Baseline Water Quality Monitoring in the

Eightmile River Watershed

Summer 2014, 2015 and 2016

Acknowledgements

A Special thanks to our summer interns….

Douglas Morey

and

David Lloyd

Executive Summary

Overview

In the summers of 2014 and 2015 the Eightmile River Wild & Scenic Coordinating Committee conducted stream monitoring at eight sites in the watershed. In the summer of 2016, a ninth site (6A at Muddy Brook) was added. Below, is a brief summary of the full report and some general interpretations of the results. Establishing baseline conditions is important for future comparisons.

Site Locations

1. East Branch of the Eightmile River at Darling Rd (Salem)
2. East Branch of the Eightmile River at Salem Rd (Lyme)
3. Beaver Brook at Beaver Brook Rd (Lyme)
4. Main Stem of the Eightmile River below the confluence at Macintosh Rd (Lyme)
5. West Branch of the Eightmile River at Norwich Salem Rd (East Haddam)
6. West Branch of the Eightmile River at Hopyard Rd (East Haddam)
6a. Muddy Brook at Hopyard Rd (East Haddam)
7. East Branch of the Eightmile River at Morgan Rd (Salem)
8. Harris Brook above Music Vale Rd (Salem)

What We Measured and the Results

Water Temperature: Temperature is measured in °C. Juvenile brook trout need water temperatures under 19°C for growth and will generally not survive in temperatures above 24°C. The bulk of the measurements were between 19°C and 24°C for the ten week period. In 2016, temperatures were similar to 2015, but slightly warmer than 2014 results. Six sites exceeded the 24°C on August 17, 2016. The removal of Ed Bills Dam on the East Branch of the Eightmile in the fall of 2015 resulted in a notable stream temperature decrease at the monitoring point immediately below the dam. The new site at Muddy Brook within Devil's Hopyard was added in 2016 and this site consistently had the lowest temperatures.

pH: pH measures how alkaline or acidic a substance is. A pH of 7 is neutral. Most inland streams have a pH range of about 6.5 to 8. With the exception of one low reading on the East Branch of the Eightmile at Morgan Road, which may very well have been due to instrument/human error, pH was within expected ranges.

Dissolved Oxygen: Dissolved oxygen (DO) is measured in mg/L. Brook trout need DO levels above 7 mg/L to survive. The minimum standard adopted by CT DEEP is no less than 5mg/L in freshwater streams. DO levels are generally lowest on hot summer days early in the morning as aquatic plants have not been producing oxygen. Overall DO levels were lower in 2016, with a number of stream segments falling below 7 mg/L on several days. On average, Muddy Brook maintained the highest levels of DO during the summer and was the only stream to stay above 7 mg/L on all days measured.

Conductivity: Conductivity is the measurement of an electrical current in the stream as a result of inorganic dissolved solids. It is measured in microsiemens per centimeter (us/cm). Each stream tends to have its own conductivity "fingerprint" since it is often based on the geology and soil in the area. Significant changes though can indicate possible pollution sources. Slight upward trending of two segments, East Branch of the Eightmile at Darling Road and Morgan Road, may be partially explained due to drought conditions. All streams segments were within acceptable ranges.

Total Dissolved Solids (TDS): This is a measurement of the amount of solids dissolved in the water. It is measured in mg/L or ppm. Distilled water has very low levels of TDS. Polluted water can have much higher measurements. Each stream generally has its own baseline range. Freshwater lakes and streams generally fall within the range of 50-250 mg/L. Slight upward trending of two segments, East Branch of the Eightmile at Darling Road and Morgan Road, may be partially explained due to drought conditions. All stream segments were within acceptable ranges.

Salinity: Salinity is a measure of the amount of salt in the water. It is measured in ppm or mg/L. Freshwater streams, ponds and lakes typically have a range of 0-500ppm. There is growing concern about deicing salts impacting groundwater which can be a significant source of streamflow in summer months. . Slight upward trending of two segments, East Branch of the Eightmile at Darling Road and Morgan Road, may be partially explained due to drought conditions. All stream segments were within acceptable ranges.

Full Report

A Word about the Results:

Following the graphed results for each parameter, a "Quick Summary" is provided. These include general observations. Since variations in rainfall and streamflow affect measurements, it is important not to over interpret the results at this stage. Multiple years of data will be a better reflection of the ranges associated with each stream segment monitoring location.

Purpose and Summer Stressors

The Eightmile River Wild & Scenic Coordinating Committee initiated a stream sampling program in the summer of 2014 and conducted a second sampling in the summers of 2015 and 2016. The purpose of multi-year sampling is to establish baseline data for future comparisons. Collected data will be used to ascertain seasonal ranges and long-term trends. Summer represents a particularly stressful time for stream inhabitants. Higher water temperature with lower stream flow can result in lower dissolved oxygen levels. Additionally summer rain events can be intense, elevating stream temperatures and depositing whatever pollutants picked in stormwater runoff. Understanding baseline conditions allows us to set realistic goals to protect the river system.

Watershed

The Eightmile River Watershed is approximately 62 square miles and is comprised of land area from the five towns of Salem, East Haddam, Lyme, Colchester and East Lyme. The Eightmile River was designated by Congress as a Wild & Scenic Partnership River in 2008. The watershed is home to a wide variety of flora and fauna and hosts a number of threatened and endangered species of statewide and federal significance. With approximately 40% of its land currently preserved as permanent open space, the watershed is relatively undeveloped and is an excellent example of an intact system in close proximity to Long Island Sound.

Equipment and Parameters Sampled

Two Extech hand-held instruments (ExStik® EC500 & ExStik® DO600) were used to collect data. The instruments were calibrated at the beginning of each sampling day and were also calibrated at a lab at the beginning of the season and again half way through the monitoring season. Data was collected for temperature, pH, dissolved oxygen, conductivity, total dissolved solids and salinity. Field monitoring was generally conducted between 8am-10am on days noted.

Sampling Points and Duration

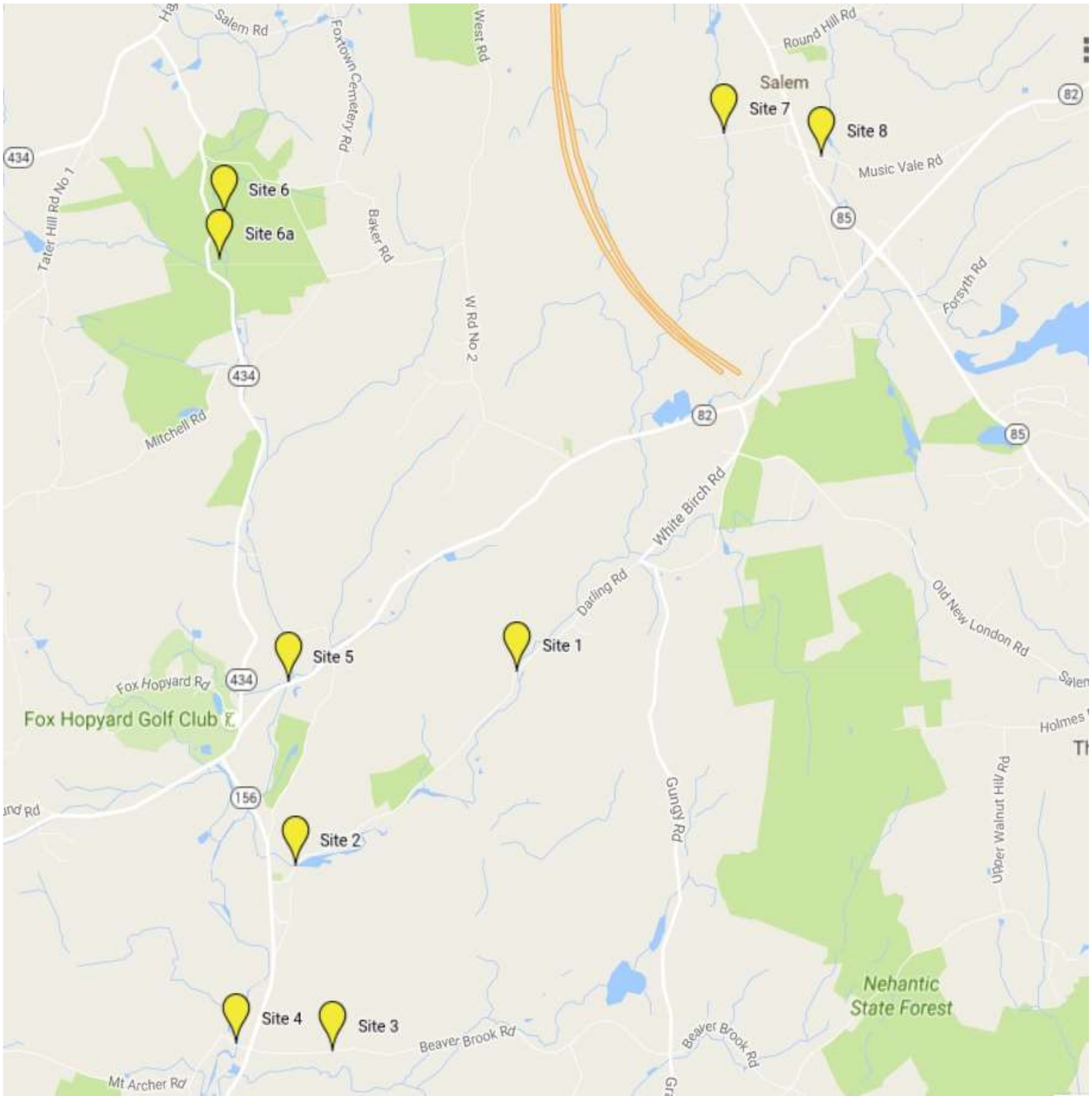
Sampling points were selected to collect data on main stream segments throughout the watershed. Access to sites was a consideration as well as establishment of a relatively easy driving route. The same route was used for all three summer monitoring seasons, with the exception that an additional stream segment, Muddy Brook in East Haddam (site 6A), was included in the summer 2016 monitoring season.

Streams were sampled the same day every week at approximately the same time for ten week periods. Sampling locations are shown on the map on the following page.

Limitations

This data collection and reporting is intended for general management purposes. Constituents such as temperature and dissolved oxygen change throughout the day so results do not necessarily reflect the full range spectrum. Further, all constituents may be affected by rain events or other discharges to a stream system and depending upon the timing of sampling the results may or may not fully reflect the complete impact. Even short duration changes however, can be of significant concern to aquatic life. Monitoring is conducted by student intern volunteers. Training is provided by the watershed coordinator. As with any stream monitoring effort, both human error and equipment malfunction can result in errors in data.

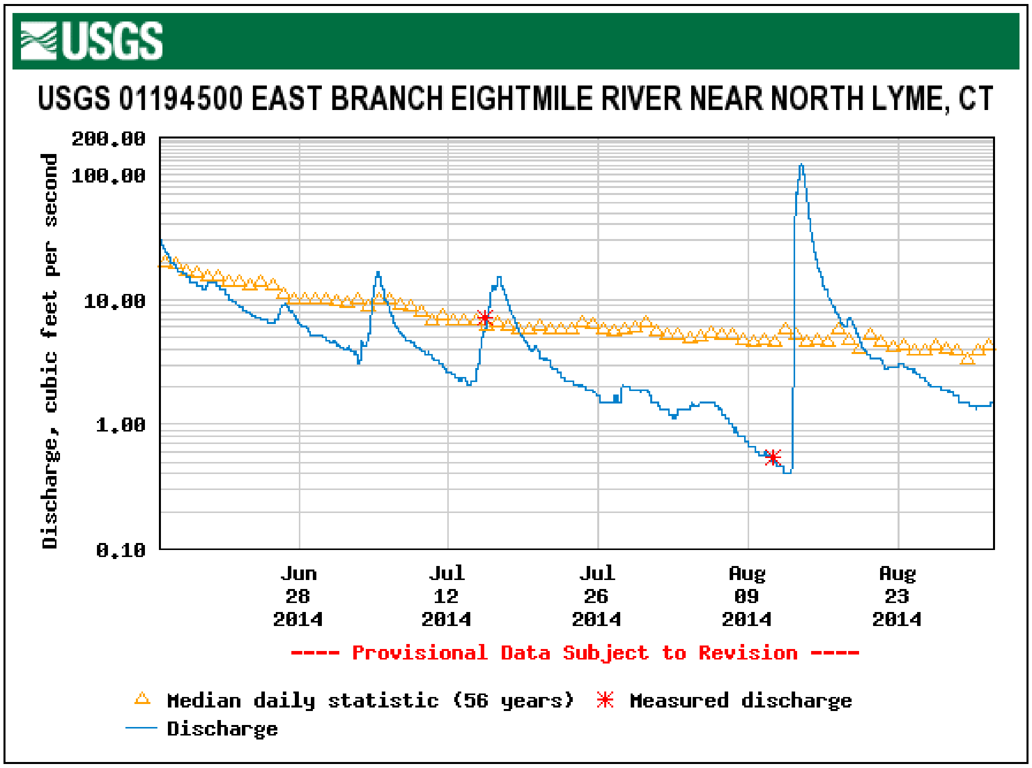
Eightmile River Watershed Monitoring Points



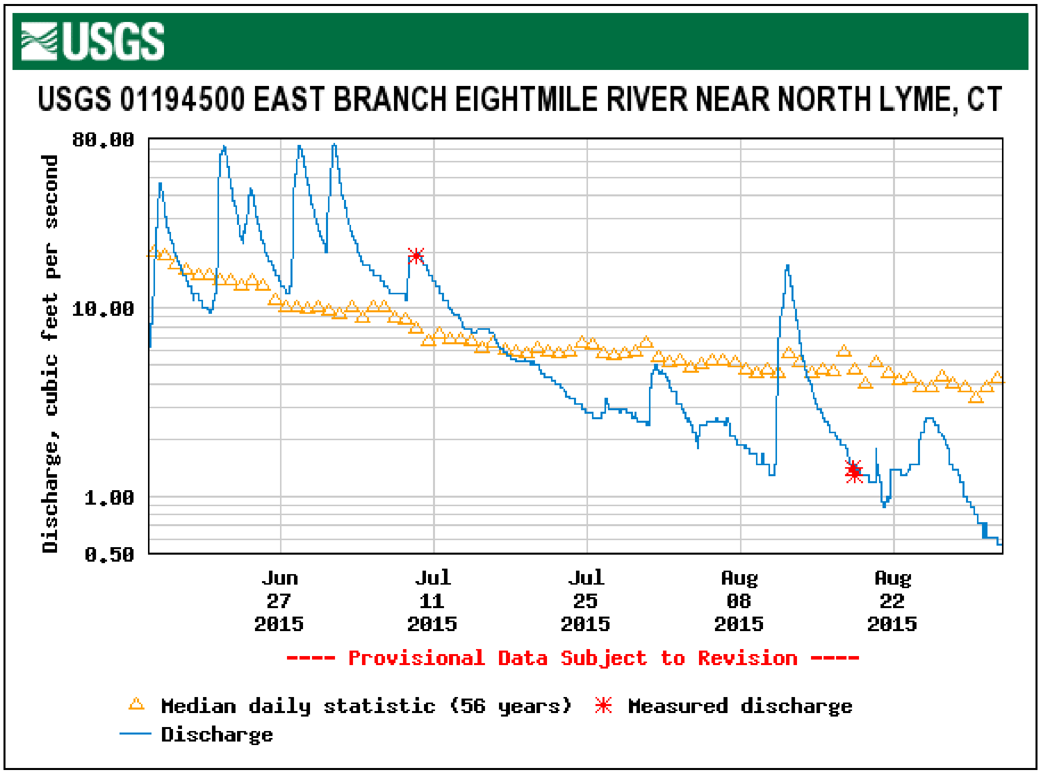
Site 1: East Branch of the Eightmile River (above former Ed Bills Dam)
Site 2: East Branch of the Eightmile River (below former Ed Bills Dam)
Site 3: Beaver Brook (off Beaver Brook Rd)
Site 4: Eightmile River (below confluence with East Branch and Lyme swimming hole)
Site 5: Eightmile River (at RT 82)
Site 6: Eightmile River (at Devil's Hopyard State Park)
Site 6a: Muddy Brook (at Devil's Hopyard State Park)
Site 7: East Branch of the Eightmile (at Morgan Rd)
Site 8: Harris Brook (above Music Vale Rd)

Streamflow Conditions: Graphs below show the stream discharge on the East Branch of the Eightmile River at the USGS gaging station. While streams flows were low during late-summer in 2014 and 2015, the flow was well below median levels throughout almost the entire sampling period in 2016.

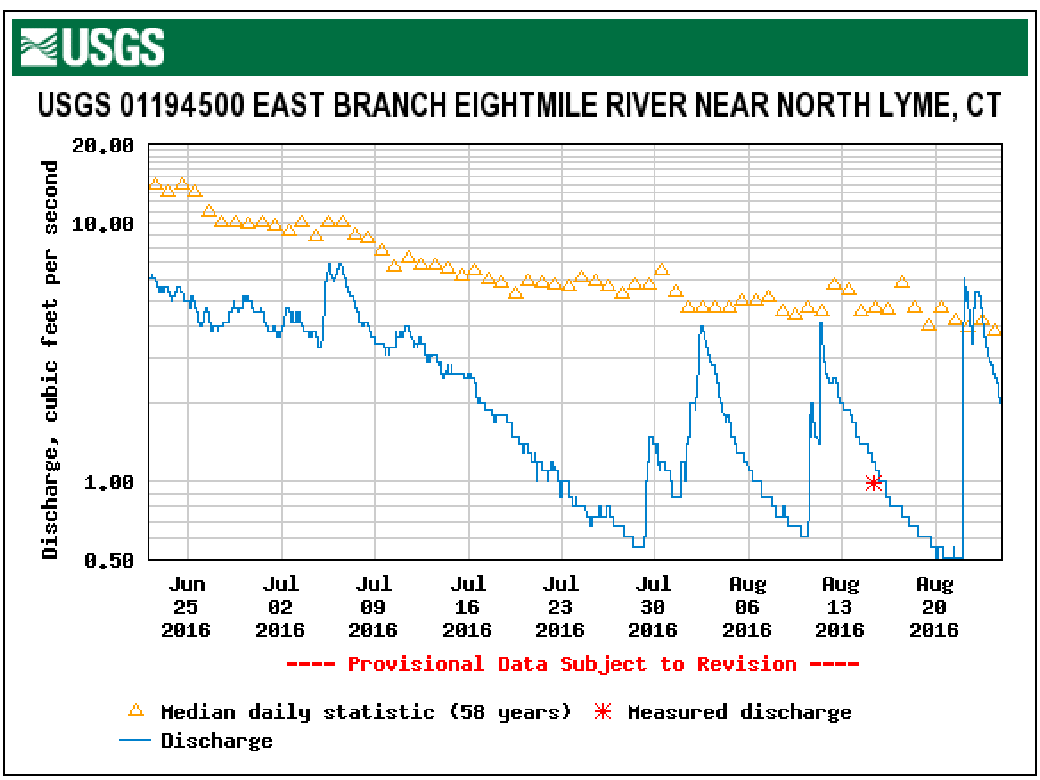
Summer 2014 Stream Discharge



Summer 2015 Stream Discharge



Summer 2016 Stream Discharge



Water Temperature

Why is temperature important?*

The rates of biological and chemical processes depend on temperature. Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend on the species: some survive best in colder water, whereas others prefer warmer water. Benthic macroinvertebrates are also sensitive to temperature and will move in the stream to find their optimal temperature. If temperatures are outside this optimal range for a prolonged period of time, organisms are stressed and can die. Temperature is measured in degrees Fahrenheit (F) or degrees Celsius (C).

For fish, there are two kinds of limiting temperatures, the maximum temperature for short exposures and a weekly average temperature that varies according to the time of year and the life cycle stage of the fish species. Reproductive stages (spawning and embryo development) are the most sensitive stages. Table 5.5 provides temperature criteria for some species.

Temperature affects the oxygen content of the water (oxygen levels become lower as temperature increases); the rate of photosynthesis by aquatic plants; the metabolic rates of aquatic organisms; and the sensitivity of organisms to toxic wastes, parasites, and diseases.

Causes of temperature change include weather, removal of shading streambank vegetation, impoundments (a body of water confined by a barrier, such as a dam), discharge of cooling water, urban storm water, and groundwater inflows to the stream.

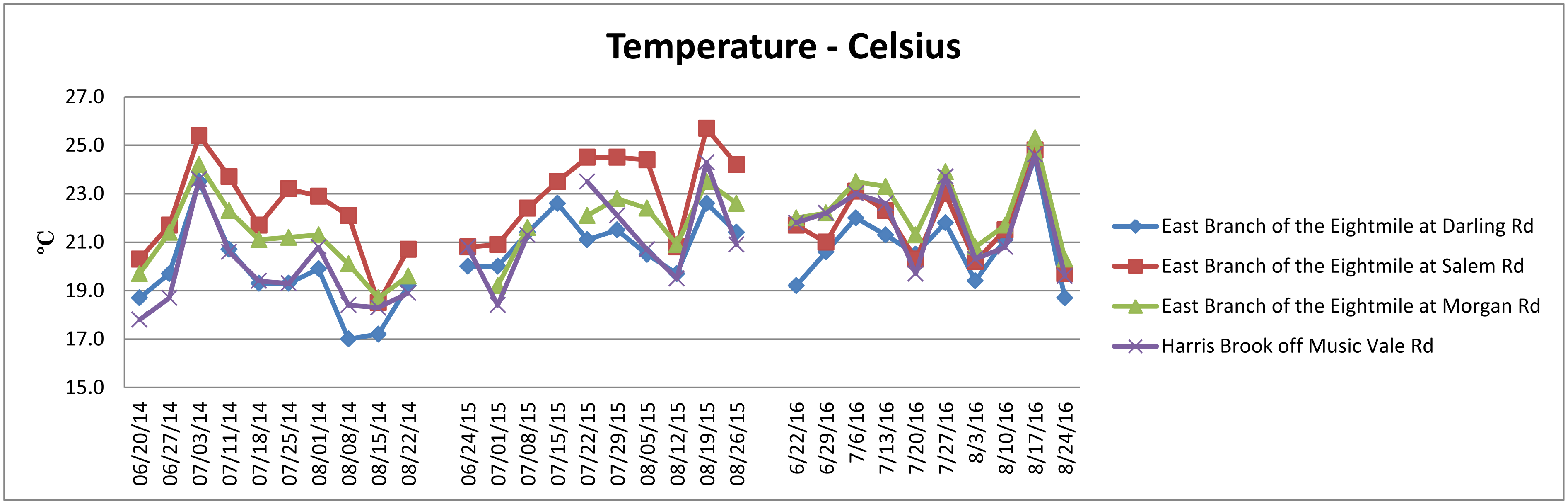
Table 5.5-Maximum average temperatures for growth and short-term maximum temperatures for selected fish (°C and ° F)

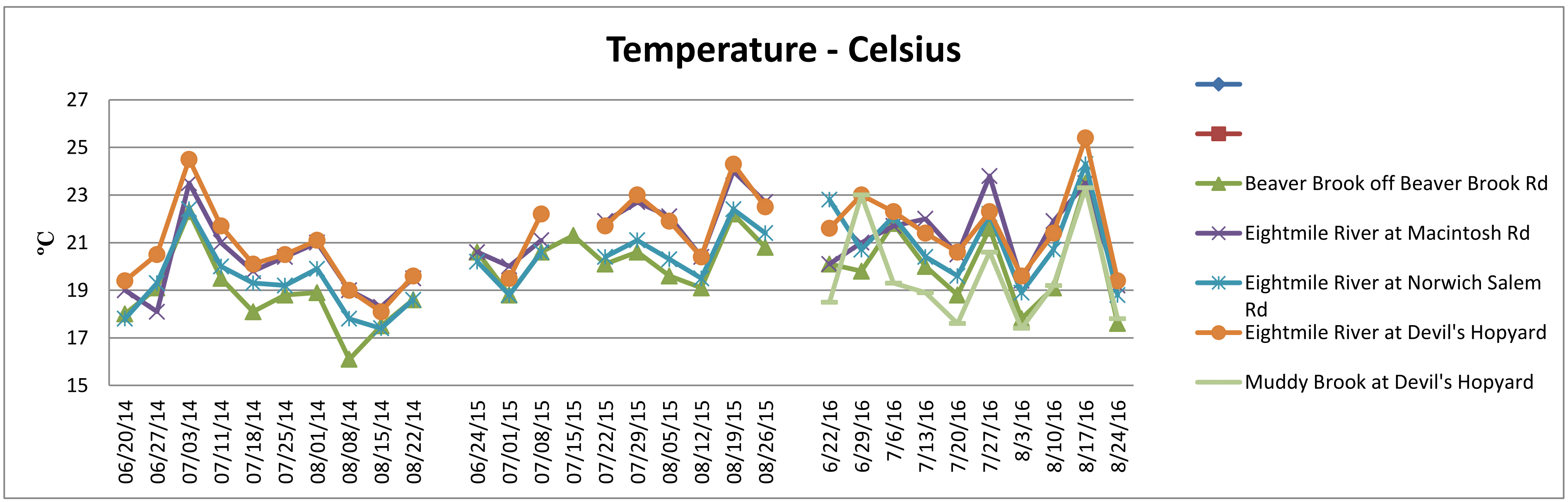
Species	Max. weekly average temp for growth (juveniles)	Max. temp for survival of short exposure (juveniles)	Max. average weekly temp. for spawning (a)	Max. temp. for embryo spawning(b)
Atlantic salmon	20 °C (68 °F)	23 °C (73 °F)	5 °C (41 °F)	11 °C (52 °F)
Bluegill	32 °C (90 °F)	35 °C (95 °F)	25 °C (77 °F)	34 °C (93 °F)
Brook trout	19 °C (66 °F)	24 °C (75 °F)	9 °C (48 °F)	13 °C (55 °F)
Common carp	---	---	21 °C (70 °F)	33 °C (91 °F)
Channel catfish	32 °C (90 °F)	35 °C (95 °F)	27 °C (81 °F)	29 °C (84 °F)
Largemouth bass	32 °C (90 °F)	34 °C (93 °F)	21 °C (70 °F)	27 °C (81 °F)
Rainbow trout	19 °C (66 °F)	24 °C (75 °F)	9 °C (48 °F)	13 °C (55 °F)
Smallmouth bass	29 °C (84 °F)	---	17 °C (63 °F)	23 °C (73 °F)
Sockeye salmon	18 °C (64 °F)	22 °C (72 °F)	10 °C (50 °F)	13 °C (55 °F)

a - Optimum or mean of the range of spawning temperatures reported for the species
b - Upper temperature for successful incubation and hatching reported for the species
c - Upper temperature for spawning *(Brungs and Jones 1977)*

*Excerpted from Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003, November 1997

http://water.epa.gov/type/rsl/monitoring/stream_index.cfm


Temperature - Celsius
°C
27.0
25.0
23.0
21.0
19.0
17.0
15.0
06/20/14
06/27/14
07/03/14
07/11/14
07/18/14
07/25/14
08/01/14
08/08/14
08/15/14
08/22/14
06/24/15
07/01/15
07/08/15
07/15/15
07/22/15
07/29/15
08/05/15
08/12/15
08/19/15
08/26/15
6/22/16
6/29/16
7/6/16
7/13/16
7/20/16
7/27/16
8/3/16
8/10/16
8/17/16
8/24/16
East Branch of the Eightmile at Darling Rd
East Branch of the Eightmile at Salem Rd
East Branch of the Eightmile at Morgan Rd
Harris Brook off Music Vale Rd


Temperature - Celsius
°C
27
25
23
21
19
17
15
06/20/14
06/27/14
07/03/14
07/11/14
07/18/14
07/25/14
08/01/14
08/08/14
08/15/14
08/22/14
06/24/15
07/01/15
07/08/15
07/15/15
07/22/15
07/29/15
08/05/15
08/12/15
08/19/15
08/26/15
6/22/16
6/29/16
7/6/16
7/13/16
7/20/16
7/27/16
8/3/16
8/10/16
8/17/16
8/24/16
Beaver Brook off Beaver Brook Rd
Eightmile River at Macintosh Rd
Eightmile River at Norwich Salem Rd
Eightmile River at Devil's Hopyard
Muddy Brook at Devil's Hopyard

Quick Summary: The removal of Ed Bills Dam on the East Branch of the Eightmile resulted in a notable stream temperature decrease at the East Branch of the Eightmile at Salem Road (red line on graph) in the summer of 2016. Muddy Brook (a new site added in the summer of 2016) consistently had the lowest temperature of all sites. Similar to an event that occurred at four of the sites in mid-August of 2015, on August 17 of 2016, six of the sites had temperatures exceeding 24^oC, which is the maximum temperature for short term survival of juvenile Brook Trout.

The table below shows averaged stream temperatures for each summer monitoring period.

Averaged Stream Temperatures (^oC) for Each Summer Monitoring Period			
Stream Segment (Site No. on Map)	**Avg. Temp. 2014**	**Avg. Temp. 2015**	**Avg. Temp. 2016**
East Branch of the Eightmile at Darling Road (Site 1)	19.5	21.08	20.91
East Branch of the Eightmile at Salem Road (Site 2)	22.5	23.17	21.76
Beaver Brook off Beaver Brook Road (Site 3)	18.7	20.37	20.01
Eightmile at Macintosh Road (Site 4)	20.0	21.72	21.31
Eightmile (West Branch) at Norwich-Salem Road (Site 5)	19.2	20.52	21.05
Eightmile (West Branch) at Hopyard (Site 6)	20.5	21.94	21.7
Muddy Brook at Hopyard (Site 6A)	--	--	19.56
East Branch of the Eightmile at Morgan Road (Site 7)	21.0	21.89	22.43
Harris Brook above Music Vale Road (Site 8)	19.6	21.28	21.83

Please Note: Variations in weather, rainfall and streamflow from one summer to another can account for differences in measurements, which is why multiple years of data are important.

pH

What is pH and why is it important?*

pH is a term used to indicate the alkalinity or acidity of a substance as ranked on a scale from 1.0 to 14.0. Acidity increases as the pH gets lower.

pH affects many chemical and biological processes in the water. For example, different organisms flourish within different ranges of pH. **The largest variety of aquatic animals prefers a range of 6.5-8.0.** pH outside this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds to become mobile and "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life, particularly to sensitive species like rainbow trout. Changes in acidity can be caused by atmospheric deposition (acid rain), surrounding rock, and certain wastewater discharges.

The pH scale measures the logarithmic concentration of hydrogen (H+) and hydroxide (OH-) ions, which make up water (H+ + OH- = H2O). When both types of ions are in equal concentration, the pH is 7.0 or neutral. Below 7.0, the water is acidic (there are more hydrogen ions than hydroxide ions). When the pH is above 7.0, the water is alkaline, or basic (there are more hydroxide ions than hydrogen ions). Since the scale is logarithmic, a drop in the pH by 1.0 unit is equivalent to a 10-fold increase in acidity. So, a water sample with a pH of 5.0 is 10 times as acidic as one with a pH of 6.0, and pH 4.0 is 100 times as acidic as pH 6.0.

*Excerpted from Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003, November 1997
http://water.epa.gov/type/rsl/monitoring/stream_index.cfm

The diagram below shows pH ranges for types of water and general ranges affecting survival of various plants and animals

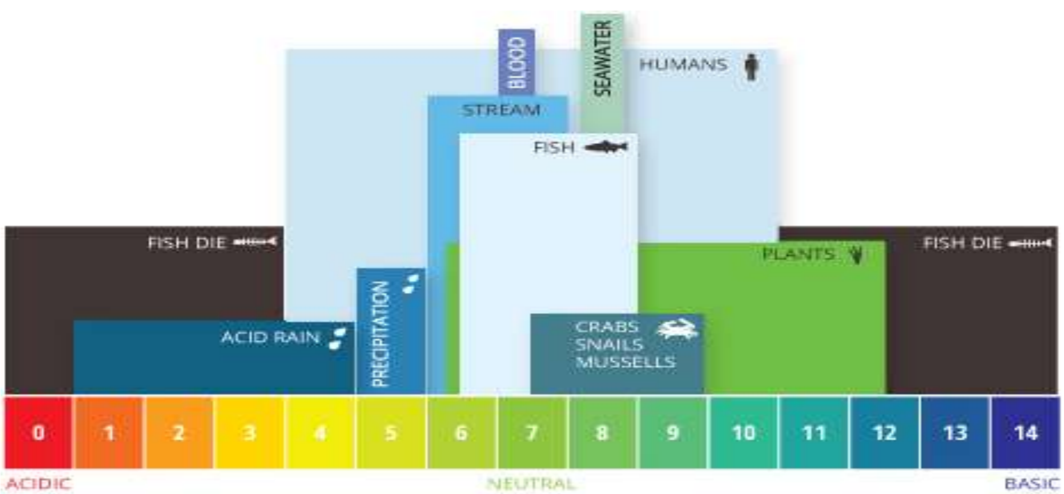
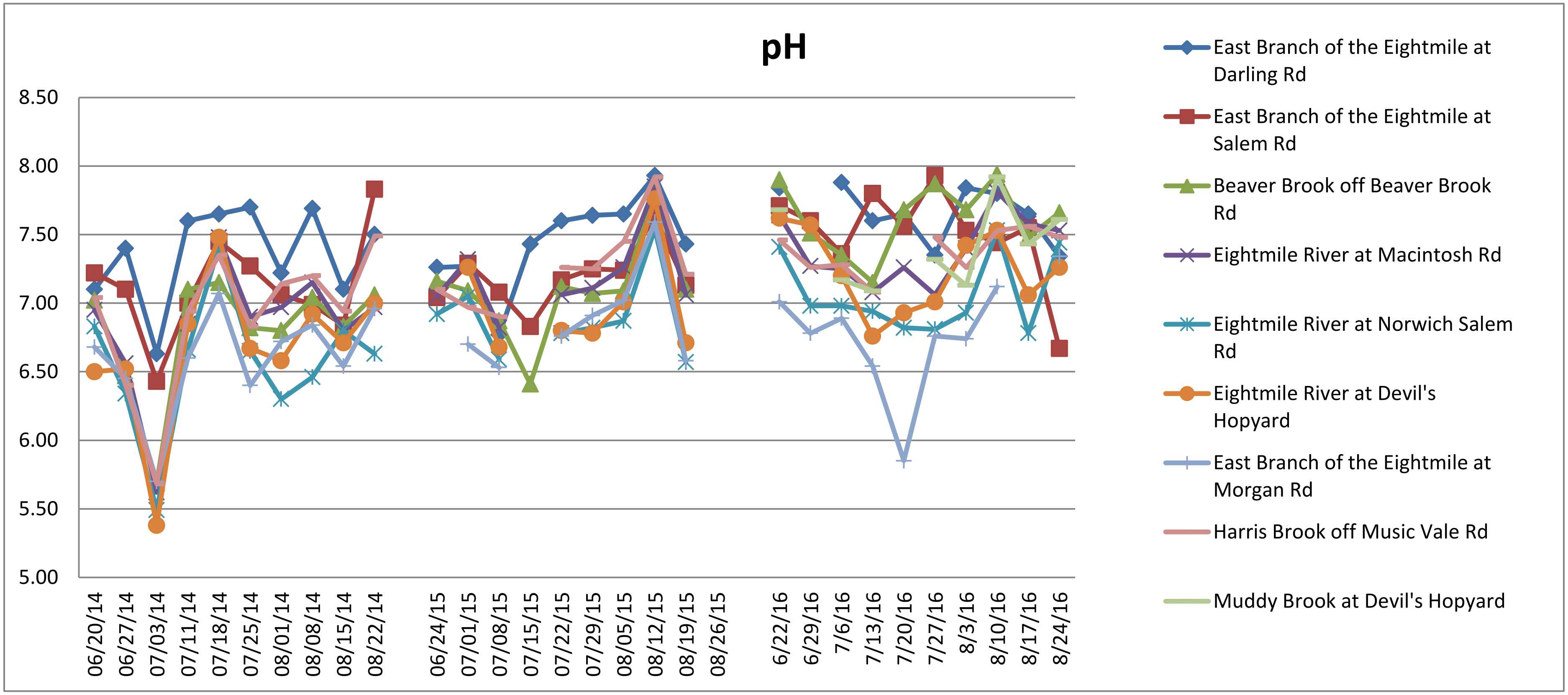


Diagram and facts information from the article *"Fundamentals of Environmental Measurement"* on the Fondriest website:
http://www.fondriest.com/environmental-measurements/parameters/water-quality/ph/#p1



Quick Summary: Summer 2016 pH readings were generally within anticipated range, with the exception of one reading on July 20, 2016 for East Branch of the Eightmile at Morgan Road. Since this did correspond with a rain event, this may be due to instrument or reading error.

Please Note: Variations in weather, rainfall and streamflow from one summer to another can account for differences in measurements, which is why multiple years of data are important.

Dissolved Oxygen

What is dissolved oxygen and why is it important?*

The stream system both produces and consumes oxygen. It gains oxygen from the atmosphere and from plants as a result of photosynthesis. Running water, because of its churning, dissolves more oxygen than still water, such as that in a reservoir behind a dam. Respiration by aquatic animals, decomposition, and various chemical reactions consume oxygen.

Wastewater from sewage treatment plants often contains organic materials that are decomposed by microorganisms, which use oxygen in the process. (The amount of oxygen consumed by these organisms in breaking down the waste is known as the biochemical oxygen demand or BOD. Other sources of oxygen-consuming waste include stormwater runoff from farmland or urban streets, feedlots, and failing septic systems.

Oxygen is measured in its dissolved form as dissolved oxygen (DO). If more oxygen is consumed than is produced, dissolved oxygen levels decline and some sensitive animals may move away, weaken, or die.

DO levels fluctuate seasonally and over a 24-hour period. They vary with water temperature and altitude. Cold water holds more oxygen than warm water and water holds less oxygen at higher altitudes. Thermal discharges, such as water used to cool machinery in a manufacturing plant or a power plant, raise the temperature of water and lower its oxygen content. **Aquatic animals are most vulnerable to lowered DO levels in the early morning on hot summer days when stream flows are low, water temperatures are high, and aquatic plants have not been producing oxygen since sunset.**

*Excerpted from Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003, November 1997

http://water.epa.gov/type/rsl/monitoring/stream_index.cfm

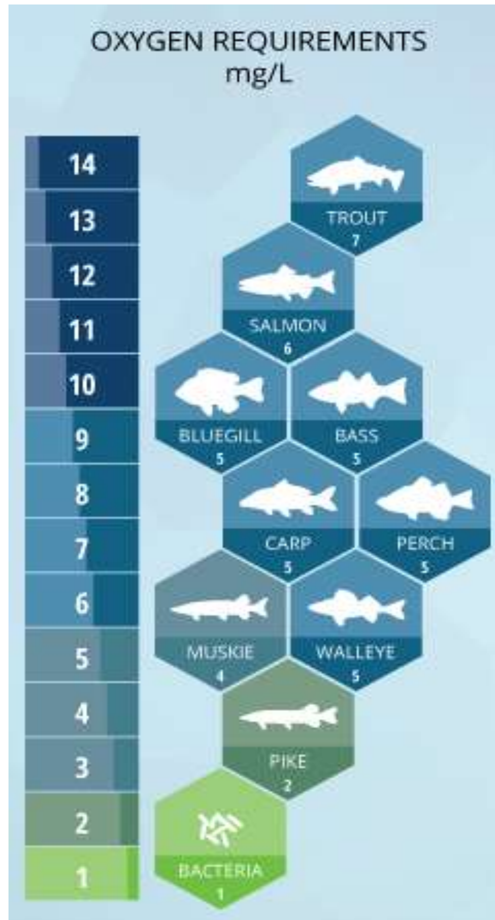
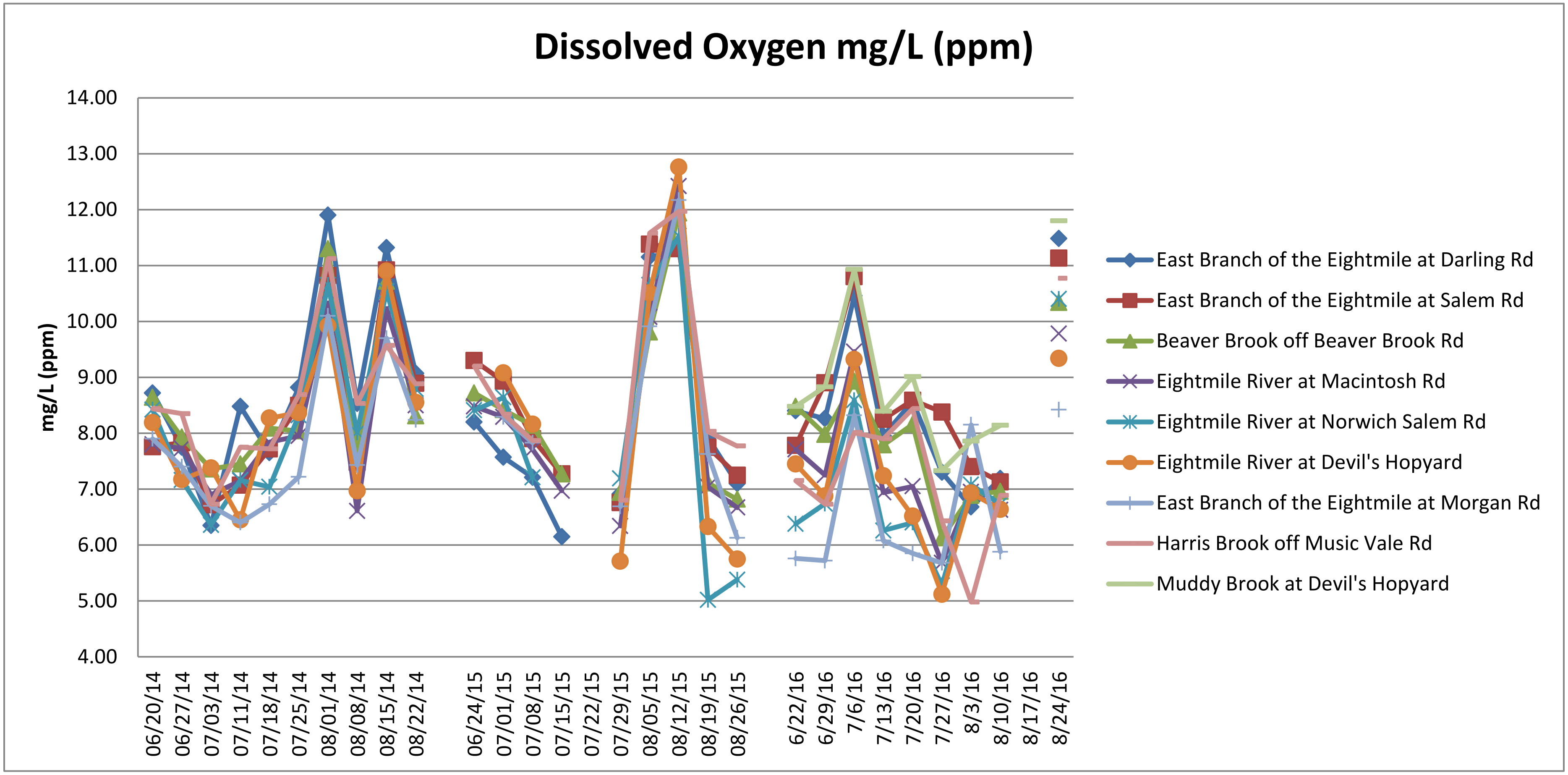


Diagram showing the Minimum dissolved oxygen requirements of freshwater fish.

Diagram and facts information from the article "Fundamentals of Environmental Measurement" on the Fondriest website: http://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen/#1



Quick Summary: Gaps in 2015 and 2016 data indicate temporary instrument malfunction. In general, DO levels were highest on average for Muddy Brook and lowest for East Branch of the Eightmile at Morgan Road. Overall DO levels were also lower in 2016, but rose (8/24/2016) toward the end of the summer, most likely due to a response in cooler air temperatures and timing of rain events.

Please Note: Variations in weather, rainfall and streamflow from one summer to another can account for differences in measurements, which is why multiple years of data are important.

Conductivity

What is conductivity and why is it important?*

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as conductivity at 25 degrees Celsius (25 C).

Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through.

Discharges to streams can change the conductivity depending on their make-up. A failing sewage system would raise the conductivity because of the presence of chloride, phosphate, and nitrate; an oil spill would lower the conductivity.

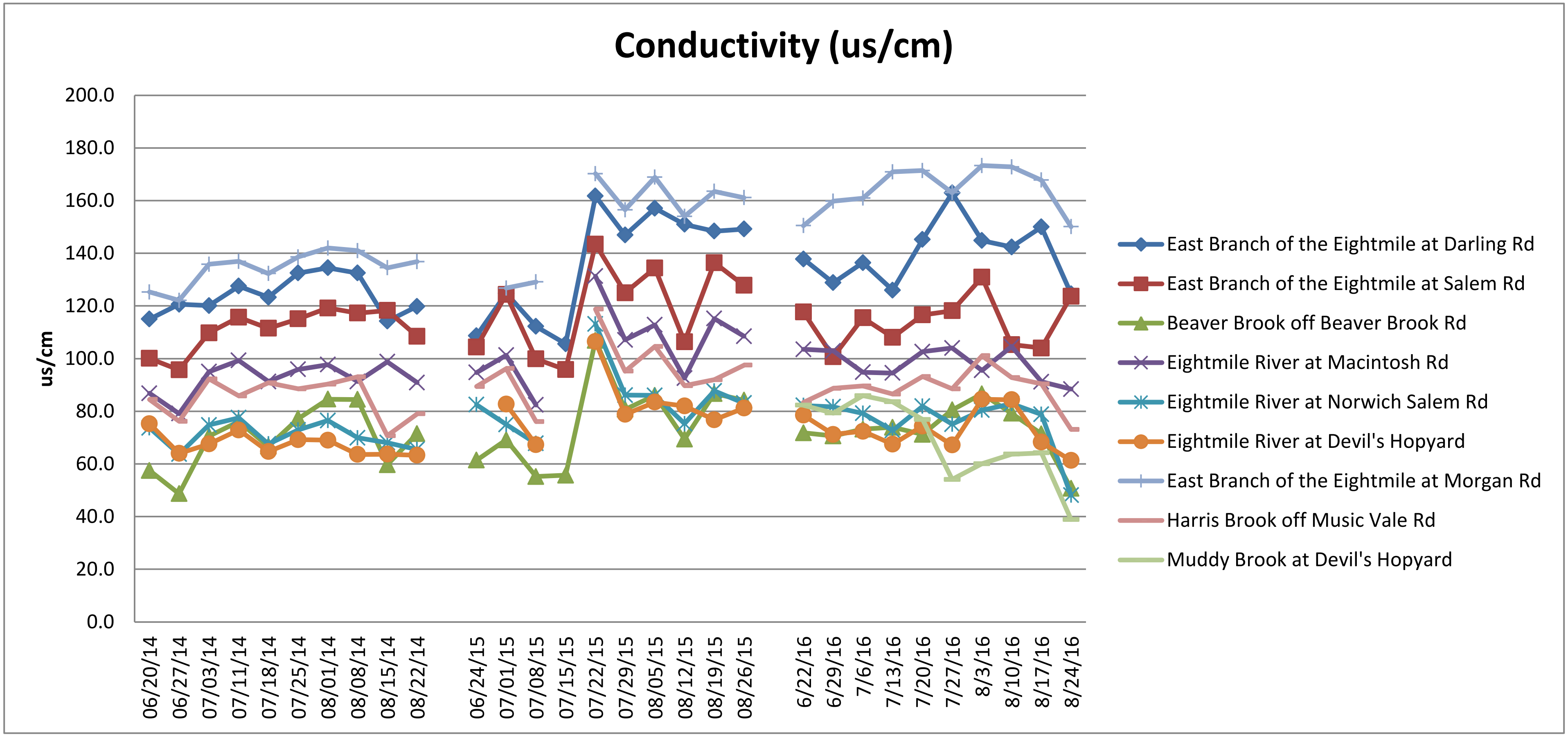
The basic unit of measurement of conductivity is the mho or siemens. Conductivity is measured in micromhos per centimeter (µmhos/cm) or microsiemens per centimeter (µs/cm). Distilled water has a conductivity in the range of 0.5 to 3 µmhos/cm. **The conductivity of rivers in the United States generally ranges from 50 to 1500 µmhos/cm.** Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µhos/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates. Industrial waters can range as high as 10,000 µmhos/cm.

Sampling Considerations

Conductivity is useful as a general measure of stream water quality. **Each stream tends to have a relatively constant range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements.** Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream.

*Excerpted from Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003, November 1997

http://water.epa.gov/type/rsl/monitoring/stream_index.cfm



Quick Summary: Gaps in data indicate instrument malfunction. While there appears to be slight upward trending of conductivity levels, especially with the East Branch of the Eightmile at Morgan and Darling Roads, this may be partially explained due to drought conditions. Worth noting is that in all three years, sites generally held the same conductivity-ranked position in relation to one another, which is expected if conductivity levels are primarily based on the type of geologic deposits, rather than man-induced activities. Muddy Brook exhibited the lowest levels of conductivity, especially as the summer went on, while the East Branch of the Eightmile at Morgan Road had the highest levels of conductivity on every day that the testing was done.

Please Note: Variations in weather, rainfall and streamflow from one summer to another can account for differences in measurements, which is why multiple years of data are important.

Total Dissolved Solids

What are total dissolved solids and why are they important?*

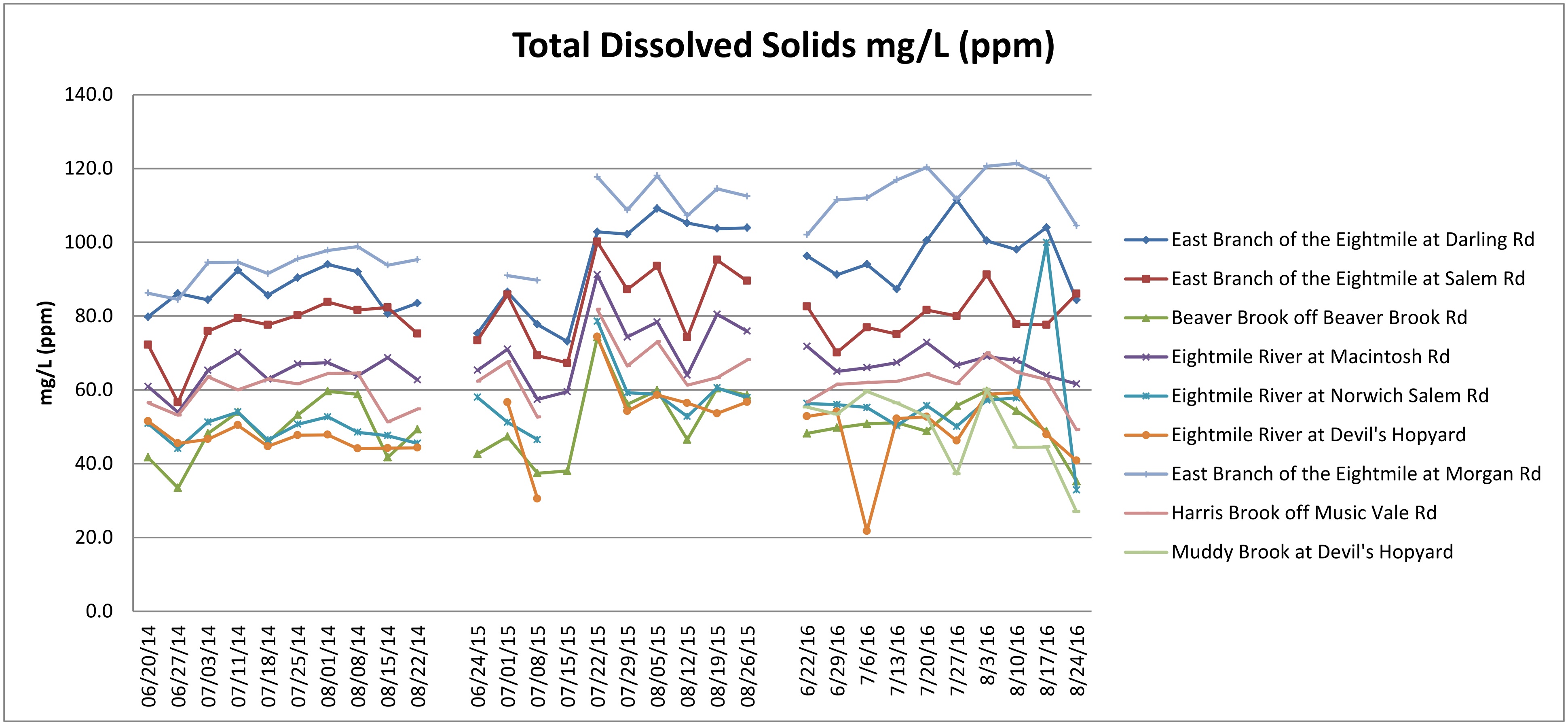
In stream water, dissolved solids consist of calcium, chlorides, nitrate, phosphorus, iron, sulfur, and other ions particles that will pass through a filter with pores of around 2 microns (0.002 cm) in size. The concentration of total dissolved solids affects the water balance in the cells of aquatic organisms. An organism placed in water with a very low level of solids, such as distilled water, will swell up because water will tend to move into its cells, which have a higher concentration of solids. An organism placed in water with a high concentration of solids will affect that organism's ability to maintain the proper cell density, making it difficult to keep its position in the water column. It might float up or sink down to a depth to which it is not adapted, and it might not survive.

Sources of total dissolved solids include industrial discharges, sewage, fertilizers, road runoff, and soil erosion. Total solids are measured in milligrams per liter (mg/L).

*Excerpted from Volunteer Stream Monitoring: A Methods Manual, Total Solids Section, EPA 841-B-97-003, November 1997

http://water.epa.gov/type/rsl/monitoring/stream_index.cfm

Note: Freshwater lakes and streams generally fall within the range of 50-250 mg/L.



Quick Summary: Gaps in data indicate instrument malfunction. While there appears to be slight upward trending of total dissolved solids levels, especially with the East Branch of the Eightmile at Morgan and Darling Roads, this may be partially explained due to drought conditions. And in general, the East Branch of the Eightmile continues to exhibit the highest readings, followed by the East Branch of the Eightmile on Darling Road. Muddy Brook generally exhibited the lowest levels of TDS.

Please Note: Variations in weather, rainfall and streamflow from one summer to another can account for differences in measurements, which is why multiple years of data are important.

Salinity

Salinity is a measure of the salt concentration of water. It is a measure of the total amount of dissolved salts. Higher salinity means the water is more salty, while low salinity means that the water is more fresh. Salinity is measured in parts per million (ppm) or mg/L.

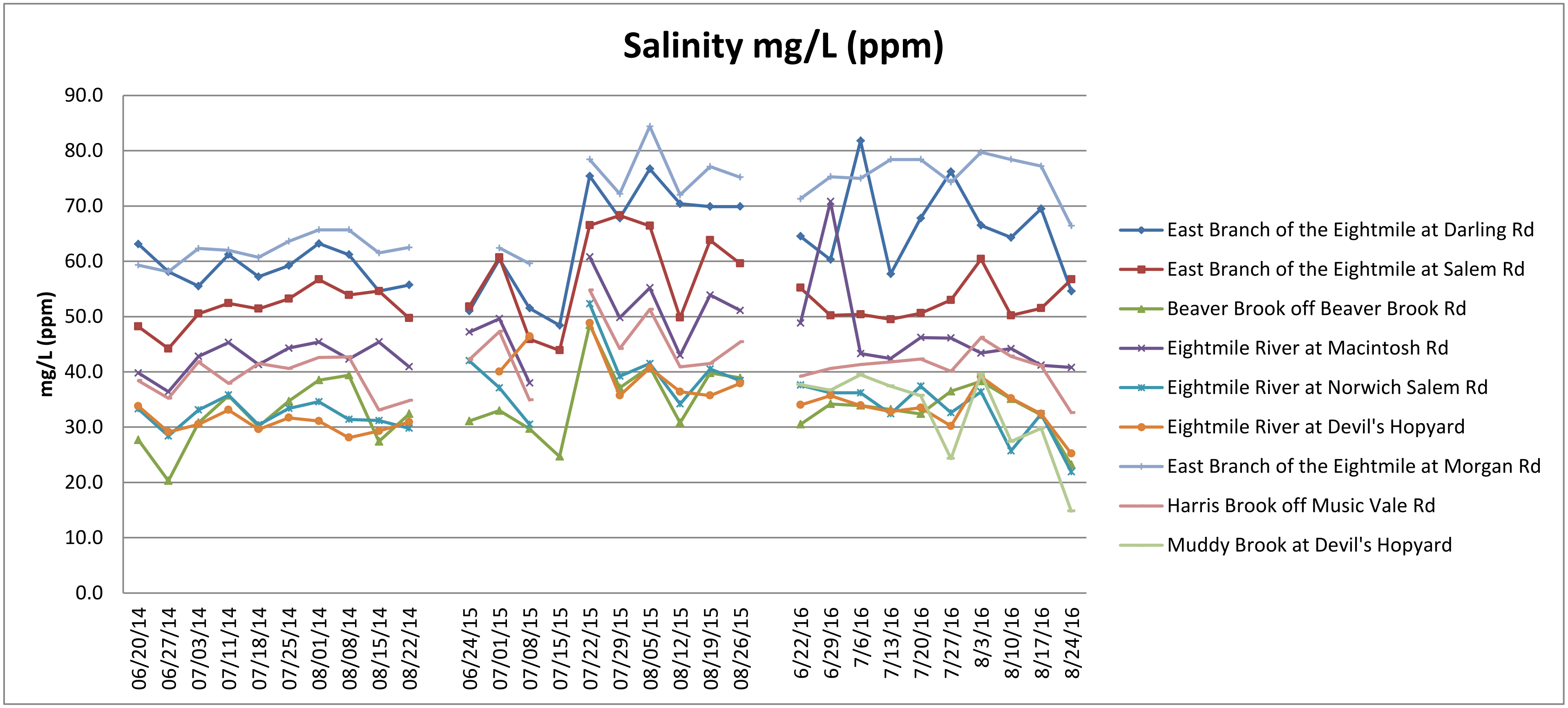
Saline in Various Waters

- **fresh water (typical city water in United States) : < 100 ppm**
- **fresh water, ponds, lakes, rivers, streams, aquifers: 0-500ppm**
- **water supply typically restricted to : 500 ppm**
- **fresh water - official salt concentration limits in drinking water US: 1000 ppm**
- **typical limit agriculture irrigation : 2000 ppm**
- **brackish water, mildly : 1000 - 5,000 ppm**
- **brackish water, moderately : 5000 - 15,000 ppm**
- **brackish water, heavily : 15,000 - 35,000 ppm**
- **sea water : 30,000 - 50,000 ppm (approx. 35,000)**

Increasingly, due to winter deicing practices, especially in northern states, the possibility of increased salinity levels in ground and surface waters has raised concerns. While there may be flushes of higher salinity concentrations after winter storm events in surface waters, higher concentration of salts in groundwater is a concern when it contributes to base flow in streams. In summer months when rainfall may be more limited, contributing groundwater through base flow may make up a higher percentage of water in a stream segment. Baseline data during summer months will help determine whether there are any changes to salinity in stream segments during critical times.

The link below provides further information about the connection of impervious surfaces and levels of salinity in streams.

http://www.bayjournal.com/article/impervious_surfaces_driving_up_levels_of_salinity_in_streams



Quick Summary: Gaps in data indicate instrument malfunction. The salinity levels in 2015 and 2016 for some segments showed greater range and variability than the levels of 2014. While there appears to be slight upward trending of salinity, especially with the East Branch of the Eightmile at Morgan and Darling Roads, this may be partially explained due to drought conditions. Generally, the sites maintained their relative ranking compared to each other, with Muddy Brook, the Eightmile at Norwich Salem Road, and the Eightmile at Devil's Hopyard having the lowest readings.

Please Note: Variations in weather, rainfall and streamflow from one summer to another can account for differences in measurements, which is why multiple years of data are important.