Carpenter Creek At Bridge on CTH M, 10020685
Carpenter Creek
Latitude: 44.17959, Longitude: -89.05607

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Reporting Period: 01/02/2006 to 10/08/2010

Understanding the Level 2 Stream Monitoring Data Report

This report provides summary information for data gathered by volunteers participating in Level 2 monitoring of the Citizen Based Stream Monitoring Program. The report includes data for Carpenter Creek 2 At Bridge On Cth M which is referred to as Station ID 10020685, and includes all data entered into the WDNR database (SWIMS) under the CBSM program. This report includes any data collected between the dates of 01/02/2006 and 10/08/2010.

This report highlights monthly recorded values for dissolved oxygen (DO), pH, transparency, and temperature. Data are summarized to report minimum, maximum, mean, and median values for the period the site has been monitored. We also report minimum, maximum, and mean daily temperatures calculated from temperature data originally recorded hourly by continuous data loggers.

Helpful Terms

In this report, for each parameter monitored, some statistical information is provided to help explain what has been found. You may want to refer back to this section as you read through the report to help you understand what is being presented.

Mean: This is the average score in a dataset, or a typical expected value.

Median: This is the middle value in a data set of ranked values. When few data points have been collected, the median is considered a better estimate than the mean for a typical expected value.

For instance, assume the following readings (in mg/L) were found for five D.O. assessments: 10.5, 10.0, 12.5, 14.5, and 8.0. Ranking them in order from lowest to highest, we get: 8.0, 10.0, 10.5, 12.5, and 14.5. The value in the middle of that ranked data set is 10.5.

Thus, 10.5 mg/L is the median. (If you have an even number of data points in the data set, the median is the mean of the middle two numbers in the ranked list.)

If we determined the mean for the same data set, very high and/or low values might affect it. For this example the mean is determined in the following way:
8.0 + 10.0 + 10.5 + 12.5 + 14.5 = 55.5

55.5/ 5 = 11.1 mg/L Thus, 11.1 mg/L is the mean.

Although there isn't a large difference in the median (10.5 mg/L) and the mean (11.1 mg/L) in this example, in a small data set where one or two values are very different than most of the other values, using the median instead of the mean should provide a better estimate of the expected value. In a large data set, the mean and median are expected to be the same or nearly the same.

Dissolved Oxygen

Dissolved oxygen (DO) is a gas found in water that is critical for sustaining aquatic life (just as oxygen is required for us to survive). Dissolved oxygen enters water through mixing with air in turbulent waters or through photosynthetic processes by aquatic plants and algae. Dissolved oxygen leaves water through decomposition of organic materials that have entered the system from point or non-point source inputs (such as runoff from a yard or field), plant respiration and oxygen demand by organisms such as macroinvertebrates and fish. DO varies over a 24-hour period, with lowest levels expected just before sunrise, when plants and animals have been respiring, but photosynthesis has not been occurring. This flux over a 24-hour period is called diurnal variation. Large fluctuations in diurnal DO levels (e.g., 8-10 mg/L and supersaturated conditions at times) generally indicate increased photosynthesis and respiration due to elevated levels of plant and/or algal growth. Streams having levels of dissolved oxygen at greater than 100% saturation (i.e. supersaturation) do so during the day when the rate of oxygen production via photosynthesis exceeds the rate of diffusion of dissolved oxygen from water to air. Levels of DO saturation typically range from 80-120%, although highly productive streams can experience levels upwards of 140-150% during the middle of the day.

Dissolved oxygen levels are important in determining various communities of aquatic life. DO levels below 2 mg/L generally do not support aquatic life, and most fish and many insects cannot tolerate levels below 4-5 mg/L for a sustained period of time. DO levels above 7 mg/L are amenable to coldwater species such as trout. Different species of fish will migrate within a stream to seek suitable dissolved oxygen conditions.

There are several categories by which waters of Wisconsin are classified by state law. These include (but aren't limited to) trout waters, other fish or aquatic life-designated waters, limited forage fish communities, and limited aquatic life communities. There are defined DO minimums set for each type of classification. The minimums are designed to allow the aquatic organisms defined in the classification to survive in those waters. Since different organisms have different DO requirements, the DO minimums vary based on stream classification. The table below shows the minimum DO allowed in waters classified in certain ways by Wisconsin state law.

Stream classification	Minimum dissolved oxygen allowed
Trout waters	6 mg/l (out of spawning season) and 7 mg/L (during spring/fall spawning season)
Fish or aquatic life-designated waters	5 mg/L
Limited forage fish waters	3 mg/L
Limited aquatic life waters	1 mg/L

Is My Site on a Warm Water or Cold Water Stream?

You can identify if your stream is designated as a trout stream by opening this file from the Wisconsin Department of Natural Resources (WDNR) website (available at: http://dnr.wi.gov/fish/species/trout/wisconsintroutstreams.pdf).

Lists of waters that are designated as limited forage fish or limited aquatic life communities are included in Chapter NR 104 Uses and Designated Standards (available at: http://dnr.wi.gov/org/water/wm/wqs/codes/nr104.pdf) and in Chapter NR 102 Water Quality

Standards for Wisconsin Surface Waters (available at: http://www.legis.state.wi.us/rsb/code/nr/nr102.pdf).

You can also create your own maps of your monitoring station and river using the ***Surface Water Data Viewer***. More information is located at: http://dnr.wi.gov/org/water/data_viewer.htm

Dissolved Oxygen and Temperature -- a Special Link

Since DO and temperature are intimately related (e.g., water with a higher temperature can hold less oxygen than water with a lower temperature, so the general concentration of the two parameters in water generally mimic one another), it's important to consider the two together.

Dissolved oxygen content in streams is linked with temperature requirements of aquatic life. Colder water generally holds more oxygen and warmer water holds less oxygen.

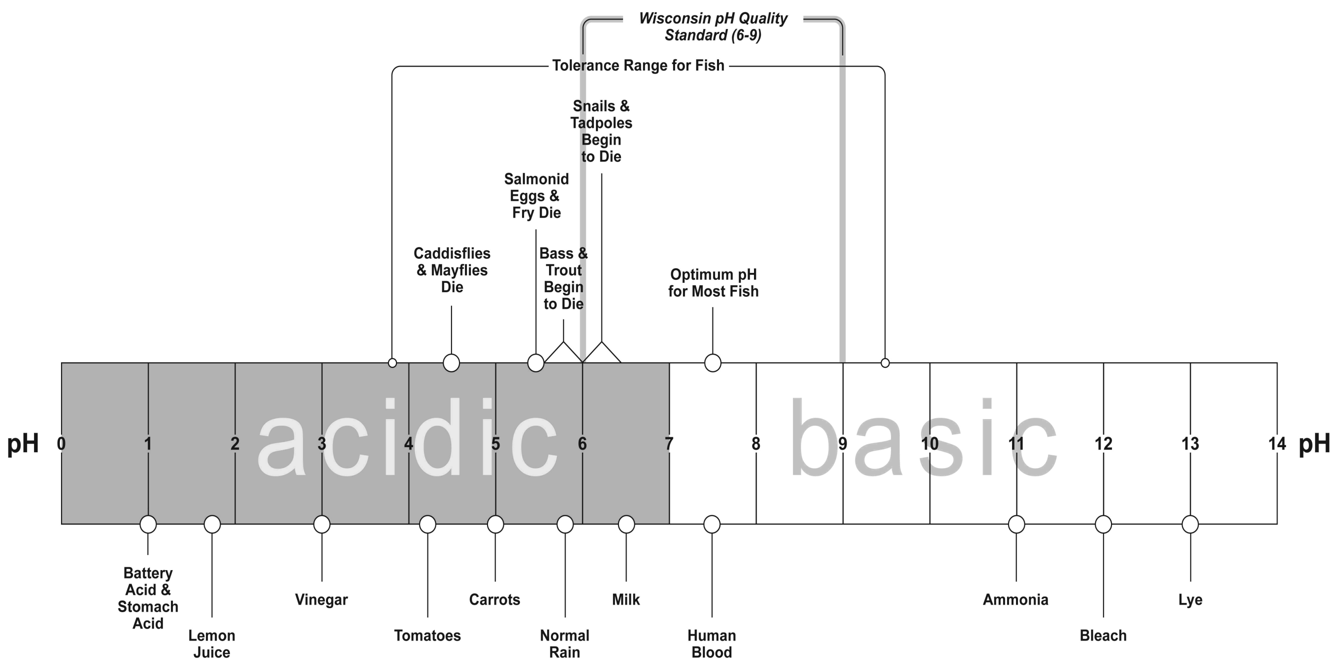
Very High DO	Moderately high DO	Low DO
ANIMALS		
Brook or rainbow trout	Brown trout	Carp
Mottled sculpin	Redbelly dace	Green sunfish
	Bass	Fathead minnow
PLANTS		
Much plant variety	Moderate plant variety	Little plant variety

Source: Dane County Water Watchers

pH

pH is a measure of the hydrogen-ion activity of water and is expressed as a logarithmic unit that ranges from 1 to 14 Standard Units. That means for every 1 pH unit change, there is a tenfold change in the activity of hydrogen ions. Waters with high hydrogen-ion activity have low pH and are considered acidic. The presence of dissolved carbon dioxide, carbonic acid, bicarbonate ions and carbonate ions strongly influence the pH of freshwater systems. Much of Wisconsin has bedrock that is composed of limestone and other rock that is rich in bicarbonate and carbonate. These types of rock can minimize impacts of acid rain or other acidic inputs to the water. In northern Wisconsin, bedrock is composed of granite which is not rich in bicarbonates and carbonates, and thus those rocks are less able to buffer or offset the impacts of acid rain or other acid inputs to the waters. In poorly buffered waters, pH may change a lot in the course of a 24-hour period based on photosynthesis (which uses carbon dioxide) and respiration (which releases carbon dioxide) by aquatic plants and algae. In other parts of the state which are well buffered, pH may not change much over a 24-hour period. Dissolved metal ions tend to increase with increased acidity and as a result, pH is an important factor influencing toxicity of metals. pH also affects the concentration of un-ionized ammonia, a form of nitrogen that is extremely toxic to aquatic life. Wisconsin has adopted a pH standard that incorporates a range from 6 to 9 units to protect and support aquatic life use.

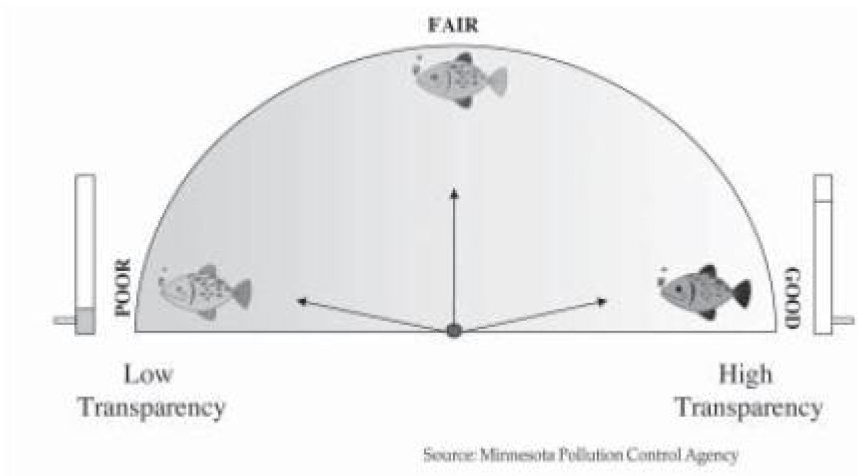
This figure shows the WI pH quality standard along with some reference points for aquatic organisms and everyday substances. Is your site's pH fairly static or does it vary over time?



Transparency

Stream water transparency is a measure of water clarity made with a transparency tube. The transparency tubes used by Level 2 Stream Monitors are 120 centimeters (cm) long and have a black and white disc at the bottom. Transparency is measured by determining the maximum depth of water in the tube that still allows the black and white disc to be visually detected from above. Transparency is measured in centimeters. Since the maximum tube depth is 120 cm, when the disc is visible with a full tube of water, the exact transparency is not measurable, but is greater than or equal to 120 cm. High transparencies indicate good water quality (Figure below).

Low Water Transparency Influences Fish Health



Transparency measurements are affected by both the presence of suspended particles, such as soil particles and microscopic organisms, and by water color, which is caused by certain dissolved substances. Transparency is an easily made measurement that can be correlated with turbidity, although the two measurements are not directly comparable.

Turbidity is a somewhat more difficult measurement that is often made in a lab. Turbidity has been a commonly used measurement in water quality studies and its relationship to the health of fish and other aquatic life has been established.

Turbidity is a measure of water clarity or "cloudiness" caused primarily by the presence of suspended particulate matter. It is basically an optical measurement of the amount of light scattering caused by fine organic or inorganic particles and to a lesser extent some dissolved substances in the water. These small particles of soil, algae or other materials generally range in size from microscopic to about one millimeter (about the thickness of a pencil lead). More suspended particles cause greater turbidity resulting in less light penetration through the water. This hinders photosynthesis, necessary for healthy aquatic plant growth and production of dissolved oxygen. With increased turbidity, water also becomes warmer because the suspended particles absorb heat. Since warmer water holds less dissolved oxygen than cold water, oxygen levels are also affected by turbidity. Extremely high levels of turbidity may also impair aquatic organism survival, for instance, by blocking gas exchange in membranes used for respiration, interfering with filter feeding mussels, or by restricting predation by sight-feeding fish. In general, turbidity increases with increasing river flow due to erosional processes and bad sediment resuspension. Sources of turbidity include:

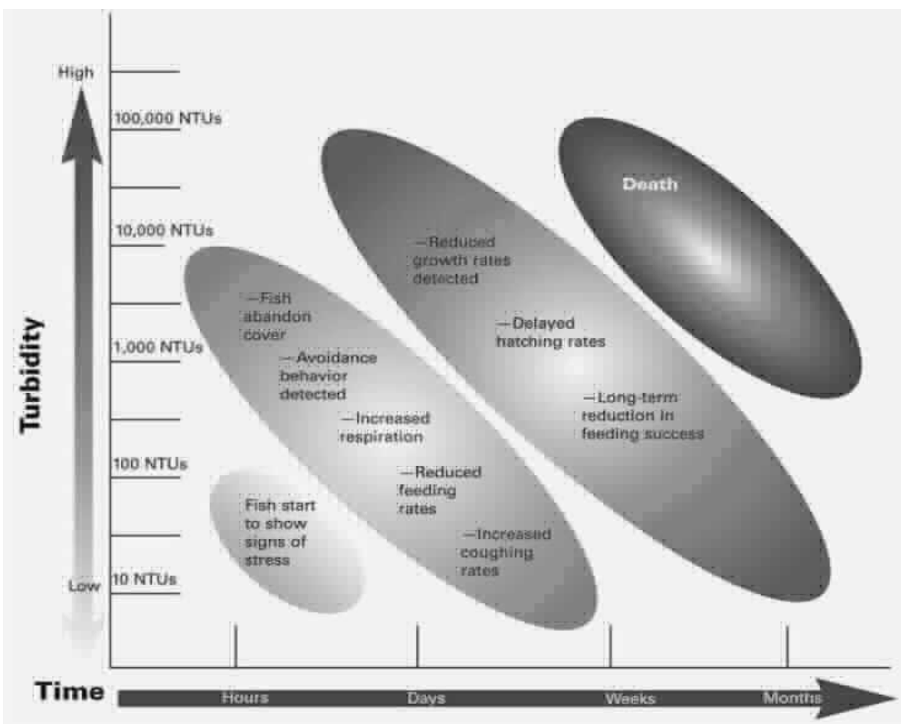
- erosion from fields, construction sites
- urban runoff from rainstorms and melting snow
- eroding stream banks
- decaying plant matter
- large number of bottom feeders (such as carp) which stir up bottom sediments
- algae
- wastewater discharges

All streams have background or normal levels of water clarity. Fish and aquatic life that inhabit particular streams are adapted to those background levels of water clarity. Time is probably the most influential factor in determining how turbidity affects the aquatic environment. The longer the water remains at unusually high values of turbidity, the greater effect it has on fish and other aquatic life. Fish in particular become very stressed in waters that remain highly turbid for a long time. Signs of stress include increased respiration rate, reduced growth and feeding rates, delayed hatching and, in severe cases, death. Fish eggs are ten times more sensitive to changes in turbidity than adult fish.

Since transparency is a surrogate measurement of turbidity and the two measurements are correlated, the table to the right can be used to covert transparency values to approximate turbidity values. The figure below can be used to further understand how the resultant turbidity values and exposure times impact fish.

Transparency (cm)	Turbidity (NTUs)
<6.4	>240
6.4 to 7.0	240
7.1 to 8.2	185
8.3 to 9.5	150
9.6 to 10.8	120
10.9 to 12.0	100
12.1 to 14.0	90
14.1 to 16.5	65
16.6 to 19.1	50
19.2 to 21.6	40
21.7 to 24.1	35
24.2 to 26.7	30
26.8 to 29.2	27
29.3 to 31.8	24
31.9 to 34.3	21
34.4 to 36.8	19
36.9 to 39.4	17
39.5 to 41.9	15
42.0 to 44.5	14
44.6 to 47.0	13
47.1 to 49.5	12
49.6 to 52.1	11
52.2 to 54.6	10
>54.7	<10

* Nephelometric Turbidity Units (NTU) are units of particle dispersion (suspended particles) providing a measure of turbidity using a *nephelometer*.



Water Temperature

Water temperature is an important physical property that influences the growth and distribution of aquatic organisms. It is also an important factor regulating chemical and biochemical reactions in aquatic animals and plants. Surface water temperature is strongly influenced by solar radiation, local climate and groundwater inflows.

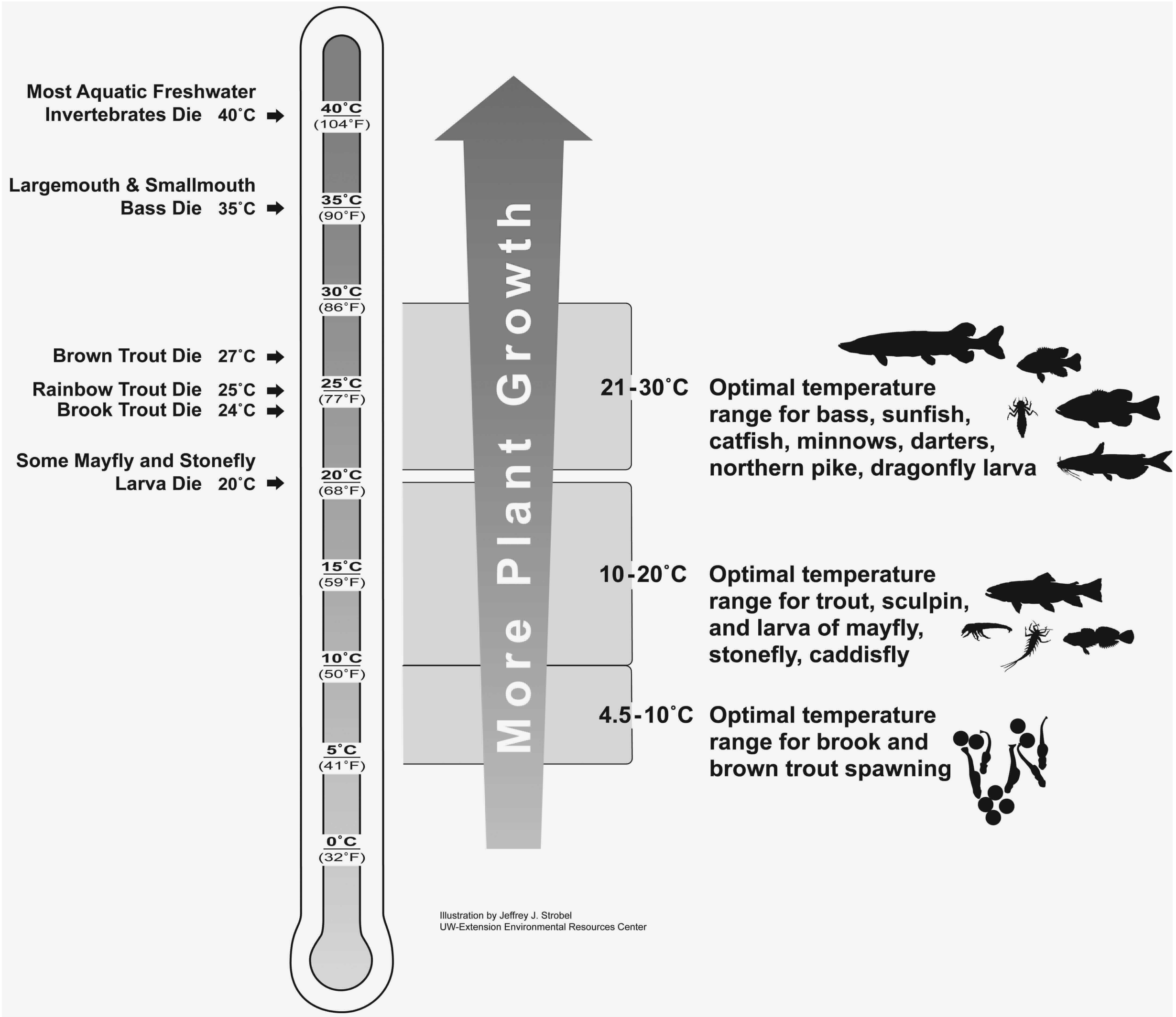
Wisconsin uses water temperature as an important variable in the designation of fish and aquatic life uses for surface waters. Use designations are utilized to classify waters of the state into certain categories so that management decisions can be made to protect the quality of those water resources.

Long-term water temperature data are useful for interpreting temporal variations. The WDNR uses temperature data averaged over months or seasons to calculate effluent limits. By setting effluent limits to surface waters, aquatic life present in the streams being monitored can be protected.

The WDNR also classifies streams by their water temperatures, indicating if they are cold, cool, or warm water streams (Table below).

Thermal regime	Maximum instantaneous temperature	Maximum daily mean temperature
Cold water stream	<25 °C (77 °F)	< 22 °C (72 °F)
Cool water stream	25-28 °C	22-24 °C
Warm water stream	>28 °C (82 °F)	> 24 °C (75 °F)

These classes of streams support different types of fish species. The best quality coldwater streams have relatively few species of fish as compared to warm water streams. Salmonids such as brook trout dominate the fish populations in the best quality coldwater streams, while brown trout, an exotic salmonid species, dominate coldwater streams that have slightly less pristine water quality. Bass, darter and sucker species are more prevalent in warmwater streams than in coldwater streams. Different species of fish have different temperature requirements. Trout need cool temperatures, while fish species such as bass can live in waters with higher temperatures (see figure 3 on following page).



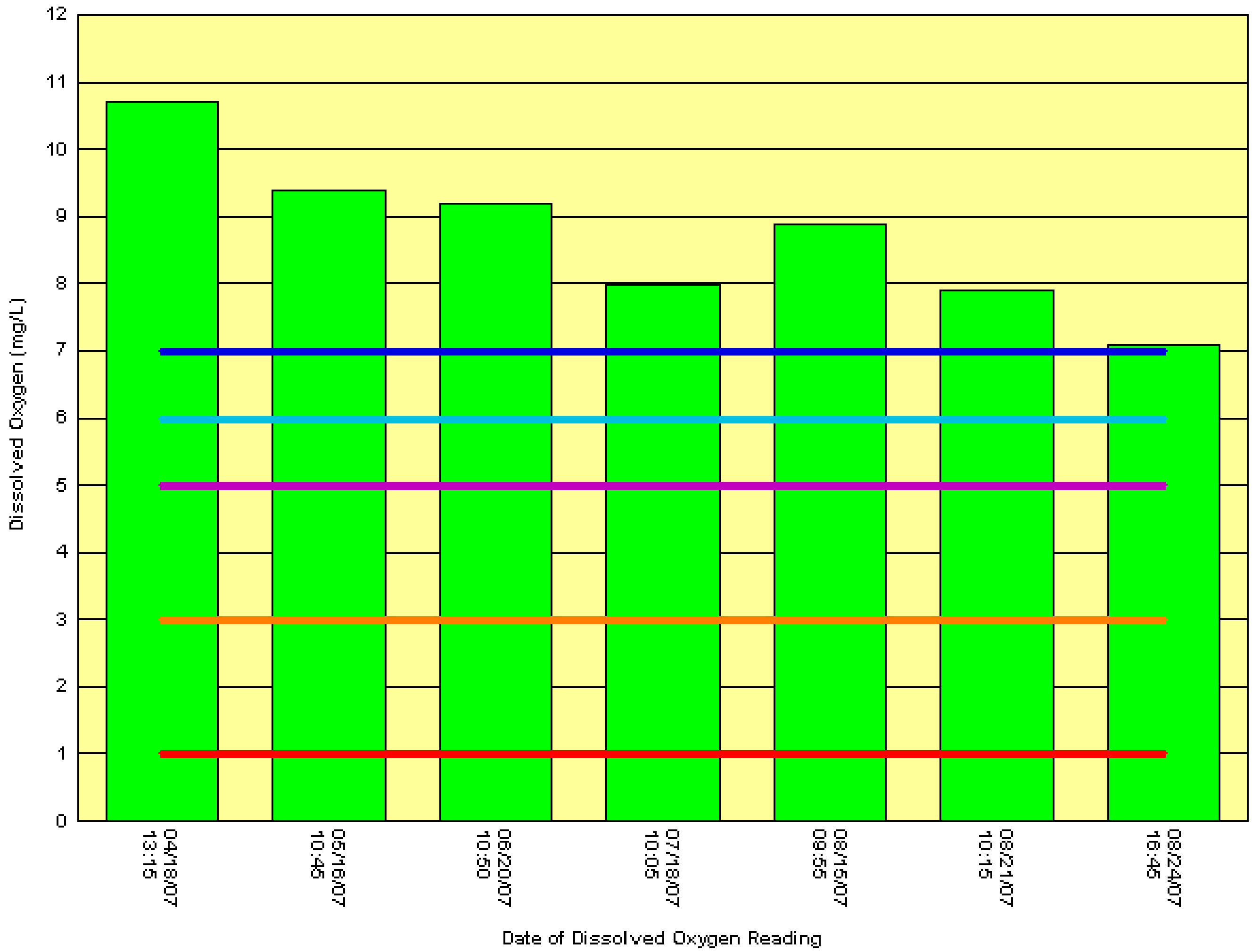
Based on the table above and your site's minimum, maximum and mean water temperatures for each month (see next page), how would you classify your stream based on its temperature over time? Coldwater, coolwater, or warmwater? If you monitor macroinvertebrates, how do your findings for macroinvertebrates and temperature compare with their temperature tolerances as listed in Figure 3? Do you find many plants at your monitoring site? Does their presence make sense in relation to average water temperatures?

The following pages summarize the results of monitoring on Carpenter Creek 2 At Bridge On Cth M, 10020685.

Dissolved Oxygen (Instantaneous Data) at Carpenter Creek 2 At Bridge On Cth M, 10020685

Instantaneous dissolved oxygen was gathered at this station 7 times during the period of monitoring, from 04/18/07 to 08/24/07. Dissolved oxygen values are displayed in the Graph 1 below and reflect the following values:

Instantaneous D.O. minimum: 7.09 mg/l
Instantaneous D.O. maximum: 10.71 mg/l
Instantaneous D.O. mean: 8.73 mg/l
Instantaneous D.O. median: 8.87 mg/l



Measured Dissolved Oxygen

Standards

- Coldwater Streams (spawning)
- Coldwater Streams (CW)
- Default / Warm Water Sport Fisheries (WWSF) / Warm Water Forage Fisheries (WWFF)
- Limited Forage Fishery (LFF)
- Limited Aquatic Life (LAL)

Dissolved Oxygen, Percent Saturation (Instantaneous Data) at Carpenter Creek 2 At Bridge On Cth M, 10020685

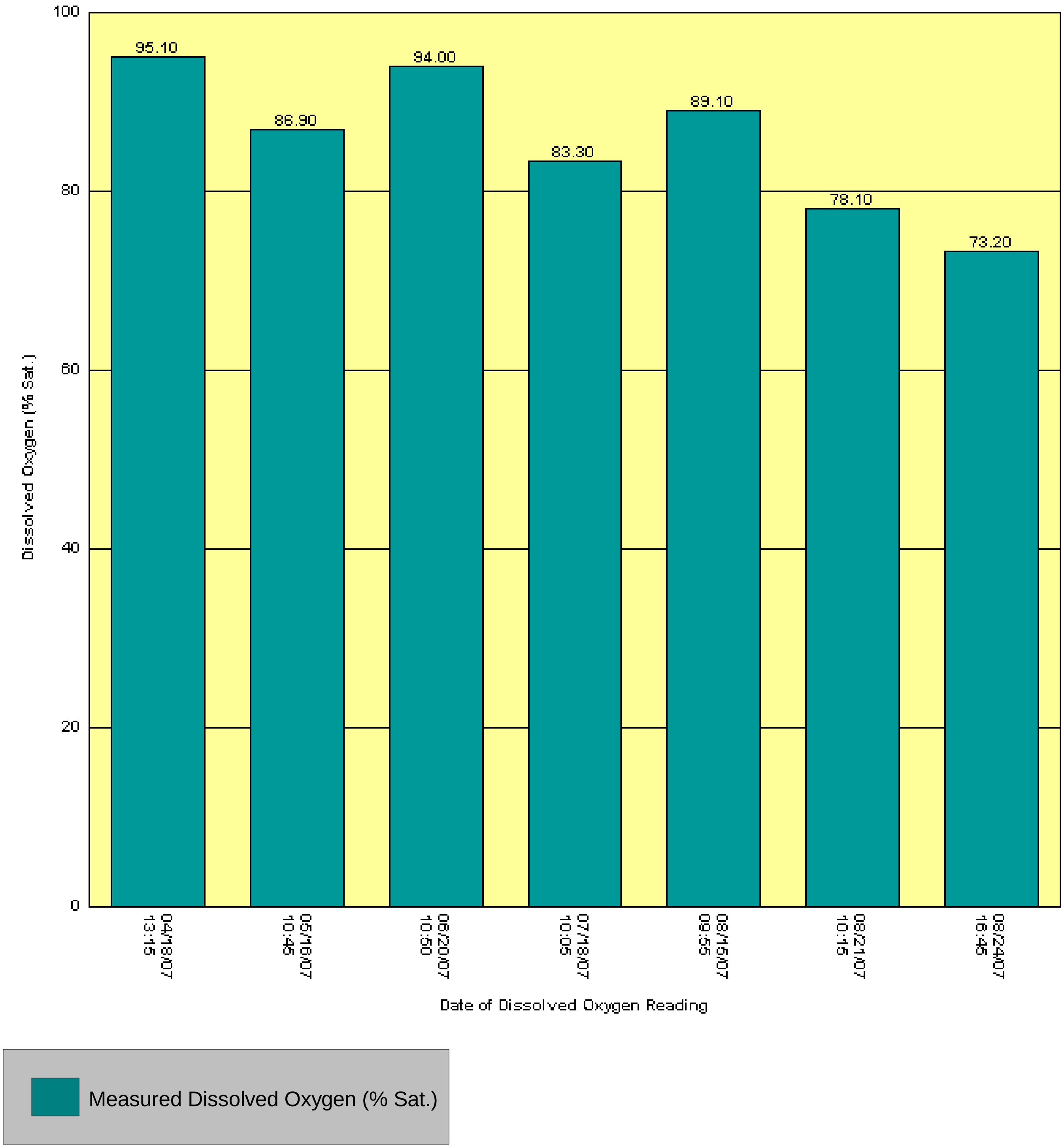
Instantaneous dissolved oxygen percent saturation was gathered at this station 7 times during the period of monitoring, from 04/18/07 to 08/24/07. Dissolved oxygen percent saturation values are displayed in the Graph 2 below and reflect the following values:

Instantaneous D.O. percent saturation minimum: 73.2 % Saturation

Instantaneous D.O. percent saturation maximum: 95.1 % Saturation

Instantaneous D.O. percent saturation mean: 85.67 % Saturation

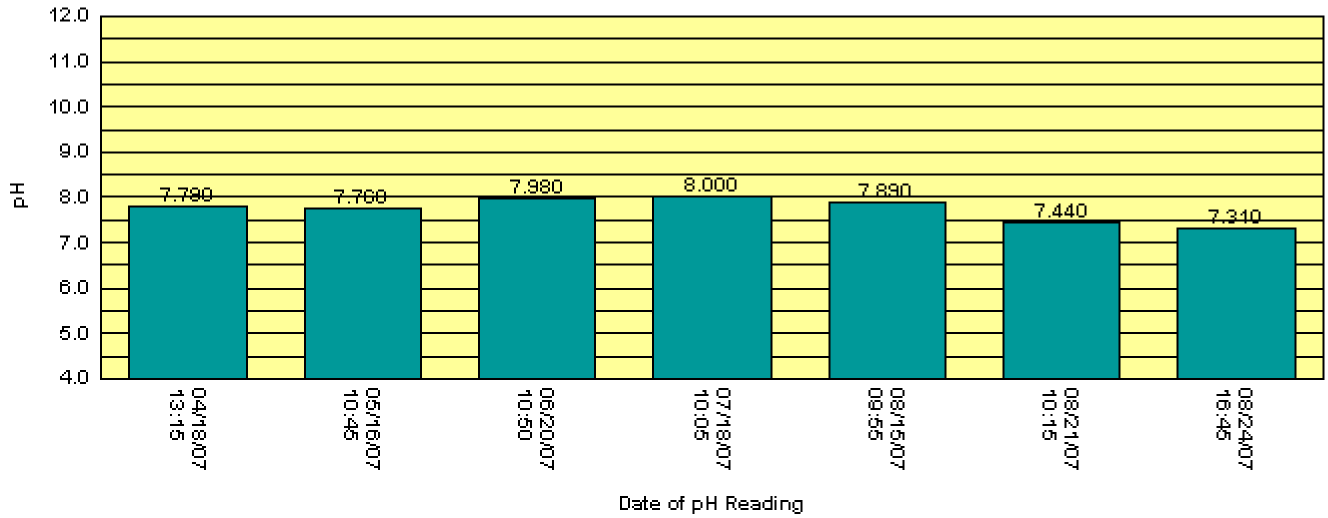
Instantaneous D.O. percent saturation median: 86.9 % Saturation



pH (Instantaneous Data) at Carpenter Creek 2 At Bridge On Cth M, 10020685

Instantaneous pH was gathered at this station 7 times during the period of monitoring, from 04/18/07 to 08/24/07. pH values are displayed in the Graph 3 below and reflect the following values:

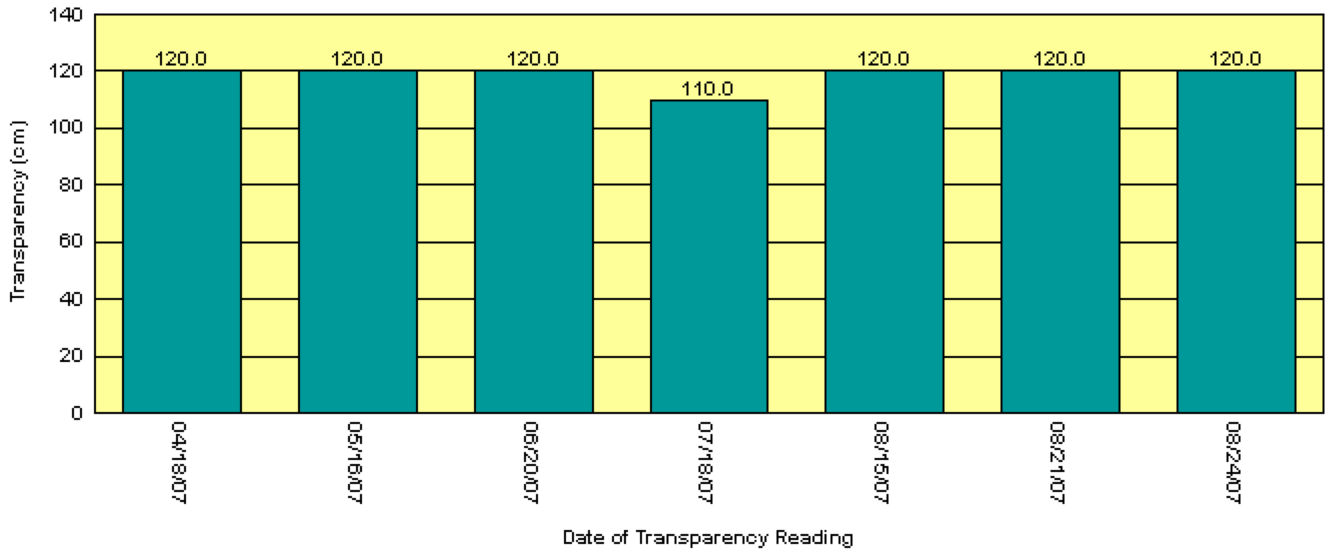
Instantaneous pH minimum: 7.31
Instantaneous pH maximum: 8
Instantaneous pH mean: 7.74
Instantaneous pH median: 7.79



Average Transparency (cm)

Instantaneous transparency was gathered at this station 7 times during the period of monitoring, from 04/18/07 to 08/24/07. Transparency values are displayed in the Graph 4 below and reflect the following values:

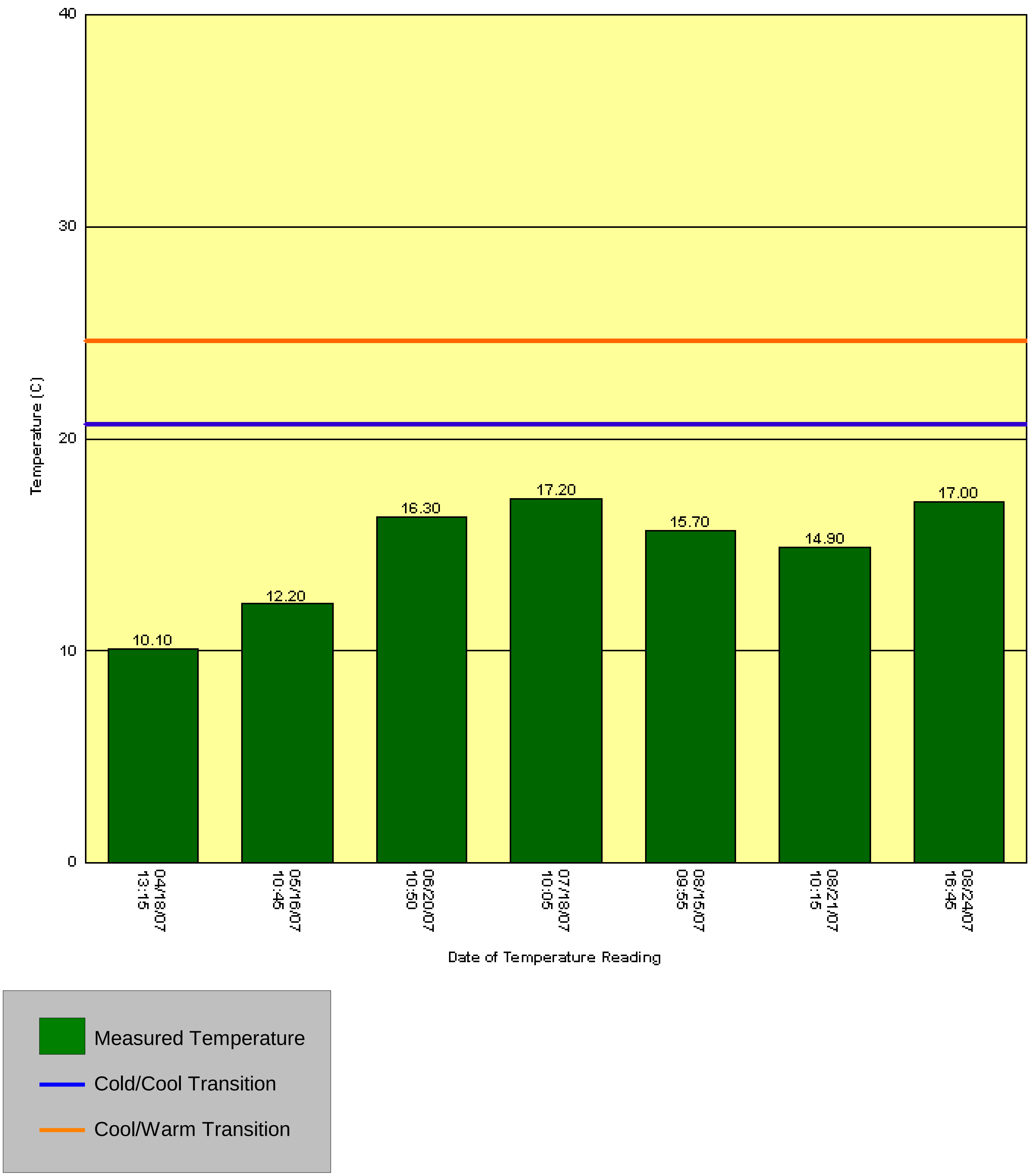
Instantaneous transparency minimum: 110
Instantaneous transparency maximum: 120
Instantaneous transparency mean: 118.57
Instantaneous transparency median: 120

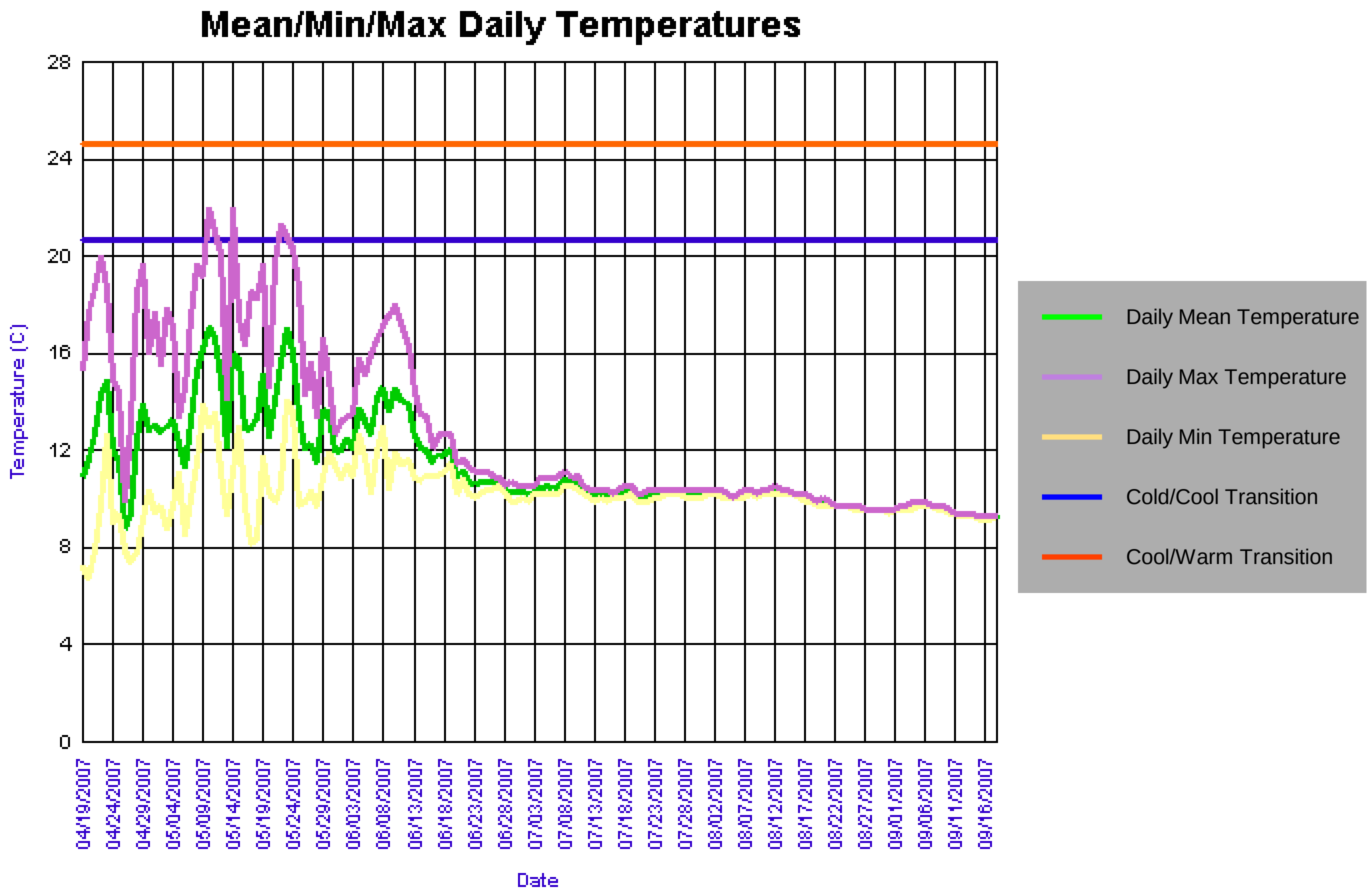


Instantaneous Water Temperature (C)

Instantaneous water temperature was gathered at this station 7 times during the period of monitoring, from 04/18/07 to 08/24/07. Water temperature values are displayed in the Graph 5 below and reflect the following values:

Instantaneous temperature minimum: 10.1
Instantaneous temperature maximum: 17.2
Instantaneous temperature mean: 14.77
Instantaneous temperature median: 15.7




Mean/Min/Max Daily Temperatures
Temperature (C)
28
24
20
16
12
8
4
0
04/19/2007
04/24/2007
04/29/2007
05/04/2007
05/09/2007
05/14/2007
05/19/2007
05/24/2007
05/29/2007
06/03/2007
06/08/2007
06/13/2007
06/18/2007
06/23/2007
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07/03/2007
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07/13/2007
07/18/2007
07/23/2007
07/28/2007
08/02/2007
08/07/2007
08/12/2007
08/17/2007
08/22/2007
08/27/2007
09/01/2007
09/06/2007
09/11/2007
09/16/2007
Date
Daily Mean Temperature
Daily Max Temperature
Daily Min Temperature
Cold/Cool Transition
Cool/Warm Transition