# Fish Creek Stream Monitoring 1999 – 2021

## Report Prepared for Town of Gibraltar

## 2022 Annual Meeting

*April 19, 2022*

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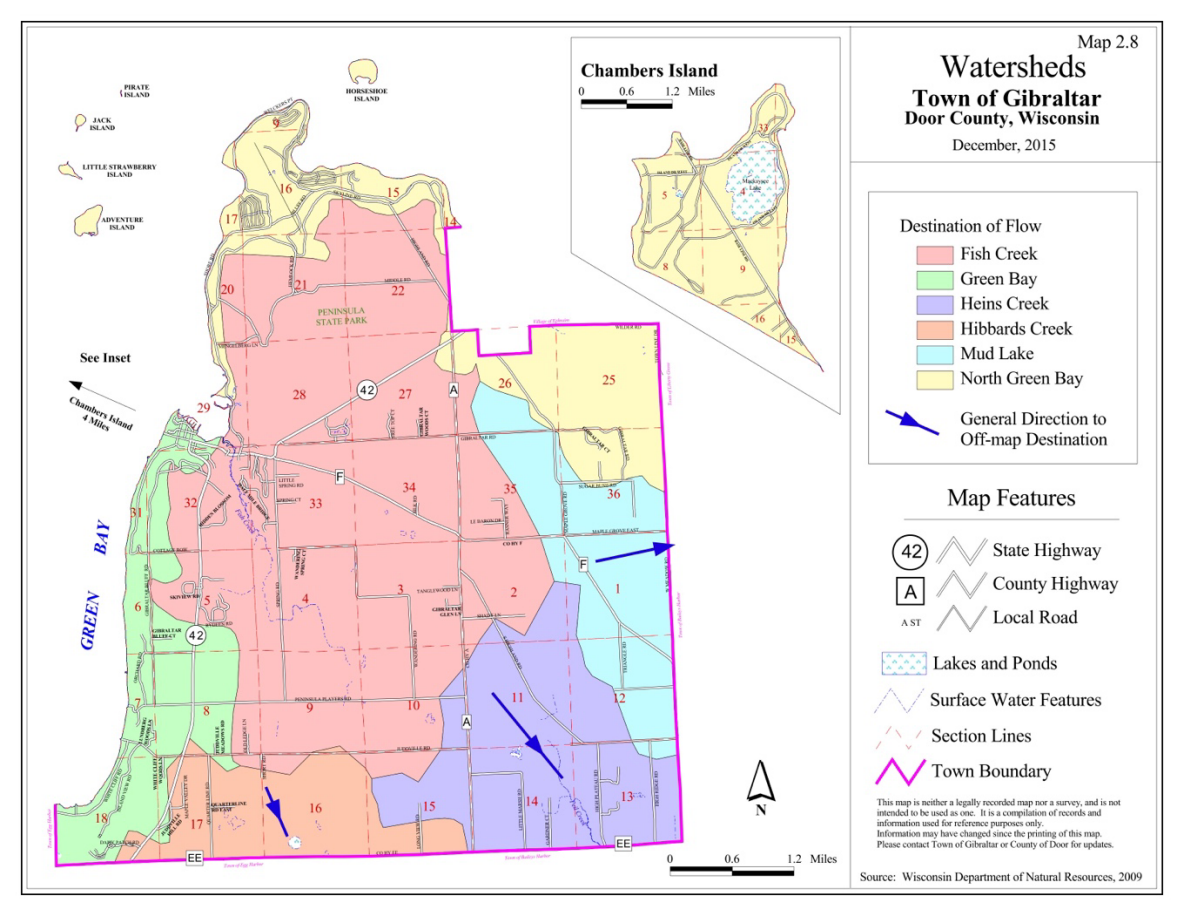
# INTRODUCTION

Since 1999 volunteers have been monitoring Fish Creek water quality at several locations downstream from its source to near where it flows into Fish Creek Harbor. The monitoring has included field tests of water temperature, dissolved oxygen, pH, and transparency. Samples have also been collected for laboratory testing of alkalinity, chlorides, ammonia, conductivity, nitrogen, phosphorus, as well as E. Coli and total coliforms. Since 2018, stream flows, stream habitat, and biotic index have been monitored. These physical, chemical, and biological characteristics provide measures of the safety and quality of the creek water, as well as its ability to support plant and animal life.

The Fish Creek monitoring program is administered by the Town of Gibraltar Plan Commission. The Town has provided financial support for the laboratory testing. Some key results from three test sites are highlighted in this summary. Results are compared with Wisconsin DNR limits where applicable.[1]

[1] The Wisconsin DNR sets criteria to address water quality of lakes, rivers, and streams (https://dnr.wisconsin.gov/topic/SurfaceWater/WQC.html). These criteria relate to both human and ecosystem health. They are established through the Wisconsin State Administrative Code. Surface waters are covered in ***Chapter NR 102 – Water Quality Standards for Wisconsin Surface Waters*** (https://docs.legis.wisconsin.gov/code/admin_code/nr/100/102).

# FISH CREEK




Fish Creek is several miles long, with a moderate gradient. Springs supply water to a wetland area that feeds the stream. The stream flows along the edge of the escarpment until it reaches a ponding area and then runs through the village of Fish Creek crossing Highway 42 before discharging into Fish Creek Harbor. Fish Creek supports spring spawning runs of suckers, and pike have also been found. Emergent plants include cattails, bluejoint grass, various sedges and rushes. (Surface Water Inventory of Door County, Dec. 2000)

# TEST SITES


Starting in 1999 seven sites along Fish Creek were monitored at varying times. Samples were taken in the creek at the headwaters in the south, at locations where the creek crosses Wandering Road and Spring Road, the pond behind the dam in Fish Creek, and immediately south of the culvert where Fish Creek crosses Highway 42. From 1999 to 2017, primary sampling was at the headwaters, the bridge near the pond, and near the culvert where Fish Creek crosses Highway 42

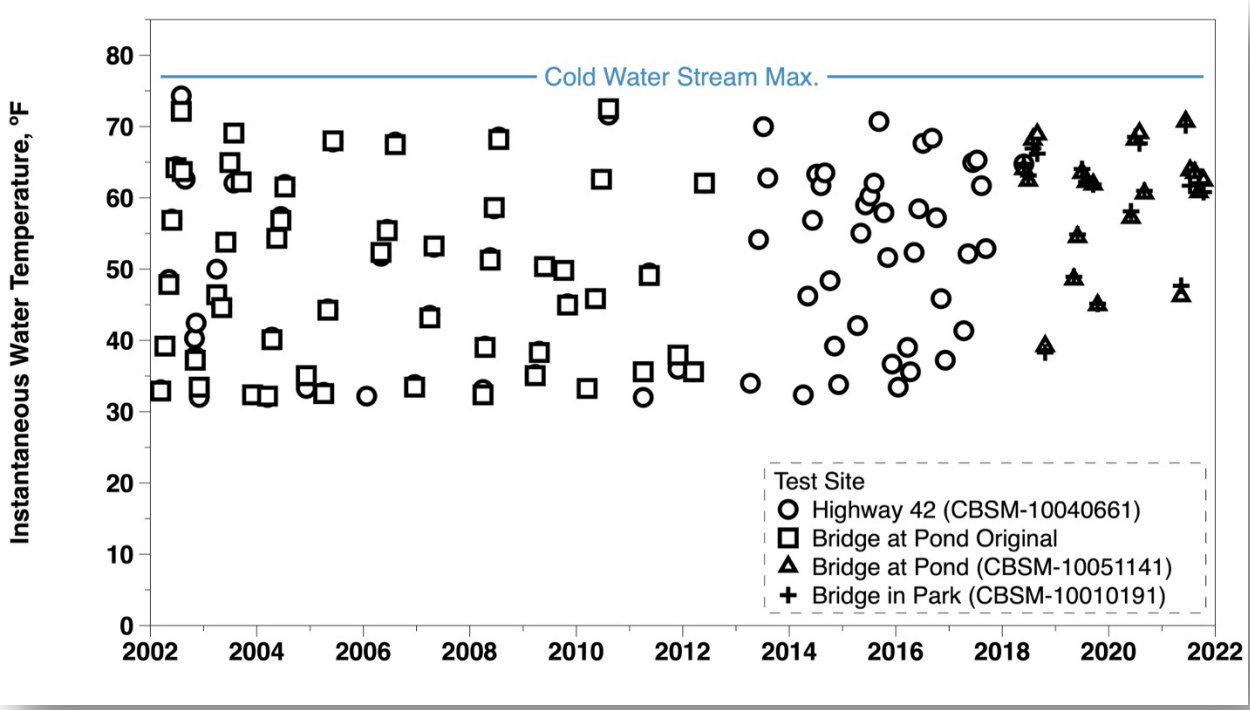
From 2013, data for the site where Fish Creek crosses Highway 42 have been entered into the Wisconsin DNR's Surface Water Integrated Monitoring System (SWIMS) database as part of the Water Action Volunteers (WAV)[2] program. The WAV Station ID for this site is CBSM-10040661.

[2] The Water Action Volunteers (WAV) citizen stream monitoring program is an ongoing partnership between the University of Wisconsin–Madison Division of Extension, the Wisconsin Department of Natural Resources (WDNR), and Wisconsin citizen volunteers (https://wateractionvolunteers.org). Fish Creek monitoring results are included in the WAV program database. More detailed information to help in understanding the test data is included in annual summary reports from the WAV program (https://wateractionvolunteers.org/data/station-data/?cnty=door).

Beginning in 2018 a new test site replaced the Highway 42 site. This was at a bridge in Fish Creek Town Park (CBSM-10010191). In addition, sampling was restarted at a bridge near the pond in Fish Creek and that site was given a WAV Station ID (CBSM-10051141). These sites were selected in conjunction with work on the Fish Creek Watershed Plan prepared by Nancy Turyk of the University of Wisconsin-Stevens Point in September 2017 (https://townofgibraltar.com/wp-content/uploads/2019/03/Fish-Creek-Watershed-Plan.pdf).

In this report, data from 1999 through 2012 for the site near the dam are identified as "**Bridge at Pond Original**" to distinguish the results from the same site starting in 2018 (CBSM-10051141). The photo below shows the pond behind the dam.

# WATER TEMPERATURES



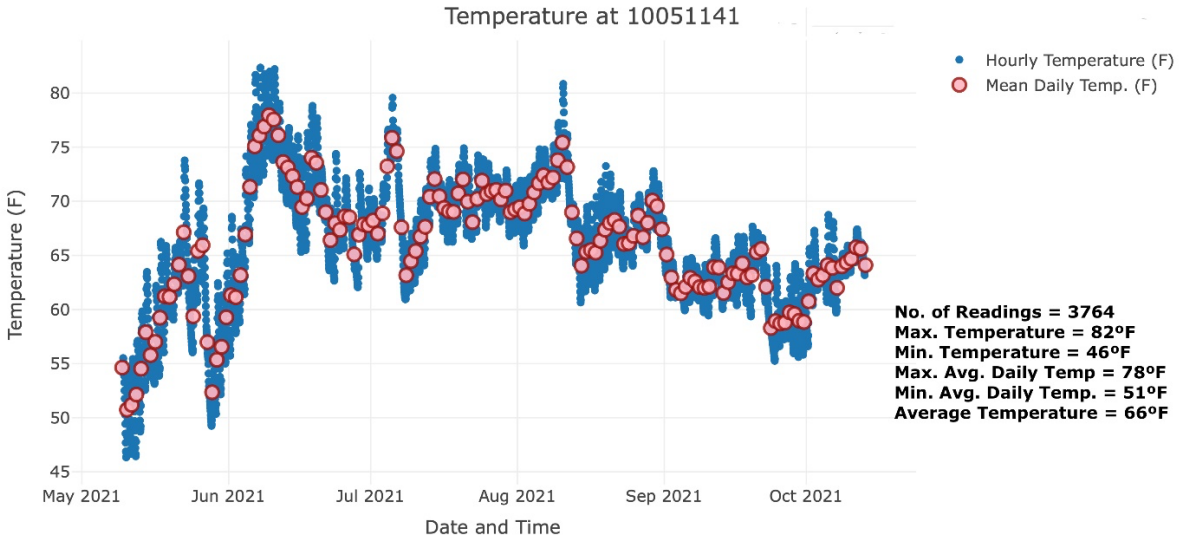

Water temperature impacts the types of fish and aquatic organisms that will survive in streams and creeks. For example, water temperatures in the 50 to 68ºF range are considered optimal for trout and larva of mayfly, stonefly, and caddisfly. Temperatures ranging from 68 to 86ºF are optimal for minnows, northern pike, and dragonfly larva. Higher temperatures also support greater plant growth. Water temperatures are seasonal in nature and are influenced by such factors as origin of the water, water depth, streamflow, vegetation, shading and solar heating. Temperature affects the maximum dissolved oxygen concentration of the water. Temperatures of Fish Creek water were measured during each site visit as shown in the figure above. Maximum and minimum instantaneous temperatures recorded at each site are as follows.

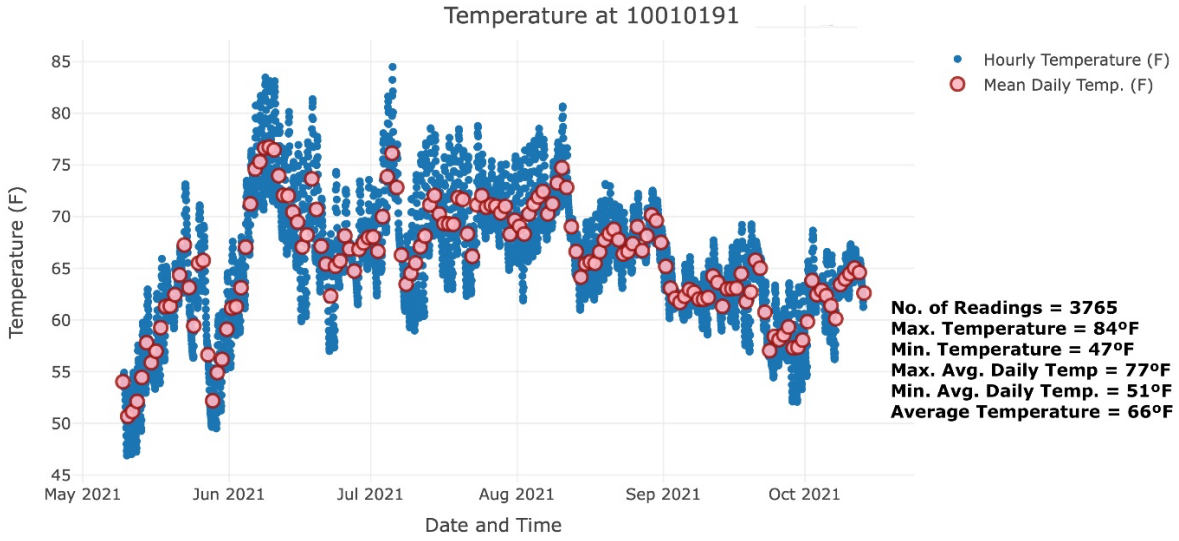
| | Max. Instantaneous Temperature | Min. Instantaneous Temperature |
|---|---|---|
| **Highway 42 (CBSM-10040661)**<br>2002 – 2018 (89 Readings) | 74 ºF | 32 ºF |
| | | |
| **Bridge at Pond (CBSM-10051141)**<br>2018 – 2021 (21 Readings)<br>2002 – 2012 (50 Readings) | <br>71 ºF<br>72 ºF | <br>39 ºF<br>32 ºF |
| | | |
| **Bridge in Park (CBSM-10010191)**<br>2018 – 2021 (21 Readings) | 70 ºF | 38 ºF |

The Wisconsin DNR uses the following classification for streams.

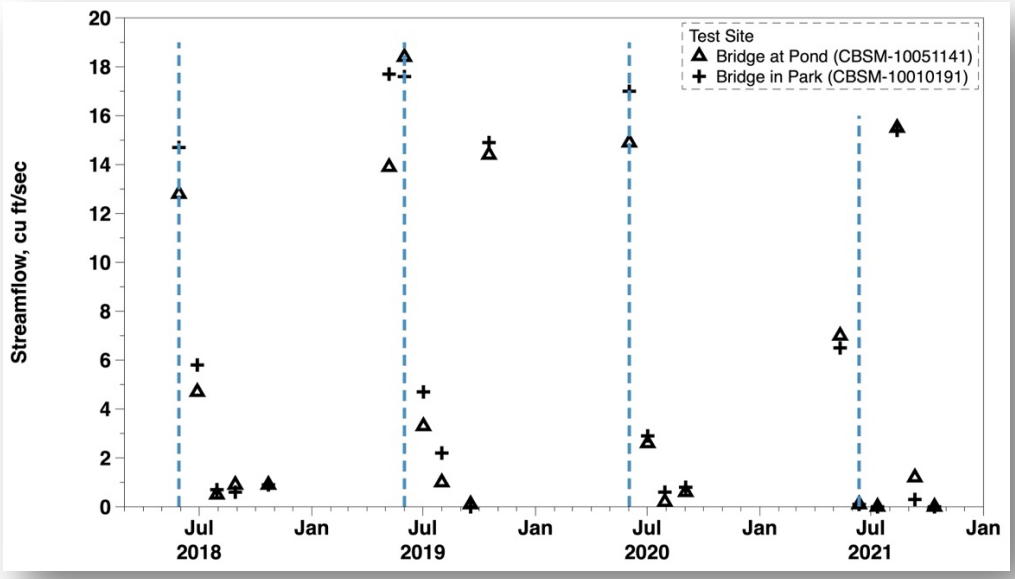
| | Max. Instantaneous Temperature | Max. Daily Mean Temperature |
|---|---|---|
| **Cold Water Stream** | < 77 ºF | < 72 ºF |
| **Cool Water Stream** | 77-82 ºF | 72-75 ºF |
| **Warm Water Stream** | > 82 ºF | > 75 ºF |

In addition to instantaneous readings taken by volunteers, as part of the WAV program, thermistors were installed in the creek at each site. These instruments record water temperatures at hourly intervals throughout the monitoring season. Temperatures recorded for 2021 at the site near the pond (CBSM-10051141) and the park (CBSM-10010191) are shown below.

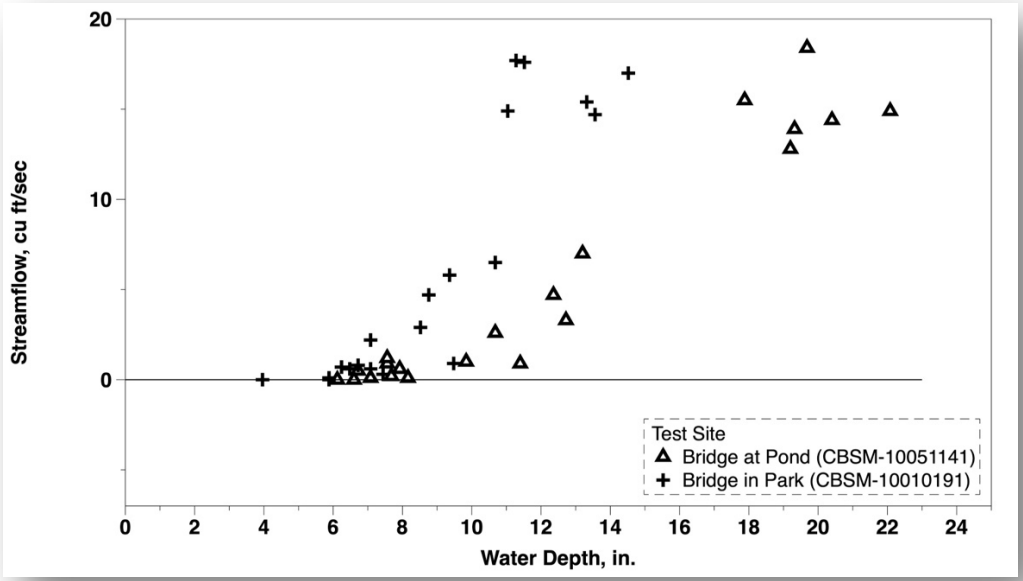


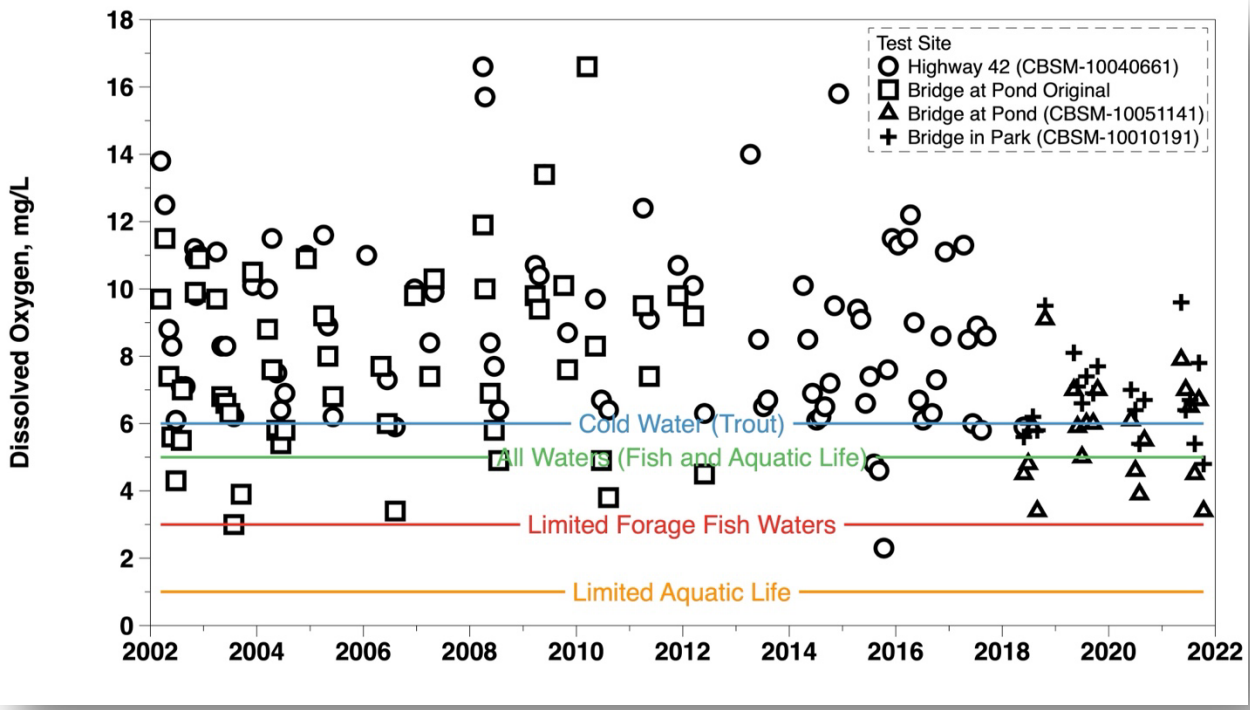
# STREAMFLOW




Since 2018, volunteers have monitored creek streamflow at the new test sites. Streamflow is the volume of water that passes through a cross section of the creek over a specific time (cubic feet of water per second). Flow data help in evaluating watershed hydrology, water quality, and habitat. Fish Creek flows tend to be highest in the spring and lowest in summer and fall, although significant rain events impact general trends. Streamflow is related to water depth (flows could not be measured at low depths).



# DISSOLVED OXYGEN



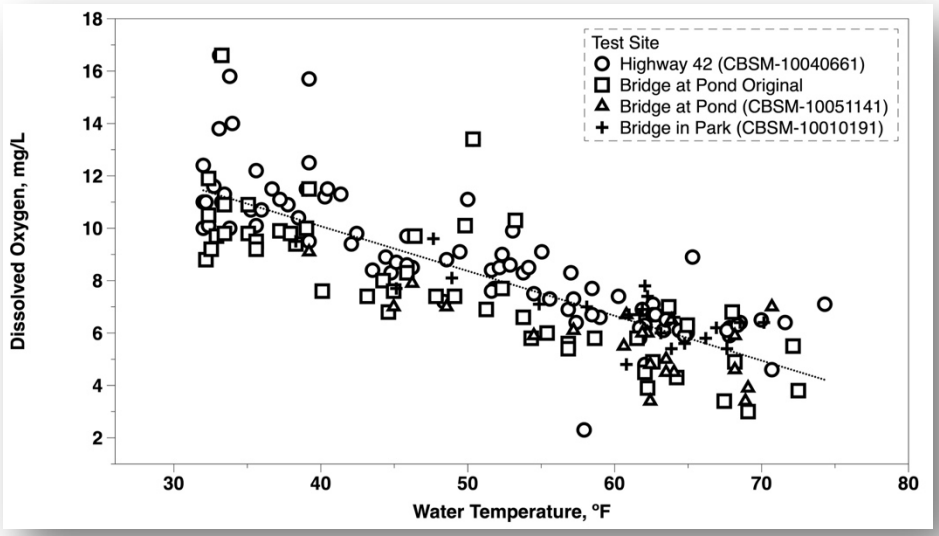

Dissolved oxygen (DO) in streams is essential for sustaining aquatic life. Oxygen is dissolved through mixing of air in turbulent waters or through photosynthesis of aquatic plants and algae. Rapidly flowing water generally has higher oxygen levels than stagnant water. Oxygen is depleted with demand from fish, macroinvertebrates, and plant decomposition. Bacteria in water can consume oxygen as organic matter decays. Thus, excess organic material can cause oxygen-deficient conditions. Aquatic life may not survive in water that has high levels of rotting, organic material in it, especially in summer, when dissolved-oxygen levels are at a seasonal low (https://www.usgs.gov/special-topics/water-science-school/science/dissolved-oxygen-and-water).

The figure above shows measured dissolved oxygen levels for the three test sites. It should be noted that creek measurements were made in early mornings when DO levels tend to be lower.

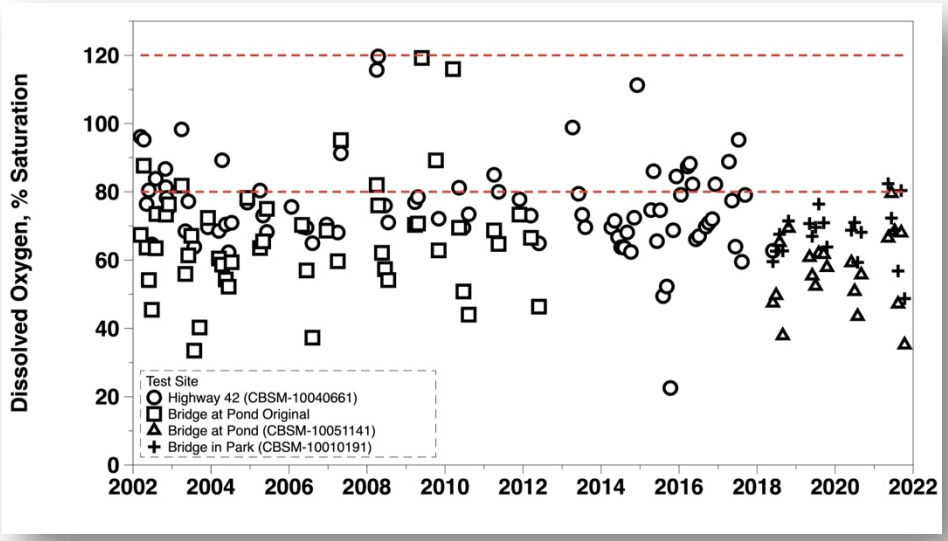
The Wisconsin DNR sets the following limits for the minimum amount of dissolved oxygen in streams.

| Stream Classification | Min. DO (mg/L) |
|---|---|
| Cold Water (Trout) | 7 (trout spawning)<br>6 (out of spawning) |
| All Waters (Fish and Aquatic Life) | 5 |
| Limited Forage Fish Waters | 3 |
| Limited Aquatic Life | 1 |

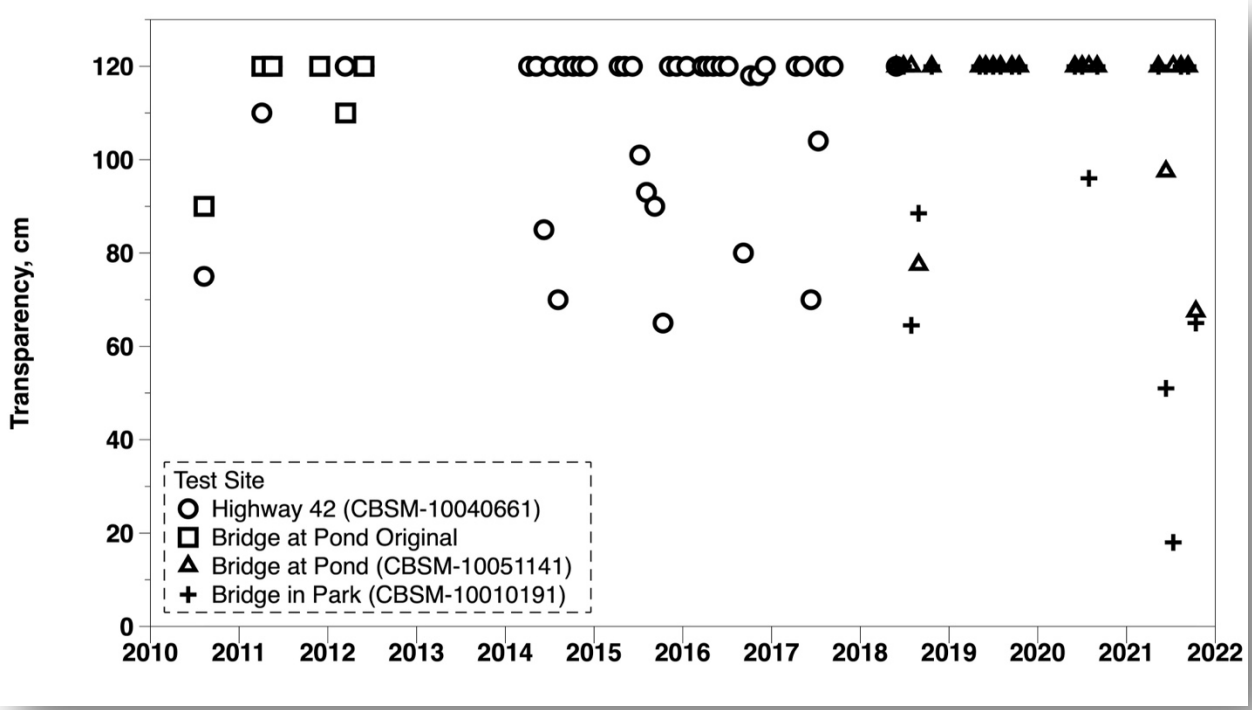
The amount of dissolved oxygen is impacted by the temperature of water. Colder water can hold more oxygen. Generally, when water temperatures are lower, dissolved oxygen levels are higher. And when water temperatures are higher, dissolved oxygen levels are lower.




Dissolved oxygen can be expressed in terms of saturation level where oxygen saturation is calculated as the percentage of dissolved oxygen concentration relative to that for water completely saturated at the temperature of the measurement. Saturation levels between 80 and 120% are considered representative of healthy waters. Saturation levels below about 50% are concerning. (https://wateractionvolunteers.org/files/2019/10/Dissolved-Oxygen-Methods.pdf). The following figure shows the measured dissolved oxygen values in terms of percent saturation referenced to measured water temperatures.



# TRANSPARENCY

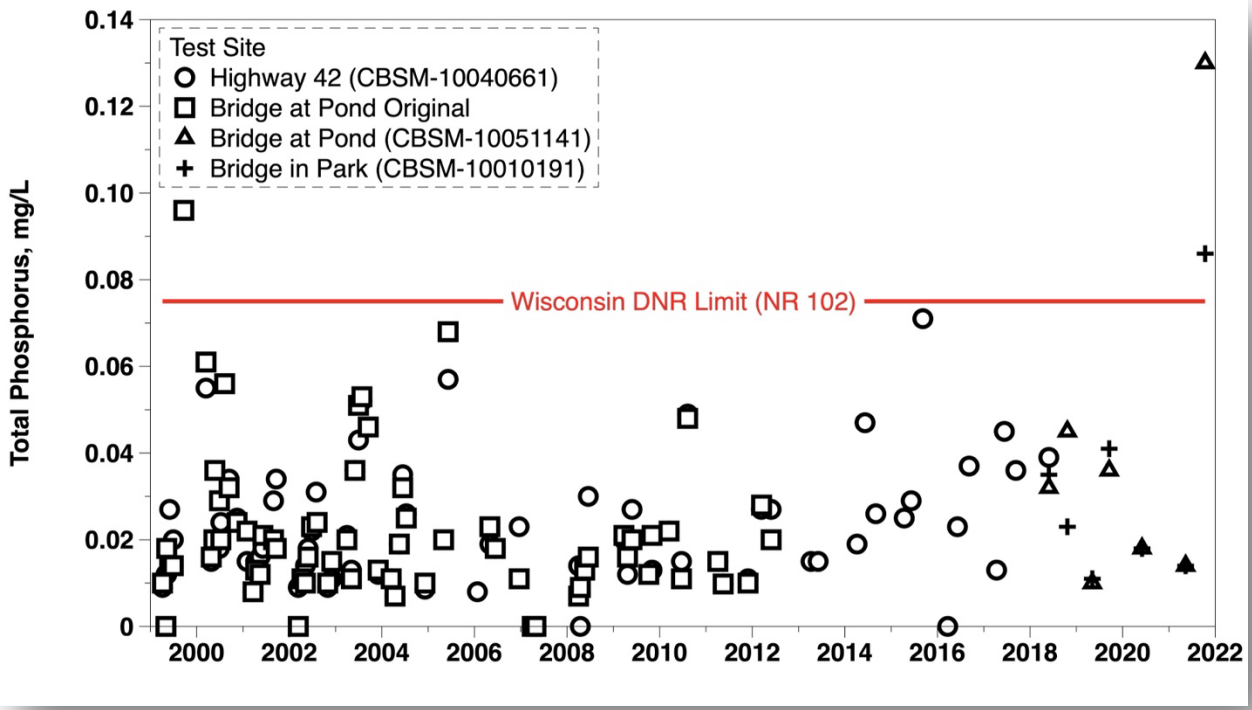



Transparency is an indicator of water clarity. It is measured by filling a 120 cm transparency tube with water from the creek and determining the maximum depth of water in the tube that permits visual contact with a secchi disk (target) on the bottom. Water with high levels of suspended particles, microscopic organisms, and dissolved substances will be less transparent. Transparency is related to turbidity, a property that is more difficult to measure. Thus, transparency is commonly used as a surrogate for turbidity.

C**lear** water does not necessarily mean **clean** water. For example, fecal coliform bacteria can be found in clear water. However, in general, clear water is indicative of good water quality that supports plant photosynthesis, and aquatic animal respiration and navigation.

Transparency values greater than about 60 cm are considered very good.

# TOTAL PHOSPHORUS

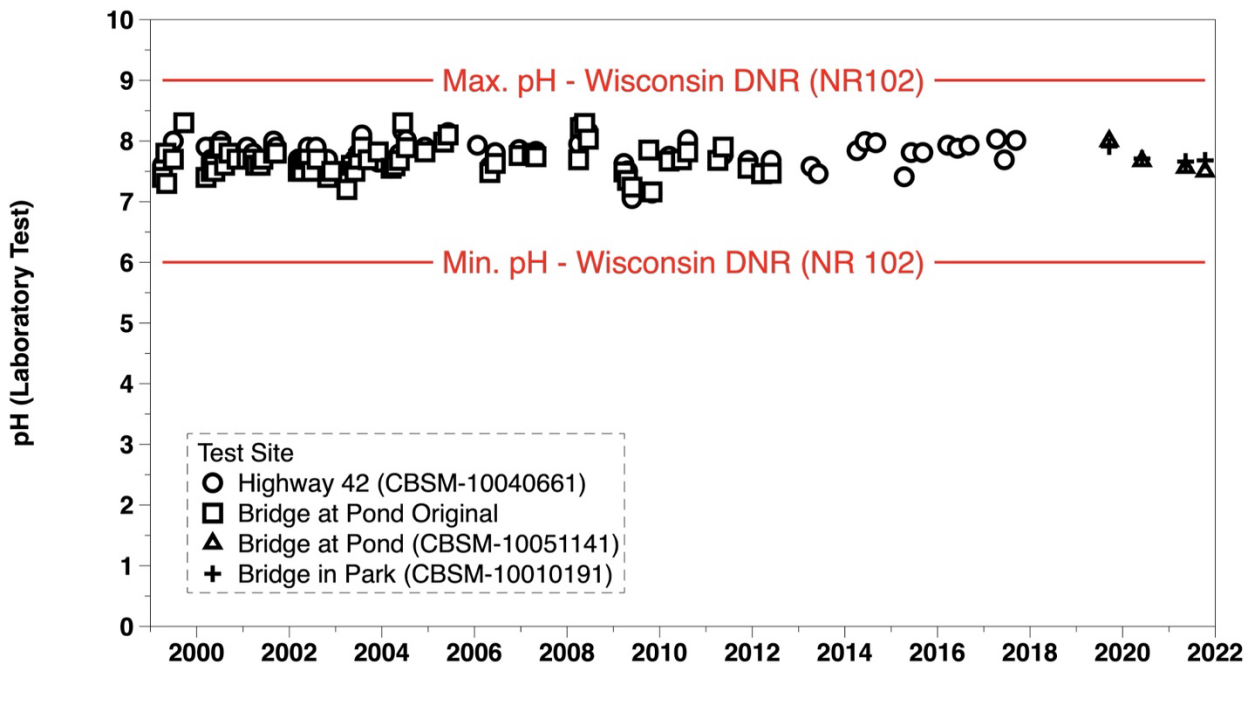



Phosphorus, an essential nutrient for plant growth, is also considered a widespread water pollutant in Wisconsin. High levels of phosphorus contribute to excess algae and aquatic plant growth in streams. Subsequent decomposition of excess plants can result in lower water oxygen levels that in turn affects ability of fish to survive (see discussion of dissolved oxygen).

The source of phosphorus in streams can be naturally occurring from rock, but excess levels are commonly associated with soil erosion, runoff, human and animal wastes, and detergents.

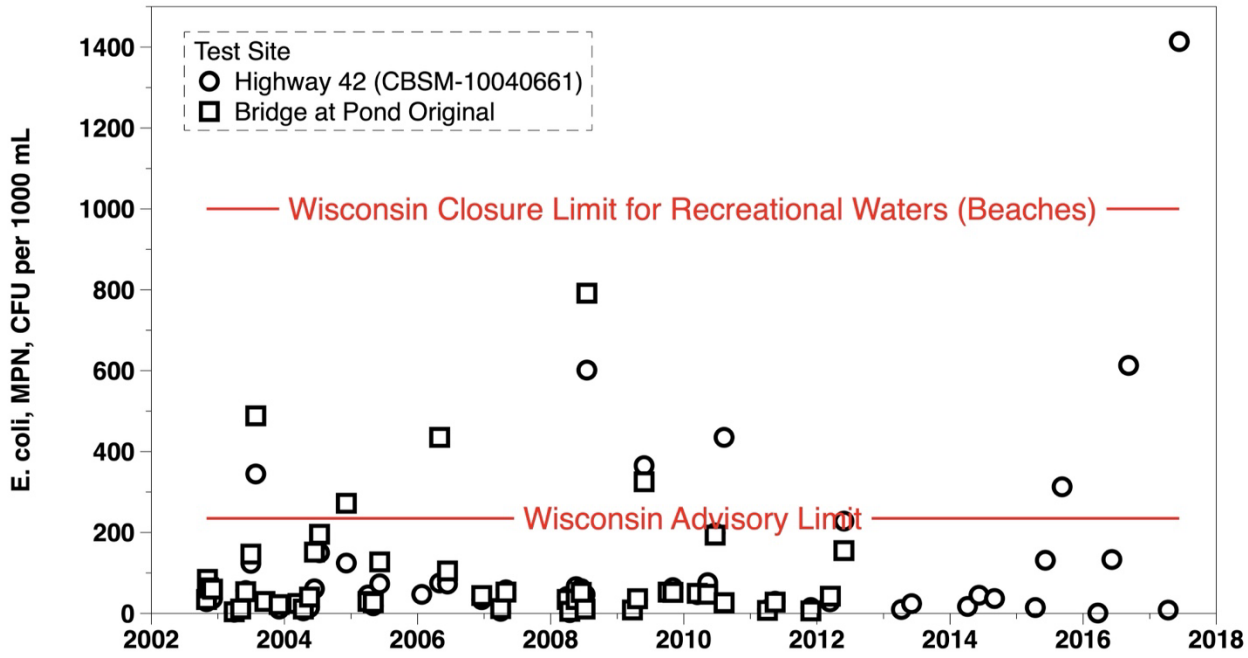
Because of concerns over phosphorus, the Wisconsin DNR sets limits on phosphorus for surface waters. Except for the last set of readings in October 2021, Fish Creek total phosphorus data are below the DNR limit. (Tests in 2022 will verify whether the October readings are an anomaly.)

# pH




pH is a measure of hydroxyl ions and indicates whether water is acidic (less than 7) or basic (greater than 7), with a pH of 7 being neutral. Optimum pH levels for fish range from about 7 to 8. The DNR standard for pH is 6 to 9, and Fish Creek pH data are within those limits.

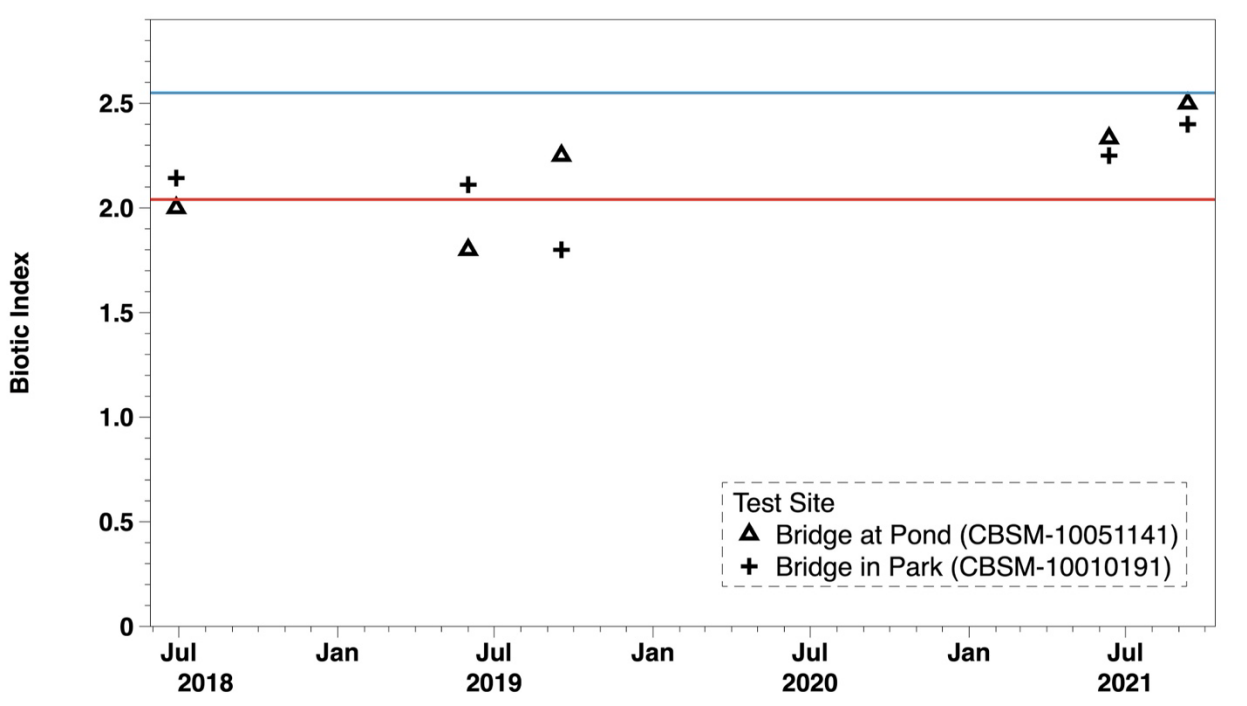
# E Coli




Escherichia coli (E. Coli) is a type of coliform bacteria that indicates water has been contaminated with human or animal fecal material, and thus may contain potentially disease-carrying organisms. Wisconsin imposes maximum limits on E. Coli for recreational waters, for example, beaches. Although Fish Creek is not necessarily intended for swimming, it is noteworthy that, except for one reading, test data fall below the state limit for beach closures.

Bacteria and E Coli measurements were discontinued in 2018 as an outcome of the 2017 ***Fish Creek Watershed Plan***.

# Biotic Index




The biotic index was developed to provide a relatively simple means for citizen scientists to quantify water quality in terms of the types of aquatic organisms (macroinvertebrates) that exist in water bodies. Macroinvertebrates are small organisms without backbones; they commonly live in the creek beds and banks. They are relatively immobile and cannot readily escape their environment so they are susceptible to poor water quality.

Macroinvertebrates respond differently to physical, chemical, and biological conditions. For example, stoneyfly larva are sensitive to pollutants whereas leeches can tolerate pollutants. The biotic index is determined by sampling the creek bed and understory of the creek banks to collect macroinvertebrate organisms. Individual macroinvertebrates are then identified and assigned to groups organized by level of tolerance to pollutants. The biotic index is calculated based on the number of macroinvertebrates in each group. Healthy waters contain more macroinvertebrates that are sensitive to pollution.

The following criteria have been developed for biotic index results.

| Water Health | Biotic Index |
|---|---|
| **Good** | 2.6 – 3.5 |
| **Fair** | 2.1 – 2.5 |
| **Poor** | 1.0 – 2.0 |

To date, Fish Creek results generally indicate fair conditions.

# Monitoring Fish Creek

Numerous volunteers have participated in monitoring Fish Creek since 1999. In recent years, Linda Merline (Chair of the Town of Gibraltar Plan Commission) and Bob Merline have organized the team. Judith Kalb, Dave Lea, and Tony Fiorato are other recent volunteers. Photos below illustrate some of the work of the volunteers.

## Linda, Bob, Judith and Tony Measuring Water Temperature and Dissolved Oxygen

## Bob Preparing Thermistor for Installation

## Judith, Bob, and Linda Preparing to Measure Creek Width

## Judith, Dave, and Tony Measuring Water Depth and Streamflow

## Bob and Judith Sampling for Water Chemistry

## Dave Measuring Transparency

## Linda, Bob, and Dave Evaluating Biotic Index Samples

## What's in the Creek?

# NEED FOR CONTINUED MONITORING

The Vision for Fish Creek as defined in the 2017 ***Fish Creek Watershed Plan*** is "A Healthy Stream Ecosystem that Supports the Environmental and Economic Interests of the Community." Key goals of the Plan highlight the need for continued monitoring of Fish Creek water quality conditions and trends. Specifically, the Plan recommends creation of a reliable dataset to help understand current creek conditions, to support informed decisions regarding implementation of the Plan, and to help evaluate the success of mitigation strategies outlined in the Plan.