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MRWC Stream Temperature Monitoring Program

2014 Volunteer Report



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3/19/15

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Executive Summary

Tributary streams are critical to the health of rivers and their watersheds. In 2014, MRWC conducted its second season of volunteer stream temperature monitoring to continue to generate a long-term baseline record of stream temperatures across the basin. Such basic water quality data is useful in assessing stream health, especially in an era of acknowledged climate change.

This effort is part of the development of the larger MRWC monitoring program: TribWatch, which has the goal of collecting stream data from all named streams in the watershed. Having stream data from as many streams as possible will enable MRWC to better assess overall watershed health. TribWatch started with temperature sampling and in 2014 began to phase in macroinvertebrate sampling and flow monitoring. Physical-chemical sampling is a future step. Stream continuity surveys will be a restoration component of this new program.

In 2014, MRWC collected temperature data from 28 streams at 31 sites using volunteers who sampled streams weekly. Though temperatures varied somewhat from stream to stream, similar seasonal temperature profiles were noted. July was the warmest month, with many of the sampled streams tipping above 20 degree C (68 F), the cold water fishery threshold. A few streams did hold under this level.

2014 was the second year of what is hoped will continue to be a regular and ongoing effort which is being complemented by in-situ temperature data-loggers at some sites. With the help of new volunteers, the number of sites was nearly tripled in 2014, MRWC rates this second season as a success.

Our thanks to the following volunteers: Rinky Black, Elaine Reardon, Sarah Trafton Anderson, Samantha Hutchins, Irene Murray, Gavin Scott, Rick Martin, Becky Finn, Paul Goyette, Janice Kurkoski, Diane Nassif, Shaun Grimley and Scott MacDonald/TU.

Introduction/Purpose

“Aquatic ecosystems are vulnerable to climate change. Predicted changes in timing, frequency, and duration of precipitation events, more intense storms, a shift from winter snow to rain, more frequent and longer summer droughts, and increases in temperature trends and extreme high temperatures will affect both lotic (flowing water) and lentic (still water) habitats. Water quality and quantity are expected to be adversely affected by predicted increased temperature, drought, an increase in the number of extreme heat days, and a decrease in summer precipitation.”

Source: *Massachusetts Climate Change Adaptation Report*, Sept. 2011, MA Executive Office of Energy and Environmental Affairs, p. 42

One of MRWC’s major roles of watershed stewardship is monitoring the health of rivers and streams in the basin. This role is best served when the effort includes engaging local people as it promotes watershed awareness. Long term monitoring provides key trending information which is most useful in stewardship planning. MRWC’s TribWatch program hopes to provide such information while engaging citizen scientists. One long term issue which is gaining awareness is the effects of climate change.

Climate change is a complex issue that requires careful and long-term study. MRWC’s approach is to use volunteer monitors to collect weekly stream data, which creates an “eyes and ears” network, while using additional tools to expand the study of stream temperatures.

Climate change has the potential to affect the nearly 400 square-mile Millers River watershed. Whatever its causes, long-term monitoring is needed to identify budding impacts and inform stewardship of sensitive areas and species that may need attention. Baseline data, collected over many years, is needed to inform watershed managers and stakeholders of changing stream conditions of concern. In the summer of 2013 MRWC launched a volunteer stream temperature monitoring pilot study to initiate a long-term stream temperature monitoring effort. Volunteers observed general stream conditions and MRWC obtained useful data.

The second tier of MRWC’s larger stream temperature monitoring effort utilizes in-situ temperature data loggers. These submerged probes provide temperature sensing and data storage year-round. A more detailed temperature profile can be collected, but less frequent stream visits are done and fewer volunteers engaged. The data is reviewed only a few times per year, but it can be used by researchers for climate modeling analysis.

MRWC has determined that a mix of these approaches best serves our mission and has begun to use both. This report focuses on the second season of volunteer efforts in 2014. A complimentary report of the first year of data logger information will be available.

Approach

MRWC reviewed a MassDEP list of all streams in the watershed and the available data for each to determine the distribution of temperature monitoring sites. The size/area, length, flow, and access to a stream were considered. Ultimately, it would be useful to have temperature data from all or most of the named streams in the basin, but this may not be possible on a yearly basis without large numbers of dedicated volunteers. Some streams may not flow adequately in the summer months, so regular monitoring there would have limited value.

A pilot temperature monitoring program was done in 2013 and determined a success. This began as a summer study, when volunteers like to be outside, aquatic species are most active and some species are vulnerable to rising stream temperatures. Winter sampling was not considered safe. It may be possible to expand the sampling season from early April to November in the future, but Late May through October seems best for volunteers.

MRWC began the project in 2013 with 11 streams. Most of the 2013 streams were in the western portion of the basin. In 2014 MRWC sampled 29 streams at 31 sites which included more eastern watershed sites.

Volunteers were requested to sample their sites about a week apart at a similar time of the day to provide better comparability of the data while offering them some flexibility. MRWC provided NIST traceable digital thermometers and QC'ed them at the CRWC lab with a certified NIST thermometer.

MRWC determined that this approach would provide a reliable dataset from which to identify basic temperature issues and trends over time. The data collected by volunteers could also inform the need for employing more technologically-based approaches, such as data loggers.

Procedures/QC/Equipment

MRWC prepared a volunteer temperature sampling manual containing program information and outlining procedures for stream sampling. Data/field sheets were created for volunteers to record all observations and temperatures.

MRWC uses VWR model DURAC waterproof electronic thermometers that have NIST traceable certification. This means their manufacture and quality control provides assurance of reliable and accurate readings. MRWC further checked the accuracy of these units versus a NIST (National Institute Standards and Technology) certified lab thermometer at the CRWC (Connecticut River Watershed Council) lab at both the beginning and end of the sampling season (Appendix 2). These procedures and QC should ensure that the data generated will be reliable.

All volunteers received training on the use and care of the equipment. Each were given a sampling kit that included a thermometer, data forms, clip board, probe string, volunteer manual and float bob. Each volunteer's probe was also compared to another probe's readings at some point during the season. The project coordinator duplicated field readings when possible.

The basic sampling procedure was as follows:

1. Remove cap from probe, turn on, let stand for 2 min for air temp.
2. Record air temp.
3. Begin filling in field sheet and season record information.
4. Be sure probe is secured to tether, then lower into flowing water.
5. Let probe stand in flow with tip at least 2 inches submerged for 2-3 min.
6. Record water temp.
7. Complete field sheet and season record for the day.
8. Clean probe, secure cap on probe.

Safety was always a high priority. If stream flows were too high, volunteers were instructed not to jeopardize their safety.

Volunteers began recording data during early June 2014 and sampled till the end of October 2014. Data was handed in periodically to the coordinator and finally at the end of the season. The project coordinator then assembled the data onto excel spreadsheets to chart the results and trends for analysis.

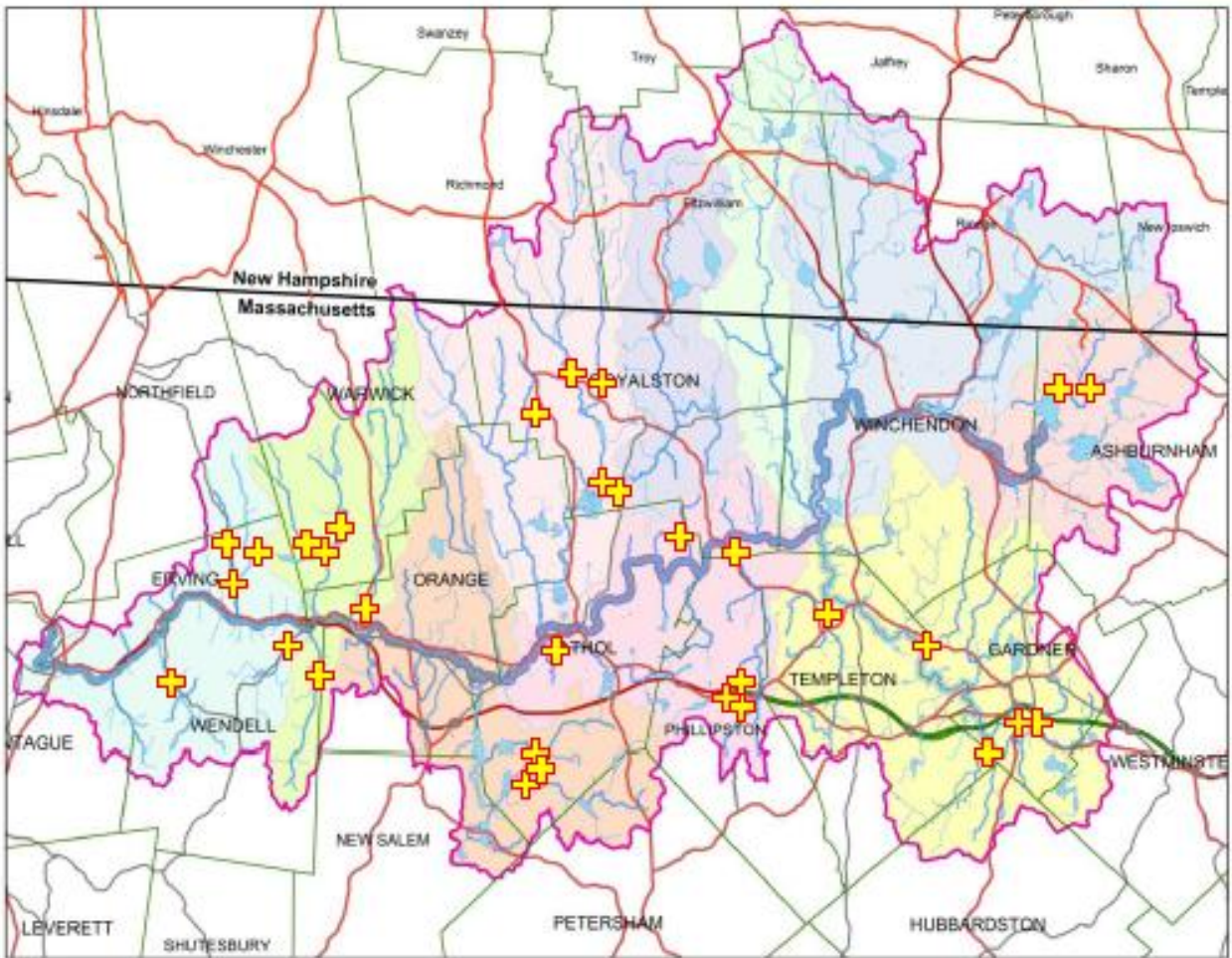
2014 Sampling Sites

Listed below are the streams and sites sampled, followed by a map of their location within the watershed.

Table 1: 2014 Temperature Streams

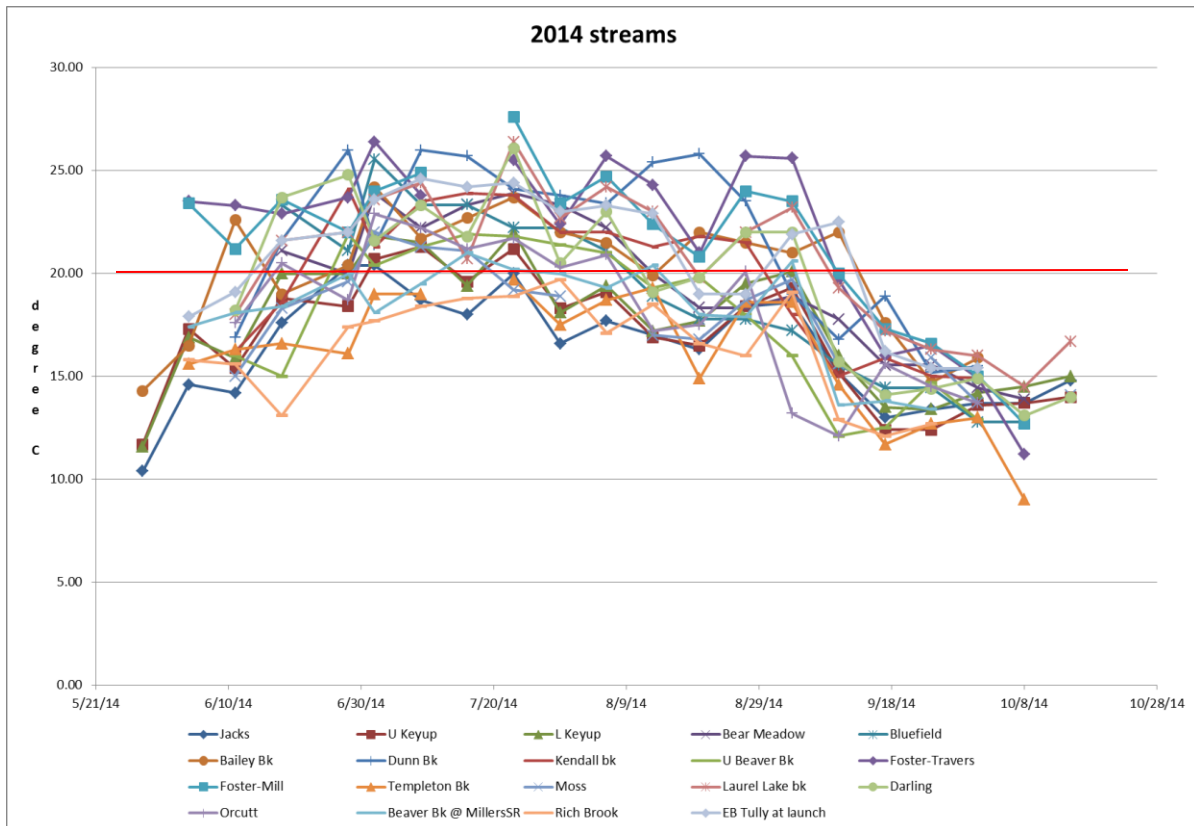
2014 Weekly Stream Temperature Volunteer Monitor Sites				
Stream	Town	Road	Lat	Lon
Bailey Bk	Gardner	Bridge St	42°35'20.36"N	72° 2'17.33"W
Dunn Bk	Phillipston	Carruth Rd	42°34'4.97"N	72° 7'36.91"W
Kendall Bk	Phillipston	Carruth Rd	42°34'8.16"N	72° 7'46.35"W
Beaver Bk - upper	Phillipston	202/2 interchange	42°34'17.61"N	72° 7'38.01"W
Beaver Bk - lower	S Royalston	Rt 68/sportmans	42°37'9.81"N	72° 8'10.68"W
Rich Bk	S Royalston	Gulf Rd	42°37'49.02"N	72° 9'52.16"W
Moss Bk	Warwick	Quarry Rd/Wendell Rd	42°37'26.00"N	72°21'30.80"W
Darling Bk	Warwick	Wendell Rd	42°37'42.07"N	72°20'54.74"W
Laurel Lake Bk	Warwick	Quarry Rd	42°37'22.52"N	72°21'29.75"W
Orcutt Bk	Orange	Rt 2A	42°35'55.93"N	72°20'24.57"W
Templeton Bk	Hubbardston	Pitcherville Rd	42°31'48.44"N	72° 1'31.35"W
Foster Bk -	Gardner	Mill St	42°33'18.28"N	71°59'42.05"W
Foster Bk -	Gardner	Travers St	42°33'37.70"N	71°59'0.16"W
Keyup Bk - upper	Erving	Laurel Lake Rd	42°37'9.13"N	72°23'35.55"W
Keyup Bk - lower	Erving	Arch St/Crescent St	42°35'56.04"N	72°24'3.77"W
Jacks Bk	Erving	North St	42°36'53.58"N	72°24'4.38"W
Trout Bk	Templeton	3 Pipes/Maple St	42°36'23.78"N	72° 5'32.17"W
Lawrence Bk	Royalston	Athol Rd	42°38'59.55"N	72°12'1.30"W
Boyce Bk	Royalston	Rt 68-Warwick Rd	42°41'5.26"N	72°12'41.47"W
Collar Bk	Royalston	Butterworth Rd	42°41'2.11"N	72°15'6.55"W
EB Tully - Launch	Royalston	Doane Hill Rd	42°39'3.05"N	72°12'30.10"W
EB Tully Rt 68	Royalston	Warwick Rd	42°41'26.12"N	72°13'25.92"W
Mill Bk - Hapgood	Athol	Hapgood St	42°35'18.77"N	72°13'21.96"W
Ellinwood Bk	Athol	S Athol Rd	42°32'57.34"N	72°14'26.06"W
Riceville Bk	Athol	S Athol Rd	42°32'16.27"N	72°14'50.60"W
Thrower Bk	Athol	Riceville Rd	42°32'48.87"N	72°14'18.61"W
Hormon Hollow Bk	Wendell	Mormon Hollow Rd	42°34'48.38"N	72°26'15.93"W
Whetstone Bk	Wendell	Kentfield Rd	42°35'16.80"N	72°21'26.85"W
Osgood Bk	Wendell	Wendell Depot Rd	42°35'36.29"N	72°21'57.10"W
Bear Meadow Bk	Ashburnham	Tuckermans Rd	42°41'23.12"N	42°41'23.12"N
Bluefield Bk	Ashburnham	E Ringe Rd	42°41'25.08"N	71°57'3.68"W

Map 1: 2014 Sampling Site Map/Sites



Results: Stream Temperature Profiles

Data for streams are presented in sets of streams, typically found near each other in a sub-region of the watershed. A summary graph for most streams is presented below. For a select few streams, this report will present 2013 data in direct comparison to 2014 data. Also, for select streams, air temperatures are presented, often in an additional graph to simplify review. All temperatures are in Centigrade.

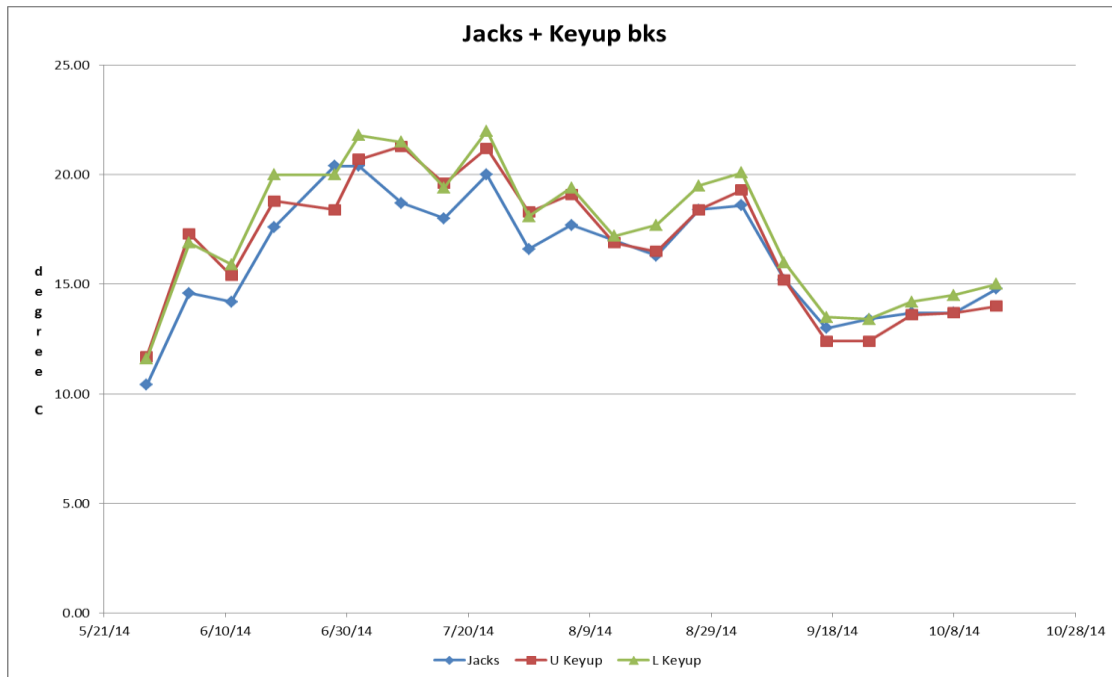


Note the similar curve profiles for the stream data. This indicates data comparability and consistency. Temperatures start low in late May, rise through mid/late July, then trend lower through October. The horizontal red line is the 20 deg C CWF boundary.

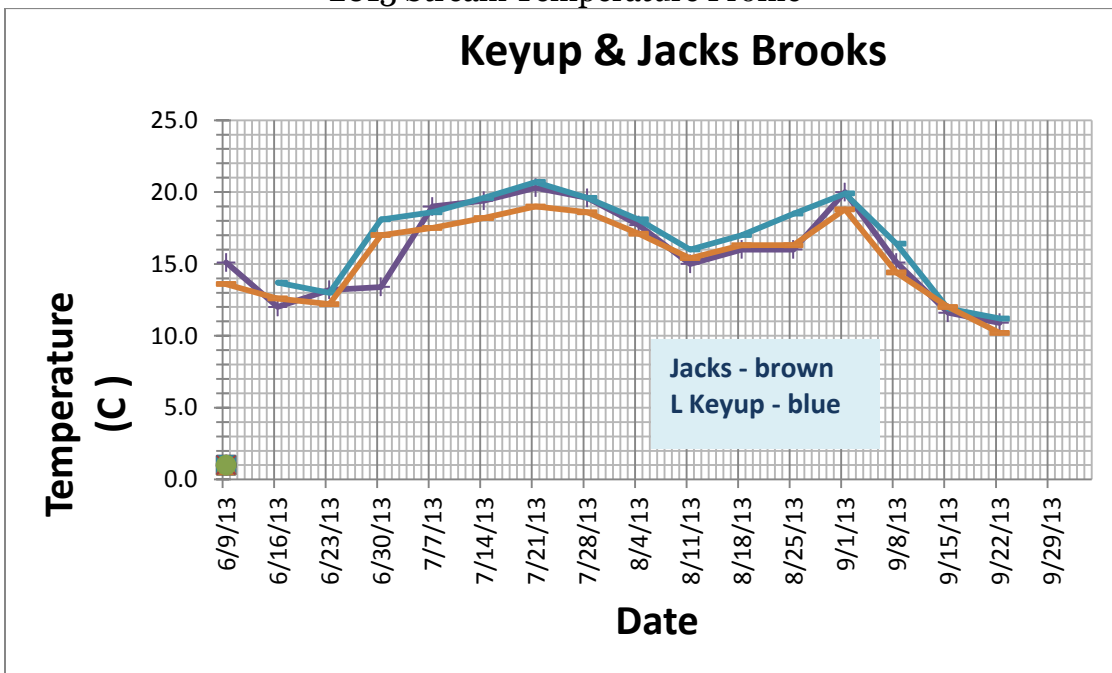
Keyup & Jacks Brooks, Erving

These brooks originate in south Northfield, meet about a mile north of Erving Center to become Keyup Brook, then flow into the Millers River. Both are largely rural with only the lower Keyup in somewhat urban Erving Center.

2014 Stream Temperature Profile

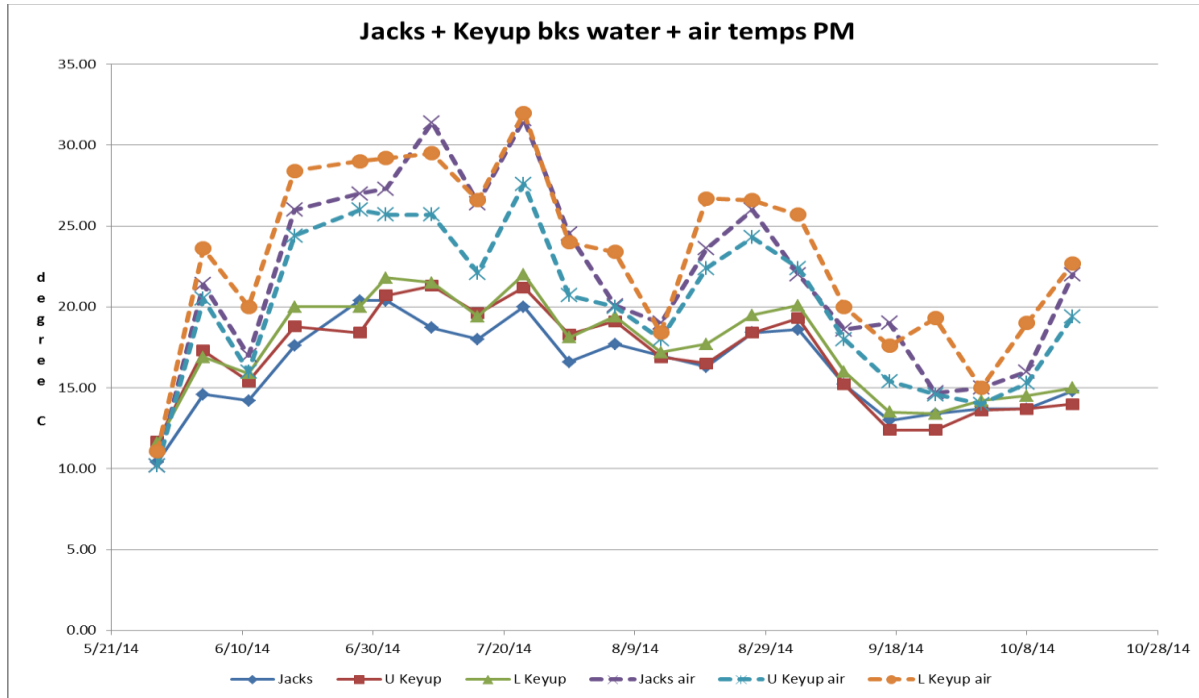


2013 Stream Temperature Profile



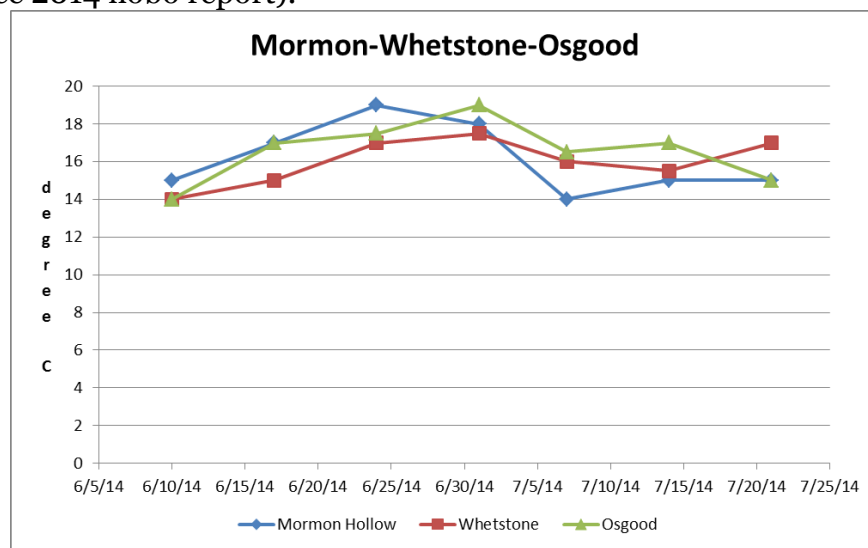
Air Temperatures

Another dimension that can be considered is air temperatures. In 2014 these streams were sampled in the late afternoon (in 2013 the AM). Usually air temps swing more widely, but do affect water temps. Afternoon water temps are typically a bit higher.



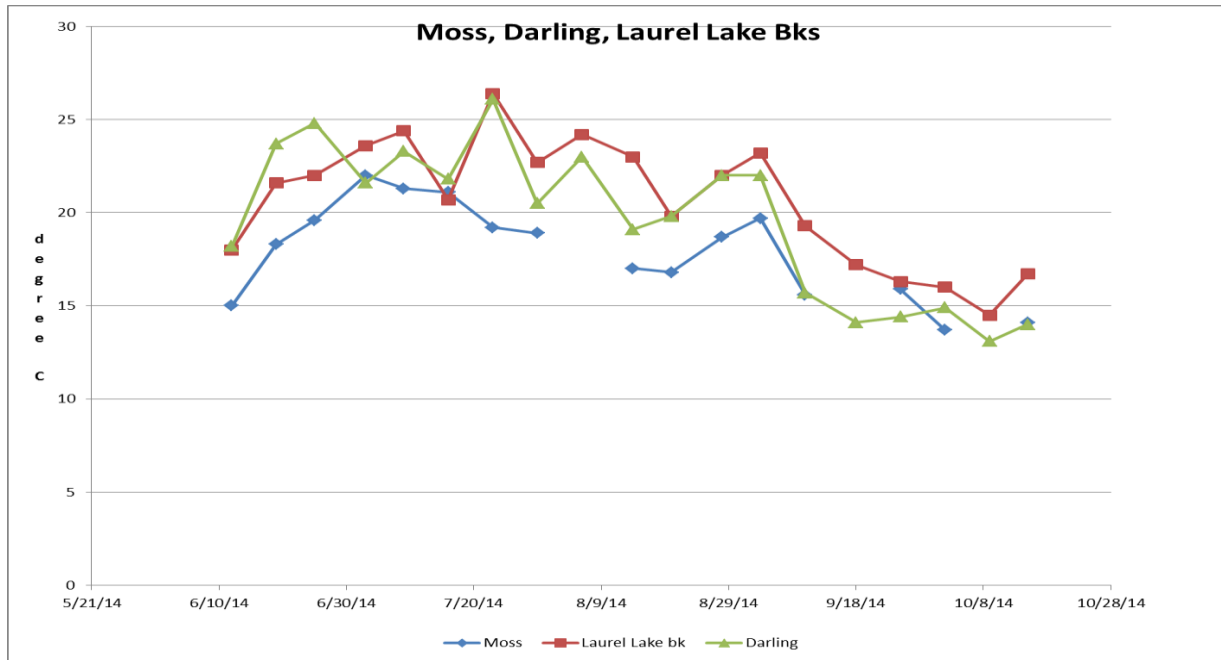
Mormon Hollow, Whetstone, Osgood Brooks

These brook flows from the areas near Wendell Center. Each flows northerly to meet the Millers River. The 2014 data stops short as our volunteer had a probe failure. Luckily, MRWC had a long term probes in Mormon Hollow and Whetstone to extract data from (see 2014 hobo report).



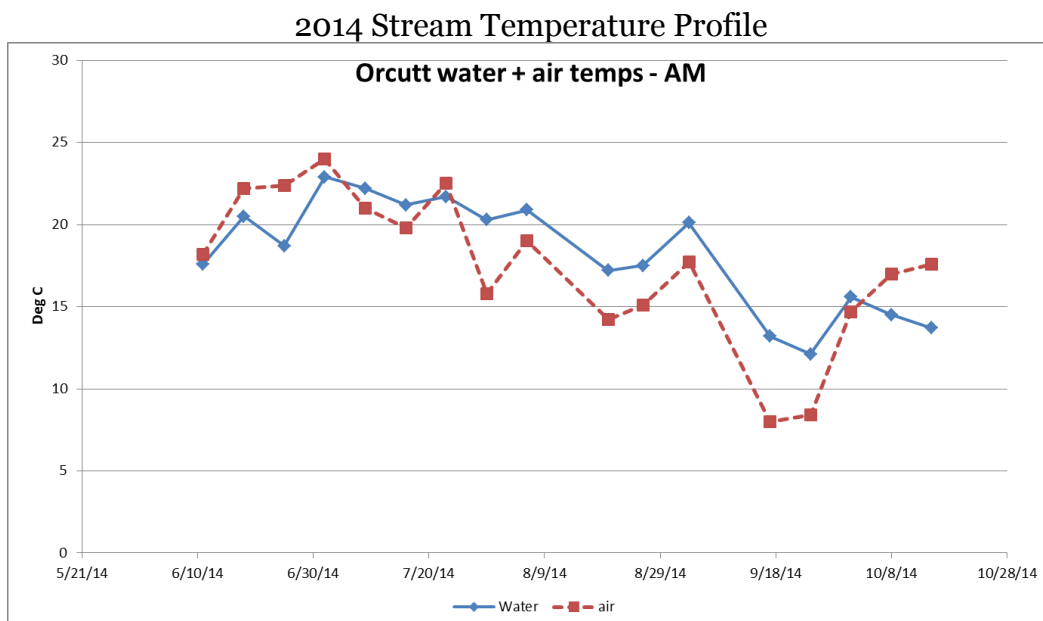
Moss, Darling, Laurel Lake Brooks

These flow out of Warwick, combine to form Moss Brook, and flow southerly towards the Millers Rivers. Moss Brook enters the Millers on the north side of Wendell Depot. MRWC has a long term probe a mile south of the confluence of these streams.

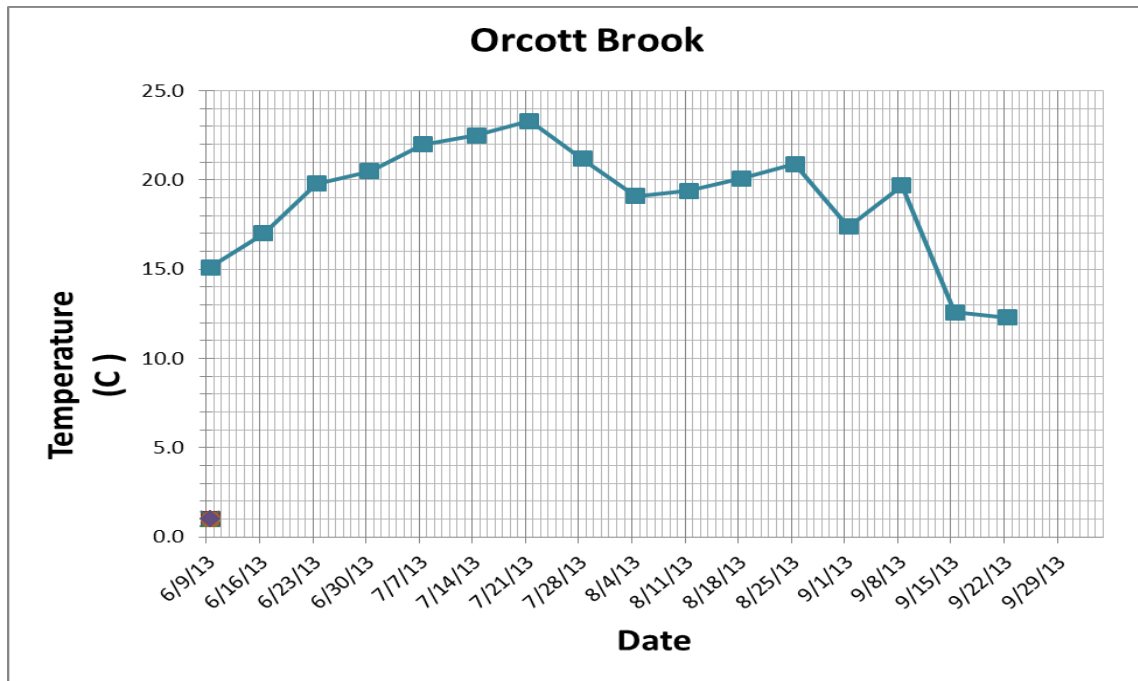


Orcutt Brook

This stream rises in the eastern section of Warrick and flows southerly into the Millers in West Orange. Sampled early AM.

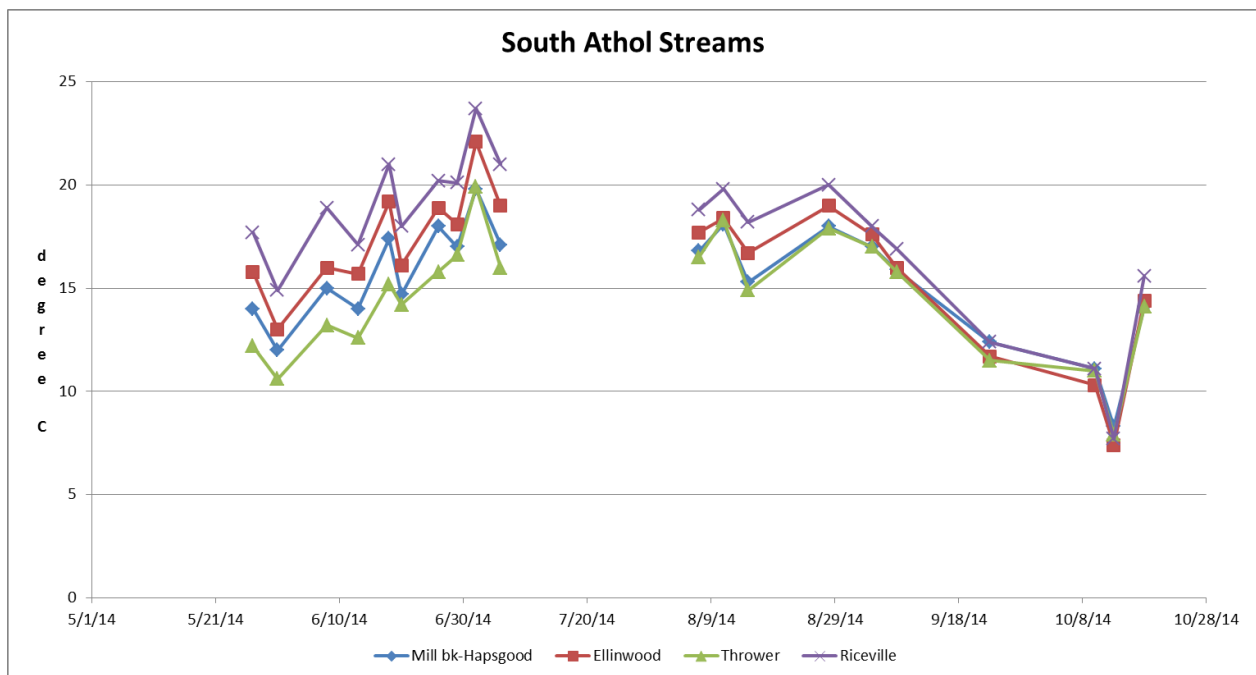


2013 Stream Temperature Profile



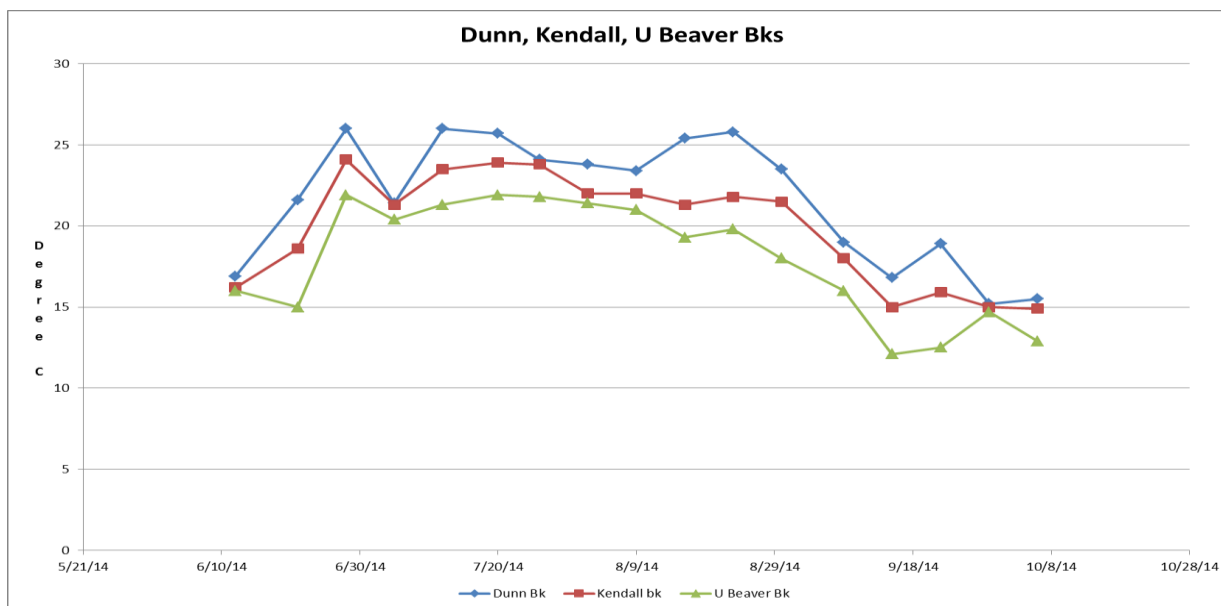
South Athol Streams

These streams (with the exception of Mill brook) flow westward towards Lake Rohunta. Mill Brook flows through in town Athol. MRWC had hobo probes on Mill and Ellinwood Brooks. Data was not collected in July.



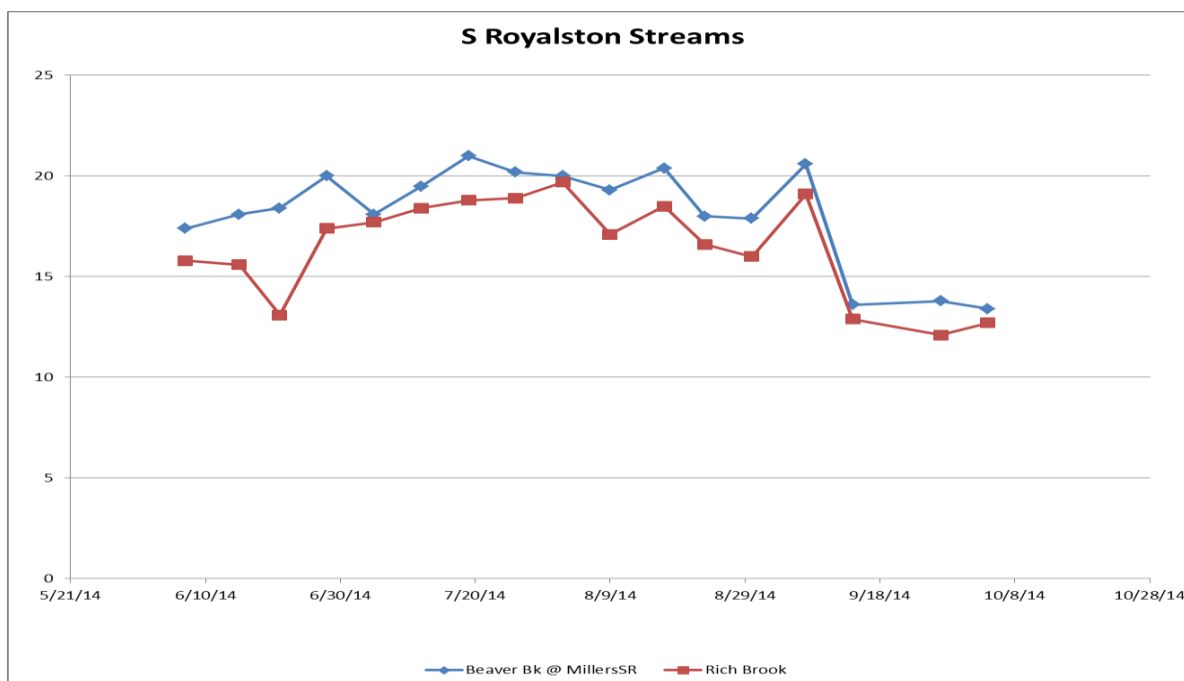
Phillipston Streams (Kendall, Dunn, upper Beaver Brooks)

Kendall and Dunn Brooks meet to form Beaver Brook and flow from the area of the Rt 2/202 interchange northward to the Millers River in S Royalston.

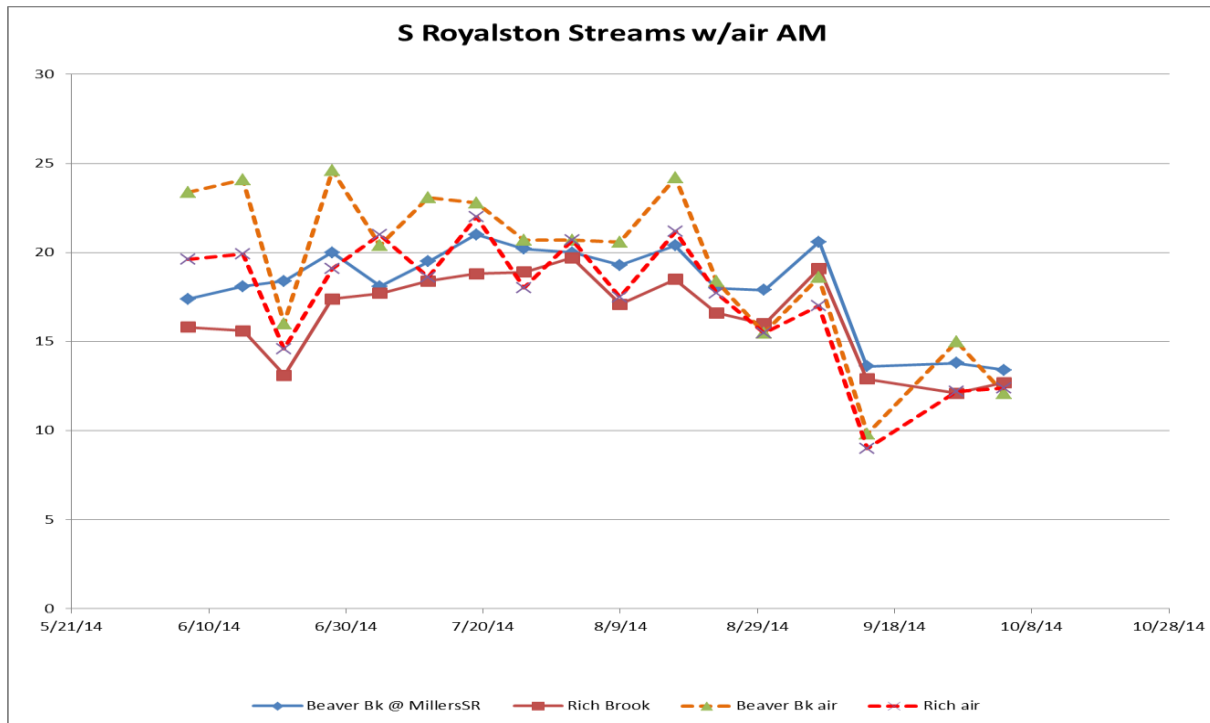


South Royalston Streams

These two streams enter the Millers in South Royalston. Lower Beaver flows through an open meadow area from the south and Rich Brook through woods from the north. Lower Beaver can be compared to upper Beaver temperatures.

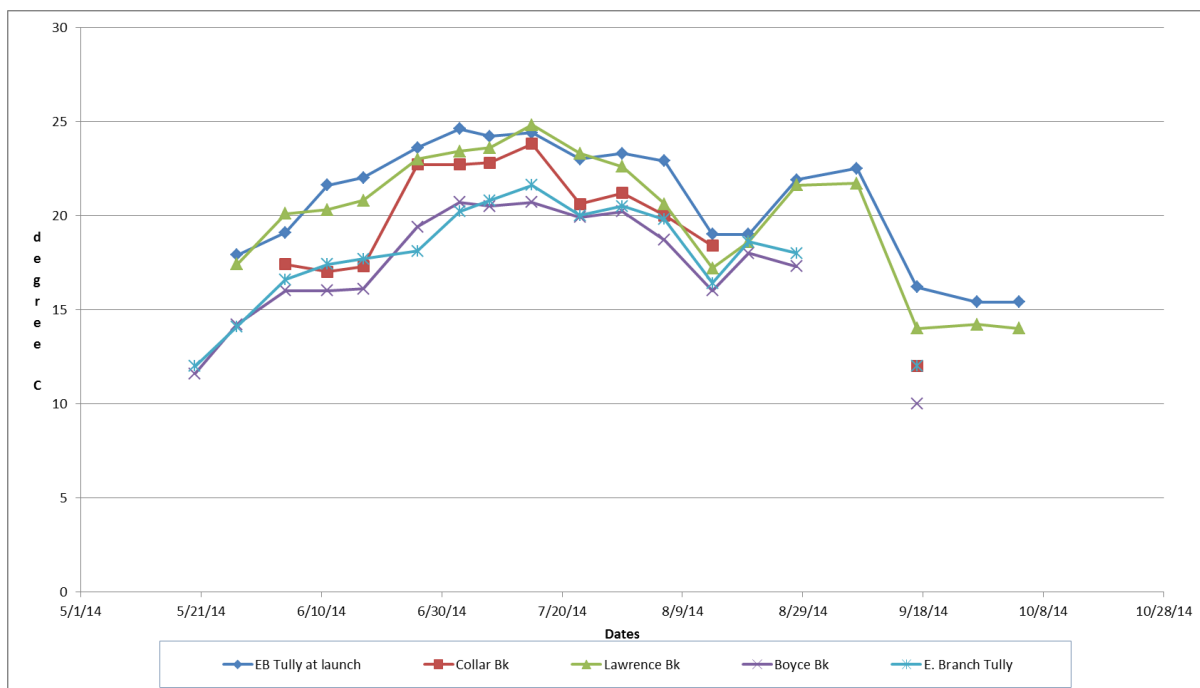


Adding air temperatures



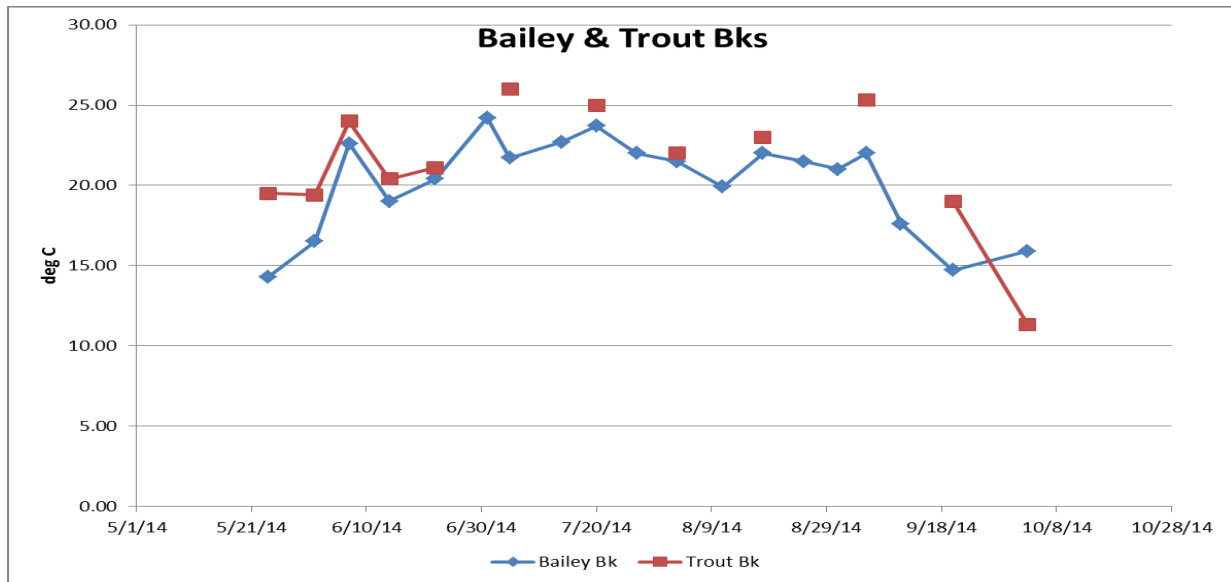
Royalston Streams

These streams flow in the Tully River sub-basin. Two compare stream temperatures above and below Long Pond on the EB Tully (launch is below the pond). Collar Brook flows into the west branch Tully.



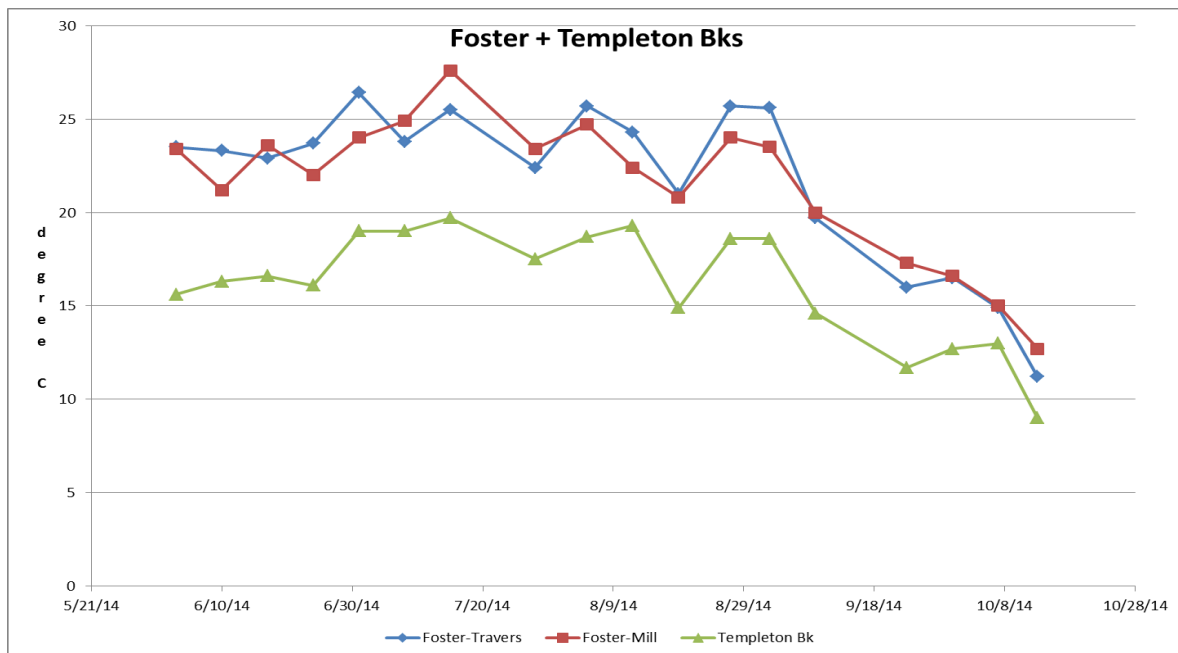
Trout & Bailey Brooks

These streams flow into the Otter River near Baldwinville in Templeton. Bailey flows SW out of Winchendon whereas Trout flows northerly just west of Templeton center. The data set for Trout Brook missed a few weekly samples.



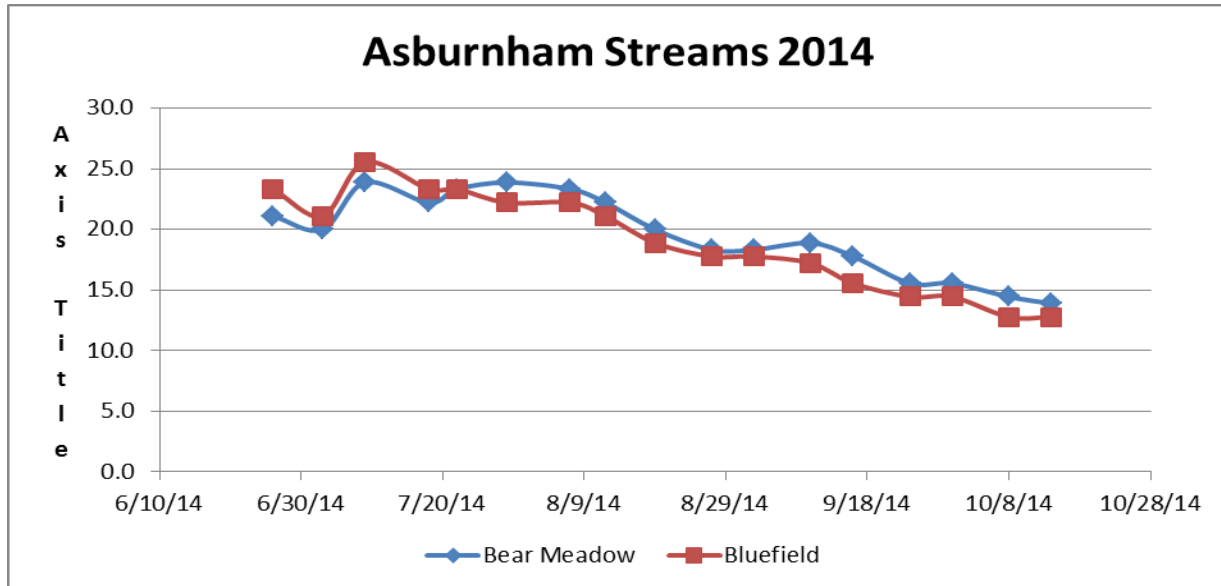
Foster & Templeton Brooks

Foster flows WSW through urban south Gardner and enters the ponded area of the Otter River Conservation area in Gardner. Templeton Brook flows through woodlands in parts of Templeton and Hubbardston to enter the same pond from the southern end. Foster was sampled at two locations.

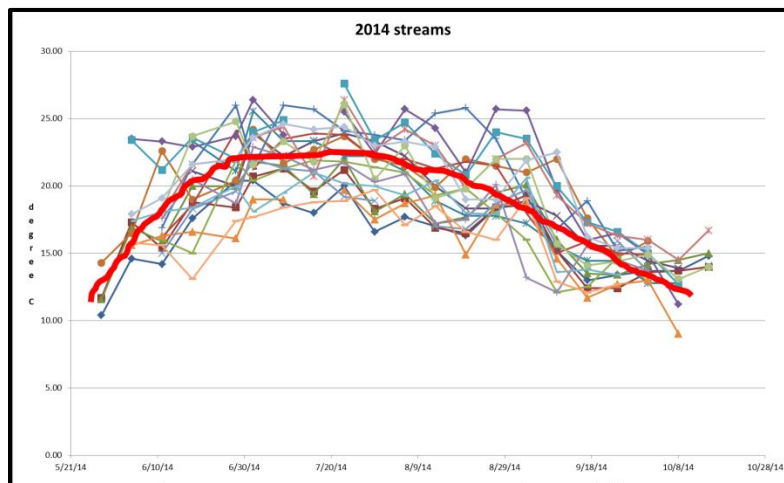


Asburnham Streams

MRWC had the opportunity through volunteers to begin to collect data on these headwater streams. They flow SW into Sunset Lake, from which emerges the Millers River. MRWC got a later start on these streams.



Data interpretation



Temperature: A review of the data shows a consistent profile for the sampled streams: a noticeable temperature rise in June, peaking through July, then cooling off in August. The composite graph overlaps all stream data and shows that July was the warmest month for stream and river temperatures. A second, shorter rise took place in late August/early September, which lasted a week. September also saw the lowest flow levels of the sampling season.

Precipitation/Flow: May had near normal rainfall, but June was below normal(as measured at Quabbin HQ, Belchertown MA). July rain fall was higher than normal this led to stream flows remaining high till late August. MRWC is uncertain if this rainfall had any effect on the temperature profile.

Cold Water Fisheries: Mass Fish & Wildlife has designated that a cold water fishery (CWF) exists where stream temperatures are typically under 20 degree C (68 F). Fish such as trout thrive only in CWF conditions. Bass and pan fish do well in warmer streams. Of the streams sampled in Summer 2014, some of them seem to have met the CWF threshold, some were borderline due to warm July temperatures, and some seem not be CWF. The borderline streams may support CWF where fish can find cold seeps to shelter in during brief warm spells.



This second year of our effort begins to add to a baseline of study. MRWC should contact MassDEP to obtain historical stream temperature data from past years as a means of further comparison and baseline expansion. For climate change evaluation, older data and more future data will be needed.

Evaluation and Future Efforts

This second and expanded season of volunteer stream temperature monitoring was a success. The season experienced only a few data gaps, but these were essentially backed up by our data logger program. Volunteers provided consistent and useful information. This experience shows that this kind of grassroots monitoring effort is an excellent way to engage volunteers and obtain regular observations of stream temperatures. Further emphasis on broader observations of stream areas will be a useful added step for this project. Building and maintaining a volunteer base that can function as the “eyes and ears” of the watershed is an ongoing MRWC goal.

MRWC plans to continue volunteer temperature monitoring at most of these same streams, and where possible add new streams--particularly in areas where no data exists. For 2015, MRWC hopes to monitor 6-8 new streams, possibly enter New Hampshire, and will be seeking new volunteers.

Deployed data logger program

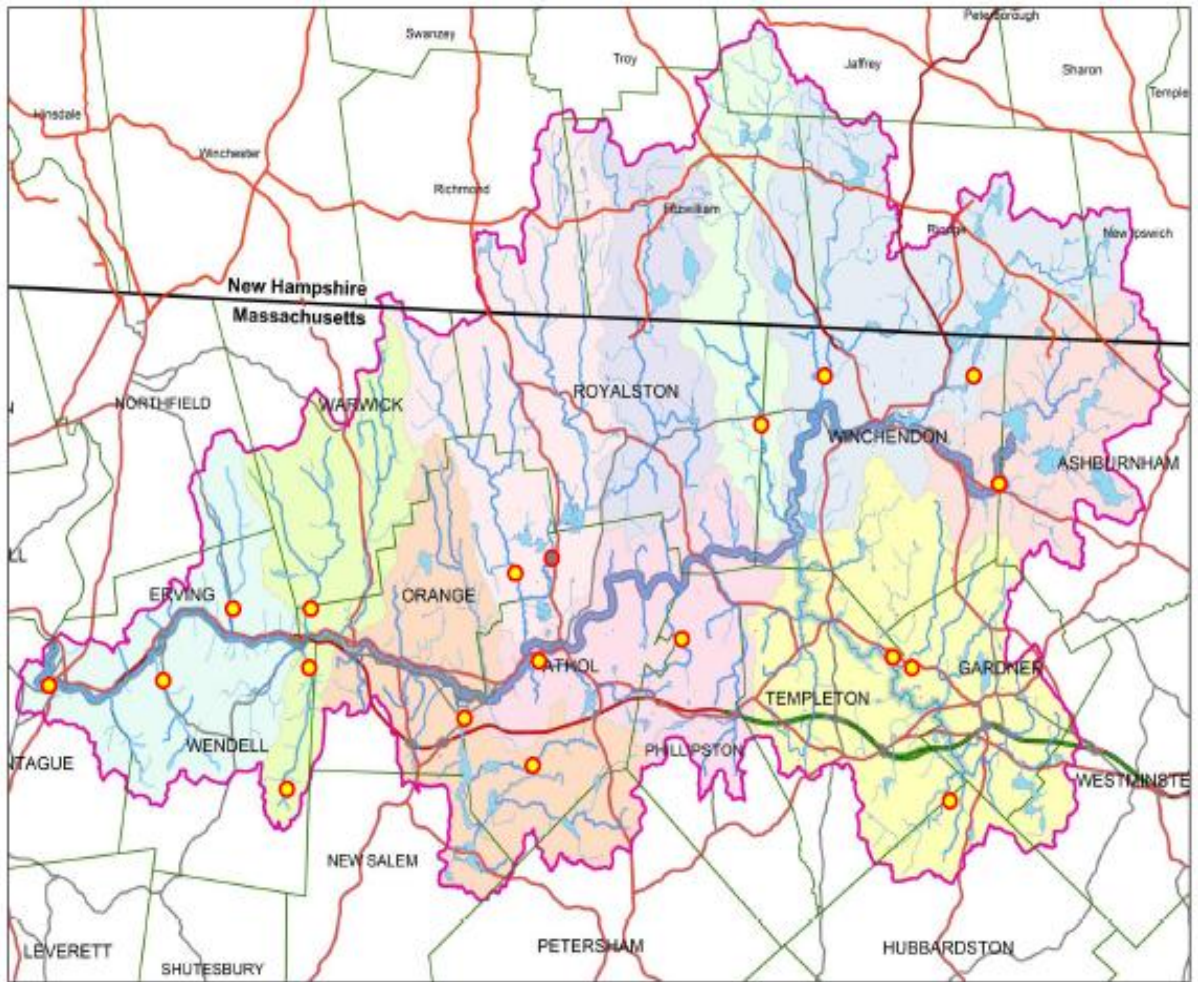
MRWC in late 2013 began an effort to collect and provide stream temperature data to the NorEast Climate Monitoring Network utilizing deployed temperature data loggers. A data logger is a battery-operated and waterproof probe that reads and records temperatures at programmed time intervals. Once or twice a year, the digital data from these probes will be retrieved by MRWC, shared with the watershed community and entered into a national database. Such data is useful for climate modeling and long-term trend review.

Staff deployed probes on 18 streams across the watershed in the fall of 2013--see Map below. MRWC performed the first round of data downloads in the Fall 2014. MRWC redeployed probes at 8 sites for continued year round data collection. Hopefully MRWC will deploy probes at 6-8 new sites in 2015 and perhaps locate 2-4 long term “air” temperature monitoring sites next to “water” sites. Volunteers will be needed to visit data logger sites for routine inspections, and when necessary to help staff with downloading and battery replacement.

A separate report for the 2013-14 stream temperature data logger profiles is available. Since methods and time frames differ, though purpose is similar, a distinct report was determined appropriate.

Late 2013 deployed temperature probe sites

Hobo Deploys ● deployed ● planned deploy



Additional

At some point, after generating more watershed-wide baseline data, and reviewing manpower resources, MRWC may take a more cyclical approach to temperature monitoring, perhaps alternating streams every other year to keep expanding the database and assessing watershed health.

MRWC may also contact MassDEP and Mass F&W to obtain their historic stream temperature data as a means of further comparison and baseline expansion. For the most robust climate change evaluation, older data can be of great value.

Appendices

Appendix 1



Thermometer Quality Check Report 2014

Pre-season check
QC used: CRWC lab NIST

Date: 5/16/14
QC by: K Davies

Probe ID	Probe temp	Nist Temp	Probe temp2	Nist temp2	Notes
T-1	72/22.2	21.85	38/3.3	3.8	P
T-3	72/22.2	‘	38/3.3	‘	P
T-4	73/22.7	‘	38/3.3	‘	P - precision
T-5	72/22.2	‘	38/3.3	‘	P
D-14140*	22.0	‘	3.8	‘	P – not used
D-20458	22.2	‘	3.9	‘	P
D-20421	22.3	‘	4.1	‘	P
D-14052	22.3	‘	4.0	‘	P
D-14056	22.0	‘	4.0	‘	P
D-20480	22.2	‘	3.8	‘	P
D-20473	22.1	‘	4.0	‘	P
D-20448	22.0	‘	4.1	‘	P
D-14028	22.1	‘	4.0	‘	P
D-20420	22.0	‘	3.8	‘	P
D-20397	22.0	‘	4.0	‘	P
D-20479	22.0	‘	4.1	‘	P

MRWC

Post-season check

QC used: CRWC lab NIST

Date: 12/11/14

QC by: K Davies

Probe ID	Probe temp	Nist Temp	Probe temp2	Nist temp2	Notes
T-1	62/16.6	16.45	44.5/6.9	6.5	P
T-3	62/16.6	"	44/6.7	6.5	P
T-4	63/17.2	"	44.5/6.9	6.5	P - precision
T-5	62/16.6	"	44/6.7	6.5	P
D-20465*	16.8	"	7.3	7.2	P – no may qc
D-20458	16.9	"	6.8	6.8	P
D-20421	17.0	"	7.0	6.5	P
D-14052	17.0	"	7.4	7.2	P
D-14056	16.0	"	6.0	6.5	P
D-20480	17.0	"	7.0	7.2	P
D-20473	16.9	"	7.2	7.2	P
D-20448	16.7	"	7.3	7.2	P
D-14028	16.8	"	6.8	6.8	P
D-20420	16.8	"	6.7	6.8	P
D-20397	16.9	"	7.2	7.2	P
D-20479	16.8	"	6.8	6.8	P

All Temps C/F, T= spirit thermometers, D= digital thermometers

QC limit per QAPP = 1 deg C precision, 0.5 deg C accuracy, P=passed QC

Appendix 2

2014 Summer Weather Notes

Quabbin Visitors Center, Belchertown, MA

May Rain = 3.82 inches (2013=6.04")
Air Temperature = 67.4 F average max, (2013=70.7)

June Rain = 1.74 inches (2013=8.16")
Air Temperature = 77.3 F ave max, (76.4=2013)

July Rain = 6.68 inches (2013=5.61")
Air Temperature = 80.1 F ave max, (83.45=2013)

Aug Rain = 3.86 inches (2013=5.48")
Air Temperature = 77.4 F ave max, (78.13=2013)

Sep Rain = 1.34 inches (2013=4.13")
Air Temperature = 72.1 F ave max, (71.3=2013)

Oct Rain = 5.68 inches
Air Temperature = 60.8 F ave max

Monthly average rainfall in central MA is just over 4 inches.