



Water Quality Monitoring at Saugus Iron Works National Historic Site

Northeast Temperate Network 2011 Summary Report

Natural Resource Data Series NPS/NETN/NRDS—2012/349



ON THE COVER

Turning Basin, May 2011
Photograph by: Eric Davis

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William G. Gawley
National Park Service
Acadia National Park
PO Box 177
Bar Harbor, Maine 04609

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Introduction

This report on the water quality of Saugus Iron Works National Historic Site (SAIR) generated by the Northeast Temperate Network (NETN) Water Quality Monitoring Program includes data gathered in the 2011 monitoring season and displays these results in graphic form, accompanied by a brief interpretation. Appendix A contains data collected from 2006 through 2011.

The vital signs for freshwater bodies included in the NETN Freshwater Monitoring Protocol (Lombard et al 2006) are water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species. These metrics were chosen to address the NPS Inventory and Monitoring Program objective to detect change in the status of physical, chemical, or biological attributes of the ecosystem.

The NETN Freshwater Monitoring Protocol calls for a total of two stream sites at SAIR to be sampled twice annually in May and August. A cooperator from the University of Vermont or a NETN hydrologic technician measured physical and in-situ water chemistry parameters and collected water samples for analysis at the University of Maine's Sawyer Environmental Chemistry Research Laboratory. All monitoring data are incorporated into a series of comprehensive databases that ultimately feed the U.S. Environmental Protection Agency's "STORET" data system, the repository for all NPS water quality and quantity data.

Sampling Sites

Two water quality monitoring sites have been selected at SAIR for the long-term monitoring program (Table 1). The Saugus River site (SAIRSA) is at the U.S. Geological Survey (USGS) continuous-record streamflow-gage on the Saugus River just upstream of the park boundary (USGS 01102345 Saugus River at Saugus, MA) which has been in operation since 1994. Although the station is upstream of the park, this station adequately represents water quality where the river enters the park (Lombard et al 2006). This station is useful because it is immediately upstream of the upper limit of tidal influence. Data from this station can be accessed at: http://waterdata.usgs.gov/ma/nwis/uv/?site_no=01102345&agency_cd=USGS. The Saugus River is classified as a warm water fishery (Lombard et al. 2006), capable of supporting bass, pickerel, sunfish, and similar species.

The second sample site is located at the Turning Basin (SAIRSB). The Turning Basin is a modified tidal basin, first used by the original iron works from 1650-1679 as a location for boats to turn around at the head of the estuary. Brackish water intrudes into the basin during high (spring) tides and affects the water quality. The river channel within and below the Turning Basin, including the benthic zone, intertidal surface, and floodplain was the subject of a major restoration project between the 2007 and 2008 sampling years.

Nutrient chemistry samples and in-situ water quality sonde measurements are scheduled to be taken twice a year at the location of the USGS gage and in the Turning Basin (Figure 1). No in-situ water quality measurements were taken in 2006 and May and August nutrient chemistry samples were collected from SAIRSA only. From 2007 through 2011 nutrient chemistry samples were taken from both sites, although sonde measurements were collected only at the Turning Basin, likely due to misinterpretation of protocol instructions.

In addition, water chemistry, sediment pollutants, channel morphology, and tidal hydrology data have been collected as part of the Turning Basin restoration project monitoring program in 2008 and 2010 (CH2MHill 2011). Additional data collection is expected in 2012, 2013, 2015, and 2017.

Table 1. Water quality monitoring sites at Saugus Iron Works NHS.

Water Body	NETN Site Code	USGS Station Number	Latitude	Longitude	Site Remarks
Saugus River	SAIRSA	01102345	42.4693861	-71.0071722	Warm water fisheries
Turning Basin	SAIRSB	n/a	42.4688833	-71.0077000	

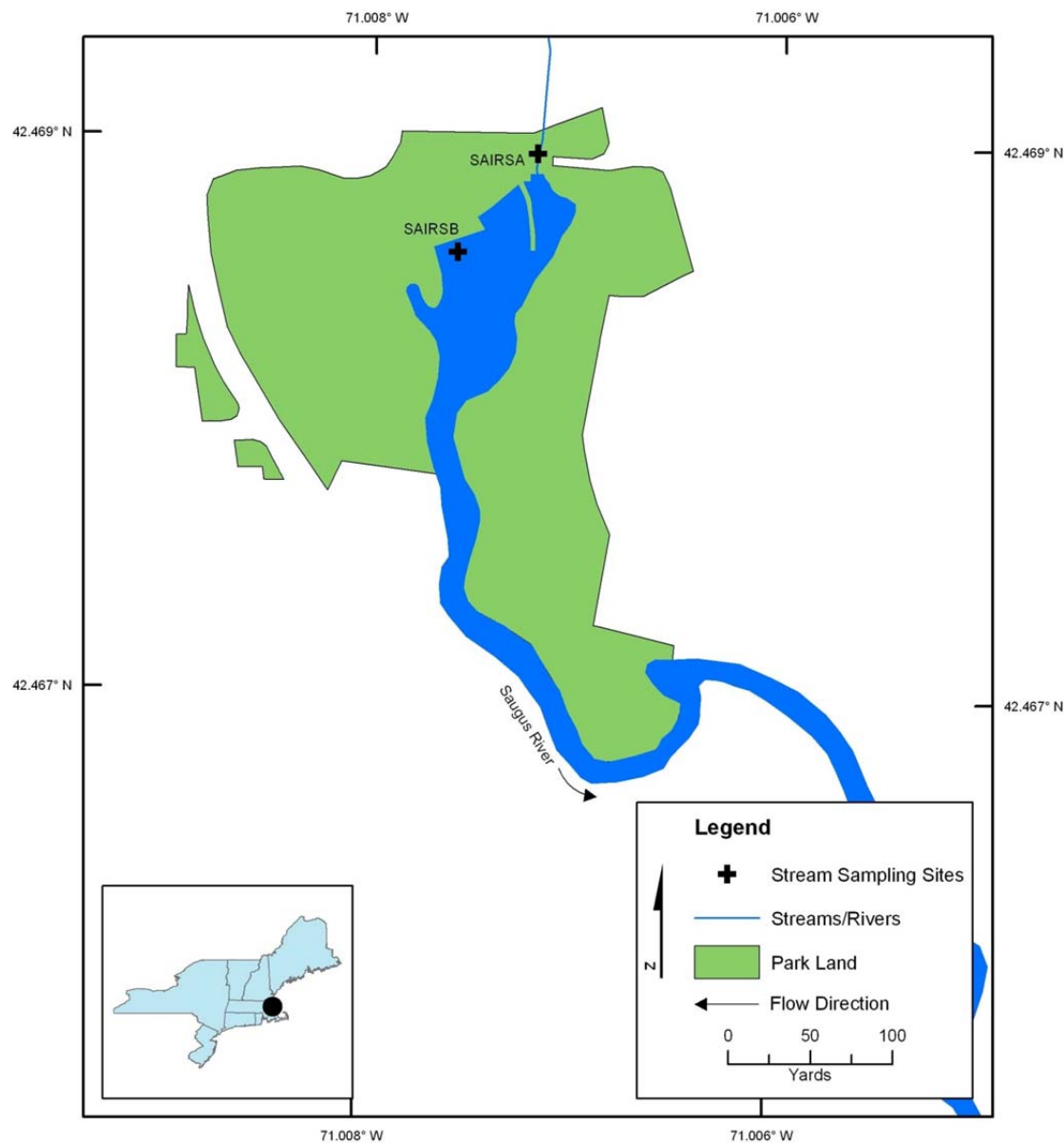


Figure 1. NETN water monitoring sites at Saugus Iron Works NHS.

Methods

Detailed descriptions of all monitoring methods are found in the protocol (Lombard et al. 2006). In-situ water quality measures (pH, specific conductance, temperature, and dissolved oxygen) were determined with a YSI 600XL sonde. In May and August, water samples were obtained and analyzed for acid neutralizing capacity (ANC), color, and nutrients. Nutrient chemistry parameters were analyzed from a grab sample.

Stream discharge is measured continuously by the gage at the Saugus River (SAIRSA) site. Instantaneous discharge data are available on the USGS website and are summarized in annual USGS data reports. No discharge or stage measurements are collected at the Turning Basin.

In-situ stream water chemical and physical measurements and water samples at SAIRSA were collected within 5 meters of the location of the USGS gage. Sonde measurements were taken in the main stream flow with care taken that the sonde was not resting directly on the stream bottom. Grab samples were obtained by submerging the sample bottle directly in the stream with a gloved hand. A peristaltic pump and Tygon tubing were used to collect samples if water levels were too low to completely submerge a bottle. Identical procedures were used in the Turning Basin's (SAIRSB) standing water.

Water Quality Standards

Massachusetts surface-water quality standards designate Class A waters as “excellent habitat for fish, other aquatic life and wildlife, and suitable for primary and secondary contact recreation” (Massachusetts Department of Environmental Protection 2007). Outstanding Resource Waters (ORW) is used to denote those waters, other than Public Water Supplies, designated for protection as outstanding resources. “Class A waters shall have DO [dissolved oxygen] concentrations of not less than 6 mg/L unless background conditions are lower. Temperatures shall not exceed 68° F [20° C] in cold water fisheries or 83° F [28.3° C] in warm water fisheries, and natural and seasonal variations shall be maintained. The pH shall range from 6.5 to 8.3 standard units but not more than 0.5 units outside of the background range. Class A waters shall be free from color in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class”.

Table 2. Massachusetts stream water quality standards.

Water quality classification code	Minimum Dissolved Oxygen (mg/L)	pH range (standard units)	Maximum Total Nitrogen (µg/L)	Maximum Total Phosphorus (µg/L)
A	6.0	6.5-8.3	As naturally occurs	As naturally occurs

EPA Ecoregion 14 water quality criteria (Table 3; U.S. Environmental Protection Agency 2000) are also used as a benchmark in this report. EPA water quality criteria for nutrients help translate narrative criteria within State or Tribal water quality standards by establishing values for causal variables (e.g., total nitrogen and total phosphorus) and response variables (e.g., turbidity and chlorophyll *a*). Causal variables are necessary to provide sufficient protection of designated uses before impairment occurs and to maintain downstream uses. Early response variables are necessary to provide warning signs of possible impairment and to integrate the effects of variable and potentially unmeasured nutrient loads (U.S. Environmental Protection Agency 2002).

Table 3. EPA Ecoregion 14 nutrient criteria for streams.

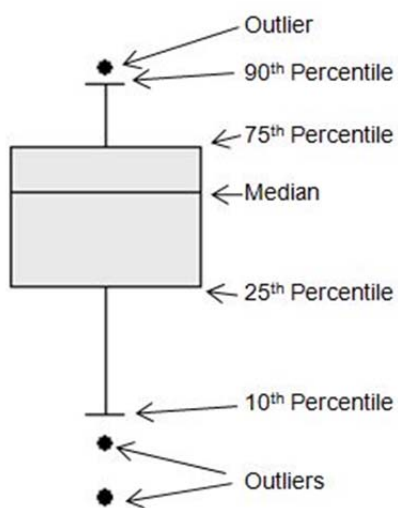
Nutrient Criteria	Value
Total Phosphorus	31.25 µg/L
Total Nitrogen	0.71 mg/L

These criteria were developed specifically for Ecoregion 14 (which includes Saugus Ironworks NHS, Minute Man NHP, and Weir Farm NHS) and are designed to represent conditions of surface waters that are minimally impacted by human activities and thus protect against the adverse effects of nutrient over-enrichment from cultural eutrophication. The values are EPA's scientific recommendations regarding ambient concentrations of nutrients that protect aquatic resource quality. They do not have any regulatory impact or meaning.

The criteria were established based on the lower 25th percentile of streams for which the EPA found data. This percentile of all streams is expected to approximately correspond to the 75th percentile of reference (undisturbed) streams. In other words, 75% of streams in the ecoregion do not meet the criteria, nor do roughly 25% of reference streams. (U.S. Environmental Protection Agency 2000).

Results

Monitoring results for 2011 are displayed in scatter-plot graphs showing all data for each site for a given parameter. The scatter plots of 2011 data are overlaid on box plots representing the



overall range and distribution of data values collected from 2006 through 2011 for the specified parameter and site (Appendix A contains all data in tabular form). A box plot (Figure 2) is a summary plot that graphs data as a box representing statistical values. The boundary of the box closest to zero indicates the 25th percentile, a line within the box marks the median, and the boundary of the box farthest from zero indicates the 75th percentile. Whiskers (error bars) above and below the box indicate the 90th and 10th percentiles respectively. Outliers are displayed as black filled circles. At least nine data points are required to compute the 5th, 10th, 90th and 95th percentiles. If a percentile point is unable to be computed, that set of points is not drawn. If EPA or other water quality criteria exist for a particular parameter they are displayed on the graphs as specification lines.

Figure 2. Explanation of box plot graph.

Water Quality

Measures of water quality include specific conductance, pH, water temperature, dissolved oxygen (DO), acid neutralizing capacity (ANC), and apparent color. Assessment of water quality data aids in the interpretation of the biotic condition and ecological processes of surface water resources.

Specific Conductance

Specific conductance (Figure 3) is a measure of the ability of water to carry an electrical current, and is directly related to the level of dissolved ions in the water. An increase in specific conductance can be an indicator of pollutants in the water. Naturally occurring values range from less than 20 to more than 1,000 microsiemens per centimeter ($\mu\text{S}/\text{cm}$). Specific conductance values from 2011 were within the appropriate range for moderate ionic strength waters, and were within the lower range of values shown on the box plot.

The historic high outlier values noted on the graph in Figure 3 may be due to saltwater intrusion from storm events or high tides. According to the USGS 2009 Water-Data report for Station 01102345 (U.S. Geological Survey 2011), no corresponding high conductance values were recorded at the SAIRSA station (which is above the range of tidal influence) on August 20, 2009. Specific conductance values are unavailable from SAIRSA on August 10, 2010.

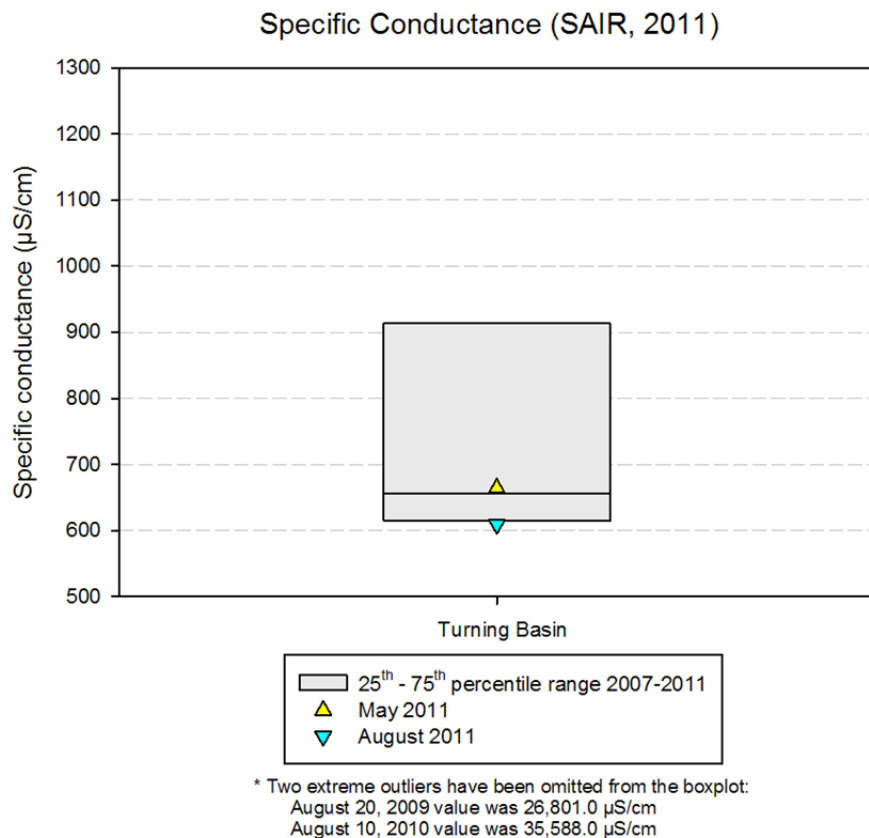


Figure 3. Specific conductance from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2007-2011.

pH Level

The pH of a water body reflects how acidic or basic the water is, measured on a scale of 1 to 14, with 7 being neutral. Acid waters are below 7, and alkaline waters are above 7. A one unit change in pH represents a 10-fold change in acidity or alkalinity. Massachusetts standards, similar to those of most northeast states, indicate that a pH between 6.5 and 8.3 is within the acceptable range. pH values from the 2011 monitoring season (Figure 4) were slightly basic, and were between the upper and lower Massachusetts water quality standards.

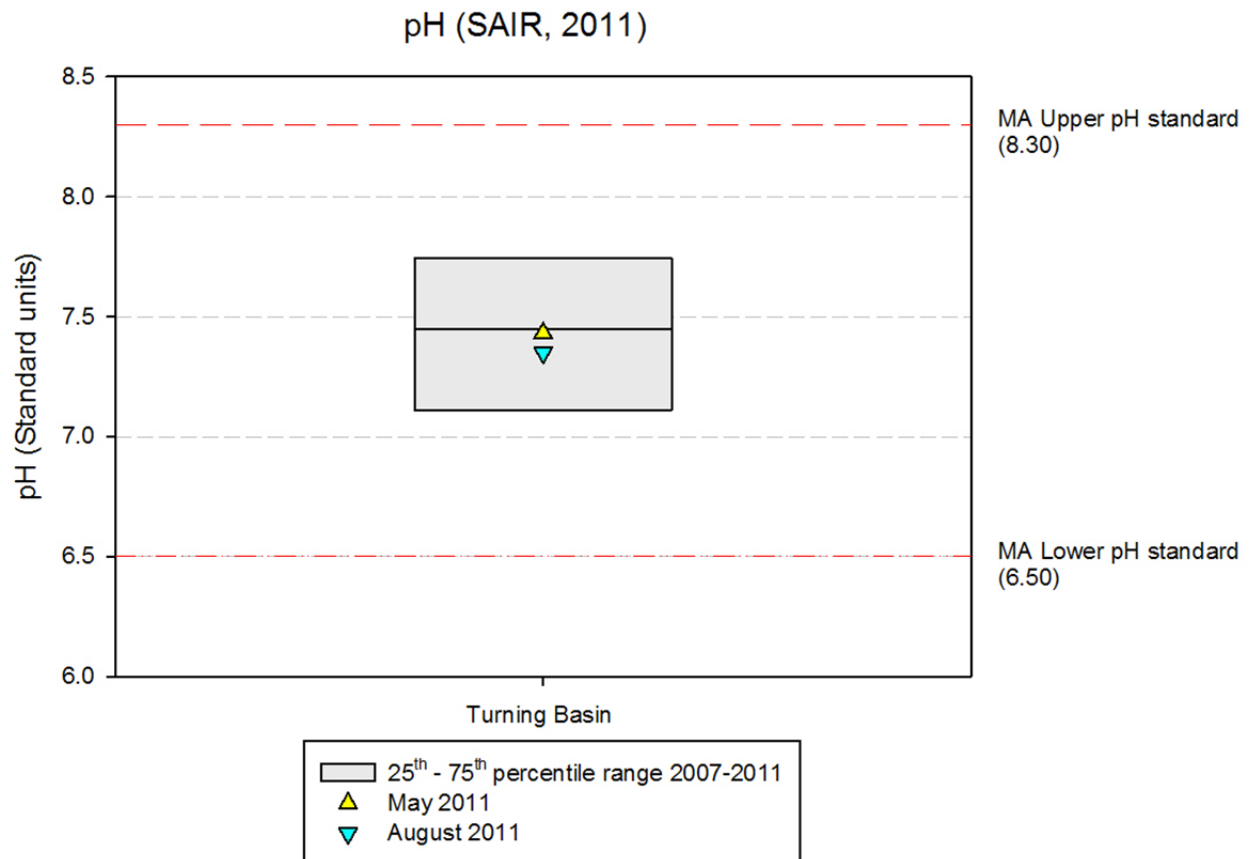


Figure 4. pH from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2007-2011.

Temperature

Temperature can affect water chemistry and biology. For example, the amount of oxygen that water can hold is directly related to the temperature of the water. The higher the temperature, the less oxygen water can hold, which can be observed in both diel (day and night) and seasonal shifts. Oxygen will naturally decline during the summer months as water temperatures rise. Temperature can also determine the kinds of plants and animals found in the lake or pond. Certain species of fish, insects, and algae will predominate during the cooler temperatures of the spring and fall, yet be less apparent during the warmer temperatures of summer. Surface water temperatures (Figure 5) appeared to be within the normal range of variability in 2011.

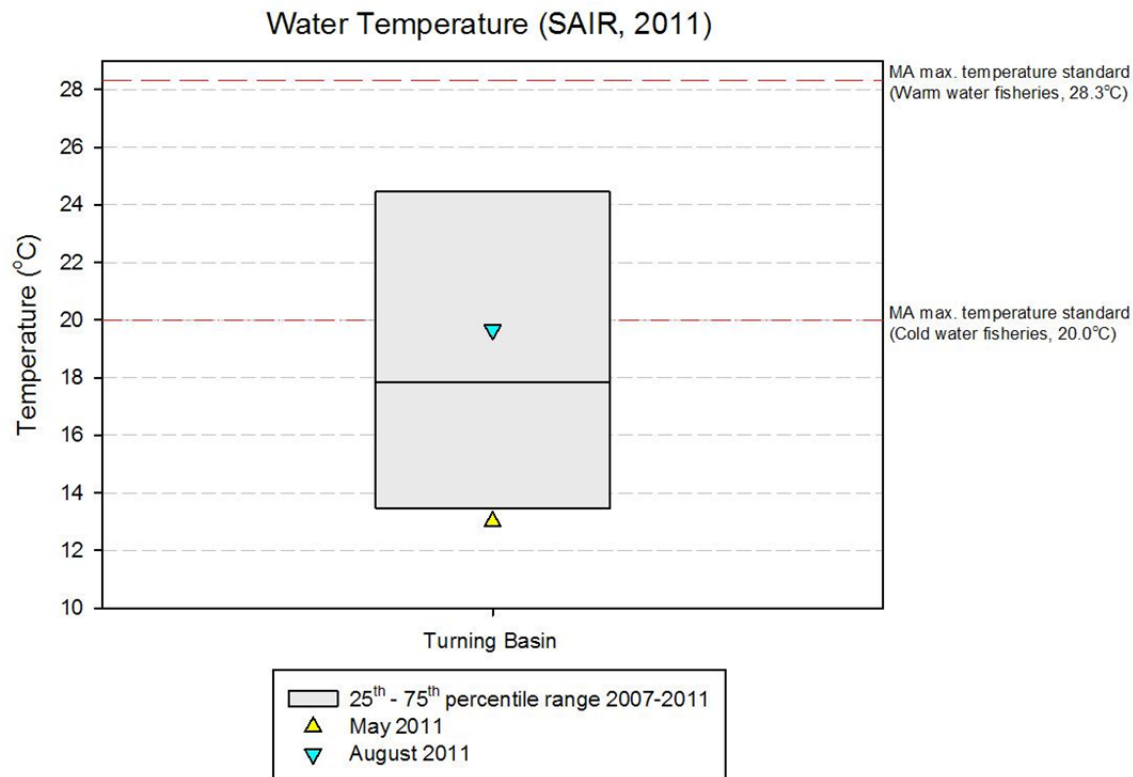


Figure 5. Water temperature (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2007-2011.

Dissolved Oxygen

Dissolved oxygen is a critical indicator of water quality because aquatic life generally needs it in concentrations at or above 5 mg/L to thrive. Low oxygen can directly kill or stress organisms such that they will not be able to successfully reproduce or grow. Water with less than 1 part per million (ppm) of oxygen is considered anoxic (no oxygen present). Both SAIR DO measurements in 2011 (Figure 6) were well above the more stringent (6 mg/L) state stream DO standard.

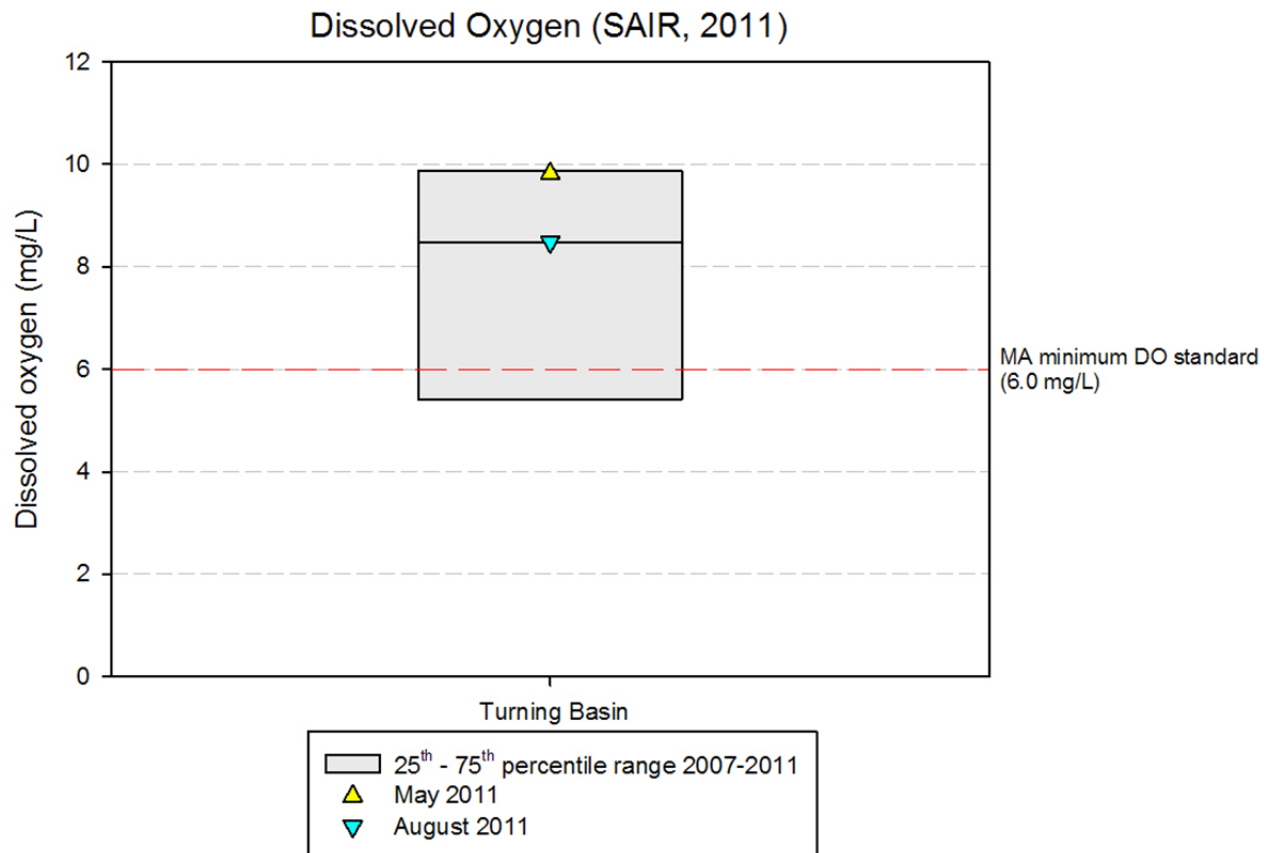


Figure 6. Dissolved oxygen (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2007-2011.

Acid Neutralizing Capacity

Acid neutralizing capacity (ANC) is also known as alkalinity, or buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. Most states do not have numerical criteria for ANC in their water-quality standards. ANC values greater than 100 $\mu\text{eq/L}$ are considered well-buffered, while values less than zero typify acidic waters (Stoddard et al. 2003). Acid neutralizing capacity measured in the 2011 samples (Figure 7) illustrates that the SAIR waters were well-buffered, likely due to the underlying geology. The May 2011 ANC measurements follow the typical seasonal pattern of being lower than the August values. This is likely due to the contribution of episodic acidification from spring snowmelt and runoff (and also illustrates the ability of the robust ANC to counteract the acidification pulses).

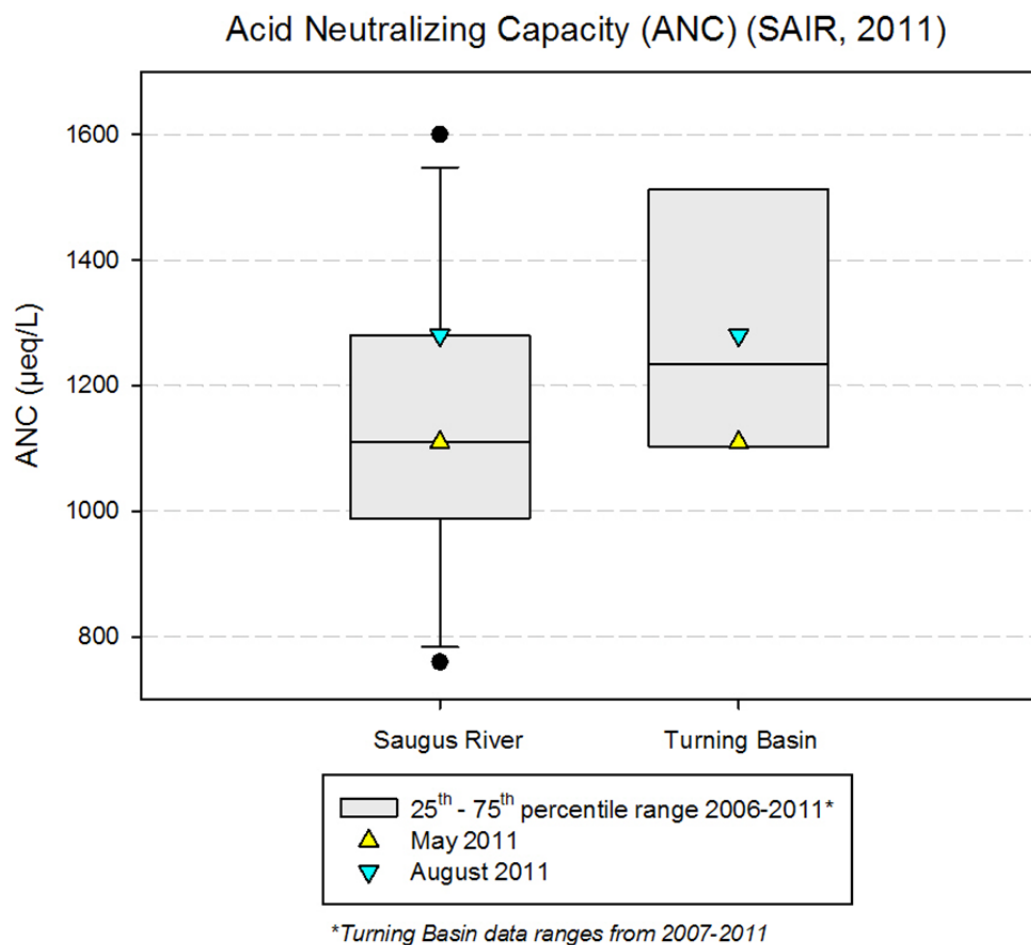


Figure 7. Acid neutralizing capacity from 2011 May and August water samples overlaid on a box plot of measurements taken from 2006-2011 (Saugus River) and 2007-2011 (Turning Basin).

Apparent Color

Color in pond and stream water is caused by natural metallic ions, humus and peat materials, plankton, weeds, and industrial wastes. Color is reported in Pt-Co units (PCU). True color is the color measurement of water from which suspended particles have been removed by filtration. Apparent color (the measurement method utilized by NETN) is determined on original samples without filtration. Color can be a rough indicator for organic acidity.

Water bodies with apparent color values of greater than 25 PCU are considered to be highly colored, and often exhibit reduced water clarity and high phosphorus concentrations. Values of color are usually not included in water quality standards, except to note that they should be as naturally occurs.

Color values from both sites were high in all 2011 samples (Figure 8). Saugus River historic measurements were more variable. This could be the effect of runoff and sediment input to the river, rather than dissolved constituents, since the samples were not filtered before analysis. Field turbidity measurements, which will begin in 2012, may provide additional information on the impacts to SAIR streams from episodic runoff events.

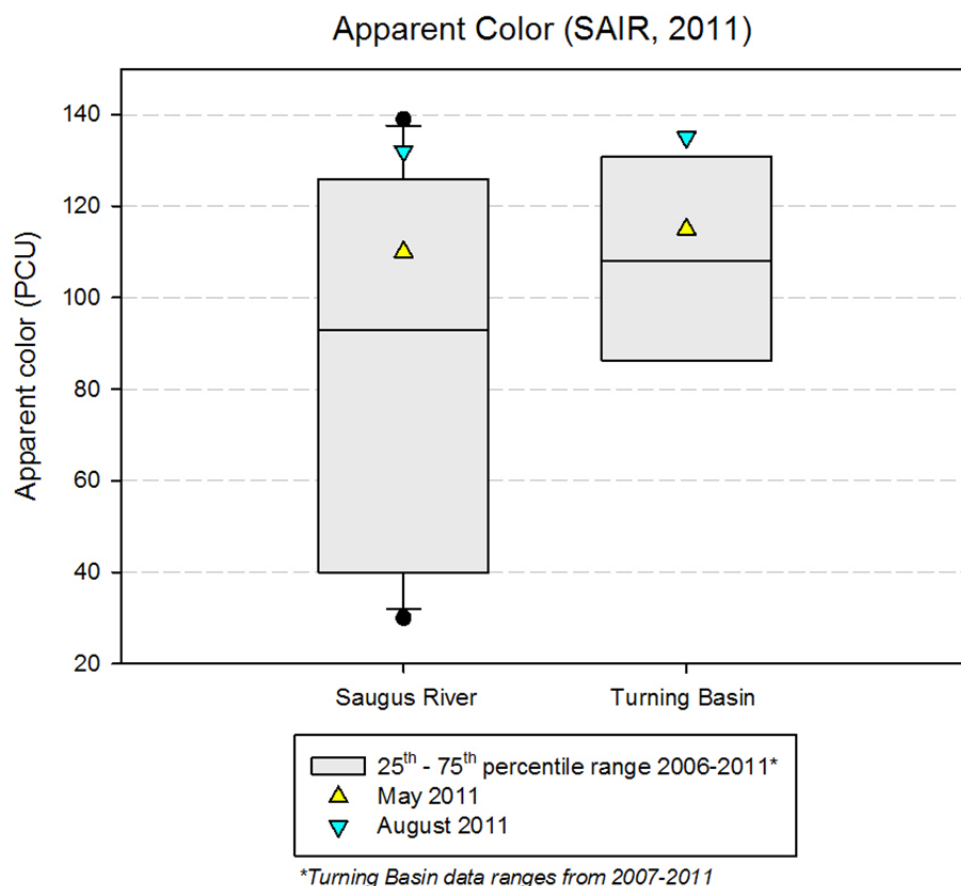


Figure 8. Apparent color from 2011 May and August water samples overlaid on a box plot of measurements taken from 2006-2011 (Saugus River) and 2007-2011 (Turning Basin).

Nutrient Enrichment

Nutrient enrichment and the acceleration of eutrophication have been identified in most NETN parks as one of the stressors of greatest concern. Several forms of total and dissolved phosphorus and nitrogen are measured to give managers information regarding the trophic status and productivity of freshwater systems.

Phosphorus

Phosphorus (P) is one of the major nutrients needed for plant growth. It is generally present in small amounts and limits the plant growth in streams and ponds. Several forms of phosphorus were tested individually. Total phosphorus (TP) is a measure of both inorganic and organic forms of phosphorus, and is the common water quality standard or criteria metric. Phosphorus can be present as dissolved or particulate matter, and filtered samples were analyzed for total dissolved phosphorus (TDP). Soluble reactive phosphorus (SRP, or “orthophosphate”) is a measure of the inorganic oxidized form of soluble phosphorus. This form of phosphorus is the most readily available for uptake during photosynthesis. High concentrations of SRP generally occur in conjunction with algal blooms.

In 2011, total phosphorus concentrations (Figure 9) were moderately high, and all values were above the EPA Ecoregion 14 criteria of 31.25 $\mu\text{g/L}$ for streams. As described above (“Water Quality Standards”), the EPA criteria do not have any regulatory meaning. TDP levels were in the moderate range, and SRP was generally low.

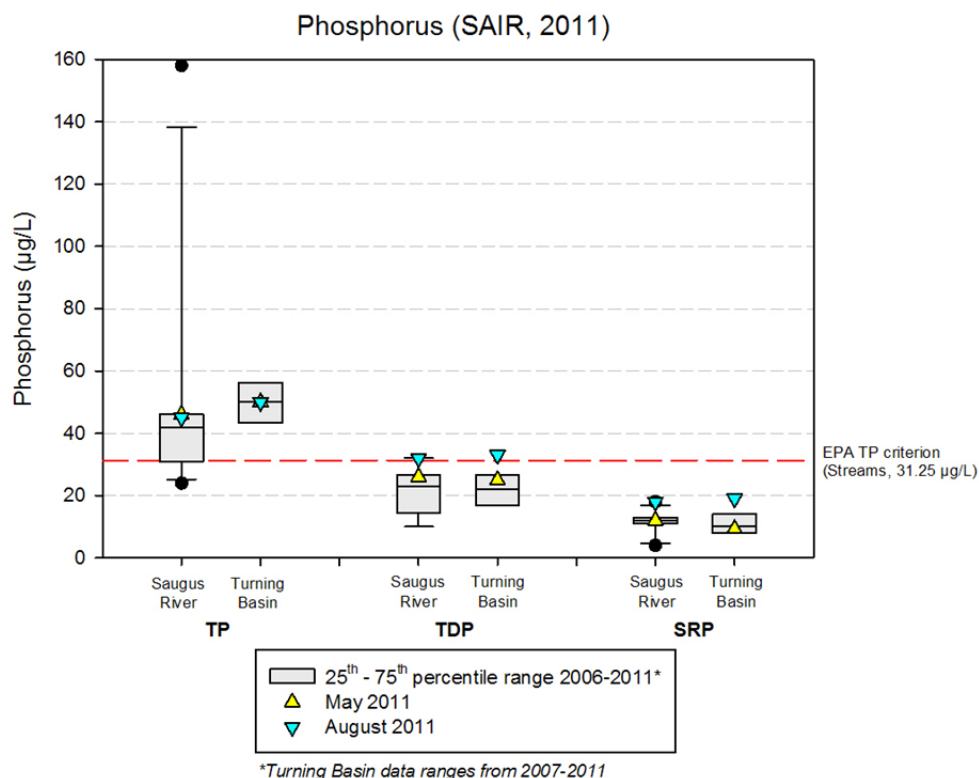


Figure 9. Total phosphorus (TP), total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP) from May and August water samples. The data are overlaid on a box plot of measurements taken from 2006-2011 (Saugus River) and 2007-2011 (Turning Basin). There is no numeric Massachusetts state water quality TP standard.

Nitrogen

Total nitrogen (TN) is a measure of all forms of nitrogen (organic and inorganic). Nitrogen is an essential plant element and is often the limiting nutrient in marine waters, and it can also limit some freshwater systems. Filtered samples were analyzed for total dissolved nitrogen (TDN). The importance of nitrogen in the aquatic environment varies according to the relative amounts of the forms of nitrogen present, including nitrate, nitrite, and ammonia.

Test results for several forms of nitrogen are shown in Figure 10. All 2011 TN and TDN measurements were below 2.0 mg/L, the value used as a TN standard in several northeast states (Massachusetts has no numeric TN standard). TN values slightly exceeded the EPA Ecoregion 14 criterion of 0.71 mg/L, although as with TP this criterion does not have regulatory meaning. Nitrate (NO_3) is the most oxidized and stable form of nitrogen in a water body, and is the primary form of nitrogen used by plants as a nutrient. Nitrite (NO_2) is an unstable form of nitrogen that is either rapidly oxidized to nitrate (nitrification) or reduced to nitrogen gas (denitrification). This form of nitrogen can also be used as a source of nutrients for plants. NETN water samples were analyzed with a combined test for nitrate and nitrite, and results were relatively low. Nitrite concentrations were very low, and 2011 ammonia (NH_3 , another inorganic, bioavailable form of concern) test results were also very low, with May values below the method reporting limit of 0.08 mg/L.

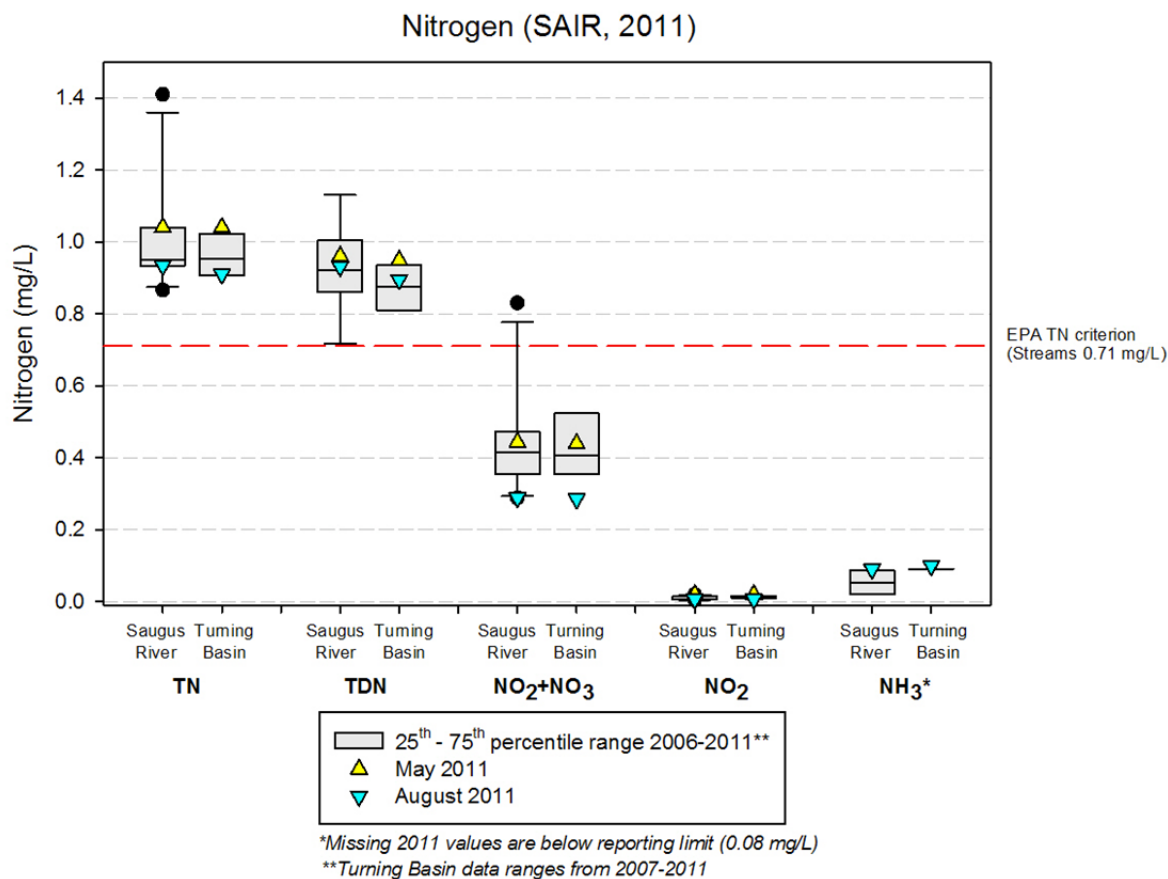


Figure 10. Total nitrogen (TN), total dissolved nitrogen (TDN), nitrite + nitrate ($\text{NO}_2 + \text{NO}_3$), nitrite (NO_2), and ammonia (NH_3) from 2011 May and August water samples. The data are overlaid on a box plot of measurements taken from 2006-2011 (Saugus River) and 2007-2011 (Turning Basin).

Water Quantity

Stream discharge measurements can be used to calculate loading of nutrient chemical constituents (flow times concentration), and also provide a record of variations in stream flow. Mean daily discharge values from dates from 2006 to 2011 in which water chemistry measurements were made are listed in Table A3 in Appendix A.

Streamflow in 2011 (Figure 11) followed the expected seasonal sequence of high discharge in the spring to minimal flow in July and August, with recovery in September and October. NETN staff are currently reviewing discharge and stage measurement methodology and quality assurance/quality control procedures in order to enhance the quality and utility of the water quantity data. It is recommended that stage (water level) measurements should be taken in the Turning Basin to document changes over time and to develop a relationship between Turning Basin stage and the discharge measurements from the USGS gage.

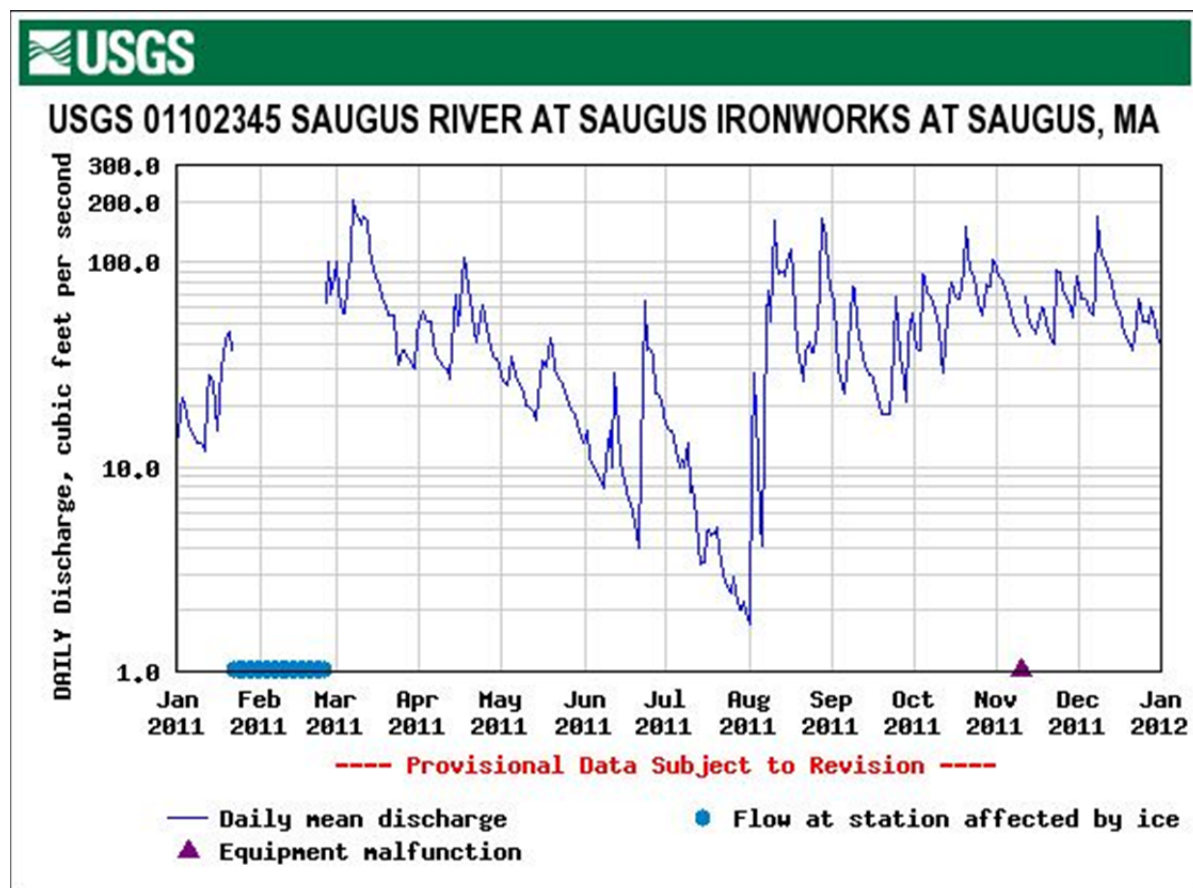


Figure 11. 2011 stream discharge from U.S. Geological Survey continuous-record streamflow-gage on the Saugus River.

Invasive Aquatic Plants

Invasive aquatic plant monitoring was not conducted at SAIR during the 2011 monitoring season, since the protocol specifies that targeted invasive aquatic plant monitoring is only conducted at pond and lake sites. However, during future visits to all NETN parks, monitoring crews will be increasingly attentive for the presence of Didymo (*Didymosphenia geminata*), also known as “rock snot,” a highly invasive alga that has recently invaded the northern reaches of the Connecticut River in New Hampshire and in the White River and Battenkill River in Vermont. This species has a great potential to alter habitats and displace native species, and is of great concern to officials in regions where infestations have been established.

Didymo is easily spread by even just one cell of the alga breaking off and drifting downstream in infested reaches. It is also very easily spread by waders, and potentially, water monitoring equipment and other gear that touches the bottoms of streams in infested areas. Enhanced equipment cleaning and decontamination procedures are being included in the latest NETN monitoring protocol revision.

The early detection of an invasive plant infestation can make eradication or control more feasible, and it can lead to efforts that reduce the spread of the plant to neighboring water bodies. Designating the early detection of these plants as a NETN vital sign and the ongoing partnership with state and local monitoring and eradication efforts are highly effective prevention strategies.

Summary

All 2011 water quality parameters monitored in Saugus Iron Works National Historic Site are within state standards, where applicable, and slightly above the EPA Ecoregion 14 nutrient criteria. The majority of values are within the ranges of the historic NETN monitoring data from SAIR.

Phosphorus concentrations were in the moderate to high range, indicating that some nutrient enrichment is occurring at SAIR. ANC measurements showed that all sites were very well-buffered, sufficient to avoid severely depressed pH values from episodic acid deposition. Test results for TN, TDN, and NO₃ were moderate in most 2011 samples. Results for NO₂ and NH₃ were low, with several NH₃ test results below the method reporting limit of 0.08 mg/L.

It is recommended that in-situ water quality sonde measurements be taken at both SAIR sites in future monitoring. Two extremely high specific conductance data points from the Turning Basin (August 2009 and 2010) that had no corresponding high values in the USGS conductance data from the Saugus River suggest that there are unique water quality influences and characteristics at each site, despite their close physical proximity. Tidal influence is clear from observations of park staff (National Park Service, Marc Albert, SAIR Resource manager, pers. comm., 13 June 2012), and is borne out in the Turning Basin monitoring report (CH2MHill 2011). A second recommendation is the establishment of a stage datum point (or installation of an automated water level logger) at the Turning Basin to enable a better understanding on the relationship between Turning Basin water levels and the discharge measurements from the USGS gage.

Monitoring under the NETN protocol builds on the historic water quality monitoring by park staff and other agencies to provide critical baseline information on the chemical and physical

status of the water resources Saugus Iron Works National Historic Site. Several changes will be implemented in the 2012 monitoring season, including taking monthly stream turbidity measurements, and the addition of sulfate, chloride, and dissolved organic carbon (DOC) analyses to the May and August water chemistry testing. These changes will expand the scope and usefulness of the monitoring data. As more data are collected, the ability to detect changes outside this natural range of variability will increase, which in turn will more clearly indicate the status of the vital signs of water quality, nutrient enrichment, water quantity, and the detection of invasive plant species.

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Appendix A. Saugus Iron Works National Historic Site (SAIR) Water Monitoring Data, 2006-2011.

Table A1. YSI sonde in-situ water quality measurements collected at SAIR.

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Specific Conductance (µS/cm)
Turning Basin	5/7/2007	0.74	12.03	9.88	6.99	826
Turning Basin	8/13/2007	0.21	15.99	8.13	7.89	1,174
Turning Basin	5/19/2008	0.49	14.86	10.37	7.64	649
Turning Basin	8/20/2008	1.19	18.22	7.73	7.44	639
Turning Basin	5/8/2009	0.91	14.73	9.38	7.42	641
Turning Basin	8/20/2009	0.79	26.67	0.72	7.03	26,801
Turning Basin	5/24/2010	0.21	22.22	9.27	7.95	611
Turning Basin	5/24/2010	0.55	21.47	8.48	7.78	617
Turning Basin	8/10/2010	0.47	25.45	4.50	7.46	35,588
Turning Basin	5/23/2011	0.31	13.00	9.82	7.43	664
Turning Basin	8/24/2011	0.61	19.66	8.48	7.35	609

Appendix A. Saugus Iron Works National Historic Site (SAIR) Water Monitoring Data, 2006-2011 (continued).

Table A2. Laboratory nutrient chemistry data for SAIR. “<MRL” indicates the result was below the method reporting limit (provided after the abbreviation). *Missing values indicate data are unavailable.*

Site	Date	ANC (µeq/L)	Apparent Color (PCU)	TP (µg/L)	TDP (µg/L)	SRP (µg/L)	TN (mg/L)	TDN (mg/L)	NO2+NO3 (mg/L)	NO2 (mg/L)	NH3 (mg/L)
Saugus River	8/21/2006	760.0	40	42		13	0.950		0.458	0.004	0.017
Saugus River	6/12/2006	880.0	60	30		12	0.910		0.315	0.009	0.025
Saugus River	5/7/2007	987.5	40	24	10	4	0.940	0.880	0.473	0.006	<MRL 0.02
Saugus River	8/13/2007	1,336.6	30	31	14	11	1.160	1.130	0.830	0.005	0.021
Saugus River	5/19/2008	1,092.0	85	38	15	8	0.939	0.717	0.379	0.014	
Saugus River	8/20/2008	1,270.0	126	45	23	12	0.970	0.839	0.415	<MRL 0.005	<MRL 0.08
Saugus River	8/20/2009	1,600.0	139	158	27	12	1.410	1.050	0.565	0.005	0.086
Saugus River	5/8/2009	1,100.0	109	41	21	12	0.866	0.920	0.387	0.011	<MRL 0.08
Saugus River	5/24/2010	1,200.0	93	59	25	13	1.030	0.888	0.353	0.016	0.080
Saugus River	8/24/2011	1,280.0	132	45	32	18	0.934	0.931	0.288	0.006	<MRL 0.08
Saugus River	5/23/2011	1,110.0	110	46	26	12	1.040	0.960	0.443	0.019	0.090
Turning Basin	5/19/2008	1,098.0	85	39	14	8	0.946	0.542	0.391	0.014	
Turning Basin	8/20/2008	1,280.0	195	51	23	14	0.960	0.884	0.410	<MRL 0.005	<MRL 0.08
Turning Basin	5/8/2009	1,100.0	118	44	19	8	0.906	0.869	0.401	0.011	0.080
Turning Basin	8/20/2009	1,590.0	101	58	27	14	1.090	1.040	0.586	<MRL 0.005	<MRL 0.08
Turning Basin	5/24/2010	1,190.0	90	43	21	11	0.904	0.854	0.341	0.015	<MRL 0.08
Turning Basin	8/10/2010	1,640.0	85	59	16	7	0.969	0.796	0.551	0.015	<MRL 0.08
Turning Basin	8/24/2011	1,280.0	135	50	33	19	0.910	0.895	0.285	0.006	<MRL 0.08
Turning Basin	5/23/2011	1,110.0	115	50	25	9	1.040	0.949	0.439	0.019	0.100

Table A3. Mean daily stream discharge data for water monitoring visit days at SAIR. *Complete data available from USGS at http://waterdata.usgs.gov/ma/nwis/uv/?site_no=01102345&agency_cd=USGS.*

Site	Date	Discharge (cfs)
Saugus River	6/12/2006	133.00
Saugus River	8/21/2006	11.00
Saugus River	5/7/2007	41.00
Saugus River	8/13/2007	5.60
Saugus River	5/19/2008	20.00
Saugus River	8/20/2008	26.00
Saugus River	5/8/2009	36.00
Saugus River	8/20/2009	5.70
Saugus River	5/24/2010	20.00
Saugus River	8/10/2010	0.72
Saugus River	5/23/2011	26.00
Saugus River	8/24/2011	36.00

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Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

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