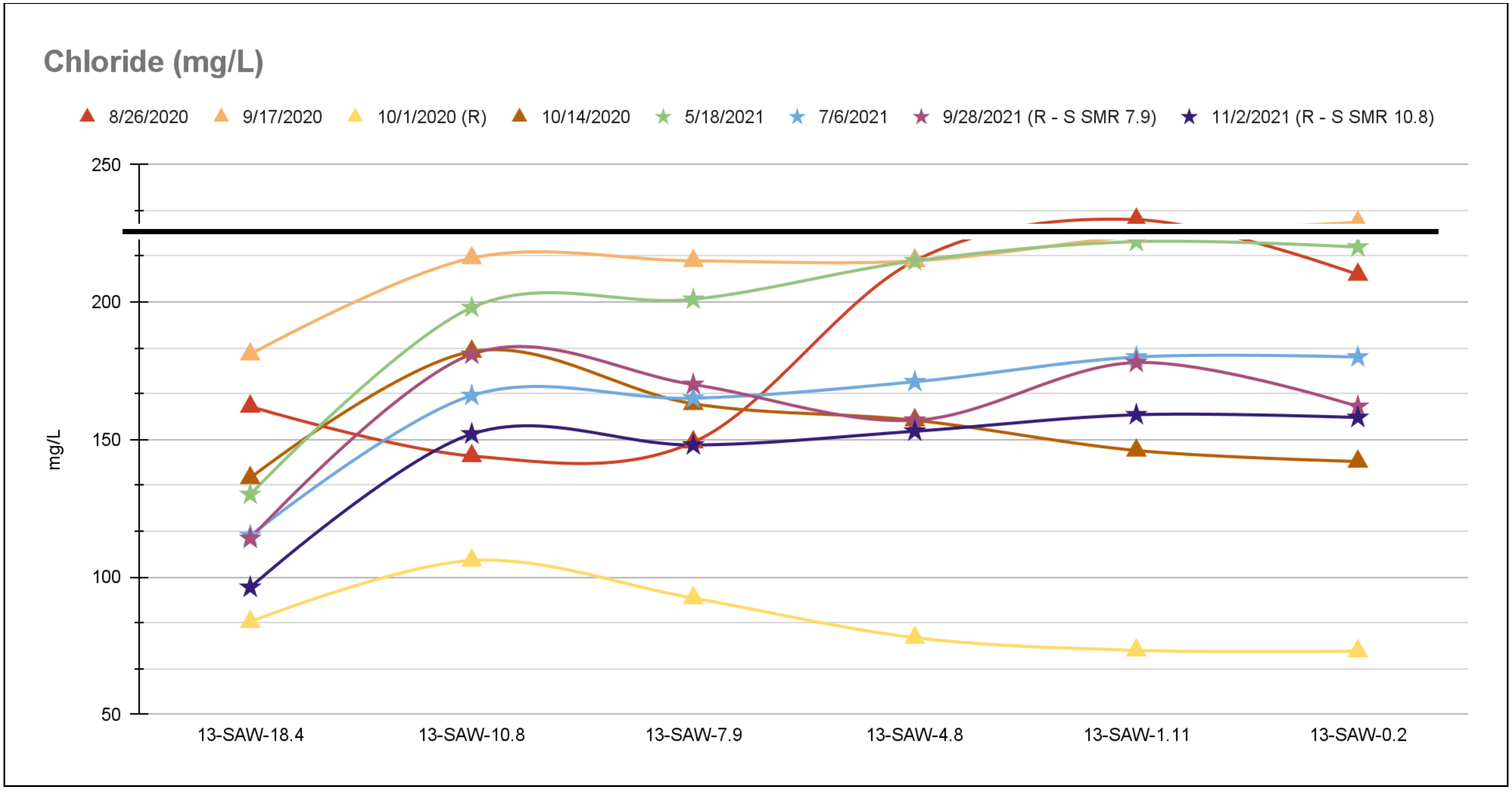
Evaporation: The process of turning from liquid into vapor

CHLORIDE

EPA National Recommended for Aquatic Life Criteria: 230 mg/L

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Due to the nature of chloride in systems, we can expect heightened levels of the salt in hotter months due to excessive evaporation and during coolests months due to road salt distribution on roads and sidewalks in prevention of freezing standing water and snow. Rain is a main transporter of road salts into natural environments and rivers. Accumulations of salts become greater over time.



CHLOROPHYLL A

This green pigment is a specific form of chlorophyll used in oxygenic photosynthesis. This pigment can be found in all green plants (such as phytoplankton) and cyanobacteria. Phytoplankton act as an important source of food for many aquatic life. Excessive amounts of phytoplankton growth correlate with nutrient enrichment in waters. The rapid decay of these excessive numbers of algae can cause impacts on other water quality indicators such as turbidity, dissolved oxygen, and bacterial overgrowth.

Vocabulary

Chlorophyll: Most of the important class of pigments involved in photosynthesis

Photosynthesis: The process by which light energy is converted to chemical energy and produces the byproducts oxygen and glucose.

Phytoplankton: Also known as microalgae; are plant structures that cannot move against the current

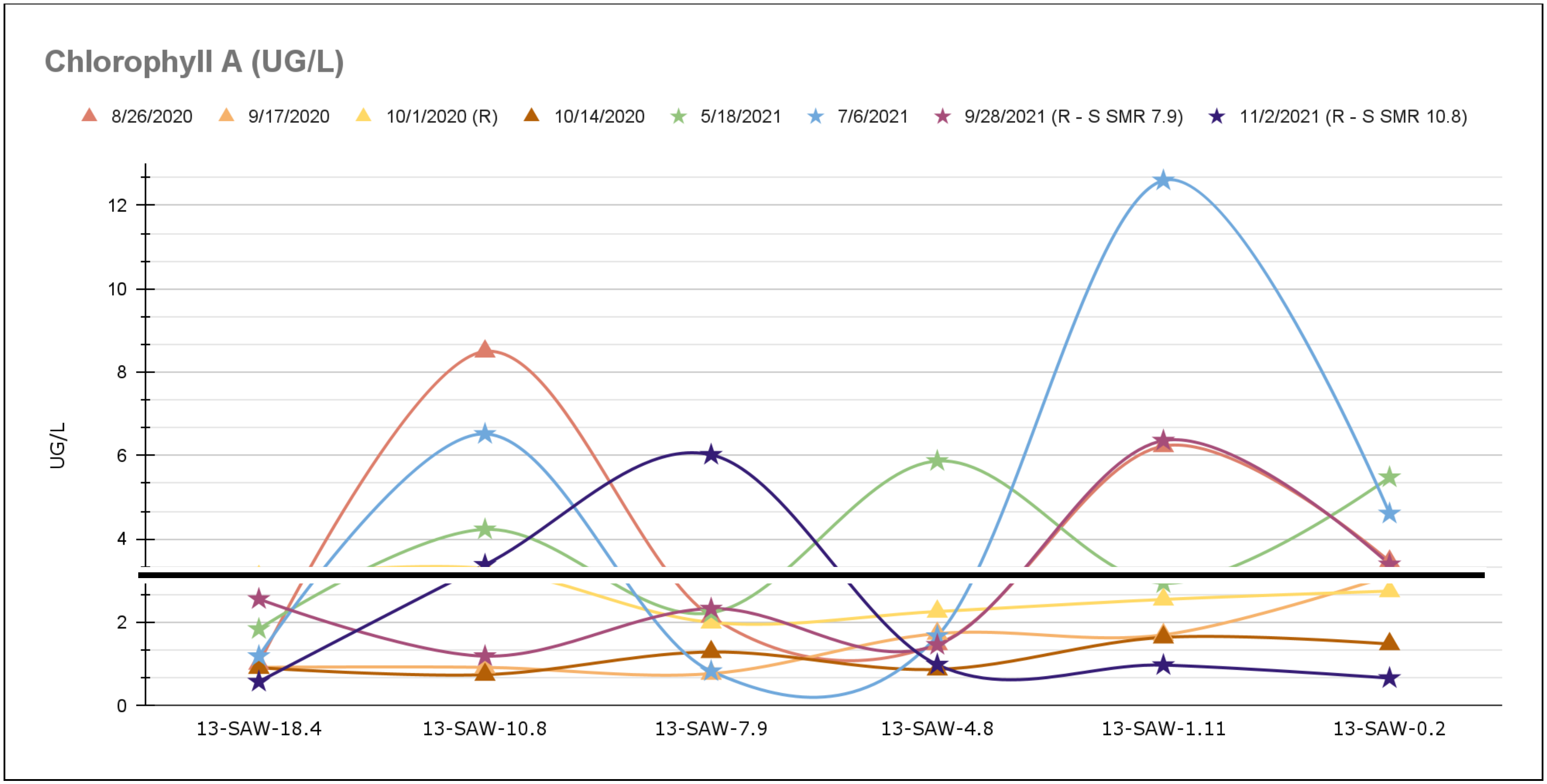
Algae: Aquatic plant-like group

CHLOROPHYLL A

EPA Regional Nutrient Criteria: 3.09 - 3.75

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Chlorophyll A measurements are predominantly influenced by other aquatic content such as nutrient amounts, canopy cover, flushing rates and temperature. Sites along the river with dominant canopy cover can show lowest levels of chlorophyll due to the aquatic plants' lack of access to sunlight. Areas of the river with heightened water column movement will also have lower amounts of chlorophyll due to the dilution of nutrient content.



HARDNESS

Calcium and Magnesium are some of the minerals that determine the "hardness" or "softness" of water depending on the total amount of minerals/ metals present. Harder water generally means there is lower toxic presence of other metals to aquatic life.

Vocabulary

Calcium: As an alkaline earth metal, calcium plays a vital role in controlling soil pH

Magnesium: A common metal found in earth and often washed from rocks into environmental waters. Also an important component of the chlorophyll molecule.

Metal: In chemistry, a metal is an element that readily forms positive ions (cations) and has metallic bonds

Mineral: Solid inorganic substance of natural occurrence

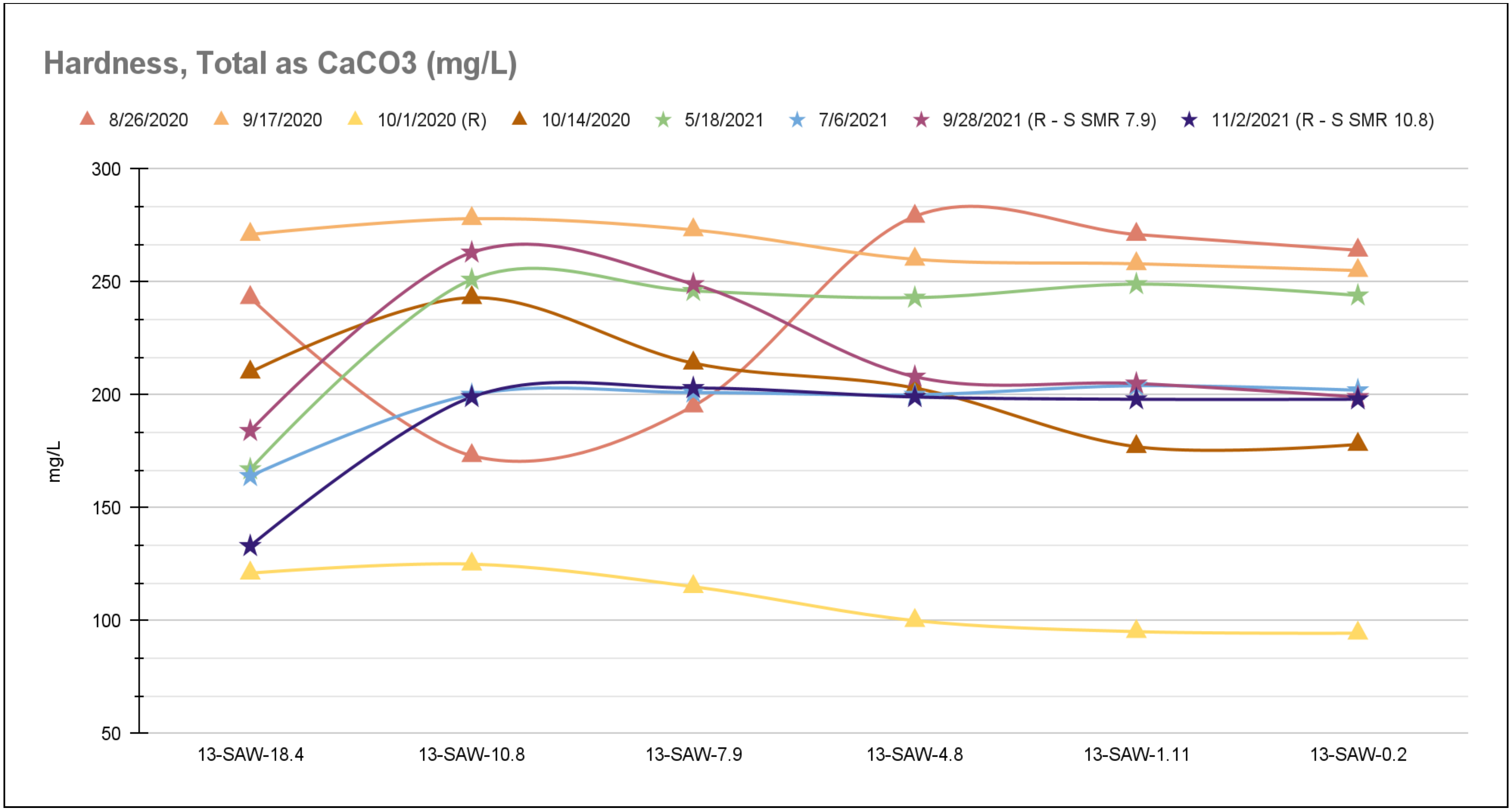
Toxicity: Quality of being very harmful or unpleasant

HARDNESS

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Higher levels of measured hardness depict fairly stable waters in terms of metallic toxicity. Softer water can correlate with rain events along the river. Rain water entering the watershed system in large amounts does not have time to percolate through rocks and stones at a slow enough rate to runoff the essential metals into the waterway. Impermeability of predominant areas around the rivers will often impact measured hardness.

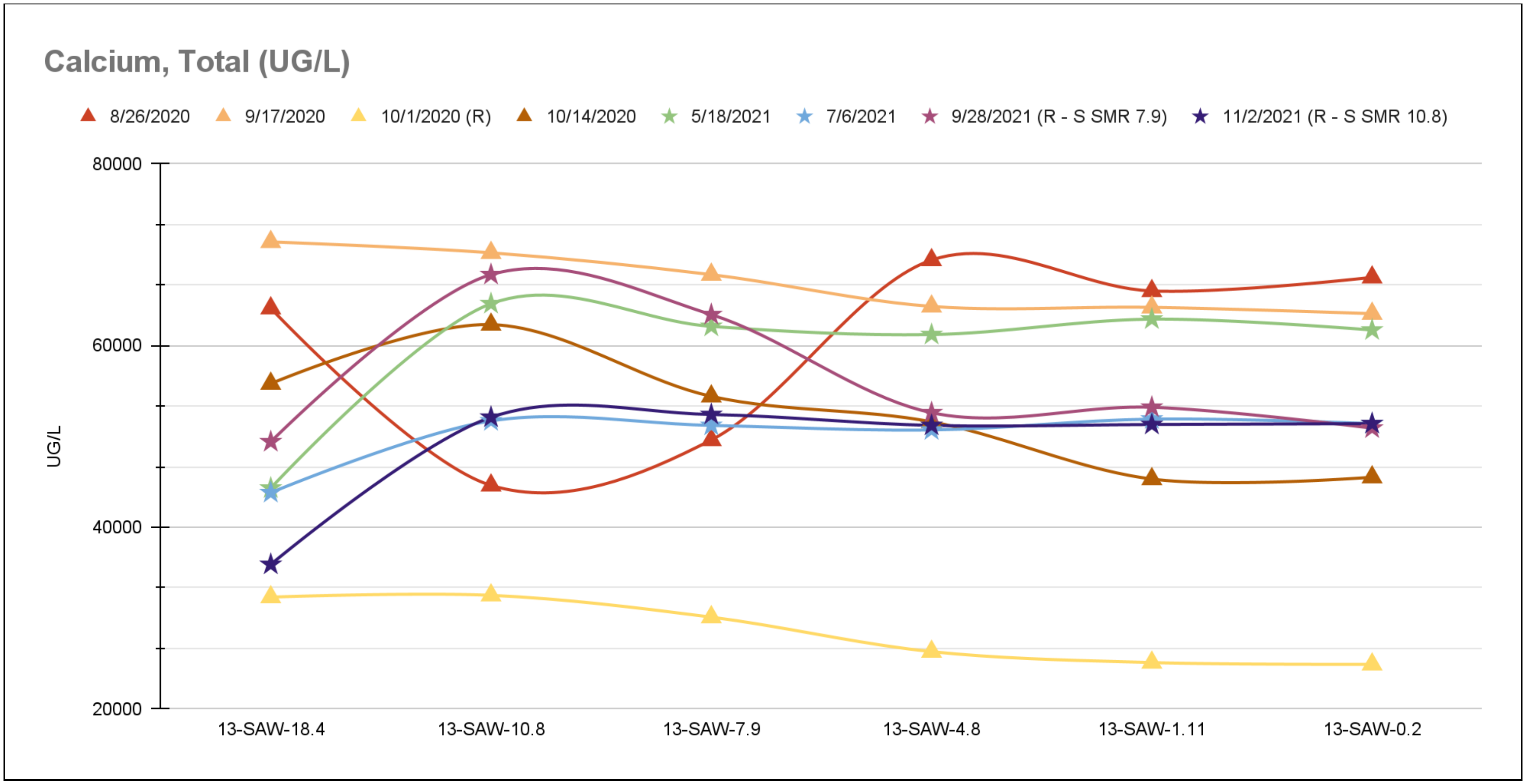


CALCIUM, TOTAL ($CaCO_3$)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Locations surrounded by large parks on its banks with ample permeable area are likely to have heightened amounts of calcium deposits from its surrounding soil. Rain events do not percolate quick enough to transport the mineral from surrounding areas and causes a dilution of the mineral within the river channel. Due to the nature of this metal, its presence will also directly impact the pH levels of the water. Larger amounts of CaCO3 will result in higher pH.

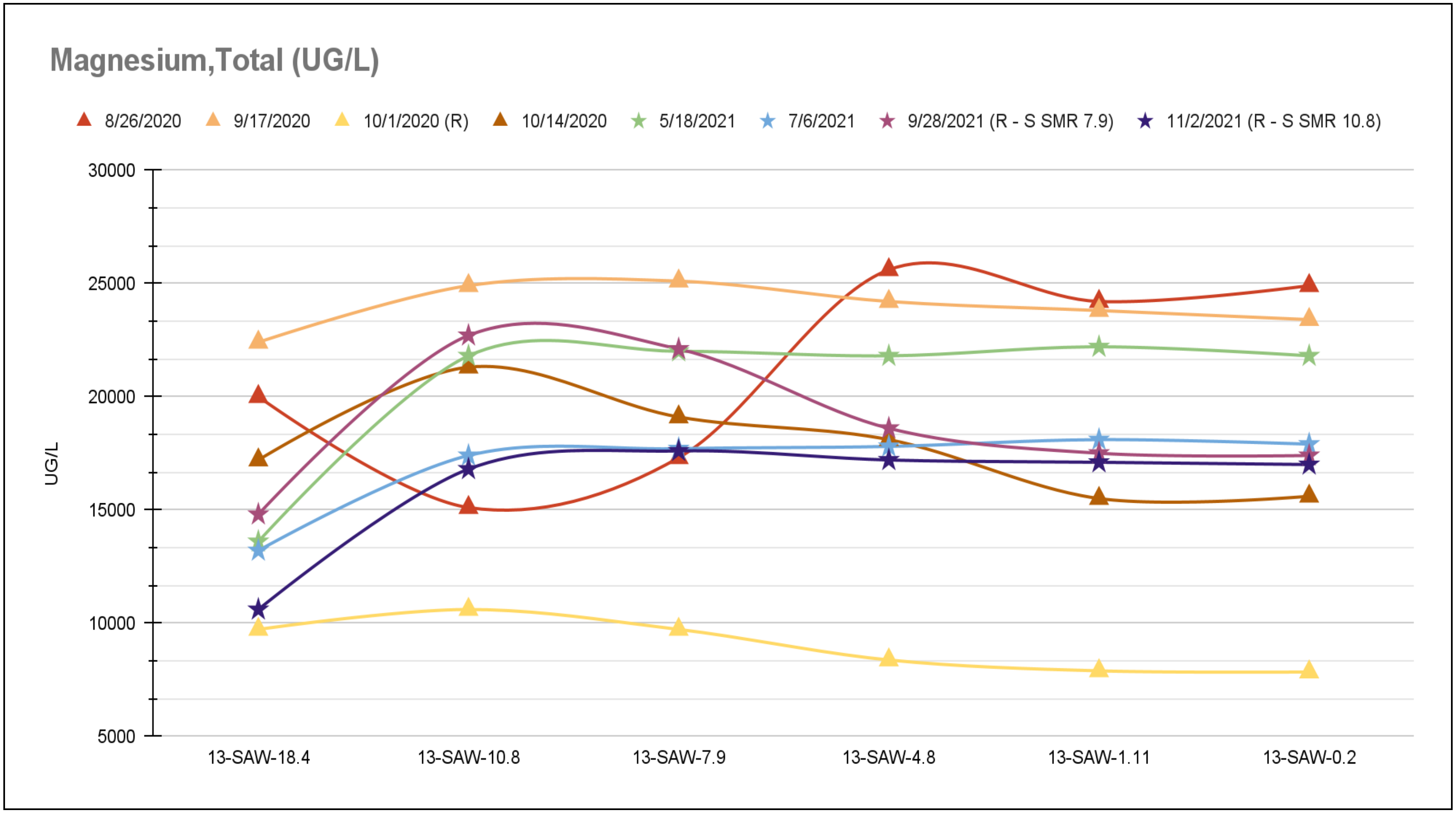


MAGNESIUM, TOTAL (Mg)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Magnesium is also primarily sourced by surrounding areas, like CaCO3. The metal presence most directly impacts species distributions and survival rates. Stable concentration amounts of magnesium leads to less probability of toxicity of other metals to life within the aquatic habitat.



NUTRIENTS

Nitrogen and Phosphorus are essential nutrients in aquatic systems for plant and animal growth and exist naturally in minerals and soil. Eutrophication can cause an overgrowth of plant life which consumes excess dissolved oxygen as they decompose leaving many creatures with hypoxic water conditions. Nitrogen occurs in different forms and can be found in natural waters as: molecular nitrogen, organic compounds, protein, and their breakdown products.

Vocabulary

Hypoxic: Conditions having low oxygen levels

Anoxic: Conditions with total lack of oxygen

Nitrogen: Most commonly introduced via agricultural processes - especially fertilizers

Phosphorus: Most commonly introduced via organic waste and industrial effluent

Eutrophication: Excess richness of nutrients in environmental waters; often caused by land runoff

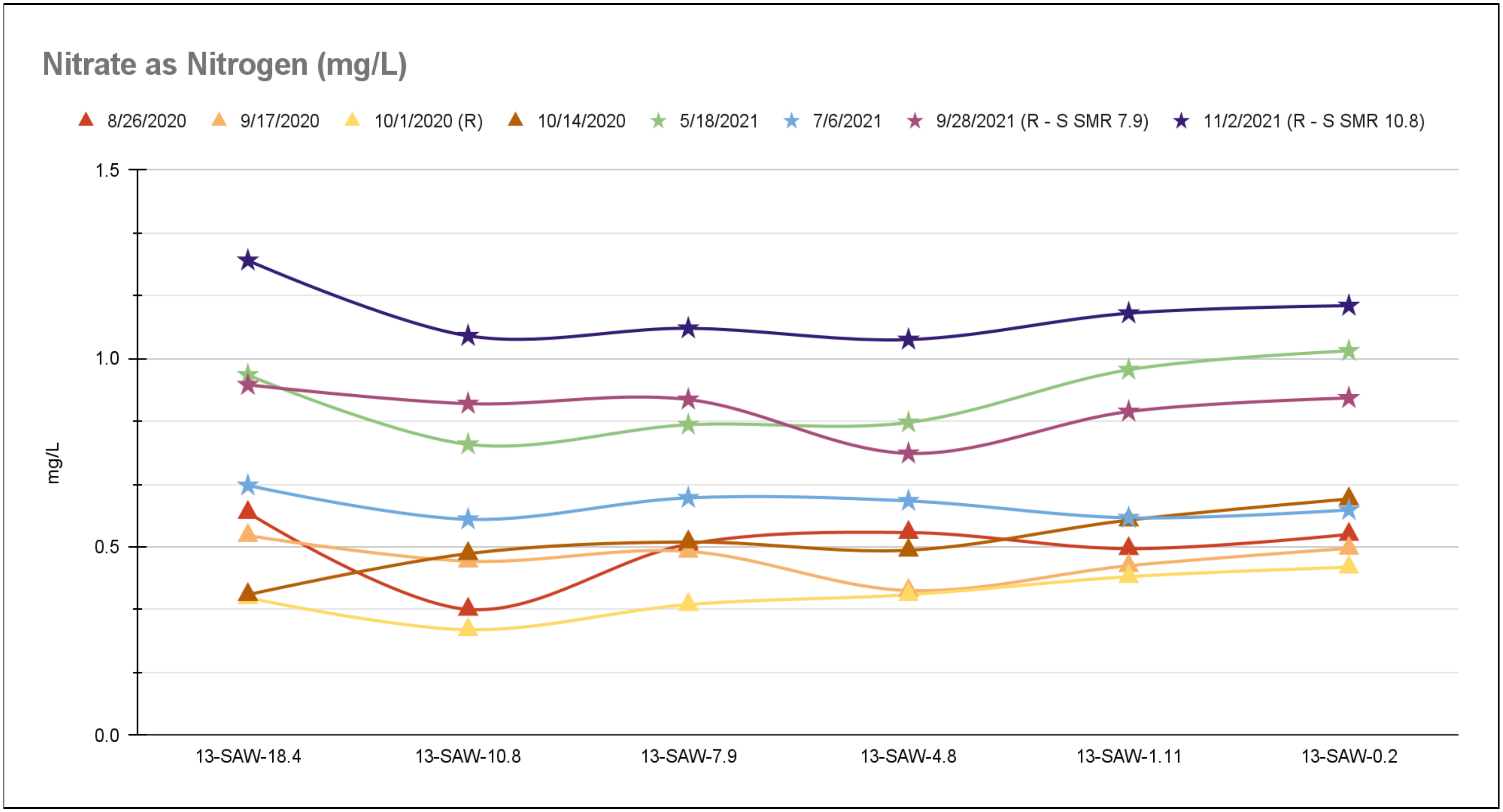
Nutrient: Substance that provides essential nourishment for growth and the maintenance of life

NITRATE AS NITROGEN (NO3-)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Heightened concentrations of NO3- in rivers are found in proximity to agricultural areas used for farming and areas that have horticultural features such as lawns and nurseries; both of these areas are known to have fertilizers present. Areas of rivers that have industrial basis along the banks and water columns with swifter movement have fewer NO3- present.

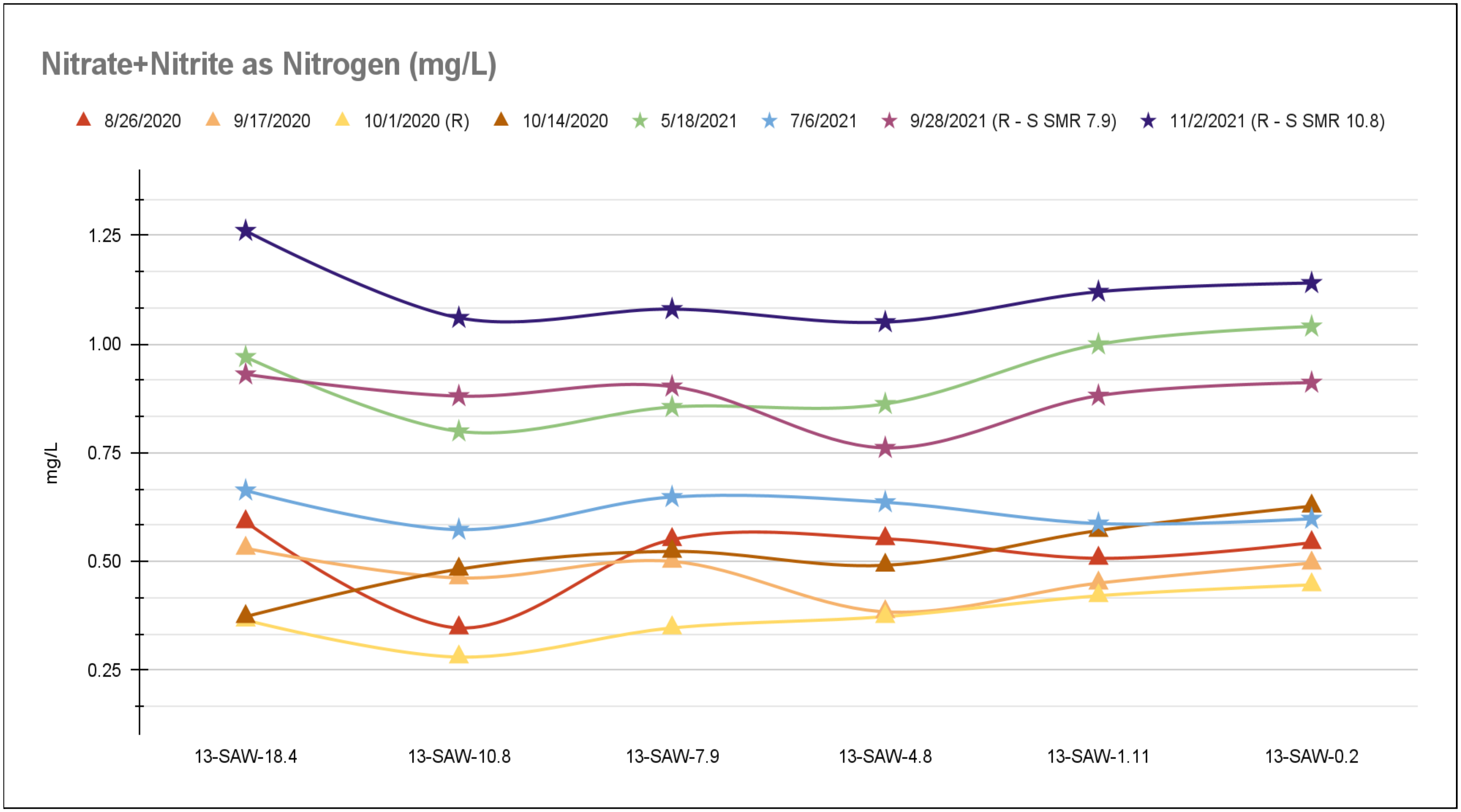


NITRATE+NITRITE AS NITROGEN (SUM OF NO3- & NO2-)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Excessive amounts of nitrogen in its different forms in a natural environment can cause a chain reaction ultimately resulting in worrisome water quality conditions. Nitrogen in rivers is closely associated with the acceleration of plant and algae growth, which impacts other important wq parameters such as dissolved oxygen levels and temperature.

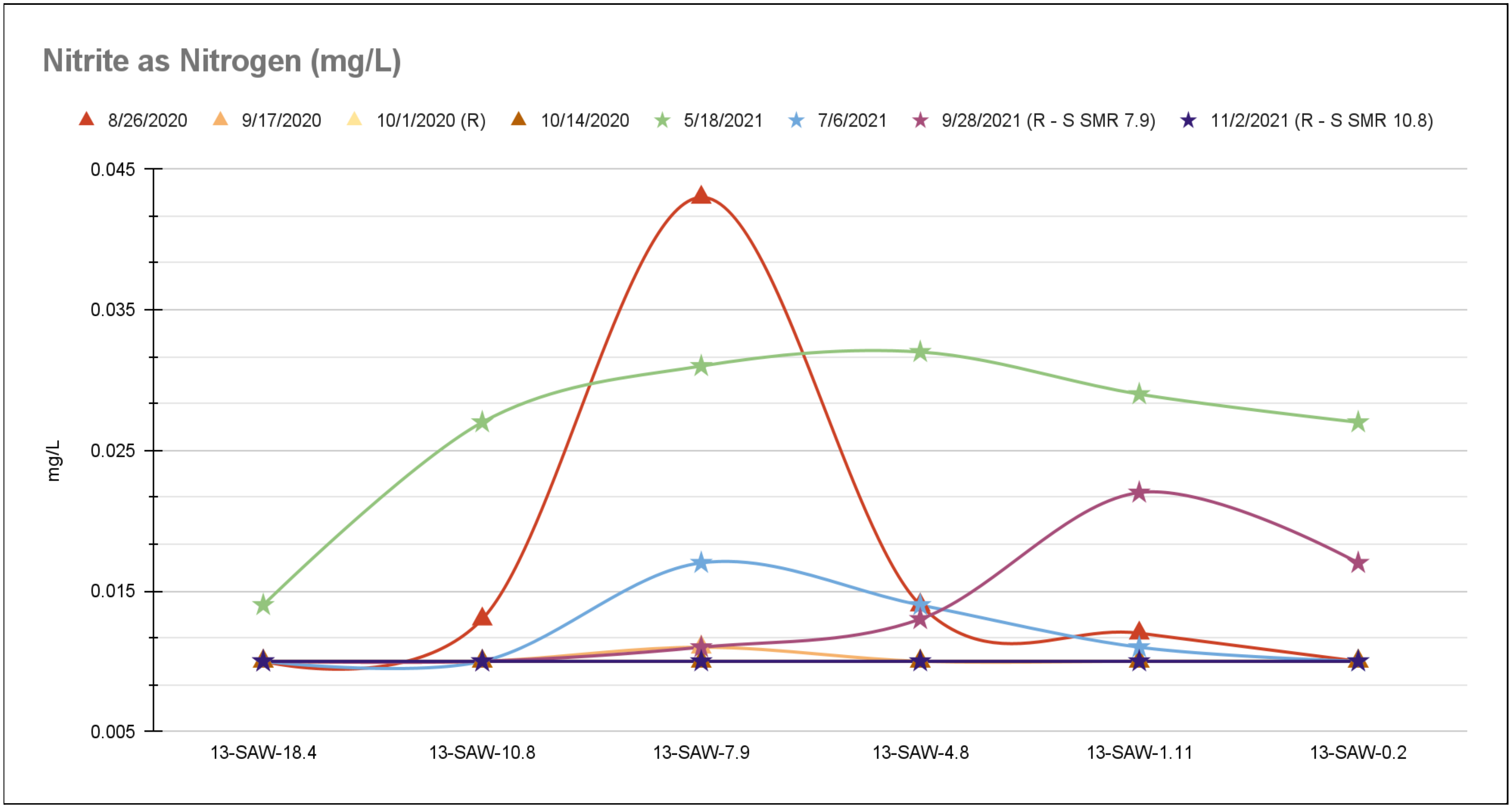


NITRITE AS NITROGEN (NO2-)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Nitrites are considered salts that are both naturally and artificially occurring in natural systems. Predominant external sourcing of nitrites are fertilizers, sewage, and mineral deposits. Bacteria present within ecosystems process ammonia into nitrates and create nitrite as an intermediate step in this process. Excess presence of bacteria and ammonia will result in heightened levels of nitrite.

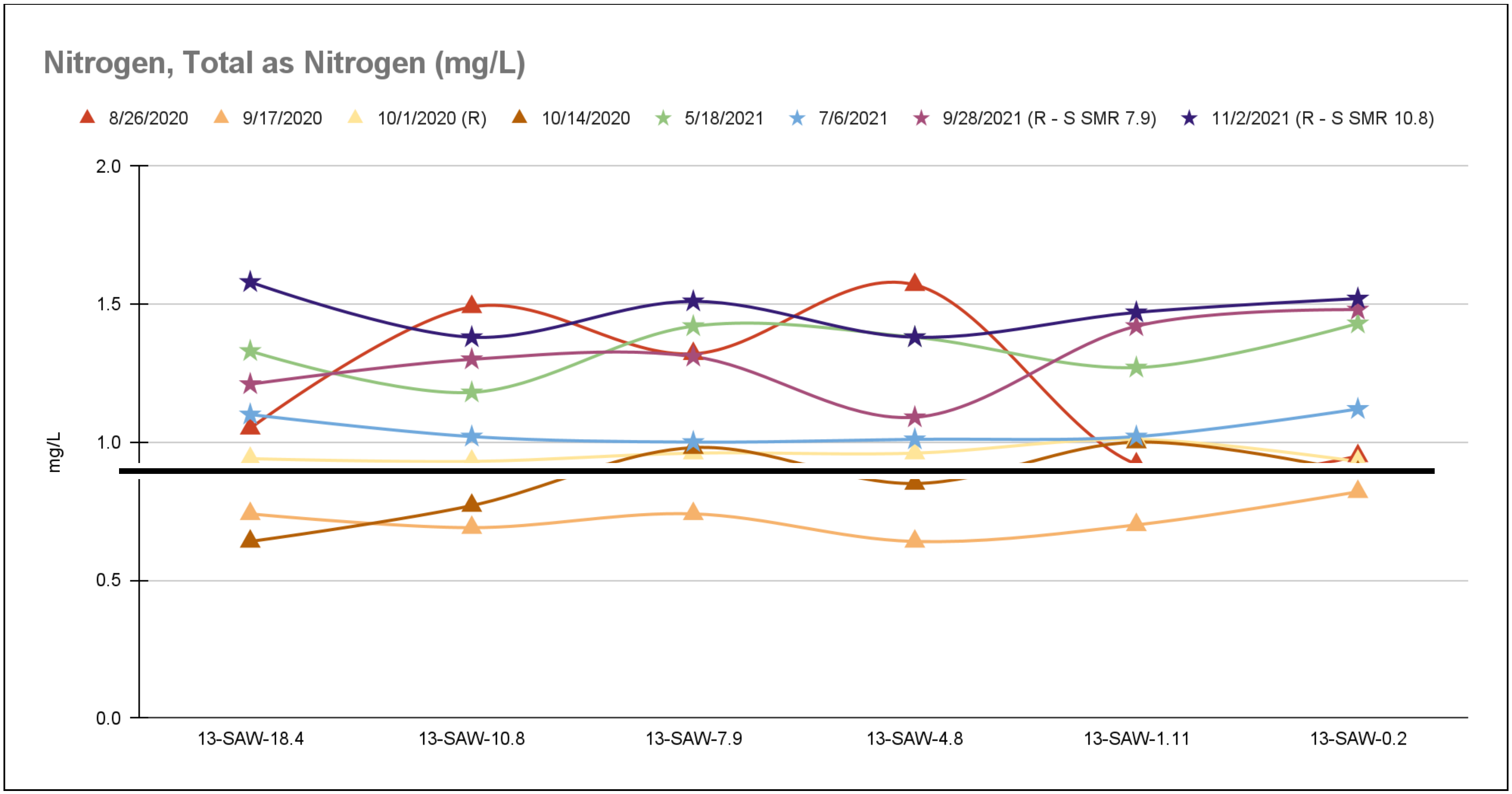


NITROGEN, TOTAL AS NITROGEN (SUM OF NO3-, NO2-, ORGANIC N & NH3)

EPA Regional Nutrient Criteria: 0.48 - 0.87 mg/L

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Lawns and other horticultural features are provided with additional growth support in the form of fertilizers in the springtime. Rain events are the primary transporter of nutrients and pollutants from surrounding areas into local waterways by way of watersheds.

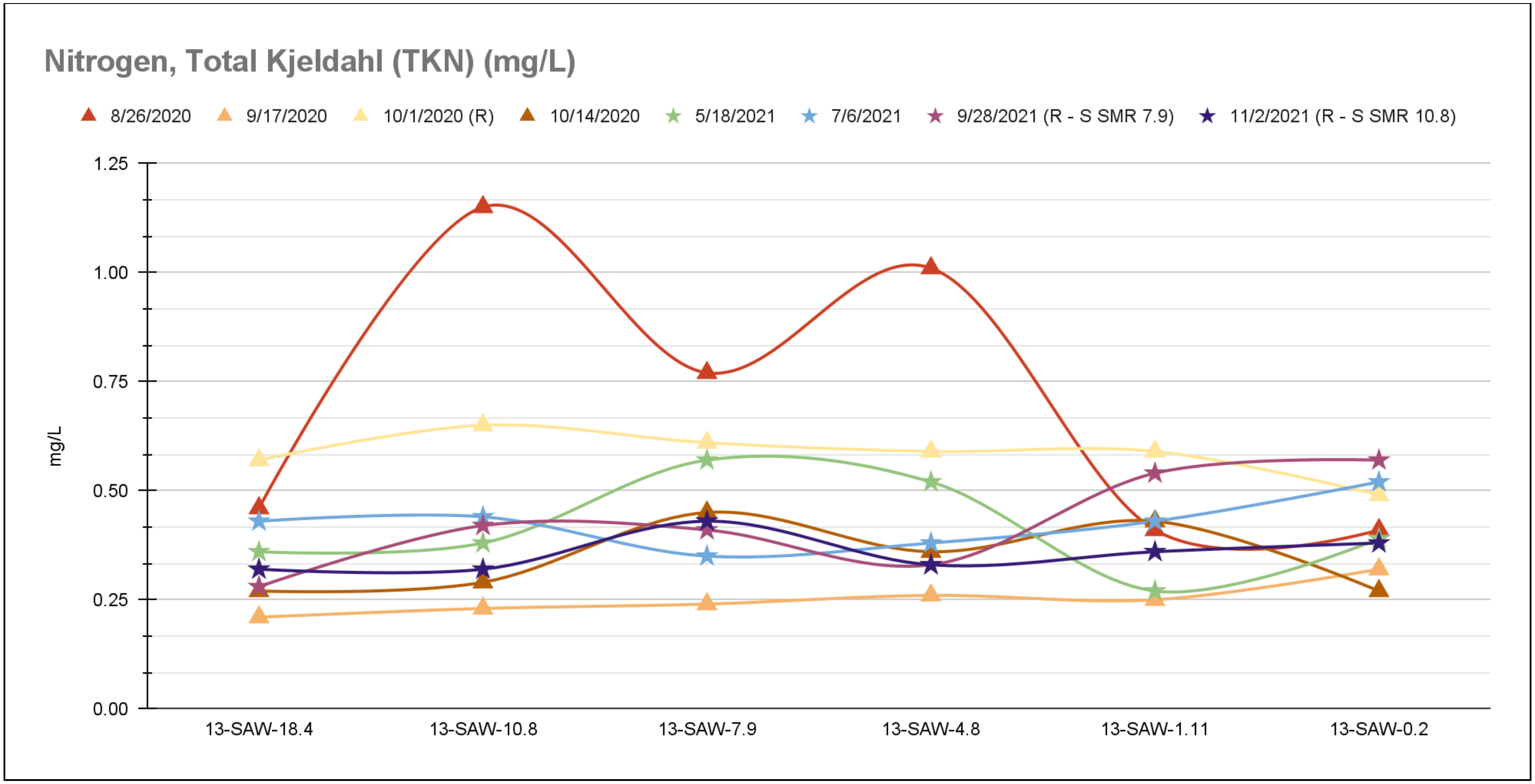


NITROGEN, TOTAL KJELDAHL (TKN: SUM OF ORGANIC N & NH3)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

TKN is a critical indicator of nutrients in the environment due to its composed parts of organic nitrogen - which is directly sourced from sewage and manure inputs into natural environments. Most high TKN amounts are associated with rain events due to the nature of natural runoff that is correlated with weather events.

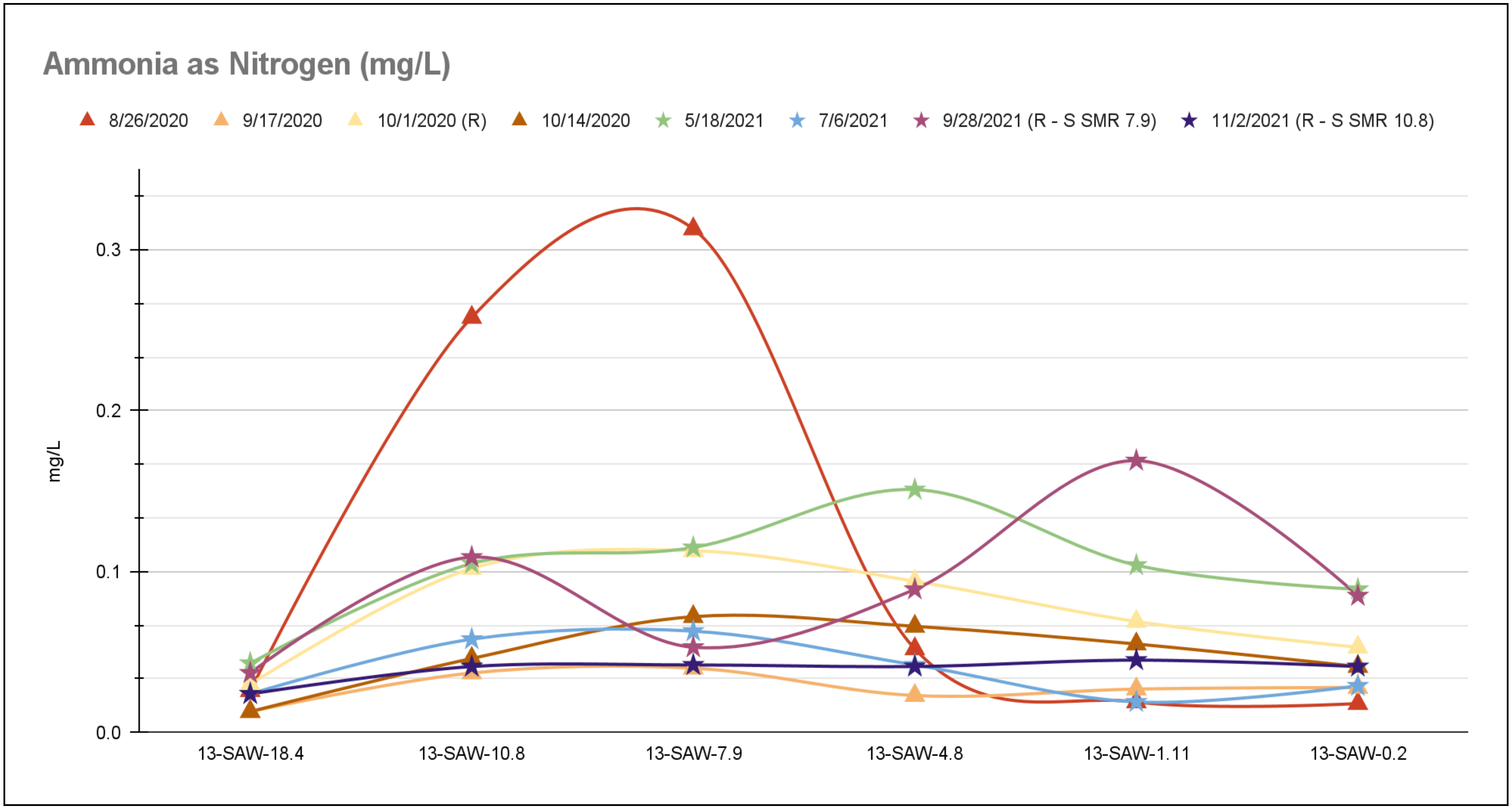


AMMONIA AS NITROGEN (NH3)

No available regulatory threshold

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Ammonia is optimal and necessary for plant growth; however, causes direct toxicity of aquatic life. Natural sources of NH3 are organic waste matter, gas exchange with surface interface, animal and human waste, and nitrogen fixation. As a key indicator of health, ammonia toxicity increases as pH increases and reduces the amount of oxygen available for use by organisms.

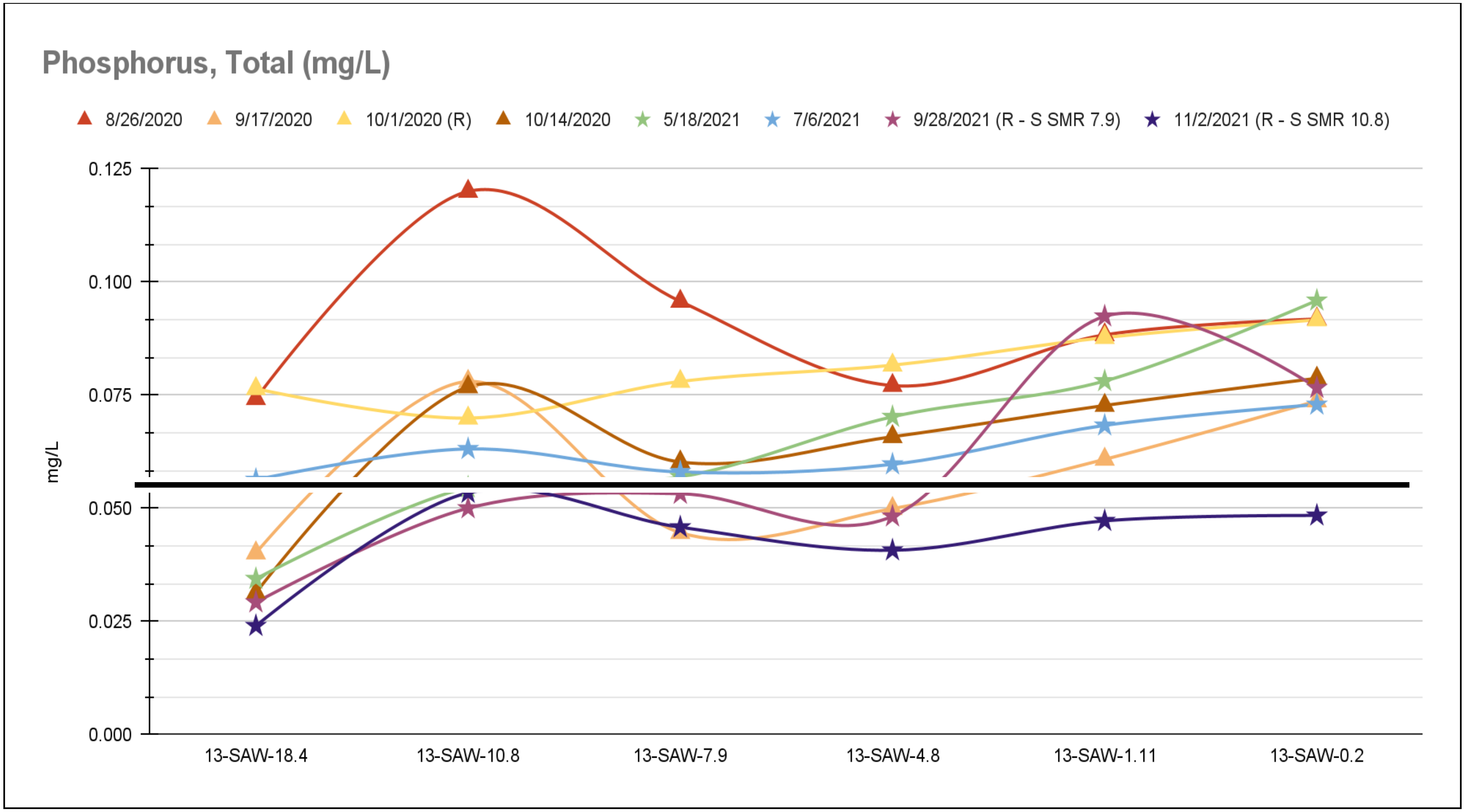


PHOSPHORUS, TOTAL

EPA Regional Nutrient Criteria: 0.00688 - 0.0528 mg/L

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Amounts of phosphorus cause the increased growth of algae and large aquatic plants. This overgrowth has a large impact on decreased levels of oxygen and toxic blooms. Most sources of phosphorus input to natural environments come from urban runoff and sewage treatment systems.



TURBIDITY

The measurement of the transparency of water due to suspended particles is called turbidity. Too many particles can reduce a creature's ability to find food and impact gill function. High turbidity can be caused by many sources including runoff, sediment disturbance and plant decomposition.

Vocabulary

Transparency: The quality that makes it possible to see through something

Particle: A portion, piece, fragment, or amount

Decomposition: The state or process of rotting, decay

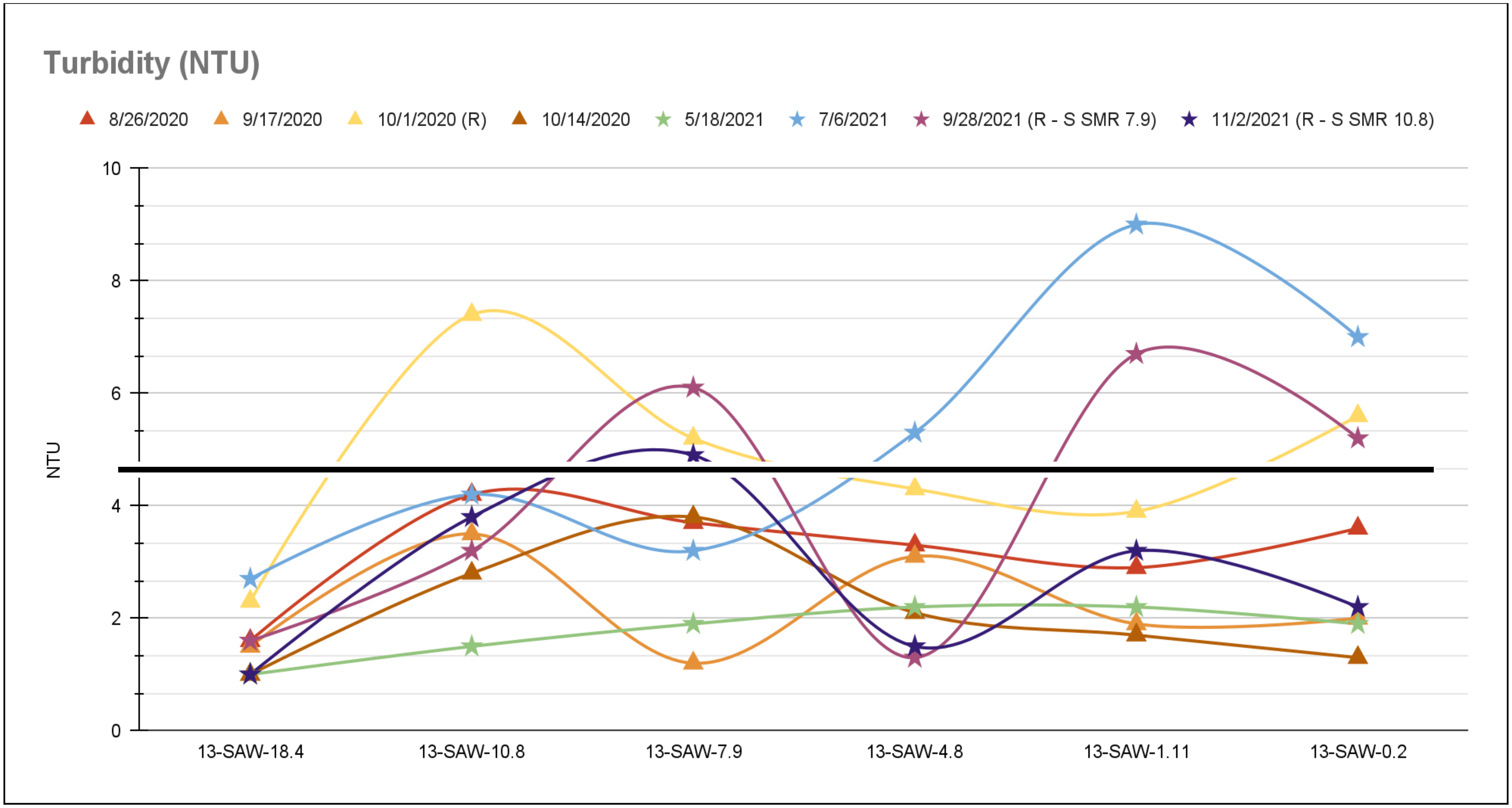
Gill: The paired respiratory organ of fish where oxygen is extracted from water flowing over surfaces within or attached to the walls of the pharynx

TURBIDITY

EPA Regional Criteria: 1.26 - 4.5

Site Key:
13-SAW-18.4: Pleasantville
13-SAW-10.8: Elmsford
13-SAW 7.9: Ardsley
13-SAW-4.8: Hastings
13-SAW-1.11: Yonkers
13-SAW-0.2: Yonkers

Turbidity, or clarity of water, has many physical influencing factors such as rippling of surrounding areas, plankton populations, and sediment size. Heightened murkiness of the water is often correlated with rain storms and flooding of watershed streams. Bank stability and plant life along river banks will also have an impact on erosion and the content of silt, plant matter, etc. which can impact the turbidity measurement of a river sample.



2020 RAW DATASET

	Alkalinity, Total as CaCO3 (mg/L)	Ammonia as Nitrogen (mg/L)	Chloride (mg/L)	Chlorophyll A (UG/L)	Hardness, Total as CaCO3 (mg/L)	Nitrate as Nitrogen (mg/L)	Nitrate+Nitrite as Nitrogen (mg/L)	Nitrite as Nitrogen (mg/L)	Nitrogen, Total as Nitrogen (mg/L)	Nitrogen, Total Kjeldahl (TKN) (mg/L)	Phosphorus, Total (mg/L)	Turbidity (NTU)	Calcium, Total (UG/L)	Magnesium, Total (UG/L)
	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1	Day 1
13-SAW-18.4	154	0.026	162	1.01	243	0.591	0.591	~~0.01~~	1.05	0.46	0.0742	1.6	64100	20000
13-SAW-10.8	106	0.258	144	8.5	173	0.334	0.347	0.013	1.49	1.15	0.12	4.2	44600	15100
13-SAW-7.9	118	0.313	149	2.14	195	0.507	0.55	0.043	1.32	0.77	0.0957	3.7	49600	17300
13-SAW-4.8	162	0.052	215	1.48	279	0.538	0.552	0.014	1.57	1.01	0.0771	3.3	69400	25600
13-SAW-1.11	162	0.019	230	6.23	271	0.495	0.507	0.012	0.92	0.41	0.0883	2.9	66000	24200
13-SAW-0.2	155	0.018	210	3.46	264	0.533	0.543	0.01	0.95	0.41	0.0918	3.6	67500	24900
	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2	Day 2
13-SAW-18.4	167	0.013	181	0.921	271	0.53	0.53	~~0.01~~	0.74	0.21	0.0401	1.5	71400	22400
13-SAW-10.8	161	0.037	216	0.921	278	0.462	0.462	~~0.01~~	0.69	0.23	0.078	3.5	70200	24900
13-SAW-7.9	163	0.04	215	0.77	273	0.488	0.5	0.011	0.74	0.24	0.0446	1.2	67800	25100
13-SAW-4.8	154	0.023	215	1.73	260	0.384	0.384	~~0.01~~	0.64	0.26	0.0499	3.1	64300	24200
13-SAW-1.11	154	0.027	224	1.7	258	0.45	0.45	~~0.01~~	0.7	0.25	0.0608	1.9	64200	23800
13-SAW-0.2	155	0.028	229	3.12	255	0.496	0.496	~~0.01~~	0.82	0.32	0.0737	2	63500	23400
	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)	Day 3 (R)
13-SAW-18.4	82.8	0.03	83.7	3.09	121	0.365	0.365	~~0.01~~	0.94	0.57	0.0764	2.3	32300	9720
13-SAW-10.8	84.8	0.102	106	3.29	125	0.28	0.28	~~0.01~~	0.93	0.65	0.0699	7.4	32500	10600
13-SAW-7.9	77.6	0.113	92.3	2	115	0.347	0.347	~~0.01~~	0.96	0.61	0.078	5.2	30100	9720
13-SAW-4.8	70.4	0.094	77.9	2.26	100	0.373	0.373	~~0.01~~	0.96	0.59	0.0816	4.3	26300	8370
13-SAW-1.11	66.8	0.069	73.3	2.55	95.1	0.421	0.421	~~0.01~~	1.01	0.59	0.0877	3.9	25100	7890
13-SAW-0.2	66.8	0.053	73	2.75	94.4	0.446	0.446	~~0.01~~	0.93	0.49	0.0916	5.6	24900	7840
	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4	Day 4
13-SAW-18.4	135	0.013	136	0.912	210	0.373	0.373	~~0.01~~	0.64	0.27	0.0313	1	55800	17200
13-SAW-10.8	148	0.046	182	0.745	243	0.482	0.482	~~0.01~~	0.77	0.29	0.0768	2.8	62300	21300
13-SAW-7.9	129	0.072	163	1.29	214	0.513	0.523	~~0.01~~	0.98	0.45	0.0602	3.8	54400	19100
13-SAW-4.8	127	0.066	157	0.872	203	0.491	0.491	~~0.01~~	0.85	0.36	0.0658	2.1	51600	18100
13-SAW-1.11	112	0.055	146	1.64	177	0.571	0.571	~~0.01~~	1	0.43	0.0727	1.7	45300	15500
13-SAW-0.2	107	0.041	142	1.48	178	0.627	0.627	~~0.01~~	0.89	0.27	0.0787	1.3	45500	15600

2021 RAW DATASET

	Alkalinity, Total as CaCO3 (mg/L)	Ammonia as Nitrogen (mg/L)	Chloride (mg/L)	Chlorophyll A (UG/L)	Hardness, Total as CaCO3 (mg/L)	Nitrate as Nitrogen (mg/L)	Nitrate+Nitrite as Nitrogen (mg/L)	Nitrite as Nitrogen (mg/L)	Nitrogen, Total as Nitrogen (mg/L)	Nitrogen, Total Kjeldahl (TKN) (mg/L)	Phosphorus, Total (mg/L)	Turbidity (NTU)	Calcium, Total (UG/L)	Magnesium, Total (UG/L)
	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5	Day 5
13-SAW-18.4	112	~~0.043~~	130	1.84	167	0.956	0.97	0.014	1.33	0.36	0.0344	1	44300	13600
13-SAW-10.8	157	~~0.105~~	198	4.23	251	0.772	0.799	0.027	1.18	0.38	0.0546	1.5	64600	21800
13-SAW-7.9	160	~~0.115~~	201	2.23	246	0.824	0.855	0.031	1.42	0.57	0.0569	1.9	62100	22000
13-SAW-4.8	158	~~0.151~~	215	5.87	243	0.83	0.862	0.032	1.38	0.52	0.0702	2.2	61200	21800
13-SAW-1.11	156	~~0.104~~	222	2.94	249	0.97	0.999	0.029	1.27	0.27	0.0781	2.2	62900	22200
13-SAW-0.2	156	~~0.089~~	220	5.48	244	1.02	1.04	0.027	1.43	0.39	0.0959	1.9	61700	21800
	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6	Day 6
13-SAW-18.4	120	0.024	115	1.19	164	0.663	~~0.663~~	~~0.01~~	1.1	0.43	0.0563	2.7	43800	13200
13-SAW-10.8	130	0.058	166	6.52	200	0.573	~~0.573~~	~~0.01~~	1.02	0.44	0.0631	4.2	51700	17400
13-SAW-7.9	136	0.063	165	0.83	201	0.63	~~0.648~~	0.017	1	0.35	0.058	3.2	51200	17700
13-SAW-4.8	136	0.042	171	1.67	200	0.622	~~0.636~~	0.014	1.01	0.38	0.0597	5.3	50700	17800
13-SAW-1.11	136	0.019	180	12.6	204	0.577	~~0.587~~	0.011	1.02	0.43	0.0683	9	51900	18100
13-SAW-0.2	133	0.029	180	4.61	202	0.598	~~0.598~~	~~0.01~~	1.12	0.52	0.0729	7	51400	17900
	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7	Day 7
13-SAW-18.4	135	~~0.037~~	114	2.56	184	0.93	0.93	~~0.01~~	1.21	0.28	0.0292	~~1.6~~	49400	14800
13-SAW-10.8	178	~~0.109~~	181	1.19	263	0.88	0.88	~~0.01~~	1.3	0.42	0.05	~~3.2~~	67800	22700
13-SAW-7.9	174	~~0.053~~	170	2.33	249	0.891	0.902	0.011	1.31	0.41	0.0532	~~6.1~~	63400	22100
13-SAW-4.8	148	~~0.089~~	157	1.46	208	0.748	0.761	0.013	1.09	0.33	0.0482	~~1.3~~	52600	18600
13-SAW-1.11	143	~~0.169~~	178	6.36	205	0.859	0.881	0.022	1.42	0.54	0.0924	~~6.7~~	53200	17500
13-SAW-0.2	141	~~0.085~~	162	3.39	199	0.895	0.911	0.017	1.48	0.57	0.0766	~~5.2~~	50900	17400
	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8	Day 8
13-SAW-18.4	103	0.024	96.2	0.578	133	1.26	1.26	~~0.01~~	1.58	0.32	0.024	1	35900	10600
13-SAW-10.8	146	0.041	152	3.38	199	1.06	1.06	~~0.01~~	1.38	0.32	0.0534	3.8	52100	16800
13-SAW-7.9	153	0.042	148	6.02	203	1.08	1.08	~~0.01~~	1.51	0.43	0.0458	4.9	52400	17600
13-SAW-4.8	152	0.041	153	0.987	199	1.05	1.05	~~0.01~~	1.38	0.33	0.0407	1.5	51200	17200
13-SAW-1.11	150	0.045	159	0.975	198	1.12	1.12	~~0.01~~	1.47	0.36	0.0472	3.2	51300	17100
13-SAW-0.2	150	0.041	158	0.663	198	1.14	1.14	~~0.01~~	1.52	0.38	0.0484	2.2	51400	17000

ADDITIONAL WQ INDICATORS

AQUATIC MACROINVERTEBRATES

These are creatures living within our rivers and streams that are large enough for us to see without the need of a microscope. These are a great indicator of water quality because these bugs have different known ranges of pollution tolerance. Macroinvertebrates can also act as a historic log of long term aquatic health.

Vocabulary

Macroinvertebrate: A spineless creature that can be seen without the need of a microscope

Indicator: A thing that indicates the state or level of something

Bug: A small insect

Pollution Tolerance: Evaluation of tolerance and sensitivity to certain pollutants within an environment

AQUATIC MACROINVERTEBRATE

2021 Data Collected by CURB staff and volunteers via DEC WAVE Program
Preliminary Assessment with reference to the Izaak Walton League of America (IWL)

Most Wanted Species	Least Wanted Species	WAVE Assessment*	IWL Assessment	IWL Score**
0	-2	No Conclusion	Poor	11

Bugs found in the Voucher:

(Mollusca: Bivalvia) Corbiculidae, (Wormlike) Oligochaeta
(Crustacea: Decapoda) Pleocyemata: Cambaridae
(Diptera: Chironomidae), (Diptera) Tipulidae
(Crustacea: Amphipoda) Gammaridea
(Crustacea: Isopoda) Asellota, (Wormlike) Tricladida, Planariidae
(Odonata: Zygoptera) Calopterygidae
(Trichoptera) Hydropsychidae
(Mollusca: Gastropoda) Lymnaeidae

****IWL Water Quality Rating Score**

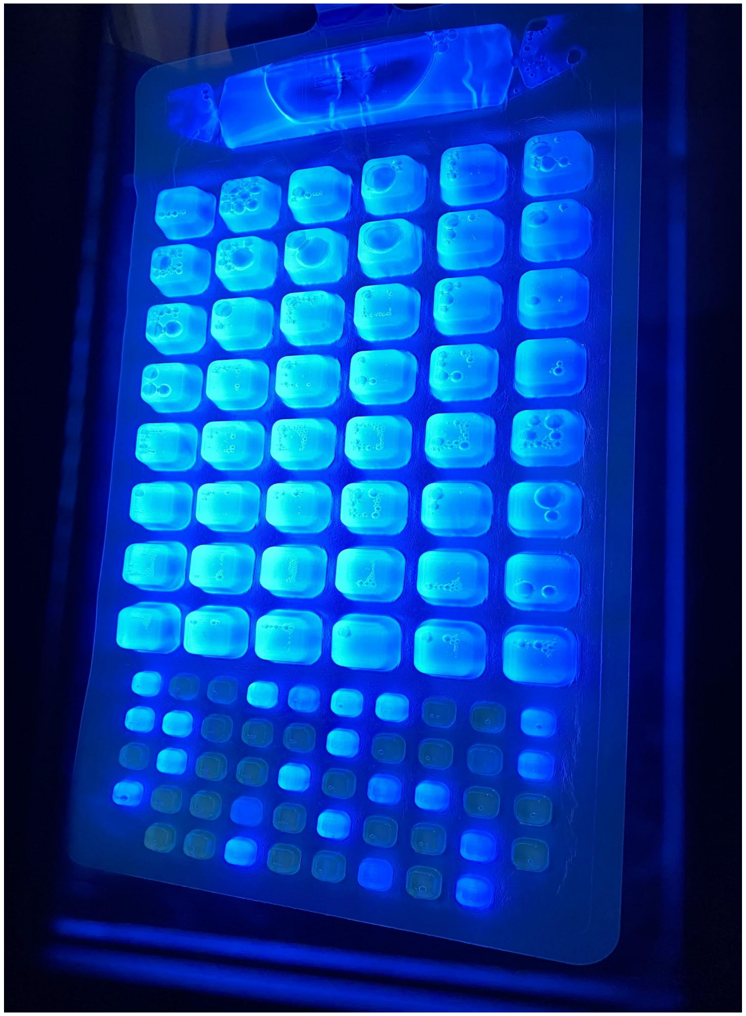
Excellent (>22) Good (17-22) Fair (11-16) Poor (<11)

***NYS DEC Assessment Data**

Sample Contents	Water Quality Assessment	Assessment Description
More than six "MOST wanted" organisms	No Known Impact	The stream is healthy in that there is no observed impact to the aquatic life. This assessment is high quality and may be used for state and federal reporting purposes.
More than four "LEAST wanted" organisms	Possibly Impaired	This assessment serves as a red flag for sites that may deserve further investigation at the professional level. So far, we've been able to respond to every site that was flagged as possibly impared.
Other	No Conclusion	Sometimes a sample does not meet either of these criteria: it doesn't have six or more "most wanted" NOR four or more "least wanted". If the sampling was done properly, then the site is probably slightly impacted but not impaired. This can also happen, however, when sampling is performed incorrectly which is why the DEC records this assessment as "No Conclusion"

ENTEROCOCCUS

This bacteria lives within the guts of warm blooded mammals. In aquatic environments, it acts as a fecal indicator bacteria - meaning there is a presence or lack of fecal matter. Different bacteria strains are naturally found within environments; however, enterococcus in high amounts are often attributed to anthropogenic infrastructure, such as CSO systems.



Vocabulary

Bacteria: Member of a large group of unicellular microorganisms

Fecal: Bodily waste discharge

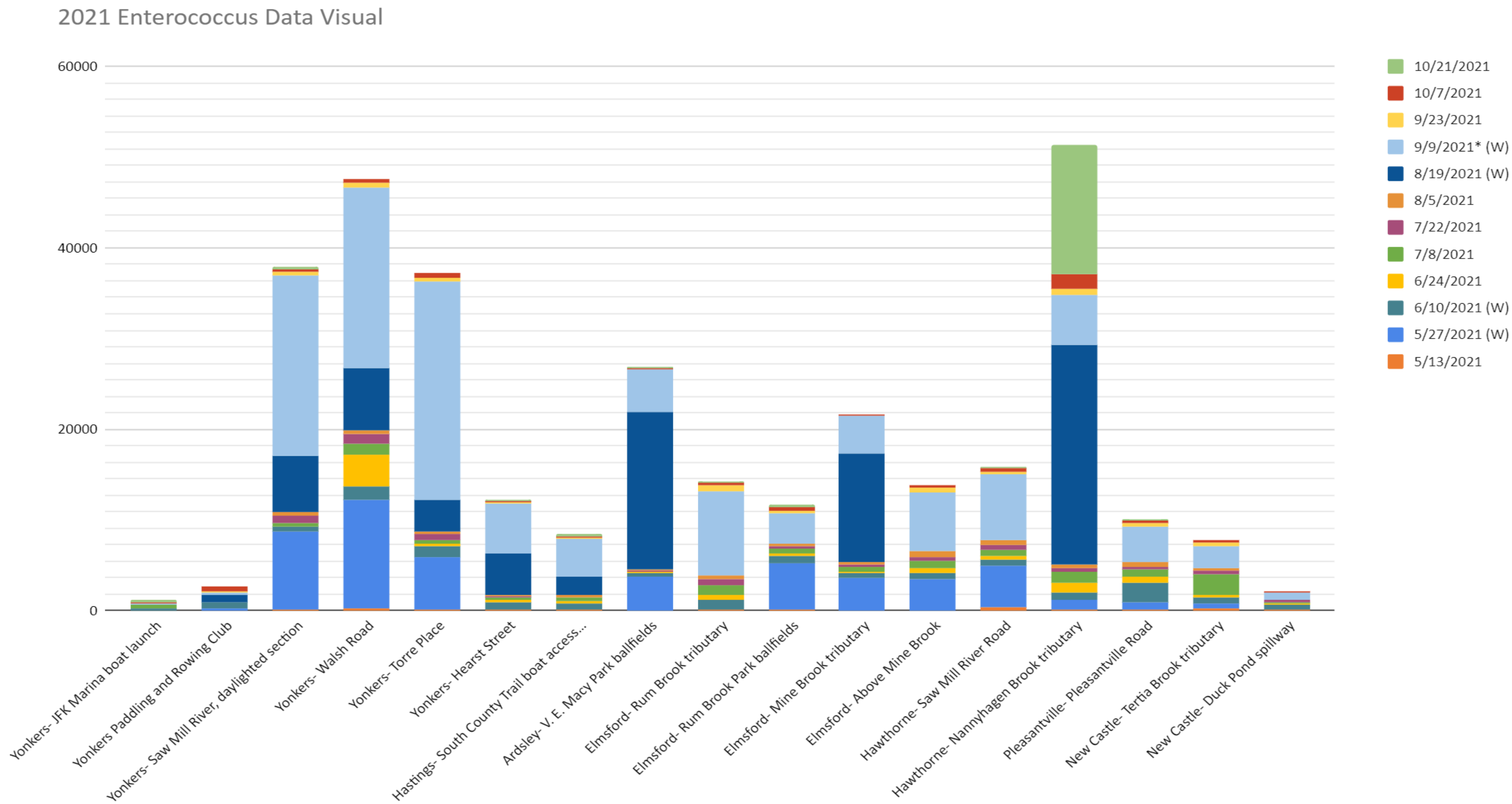
Infrastructure: Basic physical and organizational structures and facilities

ENTEROCOCCUS

2021 Data Collected by Community Science Program
Geometric Mean (GM*) Data Summary

Site ID	Town	Site Name	GM Data Enterococcus (MPN)
SMR 21.18	New Castle	Duck Pond Spillway	107
SMR-TB-0.34	*New Castle*	*Tertia Brook Tributary*	426
SMR 18.84	Pleasantville	Pleasant Ave**	533
SMR-NB-0.07	*Hawthorne*	*Nannyhagen Tributary*	1,405
SMR 14.88	Hawthorne	Saw Mill River Road	682
SMR 11.82	Elmsford	Above Mine Brook	877
SMR-MB-0.15	*Elmsford*	*Mine Brook Tributary*	575
SMR 10.41	Elmsford	Rum Brook Ballfields	460
SMR-RB-0.13	*Elmsford*	*Rum Brook Tributary*	563
SMR 7.9	Ardsley	V.E. Macy Park	325
SMR 4.87	Hastings	South County Trail	332
SMR 4.22	Yonkers	Hearst Street	318
SMR 2.44	Yonkers	Torre Place	917
SMR 1.11	Yonkers	Walsh Road**	1616
SMR 0.19	Yonkers	Saw Mill River Daylighted**	653
NYC-HR-18.5	Yonkers	Yonkers Paddling and Rowing Club	94
NYC-HR-20	Yonkers	JFK Marina	96

* *GM: average value or mean which signifies the central tendency of the set of numbers by finding the product of their values*
** Used as a PEERS sampling site



*Most Probable Number of Colony Forming EnteroBacteria per 100mlsample. EPA recommends public notification and possible temporary beach closure for single Entero samples above 60 cells/100ml.Samples testing above this threshold appear red on theRiverkeeper website, while those below it appear in green. To avoid exposure to chronic contamination,the geometric mean, a weighted 30-day average, should not exceed 30 cells/100ml. To avoid exposure to occasional high levels of contamination, no more than 10% of samples should exceed 110cells/100ml.

MICROBIAL SOURCE TRACKING (qPCR)

2020 and 2021 Data Collected by Community Science Program and Sarah Lawrence College students
Summary by Dr. Michelle Hersh and Salem Hunter '21, Sarah Lawrence College

The Hudson River and the Saw Mill River historically have had high levels of enterococci when tested by CURB and Riverkeeper. These levels have been well above EPA standards of safe water for recreation. *Enterococcus* is one fecal indicator bacteria that gives us a very broad view of what amount of waste is in the water. In collaboration between the Sarah Lawrence College Ecology Laboratory, CURB, Riverkeeper, and community science participants, a pilot study was conducted to establish protocols to determine the source of the enterococci present. We found and implemented quantitative PCR (qPCR) assays to determine if the waste present stemmed from human, avian, or canine sources.

Quantitative PCR is a powerful and sensitive method to determine the source of microbial contaminants. These samples test for the presence or absence of DNA from bacterial species indicative of the fecal matter of different species (humans, dogs) or groups of species (birds). Positive samples indicate that not just fecal contamination is present, but if contamination is originating from a particular source. Using multiple assays allows us to test each water sample for the presence of contamination from each source type. With that in mind, we researched different published qPCR protocols and selected four to pilot – two human assays (HF183, HumM2), one canine (DogBact), and one avian (GFD). Each different bacterial indicator run for qPCR had a different protocol, including unique forward and reverse primers, and probes to determine if the targeted DNA sequence is present within the samples.

Water samples were collected with replication from both the Hudson River at CURB and at several locations along the Saw Mill River by community scientists and Sarah Lawrence research assistants. Sampling occurred on five different days ranging from late October to early April. Two of those sampling days were considered dry days, no rain 72 hours prior to sampling, and three were considered wet days. Each sampling day included two replications on the Hudson River and two replications at the Saw Mill River.

The water samples were kept cool during transport and were filtered the same day at the Sarah Lawrence lab to collect any microbes that were present in the water samples. These filters were stored at -80°C then went on to be extracted for DNA and were run in triplicate using quantitative PCR (qPCR) assays to determine if bacterial indicator species were present for human, avian, and canine fecal contamination. We used funding from this grant to purchase reagents for DNA extractions and qPCR assays, but also to synthesize fragments of DNA to use as positive controls.

Work on these samples is still ongoing. Both human assays appeared to work successfully, though some sample design considerations such as the amount of water collected and template dilution need to be optimized. Evidence of human contamination appeared at both sites on multiple sampling dates. No samples were positive for the canine assays; however, not all positive controls amplified successfully, so these samples need to be tested for PCR inhibition. The avian protocol unfortunately did not work successfully for our samples, so a new protocol and reagents needs to be researched and implemented. However, it is promising that 3/4 assays could successfully amplify target DNA. Development of new protocols is an ongoing process, but we have taken the critical first steps towards robust sampling methods.

In addition, we also assayed the entire bacterial community in a subset of water samples using 16S amplicon sequencing. This method samples the total bacterial DNA in a water sample to determine the composition of bacteria present. The same samples were used for both qPCR and amplicon sequencing. Total DNA was extracted from samples, and community structure determined using Illumina sequencing. We found clear differences between samples collected in the Hudson vs. Saw Mill Rivers. Further, the Saw Mill samples appeared more dynamic, changing more between sampling dates, while the Hudson River communities remained more constant. Work is ongoing to determine if any bacteria from those samples can be traced to fecal contamination from humans or other animal species. This work was carried out in two Sarah Lawrence classes, Microbiology (Spring 2020) and Environmental Metagenomics (Spring 2021).

LITTER

In our everyday lives, we encounter moments when materials we have become unneeded or unusable any longer; this is considered trash. When trash is left in environments that society has determined to be incorrect, this trash is assigned a new name - litter. Litter is not only aesthetically unpleasing, it is a very dangerous obstacle faced by natural environments throughout the world.

Vocabulary

Trash: Discarded matter

Materials: The matter from which a thing is or can be made

Litter: Trash that is left lying in an open or public space

Aesthetic: The appreciation of beauty

Obstacle: A thing that blocks one's way or prevents or hinders progress

LITTER

2021 Data Collected by volunteers organized by Groundwork Hudson Valley (GWHV)
Summary by Oded Holzinger, Climate Resilience Manager GWHV

Site	# Volunteers	# Trash Bags filled	# Tires	Most Common Type of Trash	Most Unique Find
Mount Pleasant	33	54	10	Metal, glass, car parts	bathtub, pool liner, car chassis, shopping cart, 55 gallon drum, commercial concrete
Executive Blvd	20	18	0		
Daylight 1, 2, 3	36	29	0	styrofoam, cigarette butts, bottle caps	asthma pump
Walsh Rd	12	23	0	cigarette butts, bottle caps	rubber thumbs up stamp
Farragut Ave	40	52	0		
Lawrence	43	98	2	bottles, carpet, cardboard, foam, plastic bags	2 toilets, shovel, wires, broken A/C unit, concrete, steel
Chauncey	11	18	2	paper, bottles	front fender, metal ducts
Woodlands Lake	29	31	3	water bottles, styrofoam	chicken coop, bowling ball, tail light, car parts
Bridge St	16	19	1	cigarette butts, masks, plastic bottles	baseball, shopping cart, washing machine cover, headlight, brake rotor, fluorescent bulbs
TOTAL	**240**	**342**	**18**		

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Prosser, J. I. (2005). Nitrogen In Soils - Nitrification. *Nitrogen In Soil*, Summary. Retrieved January 21, 2022.

ADDITIONAL RESOURCES

Groundwork Hudson Valley - Saw Mill Coalition “State of the Saw Mill River Watershed” 2019 Report
https://gwhv.app.box.com/s/diwowtc6w947cfs7xg8msyam85gq14qg

The Saw Mill River Coalition
https://www.groundworkhv.org/programs/transforming-places/saw-mill-river-coalition/

Land Acknowledgment
http://landacknowledgements.org/ & https://native-land.ca/

NYS DEC WAVE Assessment
https://www.dec.ny.gov/chemical/92229.html

Izaak Walton League of America - Save Our Streams
https://www.iwla.org/

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All photos featured throughout this report has been collected by dedicated stakeholders as part of the community science water sampling enterococcus program: Thank you - Bill Dennison, Diane McKay, Helen Meurer, Marcia Brewster, Maxwell Thomas, Michael Thomas, Sarita Eisenstark, Sharon AvRutick, Steve Pucillo, and Richard Novak.

Primary Author: Katie Lamboy, Eductor and Science Coordinator, CURB

With Assistance From: Ryan Palmer, Director, CURB

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SARAH LAWRENCE COLLEGE

CENTER FOR THE URBAN RIVER AT BECZAK