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Water Quality Monitoring Update

Results of the 2012 Water Quality Monitoring Season for Saugus Iron Works NHS

Background

The Northeast Temperate Network (NETN) monitors a variety of natural resource indicators, which it calls “vital signs”, for 12 parks in the northeast and the Appalachian National Scenic Trail. The vital signs for freshwater bodies are water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species. These 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.

Methods

Detailed descriptions of all monitoring methods can be found in NETN’s Freshwater Monitoring protocol available for download from the network’s website. Two stream sites are sampled twice annually in May and August. In 2012, NETN hydrologic technician Brian Schuetz measured physical and in-situ water chemistry parameters and collected water samples for analysis at the University of Maine. All monitoring data are incorporated into a series of comprehensive databases that feed into an EPA data system.

The Saugus River site is at the U.S. Geological Survey continuous-record streamflow-gage site just upstream of the park boundary 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. The Saugus River is classified as a warm water fishery, capable of supporting bass, pickerel, sunfish, and similar species. The second sample site is located at the Turning Basin. 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-time 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. See NETN’s Google Earth park module for locations of monitoring sites.

Sampling measurements include pH, specific conductance, temperature, dissolved oxygen, and weather. Stream flow and stage are not collected during sampling events because a USGS gage provides continuous stream flow data. Water samples obtained from grab samples in May and August were analyzed for acid neutralizing capacity, color, and nutrients.

Results and Findings

Complete details of 2012 monitoring season findings can be found in the full report which is available for downloading from the website. Brief synopses of some findings are available below.

Specific conductance measures the ability of water to carry an electrical current. If it increases it can be an indicator of pollutants in the water. Specific conductance values from 2012 were within the appropriate range for moderate ionic strength waters, and were the lowest measurements in the history of NETN monitoring there.

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 2012 monitoring season were slightly basic, and were between the upper and lower state water quality standards.

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 it can hold. Temperature can also determine the kinds of plants and animals found in a lake or pond. Certain species of fish, insects, and algae will predominate during the cooler temperatures of spring and fall, yet be less apparent during the warmer temperatures of



The iron works buildings and restored Turning Basin. Bill Gawley photo.

summer. Surface water temperatures appeared to be within the normal range of variability in 2012, and were below the state maximum temperature standard for warm water fisheries.

Dissolved oxygen (DO) is a critical indicator of water quality because aquatic life generally needs certain concentrations to thrive. Low oxygen can directly kill or stress organisms such that they will not be able to successfully reproduce or grow. All 2012 measurements were above the stringent state stream DO standard.

Color in pond and stream water is caused by natural metallic ions, humus and peat materials, plankton, weeds, and industrial wastes. **Apparent color** is determined using water samples that have not had suspended particles filtered out. Color can be a rough indicator for organic acidity. Color values from both sites were high in 2012. The May sample from the Turning Basin was accidentally mishandled by laboratory personnel, resulting in insufficient volume for analysis.

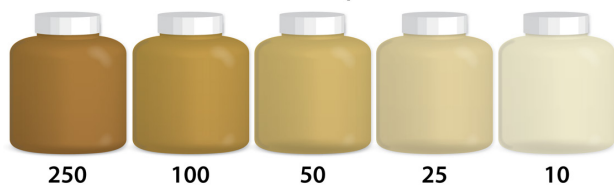
Acid neutralizing capacity (ANC) is also known as alkalinity, or buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. Acid neutralizing capacity measured in the 2012 samples illustrates that park waters were well-buffered, likely due to the underlying geology, although the August values were the lowest recorded to date.

NETN began measuring **dissolved organic carbon (DOC)** for the first time in 2012. Carbon is a nutrient required for biological processes. Sources of organic carbon in water include humic substances from plant and soil organic matter, wetland peat deposits, and atmospheric deposition. Certain forms of DOC can contribute to “tea” color in water, which can affect light penetration. It also affects the transport (solubility and bioavailability) of metals, including mercury, in aquatic systems. Park DOC concentrations were moderate in 2012, reflecting the surrounding marsh and wetland systems. The values were within the range of the monitoring results from USGS studies from 1994-2004 cited in the park’s Natural Resources Condition Assessment.

This was also the first year of turbidity testing for network waters. **Turbidity** is the measure of the relative clarity of a liquid. It is measured by passing light through a water sample to determine how much light is scattered, and the results are reported in nephelometric turbidity units (NTU). Turbidity is caused by suspended matter or impurities that interfere with the clarity of water. These impurities may include clay, silt, finely divided inorganic and organic matter, soluble colored organic compounds, and plankton and other microscopic organisms. Turbidity can create aesthetic, ecological, and health issues, and could be an indication of runoff from construction, roads, agriculture, or other types of pollution. Suspended

Turbidity (NTU)

Water Samples:



Samples of different turbidity levels.

solids prevent sunlight from reaching aquatic plants, inhibiting photosynthesis which may reduce the amount of dissolved oxygen in the water. Sediment also absorbs heat, so turbidity can raise the surface water temperature. Turbidity can make it hard for fish to see their prey, and heavy loads of suspended solids can even clog fish gills and filter-feeding structures of aquatic macroinvertebrates. Turbidity values measured in 2012 were all less than 5.5 NTU, in the low range of dry-weather turbidity of surface waters, which normally ranges from 0 to 10 NTU.

Summary

All 2012 water quality parameters monitored in Saugus Iron Works NHS were within state standards, where applicable, and slightly above EPA criteria. The majority of values were also within the ranges of historic park NETN monitoring data. Monitoring under the NETN protocol builds on the historic water quality monitoring by the National Park Service and other agencies to provide critical baseline information on the chemical and physical status of the water resources of the park. Several changes were implemented in the 2012 monitoring season, including taking monthly stream turbidity measurements, and the addition of sulfate, chloride, and dissolved organic carbon analyses to the May and August water chemistry testing. Test results for all of these new analytes were within the range of historic data collected by other agencies. The revised analytical parameters 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.

More Information

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Full Report online at:
<http://science.nature.nps.gov/im/units/netn/monitor/programs/lakesPonds/lakesPonds.cfm>



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