

Draft Ausable River Water Quality Report (Summer 2009, Phase I Results)



Thank you to the Tri Lakes Chapter of Trout Unlimited for donating the funds that purchased the Lab Quest probes that were used to record the data for this study.



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Why Measure Water Quality

Although water quality is reported as generally “good” in the Ausable, incidences of poor water quality and absence of consistent information about water quality from all Branches of the Ausable is lacking. This has left many citizens of the Ausable Watershed wondering “What is in the river water?” Should I drink it? Fish in it? or Swim in it?¹

The Ausable Technical Advisory Committee (ATAC) chose to conduct river sampling in two phases. In Phase I (year 1) a water quality indicator tests will be conducted using field probes. In Phase II (year 2) grab samples will be collected and analyzed in a laboratory for specific parameters.

Conductivity is the chosen parameter for Phase I because it is a general indicator of water quality. In Year 2 (Phase II) areas or tributaries of higher conductivity will be sampled and analyzed for specific pollutants such as: pH, total suspended solids, phosphorous, organic compounds, nitrates, total coliform and fecal coliform.

What is conductivity?

Conductivity is an easy and informative water quality test. It is sometimes used as a “watchdog” environmental test. Conductivity measures the ability of water to pass an electrical current due to the presence of dissolved ions. Rain, streambank erosion, snow melt, barnyard or pet waste runoff, a failing septic system, or road salt will raise conductivity because of the presence of ions such as chloride, phosphate, nitrate etc. Oil spills lower water conductivity. Temperature influences conductivity therefore tributaries, shade, sunlight, stream depth, and sampling depth, all affect a measured conductivity. A conductivity probe does not identify the specific ion responsible for an increase or decrease in conductivity; it is simply an indication of the level of total dissolved solids (TDS) in the stream. Laboratory tests can be used to help determine a specific ion or ions that contribute to conductivity readings.

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 conductivities because granite is composed of more inert materials that do not ionize (dissolve into ionic components). Conversely, streams that run through areas with sedimentary rock or 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 affect depending on the bedrock they flow through. Surface water discharges to streams can change the conductivity depending upon their make-up.

The basic unit of measurement of conductivity is the mho or siemens. Conductivity is measured in micromhos per centimeter ($\mu\text{mhos/cm}$) or microsiemens per centimeter ($\mu\text{s/cm}$). A mho is an older name for a siemens, which is defined to be the inverse of the ohm.

Typical Conductivity Readings in Natural Settings

Water	Conductivity Range
Distilled water	0.5 to 3 $\mu\text{mhos/cm}$
Typical conductivity of rivers in the United States	50 to 1500 $\mu\text{mhos/cm}$
Ponds in the upper Ausable Watershed	19.6 to 120 $\mu\text{mhos/cm}$
Inland fresh waters that support good mixed fisheries	150 and 500 $\mu\text{hos/cm}$
Industrial waters	As high as 10,000 $\mu\text{mhos/cm}$

¹ Ausable Watershed Management Strategy, 2008, Ausable Watershed Management Planning public input meetings, p. 32.

Procedure

Water samples were taken at every bridge that crosses the river and at the mouth of every major tributary (Figures 1 and 2). This includes 21 sites on the East Branch, 20 sites on the West Branch and 13 sites on the Main Stem.

Samples were retrieved from the thalweg (swiftest, deepest flow) using a bottle suspended on a rope. Each sampling station was permanently marked in order to duplicate the exact sampling location for each month of sampling.

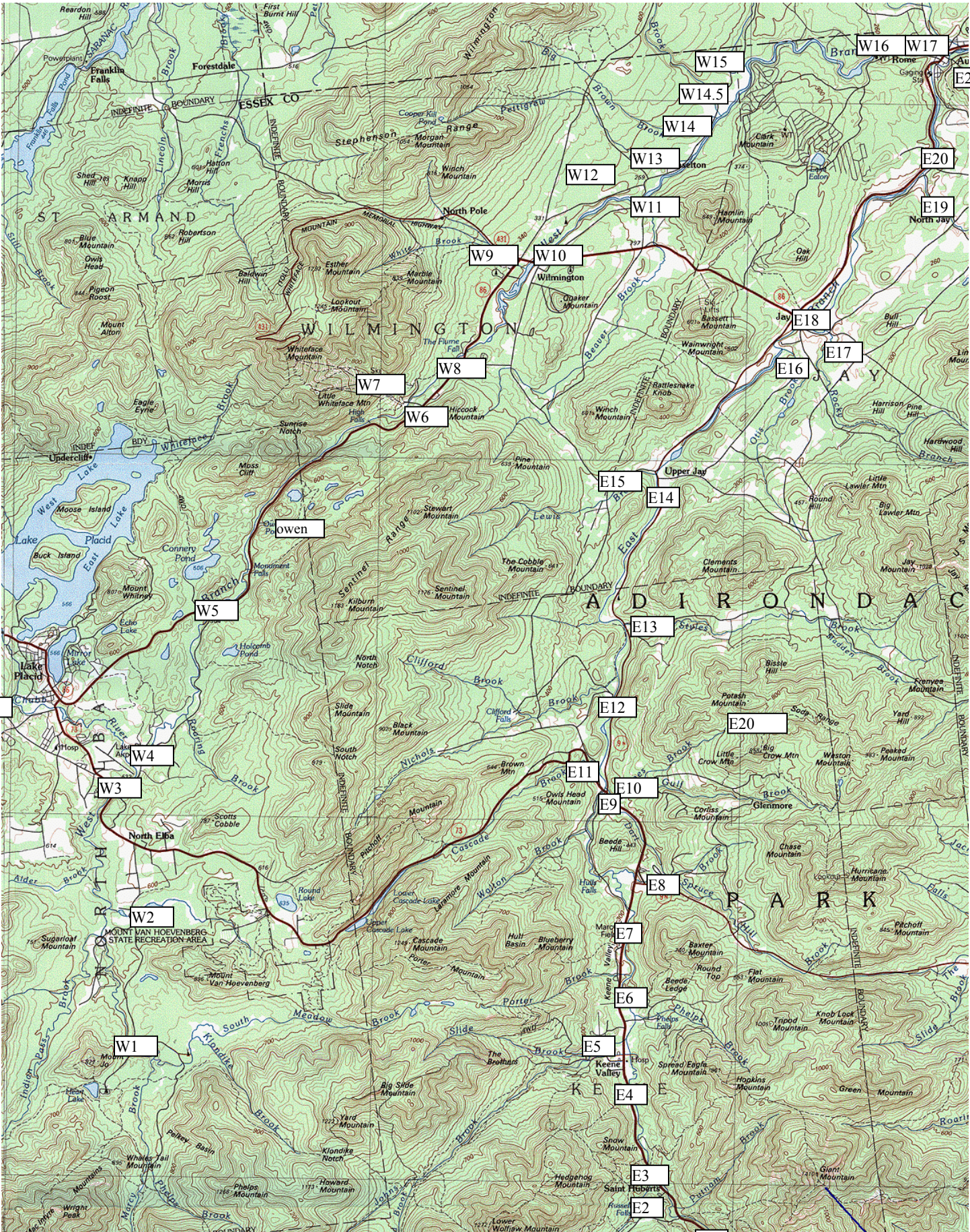
Equipment:

The Ausable River samples were analyzed using a Lab Quest instrument with conductivity and temperature probes attached.

The Lab Quest has an internal thermometer that corrects readings to report conductivity at 25 degrees C. This compensates for changes in conductivity due to changes in water temperature.

Figure 1. Location of water sampling stations on the East (E) and West (W) Branch Ausable River (p.4).

Figure 2. Location of water sampling stations on the Main Stem (M) Ausable River (p.5)





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Results

Specific conductance of samples taken at the river sample stations is shown in Figures 3 and 4.

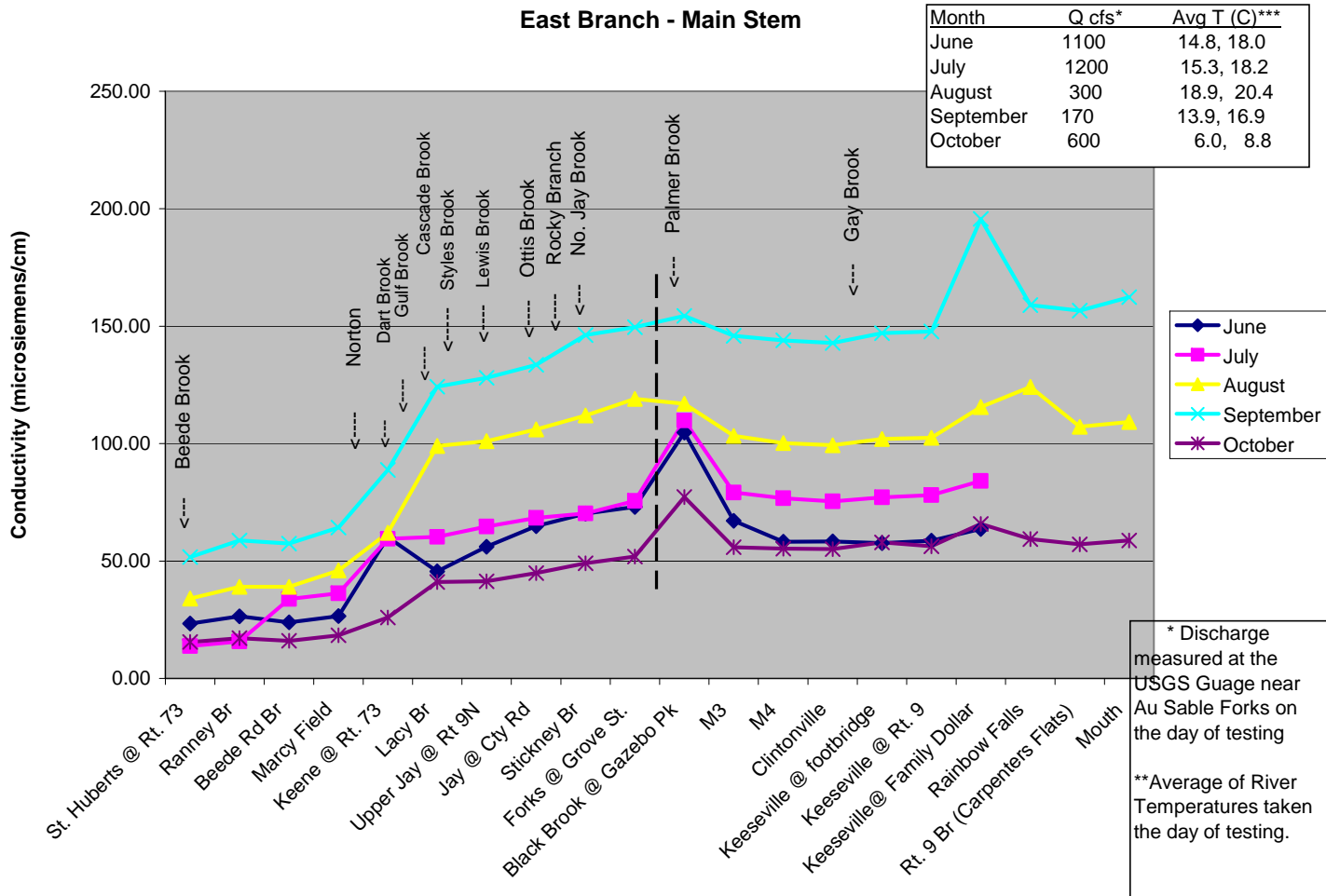


Figure 3. Specific Conductance of the Ausable River taken at each bridge crossing on the East Branch and Main Stem. Arrows with brook names indicate the location along the profile where major tributaries enter. These correspond to the monitored tributaries shown in figures 3 and 4. The inset table lists discharge measured at the USGS Gauge near Au Sable Forks on the day of testing and the average of river temperatures taken on the day of testing.

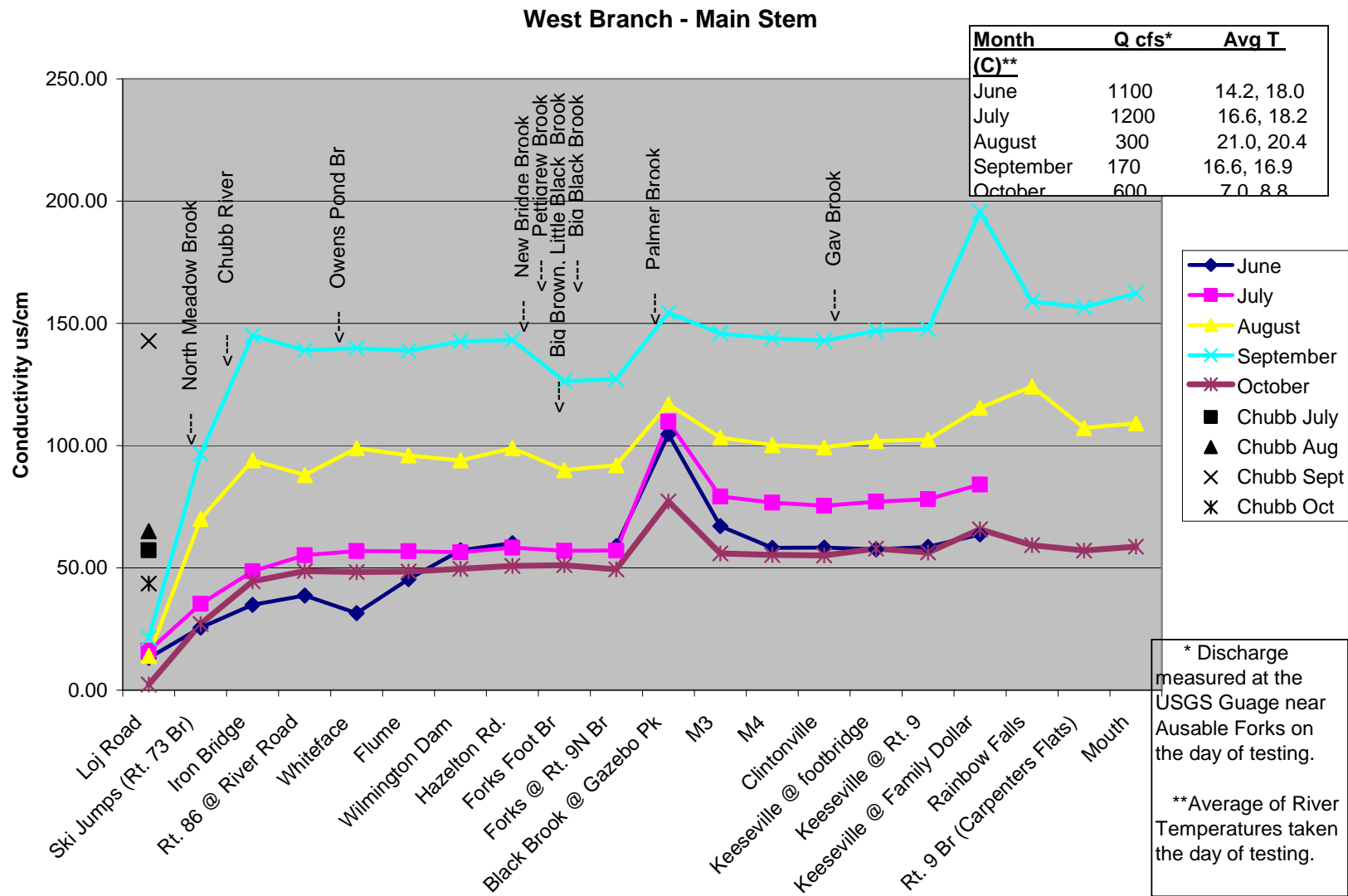


Figure 4. Conductivity of Ausable River taken at each bridge crossing on the West Branch and Main Stem. Arrows with brook names indicate the location along the profile where major tributaries enter. These correspond to the monitored tributaries shown in figures 3 and 4. The inset table lists discharge measured at the USGS Gauge near Au Sable Forks on the day of testing and the average of river temperatures taken on the day of testing.

Results for conductivity and temperature at river points and tributary mouths are shown in Figures 5 and 6.

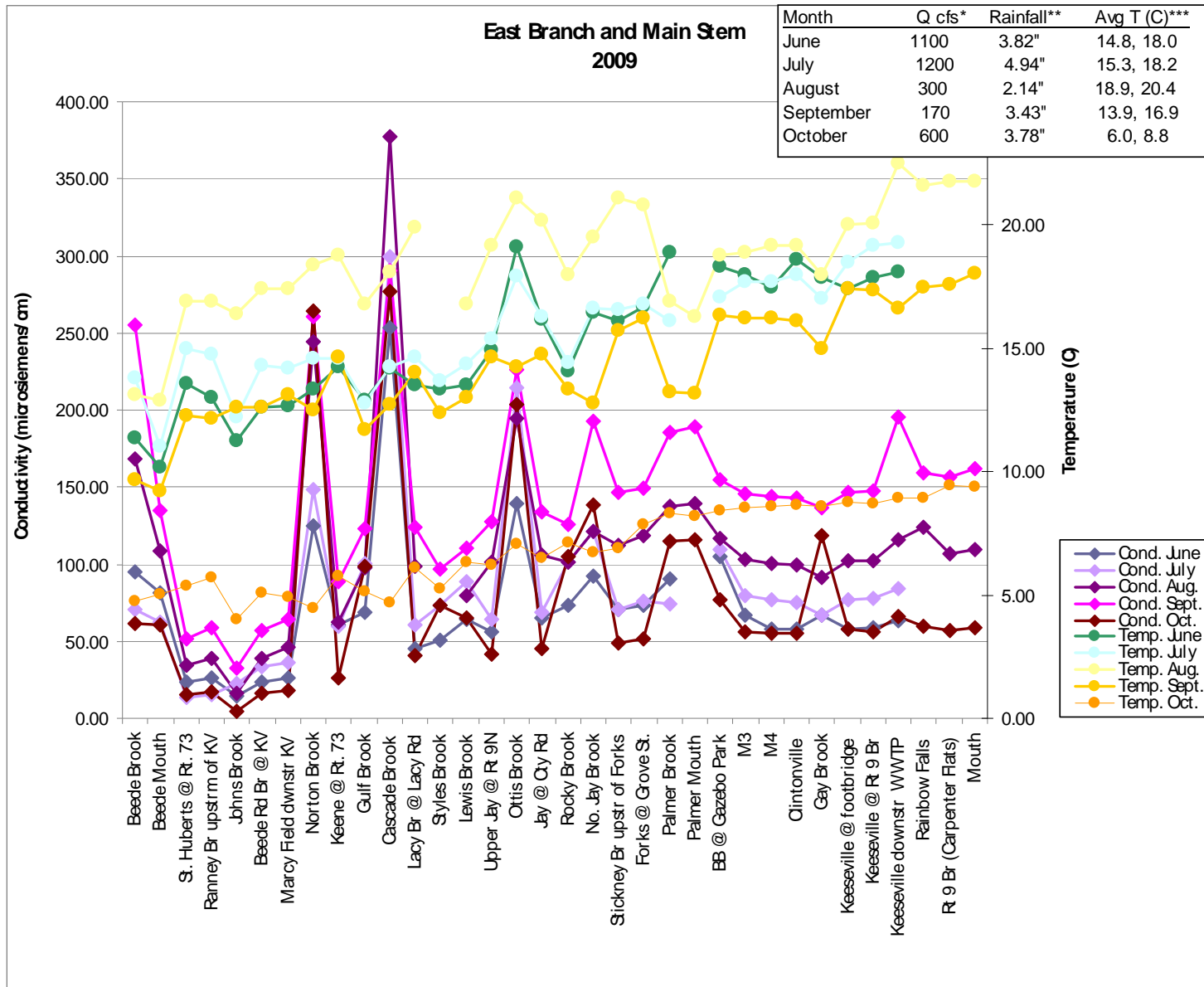


Figure 5. Conductivity and temperature of East Branch, Main Stem, and tributaries. * Discharge measured at the USGS Gauge near Au Sable Forks on the day of testing. **Total Monthly Rainfall measured at Saranac Lake. ***Average of River Temperatures taken on the day of testing.

West Branch and Main Stem 2009

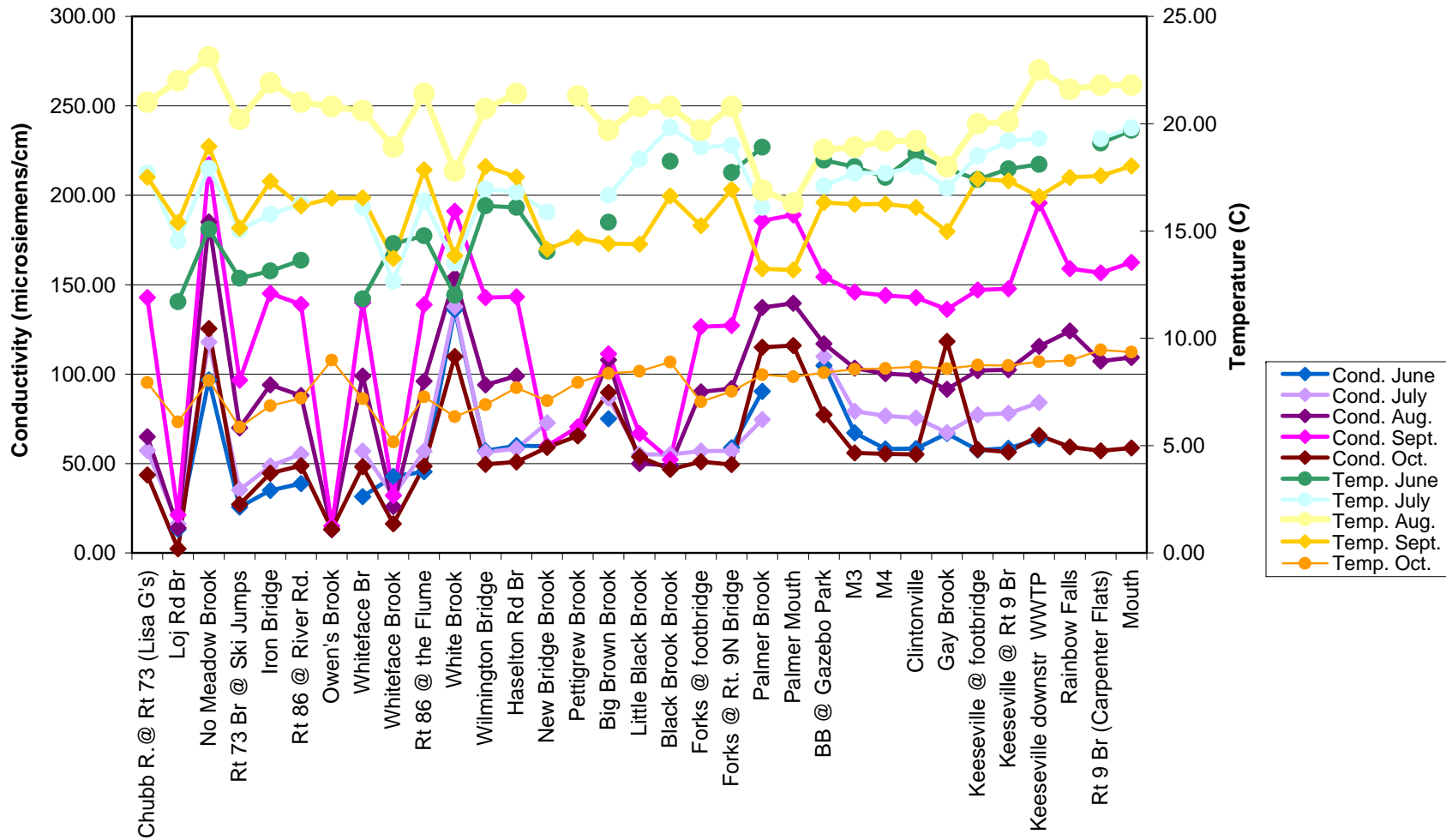


Figure 6. Conductivity and temperature of East Branch, Main Stem, and tributaries.
 * Discharge measured at the USGS Gauge near Au Sable Forks on the day of testing.
 ** Total Monthly Rainfall measured at Saranac Lake.
 *** Average of River Temperatures taken on the day of testing.

General Trends

Two obvious trends in temperature can be seen in Figures 1 through 4. River temperature slowly warmed through the summer followed by drastic, sudden fall cooling. The warmest temperatures were recorded in August. More detailed temperature records were recorded using data loggers placed in the river at eight of the sample points. This data is currently being processed and will be available soon.

Trends in conductivity are more difficult to discern but some general trends can be qualified. First, conductivity of river water is very low. The typical conductivity of rivers in the U.S. is between 50 and 1500 microsiemens/cm. Specific conductance reported by the USGS for 5 other in the Eastern Adirondack Rivers ranges from 49 to 1169 $\mu\text{S}/\text{cm}^2$. The Ausable conductance ranges from 10 $\mu\text{S}/\text{cm}$ at the headwaters to 120-150 $\mu\text{S}/\text{cm}$ at the mouth. This is an indication of good water quality and also a reflection of rock type found in the Adirondack Mountains. The bedrock in headwater streams is Anorthosite and high grade metamorphic rock; both very low solubility rocks that contribute few ions to runoff.

September and August conductivity values are the highest of those recorded in the study. This corresponds to months when river discharge was at its lowest. In June, July, and October conductivities are lower and in these months discharge was at its highest. Conductivity rises as river temperature rises. October conductivity levels are lowest and this is when river temperatures are lowest.

When conductivities are compared in the downstream direction (Figures 3 and 4) several important trends are observed. On the East Branch, conductivity is low along the entire river length, ranging from 15 to 150 $\mu\text{S}/\text{cm}$. In June, July, and October river length conductivities remain low with a gradual rise in the downstream direction (ranging from 15 to 75 $\mu\text{S}/\text{cm}$). In August and September conductivities range from 34 to 150 $\mu\text{S}/\text{cm}$; however, instead of a gradual rise in the downstream direction, there is a rise in conductivity starts somewhere downstream of the Beede Bride sample point in Keene.

On the Main Stem conductivities range from 58 to 195 $\mu\text{S}/\text{cm}$ throughout the summer (Figure 3 & 4). Except for two points along its length conductivity readings show little variation between Au Sable Forks and the Mouth. Two exceptions are found, one at the Town of Black Brook Gazebo Park (downstream of the mouth of Palmer Brook in Au Sable Forks), and at the Family Dollar in Keeseville. In June, July, and October samples at Gazebo Park show that conductivity increases by 25 $\mu\text{S}/\text{cm}$ over baseline river water. Conductivity drops back to baseline at the next sample site downstream of Gazebo Park. These increases in conductivity coincides with the highest recorded flows but is not prevalent at the lowest flows

The other anomalous reading on the Main Stem is at the Family Dollar sample site in Keeseville (Figure 3 & 4). Conductivity is higher at this site as compared to up and downstream. The increase is most prominent in September and August when conductivity rose 12 to 47 $\mu\text{S}/\text{cm}$ above the upstream measurement.

On the West Branch Ausable conductivities range from 13 $\mu\text{S}/\text{cm}$ to 127 $\mu\text{S}/\text{cm}$. Conductivities at the upstream most sample sites are extremely low (13 to 21 $\mu\text{S}/\text{cm}$). During the months of June, July, and October conductivity ranges from 2 to 59 $\mu\text{S}/\text{cm}$ (the highest flow months). In August and September, the lowest flow months, conductivities range from 14 to 127 $\mu\text{S}/\text{cm}$. West Branch conductivity readings rise gradually between the headwaters and the Iron Bridge sample points and then stay at a consistent conductivity with little variation until the West Branch joins the East Branch at Au Sable Forks. In June, July, and October the increase in conductivity is gradual between the headwaters and Iron Bridge. In

² Butch, G.K., Murray, P.M., Brooks, L.T., McGrath, Kenneth, Edwards, D.D., 2005, Water resources data, New York, water year 2004, volume 1, eastern New York excluding Long Island: U.S. Geological Survey Water-Data Report NY-04-1, 581 p

August and September a sudden, large increase in conductivity is recorded at the Iron Bridge sample point. Conversely, there is a 10 to 17 us/cm drop in conductivity between the Hazelton bridge site and the Au Sable foot bridge site in August and September.

In summary, conductivity in the Ausable River is generally low and rises gradually in the downstream direction. Changes in conductivity in the downstream direction are most drastic during low flow months. In these months significant changes in conductivity occur downstream of Keene, Lake Placid, and Keeseville. Conversely, downstream of Au Sable Forks, an increase in conductivity is observed during high flow months. A look at conductivity in major tributaries feeding the Ausable may explain some of these changes while human influence may explain others.

Conductivity of Tributaries

Tributaries show no consistent trend in temperature or conductivity. Conductivity in some tributaries is much higher than the river and a few tributaries have conductivities lower than the river. High conductivity in some tributaries can be explained by the presence of elevated levels of salt, high nutrient and organic loading from wetlands, or livestock in the subwatershed.

Tributary conductivity and possible explanations for conductance levels are summarized in the table below.

Table 1. Tributaries having measured conductivity higher than the in the Ausable River.

Tributary Name	Average conductivity. us/cm	River conductance up/downstream	Tributaries with large wetland areas or possible questions to address
East Branch			
Beede Brook at Club Parking lot	130	/28	
Beede Brook Mouth	89	/28	
Norton Brook	208	38/59	Large wetland area
Gulf Brook	98	59/74	
Cascade Brook	299	59/74	Salt?
Ottis Brook	195	78/83	Large wetland area Cattle?
Rocky Branch	101	83/89	
North Jay Brook	133	83/89	Cattle?
Main Stem			
Palmer Brook at Golf Course Rd	120		Golf Course? P/N Septic?
Palmer Brook at Mouth	89	/112	Golf Course? P/N Septic?
West Branch			
North Meadow Brook	148	13/50	Large wetland area
White Brook	145	77/79	
Big Brown	94	82/64	Large wetland area

Table 2. Tributaries having measured conductivity similar or lower than the Ausable River:

Tributary Name	Avg conductivity. us/cm	River conductance up/downstream	Possible Questions to Address
East Branch			
John's Brook	18	31/34	
Styles Brook	58	74/78	
Lewis Brook	82	78/83	
Main Stem			
Gay Brook	96	86/88 -- wetlands	
West Branch			
Owen's Brook	8	73/75	
Whiteface Brook	30	75/77	
New Bridge Brook	50	82/64	
Pettigrew Brook	40	82/64	
Little Black Brook	45	82/64	
Big Black Brook	50	82/64	

Interpretation

The conductivity in the Ausable River tributaries varies widely and is influenced by a number of natural and human factors. In some cases tributary conductivity appears to influence river conductivity. In other cases human influences may affect river conductivity.

Conductivity in the Ausable River appears to increase below Keene Valley, Lake Placid, and Keeseville; this trend is especially prevalent during low flow months. River conductivity increases below Au Sable Forks during high flow months; and it *decreases* below Hazelton in low flow months. Many of these trends can be explained by tributary contributions.

Downstream of Keene Valley, Norton, Dart, Golf, and Cascade Brooks enter the Ausable. All have conductivities higher than the river (Cascade Brook has the highest conductivity found in the entire study!). Norton, Golf, and Cascade Brooks have especially large subwatersheds and clearly the added volume of high conductivity water is not diluted by the Ausable flow. During periods of high discharge this effect is not as prevalent as during dryer, low flow periods. At low flow conductivity of the river increases 75 us/cm downstream of these brooks. These brooks appear to have a significant affect on the river water.

Downstream of Lake Placid, conductivities significantly increase during low flow months. It appears that a major tributary, the Chubb River, contributes to this increase. The Chubb River has large wetland areas in its watershed, it flows through Lake Placid, past a WWTP and enters the West Branch upstream of the Iron Bridge. Samples taken from the Chubb, upstream of the Lake Placid WWTP have equally high conductivities indicating that the rise in conductivity in the West Branch during dry months is largely the influence of the Chubb subwatershed itself and not largely changed by WWTP discharges. The Chubb subwatershed contains significant acreage in urban development and wetlands. The source of the dissolved contents of the water may therefore be natural or manmade.

Conductivities in the Main Stem increase below Au Sable Forks during the high discharge months. The sampling point here is also downstream of Palmer Brook; a brook which has high recorded conductivities. Unlike the other tributaries, this brook seems to have the largest influence during the months of high discharge (wetter periods). Possibly suggesting a source which is contributed during runoff events or high water; possibly fertilizer runoff or septage.

Downstream of Keeseville, at the Family Dollar sampling point, conductivities are elevated during low discharge months, but only slightly higher at high discharge. A possible cause may be discharge from the Keeseville WWTP. Although other riverside homes and businesses may affect the water also the treatment plant outfall is tenths of a mile upstream of the sample point.

While the tributaries and point sources listed above result in increases in river water conductivity some tributaries actually freshen the River. Sample points at Au Sable Forks Foot Bridge and Route 9N Bridge show a slight decrease in conductivity as compared to the upstream samples. Upstream of the Forks four low conductivity brooks enter the West Branch – New Bridge Brook, Pettigrew brook, Little Black Brook, and Black Brook (Black Brook has the largest subwatershed area and discharge of all of these). During low flow months conductivity in the West Branch downstream of Black Brook are actually lower than points upstream. During high flow events this “freshening” affect is not apparent.

Error Analysis

Although river conductivities change from month to month at a single point this appears to be in response to volume of flow. Despite these variations general trends within the data are consistent from month to month (increasing and decreasing at similar points along the river). This is a good indication that the trends discussed are valid and that the data is consistently good.

While water quality is good on an average sunny day one important piece of data is missing. Rainstorm flows were not sampled. Pollutant runoff will generally be greater during rainstorms. Although it was the intention of this study to measure flow during rainstorm events the summer of 2009 was very wet and the measurement criteria were never met (6 dry days followed by a ½ inch rainstorm).

Next Steps

The Ausable Watershed conductivity study completed in the summer of 2009 suggests some tributaries and point sources have an important influence on conductivity of river water. Conductivity alone however, does not identify what is dissolved in the water; it only suggested elevated or lower dissolved content. An important next step will be to take grab samples in key subwatershed in order to explore reasons for increased conductivity. The Ausable Technical Advisory Committee will be consulted in order to carefully design a sampling strategy and water chemistry analysis.