Water Quality Report: 2015
Quabbin Reservoir Watershed
Ware River Watershed

Two turtles and a dragonfly, Demond Pond (Bernadeta Susianti, 2014)

August 2016

Massachusetts Department of Conservation and Recreation
Office of Watershed Management
Division of Water Supply Protection

ABSTRACT

This report is a summary of water quality monitoring methods and results from 25 surface water stations established throughout the Quabbin Reservoir and Ware River watersheds and other special investigative samples. The Department of Conservation and Recreation (DCR), Division of Water Supply Protection (DWSP), is the state agency charged with the responsibility of managing Quabbin Reservoir and its surrounding natural resources in order to protect, preserve, and enhance the environment of the Commonwealth and to assure the availability of pure water to future generations. The Environmental Quality Section manages a comprehensive water quality monitoring program to ensure that Quabbin Reservoir and its tributaries meet state water quality standards. As part of this task, the Environmental Quality Section performs the necessary field work, interprets water quality data, prepares reports of findings, and makes changes as necessary. This annual summary is intended to meet the needs of watershed managers, the concerned public, and others whose decisions must reflect water quality considerations.

Quabbin Reservoir water quality in 2015 satisfied the requirements of the Filtration Avoidance Criteria established under the Environmental Protection Agency Surface Water Treatment Rule. Monitoring of tributaries is a proactive measure aimed at identifying general trends and problem areas that may require additional investigation or corrective action. Compliance with state surface water quality standards among the tributaries varied with minor exceedances attributed to higher pollutant loads measured during storm events, wildlife impacts on water quality, and natural attributes of the landscape.

The appendices to this report include field investigation reports, summary information on mean daily flows of gaged tributaries, water quality data summary tables, and plots of reservoir water quality results. Some of the ancillary data presented in this report has been compiled with the help of outside agencies (*e.g.*, U.S. Geological Survey) and other workgroups within DWSP whose efforts are acknowledged below.

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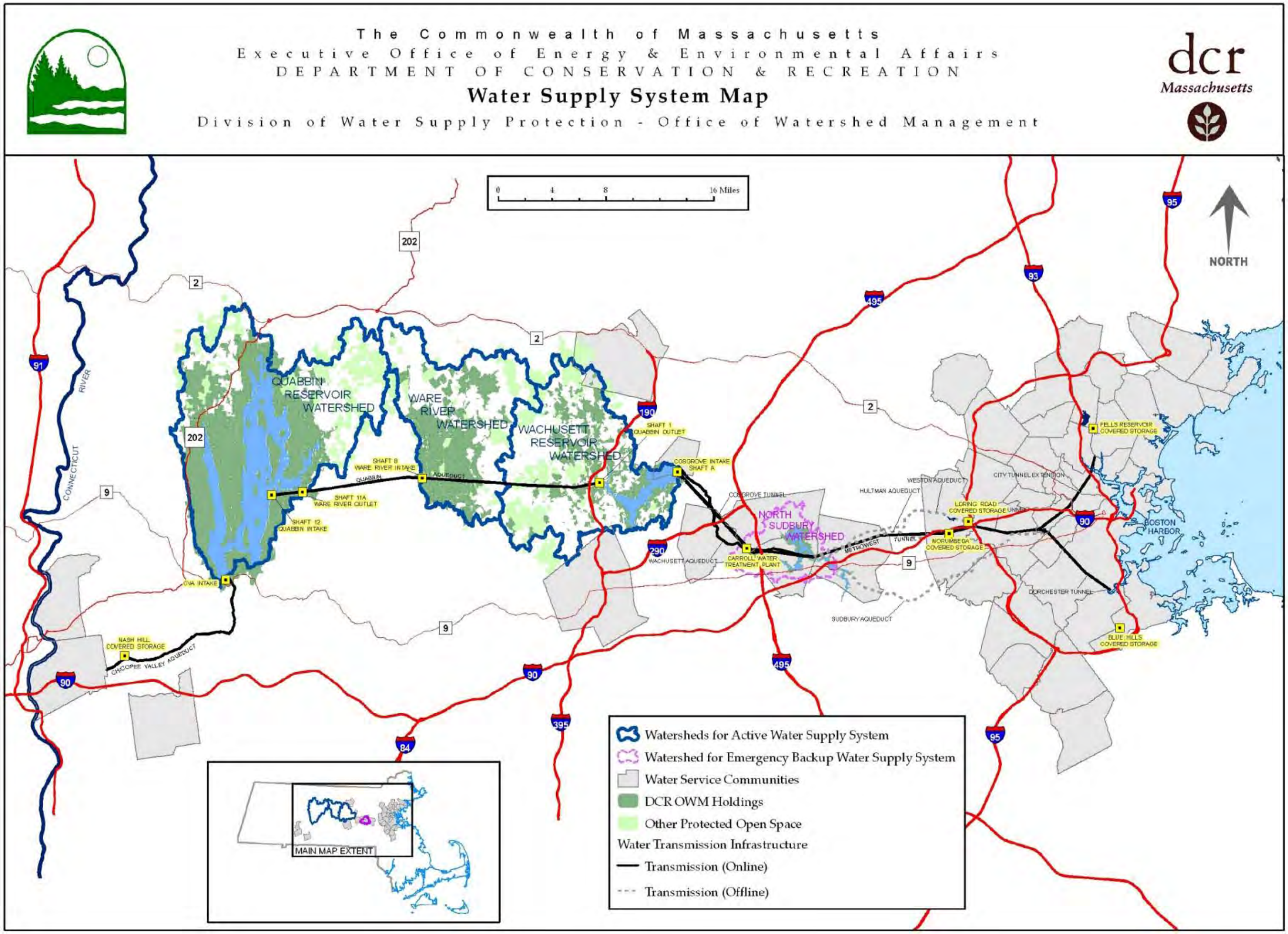


Figure 1. Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed System

1 INTRODUCTION

The Quabbin Reservoir, Ware River, and Wachusett Reservoir watershed system supplies drinking water to 51 communities, including 45 communities in the greater Boston and MetroWest region, three in western Massachusetts, and three as an emergency supply only. The Department of Conservation and Recreation, Division of Water Supply Protection (DWSP), monitors and manages the watersheds to protect the drinking water source, while the Massachusetts Water Resources Authority (MWRA) manages the infrastructure and provides treatment. Both DWSP and MWRA monitor the water quality and quantity to deliver safe and sufficient drinking water. The watershed system and the MWRA service area are shown in **Figure 1**. This report summarizes the water quality monitoring performed by DWSP in the Quabbin Reservoir and Ware River watersheds during 2015; a separate report summarizes the monitoring performed during 2015 in the Wachusett Reservoir watershed.

The three drinking water sources, Quabbin Reservoir, Ware River, and Wachusett Reservoir, are interconnected via the Quabbin Aqueduct. The largest of the three sources, Quabbin Reservoir, is capable of holding 412 billion gallons of water. Because of Quabbin's size, it required seven years after the damming of the Swift River in 1939 before the reservoir was completely filled. The reservoir surface is best described as two interconnected fingers. The larger eastern finger stretches about 18 miles in length and has a maximum width of roughly four miles. The western finger stretches about 11 miles in length and has a maximum width of roughly one mile. In total, the reservoir surface area covers 39 square miles (25,000 acres) and contains 118 miles of shoreline. **Table 1** summarizes some basic facts and figures about Quabbin Reservoir.

Quabbin Reservoir water transfers to Wachusett Reservoir via the Quabbin Aqueduct Intake at Shaft 12 typically account for more than half of the of MWRA's system supply. In 2015, transfers to Wachusett Reservoir totaled 53,192.36 million gallons (MG). In the 273 days that transfers occurred, the Quabbin Aqueduct delivered an average of 194.84 million gallons per day (MGD). A much smaller amount of water is transferred directly to three western Massachusetts communities on a daily basis, via the Chicopee Valley Aqueduct (CVA) at Winsor Dam. In 2015, the CVA delivered on average 7.60 MGD of flow to the CVA communities. The reservoir maintained a normal operating level throughout 2015. In 2015, the reservoir had a net storage loss of 20,250 MG, and operating levels experienced a maximum fluctuation of 5.10 feet. Daily fluctuations in reservoir water level during the past two years are shown in **Figure 2**.

The Quabbin Reservoir watershed covers 187.5 square miles (119,935 acres) and contains practically all of the towns of New Salem and Petersham, considerable portions of Pelham, Shutesbury, and Wendell, and much smaller portions of Orange, Hardwick, Phillipston, Belchertown, Ware and Athol. Nearly 90% of the watershed lands are forested, and DWSP owns and controls 53,278 acres (56%) of watershed lands for water supply protection purposes.

Table 1. Quabbin Reservoir Facts and Figures

FACTS ABOUT THE RESERVOIR		FACTS ABOUT THE WATERSHED	
Capacity	412 Billion Gallons	**Watershed Area**[1]	119,935 acres
Surface Area	24,469 acres	**Land Area**	95,466 acres
Length of Shore	118 miles	**Forest**[2]	84,210 acres, or 88% of Land Area
Maximum Depth	150 feet	**Forested Wetland**[2] **+ Nonforested Wetland**	5,317 acres, or 5.6% of Land Area
Mean Depth	45 feet	**DWSP Land**	53,278 acres, or 56% of Land Area
Surface Elevation, at Full Capacity	530 feet (Boston City Base)	**% DWSP Owned**	56% of Land Area, or 65% of Watershed Area
Year Construction Completed	1939	**Avg. Reservoir Gain From 1" of Precipitation**	1.6 Billion Gallons
Calendar Year:	***2015***	***2014***	***2013***
Maximum Reservoir Elevation (ft)	528.37 on April 28	529.26 on May 28	528.15 on July 9
Minimum Reservoir Elevation (ft)	523.27 (DWSP data) on December 14	523.63 (DWSP data) on January 1	522.60 (DWSP data) on January 11
Total Diversions to Wachusett Reservoir	53,192.36 MG (273 days: 194.84 MGD)	47,263.56 MG (224 days: 211.00 MGD)	48,906.31 MG (230 days: 212.64 MGD)
Total Diversions to CVA	2,773 MG (365 days: 7.60 MGD)	2,754 MG (365 days: 7.54 MGD)	2,820 MG (365 days: 7.73 MGD)
Ware River Transfers	90.6 MG (1 day: 90.6 MGD)	1,360.8 MG (8 days: 170.1 MGD)	3,218.7 MG (22 days: 146.3 MGD)
Spillway Discharges	168.7 MG (33 days: 5.11 MGD)	2,593 MG (55 days: 47.1 MGD)	2.8 MG (3 days: 0.93 MGD)
Total Diversions to Swift River	15,673 MG (42.9 MGD)	12,460 MG (34.1 MGD)	9,034 MG (24.75 MGD)
Reservoir Ice Cover	Hl00% on February 3, complete ice cover on February 5, ice out on April 17.	Hl00% on January 23, complete ice cover on February 5, ice out on April 13.	Full reservoir ice cover not obtained.

Notes:
[1] Includes reservoir surface area.
[2] Land previously identified as forest has been reclassified more accurately as forested wetland.
(….) Denotes number of days and average flow for those days.
Sources: Watershed Protection Plan Update (DWSP, 2013a), DWSP Civil Engineering Yield Data 2013-2015, MWRA Flow Data

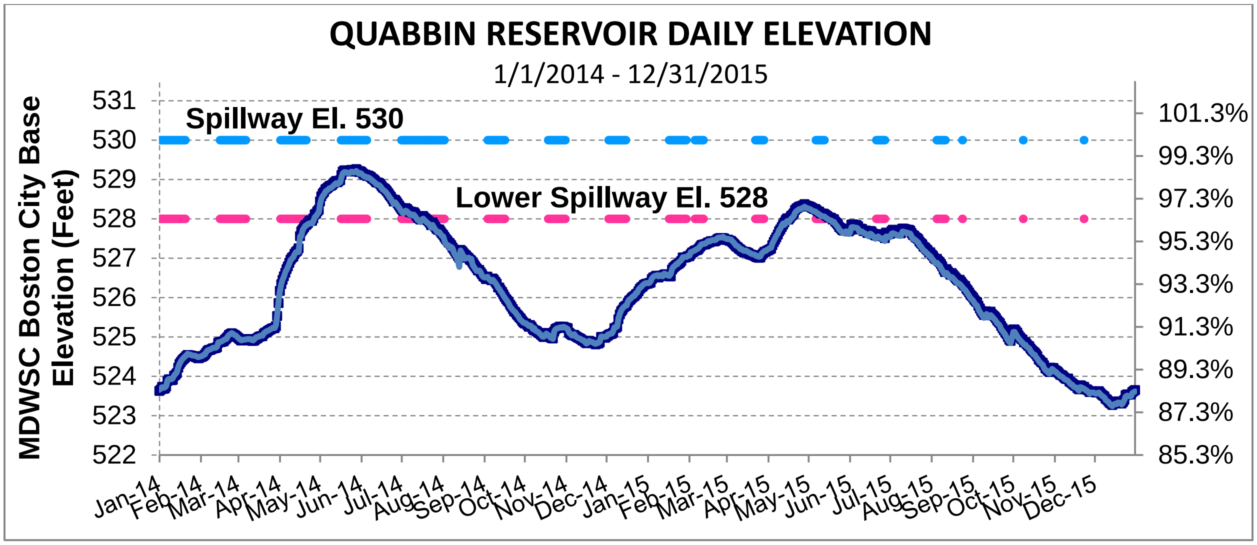


Figure 2. Quabbin Reservoir Daily Elevation, January 2014 - December 2015
(Source: DWSP Civil Engineering)

Including the reservoir, DWSP owns and controls 65% of the entire watershed area. Non-DWSP owned lands can be characterized as sparsely populated and having limited agricultural sites, helping to maintain the pristine character often attributed to Quabbin Reservoir water. For more information on land use and ownership in the Quabbin Reservoir watershed, see the *2013 Watershed Protection Plan Update* (DWSP, 2013a).

The eastern portion of the watershed and much of the Petersham area is drained by the East Branch of the Swift River. This 43.6 square mile subwatershed area is the largest stream tributary to Quabbin Reservoir. The U.S. Geological Survey (USGS), Water Resources Division, maintains stream gages on the East Branch Swift River in Hardwick, the West Branch Swift River in Shutesbury, and the Ware River at the Intake Works in Barre. In 2015, mean daily flows for the East Branch Swift River in Hardwick averaged 52.8 MGD (81.7 cfs). **Figure 3** depicts the hydrograph for the East Branch Swift River as measured at the horseshoe dam located at the outlet of Pottapaug Pond. As shown in **Figure 3**, the flow in the East Branch Swift River was generally above average in January then declined until late March, and then rose with snowmelt and precipitation in late winter and early spring. Stream flow decreased in May with lower than normal rainfall, then increased in June and July. Flow during the latter half of 2015 was generally normal to below normal range compared to the 78-year record.

The western part of the watershed is principally drained by the West Branch of the Swift River. This 14.10 square mile catchment area runs north-to-south between two well-defined, steeply sloped ranges. Steeply sloping ground, shallow soils, and a narrow drainage area combine to generate runoff that is extremely quick, and stream flows are typically characterized as flashy. In 2015, mean daily flows for the West Branch Swift River averaged 10.4 MGD (16.1 cfs). Monthly mean flows were generally at the lower range compared to the historical record.

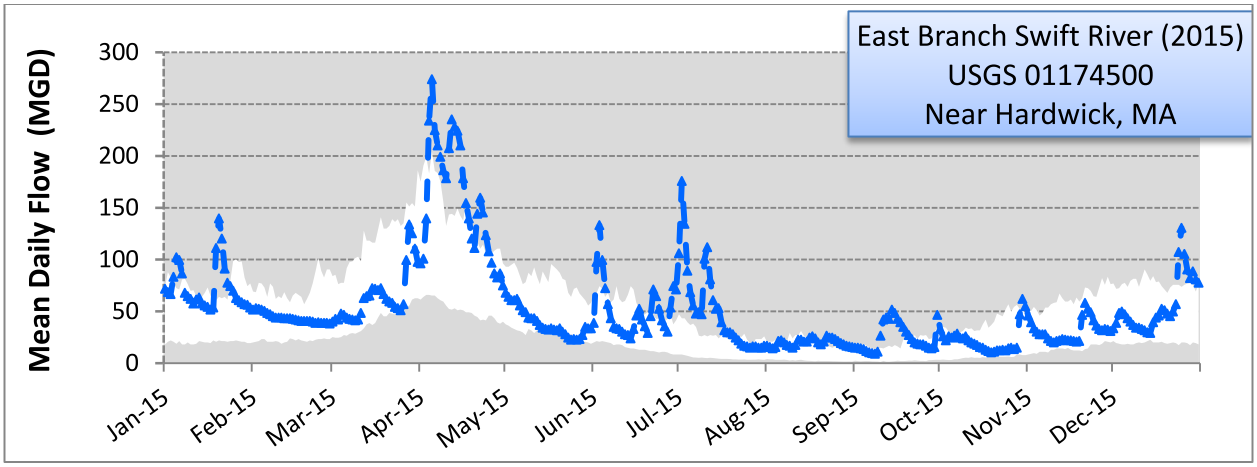


Figure 3. East Branch Swift River near Hardwick, MA, January-December 2015
Non-shaded region depicts "normal" (20 to 80 percentile) range of flows.
(Source: DWSP Civil Engineering from USGS data)

Water from Ware River may augment Quabbin Reservoir supplies by being diverted into the Quabbin Aqueduct at Shaft 8 in Barre and directed west towards Quabbin Reservoir via gravity flow. DWSP and MWRA closely coordinate on all diversion decisions. Under the authority granted by Chapter 375 of the Massachusetts Acts of 1926, the diversion of water from the Ware River is limited to a period from October 15 to June 15, and at no time is diversion allowed when the flow of the river at the diversion works is less than 85 MGD. Water from the Ware River enters the reservoir at Shaft 11A, located east of the baffle dams in Hardwick. In 2015, Ware River transfers to Quabbin Reservoir totaled 90.6 MG over 1 day in April. At the USGS stream gage near the Shaft 8 intake works, mean daily flows averaged 74.1 MGD (115 cfs) in 2015.

Daily precipitation has been recorded at the Belchertown monitoring station for 77 years. In 2015, the annual precipitation of 41.65 was below the 77-year annual average of 46.32 inches (DWSP, 2015). Precipitation totals for May (1.47 inches) and October (1.49 inches) were abnormally low, ranking among the lowest 20 percentile compared to the 76-year period-of-record for each respective month. June 2015 ranked among the highest 20 percentile for that month's historical record, with 7.45 inches. Snowfall, with a total of 75.4 inches, was above the 42-year historical average of 49.4 inches (DWSP, 2015). Record cold temperatures and snowfall were noted for parts of the northeast (NCDC, 2016). Statewide, Winter 2015 (December 2014 - February 2015) was colder and wetter than average, while Spring (March - May) 2015 temperatures were about average, with precipitation much below average (NRCC, 2016). Temperature and precipitation were above average for Summer (June - August) 2015, and compared to the period of record, Autumn (September - November) 2015 temperature ranked second highest in 121 years, while precipitation was near average (NRCC, 2016). Overall, for Massachusetts in 2015, temperature was above average and precipitation was below average, compared to the 121-year period of record (NCDC, 2016; NRCC, 2016). Abnormally dry to moderate drought conditions in portions of Massachusetts were observed from April through the rest of 2015 (DWSP, 2016). The 2015 North Atlantic hurricane season was relatively mild, with a total of 11 tropical storms, four hurricanes, and two major hurricanes (NCDC, 2016).

2 METHODOLOGY

This report presents water quality data results from routine sampling performed throughout the Quabbin Reservoir and Ware River watersheds. A comprehensive water quality monitoring program helps accomplish the following goals:

1) To maintain long term water quality statistics in terms of public health protection.
2) To satisfy watershed control criteria applicable to the filtration avoidance requirements stipulated under the EPA's Surface Water Treatment Rule.
3) To identify streams and water bodies that do not attain water quality standards where specific control measures may be initiated to eliminate or mitigate pollution sources.
4) To conduct proactive surveillance of water quality trends, supporting ongoing evaluations of threats to water quality (referred to as Environmental Quality Assessments, or EQAs).

2.1 Sample Station Locations

In 2015, Environmental Quality staff routinely monitored 24 surface water monitoring stations, including all major tributary inflows to Quabbin Reservoir, some minor tributaries flowing to the Quabbin Reservoir or Ware River, and selected locations within the Quabbin Reservoir. **Tables 2 and 3** present drainage area characteristics for the tributary surface water stations, and **Figures 4 and 5** depict locations of all surface water monitoring stations. Of the 24 monitoring stations, 12 were located within the Quabbin Reservoir watershed, and 9 were located in the Ware River watershed to characterize this source water supply. As shown in **Figures 4** and **5**, each watershed is divided into sanitary districts, and water quality of each watershed is monitored with "core" sites and "EQA" sites. Core sites are long-term monitoring stations, while Environmental Quality Assessment (EQA) sites support ongoing evaluations of threats to water quality by sanitary district. The remaining three sampling stations are located within the reservoir and are monitored monthly during the months of April through December, weather-permitting, with samples collected from several depths at each location.

Table 2. Quabbin Reservoir Tributaries
2015 Surface Water Monitoring Stations

		Basin Characteristics		
Tributary and Monitoring Station Description	**DWSP Sample Site #**	**Drainage Area[3] (sq. miles)**	**% Wetland Coverage[4]**	**% DWSP Owned Land[5]**
CORE SITES [1]				
West Branch Swift River at Route 202	211	12.4	3.4%	45.9%
Hop Brook inside Gate 22	212	4.66	2.5%	38.7%
Middle Branch Swift River at Gate 30	213	9.0	8.2%	23.1%
East Branch of Fever Brook at West Street	215	3.94	11.9%	12.8%
East Branch Swift River at Route 32A	216	30.3	9.5%	2.0%
Gates Brook at mouth	Gates	0.93	3.0%	100%
Boat Cove Brook at mouth	BC	0.15	<1%	100%
EAST BRANCH SWIFT RIVER SANITARY DISTRICT EQA SITES [2]				
Roaring Brook at East Street, Petersham Center	216G	1.03	6.6%	0%
Moccasin Brook above Quaker Road	216I-X	6.99	16.3%	1.3%
Connor Pond Outlet at Dam, near Pat Connor Rd	216D	21.6	10.3%	<1%
North Tributary of Site 216E at South Street	216E-1	0.14	5.3%	0%
Carter Pond below Outlet, at Glen Valley Road	216C	2.44	8.6%	0%

Notes:

[1]Core Sites: Samples collected biweekly for field parameters, turbidity, bacteria, and calcium. Samples for nutrient analysis and UV_{254} collected quarterly.

[2]EQA Sites: Samples collected biweekly for field parameters, alkalinity, turbidity, bacteria, nutrients, UV_{254}, and calcium.

[3]Source: DWSP Office of Watershed Management Geographic Information System, June 2007 revision.

[4]Source: DEP Wetland Conservancy Program (interpreted from 1:12000 Spring 1992-93 photos, January 2009 revision).

[5]Source: DWSP Office of Watershed Management Geographic Information System, January 2015 revision.

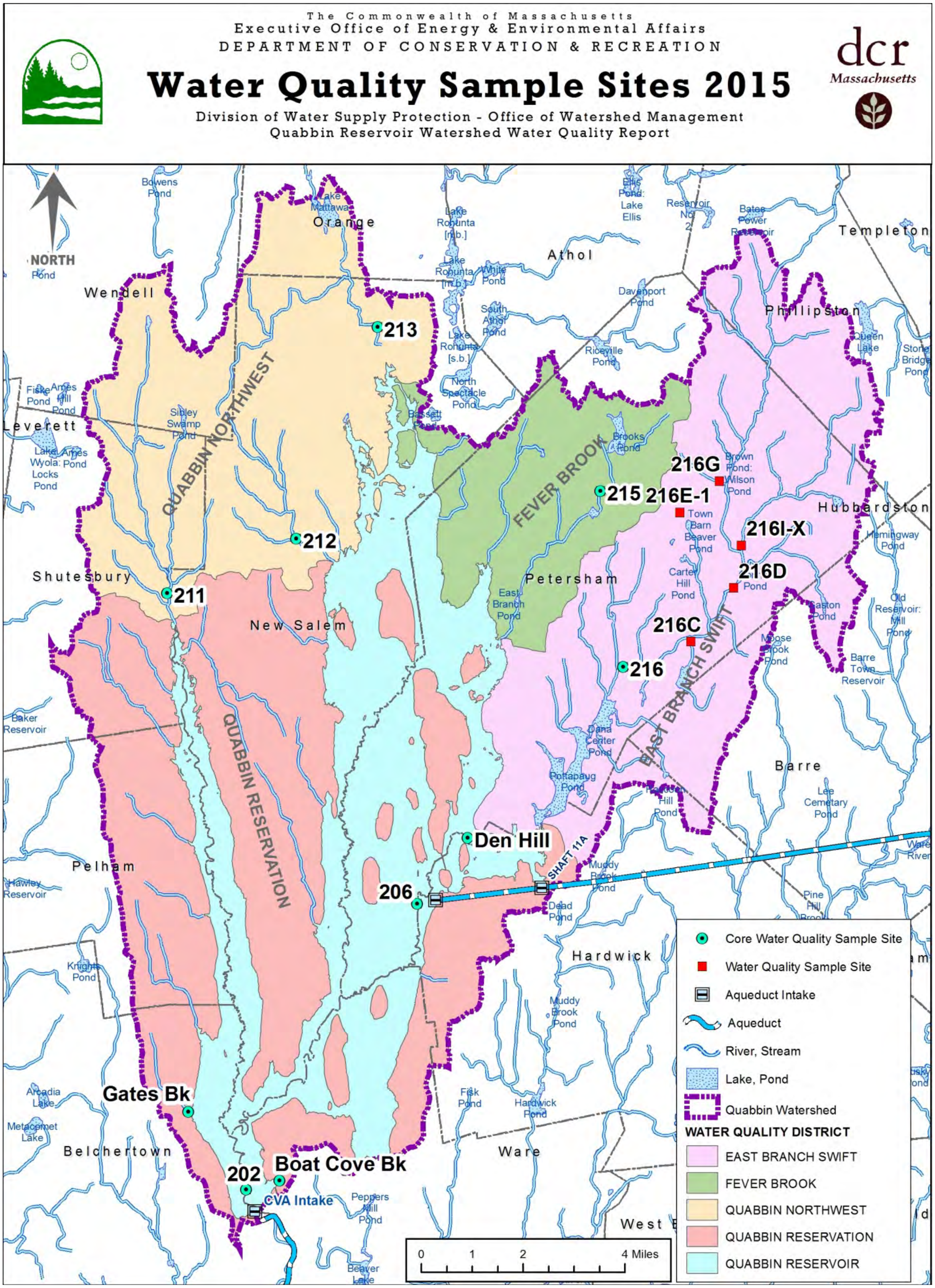


Figure 4. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2015 in the Quabbin Reservoir Watershed

Table 3. Ware River Tributaries
2015 Surface Water Monitoring Stations

Tributary and Monitoring Station Description	DWSP Sample Site #	*Basin Characteristics* Drainage Area[4] (sq. miles)	% Wetland Coverage[5]	% DWSP Owned Land[6]
CORE SITES [1]				
Ware River at Shaft 8 (intake)	101	96.5	13.9%	37.8%
Burnshirt River at Riverside Cemetery	103A	31.1	10.5%	28.3%
West Branch Ware River at Brigham Road	107A	16.6	15.6%	45.8%
East Branch Ware River at Intervale Road	108	22.3	16.8%	12.6%
Thayer Pond at inlet [2]	121B	2.0	16.5%	3.1%
EAST BRANCH WARE RIVER SANITARY DISTRICT EQA SITES [3]				
East Branch Ware River at Route 68	108A	17.1	17.2%	10.4%
Cushing Pond Outlet at Bemis Rd	108B	0.91	18.2%	53.1%
East Branch Ware River (Bickford Pond) at Lombard Rd	108C	3.39	14.2%	0%
Comet Pond Outlet	116	0.84	29.7%	21.1%
Comet Pond Outlet Trib. Near Clark Rd	116B	1.5	22.4%	25.5%

Notes:

[1]Core Sites: Samples collected biweekly for field parameters, turbidity, bacteria, and calcium. Samples for UV_{254} analysis collected biweekly. Samples for nutrient analysis collected quarterly.

[2]Before May 2007, Thayer Pond was monitored at the outlet (Site 121A). Because of continuous beaver activity at Thayer Pond outlet, monitoring location was moved to Site 121B as of May 2007.

[3]EQA Sites: Samples collected biweekly for field parameters, alkalinity, turbidity, bacteria, nutrients, UV_{254}, and calcium.

[4]Source: DWSP Office of Watershed Management Geographic Information System, April 2009 revision.

[5]Source: DEP Wetland Conservancy Program (interpreted from 1:12000 Spring 1992-93 photos, April 2009 revision).

[6]Source: DWSP Office of Watershed Management Geographic Information System, January 2014 (core sites) or February 2011 (EQA sites) revision.

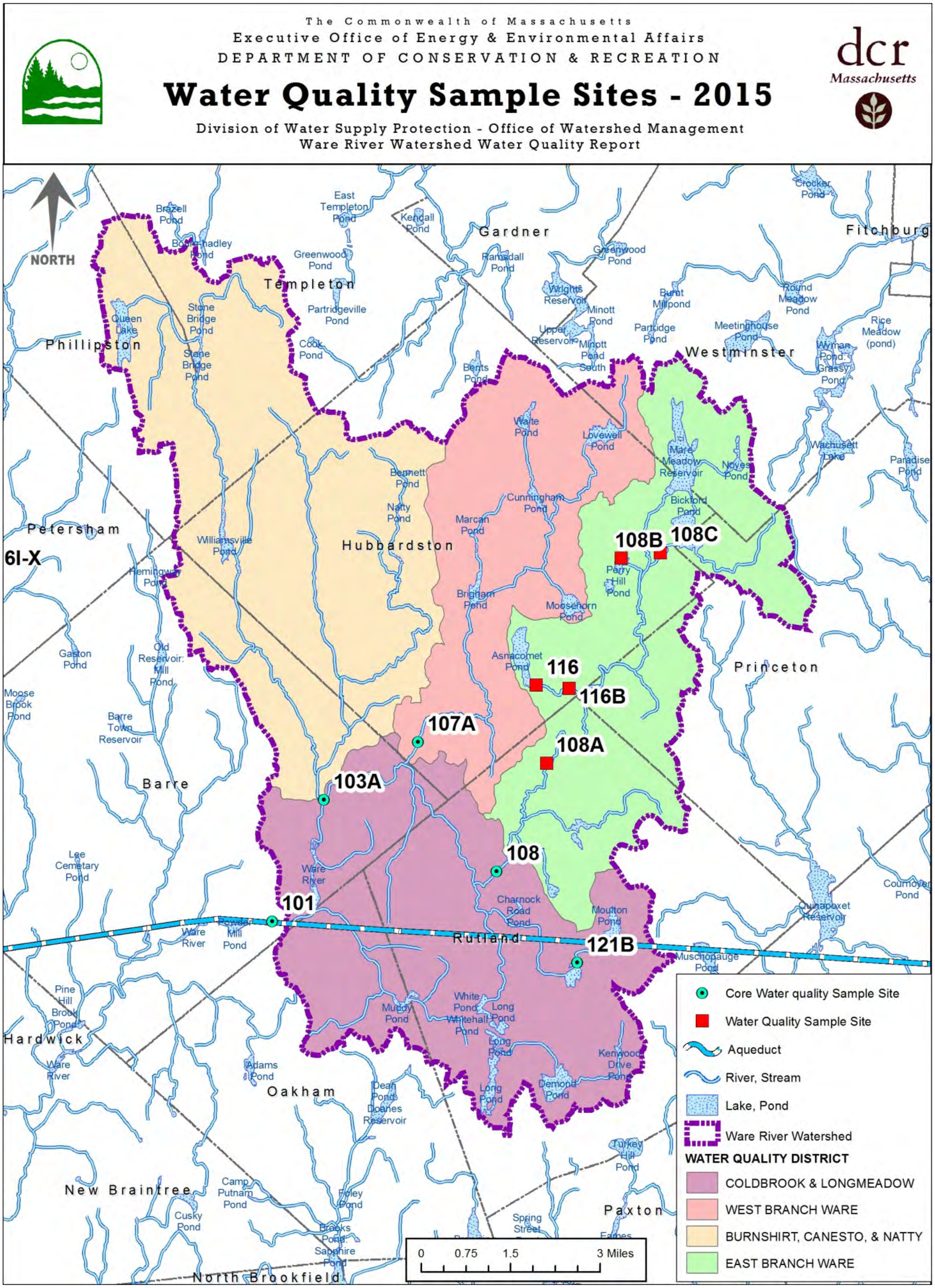


Figure 5. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2015 in the Ware River Watershed

2.2 Data Collection

Each tributary station is sampled biweekly, with sampling runs alternating between the Quabbin Reservoir watershed and the Ware River watershed. Samples are collected by hand early in the work week (typically Tuesday) regardless of weather conditions. The frequency of sampling gives a more complete assessment of tributary health, capturing variations from seasonal flow conditions, as well as both dry and wet weather flows. Tributary stream temperature, dissolved oxygen, pH, and specific conductance levels are determined in the field using a Eureka multiprobe meter. Data are stored digitally using a Eureka Amphibian personal digital assistant (PDA) and transferred to a Microsoft Access database.

In 2015, Environmental Quality staff collected 2,912 source water (tributary and reservoir) samples. Of those samples, 639 (22 percent) were collected for microbial analysis, 632 (22 percent) for physicochemical properties, and the remaining 1,641 samples (56 percent) were collected for nutrient analysis. Over 5,600 individual analyses were performed on these samples, of which 43 percent were nutrient analyses performed at the MWRA Central Laboratory at Deer Island. The remaining analyses were 40 percent physiochemical parameters (1,283) and 60 percent bacterial analyses (1,917) performed by MWRA staff at Quabbin Laboratory. MWRA staff at Quabbin Laboratory also processed and analyzed 365 microbiological samples collected at the William A. Brutsch Water Treatment Facility. In addition, over 2,200 physiochemical measurements (not including reservoir profiles) were collected in the field by DWSP staff using a Eureka Manta Multiprobe. All records are maintained in permanent bound books and in a digital format (Microsoft Access database) by DWSP.

2.3 Analytical Procedures

Water quality parameters routinely analyzed include temperature, pH, alkalinity, dissolved oxygen, specific conductance, turbidity, total coliform bacteria, fecal coliform bacteria and *Escherichia coli* (*E. coli*) bacteria. **Table 4** lists the equipment and laboratory methods employed at Quabbin Laboratory.

Table 4. Quabbin Laboratory: Analytical and Field Methods

PARAMETER	STANDARD METHOD (SM)[1]
Turbidity	SM 2130 B
pH	Eureka Manta Multiparameter Probe, SM 4500 H+ using Orion 920A+ pH Meter
Alkalinity	SM 2320 B (low level)
Conductivity	Eureka Manta Multiparameter Probe
Temperature	Eureka Manta Multiparameter Probe
Dissolved Oxygen	Eureka Manta Multiparameter Probe
Total Coliform	SM 9223 (Enzyme Substrate Procedure)
Fecal Coliform	SM 9222D
Escherichia coli (E. coli)	SM 9223 (Enzyme Substrate Procedure)

[1]Standard Methods for the Examination of Water and Wastewater, 20th Edition

2.4 Measurement Units

Chemical concentrations of constituents in solution or suspension are reported in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as mass (milligrams) of solute per unit of volume of water (liter). One milligram per liter is equivalent to 1,000 micrograms per liter. Bacteria densities are reported as number of presumptive colony forming units per 100 milliliters of water (CFU/100 mL) or, for methods using the enzyme substrate procedure, most probable number (MPN/100 mL). The following abbreviations are used in this report:

cfs	Cubic feet per second
CFU	Colony forming unit
MGD	Million gallons per day
MPN	Most probable number
NTU	Nephelometric turbidity units
PPM	Parts per million (1 mg/L ≈ 1 PPM)
TKN	Total Kjeldahl nitrogen
µS/cm	Microsiemens per centimeter
µmhos/cm	Micromhos per centimeter (1 µmhos/cm = 1 µS/cm)
UV_{254}	Ultraviolet absorbance at 254 nanometers

2.5 Monitoring Program Changes

Significant changes were made to the Quabbin tributary monitoring program beginning in 2005 (See DWSP, 2006). The most significant change involved the establishment of special sample sites to provide supportive information for Environmental Quality Assessments (EQAs; previously also known as sanitary surveys) in selected sanitary districts of the Quabbin Reservoir and Ware River watersheds. At these "EQA" sites, data are collected biweekly on bacteria levels, physicochemical parameters, and nutrient levels for one to two years. Sampling for 2015 focused on the East Branch Swift River Sanitary District in the Quabbin watershed, as well as the East Branch Ware River Sanitary District in the Ware River watershed. The EQA sites for 2015, along with selected basin characteristics for each site, are listed in **Tables 2** and **3**.

The tributary sampling program maintains several long-term, "core" sites located on primary tributaries inside of each watershed (Quabbin and Ware River). These core sites are important because they capture significant flow information, and long-term historical data will continue to be maintained. For core sites, Quabbin Reservoir watershed sites include West Branch Swift River at Route 202, Hop Brook inside Gate 22, Middle Branch Swift River at Gate 30, East Branch Fever Brook at West Street, East Branch Swift River at Route 32A, and at the mouth of Gates Brook and Boat Cove Brook. Within the Ware River watershed, the core sites include Burnshirt River at Riverside Cemetery, West Branch Ware River at Brigham Road, East Branch

Ware River at Intervale Road, Thayer Pond inlet, and Ware River below the Shaft 8 intake. As of May 2007, the Thayer Pond sampling site was relocated from the pond outlet to the inlet because of continuous beaver activity at the outlet. Selected basin characteristics for each site are summarized in **Tables 2** and **3**.

For the reservoir monitoring program, routine plankton monitoring was implemented in September 2007, following odor complaints on the CVA water, an increase in chlorine demand at the William A. Brutsch Water Treatment Facility, and increasing numbers of smelt at the intake screens in August 2007. The plankton monitoring program includes sampling at Site 202 and Site 206, typically at two depths. Samples are collected near the middle and bottom of the epilimnion during stratified conditions and at 3-meter and 10-meter depths during non-stratified conditions. Sampling is conducted, weather and reservoir conditions permitting, twice per month from May through September and once per month from October through April. Calcium monitoring was started in 2010 at the three in-reservoir sampling stations (Site 202, Site 206, and Den Hill) to evaluate risk of aquatic invasive organisms colonization (*e.g.*, zebra mussels). Begun on a monthly basis at three depths, calcium monitoring was reduced to a quarterly frequency at one depth because of the low concentrations and low variability at these in-reservoir sampling stations.

3 RESULTS – SOURCE WATER QUALITY MONITORING

The U.S. EPA promulgated the Surface Water Treatment Rule (SWTR) in 1989 to ensure that public water supply systems using surface waters were providing safeguards against the contamination of water by viruses and other microbial pathogens such as *Giardia lamblia*. The regulations in effect require filtration by every surface water supplier unless strict source water quality criteria and watershed protection goals can be met. Source water quality criteria rely on a surrogate parameter, turbidity, and an indicator organism, fecal coliform bacteria, to provide a relative measure of the sanitary quality of the water. The SWTR standard for fecal coliform bacteria requires that no more than 10 percent of source water samples prior to disinfection over any six month period shall exceed 20 colonies per 100 mL.

The DWSP and MWRA have maintained a waiver from the filtration requirement since 1989. To ensure compliance with the filtration waiver, the MWRA monitors daily the bacterial quality of Quabbin Reservoir water at a point prior to disinfection located inside the William A. Brutsch Water Treatment Facility. **Figure 6** depicts daily fecal coliform bacteria levels for July 2014 through December 2015. In 2015, fecal coliform bacteria averaged less than one colony per 100 mL and were not detected 88 percent of the time; median concentration was less than one colony per 100 mL. The maximum level, 5 colonies per 100 mL, was most likely related to beaver activity in vicinity of the reservoir (October 6) and gulls roosting on the reservoir (December 24). Fecal coliform concentrations remained below 20 colonies per 100 mL throughout 2015.

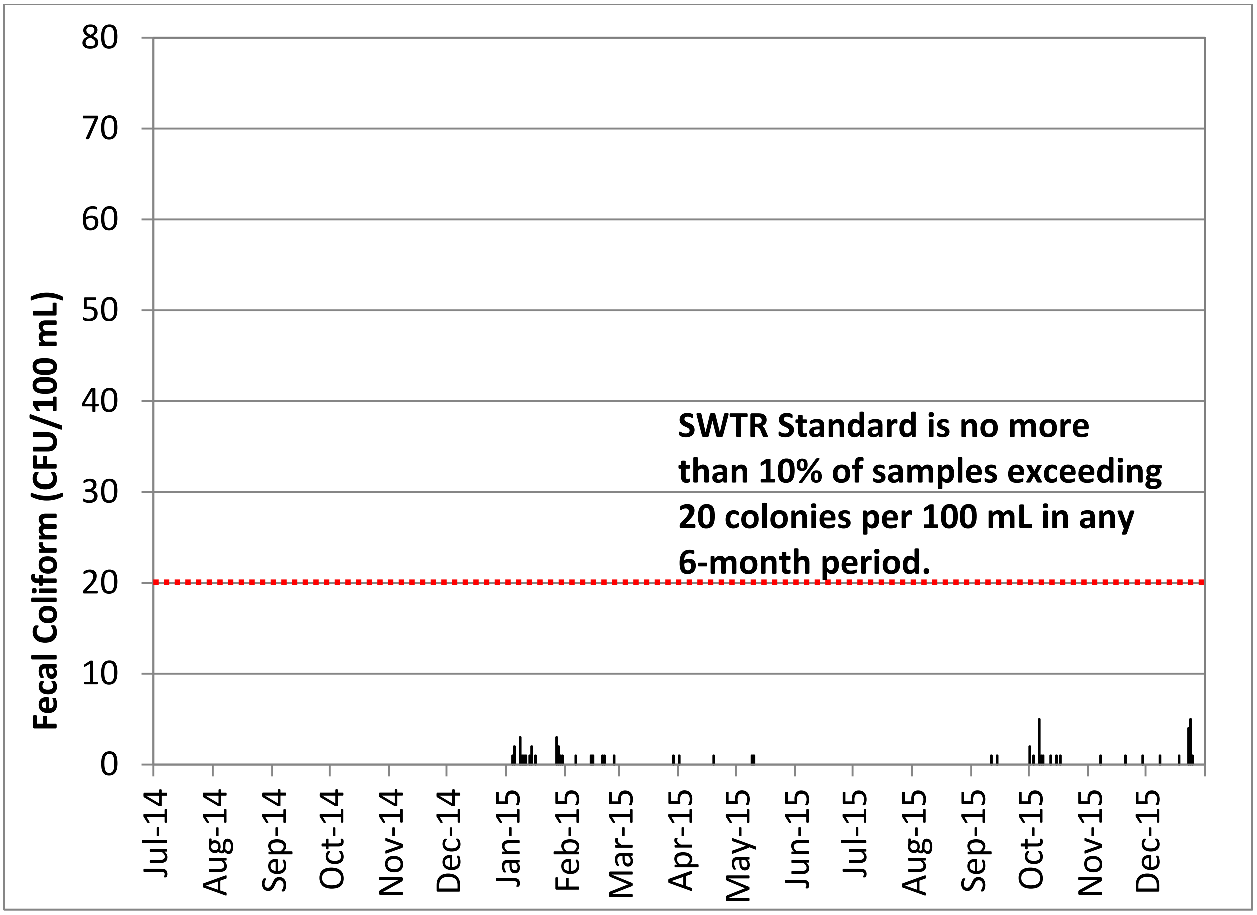


Figure 6. Fecal Coliform Bacteria Concentration prior to Disinfection, Quabbin Reservoir Source Water

For turbidity, the U.S. EPA SWTR standard is 5.0 NTU, while the Massachusetts Department of Environmental Protection (DEP) has adopted a more stringent performance standard of 1.0 NTU. MWRA monitors turbidity levels prior to disinfection using an on-line turbidity meter located inside the William A. Brutsch Water Treatment Facility. **Figure 7** depicts daily average and maximum turbidity levels for 2015 and includes a horizontal line marking the 1.0 NTU performance standard. For 2015, turbidity levels averaged 0.26 NTU, with the maximum turbidity of 0.56 NTU observed on May 11 (MWRA, 2015). Turbidity at the William A. Brutsch Water Treatment Facility remained below 1.0 NTU and met source water requirements throughout 2015.

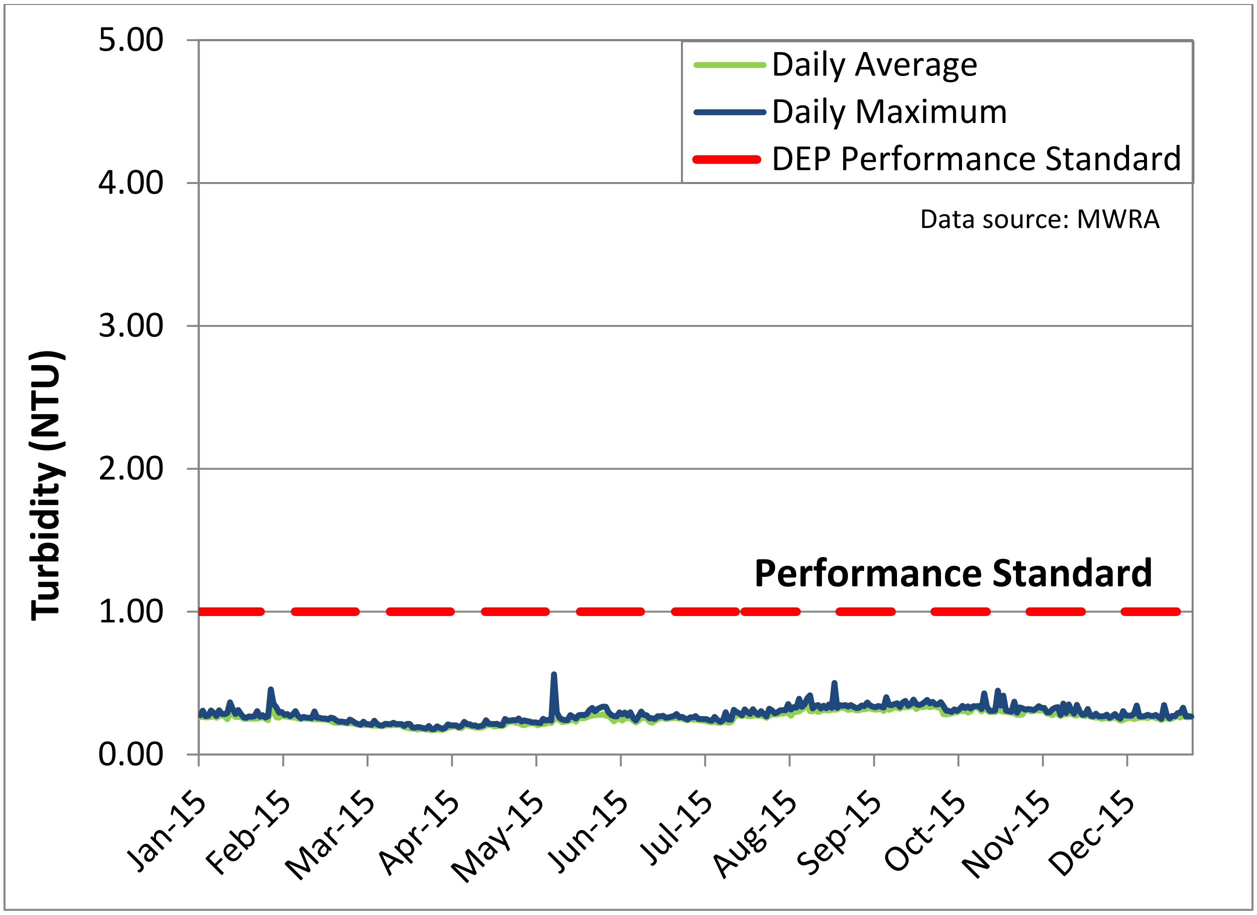


Figure 7. Quabbin Reservoir Source Water Turbidity (at William A. Brutsch Water Treatment Facility)

Giardia and *Cryptosporidium* monitoring on source water prior to disinfection is conducted biweekly. From January 2004 through January 2007, samples were collected from a tap located inside the Winsor Power Station. As of February 6, 2007, the sampling location was changed to a tap inside the William A. Brutsch Water Treatment Facility. *Giardia* and *Cryptosporidium* are of concern because their cysts have a high resistance to chlorine, infectivity doses are low, and life-cycles are longer than conventional microbial pathogens. Both pathogens have been linked to waterborne outbreaks of gastrointestinal disorders such as diarrhea, cramping and nausea. Sample collection and analysis follows protocols established under EPA Method 1623. In 2015, 26 samples were collected by MWRA staff. *Giardia* were detected in one February sample, at very low concentration, and *Cryptosporidium* were not detected in any samples. At no time did the *Cryptosporidium* or *Giardia* concentration exceed MWRA's trigger level of 10 cysts per 100 L, above which MWRA notifies the Massachusetts Department of Public Health. Additional pathogen sampling is scheduled to continue for the next year to comply with the Long Term 2 Surface Water Treatment Rule, which was promulgated in January 2006. This rule establishes levels of treatment for *Cryptosporidium* based on mean levels detected in monitoring results.

3.1 Results – Reservoir Monitoring

Reservoir water quality data documents consistently reliable source water quality that fully meets the stringent source water quality criteria stipulated under the Surface Water Treatment Rule. Water quality data are collected by Environmental Quality staff on a monthly basis, except during periods of adverse weather and/or winter ice conditions. Three sampling stations that were routinely sampled in 2015 are profiled in **Table 5**. Sample site locations are shown on **Figure 4**.

Table 5. 2015 Quabbin Reservoir Water Quality Monitoring Sites

Site (Site ID)	Location	Latitude Longitude	Approximate Bottom Depth
Winsor Dam (QR202)	Quabbin Reservoir west arm, off shore of Winsor Dam along former Swift River riverbed.	N 42°17.215′ W 72°20.926′	42 meters
Shaft 12 (QR206)	Quabbin Reservoir at site of former Quabbin Lake, off shore of Shaft 12.	N 42°22.292′ W 72°17.001′	28 meters
Den Hill (QR10)	Quabbin Reservoir eastern basin, north of Den Hill	N 42°23.386′ W 72°16.008′	19 meters

Reservoir water inside the three distinct reservoir basins is sampled monthly via boat, from April through December, weather permitting. Water samples are collected at depth using a Kemmerer bottle, and samples are analyzed at Quabbin Laboratory for turbidity, alkalinity, and bacteria. Samples for total and fecal coliform bacteria are taken at the surface (0.5 meter), 6 meters, and either the respective water supply intake depth (18 meters for Site 202, 24 meters for Site 206) or a deep sample (13 meters at Den Hill). Physicochemical grab samples are taken at the surface (0.5 meter), mid-depth, and within 2 meters of bottom when the reservoir is not thermally stratified. When the reservoir is stratified, physicochemical samples are collected from the surface (0.5 meters), mid-metalimnion (generally 9 to 14 meters), and deep (within 2 meters of bottom). Weather and reservoir conditions are recorded on each survey. A standard 20-centimeter diameter, black-and-white Secchi disk is used to measure transparency.

Water column profiles of temperature, pH, dissolved oxygen, and specific conductance are measured *in situ* using a Eureka Manta Multiprobe. Readings are taken every meter during times of thermal stratification and mixing, and every three meters during periods of isothermy. See **Appendix B** for reservoir profiles. Field data are stored digitally using a personal digital assistant (PDA) and transferred to a computer database maintained by the Environmental Quality Section. Quarterly sampling for nutrients was performed at the onset of thermal stratification (May), in the middle of the stratification period (late July), near the end of the stratification period (October), and during a winter period of isothermy (December). The MWRA Central Laboratory provided analytical support for the measurement of total phosphorus, total Kjeldahl nitrogen, nitrate, ammonia, UV_{254}, silica, and calcium.

An overview of reservoir water quality conditions at three stations routinely monitored in 2015 is presented in **Table 6**. The complete data for individual stations are included in **Appendix C**. A brief discussion of selected monitoring parameters and their significance to reservoir water quality conditions is provided below.

Table 6. General Water Chemistry Ranges, 2015 Quabbin Reservoir Monitoring Stations.

Reservoir Station (Site ID)	**pH (Field)** (units)	**Turbidity** (NTU)	**Dissolved Oxygen** (% Saturation)	**Secchi Disk Transparency** (meters)	**Total Coliform Bacteria** (MPN/100mL)	**Fecal Coliform Bacteria** (CFU/100mL)
Winsor Dam (QR202)	5.6-6.5	0.174-0.377	63-163	7.9-12.2	<10-2,250	<1-1
Shaft 12 (QR206)	5.6-6.6	0.193-0.475	74-141	7.4-10.9	<10-1,470	<1
Den Hill (QR10)	5.4-6.7	0.279-0.782	70-132	5.9-8.5	<10-6,130	<1-2

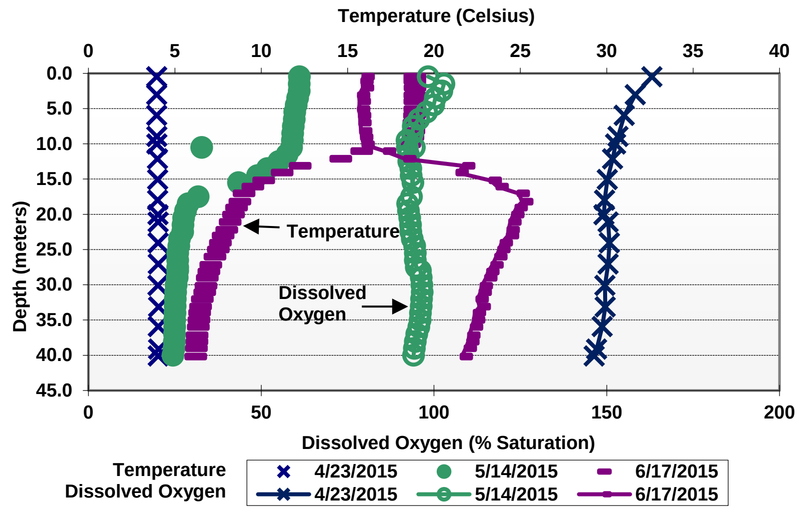
Source: Environmental Quality Database, 2015

3.1.1 Temperature

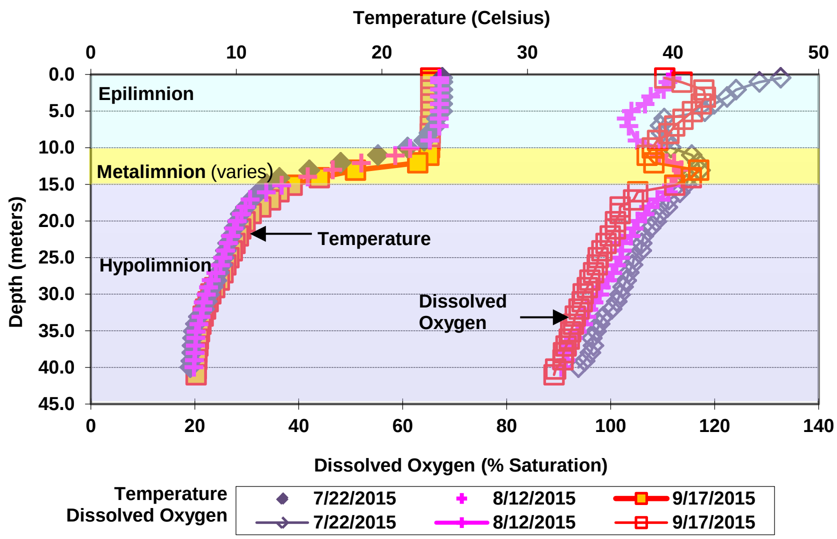
The thermal stratification that occurs in the reservoir has a profound impact on many of the parameters monitored across the reservoir profile. The temporal zones that develop within the reservoir during the warmer months of spring and summer, known as the epilimnion, metalimnion and hypolimnion (listed in order from top to bottom), have distinct thermal, water flow, and water quality characteristics. Waters of the epilimnion are warm and well mixed by wind driven currents, and the epilimnion may become susceptible to algal growth due to the availability of sunlight and entrapped nutrients introduced to the partitioned layer of surface water. Within the metalimnion, the thermal and water quality transition occurs between the warmer surface waters and colder, deep waters. The much deeper hypolimnic waters may become stagnant and serve as a sink for decaying matter and sediments that settle out from the upper layers of warmer water. Each year the reservoir becomes mixed due to the settling of cooler surface waters in the fall and following springtime ice-out when an isothermal water column is easily mixed by winds. A graphical portrayal of the thermal mixing and transition that occurs between isothermal and fully mixed to fully stratified conditions using profile data collected at Station 202 (Winsor Dam) is shown in **Figure 8,** and profiles for the three stations are included in **Appendix B**. The Station 202 and Station 206 temperature profiles indicate fall turnover likely occurred in mid- to late November. The water column at each location was completely mixed to 15-20 meters depth on October 22 and 20-25 meters depth on November 9. Both stations were fully mixed by December 2.

3.1.2 Dissolved Oxygen

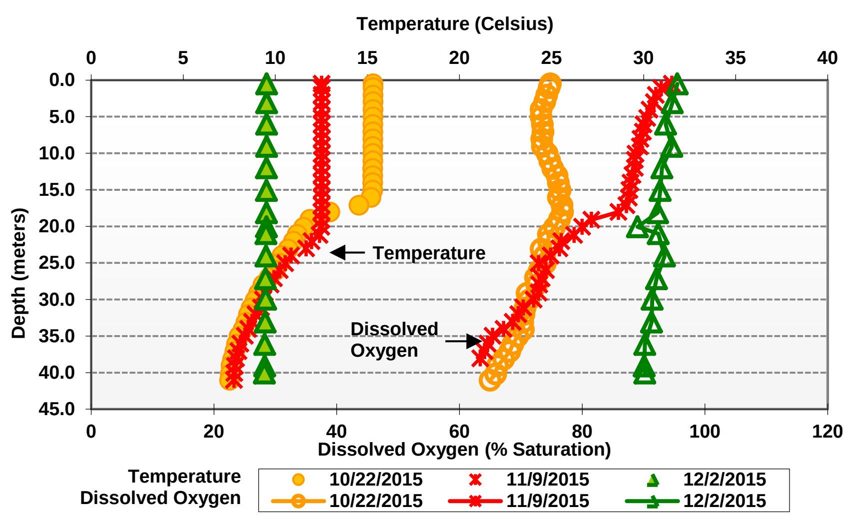
Oxygen is essential to the survival of aquatic life (e.g., trout need a minimum of 5.0 mg/L, equivalent to 44 percent saturation at 10°C). Available oxygen also plays an important role in preventing the leaching of potentially harmful metals trapped among the bottom sediments. Dissolved oxygen, or more specifically the loss of oxygen from the hypolimnion, is used as one



(a) April - June 2015



(b) July- September 2015



(c) October - December 2015

Figure 8. Temperature and Dissolved Oxygen Profiles at Quabbin Reservoir Site 202

index to characterize the trophic state of a lake. Because re-aeration factors such as wind driven turbulence, reservoir currents, and atmospheric diffusion diminish with depth, dissolved oxygen concentrations typically decrease with depth. Moreover, the sinking of decaying organic debris into the hypolimnion can be a major source of oxygen depletion in highly productive lakes because of the respiration requirements of microbial populations responsible for the decomposition of organic wastes. Hypolimnic oxygen reserves established in the spring are not replenished until the late fall when cooling surface waters ultimately settle and re-mix the reservoir. Some dissolved oxygen readings measured in 2015 appeared elevated, sometimes exceeding 25 mg/L. Equipment records indicate that the sensor response factor for dissolved oxygen was occasionally out of range during calibration; the age of the dissolved oxygen probe (approximately 5 years) is suspected as a cause. New multiprobes were put into service in late 2015.

In 2015, minimum levels of oxygen measured in the hypolimnion ranged from a low of 63 percent saturation at Station 202 (November 9) to 74 percent saturation at the bottom depth at Station 206 (October 22). Depletion levels are generally most pronounced in the latter stages of stratification (typically August through October). In mass concentration terms, the minimum dissolved oxygen levels in 2015 were 7.17 mg/L at Station 202 (June 17, 3 and 5 meters), 8.00 mg/L at Station 206 (October 22, 2 and 3 meters), and 7.71 mg/L at Den Hill (October 22, 17 meters). The seasonal development and breakdown of lake stratification are depicted in temperature and dissolved oxygen profiles shown in **Figure 8**. Complete profile data for all three reservoir monitoring stations are included in **Appendix B**.

3.1.3 Turbidity

Reservoir turbidity levels are historically very low and stable, reflective of the low productivity of the reservoir. In-reservoir turbidity levels monitored in 2015 ranged from 0.17 to 0.78 NTU. The highest turbidity level was measured at 16 meters depth on October 22 at Den Hill. Typical causes of turbidity in the reservoir include storm activity, algal blooms or shoreline erosion. A review of precipitation data from Barre Falls Dam during the week before sampling indicated storm activity is not the likely cause of the October 22 turbidity result at Den Hill. The only precipitation during that week was 0.02 inch of rain five days prior to reservoir sampling, and it seems unlikely that this relatively light rainfall led to the elevated turbidity measurement. From time to time, algae blooms may impart color and suspended organic particulates that will elevate levels of turbidity. Near-shore areas are also prone to elevated turbidity levels due to the action of waves that may resuspend shoreline sediment and deposits.

3.1.4 pH and Alkalinity

Three processes principally reflected in reservoir pH and alkalinity dynamics are 1) direct acidic inputs (i.e., rainfall, dry deposition), 2) biological respiration, and 3) algal photosynthesis. The input of acid in the form of direct precipitation will consume alkalinity available in the water and reduce pH levels. Reservoir pH is an important consideration because levels below 6 increase the solubility of persistent heavy metals such as mercury, allowing the metal to be incorporated into the water body and thus more likely to accumulate in the tissue of living organisms such as fish. As a result, most northeastern lakes like Quabbin Reservoir have posted fish consumption advisories that suggest limiting the quantity of fish consumed because of the presence of higher mercury levels in the fish. Quabbin Reservoir water is slightly acidic with a pH level that averaged 6.17 across the three stations monitored in 2015.

Alkalinity serves as a water body's principal defense by neutralizing the effects of pH. Both pH and alkalinity have a long-term record of stability in the Quabbin Reservoir, but levels fluctuate due to reservoir dynamics. Fluctuations may be caused through respiration by organisms as oxygen is consumed and carbon dioxide is released. The result will be an increase in alkalinity due to the input of carbon to the water. Photosynthetic activity in the epilimnion and metalimnion can decrease alkalinity and increase pH due to the consumption of free carbon dioxide and bicarbonate. Reservoir alkalinity is low and averaged 3.91 mg/L as $CaCO_3$ across the three reservoir stations. Most samples ranged from approximately 3 to 4 mg/L as $CaCO_3$, with one result of 7.50 mg/L as $CaCO_3$ (collected from Den Hill at 16 meters depth on October 22). Note that alkalinity in the annual water quality reports for Quabbin and Ware River have historically presented two sets of alkalinity data: "standard," which represented alkalinity to a pH endpoint of 4.5, versus "EPA," representing alkalinity to a pH endpoint of 4.2. Under Standard Method 2320B, waters of "low-level" alkalinity, which is less than 20 mg/L, should be reported using the pH 4.2 endpoint. If reporting alkalinity at pH 4.5, in the method used historically, reservoir alkalinity averaged 5.53 mg/L as $CaCO_3$ across the three reservoir stations.

3.1.5 Secchi Disk Transparency

Quabbin reservoir water has excellent clarity and visibility as evidenced by maximum Secchi disk readings that may approach 13 meters. Transparency is determined as the depth below the surface at which a 20-centimeter, black-and-white disk becomes indistinguishable to the naked eye. While sensitive to weather and reservoir conditions at the time of sampling, transparency can be greatly influenced by the level of phytoplankton activity. Historically, reservoir transparency measurements are consistent with the pattern of phytoplankton dynamics (Worden, 2000). In 2015, the maximum measured transparency was 12.2 meters at Site 202 on July 22.

Transparency at the Den Hill station is characteristically much lower, typically reflecting the contribution of large, nearby river inputs of the East Branch Swift River and the Ware River via Shaft 11A (when diverting). The East Branch Swift River, estimated to contribute as much as 9 to 16 percent of the annual flow to the reservoir, is a significant source of color that reduces transparency. In 2015, minimum transparency was measured at 5.9 meters at Den Hill on May 14. Monthly transparency measurements and weather observations are noted in Tables 7, 8, and 9.

Table 7. Transparency Measurements and Weather and Water Surface Observations in 2015, Quabbin Reservoir Site 202 (Winsor Dam).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 23, 2015	9.2	Green	Most cloudy, 4°C (39°F), NW wind 7 to 9 mph, 8" chop.
May 14, 2015	10.4	Green	Sunny, 16°C (61°F), N wind 1 mph, slight ripple.
June 17, 2015	11.8	Green	Partly cloudy, 18°C (64°F), N wind 8 to 12 mph, 10 to 12" chop.
July 22, 2015	12.2	Light blue-green	Sunny, 21°C (70°F), NW/W wind 2 to 4 mph, 2 to 3" ripple.
August 12, 2015	11.1	Green	Mostly sunny, 22°C (72°F), W wind 1 mph, slight ripple.
September 17, 2015	9.0	Blue-green	Fog then sunny, 18°C (64°F), S wind 1 mph, 2" ripple.
October 22, 2015	10.2	Blue-green	Mostly cloudy, 8°C (46°F), calm wind, calm water surface.
November 9, 2015	7.9	Green	Mostly sunny, 7°C (45°F), S wind 1 mph, slight ripple.
December 2, 2015	10.0	Blue-green	Overcast with fog, 6°C (43°F), SW wind 1 mph, slight ripple.

Table 8. Transparency Measurements and Weather and Water Surface Observations in 2015, Quabbin Reservoir Site 206 (Shaft 12).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 23, 2015	10.4	Green	Mostly cloudy, 7°C (45°F), W wind 10 to 12 mph with higher gusts, 12 to 14" chop.
May 14, 2015	8.7	Green	Sunny, 14°C (57°F), N wind 2 mph, 3 to 4" chop.
June 17, 2015	10.8	Green	Partly cloudy, 19°C (66°F), N wind 6 to 8 mph, 6 to 8" chop.
July 22, 2015	9.9	Light blue-green	Mostly sunny, 23°C (73°F), W/NW wind 3 to 5 mph, 4 to 6" chop.
August 12, 2015	9.5	Blue-green	Partly cloudy, 24°C (75°F), NW wind 4 to 5 mph, 8" chop.
September 17, 2015	9.2	Green	Mostly sunny, 22°C (72°F), NE wind 1 mph, slight ripple.
October 22, 2015	7.4	Green	Mostly cloudy, 9°C (48°F), SW wind 6 to 10 mph, 12 to 14" chop.
November 9, 2015	8.3	Green	Mostly sunny, 9°C (48°F), S wind 5 to 10 mph, 8 to 12" chop.
December 2, 2015	10.1	Blue-green	Overcast with light rain and fog, 6°C (43°F), calm wind, calm water surface.

Table 9. Transparency Measurements and Weather and Water Surface Observations in 2015, Quabbin Reservoir Site Den Hill

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 23, 2015	6.5	Olive green	Mostly sunny, 7°C (45°F), NW/W wind 5 to 6 mph, 6 to 8" chop.
May 14, 2015	5.9	Yellow-green	Sunny, 18°C (64°F), N wind 1 mph, slight ripple.
June 17, 2015	7.1	Blue-green	Partly cloudy, 21°C (70°F), NW wind 3 to 5 mph, 4 to 5" chop.
July 22, 2015	8.4	Green	Mostly sunny, 25°C (77°F), NW wind 1 to 3 mph, 2 to 3" ripple.
August 12, 2015	7.2	Olive green	Partly cloudy, 26°C (79°F), NW wind 3 to 4 mph, 5" chop.
September 17, 2015	8.5	Brown-green	Mostly sunny, 22°C (72°F), calm wind, calm water surface.
October 22, 2015	6.2	Olive green	Mostly cloudy, 18°C (64°F), SW wind 4 to 6 mph, 6" chop.
November 9, 2015	8.1	Olive green	Mostly sunny, 9°C (48°F), SW wind 2 to 5 mph, 4" chop.
December 2, 2015	6.0	Dark blue-green	Overcast with rain, 6°C (43°F), E wind 1 mph, slight ripple.

3.1.6 Coliform and *E. coli* Bacteria

The term "coliform" is used to describe a group of bacteria based on biochemical functions and not on taxonomy. Both "total" coliform and "fecal" coliform bacteria have been used as indicators of fecal contamination, although total coliforms may include many species that are natural inhabitants of the aquatic system and the environment (Wolfram, 1996; Dutka and Kwan, 1980). The so-called "fecal" coliform group is a subset of the total coliform group that can grow at temperatures comparable to those in the intestinal tracts of warm-blooded animals (Toranzos and McFeters, 1997). Because of this ability to grow at elevated temperatures, the fecal coliform group may be considered a better indicator of recent fecal pollution. However, the term "fecal" coliform is somewhat of a misnomer, as some bacteria within this grouping may originate from environmental sources rather than fecal contamination (Toranzos and McFeters, 1997; Leclerc *et al.*, 2001). *E. coli* bacteria, which are normal inhabitants of the intestinal tracts of humans and other warm-blooded animals, are a better indicator of recent fecal pollution in temperate climates.

During 2015, in-reservoir coliform bacteria (fecal coliform, *E. coli*, and total coliform) levels were monitored monthly at the routine reservoir stations beginning on April 23 and ending on December 2. Grab samples were collected from the surface (0.5 meter), 6-meter depth, and from the respective water supply intake depth at the two deep-basin sites (24 meters at Shaft 12 and 18 meters at Winsor Dam). At Den Hill, the deep sample is collected at 13 meters.

Fecal coliform bacteria were detected in several reservoir samples, and most detections were 1 CFU per 100 mL. The only fecal coliform detection greater than 1 CFU/100 mL was the Den Hill 0.5-meter sample in September, in which the fecal coliform result was 2 CFU/100 mL. At Station 202, fecal coliform bacteria were detected in the 6-meter sample in June, as well as the 0.5-meter sample in December. At Station 206, fecal coliforms were not detected in 2015. At the Den Hill station, fecal coliforms were detected in the 0.5-meter samples in September and October, the 6-meter samples in May and August, and the deep samples (13 meters) in April and September. *E. coli* were detected two times in 2015 at the detection limit of 10 MPN/100 mL. These detections were in the 0.5-meter samples at Station 202 in June and Station 206 in July.

A seasonal gull population that roosts on the reservoir overnight has been identified as the primary contributor of fecal coliform and *E. coli* bacteria contamination to the reservoir. Other sources may include other waterfowl, semi-aquatic wildlife and tributary inputs. However, because of the long residence time of the reservoir (reportedly on the magnitude of several years), fecal coliform and *E. coli* bacteria levels are normally very low, reflecting microbial die-off and predation that occurs naturally.

Reservoir total coliform bacteria concentrations are much more dynamic than fecal coliform and *E. coli*, ranging from not detected (less than 10) to 6,130 colonies per 100 mL in 2015. The total coliform concentration of 6,130 MPN/100 mL was measured in the 0.5-meter sample from Den Hill on July 22, 2015. Because of the more ubiquitous nature of the total coliform bacteria, fecal coliform and *E. coli* are the preferred indicators for regulatory and monitoring purposes. This approach is consistent with the EPA Surface Water Treatment Rule which specified that when both total and fecal coliform bacteria are analyzed, the fecal coliform findings have precedent.

3.1.7 Reservoir Phytoplankton and Nutrient Dynamics

The nutrient database for Quabbin Reservoir established in the 1998-99 year of monthly sampling and subsequent quarterly sampling through 2014 is used as a basis for interpreting data generated in 2015 (see **Table 10**). Results of quarterly nutrient sampling in 2015 were generally consistent with historical data ranges. In particular, ammonia concentrations were near or below the detection limit of 5 µg/L (0.005 mg/L) in samples from all three depths at Station 206 and Den Hill, as well as most of the samples at Station 202. Total phosphorus concentrations were generally just above the detection limit of 5 µg/L (0.005 mg/L), with a maximum of 11 µg/L (0.011 mg/L) detected at Station 206 in May. Such low ammonia and phosphorus concentrations may be factors limiting growth of phytoplankton in 2015, continuing a trend from 2009. Typically, phosphorus is the limiting nutrient in Quabbin Reservoir and other lakes in temperate climates (Worden, 2000).

In general, the patterns of nutrient distribution in 2015 quarterly samples were comparable to those documented previously in the 2000 report on Quabbin nutrient and plankton dynamics.

These patterns consist of the following: 1) prominent seasonal and vertical variations due to demand by phytoplankton in the trophogenic zone (low concentrations in the epilimnion and metalimnion) and decomposition of sedimenting organic matter in the tropholytic zone (higher concentrations accumulating in the hypolimnion); 2) a lateral gradient in silica concentrations correlated to hydraulic residence time and mediated by diatom population dynamics; and 3) variably higher concentrations and intensities at the Den Hill monitoring station due to the loading effects of the East Branch Swift River.

Routine monitoring of phytoplankton was implemented in September 2007, with samples collected from two depths at Station 202 and Station 206. Samples are collected, weather and reservoir conditions permitting, twice per month in May through September and once per month in other months. In 2015, samples were collected according to this schedule, and the most prevalent phytoplankton included the diatoms *Asterionella*, *Cyclotella,* and *Rhizosolenia*; the chlorophytes (green alga) *Gloeocystis* and *Sphaerocystis*; and the cyanophytes (blue-green alga) *Microcystis* and *Aphanocapsa*. The phytoplankton species observed in Quabbin Reservoir are "typical of many oligotrophic systems located in the temperate zone" with low densities in 2015, averaging 150 ASUs per mL at Site 202 and 182 ASUs per mL at Site 206 (Packard, 2015; see **Appendix A**). Diatoms dominated early in the year, reaching 547 ASUs per mL at Site 202 on April 23, and declined steadily thereafter. Phytoplankon densities were relatively low in late summer/early fall at Site 202, with a minimum of 53 ASUs per mL on September 10. Cyanophyte density began increasing at both sites in late summer, reaching maximums of 227 ASUs per mL at Site 202 in September and 117 ASUs per mL at Site 206 in August. Plankton monitoring is proposed to continue with the same schedule and locations in 2016.

Calcium analysis was added to the reservoir monitoring program in 2010. Because calcium varied little with depth and in monthly sampling during 2010 through 2011, sampling frequency was reduced from monthly to quarterly starting in 2012, and just one sample was collected, around mid-depth, per reservoir station. In quarterly sampling for 2015, calcium concentrations ranged from 1.89 mg/L to 2.14 mg/L at the three reservoir sites. See **Appendix C** for all reservoir data in 2015.

Table 10. Quabbin Reservoir Nutrient Concentrations:
Comparison of Ranges from 1998-2014 Database to Results from 2015 Quarterly Sampling (after Worden, 2013)

Sampling Station	Ammonia (NH3; ug/L) 1998-2014	Ammonia (NH3; ug/L) Quarterly 2015	Nitrate (NO3; ug/L) 1998-2014	Nitrate (NO3; ug/L) Quarterly 2015	Silica (SiO2; mg/L) 1998-2014	Silica (SiO2; mg/L) Quarterly 2015	Total Phosphorus (ug/L) 1998-2014	Total Phosphorus (ug/L) Quarterly 2015	UV254 (Absorbance/cm) 1998-2014	UV254 (Absorbance/cm) Quarterly 2015
WD/202 (E)	<5 - 16	<5- 13	<5 - 23	<5 - 7	0.84 - 2.40	1.90 - 2.29	<5 - 20	<5 - 9	0.017 - 0.029	0.018 - 0.023
WD/202 (M)	<5 - 29	<5	<5 - 27	<5 - 11	0.83 - 2.42	1.78 - 2.34	<5 - 13	<5 - 8	0.017 - 0.031	0.019 - 0.024
WD/202 (H)	<5 - 53	<5 - 16	<5 - 54	<5 - 17	1.08 - 2.86	2.18 - 2.50	<5 - 44	<5 - 8	0.017 - 0.026	0.019 - 0.024
MP/206 (E)	<5 - 10	<5	<5 - 20	<5	0.84 - 2.24	1.71- 2.04	<5 - 12	<5 - 8	0.017 - 0.031	0.018 - 0.023
MP/206 (M)	<5 - 34	<5	<5 - 44	<5	0.84 - 2.25	1.78 - 1.91	<5 - 12	<5 - 11	0.017 - 0.031	0.018 - 0.024
MP/206 (H)	<5 - 105	<5 - 5	<5 - 130	<5 - 7	1.02 - 3.27	1.81 - 2.15	<5 - 19	<5 - 9	0.018 - 0.031	0.018 - 0.024
Den Hill (E)	<5 - 19	<5	<5 - 45	<5 - 6	0.74 - 4.64	1.85 – 2.77	<5 - 27	6 - 10	0.025 - 0.122	0.028 - 0.046
Den Hill (M)	<5 - 28	<5	<5 - 58	<5 - 7	0.84 - 4.37	1.76 – 2.52	<5 - 15	5 - 10	0.027 - 0.139	0.028 - 0.038
Den Hill (H)	<5 - 84	<5 - 6	<5 - 78	<5 - 30	0.83 - 4.25	1.89 – 3.30	<5 - 15	9 - 10	0.028 - 0.171	0.028 - 0.045

Notes: (1) 1998-2014 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling conducted through December 2014, except for measurement of UV254 initiated in 2000 quarterly sampling.
(2) 2015 quarterly sampling conducted May, July, October, and December.
(3) Water column locations are as follows: E = epilimnion/surface, M = metalimnion/middle, H = hypolimnion/bottom

3.1.8 Monitoring for Aquatic Invasive Species at Quabbin Reservoir

Aquatic invasive species (AIS) are "nonindigenous organisms that...have the ability to become established and spread rapidly within native aquatic communities" (DWSP, 2010). They generally have adaptations that enhance their survival and reproduction, as well as a lack of predators or disease in the new environment to keep them in check. For a water supply such as the DWSP/MWRA system, the primary concerns that AIS pose are "loss of native species, habitat degradation, damage to infrastructure, disruption of ecosystem function, and impairments to water quality" (DWSP, 2010).

Because of the potential impacts, DWSP staff have implemented various programs to monitor for and prevent the spread of AIS. These programs include boat inspections and decontamination, monitoring of boat ramps, and aquatic macrophyte surveys; see **Appendix A** for brief reports on these programs. The aquatic macrophyte surveys are conducted each summer at selected water bodies within the Quabbin and Ware River watersheds, as well as occasionally at water bodies outside of these watersheds because of proximity to Quabbin Reservoir.

In addition, working with an MWRA consultant, DWSP Environmental Quality staff have conducted aquatic macrophyte surveys at Quabbin Reservoir in 2006 and 2010, and annually since 2013. Until 2014, the primary AIS finding was variable-leaf milfoil (*Myriophyllum heterophyllum*), which was documented in Quabbin Reservoir prior to 1973 (DWSP, 2010). In the 2014 survey, brittle naiad (*Najas minor*) was discovered in O'Loughlin Pond, also known as the regulating pond north of Fishing Area 2. As described in Appendix A, brittle naiad plants were removed in 2014 using diver assisted suction harvesting and an additional fragment barrier was installed to protect the reservoir. The pond and the fragment barrier were surveyed by DWSP and the MWRA consultant in 2015, and no brittle naiad plants were found.

Other AIS observed in 2015 included *Phragmites australis* (common reed), *Cabomba caroliniana* (fanwort), *Potamogeton crispus* (curly leaf pond weed), *Iris pseudacorus* (yellow flag iris), *Lithrum salicaria* (Purple Loosestrife), *Rorippa microphylla* (One Row Yellowcress), and *Myosotis scorpioides* (True Forget-me-not). These plants had been observed previously, and no new AIS were observed in 2015.

3.2 Results – Tributary Monitoring

Monitoring of tributary water quality is not required by the SWTR or other regulations. However, routine monitoring of the tributaries does serve to establish a baseline of water quality data, from which trends may be used to identify subwatersheds where localized activities may be adversely impacting water quality. Water quality data from 2000 through 2009 were reviewed in 2011 to evaluate longer term trends in water quality monitoring and analysis. This 10-year data review (http://www.mass.gov/eea/docs/dcr/watersupply/watershed/quabbinwq2000to2009.pdf) can help guide ongoing data evaluation in the Quabbin Reservoir and Ware River watersheds.

3.2.1 Bacteria

Historically, total and fecal coliform concentrations have been used as indicators of sanitary quality. Until 2007, Massachusetts Class A surface water quality standards stated that "fecal coliform concentrations shall not exceed an arithmetic mean of 20 colonies per 100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 100 colonies per 100 mL" (314 CMR 4.05(3)(a)4.). Since then, the Class A bacterial standard has been revised to differentiate between water supply intakes, where fecal coliform concentrations "shall not exceed 20 fecal coliform organisms per 100 mL in all samples in any six month period," and other Class A waters, which rely instead on *E. coli* bacteria as the indicator of sanitary quality. Water quality monitoring in the Quabbin Reservoir and Ware River tributary sites includes total coliform and fecal coliform bacteria, along with *E. coli* bacteria. The bacterial results for tributary sites are discussed below.

3.2.1.1 E. coli Bacteria

In 2015, the *E. coli* results ranged from less than 10 MPN/100 mL to 1,610 MPN/100 mL. The maximum concentration for the year, recorded at Boat Cove Brook on September 15, occurred following heavy rainfall in the week prior to sampling. This site is sometimes affected by wildlife impacts; see inspection report in **Appendix A**.

New historical maximum values were recorded in 2015 for Site 216C in the Quabbin watershed and Sites 103A, 108B, 108C, and 116B in the Ware River watershed. At Site 216C (Carter Pond below outlet), the new maximum result of 457 MPN/100 mL occurred on June 9, exceeding the previous high of 272 MPN/100 mL recorded in March 2010. In the Ware River watershed, new maximum values were recorded at Sites 103A and 116B on June 2 and at Sites 108B and 108C on August 11. At Site 103A (Burnshirt & Canesto River), E. coli of 1,420 MPN/100 mL exceeded the previous maximum of 1,040 MPN/100 mL from September 2010. At Site 116B (Comet Pond outlet tributary), the new maximum of 1,050 MPN/100 mL was about an order of magnitude higher than the previous high value of 135 MPN/100 mL from August 2011. At Site 108B (Cushing Pond outlet), the result of 262 MPN/100 mL exceeded the October 2006 result of 109 MPN/100 mL, and the new maximum of 148 MPN/100 mL at Site 108C (East Branch Ware River at Bickford) exceeded the site's previous high value of 110 MPN/100 mL from July 2006. See **Appendix A** for related inspection reports.

The Massachusetts Class A standard for non-intake waters states that

> the geometric mean of all *E. coli* samples taken within the most recent six months shall not exceed 126 colonies per 100 mL typically based on a minimum of five

samples and no single sample shall exceed 235 colonies per 100 mL (314 CMR 4.05(3)(a)4.c.).

Based on the six-month geometric mean, no sites in the Quabbin or Ware River watersheds exceeded the Class A Standard based on the 6-month geometric mean. However, 6 of 12 Quabbin tributary sites and 8 of 10 Ware River tributary sites exceeded the Class A Standard of 235 colonies per 100 mL in individual samples. In the Quabbin watershed, this standard was exceeded at Boat Cove Brook, and Sites 212, 213, 216C, 216E-1, and 216I-X. The individual standard was exceeded on a total of nine dates: January 20 (Site 216E-1), June 9 (Sites 216C and 216I-X), June 23 (Site 216I-X), July 7 (Site 212, plus follow-up sample on July 9), August 18 (Site 212, plus follow-up sample on August 20), September 1 (Boat Cove Brook), and September 15 (Site 213 and Boat Cove Brook). Of the Quabbin tributary sites, Boat Cove Brook had the highest *E. coli* concentration of 1,610 MPN/100 mL, on September 15. In the Ware River watershed, the Class A standard of 235 colonies per 100 mL was exceeded at Sites 101, 103A, 107A, 108, 108A, 108B, 116B, and 121B over five dates: May 5 (Site 121B), June 2 (Sites 101, 103A, 107A, 108, and 116B), June 16 (Site 108), August 11 (Sites 108A and 108B), and November 17 (Site 108A). Site 103A and Site 107A had highest *E. coli* concentrations in the Ware River watershed, with 1,420 and 1,400 MPN/100 mL, respectively, on June 2.

E. coli monitoring in the Quabbin Reservoir and Ware River watersheds was begun in November 2005. **Table 11** presents the geometric mean on an annual basis for the 2015 tributary sites, for both Quabbin and Ware River tributary sites. **Table 12** presents the percentage of samples by monitoring station that exceeded 126 MPN/100 mL in individual samples (note that the Class A standard of 126 colonies per 100 mL is based on a 6-month geometric mean). Similarly, **Table 13** presents the percentage of samples by monitoring station that exceeded 235 MPN/100 mL in individual samples.

Overall, the *E. coli* geometric means for Quabbin tributary core sites have generally been comparable from 2010 through 2015, but slightly higher than in 2006-2009. As shown in **Table 11**, Site 212 has recorded the highest geometric means of the Quabbin core sites, most likely related to beaver activity. The geometric means at Quabbin EQA sites in 2015 were generally comparable to those in previous sampling (2007-2008, 2010, 2014). In the Ware River watershed, the geometric means for the core site 107A were generally comparable in 2009 through 2015 and slightly lower than in 2007-2008, while Sites 101, 103A, and 108 were generally comparable since *E. coli* monitoring began. The highest geometric means were recorded for Site 121B, which has had impacts from beaver activity. In Ware River EQA sites, geometric means in 2015 were comparable to previous monitoring in 2011.

Table 11. Annual Geometric Means of *E.* coli for 2015 Tributary Sites

Site #	Monitoring Station Description	Geometric Mean (MPN/100 mL)							
		2015	2014	2013	2012	2011	2010	2009	2008
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	17.7	18.5	17.6	19.3	16.8	23.2	14.3	15.3
212	Hop Brook inside Gate 22	43.4	23.3	21.4	27.6	27.4	28.6	16.5	18.0
213	M. Br. Swift River at Gate 30	37.3	43.3	42.7	49.3	48.3	60.5	35.6	22.4
215	E. Br. Fever Brook at West St.	16.5	22.0	20.7	22.8	21.5	23.5	18.6	14.5
216	E. Br. Swift River at Rte. 32A	17.7	18.6	20.4	18.7	31.1	23.0	16.6	22.7
Gates	Gates Brook at mouth	17.5	16.1	18.5	24.1	18.2	25.7	16.0	14.2
BC	Boat Cove Brook at mouth	35.5	31.8	24.6	31.8	19.9	34.4	17.6	23.3
Quabbin Reservoir Watershed EQA Sites									
216G	Roaring Brook, Petersham Center	21.8	21.0	N/A	N/A	N/A	19.6	N/A	21.8
216I-X	Moccasin Brook above Quaker Rd.	26.4	28.9	N/A	N/A	N/A	32.9	N/A	21.6
216D	Connor Pond outlet at dam	13.8	23.7	N/A	N/A	N/A	26.0	N/A	N/A
216E-1	N. Trib of 216E at South St.	37.8	24.6	N/A	N/A	N/A	33.7	N/A	N/A
216C	Carter Pond outlet, Glen Valley Rd.	19.5	13.2	N/A	N/A	N/A	20.1	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	23.4	22.5	30.0	32.7	33.8	23.6	27.1	33.3
103A	Burnshirt River at Riverside Cemetery	37.7	39.9	28.9	25.1	28.7	39.0	23.8	43.6
107A	W. Br. Ware River at Brigham Rd.	27.1	21.9	24.6	21.8	20.9	24.1	24.2	47.5
108	E. Br. Ware at Intervale Rd.	29.2	25.4	32.1	23.6	35.4	34.3	26.4	33.1
121B	Thayer Pond at inlet	32.7	24.7	27.6	47.3	31.3	60.3	22.7	43.8
Ware River Watershed EQA Sites									
108A	E. Br. Ware River at Rte. 68	34.8	N/A	N/A	N/A	38.3	N/A	N/A	N/A
108B	Cushing Pond Outlet at Bemis Rd.	13.5	N/A	N/A	N/A	11.1	N/A	N/A	N/A
108C	E. Br. Ware River (Bickford)	13.5	N/A	N/A	N/A	12.3	N/A	N/A	N/A
116	Comet Pond Outlet	9.9	N/A	N/A	N/A	10.6	N/A	N/A	N/A
116B	Comet Pond Outlet Trib.	18.2	N/A	N/A	N/A	14.4	N/A	N/A	N/A

N/A Data not available.

Detection limit for *E. coli* was 10 MPN/100 mL. Geometric mean was calculated using a value of 9.9 in place of non-detect samples.

Table 12. Percentage of Samples Exceeding 126 Colonies *E. coli* per 100 mL

Site #	Monitoring Station Description	Samples > 126 MPN/100 mL							
		2015	2014	2013	2012	2011	2010	2009	2008
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	4%	4%	8%	12%	7%	12%	0%	4%
212	Hop Brook inside Gate 22	18%	4%	8%	12%	12%	12%	0%	4%
213	M. Br. Swift River at Gate 30	19%	12%	15%	19%	30%	31%	12%	7%
215	E. Br. Fever Brook at West St.	0%	4%	4%	8%	4%	8%	4%	4%
216	E. Br. Swift River at Rte. 32A	4%	4%	8%	4%	7%	8%	4%	7%
Gates	Gates Brook at mouth	4%	4%	4%	15%	8%	8%	4%	0%
BC	Boat Cove Brook at mouth	19%	22%	12%	15%	8%	25%	4%	15%
Quabbin Reservoir Watershed EQA Sites									
216G	Roaring Brook, Petersham Center	0%	8%	N/A	N/A	N/A	8%	N/A	11%
216I-X	Moccasin Brook above Quaker Rd.	13%	12%	N/A	N/A	N/A	27%	N/A	11%
216D	Connor Pond outlet at dam	4%	4%	N/A	N/A	N/A	15%	N/A	N/A
216E-1	N. Trib of 216E at South St.	4%	12%	N/A	N/A	N/A	8%	N/A	N/A
216C	Carter Pond outlet, Glen Valley Rd.	7%	0%	N/A	N/A	N/A	15%	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	8%	12%	15%	15%	19%	4%	4%	19%
103A	Burnshirt River at Riverside Cemetery	22%	24%	17%	4%	10%	23%	5%	24%
107A	W. Br. Ware River at Brigham Rd.	8%	12%	4%	4%	8%	8%	9%	30%
108	E. Br. Ware at Intervale Rd.	8%	12%	11%	0%	8%	4%	8%	8%
121B	Thayer Pond at inlet	19%	19%	7%	23%	12%	38%	12%	19%
Ware River Watershed EQA Sites									
108A*	E. Br. Ware River at Rte. 68	21%	N/A	N/A	N/A	12%	N/A	N/A	N/A
108B*	Cushing Pond Outlet at Bemis Rd.	4%	N/A	N/A	N/A	0%	N/A	N/A	N/A
108C*	E. Br. Ware River (Bickford)	4%	N/A	N/A	N/A	0%	N/A	N/A	N/A
116*	Comet Pond Outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
116B*	Comet Pond Outlet Trib.	9%	N/A	N/A	N/A	4%	N/A	N/A	N/A

N/A Data not available.

Table 13. Percentage of Samples Exceeding 235 Colonies *E. coli* per 100 mL

Site #	Monitoring Station Description	Samples > 235 MPN/100 mL							
		2014	2014	2013	2012	2011	2010	2009	2008
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	0%	0%	8%	0%	4%	0%	0%	4%
212	Hop Brook inside Gate 22	14%	0%	8%	12%	4%	4%	0%	4%
213	M. Br. Swift River at Gate 30	4%	4%	12%	8%	7%	12%	0%	4%
215	E. Br. Fever Brook at West St.	0%	0%	4%	0%	4%	0%	4%	0%
216	E. Br. Swift River at Rte. 32A	0%	0%	8%	4%	7%	4%	4%	7%
Gates	Gates Brook at mouth	0%	4%	4%	8%	4%	8%	0%	0%
BC	Boat Cove Brook at mouth	7%	11%	4%	15%	4%	8%	4%	11%
Quabbin Reservoir Watershed EQA Sites									
216G	Roaring Brook, Petersham Center	0%	4%	N/A	N/A	N/A	8%	N/A	7%
216I-X	Moccasin Brook above Quaker Rd.	9%	4%	N/A	N/A	N/A	15%	N/A	7%
216D	Connor Pond outlet at dam	0%	4%	N/A	N/A	N/A	12%	N/A	N/A
216E-1	N. Trib of 216E at South St.	4%	0%	N/A	N/A	N/A	4%	N/A	N/A
216C	Carter Pond outlet, Glen Valley Rd.	4%	0%	N/A	N/A	N/A	4%	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	4%	4%	7%	4%	8%	4%	0%	8%
103A	Burnshirt River at Riverside Cemetery	4%	12%	8%	4%	5%	4%	0%	8%
107A	W. Br. Ware River at Brigham Rd.	4%	4%	4%	0%	4%	8%	5%	15%
108	E. Br. Ware at Intervale Rd.	8%	0%	7%	0%	4%	4%	0%	4%
121B	Thayer Pond at inlet	4%	4%	4%	8%	8%	23%	0%	12%
Ware River Watershed EQA Sites									
108A	E. Br. Ware River at Rte. 68	7%	N/A	N/A	N/A	12%	N/A	N/A	N/A
108B	Cushing Pond Outlet at Bemis Rd.	4%	N/A	N/A	N/A	0%	N/A	N/A	N/A
108C	E. Br. Ware River (Bickford)	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
116	Comet Pond Outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
116B	Comet Pond Outlet Trib.	5%	N/A	N/A	N/A	0%	N/A	N/A	N/A

N/A Data not available.

As shown in **Table 12**, most samples in the Quabbin and Ware River watersheds were below 126 MPN/100 mL. At most, 22 percent of samples at Site 103A exceeded 126 MPN/100 mL during 2015, representing 5 of 23 samples collected. In **Table 13**, the highest percentage (14 percent) represents 4 out of 28 samples at Site 212 exceeding the single-sample Class A standard of 235 colonies per 100 mL.

3.2.1.2 Fecal Coliform Bacteria

In 2015, fecal coliform bacteria concentrations ranged from not detected (less than 1 CFU/100 mL) to 1,590 CFU/100 mL. The highest result was reported for Site 116B on June 2, which also marked a new maximum value for this site, exceeding the previous high of 830 CFU/100 mL in June 2005. Site 107A also reached a new maximum of 860 CFU/mL on June 2, exceeding the previous high of 636 CFU/100 mL in June 2007. At Site 108B, the fecal coliform result of 500 CFU/100 mL on August 11 exceeded the previous high of 180 CFU/100 mL in June 2005. In the Quabbin watershed, Site 216C reached a new maximum of 740 CFU/100 mL on June 9, compared to the previous high of 172 CFU/100 mL in March 2010. See **Appendix A** for related inspection reports.

3.2.1.3 Total Coliform Bacteria

During 2015, all analyses for total coliform bacteria concentrations were determined using an enzyme substrate procedure (Colilert method) instead of membrane filtration, the technique that had been used historically. No clear correlation between the two methods was found in side-by-side testing (DWSP, 2006; DWSP, 2013b), and the range of values appears to have shifted higher, although maximum values did not increase immediately at all sites. Median values in 2015 exceeded the historical medians in nine of twelve Quabbin watershed sites and in nine of ten Ware River sites. The increases in median total coliform concentrations do not necessarily mean a change in water quality – most of these sites have water quality records dating back to the early 1990s, and the historical medians reflect the different laboratory method in use prior to November 2005.

3.2.2 Specific Conductance

Specific conductance is the measure of the ability of water to conduct an electrical current, which is dependent on the concentration and availability of mineral ions. Elevated levels in streams may be indicative of contamination from septic system effluent, stormwater discharges or agricultural runoff. One significant source of higher levels in tributaries is chloride, found in deicing salts applied to highways and local roads (Shanley, 1994; Lent *et al.*, 1998), which may persist in watersheds for years after initial application (Kelly *et al.*, 2008). It is suspected that deicing salts contributed to elevated values of specific conductance, with peak values recorded in 2001 through 2004. In 2015, specific conductance values were generally comparable to the historical range. Slight increases in maximum value were noted at Connor Pond (Site 216D) in the Quabbin watershed, as well as in the Ware River watershed at Burnshirt and Canesto River

(Site 103A), East Branch Ware River at Route 68 (Site 108A), and Cushing Pond outlet at Bemis Road (Site 108B). For 2015, maximum values by watershed were recorded at Site 216E-1 (South Street, Petersham), with a specific conductance of 407 µS/cm on August 4, and at Site 121B (Thayer Pond), with 347 µS/cm on March 24.

3.2.3 Dissolved Oxygen

The oxygen concentration of Quabbin Reservoir tributaries and Ware River tributaries were generally quite high. The source of dissolved oxygen in a stream environment comes from re-aeration dynamics. Dissolved oxygen levels are depleted though the oxygen requirements of aquatic life, the decomposition of organic matter, and the introduction of foreign oxygen-demanding substances (*i.e.*, chemical reducing agents). Temperature, stream flow, water depth, and the physical characteristics of the stream channel are the principal drivers of re-aeration. The Massachusetts Class A standard is a minimum of 6.0 mg/L. In 2015, dissolved oxygen levels were measured below the 6.0 mg/L threshold in 20 percent of the samples monitored within the Ware River watershed and 14 percent of the samples monitored within the Quabbin Reservoir watershed. Some of the dissolved oxygen measurements in 2015 appeared extremely high, sometimes exceeding 25 mg/L. During routine calibrations, the sensor response factor for dissolved oxygen was occasionally out of range, and age of the dissolved oxygen probe (approximately 5 years) is suspected as a cause. New multiprobes were put into service in late 2015.

3.2.4 Temperature

In tributaries of the Quabbin Reservoir and Ware River watersheds, temperatures ranged between 0 and 25.1˚C. Temperature is an important parameter in its relation to dissolved oxygen because as temperature increases the amount of oxygen that can be dissolved in water decreases. Moreover, higher temperatures increase the solubility of nutrients and may correlate well with an increase in the growth of filamentous green algae.

3.2.5 Turbidity

Turbidity is the relative measure of the amount of light-refracting and light-absorbing particles suspended in the water column. It is used as an indicator of water aesthetics and as a relative measure of the water's productivity. The Massachusetts drinking water standard is 5 NTU for source water (measured at the intake) and 1 NTU for finished water. In 2015, no source water samples at the intake exceeded 1 NTU. For non-intake samples, turbidity exceeded the 5 NTU standard at Site 108B on August 11 (7.31 NTU), in the Ware River watershed. None of the samples from the Quabbin watershed exceeded 5 NTU in 2015.

Turbidity of 7.31 NTU marked a new maximum value at Site 108B, where the previous high value of 2.72 NTU was recorded in February 2011. Rainfall flushing apparently contributed to the elevated turbidity at this site in 2015. See **Appendix A** for the August 2015 inspection report on Site 108B. All other sites monitored in 2015 remained within their historical ranges.

3.2.6 pH

Stream acidity is largely a function of the groundwater hydrogeology of the basins and their effectiveness in buffering the effects of acid precipitation. pH is a measure of the number of hydrogen ions [H+] reported on a log scale of 0 to 14. The [H+] concentration of 7.0 represents neutral water and levels below this are considered acidic with a decrease of one unit representing a 10-fold increase in acidity. Median pH values in 2015 were below the Class A water quality threshold of 6.5 units at 17 of 22 monitoring stations. One site in the Quabbin Reservoir watershed had median levels below 6.0, East Branch Fever Brook (Site 215). In the Ware River watershed, median pH levels were below 6.0 at Burnshirt and Canesto River at Site 103A, West Branch Ware River at Site 107A, East Branch Ware River at Site 108A, Cushing Pond Outlet (Site 108B), and Comet Pond Outlet (Site 116) and outlet tributary at Site 116B.

3.2.7 Alkalinity

Alkalinity, a relative measure of water's ability to neutralize an acid, was monitored at the EQA sites on a biweekly basis in 2015. Data from these sites were compared to acid rain assessment criteria established under the Acid Rain Monitoring (ARM) Project at the University of Massachusetts. The ARM criteria are based on average results for the month of April (Godfrey *et al.*, 1996). In 2015, the alkalinity concentrations were below the ARM endangered threshold value of 5 mg/L as $CaCO_3$ at two of five EQA sites in the Quabbin watershed (Sites 216C, and 216D) and all five EQA sites (Sites 108A, 108B, 108C, 116, and 116B) in the Ware River watershed. Alkalinity tended to peak around July through October, except a few sites peaked in March (Site 108B, Site 216C) or April (Site 216I-X). Maximum values ranged from 3.68 mg/L (Site 116) to 21.7 mg/L (Site 216E-1). New maximum values were set at Carter Pond (Site 216C), Roaring Brook (Site 216G), and Moccasin Brook (Site 216I-X) in the Quabbin Reservoir watershed and Cushing Pond (Site 108B) and Comet Pond (Site 116) in the Ware River watershed.

It should be noted that the alkalinity values cited above are what has been called "EPA" alkalinity in the Quabbin and Ware River water quality reports since 1990. Prior to 1990, alkalinity was tested to pH 4.5 only. Since 1990, alkalinity has been tested to two pH endpoints at Quabbin Laboratory, with the result at pH 4.5 being denoted as "standard" alkalinity, and the result at pH 4.2 being denoted as "EPA" alkalinity. The purpose of reporting results at both endpoints was to preserve the historical record. However, under Standard Method 2320B, waters of "low-level" alkalinity (less than 20 mg/L) should be reported using the pH 4.2 endpoint. As a result, some care needs to be taken in interpreting alkalinity using the historical records.

3.2.8 Tributary Nutrient Dynamics

Beginning in March 2005, sampling was begun on selected tributaries with the goal of establishing a nutrient database by sanitary district in each watershed. For the Quabbin Reservoir watershed in 2015, five EQA sites in the East Branch Swift River Sanitary District were monitored biweekly for nutrients and UV_{254}. Monitoring in the Ware River watershed for 2015 included five EQA sites in the East Branch Ware Sanitary District, also biweekly for nutrients and UV_{254}. The Quabbin EQA sites were previously monitored in 2010 and 2014, with Sites 216G and 216I-X also previously monitored in May 2007 through December 2008. The Ware River EQA sites were previously monitored in 2011. Core tributary stations for both watersheds have been monitored on a quarterly basis since March 2005. **Table 14** summarizes median values and range of 2015 data for all tributary monitoring sites in the Quabbin Reservoir watershed, and **Table 15** summarizes the data similarly for Ware River watershed sites.

In the Quabbin Reservoir watershed during 2015, nutrient concentrations generally remained within the historical ranges, with slight increases at some sites compared to previous monitoring since 2005. As shown in **Table 14**, nitrate concentrations ranged from less than 5 µg/L to 1,120 µg/L (<0.005 to 1.12 mg/L) at the EQA sites, compared to a maximum of 186 µg/L (0.186 mg/L) at the core sites. A new maximum nitrate concentration was recorded at Site 216D, with 0.146 mg/L on March 17, exceeding the previous maximum of 0.123 mg/L in March 2014.

TKN, a measure of organic nitrogen plus ammonia, often constitutes a significant proportion of the total nitrogen present in a natural water body. In 2015, TKN concentrations at the Quabbin EQA sites ranged from 110 to 620 µg/L (0.110 to 0.620 mg/L), compared to a maximum of 425 µg/L (0.425 mg/L) at the core sites. A new maximum value was recorded at Quabbin EQA Site 216D. The TKN concentration of 0.606 mg/L at Site 216D occurred on September 1, exceeding the previous maximum of 0.469 mg/L in August 2014.

Unlike the reservoir monitoring, ammonia has not been routinely monitored in the tributaries to Quabbin Reservoir. Ammonia concentrations in the Quabbin tributaries ranged from less than 5 to 137 µg/L (<0.005 to 0.137 mg/L) in 2015. The maximum concentration of 0.137 mg/L was detected on March 3 at Site 216G, exceeding this site's previous high of 0.124 mg/L in February 2014. New maximum values were also recorded for EQA Sites 216I-X, 216D, and 216C, all occurring in March 2015, during the second year of ammonia monitoring for these EQA sites. At core sites, a new maximum value was recorded at Site 216, at 54 µg/L (0.054 mg/L), exceeding the March 2014 result of 0.029 mg/L at this site.

In many freshwater systems, phosphorus is the limiting nutrient in algal growth and can be a concern when excessive. Phosphorus concentrations ranged slightly higher at the Quabbin EQA sites, up to 45 µg/L (0.045 mg/L), compared to the core sites with 32 µg/L (0.032 mg/L) or less.

No new maximum values were recorded, with all Quabbin tributary sites within range of previous monitoring.

Table 14. Quabbin Reservoir Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2015 Database

Sampling Station	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Ammonia (NH_3; µg/L)		Total Phosphorus (µg/L)		UV_{254} (Absorbance/cm)		Total Calcium (µg/L)	
EQA Sample Sites (1)	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**
East Branch Swift River Sanitary District												
216G Roaring Brook, Petersham Center	100	21 - 286	289	132 - 620	16	<5 - 137	20	13- 36	0.205	0.105 - 0.361	6020	3730 - 7540
216I-X Moccasin Brook above Quaker Rd.	37	7 - 132	400	220 - 550	6	<5 - 85	28	18 - 45	0.447	0.238 - 0.624	2460	1340 - 3060
216D Connor Pond outlet below dam	13	<5 - 146	325	110 - 606	5	<5 - 111	26	17 - 39	0.273	0.161 - 0.409	2825	1700 - 3120
216E-1 N. trib of 216E, at South St.	903	492 - 1120	191	125 - 325	10	<5 - 28	23	15 - 32	0.076	0.054 - 0.159	10950	6370 - 17400
216C Carter Pond outlet, at Glen Valley Rd.	30	<5 - 160	235	115 - 396	<5	<5 - 131	17	9- 28	0.139	0.103 - 0.249	4690	3150 - 6170
Core Sample Sites (2)	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**
211 (W. Swift)	46	19- 87	80	<100 - 166	<5	<5	15	13 - 18	0.106	0.084 - 0.217	2150	1400 - 3630
212 (Hop)	65	45 - 122	156	<100 - 236	11	<5 - 16	16	13- 20	0.083	0.068 - 0.186	4565	2690 - 6080
213 (M. Swift)	42	8 - 186	256	117 - 368	4	<5 - 33	18	13 - 22	0.192	0.104 - 0.357	4065	2750 - 5960
215 (E. Fever)	24	<5 - 59	282	200 - 425	15	<5 - 44	18	16 - 26	0.271	0.211- 0.356	2325	1370 - 3020
216 (E. Swift)	19	7- 133	320	221 - 384	<5	<5 - 54	12	17 - 32	0.216	0.140 - 0.341	3265	1910 - 4080
Gates Brook	<5	<5 - 16	156	<100 - 244	<5	<5	14	11 - 20	0.073	0.068 - 0.158	1310	1000 - 1760
Boat Cove Brook	23	<5 - 41	214	177 - 236	<5	<5	23	17 - 26	0.167	0.080 - 0.222	8495	3810-12400

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December.

Table 15. Ware River Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2015 Database

Sampling Station	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Ammonia (NH_3; µg/L)		Total Phosphorus (µg/L)		UV_{254} (Absorbance/cm)		Total Calcium (µg/L)	
EQA Sample Sites [1]	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**
West Branch Ware River Sanitary District												
108A East Branch Ware River at Rt. 68	22	<5 - 102	300	119 - 698	11	<5 - 103	19	11 - 93	0.234	0.142 - 0.403	3695	2250 - 4740
108B Cushing Pond outlet at Bemis Rd	79	13 - 543	294	165 - 923	31	11 - 354	18	10 - 224	0.154	0.092 - 0.242	2980	2130 - 4560
108C Bickford Pond outlet at Lombard Rd	35	<5 - 227	161	<100 - 276	<5	<5 - 51	11	6 - 16	0.070	0.051- 0.132	2290	1780 - 4720
116 Comet Pond at outlet	8	<5 - 7	170	110 - 340	<5	<5 - 35	7	<5 - 25	0.054	0.046 - 0.064	1590	1360 - 1880
116B Comet Pond outlet at Rt. 62 near Clark Rd	<5	<5 - 39	408	138 - 557	22	<5 - 68	21	10 - 39	0.322	0.132 - 0.799	2180	1500 - 4340
Core Sample Sites [2]	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**
Shaft 8 (Intake)	25	12 - 105	299	222 - 336	16	5 - 31	25	17 - 33	0.237	0.160 - 0.426	3640	2460 - 4260
103A (Burnshirt)	19	11 - 115	236	168- 971	15	<5 - 27	24	15 - 37	0.259	0.140 - 0.475	2480	1990 - 4390
107A (W. Ware)	15	8 - 132	335	275 - 926	5	<5 - 46	25	13 - 30	0.299	0.221 - 0.666	3240	2090 - 4200
108 (E. Ware)	36	6 - 122	287	228 - 296	18	6 - 39	21	16 - 26	0.227	0.144 - 0.400	4210	2660 - 4990
121B (Thayer)	<5	<5 - 107	337	300 - 500	12	<5 - 91	18	8 - 25	0.148	0.117 - 0.204	11400	7700-13100

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December. Biweekly for UV_{254} and calcium in 2015.

UV_{254} has been monitored quarterly at core sites in the Quabbin Reservoir watershed since 2009. A surrogate measure of organic matter, UV_{254} was previously analyzed at major tributaries to Quabbin Reservoir in 1998-1999, as part of a research study at University of Massachusetts, Amherst (Garvey *et al.*, 2001). While the monitoring frequency was quarterly in 2009-2014, compared to monthly in 1998-99, UV_{254} values ranged slightly higher at core sites in 2009-2015, with greater variability. The lower UV_{254} values in 1998-99 may be related to lower-than-usual rainfall during that year of monitoring, so the higher values in 2009-2015 do not necessarily mean any degradation of water quality. As shown in **Table 14**, UV_{254} values for 2015 ranged from 0.054 cm^{-1} (Site 216E-1, on February 3) to 0.624 cm^{-1} (Site 216I-X, on July 7). This range reflects the different quality of waters, from oligotrophic to eutrophic, including productive wetlands (Reckhow, personal communication). A new maximum UV_{254} value was recorded at Site 216G (0.361 cm^{-1}) on July 21, 2015, just above the previous maximum of 0.347 cm^{-1} in June 2008.

Calcium monitoring was begun in 2010 to assess the relative risk of zebra mussel colonization in the Quabbin and Ware River watersheds. In the Quabbin watershed, calcium concentrations in 2015 ranged from 1,000 to 12,400 µg/L (1.00 to 12.4 mg/L) in core sites and from 1,340 to 17,400 µg/L (1.34 to 17.4 mg/L) in EQA sites. Except for Site 216E-1 and Boat Cove Brook, calcium concentrations in Quabbin tributary sites remained below 12 mg/L, which in combination with pH values under 7.4 places most Quabbin sites at low risk for zebra mussel colonization (see http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/phase-ii-zebra-mussel-report.pdf). Calcium sources may include agricultural lime, some road deicers, and construction activity, as well as natural site geology and weathering processes. Site 216E-1, with a peak calcium concentration of 17.4 mg/L on August 4, is downstream of residential and agricultural land, near Petersham center and adjacent to Route 122.

In the Ware River watershed, nutrient concentrations generally remained within the historical ranges during 2015. As shown in **Table 15**, nitrate concentrations were generally higher at EQA sites 108B and 108C, with peak concentrations of 543 µg/L (0.543 mg/L) and 227 µg/L (0.227 mg/L), respectively, compared to the core sites. These results also marked new historical maximum values at these two EQA sites. The new historical maximum at Site 108B occurred on March 24, exceeding the previous maximum of 0.168 mg/L in February 2006, while the new maximum at Site 108C occurred on July 28, exceeding the previous maximum of 0.209 mg/L in August 2005. Slight increases in nitrate concentration were also detected at core Sites 101, 103A, 107A, and 108, all occurring on March 24, 2015.

TKN concentrations in Ware River core sites ranged from 168 to 971 µg/L (0.168 to 0.971 mg/L) during 2015, and less than 100 to 923 µg/L (<0.100 to 0.923 mg/L) in the EQA sites. New maximum TKN concentrations were observed in 2015 at Sites 103A, 107A, 108A, and 108B. At core Sites 103A and 107A, the new peak values of 0.971 mg/L and 0.926 mg/L, respectively, were recorded on June 16, exceeding the previous highs of 0.670 mg/L (Site 103A, November 2008) and 0.635 mg/L (Site 107A, August 2008). The new historical maximum values at EQA Sites 108A (0.698 mg/L) and 108B (0.923 mg/L) occurred on July 14 and August 11, respectively, exceeding the historical maximum concentrations set in 2005.

Ammonia ranged from less than 5 to 354 µg/L (<0.005 to 0.354 mg/L) during 2015 in the Ware River watershed, with the higher concentrations generally at the EQA sites. The maximum result of 0.354 mg/L was detected at Site 108B on March 10. Ammonia was not routinely monitored in the Ware River watershed before 2012, so no historical data are available for comparison at the EQA sites, last monitored in 2011. New historical maximum values in ammonia were set at all core sites on March 24, 2015, except for Site 103A, which was set on June 16, 2015.

Total phosphorus concentrations were highest at Sites 108A (93 µg/L) and 108B (224 µg/L) compared to all other Ware River sites, where phosphorus measured 39 µg/L (0.039 mg/L) or less in 2015. The highest concentration, 0.224 mg/L, occurred on June 30 at Site 108B and also marks a new maximum for this location. This result may be related to recent rainfall of 1.33 in the 3 days previous to sampling (as reported for Barre Falls Dam). The previous maximum phosphorus concentration for Site 108B was 0.046 mg/L, observed in July 2005. The result of 0.093 mg/L at Site 108A on August 25, 2015, exceeded the previous site maximum of 0.064 mg/L in June 2005. At Site 116, the phosphorus concentration of 0.025 mg/L on February 10, 2015, exceeded the maximum of 0.016 mg/L set in June 2005.

UV_{254} values were generally similar at core sites and EQA sites in the Ware River watershed. The highest value for core sites was observed at Site 107A (0.666 cm^{-1}), and the highest value at an EQA site (0.799 cm^{-1}) was observed at Site 116B. The lowest values were associated with pond sites: Comet Pond (Site 116), Bickford Pond (Site 108C), Cushing Pond (Site 108B) and Thayer Pond (Site 121B). UV_{254} values at Ware River sites remained within each site's previous range, with no new maximum values in 2015.

Calcium concentrations in the Ware River watershed ranged between 1.50 and 13.1 mg/L. Calcium concentrations at Thayer Pond inlet (Site 121B) in 2015 ranged from 7,700 µg/L (7.70 mg/L), to 13,100 µg/L (13.1 mg/L), below the historical high value of 13.8 mg/L for this site, set in March 2014. The area surrounding Thayer Pond is primarily forested with some institutional, residential, commercial, and industrial use. It is not known if these calcium levels reflect natural, background conditions or potential water quality degradation. At Thayer Pond inlet, the median calcium concentration of 11.4 mg/L in 2015 was higher than in previous years: 10.2 mg/L in 2014, 9.22 mg/L in 2013, 8.86 mg/L in 2012, 8.51 mg/L in 2011, and 9.17 mg/L in 2010.

Calcium was monitored before, in 2011, at the East Branch Ware River EQA sites. In two years of monitoring, 2011 and 2015, concentrations in this sanitary district generally fluctuated between 1 and 5 mg/L, with several peaks throughout 2015. The median and range of concentrations were generally higher in 2015 compared to 2011, which may be related to 2015's higher-than-average snowfall totals, possibly through greater inputs from road deicing and/or increased leaching. Calcium monitoring will be continued in each sanitary district to help establish baseline data.

Comparing the two watersheds, nitrate concentrations were generally comparable except for Site 216E-1, near Petersham center in the Quabbin Reservoir watershed, where the highest nitrate concentrations were detected. TKN ranged higher in the Ware River sites, while median TKN concentrations were generally comparable. Ammonia was generally comparable among EQA sites, except for Site 108A, but was slightly higher in the Ware River core sites compared to the Quabbin core sites. The range of total phosphorus concentrations was higher in Ware River EQA sites. UV_{254} values were overall higher in the Ware River watershed, with higher UV_{254} values likely related to the greater wetlands influence on water quality. Except for EQA Site 216E-1, Boat Cove Brook and Thayer Pond inlet (Site 121B), calcium concentrations were fairly consistent in the Quabbin and Ware River watersheds, at 1 to 8 mg/L. The highest calcium concentrations in 2015 were observed at Site 216E-1, possibly influenced by nearby agricultural use and roadways. It is not known how much of the calcium variation is attributable to geology, land use, weathering or other factors.

3.2.9 Monitoring for the Diatom *Didymosphenia geminata*

In response to alerts about new infestations of the potentially invasive diatom *Didymosphenia geminata* ("Didymo") in New England, Environmental Quality staff implemented a monitoring program using artificial substrates (consisting of glass slides mounted in special samplers) and natural substrates. Artificial substrates provide a surface for colonization by attached algae and other organisms (periphyton), and deployment of glass slides is a standard technique for investigation of this component of aquatic communities. Natural substrates were sampled by gently removing periphyton growth off of sections of rocks for analysis.

Artificial substrates were deployed in late 2007 at Quabbin on the three branches of the Swift River at existing sampling stations (West Branch Site 211 at Route 202, Middle Branch Site 213 at Gate 30, and East Branch Site 216 at Route 32A) and at a fourth location, downstream of Winsor Dam and a section of the Swift River popular for fly fishing, about one kilometer downstream of Route 9 off Enoch Sanford Road. On the Ware River, the sampling station near the Shaft 8 Intake (Site 101) was selected.

Due to severe weather and the extreme changes in flow volume experienced over the last few years, sampling sites and methods were changed to facilitate consistent monitoring. Sudden, drastic changes in water levels adversely affected some of the samplers. Many were carried downstream while others were destroyed. Emerging research suggests that Didymo does not readily grow on bare rock, preferring to colonize substrates that have a well established periphyton community. We can assume that it will be slow to colonize glass slides. Therefore, beginning in 2013, slides were deployed for a two-month period to allow a sufficient time for colonization by periphyton. Weather patterns, and the growing evidence that Didymo prefers to grow on substrate that are covered in periphyton, led to the changes in sampling procedures.

In 2015, artificial substrates were not used in the West, Middle, or East Branches of the Swift River. Instead, rock scrapings were collected at these sites. Artificial substrates were still deployed at the catwalk behind the Shaft 8 building. Net samples were taken at the same location. In the Swift River outflow below Winsor Dam, artificial substrates were deployed near the McLaughlin Hatchery screens. This location has restricted public access and excellent water flow but is slightly protected from sudden changes in water volume. If the sampler was to be dislodged due to rising water levels, it could easily be retrieved from the hatchery screens. Samples of rock scrapings were analyzed from the Swift River outflow and Shaft 8 beginning in 2013.

Monitored sites were checked on a monthly basis (river stage and ice conditions permitting). Results to date have been negative for Didymo. Routine inspections, rock scraping, and renewal of artificial substrates were continued into 2016 but may be scaled back in the near future. Research has indicated that Didymo may be considered a native species that occasionally produces numerous stalks in response to low phosphorus concentrations (Taylor and Bothwell, 2014). These stalks can cause serious ecological impacts by smothering other stream-dependent organisms. The monitoring program will likely continue, but at a reduced frequency, to facilitate early detection of Didymo should it ever enter the rivers within the Quabbin or Ware watersheds.

3.3 Forestry Water Quality Monitoring

Timber harvesting operations may have short- and long-term effects on water quality. Monitoring of harvest operations and water quality is being conducted to ensure water quality standards are maintained on DWSP lands. Short-term monitoring focuses on direct water quality impacts that can occur during logging, while long-term monitoring will involve evaluating water quality changes as the forest regenerates.

3.3.1 Short-term Monitoring

Short-term forestry monitoring involves monitoring logging operations through site inspections and targeted water quality sampling. Inspections and water quality sampling are conducted prior to start of logging in order to establish a baseline, during operations to monitor immediate effects, and after completion to look for lasting effects. During 2015, the Environmental Quality Section reviewed forestry lot proposals, inspected sites, collected samples, and updated the forestry water quality monitoring database. Field review of proposed DWSP timber lots was conducted in the Ware River and Quabbin Watersheds. Water quality testing occurred on one lot in Quabbin watershed for baseline monitoring only. Results of baseline monitoring will be reported as part of active harvest operation monitoring.

3.3.2 Long-term Monitoring

Two sites have been established in Middle Branch Dickey Brook and East Branch Underhill Brook on Prescott Peninsula for long-term forestry monitoring, with monthly grab samples collected for over 10 years. These samples have been analyzed for nutrients (nitrate, nitrite, total Kjeldahl nitrogen, total phosphorus) and total suspended solids. As of January 2014, laboratory analyses of UV_{254}, ammonia, total organic carbon, and dissolved organic carbon were added to the monthly sampling program. The monthly sampling at Underhill Brook and Dickey Brook was continued throughout 2015.

The monthly sampling has been conducted on the second Wednesday of each month since April 2002. While it provides data over a relatively long term, monthly grab sampling cannot be used to characterize stream response during storms. During 2013 plans were made for periodic storm water sampling to complement the monthly sampling work performed to date. The goal of storm water sampling is to characterize the stream response during a targeted storm event. Primary data to be collected include rainfall depth, stream flow rate, and time of sample collection. The laboratory analyses will help characterize the range of nutrient and sediment concentrations in wet-weather flows. Ultimately, the hydrologic data and concentration data will be used to estimate nutrient and sediment loads delivered during storms.

Tasks that were accomplished during 2015 in order to implement the long-term forestry water quality monitoring were: annual re-installation of water level loggers and precipitation gauges; downloading of field data; monitoring of weather forecasts and staff availability; continued development of field procedures; sample and data collection for one storm; and preliminary evaluation of field data. Storm water sampling for up to four events is scheduled for 2016.

4 PROPOSED SCHEDULE FOR 2016

Water sampling protocols, including field and analytical methods, will remain the same for 2016. Calcium monitoring will continue at all tributary sites on a biweekly basis. UV_{254}, used as a surrogate measure for organic matter content in water, will continue to be monitored quarterly in Quabbin core tributary sites, biweekly in Ware River core tributary sites, and biweekly in all EQA sites. For 2016, monitoring in the Quabbin Reservoir watershed shifts to the Quabbin Northwest Sanitary District, previously monitored in 2011-2012. Ware River watershed monitoring shifts to the Coldbrook and Longmeadow Sanitary District, which was previously monitored in 2012.

Reservoir monitoring will continue on a monthly schedule in 2016 (April-December). No other changes are proposed for in-reservoir monitoring. Sampling at the three deep-water reservoir stations will continue, with temperature, dissolved oxygen, pH and conductivity profiles collected monthly. The reservoir nutrient sampling program that has been conducted quarterly since 2000 will be continued in 2016, and the plankton sampling program initiated in September 2007 will also be continued through 2016.

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APPENDIX A

Investigative Reports and Data

2015 Phytoplankton Monitoring at Quabbin Reservoir

2015 Quabbin Boat Inspection Programs

2015 Quabbin Boat Ramp Monitor Program

2015 Aquatic Macrophyte Assessments

Field Report for Sample Sites 101, 103A, 107A, 108, and 116B, 6/4/15

Field Report for Sample Site 216C, 6/12/15

Field Report for Sample Site 212, 7/9/15

Field Report for Sample Sites 108A and 108B, 8/14/15

Field Report for Sample Site 212, 8/20/15

Field Report for Boat Cove Brook, 9/3/15 and 9/18/15

Field Report for Hank’s Meadow (Quabbin Park), 9/28/15

Water Quality Results for Stockroom, May 2015

2015 Lead Results for Quabbin Administration Building, December 2015

2015 Quabbin Reservoir Phytoplankton Monitoring

Paula Packard

March 24, 2016

Monitoring efforts focused on two locations (Table 1) with two grab samples collected at each as follows: in the epilimnion at a depth of three meters and near the interface between the epilimnion and metalimnion at a depth generally around eight to ten meters. Field and laboratory procedures for collecting and concentrating plankton are identical to those conducted at Wachusett Reservoir (see 2015 Wachusett annual report for details), however the method used for microscopic analysis and enumeration of phytoplankton at the Wachusett Reservoir has been changed somewhat. The Quabbin Reservoir methods have remained consistent with those used in previous years. Ice cover precluded the collection of plankton samples during the months of January, February and March.

TABLE 1 - QUABBIN PLANKTON MONITORING PROGRAM		
Sampling Stations	**Sampling Frequency**	**Field Tasks**
1) CVA/#202 (Winsor Dam) 2) Shaft 12/#206 (Mt. Pomeroy)	Twice per month from May - Sept. (weather permitting); then decreasing to Once per month from Oct. – April (weather and ice conditions permitting)	1) Multiprobe profile 2) Collection of two grab samples: epilimnion and near epi-metalimnion interface 3) Secchi transparency

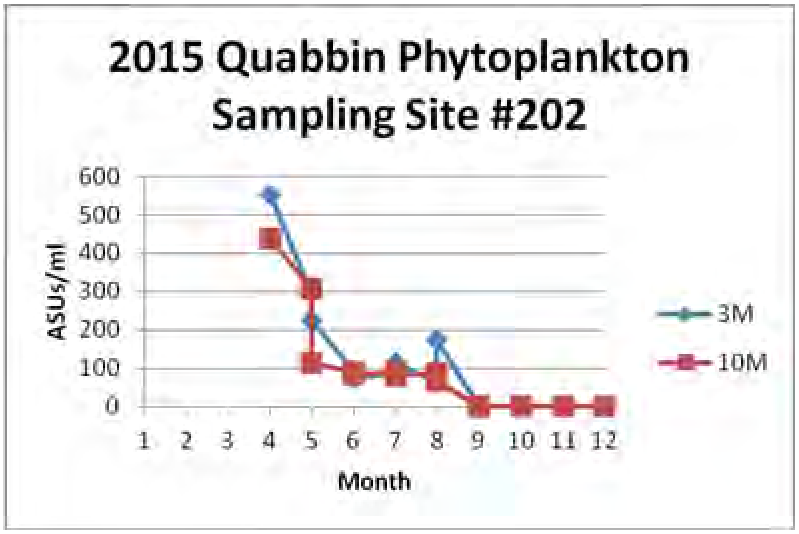
Results show that the Quabbin Reservoir supports a phytoplankton community typical of many oligotrophic systems located in the temperate zone. The most common organisms observed consisted of the diatoms *Asterionella*, *Cyclotella,* and *Rhizosolenia,* the chlorophytes (green alga) *Gloeocystis* and *Sphaerocystis*, and the cyanophytes (blue-green alga) *Microcystis* and *Aphanocapsa*. Consistent with its status as an "ultra-oligotrophic" system (Wetzel, 1983), Quabbin phytoplankton densities are still considered low, with averages for 2015 being slightly different at both sites than those documented in 2014. Sampling site #202 averaged 150 ASUs/ml (down from 163 ASUs/ml), and sampling site #206 averaged 182 ASUs/ml (up slightly from 164 ASUs/ml in 2014). See graphs below.

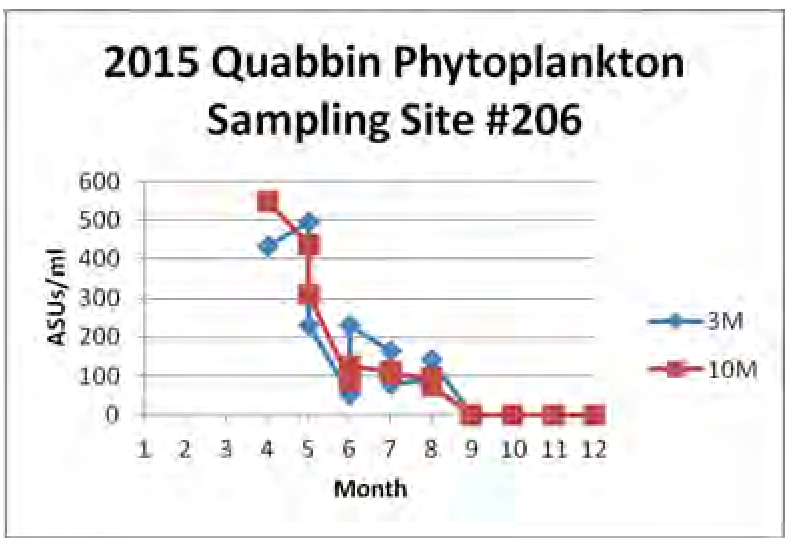
Diatoms dominated the phytoplankton community until mid-June when their numbers began to decline and samples became more diverse. The highest diatom numbers (547 ASUs/ml) of the year were observed in April at sampling site #202. Highest total phytoplankton numbers (553 ASUs/ml) were observed during this month as well. Diatom numbers declined steadily from then on, reaching their lowest point in August and remaining low throughout the remainder of the year.

In August, cyanophyte densities began to increase, continuing the trend seen for the last several years of *Aphanocapsa* and *Microcystis* proliferating in late summer. In 2015, this increase in cyanophytes was very brief. Cyanophyte densities, especially *Microcystis*, were observed to peak on September 17th at 227 ASUs/ml in the 3 meter sample collected at sampling site #202 bringing the total phytoplankton value for that sample to 258 ASUs/ml. Subsequent sampling showed a decline of the cyanophytes and a more even representation of all taxa.

There were no taste and odor complaints during the year, and exceptionally low levels of plankton were documented in 2015. September samples collected at site #202 at 3 meters had a density of 53 ASU/ml.

Plans for plankton monitoring in 2016 call for a continuation of the program outlined above with the addition of two new Eureka mutiprobes. Both Eureka units have a chlorophyll-a probe, and one multiprobe has also been fitted with a phycocyanin probe. The chlorophyll-a probes will be used to better locate the presence of all alga whereas the phycocyanin will exclusively indicate the presence of cyanobacteria. All algal species utilize chlorophyll-a as a photosynthetic pigment molecule, however only the cyanophytes produce phycocyanin. These two new tools will enable us to better locate thin stratum of cyanaophytes in the water column.





<u>Reference Cited</u>

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Results of Plankton Monitoring at Quabbin Reservoir

Sampling Station 202 (Winsor Dam)

Date	Depth	Diatoms	Chloro.	Chrysophytes					Cyanophytes		Dinoflag.	Other	Total
	(meters)	Total	Total	Total	*Chrysosph.*	*Dinobryon*	*Synura*	*Uroglenop.*	Total	*Anabaena*	Total	Total	Density
4/23/2015	**3**	547	6	0	0	0	0	0	0	0	0	0	**553**
4/23/2015	**10**	432	0	0	0	0	0	0	7	0	0	0	**439**
5/14/2015	**3**	282	7	0	0	0	0	0	7	0	0	0	**296**
5/14/2015	**10**	240	30	38	0	0	0	38	0	0	0	0	**308**
5/29/2015	**3**	223	0	0	0	0	0	0	0	0	0	0	**223**
5/29/2015	**10**	59	24	18	0	6	0	12	12	0	0	0	**113**
6/11/2015	**3**	69	13	13	0	13	0	0	0	0	0	0	**94**
6/11/2015	**10**	83	6	0	0	0	0	0	0	0	0	0	**89**
6/17/2015	**3**	62	0	6	0	6	0	0	6	0	0	0	**73**
6/17/2015	**10**	24	18	18	0	18	0	0	24	0	0	0	**83**
7/6/2015	**3**	70	0	16	0	16	0	0	0	0	0	0	**86**
7/6/2015	**10**	45	0	0	0	0	0	0	45	0	0	0	**90**
7/22/2015	**3**	8	8	0	0	0	0	0	98	0	0	0	**114**
7/22/2015	**10**	35	0	0	0	0	0	0	44	0	0	0	**79**
8/12/2015	**3**	0	23	0	0	0	0	0	39	0	0	0	**63**
8/12/2015	**10**	6	6	13	0	13	0	0	63	0	0	0	**88**
8/24/2015	**3**	23	0	0	0	0	0	0	150	0	0	0	**173**
8/24/2015	**10**	15	38	0	0	0	0	0	15	0	0	0	**68**
9/10/2015	**3**	13	13	0	0	0	0	0	26	0	0	0	**53**
9/10/2015	**10**	18	12	0	0	0	0	0	53	0	0	0	**83**
9/17/2015	**3**	31	0	0	0	0	0	0	227	0	0	0	**258**
9/17/2015	**12**	7	7	0	0	0	0	0	43	0	0	0	**58**
10/14/2015	**3**	30	15	38	0	0	0	0	23	0	0	0	**105**
10/14/2015	**10**	17	11	23	0	6	0	0	56	0	0	0	**107**
11/9/2015	**3**	53	0	23	0	0	0	0	23	0	0	0	**98**
11/9/2015	**10**	75	8	15	0	0	0	0	15	0	0	0	**113**
12/2/2015	**3**	94	0	0	0	0	0	0	94	0	0	0	**188**
12/2/2015	**10**	65	0	0	0	0	0	0	36	0	0	0	**101**

Results of Plankton Monitoring at Quabbin Reservoir

Sampling Station 206 (Shaft 12)

Date	Depth	Diatoms	Chloro.	Chrysophytes					Cyanophytes		Dinoflag.	Other	Total
	(meters)	Total	Total	Total	*Chrysosph.*	*Dinobryon*	*Synura*	*Uroglenop.*	Total	*Anabaena*	Total	Total	**Density**
4/23/2015	**3**	399	14	0	0	0	0	0	21	0	0	0	**433**
4/23/2015	**10**	489	0	58	0	58	0	0	0	0	0	0	**547**
5/14/2015	**3**	458	30	8	0	8	0	0	0	0	0	0	**495**
5/14/2015	**10**	413	23	0	0	0	0	0	0	0	0	0	**435**
5/29/2015	**3**	204	20	7	0	7	0	0	0	0	0	0	**230**
5/29/2015	**10**	252	0	41	0	41	0	0	16	0	0	0	**309**
6/11/2015	**3**	53	0	13	0	13	0	0	0	0	0	0	**66**
6/11/2015	**10**	85	27	0	0	0	0	0	0	0	0	0	**112**
6/17/2015	**3**	180	22	7	0	7	0	0	22	0	0	0	**230**
6/17/2015	**10**	53	20	33	0	33	0	0	20	0	0	0	**125**
7/6/2015	**3**	122	16	0	0	0	0	0	24	0	0	0	**163**
7/6/2015	**10**	83	0	0	0	0	0	0	28	0	0	0	**110**
7/22/2015	**3**	72	0	0	0	0	0	0	7	0	0	0	**79**
7/22/2015	**10**	105	0	0	0	0	0	0	0	0	0	0	**105**
8/12/2015	**3**	8	45	0	0	0	0	0	38	0	0	0	**90**
8/12/2015	**10**	14	14	0	0	0	0	0	65	0	0	0	**94**
8/24/2015	**3**	23	0	0	0	0	0	0	117	0	0	0	**141**
8/24/2015	**10**	28	21	0	0	0	0	0	28	0	0	0	**76**
9/10/2015	**3**	51	6	0	0	0	0	0	56	0	0	0	**113**
9/10/2015	**10**	20	7	0	0	0	0	0	66	0	0	0	**92**
9/17/2015	**3**	51	51	0	0	0	0	0	34	0	0	0	**135**
9/17/2015	**12**	24	49	16	0	0	0	0	81	0	0	0	**171**
10/14/2015	**3**	50	14	0	0	0	0	0	72	0	0	0	**137**
10/14/2015	**10**	24	8	49	0	16	0	33	24	0	0	0	**106**
11/9/2015	**3**	79	0	7	0	7	0	0	85	0	0	0	**171**
11/9/2015	**10**	38	60	0	0	0	0	0	90	0	0	0	**188**
12/2/2015	**3**	23	0	0	0	0	0	0	47	0	0	0	**70**
12/2/2015	**10**	29	14	0	0	0	0	0	22	0	0	0	**65**

2015 Quabbin Boat Inspection Programs

June 1, 2016

Paula Packard

The Quabbin Boat Decontamination program was initiated in 2009, in response to a rise in the number of aquatic invasive species (AIS) nationwide as well as to the introduction of zebra mussels into a water body in Western Massachusetts. This program was designed to minimize the risk of transporting AIS into the reservoir while still allowing for recreational use for fishing. Many anglers prefer to use their own privately owned boats over the DCR boats for fishing at Quabbin, and while many boats are used exclusively at Quabbin, some anglers prefer to fish different water bodies as well. The Warm Weather Decontamination (WWD) program and the Cold Weather Quarantine (CWQ) processes are in place to reduce the risks associated with boats being used in multiple locations, some of which may be infested with aquatic invasive species.

In 2015, 159 boaters were inspected and decontaminated through the WWD process. This is down slightly from previous years. Three boaters have been through our decontamination program seven times. Three have been through six times. Two boats failed our inspection because of carpeted bunks. One angler removed the carpet, returned at a later date and passed inspection. The other boater waited until the end of the season and went through the CWQ program where carpeted trailer bunks are allowed. Several other boaters with carpeted bunks removed the carpet while at House of Wax where the Warm Weather Decontamination is held, and then passed upon reinspection. One boat was failed because the motor would not start. That person returned at a later date after fixing the motor and passed our inspection. Two boats were failed because the horsepower of the motor exceeded half the horsepower rating for the boat. Neither one of these boaters has yet returned.

One hundred boaters took advantage of our Cold Weather Quarantine Program in anticipation of the 2016 fishing season. This number is slightly lower than in 2015. CWQ was held on October 31st and November 12th in New Salem, and in Belchertown on November 7th and December 17th and 19th. A snow date was not needed. CWQ had been underutilized in past seasons by fishermen even though it was offered free of charge and at convenient times and locations. Very few anglers complained about not hearing of this program in a timely manner and the process seems to be becoming better known. Many fishermen who went through CWQ in 2015 have used this process each year since its inception. This has enabled them to fish at Quabbin for part of the season as well as other water bodies later on, while providing them with an easy means of getting their boats tagged at no cost.

Interestingly, each year we see the return of numerous anglers who have resisted our program. Again in 2015, some of the boaters who utilized the WWD program and CWQ did so for the first time since the boat access restrictions were implemented. Approximately 80 boaters used the warm weather decontamination for the first time. Forty-five boaters, who had never participated in CWQ, took advantage of the CWQ program this year.

Quabbin Fishing Areas has had a total of 49,878 visits since 2010, the first full year of our boat decontamination program, with 8,145 during the 2015 boating season.

In past years, few, if any, boaters had heard about spiny water flea and the risks associated with this invasive zooplankton. Presently, some boaters still believe our boat decontamination program is due mainly to the threat of zebra mussels. Beginning in 2012, we began to see an interesting change take place regarding how our program was perceived. Most boaters utilizing the decontamination program understand and support our efforts to minimize the risks associated with transport of AIS. Our programs continue to gain acceptance and have now gone from being an annoyance to something we are praised for. Other states have implemented inspection and decontamination programs and are also actively educating through outreach. This has indirectly aided us with our efforts to inform people about AIS and has improved public perception of our programs.

Samples of biological substances collected off of boats inspected during both the Boat Decontamination and Cold Weather Quarantine Programs were identified and were determined to be desiccated portions of aquatic or terrestrial plants, spider webs, exoskeletons of insects and fungi. No AIS were found.

Marine species or severely degraded freshwater plants pose little or no risk of being successfully introduced to Quabbin. However, seeds, microscopic organisms and small plant fragments that may go undetected continue to pose significant risks. We must continue to pay close attention to the temperature of the water used during boat washing and require sufficient water pressure to wash effectively all areas of the boat's hull, rollers, bunks and difficult-to-reach places of the trailer. Contact time of the water should also be noted and lengthened especially if the boat was recently launched at a site known to have aquatic invasive species of concern. Education, outreach and the boat decontamination/quarantine programs help to ensure that the Quabbin Reservoir remains free of new AIS infestations.

2015 Quabbin Self-Certification/Boat Ramp Monitor Program

P. Packard

March 24, 2016

In 2010, DCR implemented a successful Boat Ramp Monitor Program utilizing two full-time seasonal positions to educate boaters and to inspect watercraft at ponds with boat access. Monitors concentrated on Comet Pond in Hubbardston and Long Pond in Rutland but also spent some time at White Hall, Demond, Brigham and Moosehorn Ponds, as well as at Lake Mattawa and Queen Lake.

Beginning in 2011, DCR did not have the funding to hire full-time Boat Ramp Monitors so the process was streamlined to encourage compliance with our requests with a minimal amount of effort and staff. Every opportunity to speak directly to boaters was taken but because our presence was reduced, a self-certification program was begun. Boaters were asked to record where they launched their boat last, when, how they cleaned it and what, if any, aquatic invasive species (AIS) were in the place they last boated.

Self-certification forms continue to be prominently displayed in a box on the kiosk near each boat ramp, along with signage directing boaters to self-certify their watercraft before launching. A letter with directions for filling out a Self-Certification Form, as well as a blank form, was placed on any vehicle that did not display a completed form on the windshield.

Since actual contact time with boaters continues to be limited to several hours per week, efforts were concentrated at Comet and Long Ponds. These two ponds are used by a large number of boaters and therefore are at risk for the introduction of aquatic invasive species. Comet Pond in Hubbardston is pristine with no AIS. Most boaters were in complete agreement with our program and willing to comply with our requests for self-certification. The feelings for Comet Pond rival those expressed when people talk about the Quabbin Reservoir, so the ongoing program to reduce the likelihood of introducing aquatic invasive species to Comet Pond continues to be readily accepted.

Unlike Comet Pond where the use of large boat motors is prohibited, Long Pond is utilized by a variety of motor craft in a range of sizes from kayaks, canoes and small boats up to larger boats with more powerful motors used to tow water skiers. Canoes and kayaks, although not completely risk-free, do not pose the same level of risk as motorized boats do for introducing invasive species because there are fewer places where AIS may be concealed plus they tend to dry completely between uses. Larger boats have more areas where organisms may remain undetected, and they may have areas that remain wet for longer periods of time.

Some types of plants use fragmentation as a means of spreading throughout a water body. Variable water milfoil (*M. heterophyllum*), the dominant species of plant found at Long Pond, utilizes fragmentation as one means of increasing its numbers. Toward the end of the growing season, these plants become brittle. Stems fragment and float to new locations rapidly grow roots. The fragments eventually colonize other locations. In their new location, they compete with and displace native species.

Motorized boats have the potential to effectively aid in the dispersal of plants that use this means of propagation. Boat activity at Long Pond has undoubtedly added to the number of variable water milfoil plants. At any time during the boating season, numerous milfoil fragments may be seen floating along the shore line especially near the launch areas. Repeated trips back and forth by boats towing water skiers chop up and disperse plant fragments. Areas of the littoral zone suitable for plant growth have been colonized and while there are many native species found at Long Pond, variable water milfoil is the dominant species of plant. This makes the self-certification program more difficult to administer because many of the impacts associated with AIS have already been realized. It is important that boaters not only think about the potential introduction of a new invasive species to Long Pond but also of the very real possibility of carrying fragments of milfoil from Long Pond to other water bodies.

Education continues to be the key to success for this program. By focusing on the overall program and not the specific organisms we are concerned about, boaters are beginning to think about the impacts of moving boats from one area to another, ultimate reducing the risk of introducing spiny water flea, Eurasian milfoil, hydrilla or many of the other aquatic invasive species of concern. Overall, the self-certification program was successful.

2015 Quabbin and Ware River Aquatic Macrophyte Assessments

Paula D. Packard

March 28, 2016

During the 2015 field season, a total of 26 water bodies were assessed for the presence of aquatic invasive species (AIS). Of the 26, 10 were in the Quabbin watershed and 14 were in the Ware River watershed. Two were off-watershed but in close proximity to the reservoir. The West Arm of the reservoir, three fishing areas and the Ware River above Shaft 8 were also surveyed in conjunction with assessments conducted by ESS Consulting Group. ESS was hired by MWRA to assist DCR with early detection of AIS and has been surveying portions of the reservoir on an annual basis. Macrophyte assessments were begun on June 18, 2015, and ended on September 17, 2015. The winter of 2014-2015 was exceptionally cold and snowy so most aquatic macrophytes got a late start to the growing season. For this reason, our assessments began slightly later than usual.

Surveys have been timed to coincide with different periods of the growing season; for example, if a water body was assessed early one year, it would be done mid- or late season of the following year. This change in survey period was made mainly to document plants such as *P. crispus*, which may be present in large numbers early in the spring but undetectable midsummer.

Many water bodies within the watershed are monitored yearly while others are done as a component of the current Environmental Quality Assessment. Approximately 60 miles of shoreline (excluding distance of reservoir shoreline) was assessed for the presence of aquatic invasive species by visually observing the littoral zone from a kayak or small boat. See Table below for a complete list of water bodies surveyed in 2015.

Nine water bodies contained *Myriophyllum hetrophyllum* (variable-leaf water milfoil). In these water bodies, this plant was abundant and widely distributed. It is also well established in sections of the reservoir and is an ongoing problem in the Ware River (ESS, 2015). Monitoring and assessment of this plant is ongoing but at this point, it is well established, and removal or eradication would be very difficult.

Five water bodies had stands of common reed (*Phragmites australis*), an invasive species which is widely distributed throughout the watershed and is firmly established along many sections of the reservoir shoreline. This species spreads using three different methods-seeds, stolons and rhizomes. As more plants mature to reproductive age, seed production and dispersal increases. Not only do plant numbers within a pond increase as seeds are spread but the likelihood of seeds being carried to other water bodies also increases. Stolons, runners that are on the top of the soil, and rhizomes, which grow beneath the soil surface, enable small patches to rapidly spread out becoming larger with each successive year. A single seed, once established, can form a large patch, eventually displacing native species.

Phragmites aggressively colonizes the shoreline and is nearly impossible to eradicate using methods such as cutting below the surface of the water, hand pulling or covering with black plastic. These processes are labor intensive and often difficult to administer. Other means of control are being researched, but to date, the only method that seems to be effective and sustainable is to use herbicides. Some success has been documented using a combination of several different methods. These methods work best if stands are small and newly established especially if efforts are intense and prolonged. Early detection and rapid response is critical. Early removal is far more effective, utilizes fewer resources and has less of an environmental impact. This is especially important in pristine water bodies such as Bassett Pond, which supports incredible amounts of biodiversity.

It has been found that *Phragmites* colony numbers increase in the year following low water levels (Hudon, 2005). Water levels were low in 2015 and continue to be below normal at the start of 2016. If this factor provides a more suitable location for the establishment of new colonies, an increase in plant numbers may be observed in the 2016 macrophyte assessments.

Interestingly, *Phragmites* had been previously documented in Harvard Pond where it seemed to be becoming well established. However, no plants were found in this assessment. This phenomenon cannot be explained at this time. Plants may possibly have been removed or treated.

In 2011, the presence of several pink water lily plants was documented along the northern shoreline of Comet Pond. USGS does not list the pink color phase of this plant in its invasive species database, most likely because the pink color phase is thought to be a color variant of the native *Nymphaea odorata*. Although this population does not seem to be increasing at a fast rate, plant numbers are increasing slightly each year and were found scattered along the north western littoral zone and were not confined to the northern end of the pond where they were initially found in 2011. Monitoring will be ongoing.

This year, three water bodies were found to be infested with fanwort (*Cabomba caroliniana*) – Queen Lake in Phillipston, Hardwick Pond in Hardwick and Lake Rohunta in Orange. Hardwick Pond and Lake Rohunta are both off-watershed. Waterfowl may potentially carry fanwort fragments capable of colonizing new areas. Most likely many birds travel between these water bodies and the Quabbin reservoir; therefore, we are monitoring for the presence of this AIS.

Queen Lake was the only water body within the watershed surveyed this year that was infested with fanwort. Numerous fragments were found in the boat launch area and in many of the coves. In the northernmost end of the lake, several rooted patches of fanwort were documented as well as floating fragments. Inaccurate Information was supplied to DCR several years ago that Queen Lake had been treated for fanwort as well as for variable-leaf water milfoil. In previous reports it was stated that the treatment appeared to be successful because no milfoil was documented during any macrophyte assessments, fanwort distribution was sparse, and fanwort densities were low. It has been recently brought to our attention that Queen Lake was treated but not for these two invasive species. It appears that variable-leaf milfoil may never have been present at all in Queen Lake and that fluctuation in fanwort density and distribution was due to natural factors unrelated to any herbicide treatment. A significant increase in the presence of fanwort would be expected considering there have never been any treatments for this AIS; however, to date, results have been surprisingly good with fewer plants than expected.

Smaller types of watercraft are less likely to carry AIS but are not risk-free. The potential introduction of aquatic invasive species through this means was realized in 2013 with the introduction of *Potamogeton crispus*, curly pond weed, to Whitehall Pond in Rutland. A small patch of this AIS was found near the access road, a sample was taken, and identification was confirmed. Tom Flannery, from the DCR Lakes & Ponds Program, removed the plants soon after they were found. Using dive gear to more accurately survey the pond, he found additional infestations near the swimming area as well as a small patch on the other side of the pond. All visible plants were removed. However, *P. crispus* grows predominantly early in the season, senesces during the summer months, and has a moderate growth spurt in early fall so due to timing, not all plants were hand harvested. As expected, additional plants came up in the spring of 2014. Staff from the Lakes and Ponds Program again hand harvested observed plants. Plant numbers increased significantly in 2015, but plants could not be removed because of a lack of staff availability. During the winter of 2015-2016, tentative plans were made to contract with a consulting firm to have them assess the situation, make recommendations and harvest or treat the pond in 2016. ESS Consulting Group was hired and is in the process of determining the extent of the infestation. Because a species of special concern is found in Whitehall Pond, ESS will have to contact MA Natural Heritage & Endangered Species Program to see what control measures will be allowed. Their decision will determine if hand harvesting or herbicides will be used.

The permitting process may make treating *P. crispus* unfeasible in 2016 because by the time all permits have been received, plants may be senescing. There is a possibility that some treatment will be attempted late in the growing season of 2016 and then again early in 2017 to better target plant growth.

Although Chinese Mystery snails are not plants, they were documented during the macrophyte surveys for the first time at Quabbin in 2011 and so will be mentioned here. Numerous snails were found near the boat dock at Fishing Area 1. In 2012, snails were also found near the hangar at the Quabbin Administration Building in Belchertown. Populations still exist in these new locations as well as in a few of the ponds surveyed. These snails displace native species of snails and are thought to compete for resources; however, few studies have been done so actual impacts have not been adequately determined. Snails may serve as the intermediate host for some parasites but to date, no problems have been associated with their presence. Anecdotal evidence suggests that they are an intermediate host for a fish parasite.

In 2013, Yellow Flag Iris, a relatively aggressive invasive species that very closely resembles our native species of iris, Blue Flag Iris, was documented at Connor Pond in Petersham where it has colonized large stretches of the western shoreline and has become densely distributed in many small coves. This plant is spreading at an accelerated rate. It is now found along the shores of the East Branch Swift, in Pottapaug Pond and occasionally at the boat launch at Fishing Area 3 in Hardwick. Many plants were hand pulled at Pottapaug Pond and at Area 3; however, a steady supply of seed pods will continue to be produced and released from plants in Connor Pond. These pods have the ability to float along with water currents. The infestation will continue to worsen as more plants become established and reach full reproductive potential. Efforts to hand harvest plants in Pottapaug Pond and at Boat Area 3 will continue although this is an ongoing problem with no readily available solution.

Lithrum salicaria (Purple Loosestrife) was found at three locations this year. This plant is somewhat difficult to notice when not in bloom so it is possible that the presence of this invasive may be more widespread than believed. Ongoing annual surveys, conducted at different times of the season, may facilitate documentation of infestations not previously observed. At the time of the survey, populations were sparse at all three locations. Sparse populations of purple loosestrife are not conducive to the introduction of *Galerucella*, the predatory beetle that is widely used to control this invasive plant. Because this beetle feeds exclusively on purple loosestrife, to be an effective method of control, plant numbers must be significant enough to support a reproducing population.

Rorippa microphylla (One Row Yellowcress) had been previously found at Pepper's Mill Pond, the east branch of the Swift River, and in a small tributary inside gate 16. It has now been found in all three branches of the Swift River, in Dickey and Underhill Brooks, and in several ponds and appears to be becoming relatively widespread. Interestingly and for reasons not yet fully understood, plant density does not seem to be increasing significantly in areas where it is established. It is edible and may be kept in check by herbivory. Whenever possible, any observed plants are hand harvested. To date, impacts from infestations of One Row Yellowcress seem to be minor. It is widespread throughout New England and has subsequently been found in the Wachusett watershed. It is most likely being transported as seeds by wildlife, water currents, and possibly with gear used by anglers.

Myosotis scorpioides (True Forget-me-not) is not truly an aquatic plant but inhabits wet, disturbed shorelines. Each year, MWRA contracts with consultants to assist with macrophyte surveys at the MWRA/DCR Source and Emergency Reservoirs. ESS Group, Inc. was awarded the contract and during the 2013 macrophyte survey, several small patches of this plant were found along the eastern shoreline of Pottapaug Pond (ESS, 2014). These infestations, as well as several others found at a later date by DCR staff, were removed by hand pulling. In 2015, True Forget-me-not was documented in the upper section of Long Pond, Gaston, Brown's, Pepper's Mill, Pottapaug and Connor Ponds and Lake Mattawa. Populations will be monitored and removed when possible. However, plants multiply by seed production and spread by an extensive, shallow, underground root system. These reproductive methods make complete eradication of this invasive species difficult. Known impacts associated with this plant are minimal at this time, but more information is needed as to its impact on ecosystems.

Najas minor (brittle naiad) was documented by ESS Group in 2014 at O'Loughlin Pond. Plants were harvested using diver assisted suction harvesting (DASH). Brittle naiad plants closely resemble the native naiads, and the difference between the seeds of the native and invasive plants are virtually indiscernible to the wildlife that feed on them. Literature indicates that 25 or more species of waterfowl readily consume the seeds, which can remain viable through the gut of a bird and are therefore easily transported by birds. This is most likely how they were introduced into O'Loughlin Pond. The infestation was small and dealt with quickly, but it is highly unlikely that all plants and seeds were removed. In 2015, additional surveys were conducted by DCR as well as ESS, and no plants were found. The fragment barrier between O'Loughlin Pond and the main body of Quabbin Reservoir was also checked approximately every 2 weeks and no brittle naiad fragments were detected. Monitoring of the fragment barrier and thorough surveys will be ongoing.

Plans to assess water bodies in the Ware River and Quabbin watersheds are in place for the 2016 field season. Special attention will be given to sections of the reservoir in close proximity to ponds with AIS.

Water Body	**Location**
Bassett Pond	New Salem
Bickford Reservoir	Hubbardston
Brigham Pond	Hubbardston
Brown's Pond	Petersham
Carter Pond	Hubbardston
Comet Pond	Hubbardston
Connor Pond	Petersham
Cunningham Pond	Hubbardston
Demond Pond	Rutland
Edson Pond	Rutland
Gaston Pond	Barre
Harvard Pond	Petersham
Hardwick Pond	Hardwick
Long Pond	Rutland

Water Body	**Location**
Upper/Middle Long Pond	Rutland
Mare Meadow Reservoir	Westminster/ Hubbardston
Mattawa Lake	Orange
Middle Swift Impoundment	New Salem
Moosehorn Pond	Hubbardston
Pepper's Mill Pond	Ware
Pottapaug Pond	Hardwick
Queen Lake	Phillipston
Raccoon Hill Pond	Barre
Unnamed Pond	Hardy Drive-Petersham
Ware River (about Shaft 8)	Barre
White Hall Pond	Rutland
Williamsville Pond	Hubbardston
Lake Rohunta (portion of)	Orange

Literature cited

ESS Group, 2015. Aquatic Macrophyte Surveys-MWRA/DCR Source and Emergency Reservoirs

Hudon, C., P. Gagnon and M. Jean (2005). Hydrological factors controlling the spread of common reed (*Phragmites australis*) in the St. Lawrence River (Quebec, Canada). Ecoscience, 12(3), 347-357.

Environmental Quality Field Report
Sample site 101 – Ware River @ Shaft 8 (Intake)
Sample site 103A – Burnshirt River @ Riverside Cemetary
Sample site 107A – West Branch Ware River @ Brigham Road
Sample site 108 – East Branch Ware River @ Intervale Road
Sample site 116B – Comet Pond Outlet Tributary near Clark Road
6/4/15
WR 2015-W-20

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. Samples collected on 6/2/15 had elevated fecal counts which ranged from 410 to 1590 cfu/100mL, and E.coli counts from 473 to 1421 MPN/100mL. On Friday 6/4/15, EQ staff Bernadeta Susianti conducted field inspections of the area draining to all sites listed above. .

- **Sample site 101– Ware River @ Shaft 8 (Intake)**
  The sample collected at this site on 6/2/2015 had a fecal count of 410 cfu/100mL and E.Coli count of 473 mpn/100mL. Staff conducted the field investigation in the morning of 6/4/2015, started from MWRA intake building going east along the northern shoreline. The inspection continued at the sampling spot, crossing the bridge onto southern shoreline. Staff then followed the river through the newly constructed MCRT for an approximate distance of 1000 feet upstream of the horseshoe dam.

  The investigation identified the following:
  1. Water level was high, flow was very good.
  2. Piles of geese feces were present on the northern shoreline just upstream of the horseshoe dam.

- **Sample site 103A – Burnshirt @ Riverside Cemetery**
  The sample collected at this site on 6/2/15 had a fecal count of 830 cfu/100mL and E.coli count of 1421 MPN/100mL. Staff inspected both upstream and downstream side of the sampling site going along the south shoreline for approximate distance of 100 feet

  The investigation identified the following:
  1. High water level.
  2. Burnshirt and Ware River systems are heavily populated by beavers. Active beaver dams, fresh chewed vegetation and mud tracks were present during the field investigation.
  3. One big beaver dam with overflowing water was located approximately 150 feet from the sampling location on the upstream side of Burnshirt River.

Department of Conservation and Recreation
Quabbin Region; 485 Ware Rd.
Belchertown MA 01007
413-323-6921 413-784-1751 Fax
www.mass.gov/dcr

Deval L. Patrick
Governor

Timothy P. Murray
Lt. Governor

Richard K. Sullivan Jr., Secretary Executive Office of Energy & Environmental Affairs

Edward M. Lambert Jr., Commissioner
Department of Conservation & Recreation

4. Another beaver dam was also located less than 50 feet downstream from the sampling location at Ware River

- **Sample Site 107A – West Branch Ware River @ Brigham Road**
  The sample collected at this site on 6/2/2015 had a fecal count 860 cfu/100mL and E.Coli count of 1401MPN/100 mL. Observation was made from the footbridge to approximately 50 ft downstream of the sampling location.

  The investigation identified the following:
  1. High water level.

- **Sample site 108 – East Branch Ware River @ Intervale Road**
  The sample collected at this site on 6/2/2015 had a fecal count 990 cfu/100mL and E.Coli count of 905 MPN/100mL. Observation was made along the shoreline in a close proximity of the sampling location.

  The investigation identified the following:
  1. High water table

- **Sample site 116B – Comet Pond Outlet Tributary near Clark Road**
  The sample collected at this site on 6/2/2015 had a fecal count 1590 cfu/100mL and E.Coli count of 1046 MPN/100 mL. Observation was made on the culvert, downstream and also upstream of the sampling location.

  The investigation identified the following:
  1. High water table, very good flow

Conclusion:
During the routine tributary sampling on 6/2/15, EQ staff Peter Deslauriers and Gary Moulton noted that rain occurred prior to sampling event. Weather.com observed 1.5 inches and 0.6 inches of rain on 6/1/15 and 6/2/15 in Barre, respectively.

Based on the field investigation, beaver activities and flushing from rainfall are likely causes for the elevated bacteria levels at sites 101, 103A, 107A, 108 and 116B. No other obvious source of pollution was observed. If bacteria counts continue to be elevated in upcoming sampling events, further investigation is recommended.

Fecal & *E. coli* Counts >15

Date	Site	Location	Fecal Count CFU/100mL	*E. coli* Count MPN/100mL
6/2/15	101	Ware River @ Shaft 8 (Intake)	410	473
6/2/15	103A	Burnshirt River @ Riverside Cemetary	830	1421
6/2/15	107A	West Branch Ware River @ Brigham Road	860	1401
6/2/15	108	East Branch Ware River @ Intervale Road	990	905
6/2/15	116B	Comet Pond Outlet near Clark Road	1590	1046

PHOTOS

Sample site 101

Geese feces on northern shoreline of Ware River

Sample site 103A

Beaver Dam on Burnshirt River-upstream of the sampling location

Sample site 107A

High water table was observed on 107A sampling site.

Sample site 108

High flow on 108.

Sample site 116B

Very good glow was observed on 116B.

Environmental Quality Field Report
Sample Site 216C – Carter Pond below outlet, at Glen Valley Road, Petersham
6/12/15

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. A sample collected at sample site 216C on 6/9/15 had a fecal coliform count of 740 CFU/100 mL and *E. coli* count of 457 MPN/100 mL. Lab results were received in the afternoon of Wednesday, 6/10/15. As shown below, results indicated much lower fecal and *E. coli* counts at downstream Site 216. Rainfall in the 7 days prior to sampling on 6/9/15 was 0.95 inch reported at Orange Airport and 0.89 inch at Worcester Airport.

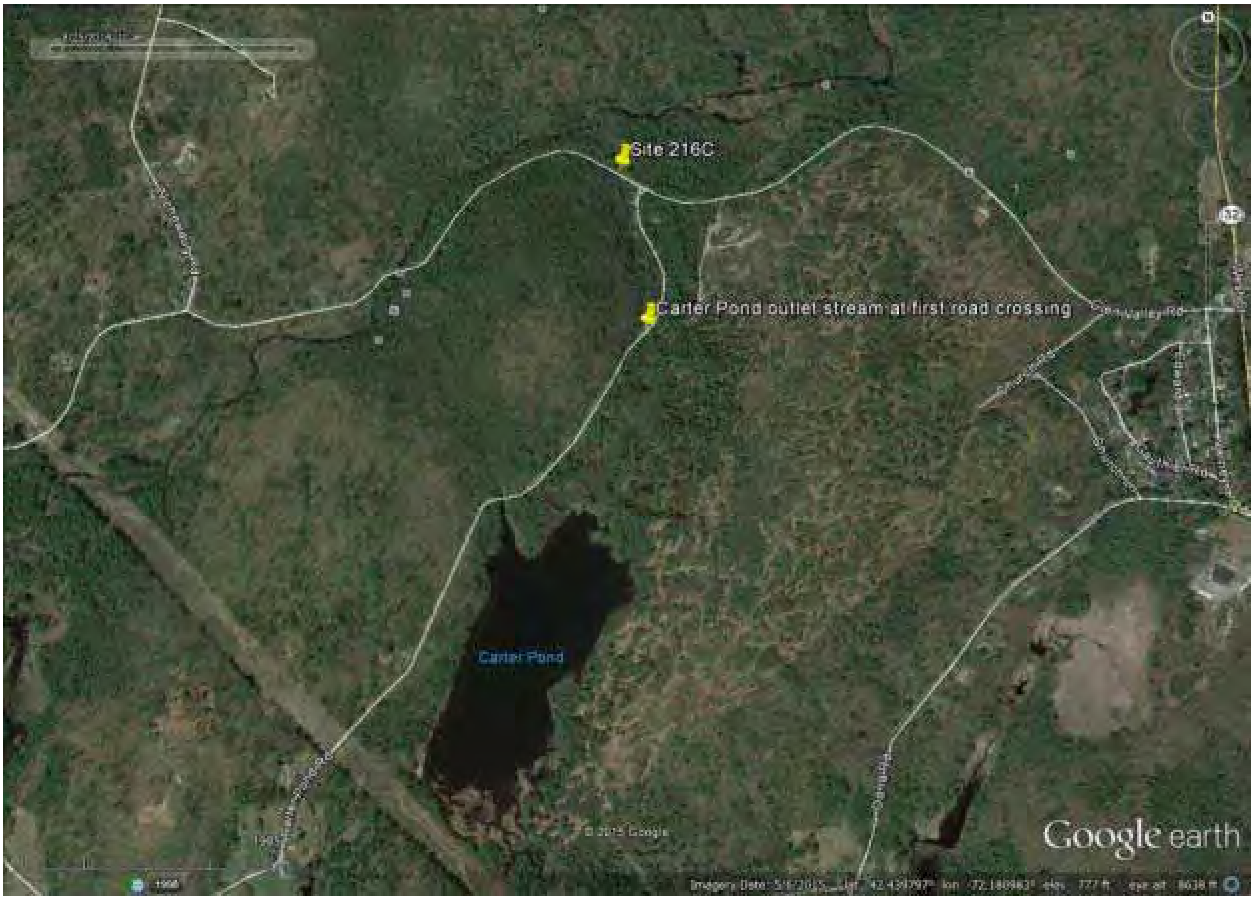
Fecal & *E. coli* Counts >15

Date	Site	Location	Fecal Count CFU/100mL	E. coli Count MPN/100mL
6/9/2015	211	West Branch Swift River @ Route 202	30	20
6/9/2015	212	Hop Brook @ Gate 22 Road	20	110
6/9/2015	213	Middle Branch Swift River @ Gate 30	80	183
6/9/2015	215	East Branch Fever Brook @ West Street	60	41
6/9/2015	216	East Branch Swift River @ Route 32A	30	20
6/9/2015	BC	Boat Cove Brook @ mouth	30	52
6/9/2015	216G	Roaring Brook @ Petersham Center	30	52
6/9/2015	216I-X	Moccasin Brook above Quaker Road	60	243
6/9/2015	216D	Connor Pond Outlet @ Dam near Pat Connor Road	30	31
6/9/2015	216C	Carter Pond below outlet @ Glen Valley Road	740	457

On Friday, 6/12/15, EQ staff Yuehlin Lee conducted a field inspection of the area near Site 216C in Petersham, MA. The field inspection day was sunny, with temperature in the low 70s. Last report of rain was on 6/9/15 in Orange (0.37 inch) and Worcester (0.67 inch). Staff started the inspection by vehicle along Carter Pond Road, stopping to inspect upstream conditions by foot at the first road crossing of the Carter Pond outlet stream and then at Sample Site 216C. See Map. Streamflow was good to fair flow.

The Carter Pond outlet stream crosses Carter Pond road approximately 1,400 feet downstream of the pond outlet. Good flow was observed through the culvert, with flow depth of several inches and no visible obstructions. No odors or visible water quality impacts were observed. See Photos 1 through 3.

The outlet stream then flows in a northerly direction along the west side of Carter Pond Road. Staff resumed the inspection by foot at Site 216C, approximately 2,700 feet downstream of the Carter Pond outlet, where Glen Valley Road crosses the outlet stream. No odors or other sign of water quality impacts were observed at this location. See Photos 4 and 5. A sample for bacterial analysis was collected at 10:00 AM. Before leaving the area, staff walked about 100 feet upstream of Site 216C. No evidence of water degradation was observed.



Map. Carter Pond, Petersham, MA.

Sample Site 216C – Carter Pond below outlet, at Glen Valley Road
6/12/15

Photo 1. Carter Pond outlet stream at Carter Pond Road, view upstream from roadway.

Photo 2. Carter Pond outlet stream at Carter Pond Road, view downstream from roadway.

Sample Site 216C – Carter Pond below outlet, at Glen Valley Road
6/12/15

Photo 3. Carter Pond outlet stream at Carter Pond Road, view upstream at culvert.

Photo 4. Carter Pond outlet stream at Glen Valley Road, view upstream at Sample Site 216C (in foreground) and bridge.

Sample Site 216C – Carter Pond below outlet, at Glen Valley Road
6/12/15

As shown below, results of the 6/12/15 sampling indicate that bacterial concentrations have declined since the routine biweekly sampling on 6/9/15. Weather forecasts and precipitation maps indicated localized rainfall on the day of sampling; see Figures 1(a) and 1(b). The elevated results on 6/9/15 could reflect storm flushing at this one site. However, if routine sampling shows periodic elevated bacterial results, further investigation may be warranted.

Fecal & *E. coli* Counts >15

Date	Site	Location	Fecal Count CFU/100mL	E. coli Count MPN/100mL
6/12/2015	216C	Cater Pond below outlet @ Glen Valley Road	130	75

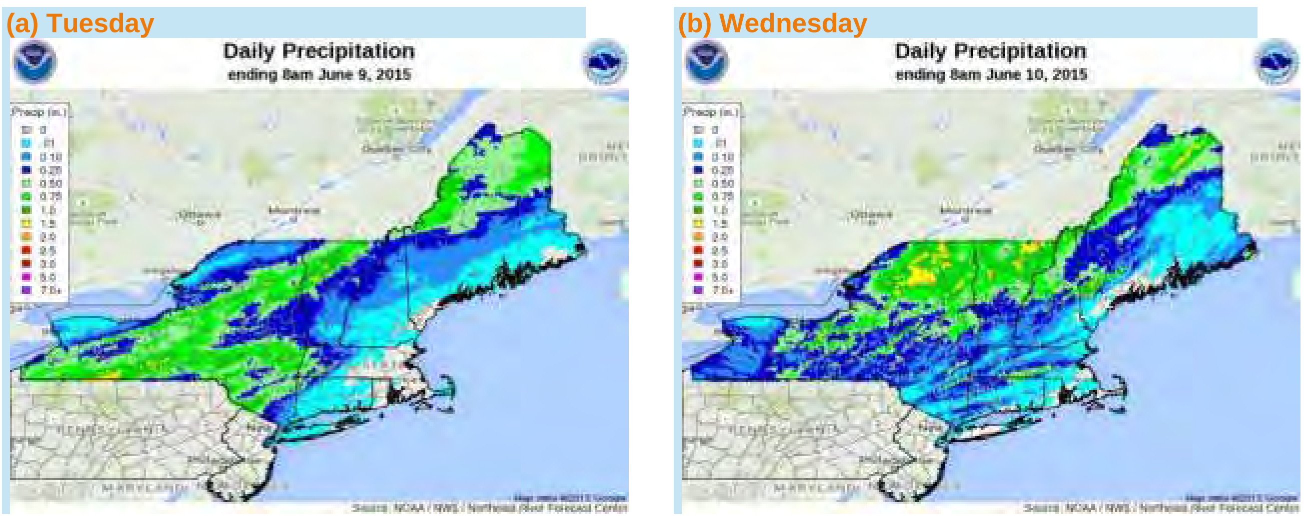


Figure 1. Precipitation maps for (a) Tuesday 6/9/15 and (b) Wednesday 6/10/15 (source: http://www.weather.gov/nerfc/WeeklyPrecipArchive, retrieved 6/15/15).

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Environmental Quality Field Report
Sample Site 212 – Hop Brook at Gate 22 Road
7/9/15

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. A sample collected at sample site 212 on 7/7/15 had a fecal coliform count of 610 CFU/100 mL and *E. coli* count of 414 MPN/100 mL. Lab results were received in the afternoon of Wednesday, 7/8/15. As shown below, results indicated much lower fecal and *E. coli* counts at all other sites. Rainfall in the 7 days prior to sampling on 7/7/15 was 1.15 inches at Orange Airport and 0.75 inch reported at Chicopee Falls (Westover Air Force Base), with much of it falling on 7/1-7/2. Most recent rainfall was reported on 7/5/15 of 0.15 inch (Orange) and 0.04 inch (Chicopee Falls). EQ staff who collected the samples on 7/7/15 reported beaver activity upstream of sample site 212, with occasional clearing of the N. Prescott Road culvert by Town of New Salem road maintenance staff.

Fecal & *E. coli* Counts >15

Date	Site	Location	Fecal Count CFU/100mL	E. coli Count MPN/100mL
7/7/2015	211	West Branch Swift River @ Route 202	<10	20
7/7/2015	212	Hop Brook @ Gate 22 Road	610	414
7/7/2015	213	Middle Branch Swift River @ Gate 30	50	63
7/7/2015	215	East Branch Fever Brook @ West Street	30	31
7/7/2015	216	East Branch Swift River @ Route 32A	30	31
7/7/2015	Gates	Gates Brook @ Mouth	10	41
7/7/2015	BC	Boat Cove Brook @ mouth	20	20
7/7/2015	216 G	Roaring Brook @ Petersham Center	30	74
7/7/2015	216 I-X	Moccasin Brook above Quaker Road	10	75
7/7/2015	216 E-1	N. Trib of 216 E @ South Street	10	63
7/7/2015	216 D	Connor Pond Outlet @ Dam near Pat Connor Road	40	10
7/7/2015	216 C	Carter Pond below outlet @ Glen Valley Road	20	31

On Thursday, 7/9/15, EQ staff Yuehlin Lee conducted a field inspection of the area near Site 212 in New Salem, MA. The field inspection day was overcast with occasional breaks of sun and temperature in the low 70s. Last report of rain was on 7/8/15 in Orange (0.51 inch) and Chicopee Falls (0.09 inch). Staff conducted the inspection by vehicle along Shutesbury Road, N. Prescott Road, and Gate 22 Road. Conditions in Hop Brook were inspected by foot at road crossings from N. Prescott Road to sample site 212. See Map. Streamflow was generally good.

Department of Conservation and Recreation
485 Ware Road
Belchertown, MA 01007
413-323-6921 413-784-1784 Fax
www.mass.gov/dcr

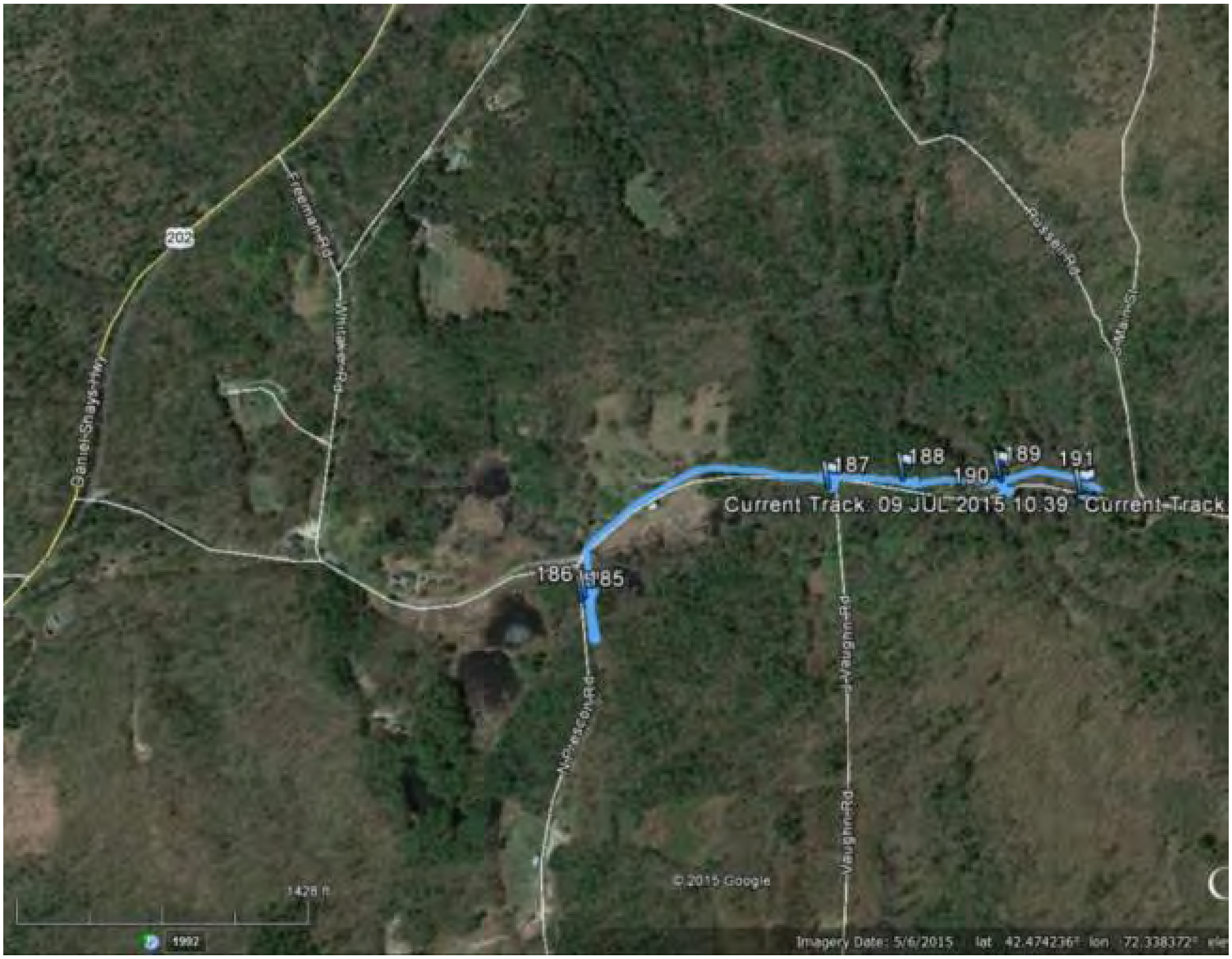
Charles D. Baker
Governor

Karyn E. Polito
Lt. Governor

Matthew A. Beaton, Secretary,
Executive Office of Energy & Environmental Affairs

Carol I. Sanchez, Commissioner
Department of Conservation & Recreation

Sample Site 212 – Hop Brook at Gate 22 Road
7/9/15



Map. Route of investigation, Hop Brook, New Salem, MA.

GPS waypoints were collected and are shown on the map as flags numbered 185 through 191. Waypoints 185 and 186 were collected at the N. Prescott Road crossing of Hop Brook, which appeared to flow unobstructed through the culvert. Photo 1 shows flow at the downstream end of the culvert, with visual evidence of some water quality impact. A slight swampy odor was detected, and a beaver dam was observed about 100 feet downstream (along the channel); see Photo 2.

Driving along Shutesbury Road, staff did not observe significant beaver dams downstream of N. Prescott Road. Waypoint 187 was collected at Vaughn Road, near intersection 22-1, and Hop Brook was observed flowing unobstructed. See Photos 3 and 4. No odor was detected.

Staff continued by vehicle to the next road crossing of Hop Brook, at sample site 212A, which was last monitored in 2011-2012. Marked on the map as waypoint 188, this site had good flow and no odor detected. See Photos 5 and 6.

Sample Site 212 – Hop Brook at Gate 22 Road
7/9/15

At the next road crossing, marked on the map as waypoints 189 and 190, water level was higher with slower flow at the upstream side, compared to the downstream side. See Photos 7 and 8. Staff observed some vegetation and a few tree branches at the upstream end of the culvert, which appeared to have a grate or other structure installed; see Photo 9. Staff walked the south bank downstream of the culvert and observed a few moose tracks. The culvert, about 4 feet in diameter, appeared to have some blockage of flow, as shown in Photo 10. No odor was noted.

Staff continued along Gate 22 Road by vehicle, then walked to sample site 212, shown on the map as waypoint 191. See Photos 11 and 12. Flow was good, and a very slight swampy odor was detected. A sample was collected at 11:35 AM for bacterial analysis.

Results received the next day, on 7/10/15, indicated fecal coliform of 320 CFU/100 mL and *E. coli* of 474 MPN/100 mL. While a decrease from the 7/7/15 sampling, these results are still elevated above the Class A surface water standard for non-intake waters (*E. coli* of 235 colonies per 100 mL in individual samples). Rainfall of 0.09 inch (Chicopee Falls) and 0.51 inch (Orange) was reported in the 1-2 days before the repeat sampling on 7/9/15, which may have flushed bacteria into the stream or downstream from beaver dams.

Site 212 will continue to be monitored biweekly according to the routine schedule. If results are elevated in the next scheduled sampling, on 7/21/15, then a follow-up investigation is recommended.

Sample Site 212 – Hop Brook at Gate 22 Road
7/9/15

Photo 1. Hop Brook, view immediately downstream from N. Prescott Road.

Photo 2. Beaver dam in Hop Brook, view downstream from N. Prescott Road.

Photo 3. Hop Brook, view upstream from Vaughn Road.

Photo 4. Hop Brook, view downstream from Vaughn Road.

Photo 5. Hop Brook at Gate 22 Road (waypoint 188), view upstream.

Photo 6. Hop Brook at Gate 22 Road (waypoint 188), view downstream.

Sample Site 212 – Hop Brook at Gate 22 Road
7/9/15

Photo 7. Hop Brook at Gate 22 Road (waypoint 189), view upstream.

Photo 8. Hop Brook at Gate 22 Road (waypoint 190), view downstream.

Photo 9. Hop Brook at Gate 22 Road (waypoint 189), view down at upstream structure.

Photo 10. Hop Brook at Gate 22 Road (waypoint 190), view upstream through culvert.

Sample Site 212 – Hop Brook at Gate 22 Road
7/9/15

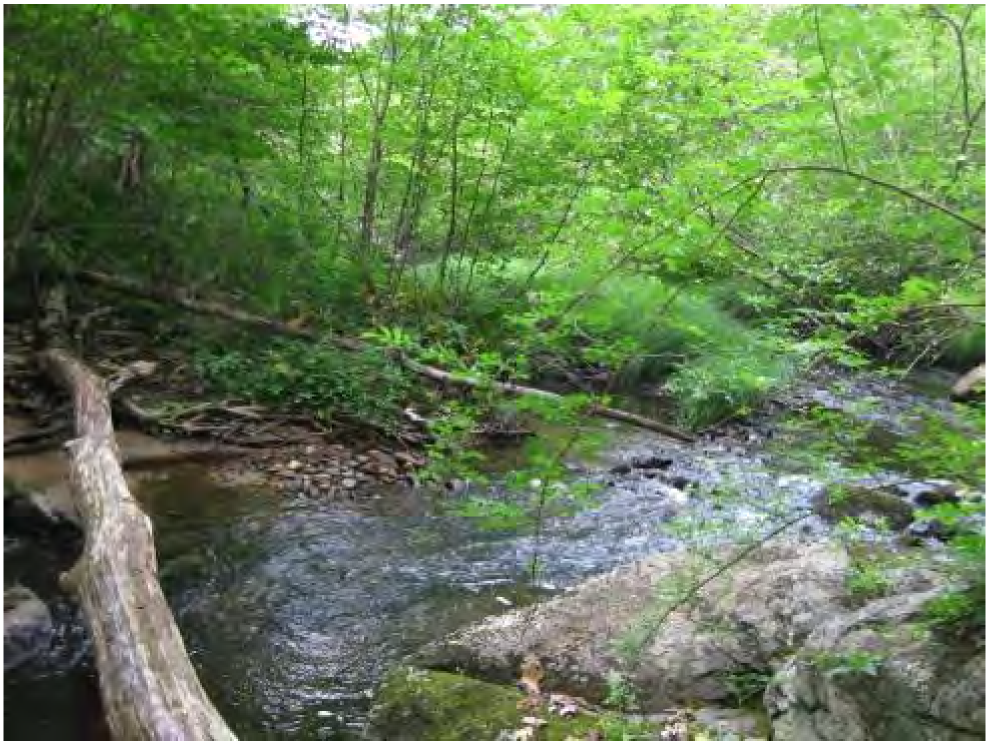


Photo 11. Hop Brook at Site 212 (waypoint 191), view upstream.

Photo 12. Hop Brook at Site 212 (waypoint 191), view downstream.

Environmental Quality Field Report
Sample site 108A – East Branch Ware River @ Route 68
Sample site 108B – Cushing Pond Outlet @ Bemis Road
8/14/15
WR 2015-W-22

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. Samples collected on 8/11/15 had elevated fecal counts which ranged from 500 to 1060 CFU/100mL, and E. coli counts from 262 to 1187 MPN/100mL. On Friday 8/14/15, EQ staff Bernadeta Susianti and Jennifer Howald collected water samples and conducted field inspections of the area draining to the above listed sites.

- **Sample site 108A – East Branch Ware River @ Route 68**
  The sample collected at 108A on 8/11/2015 had a fecal count of 1060 CFU/100mL and E. coli count of 1187 MPN/100mL. Staff conducted the field investigation in the morning of 8/14/2015, starting from the sampling location and going north towards Pout and Trout Campground for an approximate distance of 0.5 mi. Inspection was conducted both by vehicle and on foot.

  The investigation identified the following:
  1. Water level was lower than normal, and flow was very slow.
  2. A beaver dam located just upstream of the sampling location appeared to be recently deconstructed, presumably by heavy rainfall and/or stream flows. This was evident by leftover freshly chewed vegetation around the perimeter of (approximate) dam location (see photo).

- **Sample site 108B – Cushing Pond Outlet @ Bemis Road**
  The sample collected at 108B on 8/11/15 had a fecal count of 500 CFU/100mL and E. coli count of 262 MPN/100mL. Staff inspected both upstream and downstream side of the sampling site for approximately 50 feet in both directions.

  The investigation identified the following:
  1. Low water level.
  2. Three culverts feed the stream at the sampling location. Two culverts originate from the Cushing Pond outlets and one culvert originates from the storm water inlet located on Bemis Road.
  3. Iron oxide was observed originating from the storm water culvert inlet (see photo).

Department of Conservation and Recreation
485 Ware Road
Belchertown, MA 01007
413-323-6921 413-784-1784 Fax
www.mass.gov/dcr

Charles D. Baker
Governor

Karyn E. Polito
Lt. Governor

Matthew A. Beaton, Secretary,
Executive Office of Energy & Environmental Affairs

Carol I. Sanchez, Commissioner
Department of Conservation & Recreation

Conclusion:

During the routine tributary sampling on 8/11/15, EQ staff Peter Deslauriers and Gary Moulton noted that rain occurred during the sampling event. Light, steady rain occurred from 8 AM to 10 AM while heavier, steady rain fell from 10 AM into the rest of the day.

Weather.com observed 0.49 inch of rain on 8/11/15 in Hubbardston, MA. It was also noted that on the 108B sampling site, some runoff from the storm water inlet affected the turbidity of the sample.

Based on the result of the water samples and field investigations, beaver activities and flushing from rainfall are likely causes for the elevated bacteria levels at sites 108A and 108B. No other obvious source of pollution was observed. If bacteria counts continue to be elevated in upcoming sampling events, further investigation is recommended.

Fecal & *E. coli* Counts >15

Date	Site	Location	Fecal Count CFU/100mL	*E. coli* Count MPN/100mL
8/11/15 8/14/15	108A	East Branch Ware River @ Route 68	1060 170	1187 144
8/11/15 8/14/15	108B	Cushing Pond Outlet @ Bemis Road	500 <10	262 30

PHOTOS

C:\Users\Bernadeta\Documents\WR CASES\2015\2015-W-22\Photos

Upstream of Sample site 108A
Deconstructed dam located on the upstream side of sample site 108A

Upstream of Sample site 108B
Iron oxide shown originating from the storm water culvert-upstream of the sampling location

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Environmental Quality Field Report
Sample Site 212 – Hop Brook at Gate 22 Road
8/20/15

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. A sample collected at sample site 212 on 8/18/15 had a fecal coliform count of 700 CFU/100 mL and *E. coli* count of 987 MPN/100 mL. Flow was listed as fair on sample collection day 8/18/15. Last rainfall event occurred on 8/15/15, with rainfall being variable across the region. See daily precipitation map. National Weather Service (NWS) reported 0.48 inch at ORE (Orange) in the 24 hours ending 8/16/15 around 8 AM, with most of it occurring between 8 and 10 PM based on hourly data from the National Climatic Data Center (see http://www.ncdc.noaa.gov/qclcd/QCLCD for Orange Municipal Airport). A rain gage on North Prescott Road approximately one mile from sample site 212 collected 0.20 inch on 8/15/15. EQ staff has been reporting beaver activity upstream of sample site 212, and a recent field investigation conducted by Yuehlin Lee on 7/9/15 documented beaver activity upstream of the Gate 22 Road culvert.

On Thursday 8/20/15, EQ staff Gary Moulton conducted a field inspection upstream of the Hop Brook site 212 and collected water samples from three locations. The field inspection day was partly to mostly cloudy with temperatures in the mid-80s. EQ staff collected samples at sites 212, 212A, and 212B. See Map. After collecting the last sample at 212B, staff began foot inspection along southeast side of Hop Brook. A GPS waypoint was collected at first sign of beaver activity and is shown on map as “Beginning of Recent Chewing.” This was approximately 450 yards downstream of the 212B site and approximately 270 yards upstream of Hop Brook Road culvert. Staff continued downstream and found two active beaver dams. A waypoint was taken between the two dams and is shown on map as “Two Active Beaver Dams.” The upstream dam is approximately 150 yards upstream of the culvert on Hop Brook Road. See Photo 1. The downstream dam is approximately 120 yards upstream of the culvert. Staff continued downstream to culvert. Upstream side of culvert was partially blocked with beaver cuttings and debris, as shown in Photo 2. Staff returned upstream and crossed to west side of brook in area where recent cuttings were observed and continued upstream to 212B.

Results received on 8/25/15 for samples collected on 8/20/15 are listed below.

212
Fecal coliform 480 CFU/100 mL
E. coli 620 MPN/100mL

Department of Conservation and Recreation
485 Ware Road
Belchertown, MA 01007
413-323-6921 413-784-1751 Fax
www.mass.gov/dcr

Charles D. Baker
Governor

Karyn E. Polito
Lt. Governor

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Office of Energy & Environmental Affairs

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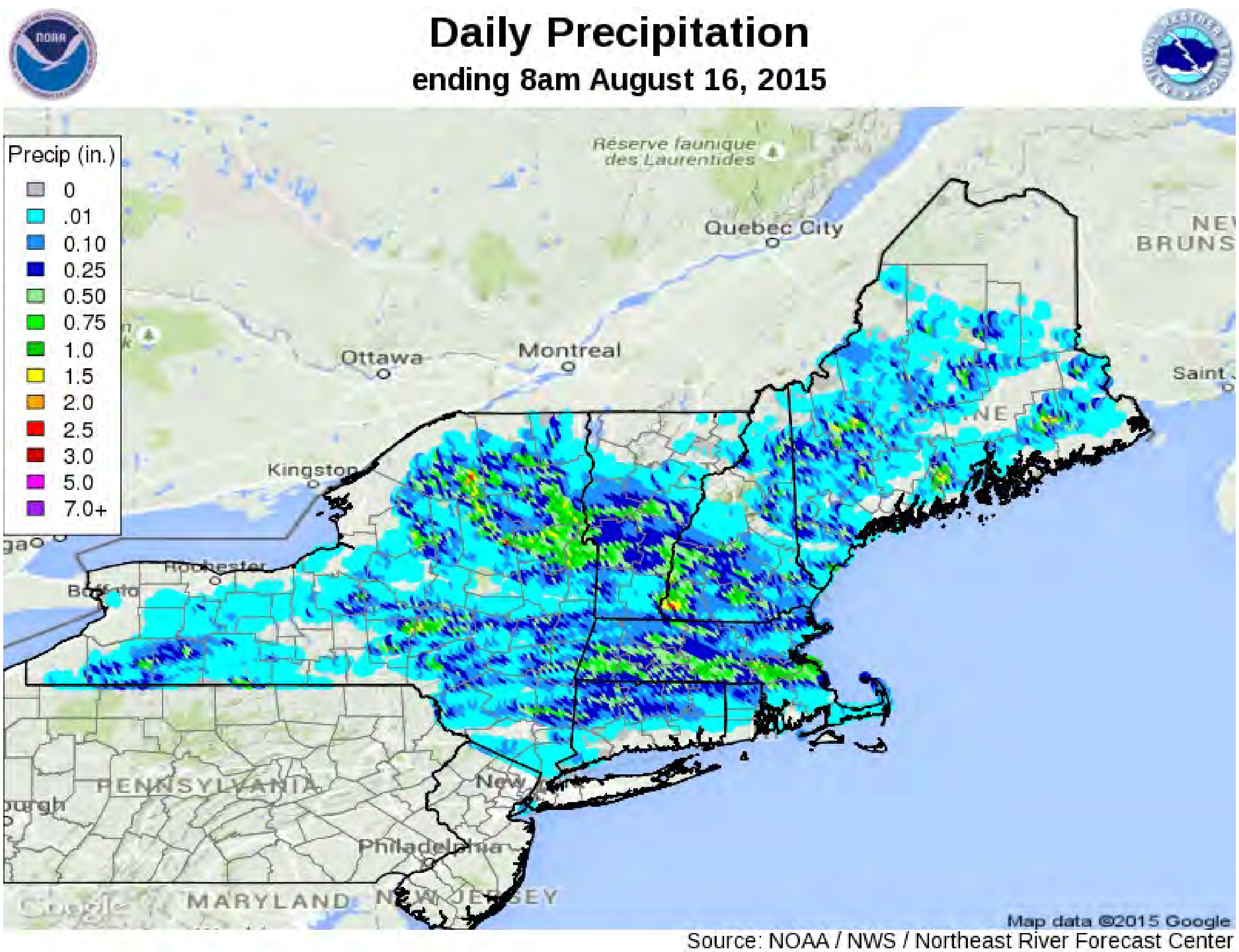
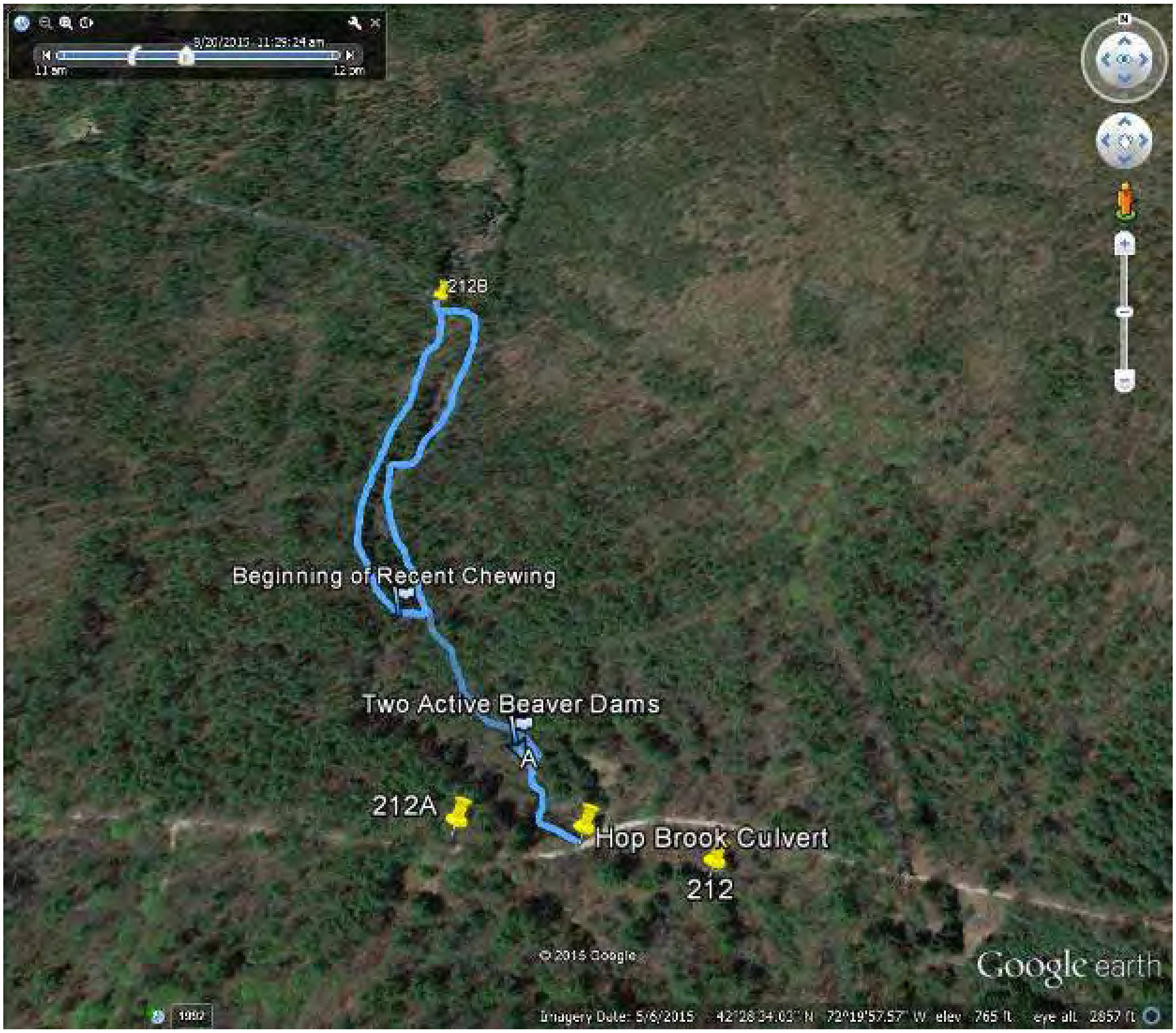
212A
Fecal coliform 90 CFU/100mL
E. coli 121 MPN/100mL

212B
Fecal coliform 30 CFU/100mL
E.coli 72 MPN/100mL

No rainfall fell in New Salem from 8/18/15 to 8/20/15. Based on the results of repeat samples and field investigation, beaver activity upstream of 212 has likely caused elevated bacteria levels. Site 212 will continue to be monitored biweekly, according to the routine schedule. Next scheduled sampling will be on 9/1/15. Sampling staff will note beaver activity upstream of Gate 22 Hop Brook Road culvert prior to sampling. DCR maintenance staff Allen Walsh and wildlife management staff Kiana Koenen have been notified about beaver activity at Hop Brook and the partial culvert blockage.



NOAA/NWS/ Daily Precipitation Map.



Map. Route of investigation, Hop Brook, New Salem,MA.


Photo 1. Upper Dam.

Photo 2. Upstream side Hop Brook Road culvert.

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Environmental Quality Field Report
Boat Cove Brook – September 3 and 18, 2015

EQ staff conducted field investigations in response to elevated bacteria in surface water. A sample collected at Boat Cove Brook on 9/1/15 had a fecal coliform count of 390 CFU/100mL and *E.coli* count of 373 MPN/100mL. Flow was listed as very slow on sample collection day 9/1/15. Last rainfall event as reported by Civil Engineering staff was 0.02 inch on 8/25/15.

On Thursday 9/3/15 EQ staff Peter Deslauriers conducted a field inspection from the mouth of Boat Cove Brook to approximately 100 yards upstream. The field inspection day was mostly sunny with temperatures in the mid-80s. Flow was lower today than on sample day. See Photos 1 and 2. Tall ferns, thick brush, blow downs, and red pine bark debris made viewing stream bed difficult. In places, stream bed appeared dry and water travelled underground. Three deer runs crossed brook upstream of sample site.

A sample collected on 9/15/15 at Boat Cove Brook had a fecal coliform count of 1100 CFU/100mL and *E.coli* of 1607 MPN/100mL. Flow was listed as slow on sample collection day. Civil Engineering staff reported 0.32 inch of precipitation on 9/9/15, 0.93 inch on 9/10/15, 0.01 inch on 9/11/15, 0.24 inch on 9/12/15, and 1.71 inch on 9/13/15.

On Friday 9/18/15 EQ staff Peter Deslauriers conducted a field inspection from the mouth of Boat Cove Brook to .25 miles upstream as measured straight line by GPS. Field inspection day was mostly sunny with temperatures in the low 70s. EQ staff collected a repeat bacteria sample and a turbidity sample at the Boat Cove Brook sample location. See Map. No rain had fallen since 9/13/15 when 1.71 inch was reported. Flow was listed as slow on the chain of custody sheet. See Photo 3. After collecting samples, staff began foot inspection crossing back and forth across brook where travel was possible. Two deer runs crossed brook slightly upstream of sample site. GPS waypoints were taken at these locations. See Map. See photos 4 and 5. Nine piles of deer scat were found near these runs in close proximity to the brook. See Photos 6 and 7. Staff continued upstream walking close as possible to brook. Tall ferns, raspberry, barberry, woodbine, grape vine, bittersweet, golden rod, and blow downs made this impossible at times. See photos 8 and 9. Numerous deer runs crossed the brook. Staff continued upstream to the location of an old beaver meadow. The old beaver meadow has transitioned to a dense alder thicket. Navigating through this thicket was very difficult. See photo 10. A waypoint was collected at far eastern side of alder thicket. See Map. Staff returned downstream crossing back and forth across brook. No evidence of beaver activity was observed during this investigation.

COMMONWEALTH OF MASSACHUSETTS · EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS

Department of Conservation and Recreation
485 Ware Road
Belchertown, MA 01007
413-323-6921 413-784-1751 Fax
www.mass.gov/dcr

Charles D. Baker
Governor

Karyn E. Polito
Lt. Governor

Matthew A. Beaton, Secretary, Executive Office of Energy & Environmental Affairs

Leo Roy, Commissioner
Department of Conservation & Recreation

Results received on 9/23/15 for samples collected on 9/18/15 are listed below.

Boat Cove Brook
Fecal coliform 150CFU/100mL
E. coli 160 MPN/100mL
Turbidity 0.331 NTU

Based on the results of repeat samples and field investigation, heavy rainfall and deer activity upstream of sample site may have caused elevated bacteria levels on sample collected 9/15/15. Elevated bacteria levels during dry periods may be related to the numerous deer runs crossing brook upstream of the sample site.

MAP. Boat Cove Brook , Ware MA - September 18, 2015.

Photo 1. Mouth Boat Cove Brook - September 3, 2015.

Photo 2. Sample site - September 3, 2015.

Photo 3. Mouth Boat Cove Brook - September 18, 2015.

Photo 4. First Upstream Deer Run - September 18, 2015.


Photo 5. Second Upstream Deer Run - September 18, 2015


Photo 6. Deer Scat - September 18, 2015.


Photo 7. Deer Scat - September 18, 2015.


Photo 8. Dense vegetation along brook - September 18, 2015.


Photo 9. Dense vegetation along brook - September 18, 2015.


Photo 10. Dense alder thicket, looking downstream and west towards Boat Cove.

dcr
Massachusetts

Environmental Quality Field Report
Hank's Meadow- Quabbin Park
9/28/15

EQ staff conducted a field investigation in response to an email received on Sunday, September 27, 2015 from the Quabbin Visitor Center. A visitor reported seeing what appeared to be an oil spill, or like someone had poured oil on the shoreline near Hank's Meadow. The visitor stated the location was in an area to the left of a trail where there is a small stream or spring.

On Monday 9/28/15 between 11 am and 12:30 pm, EQ staff Gary Moulton conducted a field inspection along the trail and shoreline near Hank's Meadow. Approximately one half mile of reservoir shoreline was inspected. The inspection day was mostly cloudy with temperatures in the mid 60's. The reservoir was 5 feet below capacity, making walking along sections of the shore line easy for visitors.

The inspection proceeded on foot, beginning at the parking lot at Hank's Meadow and followed the road northerly to the water line. The route went westerly along the shore approximately 100 feet to waypoint 203 (see Map). At waypoint 203 a sheen in a puddle off the side of a very small stream was observed (see Photo 1). After further observation, there were no vehicle tracks, no evidence of a boat being beached nearby, and there were no empty containers found. When touched, the sheen fragmented into pieces with no oily residue, confirming the sheen to be a natural occurrence of decomposed organic matter.

Not knowing for sure if this was the same location observed by the reporting visitor, the inspection continued westerly on a foot path to a very small but similar sheen found just south of the trail at waypoint 204 (see Photo 2). The inspection continued westerly to a point where the trail left the shore line. The inspection backtracked easterly along the shore line past Hank's Meadow to waypoint 207. At waypoint 207 another similar sheen was observed (see Photo 3). The inspection ended by returning to Hank's Meadow and back to the parking lot.

No oil or hazardous materials were found during the inspection. The organic sheen found at waypoint 203 was most likely the location reported to the Visitor Center. This fragmented sheen occurs naturally and is no longer a concern after this inspection.

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Department of Conservation and Recreation
485 Ware Road
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413-323-6921 413-784-1784 Fax
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Governor

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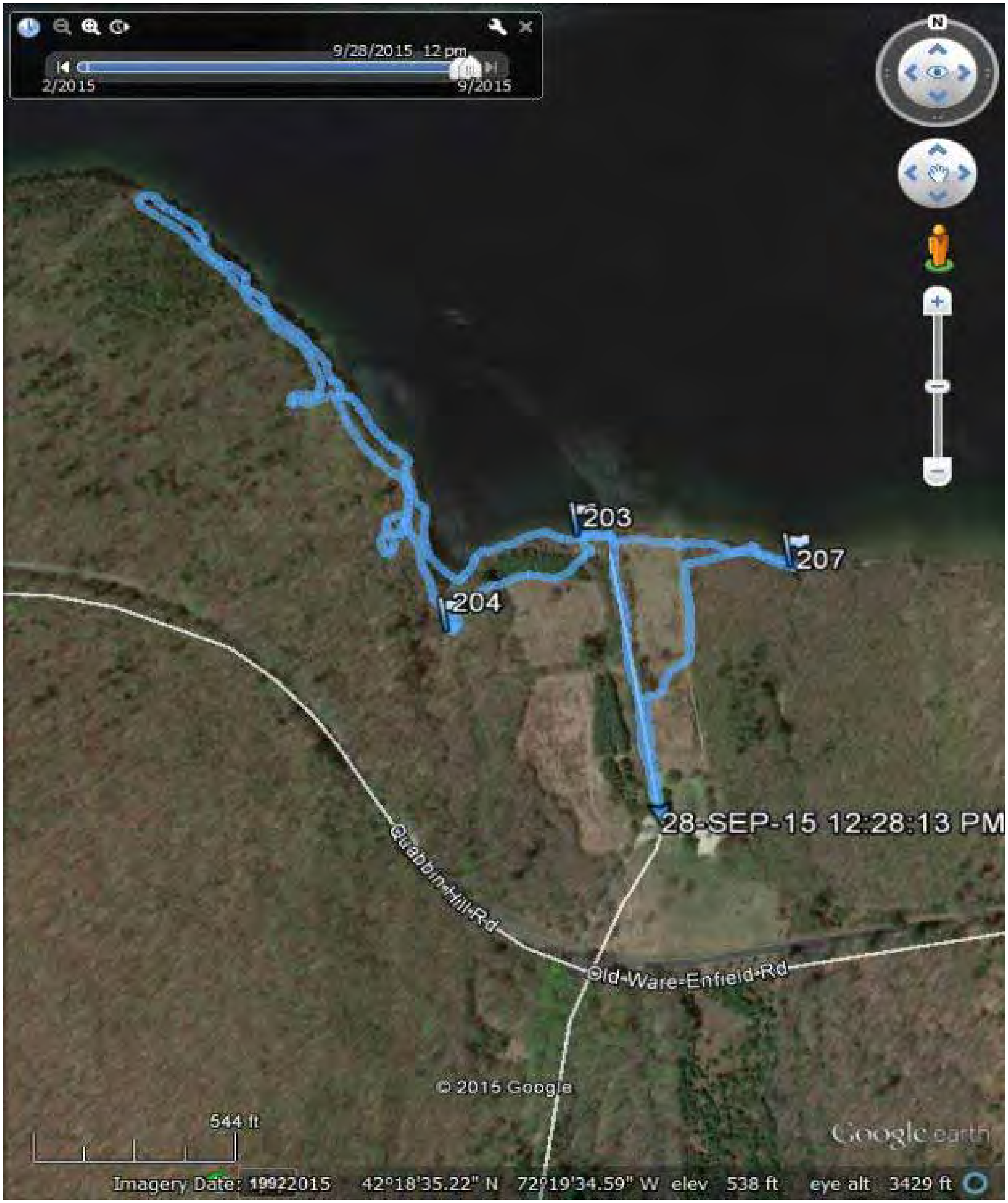
Carol I. Sanchez, Commissioner
Department of Conservation & Recreation



Map - Google earth image of inspection track


Photo 1- Decomposed organic matter on puddle near the shore line (waypoint 203)


Photo 2- Stream with similar decomposed organic matter on water surface (waypoint 204)

Photo 3 – Decomposed organic matter near the shore line of the most easterly part of investigation track (waypoint 207)

MEMORANDUM

To: Bill Pula, Lisa Gustavsen

cc: Scott Campbell, Rebecca Faucher

From: Yuehlin Lee

Date: May 11, 2015

Subject: Water Quality Results for Stockroom

Water samples were collected at the Stockroom on Blue Meadow Road on April 13-14, 2015. Samples were taken from the kitchen tap ("KTAP": raw, untreated water) and from the tap dispensing water treated through the reverse osmosis (RO) unit ("Sink RO": treated water). Maintenance on the RO unit was last completed on May 29, 2014.

Samples were analyzed for bacteria, volatile organic compounds (VOCs), nitrate, copper, lead, sodium, total dissolved solids, turbidity, and alkalinity. MWRA provided all laboratory services. Total coliform and *Escherichia coli* bacteria, turbidity, and alkalinity were analyzed at Quabbin Laboratory. All other parameters were analyzed at Deer Island Laboratory. See attached table listing all field and laboratory results.

Except for lead and sodium, all contaminant concentrations met drinking water standards and guidelines in both **untreated** and **RO-treated** water. In the untreated (KTAP) water, lead was detected at 15.7 µg/L (0.0157 mg/L), just above action level of 15 µg/L (0.015 mg/L). The RO system effectively decreased lead concentration by 75 percent to 3.95 µg/L (0.00395 mg/L), well below the lead action level. For sodium, the RO unit effectively reduced the concentration by 80 percent, below the guideline limit of 20 mg/L. In addition to reducing lead and sodium concentrations, RO treatment also decreased levels of copper, nitrate, total dissolved solids, and turbidity. Test results indicate that RO treatment continues to work effectively nearly a year after annual maintenance.

No VOCs were detected. Methyl-tert-butyl ether (MTBE) **was not detected** in the raw or RO-treated water. MTBE levels have been very low in the raw water, just above the detection limit of 0.50 µg/L, during the most recent sampling events. Previous results included detections of 0.62 µg/L in April 2010, 0.85 µg/L in July/August 2010, 0.53 µg/L in June 2012, 0.61 µg/L in April 2013, and below detection limit in April 2014. Previous monitoring in 1999 through 2000 indicated MTBE levels of 27 to 38 µg/L.

Please call me at extension 158 if you have questions or require further. Thank you.

Water Quality at Stockroom
Samples Collected 4/13 - 4/14/15

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO	Drinking Water Standard or Guideline [1]	Remarks [2]
Bacteria					
Total Coliform	MPN/100 mL	<1.00	<1.00	Absent	Total Coliform Rule
E. coli	MPN/100 mL	<1.00	<1.00	Absent	Total Coliform Rule
Physical/Chemical Properties					
Alkalinity	mg/L	31.2	4.43	-	
Total Dissolved Solids	mg/L	450	43.0	500 mg/L	SDWR, SMCL
Turbidity	NTU	0.668	0.0450	1 NTU	MCL
Inorganic Compounds					
Copper	ug/L	895	5.95	1,000 ug/L	SDWR, SMCL
Lead	ug/L	15.7	3.95	15 ug/L	MCL (Action Level)
Nitrate	mg/L	0.499	0.0187	10 mg/L	MCL
Sodium	ug/L	42700	8540	20,000 ug/L	MA ORSG
VOCs					
Benzene	ug/L	<0.500	<0.500	5 ug/L	MCL
Bromobenzene	ug/L	<0.500	<0.500	-	
Bromochloromethane	ug/L	<0.500	<0.500	-	
Bromodichloromethane	ug/L	<0.500	<0.500	80 ug/L	MCL, based on total trihalomethanes.
Bromoform	ug/L	<0.500	<0.500	80 ug/L	MCL, based on total trihalomethanes.
Bromomethane	ug/L	<0.500	<0.500	10 ug/L	MA ORSG
Butylbenzene, n-	ug/L	<0.500	<0.500	-	
Butylbenzene, sec-	ug/L	<0.500	<0.500	-	
Butylbenzene, tert-	ug/L	<0.500	<0.500	-	
Carbon tetrachloride	ug/L	<0.500	<0.500	5 ug/L	MCL
Chlorobenzene	ug/L	<0.500	<0.500	100 ug/L	MCL
Chloroethane	ug/L	<0.500	<0.500	-	
Chloroform	ug/L	<0.500	<0.500	70 ug/L	MA ORSG, for non-chlorinated supply.
Chloromethane	ug/L	<0.500	<0.500	-	
Chlorotoluene, 2-	ug/L	<0.500	<0.500	-	
Chlorotoluene, 4-	ug/L	<0.500	<0.500	-	

Water Quality at Stockroom
Samples Collected 4/13 - 4/14/15

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO	Drinking Water Standard or Guideline [1]	Remarks [2]
Dibromo-3-chloropropane, 1,2-	ug/L	<0.500	<0.500	0.2 ug/L	MCL
Dibromochloromethane	ug/L	<0.500	<0.500	80 ug/L	MCL, based on total trihalomethanes.
Dibromoethane, 1,2-	ug/L	<0.500	<0.500	-	
Dibromomethane	ug/L	<0.500	<0.500	-	
Dichlorobenzene, 1,2-	ug/L	<0.500	<0.500	600 ug/L	MCL
Dichlorobenzene, 1,3-	ug/L	<0.500	<0.500	-	
Dichlorobenzene, 1,4-	ug/L	<0.500	<0.500	5 ug/L	MA MCL
Dichlorodifluoromethane	ug/L	<0.500	<0.500	1400 ug/L	MA ORSG
Dichloroethane, 1,1-	ug/L	<0.500	<0.500	70 ug/L	MA ORSG
Dichloroethane, 1,2-	ug/L	<0.500	<0.500	5 ug/L	MCL
Dichloroethene, 1,1-	ug/L	<0.500	<0.500	7 ug/L	MCL
Dichloroethene, cis-1,2-	ug/L	<0.500	<0.500	70 ug/L	MCL
Dichloroethene, trans-1,2-	ug/L	<0.500	<0.500	100 ug/L	MCL
Dichloropropane, 1,2-	ug/L	<0.500	<0.500	5 ug/L	MCL
Dichloropropane, 1,3-	ug/L	<0.500	<0.500	-	
Dichloropropane, 2,2-	ug/L	<0.500	<0.500	-	
Dichloropropene, 1,1-	ug/L	<0.500	<0.500	-	
Dichloropropene, 1,3- (Total)	ug/L	<0.500	<0.500	0.4 ug/L	MA ORSG
Dichloropropene, cis-1,3-	ug/L	<0.500	<0.500	0.4 ug/L	MA ORSG, for 1,3-dichloropropene.
Dichloropropene, trans-1,3-	ug/L	<0.500	<0.500	0.4 ug/L	MA ORSG, for 1,3-dichloropropene.
Ethylbenzene	ug/L	<0.500	<0.500	700 ug/L	MCL
Hexachlorobutadiene	ug/L	<0.500	<0.500	-	
Isopropylbenzene	ug/L	<0.500	<0.500	-	
Isopropyltoluene, 4-	ug/L	<0.500	<0.500	-	
Methylene chloride	ug/L	<0.500	<0.500	5 ug/L	MCL
Methyl-tert-butyl ether (MTBE)	ug/L	<0.500	<0.500	70 ug/L	MA ORSG. 20-40 ug/L for odor & taste.
Naphthalene	ug/L	<0.500	<0.500	140 ug/L	MA ORSG
Propylbenzene, n-	ug/L	<0.500	<0.500	-	
Styrene	ug/L	<0.500	<0.500	100 ug/L	MCL

Water Quality at Stockroom
Samples Collected 4/13 - 4/14/15

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO	Drinking Water Standard or Guideline [1]	Remarks [2]
Tetrachloroethane, 1,1,1,2-	ug/L	<0.500	<0.500	-	
Tetrachloroethane, 1,1,2,2-	ug/L	<0.500	<0.500	-	
Tetrachloroethene	ug/L	<0.500	<0.500	5 ug/L	MCL
Toluene	ug/L	<0.500	<0.500	1000 ug/L	MCL
Trichlorobenzene, 1,2,3-	ug/L	<0.500	<0.500	-	
Trichlorobenzene, 1,2,4-	ug/L	<0.500	<0.500	70 ug/L	MCL
Trichloroethane, 1,1,1-	ug/L	<0.500	<0.500	200 ug/L	MCL
Trichloroethane, 1,1,2-	ug/L	<0.500	<0.500	5 ug/L	MCL
Trichloroethene	ug/L	<0.500	<0.500	5 ug/L	MCL
Trichlorofluoromethane	ug/L	<0.500	<0.500	-	
Trichloropropane, 1,2,3-	ug/L	<0.500	<0.500	-	
Trimethylbenzene, 1,2,4-	ug/L	<0.500	<0.500	-	
Trimethylbenzene, 1,3,5-	ug/L	<0.500	<0.500	-	
Vinyl chloride	ug/L	<0.500	<0.500	2 ug/L	MCL
Xylene, m,p-	ug/L	<0.500	<0.500	10000 ug/L	MCL, based on total xylenes.
Xylene, o-	ug/L	<0.500	<0.500	10000 ug/L	MCL, based on total xylenes.
Xylenes, Total	ug/L	<0.500	<0.500	10000 ug/L	MCL.

[1] 1 mg/L = 1 ppm = 1000 ug/L = 1000 ppb

[2] MCL = Maximum Contaminant Level
SDWR = Secondary Drinking Water Regulations (federal)
SMCL = Secondary Maximum Contaminant Level (Massachusetts)
SDWR and SMCL are set for aesthetics, not health concerns.
MA ORSG = MA Office of Research and Standards Guidelines
MA ORSG = MA Office of Research and Standards Guidelines

Memorandum

To: Scott Campbell

From: Yuehlin Lee

Date: December 10, 2015

Subject: 2015 Lead Results for Quabbin Administration Building

In accordance with the DEP Water Quality Sampling Schedule, the five approved taps in the Quabbin Administration Building were tested for lead and copper during the third quarter, on July 16, 2015. Test results revealed that two taps exceeded the lead action level of 15 ppb, as shown in Table 1. After laboratory notification on August 17, 2015, DCR-Quabbin staff posted the lead results and notified users to flush taps briefly and not to use the Garage Fountain at all. DCR staff initiated additional testing in September and October to investigate water quality issues that may increase the risk of elevated lead concentrations.

Table 1. 2015 Lead Results, in parts per billion (ppb), at the Five Approved Taps.

Date	East Wing Kitchen Tap	Garage Fountain	Visitor Center Fountain	Quabbin Lab Tap	3rd Floor Service Sink
7/16/15	30.3 ppb	96.1 ppb	1.76 ppb	1.30 ppb	3.27 ppb
9/24/15*	38.9 ppb	1.85 ppb	N/A	N/A	N/A
10/7/15	21.0 ppb	3.40 ppb	1.41 ppb	1.99 ppb	2.48 ppb

* 250-mL first-draw result from sequential sampling, conducted at the two taps with lead exceedances.
N/A: not available.

The Kitchen Tap has had occasional lead exceedances, in August 2005 and August 2008, prior to July 2015. We suspect the location of this tap, near a dead end in an extensive plumbing system, to be the most susceptible to elevated lead concentrations. The Garage Fountain had been out of service for several years. We suspect that recent plumbing work, the time offline, and possible accumulation behind the sediment filter contributed to the elevated lead result at the Garage Fountain. Lead concentrations at the other three taps have remained below action level in routine monitoring.

Sequential sampling was conducted at the Kitchen Tap and Garage Fountain on September 24, 2015, to evaluate lead concentrations during flushing. The Kitchen Tap, Garage Fountain, and the line to the Garage Fountain were flushed thoroughly the day before sequential sampling. Samples were collected in 250-mL bottles, and time of sample collection was recorded for each bottle. As shown in Figures 1 and 2, the first sample represents a 250-mL first draw. Lead concentration at the Kitchen Tap decreased below the 15-ppb action level by the third sample, or 35 seconds of flushing. At the Garage Fountain, all six samples remained well below action level, at 1.85 to 3.91 ppb.

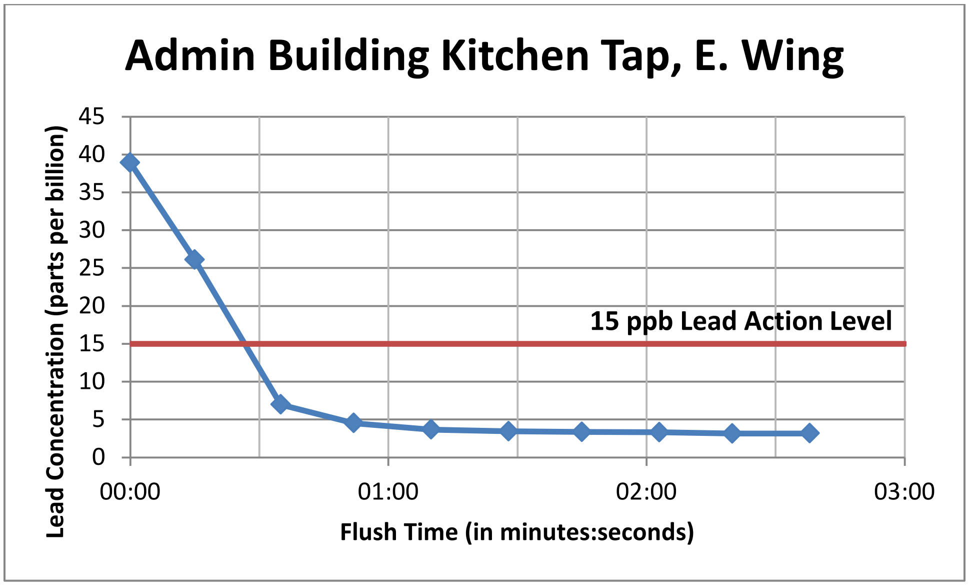


Figure 1. Sequential sampling results using 250-mL bottles, Kitchen Tap, September 24, 2015.

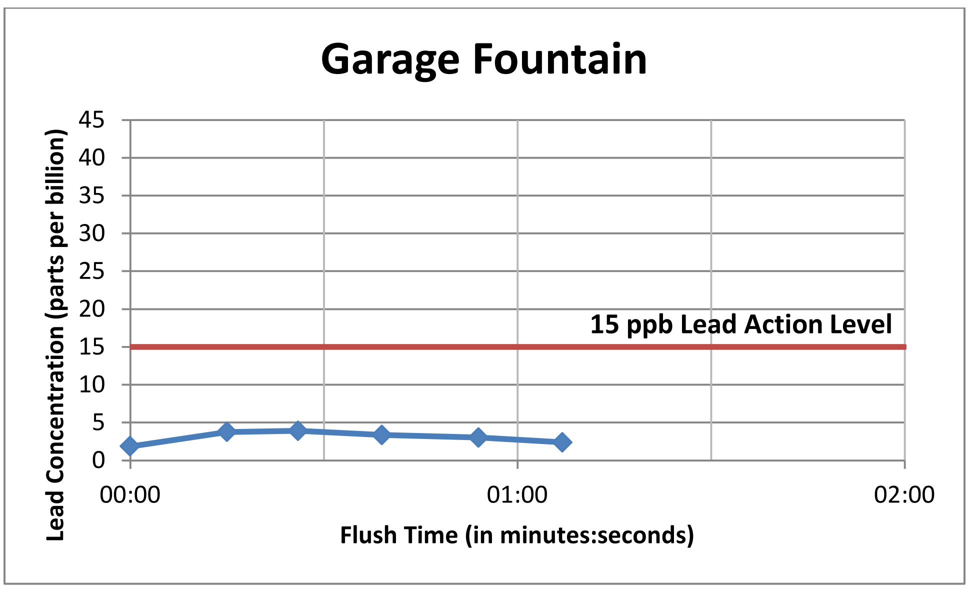


Figure 2. Sequential sampling results using 250-mL bottles, Garage Fountain, September 24, 2015.

Re-testing of lead and copper was conducted at the five approved taps on October 7, 2015. As shown in Table 1, the Kitchen Tap remained above action level at 21.0 ppb, while the Garage Fountain had a much lower lead result compared to July 16th. The other three taps remained low, comparable to previous results.

Samples for Water Quality Parameters were collected at the Well and Kitchen Tap on October 7, and repeated two weeks later at the Kitchen Tap on October 21, 2015. Table 2 lists these results, as well as Water Quality Parameter results from November 2008, following the August 2008 lead exceedances.

Table 2. Water Quality Parameter results in 2015 and 2008.

Water Quality Parameter	Unit	WELL 10/7/15	KTAP 10/7/15	KTAP 10/21/15	WELL 11/13/08	KTAP 11/13/08	KTAP 11/20/08
pH	Standard	6.85	6.87	6.84	7.2	7.6	7.7
Temperature	°C	14.69	21.00	18.61	12.7	27.4	22.3
	°F	58.4	69.8	65.5	54.9	81.3	72.1
Alkalinity	mg/L	28.6	32.4	33.3	25.0	30.0	28.6
Specific Conductance	µmho/cm	516	542	533	177	204	214
Calcium	mg/L	35	38	40	18.1	21.5	22.1

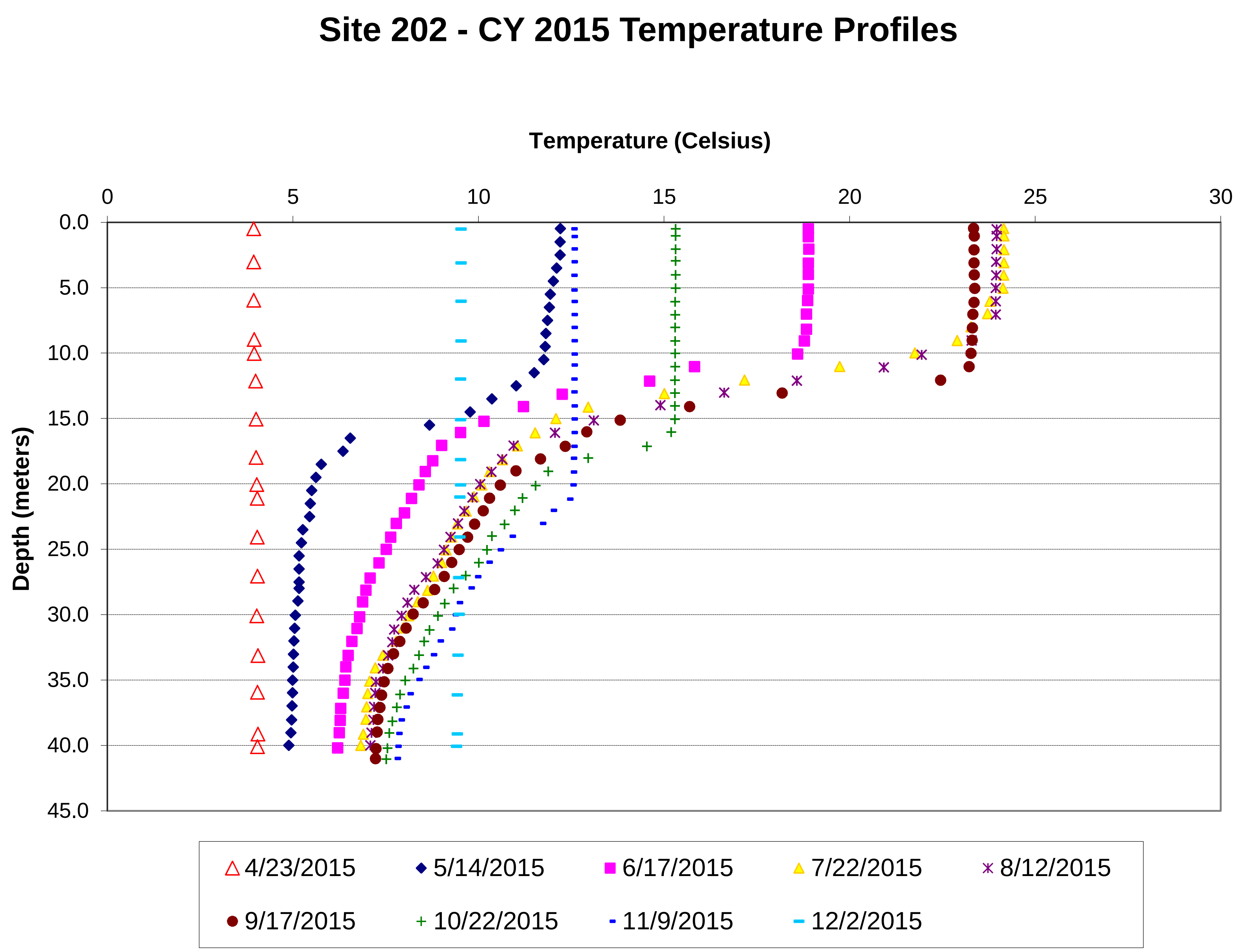
As shown in Table 2, pH is slightly acidic in 2015 compared to results in 2008, and temperatures can vary widely from Well to Kitchen Tap. Specific conductance and calcium have increased in recent testing compared to 2008 results.

APPENDIX B

Selected Plots and Graphs

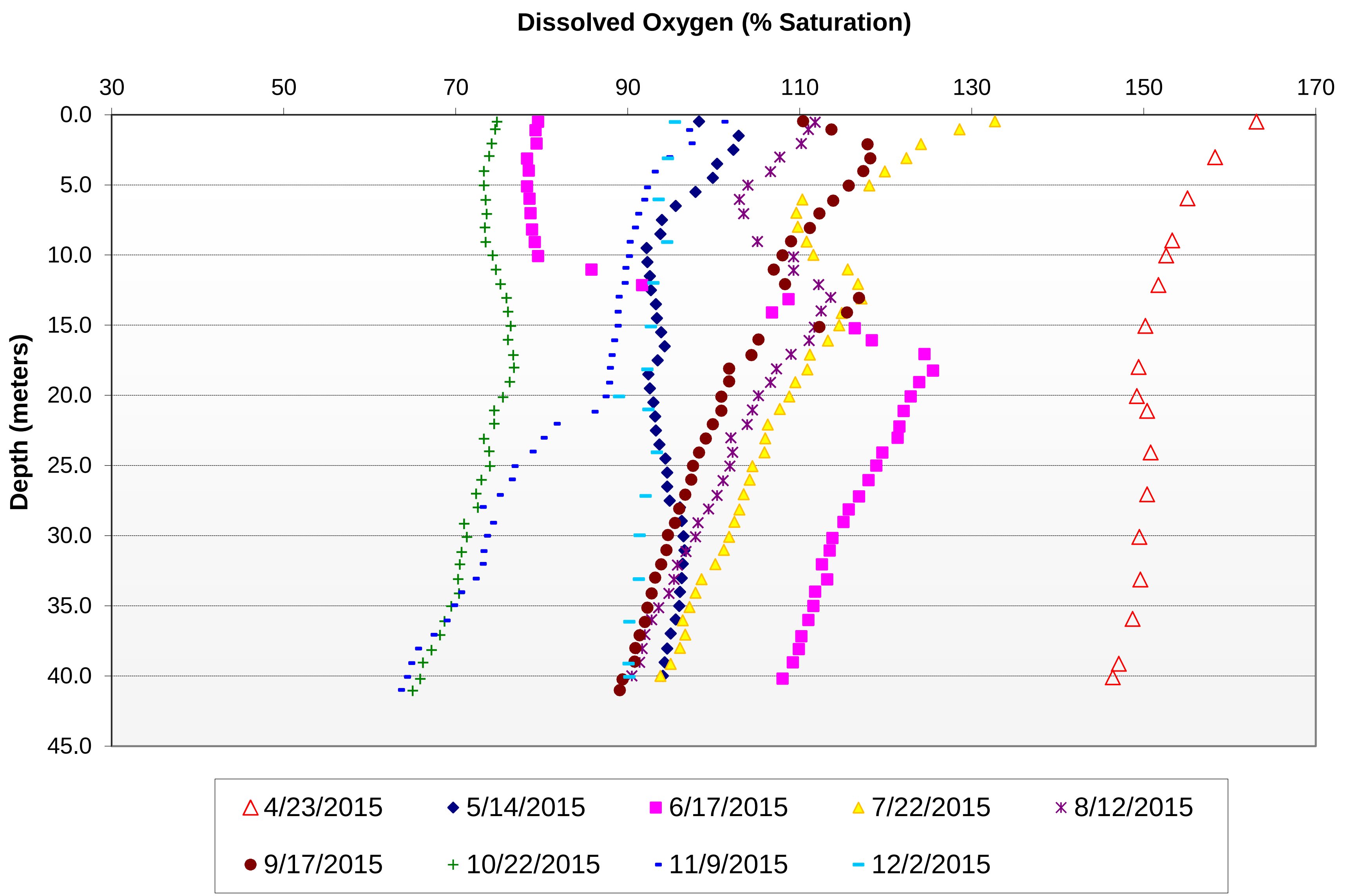
Quabbin Reservoir Profiles

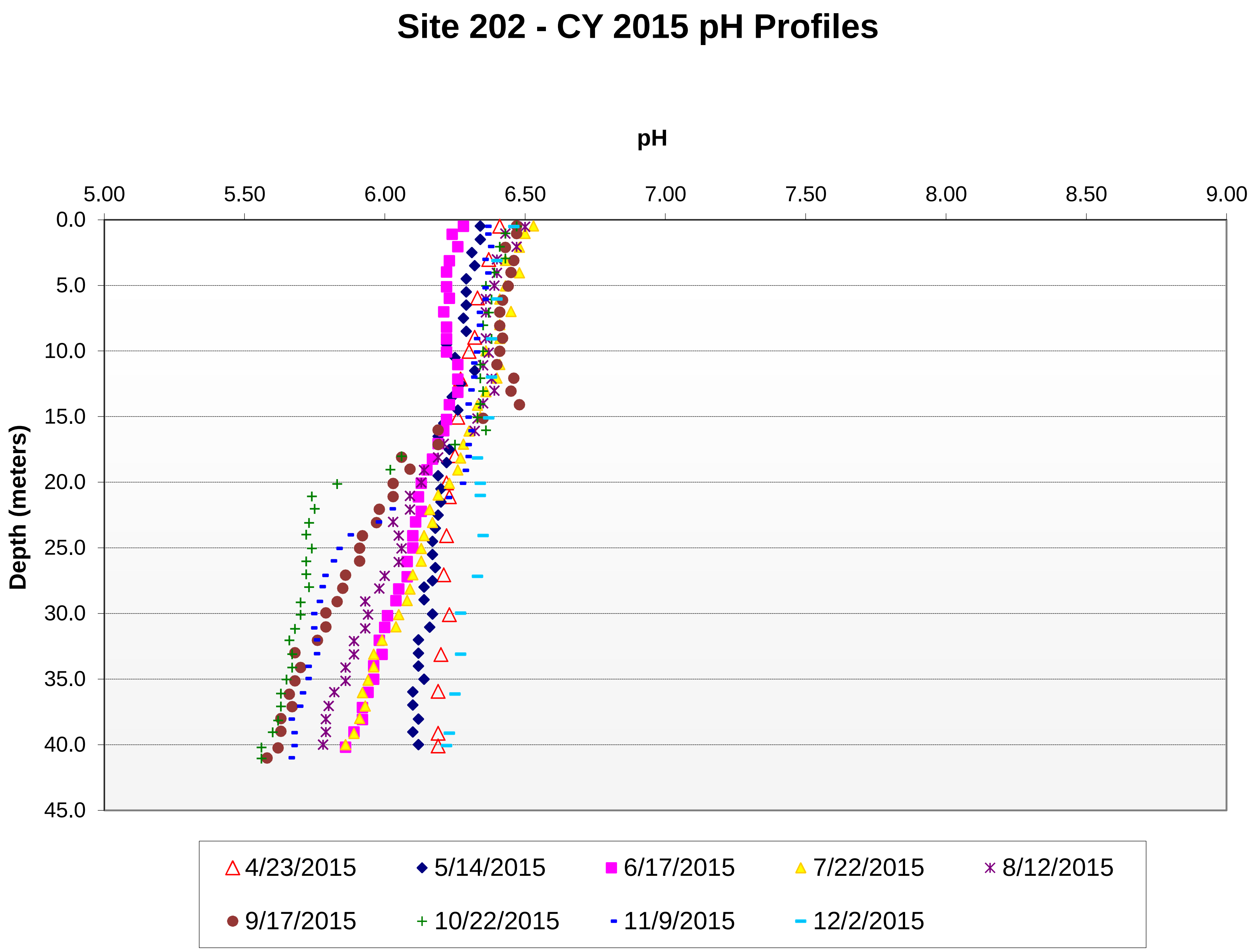
Stream Hydrographs


Site 202 - CY 2015 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Depth (meters)
4/23/2015
5/14/2015
6/17/2015
7/22/2015
8/12/2015
9/17/2015
10/22/2015
11/9/2015
12/2/2015

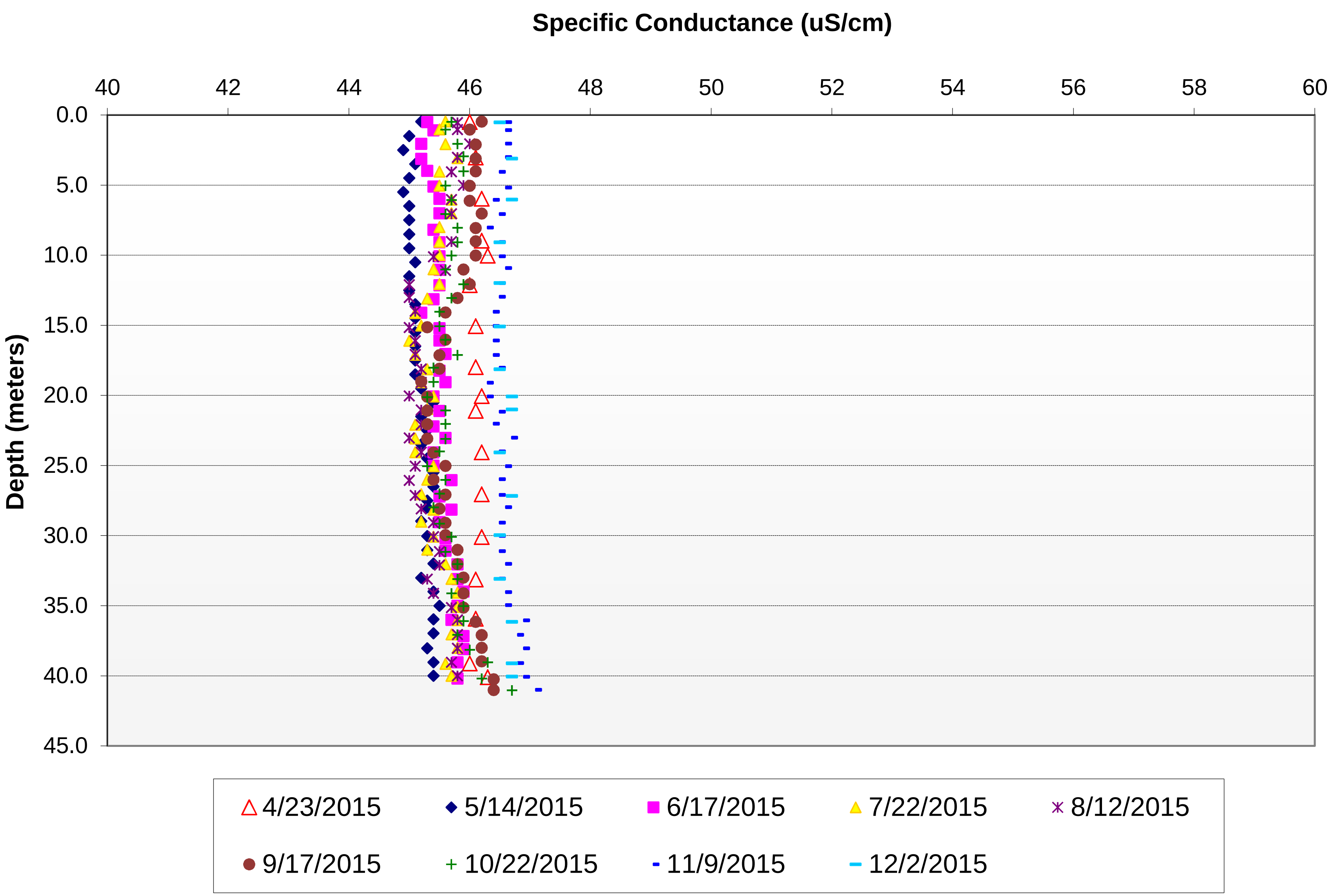
Site 202 - CY 2015 Dissolved Oxygen Profiles

Note: Sensor Response Factor occasionally out of range, age of probe (5 years) suspected as cause.

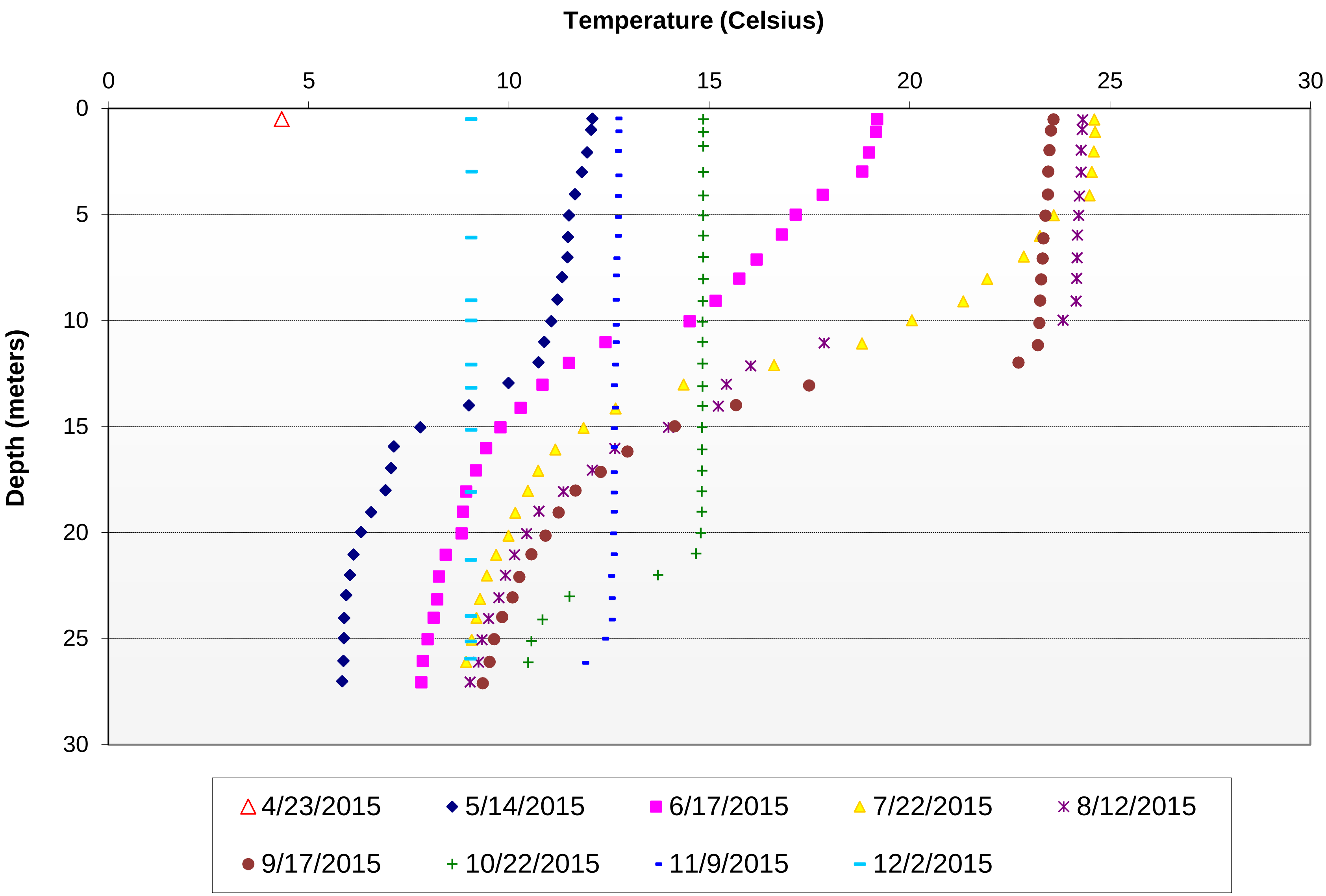



Site 202 - CY 2015 pH Profiles
pH
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
4/23/2015
5/14/2015
6/17/2015
7/22/2015
8/12/2015
9/17/2015
10/22/2015
11/9/2015
12/2/2015

Site 202 - CY 2015 Specific Conductance Profiles

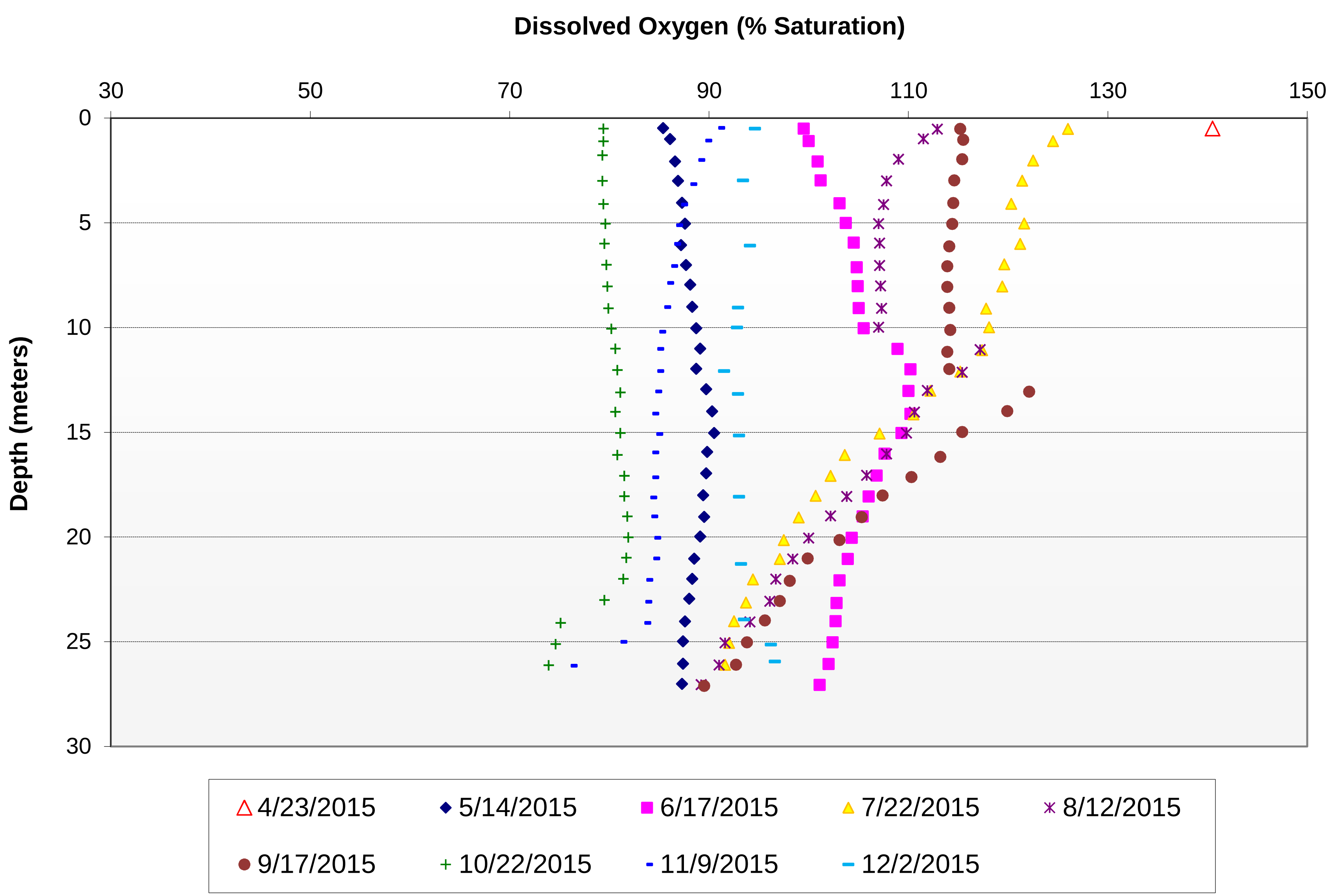


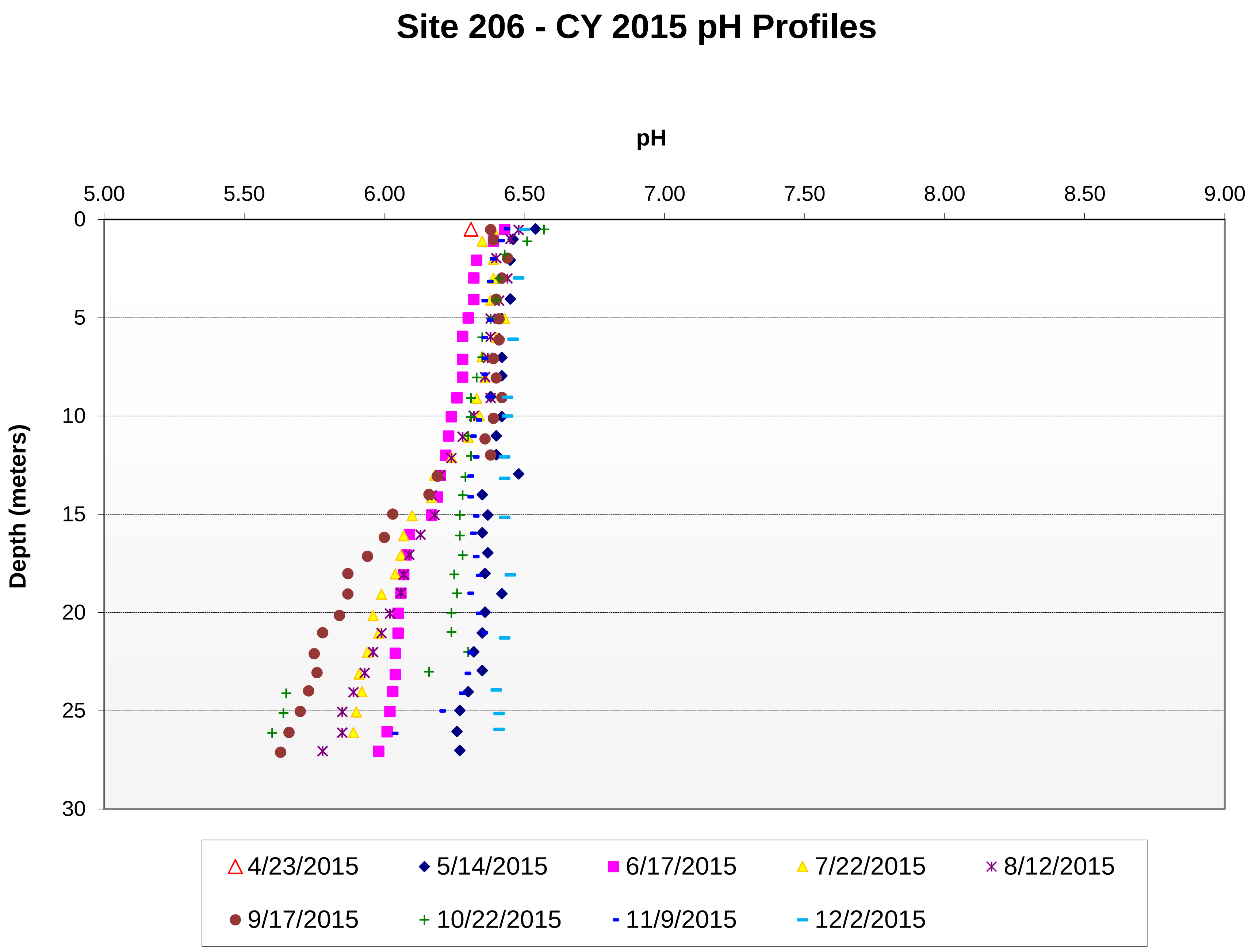
Site 206 - CY 2015 Temperature Profiles



Site 206 - CY 2015 Dissolved Oxygen Profiles

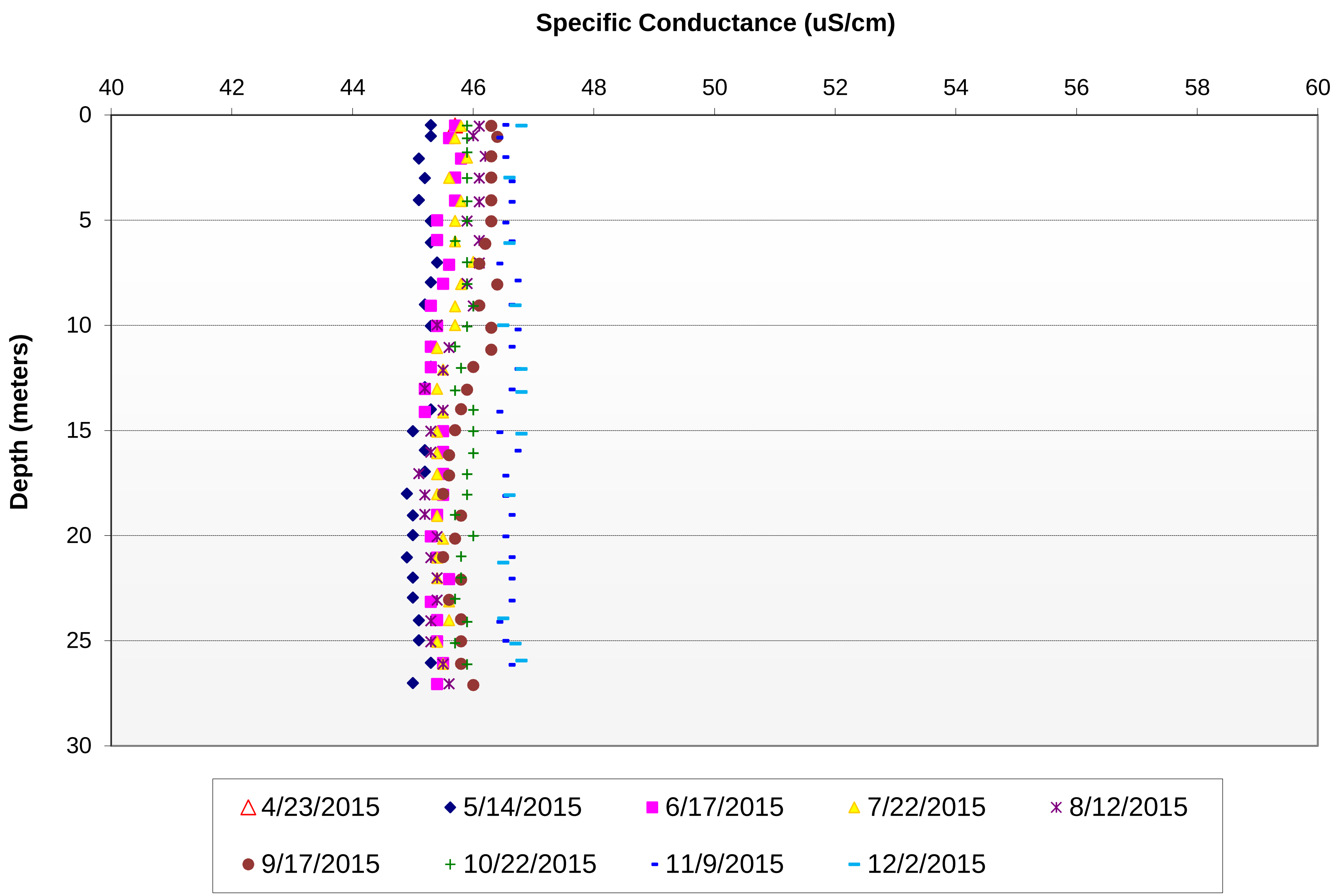
Note: Sensor Response Factor occasionally out of range, age of probe (5 years) suspected as cause.

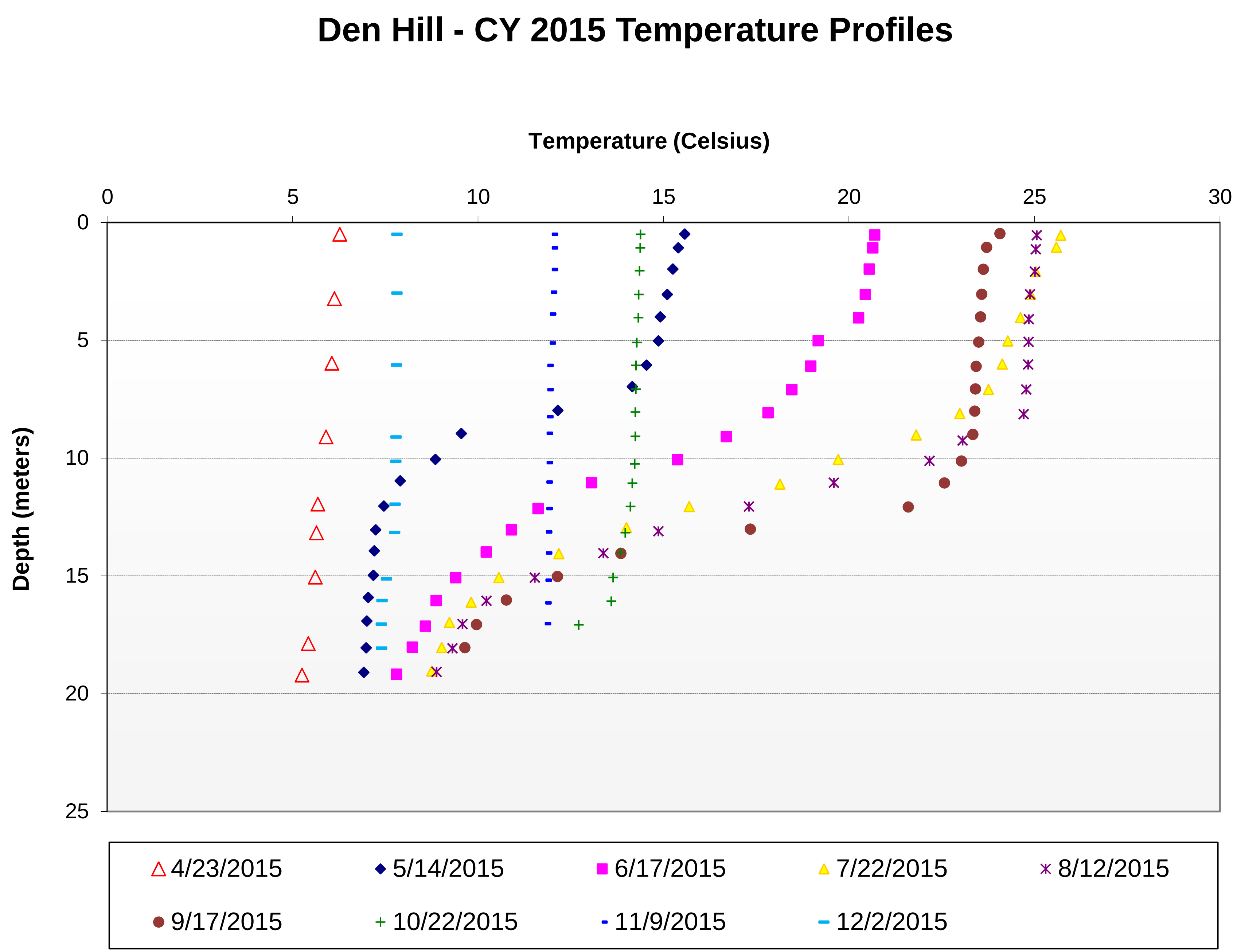




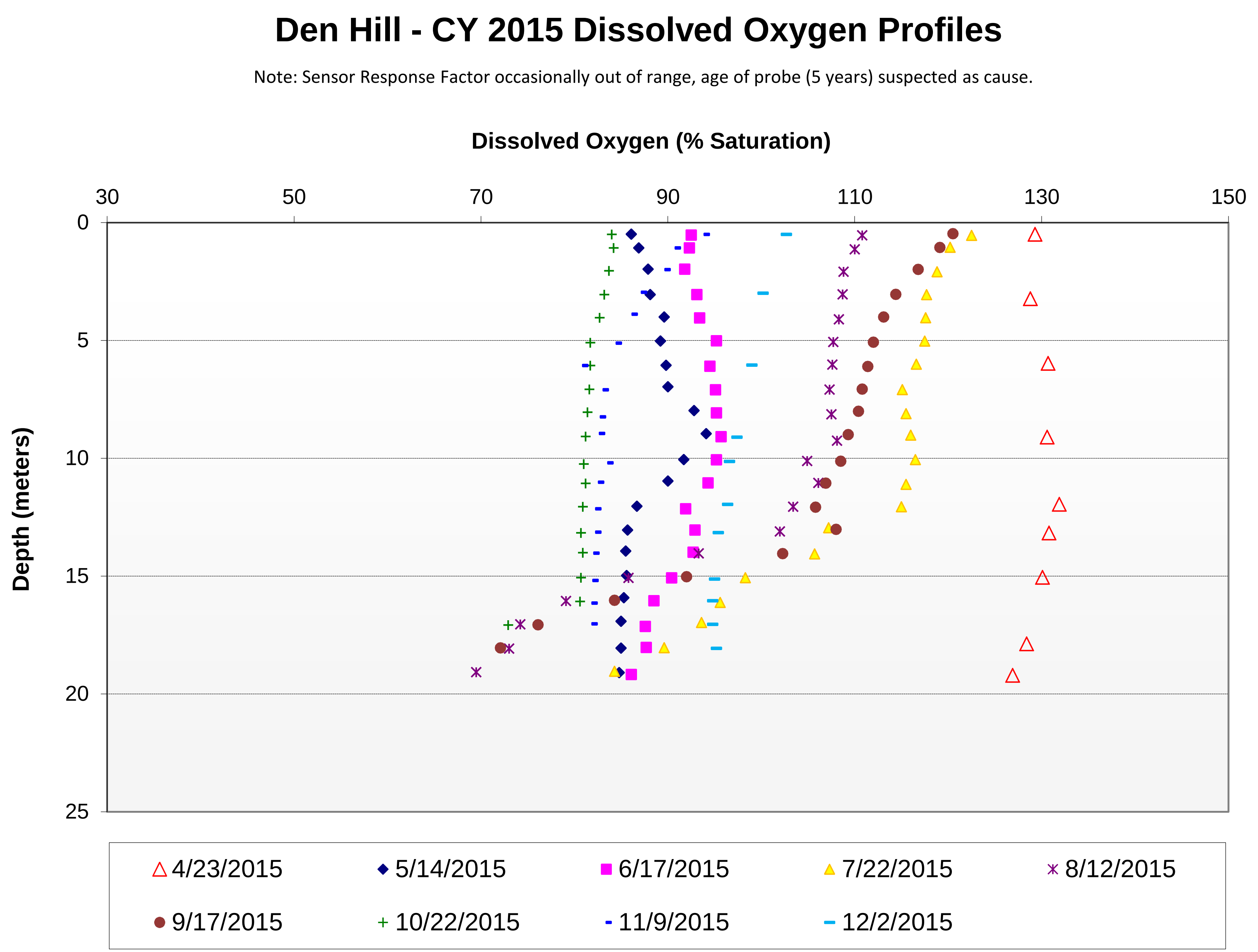
Site 206 - CY 2015 pH Profiles
pH
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
Depth (meters)
0
5
10
15
20
25
30
4/23/2015
5/14/2015
6/17/2015
7/22/2015
8/12/2015
9/17/2015
10/22/2015
11/9/2015
12/2/2015

Site 206 - CY 2015 Specific Conductance Profiles

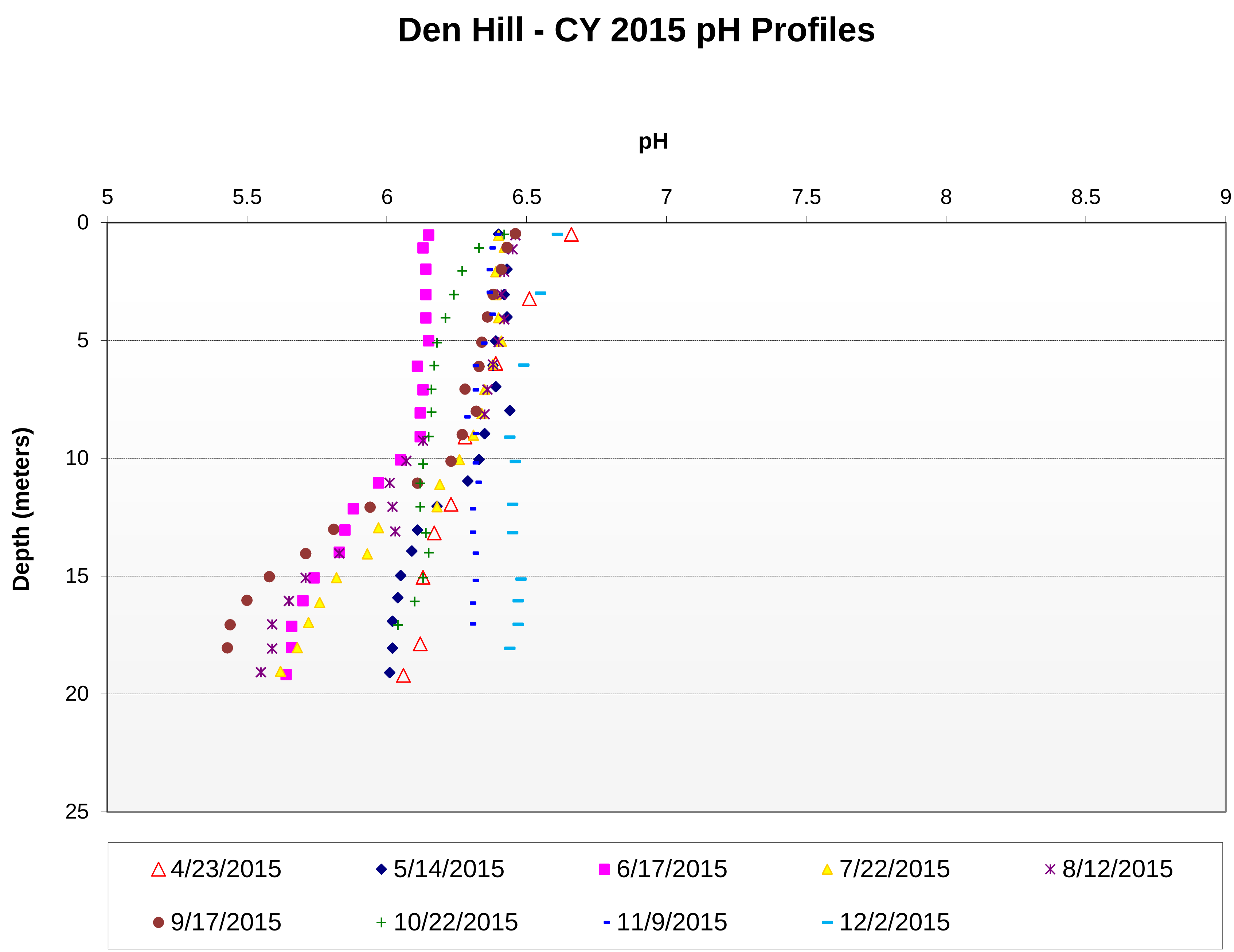




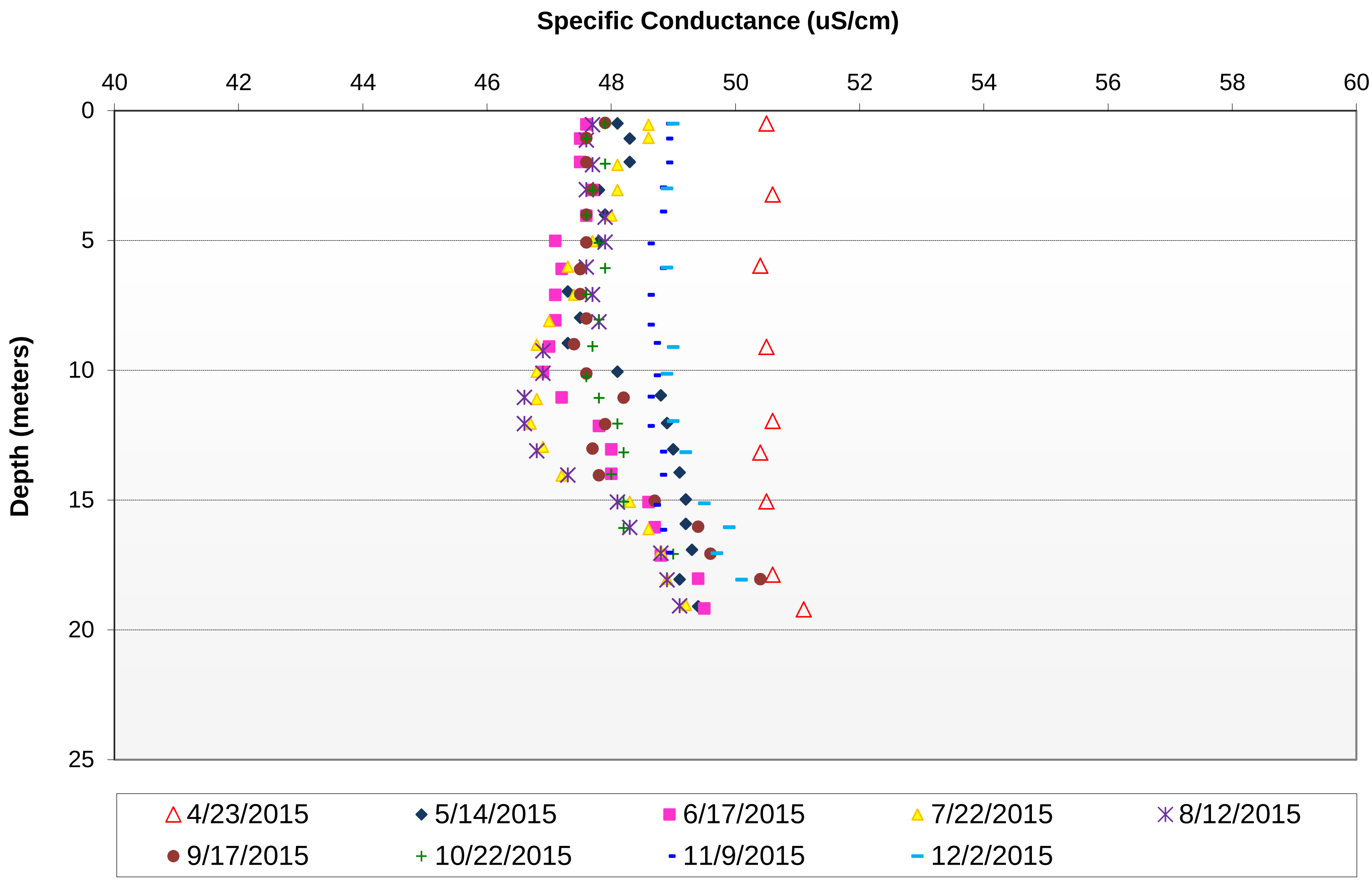
Den Hill - CY 2015 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
5
10
15
20
25
4/23/2015
5/14/2015
6/17/2015
7/22/2015
8/12/2015
9/17/2015
10/22/2015
11/9/2015
12/2/2015

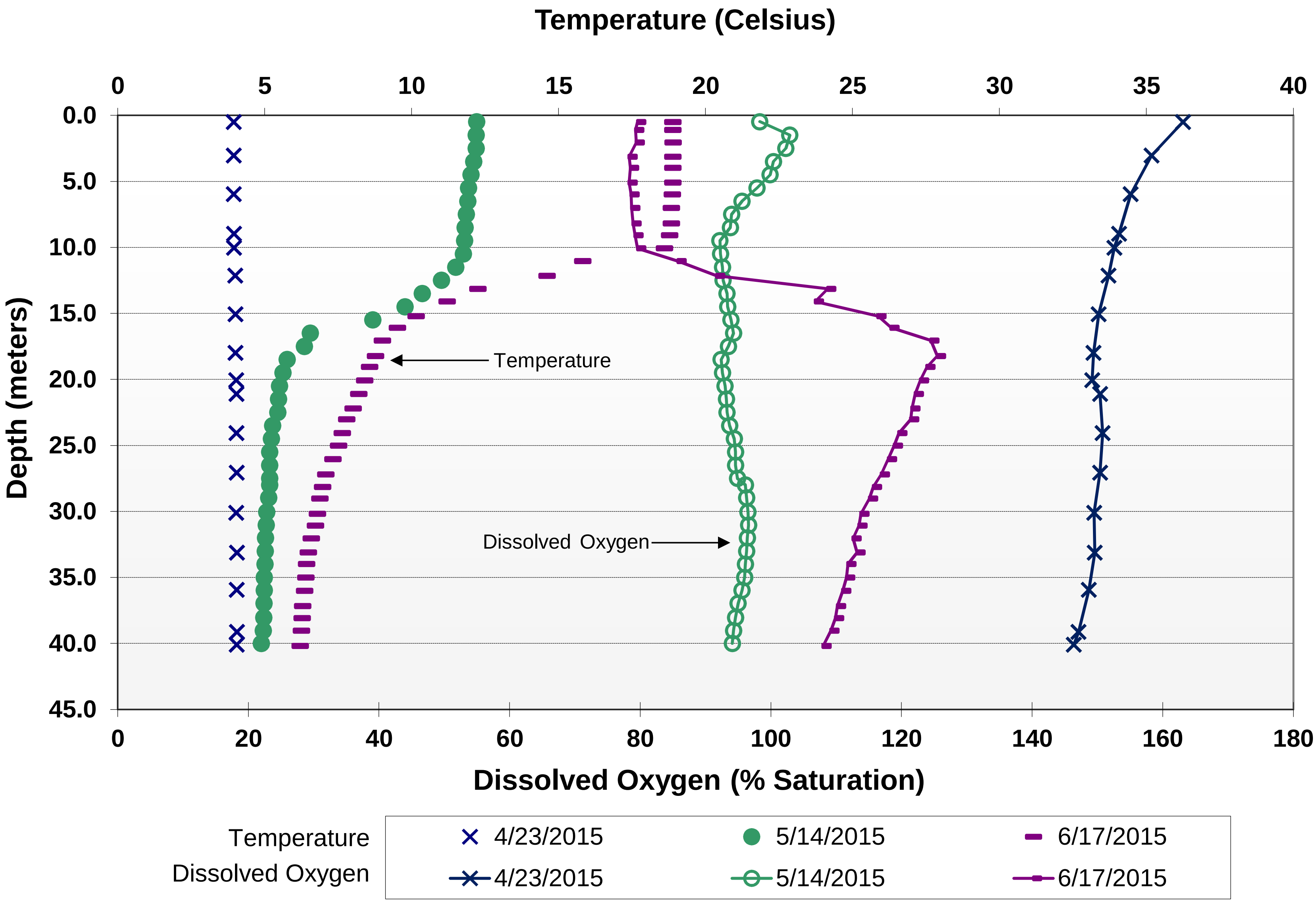


Den Hill - CY 2015 Dissolved Oxygen Profiles
Note: Sensor Response Factor occasionally out of range, age of probe (5 years) suspected as cause.
Dissolved Oxygen (% Saturation)
30
50
70
90
110
130
150
Depth (meters)
0
5
10
15
20
25
4/23/2015
5/14/2015
6/17/2015
7/22/2015
8/12/2015
9/17/2015
10/22/2015
11/9/2015
12/2/2015

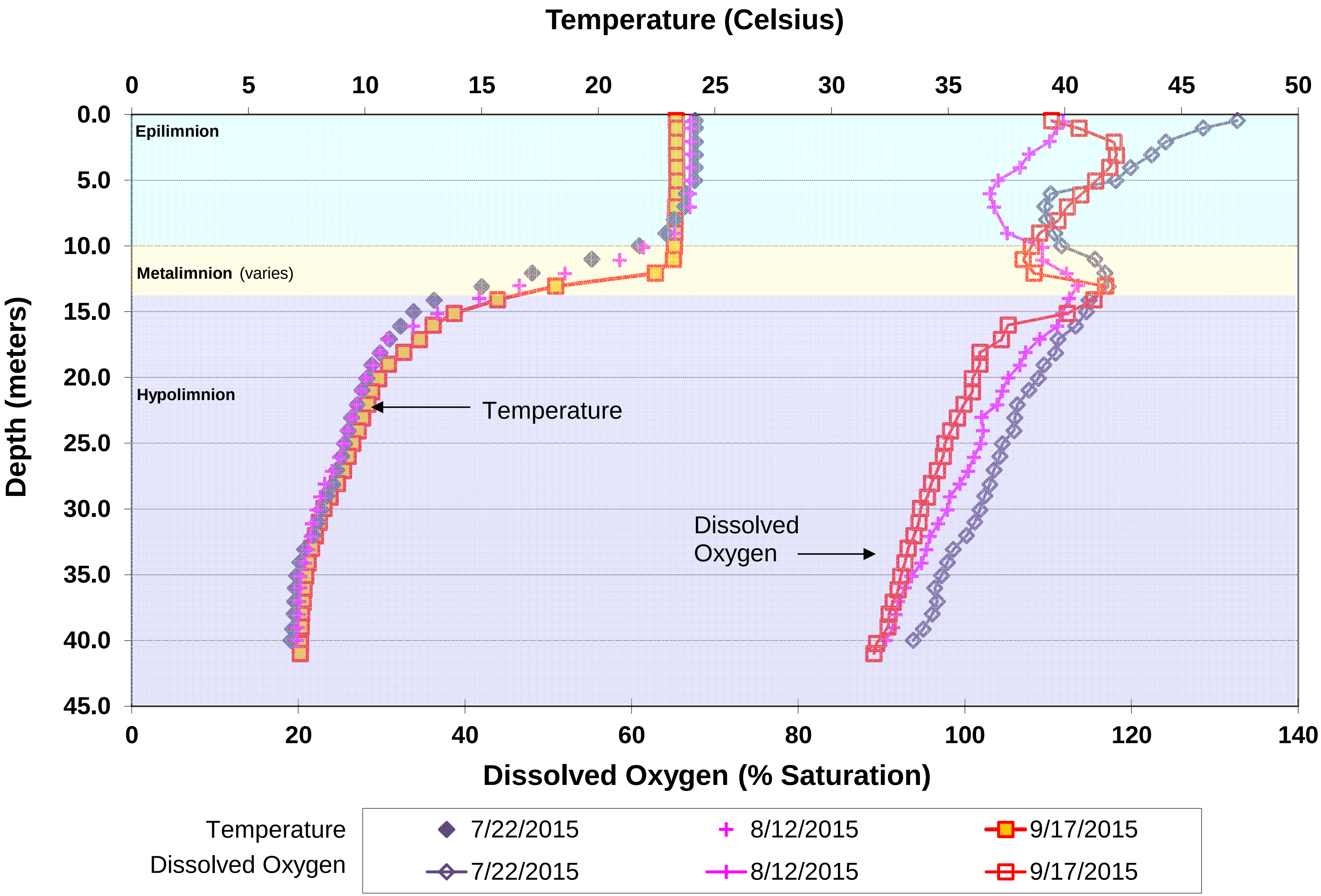

Den Hill - CY 2015 pH Profiles
pH
5
5.5
6
6.5
7
7.5
8
8.5
9
Depth (meters)
0
5
10
15
20
25
4/23/2015
5/14/2015
6/17/2015
7/22/2015
8/12/2015
9/17/2015
10/22/2015
11/9/2015
12/2/2015

Den Hill - CY 2015 Specific Conductance Profiles





Temperature (Celsius)
0
5
10
15
20
25
30
35
40
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Depth (meters)
Temperature
Dissolved Oxygen
0
20
40
60
80
100
120
140
160
180
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
4/23/2015
5/14/2015
6/17/2015
4/23/2015
5/14/2015
6/17/2015


Temperature (Celsius)
0
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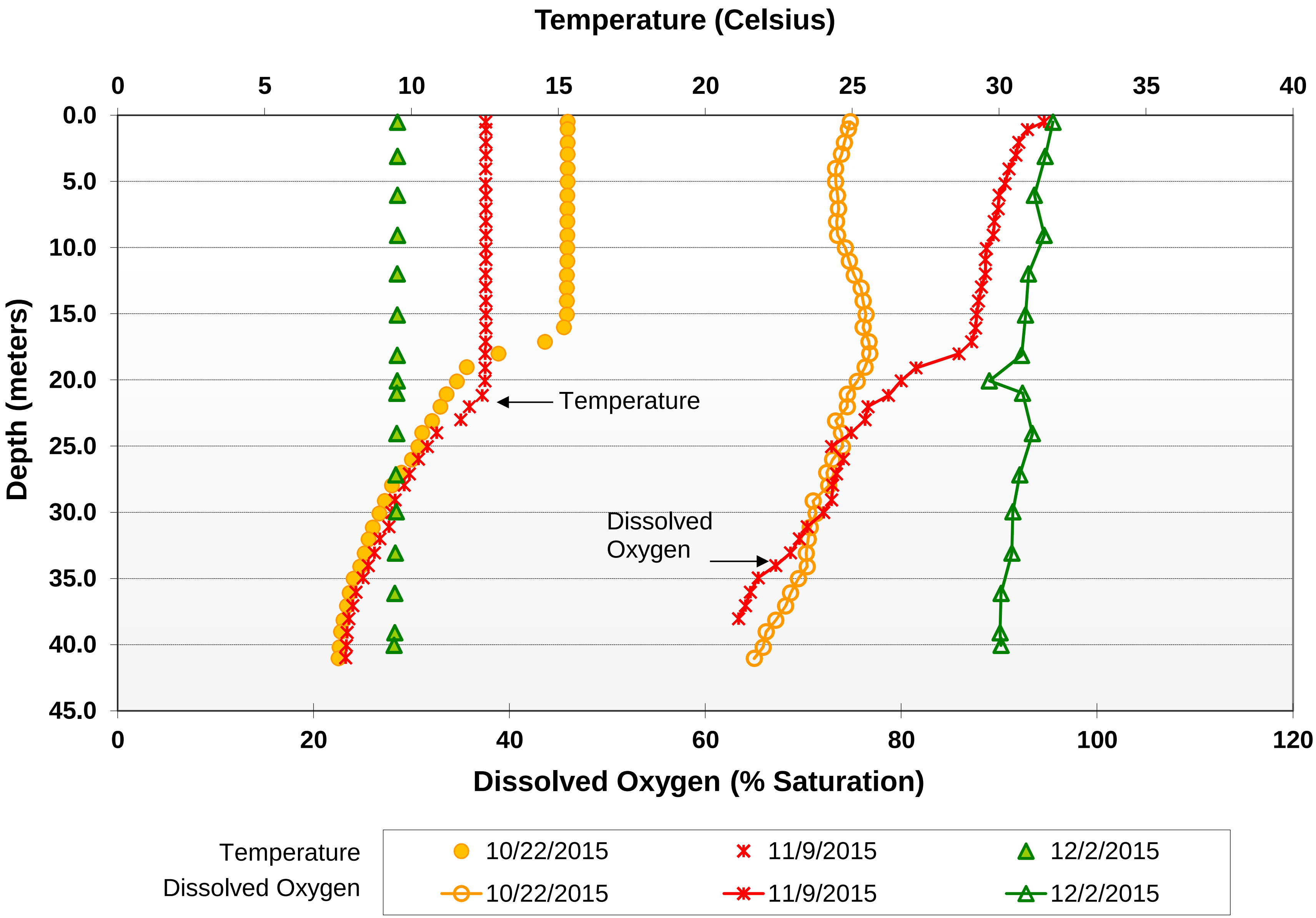
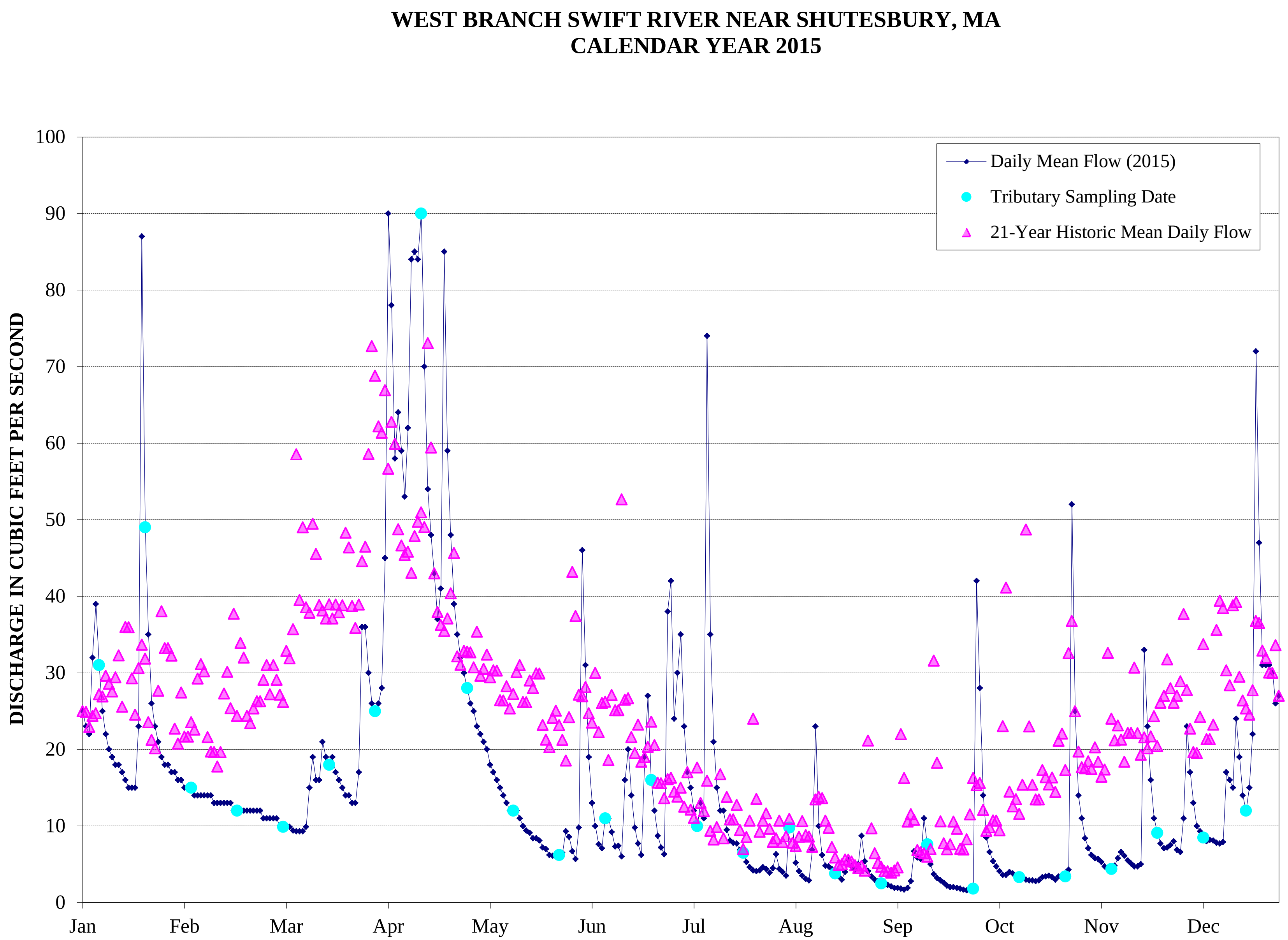
15
20
25
30
35
40
45
50
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Depth (meters)
Epilimnion
Metalimnion (varies)
Hypolimnion
Temperature
Dissolved Oxygen
0
20
40
60
80
100
120
140
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
7/22/2015
8/12/2015
9/17/2015
7/22/2015
8/12/2015
9/17/2015



Temperature (Celsius)
0
5
10
15
20
25
30
35
40
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Temperature
Dissolved
Oxygen
0
20
40
60
80
100
120
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
10/22/2015
11/9/2015
12/2/2015
10/22/2015
11/9/2015
12/2/2015



Source: U.S. Geological Survey website (provisional data accessed August 11, 2016)

USGS 01174565: WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA JANUARY 1, 2015 - DECEMBER 31, 2015 Daily Mean Discharge, cubic feet per second												
DATE	**Jan 2015**	**Feb 2015**	**Mar 2015**	**Apr 2015**	**May 2015**	**Jun 2015**	**Jul 2015**	**Aug 2015**	**Sep 2015**	**Oct 2015**	**Nov 2015**	**Dec 2015**
1	25 A:e	15 A:e	11 A:e	26 A	23 A	9.8 A	30 A	4.4 A	2.5 A	28 P	11 P	6.6 P
2	23 A:e	15 A:e	10 A:e	28 A	22 A	46 A	35 A	4.0 A	2.3 A	14 P	8.4 P	11 P
3	22 A:e	15 A:e	10 A:e	45 A	21 A	31 A	23 A	3.5 A	2.3 A	8.5 P	7.1 P	23 P
4	32 A:e	14 A:e	10 A:e	90 A	20 A	19 A	17 A	9.8 A	2.1 A	6.6 P	6.2 P	17 P
5	39 A:e	14 A:e	10 A	78 A	18 A	13 A	15 A	10 A	1.9 A	5.4 P	5.8 P	13 P
6	31 A:e	14 A:e	9.4 A:e	58 A	17 A	10 A	12 A	5.2 A	1.9 A	4.7 P	5.7 P	10 P
7	25 A:e	14 A:e	9.3 A:e	64 A	16 A	7.6 A	10 A	4.1 A	1.8 A	4.1 P	5.3 P	9.3 P
8	22 A:e	14 A:e	9.3 A:e	59 A	15 A	7.1 A	13 A	3.5 A	1.7 A	3.6 P	4.7 P	8.5 P
9	20 A:e	14 A:e	9.3 A	53 A	14 A	11 A	11 A	3.1 A	1.9 A	3.6 P	4.4 P	8.0 P
10	19 A:e	13 A:e	10 A	62 A	13 A	11 A	74 A	2.9 A	2.8 A	4.0 P	4.4 P	8.2 P
11	18 A:e	13 A:e	15 A	84 A	12 A	9.2 A	35 A	6.9 A	6.7 A	3.8 P	4.8 P	8.1 P
12	18 A:e	13 A:e	19 A	85 A	12 A	7.3 A	21 A	23 A	5.9 A	3.5 P	5.8 P	7.8 P
13	17 A:e	13 A:e	16 A	84 A	12 A	7.4 A	15 A	10 A	5.7 A	3.3 P	6.6 P	7.7 P
14	16 A:e	13 A:e	16 A	90 A	11 A	6.0 A	12 A	6.2 A	11 A	3.2 P	6.1 P	7.9 P
15	15 A:e	13 A:e	21 A	70 A	10 A	16 A	12 A	4.8 A	7.6 A	3.0 P	5.5 P	17 P
16	15 A:e	12 A:e	19 A	54 A	9.4 A	20 A	9.5 A	4.7 A	5.0 A	2.9 P	5.1 P	16 P
17	15 A:e	12 A:e	18 A	48 A	9.1 A	14 A	8.1 A	4.4 A	3.7 A	2.9 P	4.7 P	15 P
18	23 A:e	12 A:e	19 A	43 A	8.4 A	9.8 A	7.8 A	3.8 A	3.2 A	2.8 P	4.7 P	24 P
19	87 A	12 A:e	17 A:e	37 A	8.4 A	7.7 A	7.7 A	3.4 A	2.9 A	2.9 P	5.0 P	19 P
20	49 A	12 A	16 A	41 A	8.1 A	6.2 A	6.9 A	3.0 A	2.6 A	3.3 P	33 P	14 P
21	35 A:e	12 A	15 A	85 A	7.2 A	19 A	6.5 A	4.0 A	2.2 A	3.4 P	23 P	12 P
22	26 A:e	12 A:e	14 A:e	59 A	7.0 A	27 A	5.3 A	5.6 A	2.0 A	3.5 P	16 P	15 P
23	23 A:e	12 A:e	14 A:e	48 A	6.2 A	16 A	4.6 A	4.7 A	2.0 A	3.3 P	11 P	22 P
24	21 A:e	12 A:e	13 A	39 A	6.1 A	12 A	4.2 A	4.3 A	1.9 A	3.0 P	9.1 P	72 P
25	19 A:e	11 A:e	13 A	35 A	6.1 A	8.7 A	4.1 A	5.0 A	1.8 A	3.4 P	7.7 P	47 P
26	18 A:e	11 A:e	17 A	32 A	6.2 A	7.2 A	4.2 A	8.7 A	1.7 A	3.5 P	7.1 P	31 P
27	18 A:e	11 A:e	36 A	30 A	6.5 A	6.3 A	4.6 A	5.4 A	1.6 A	3.4 P	7.2 P	31 P
28	17 A:e	11 A:e	36 A	28 A	9.3 A	38 A	4.4 A	4.1 A	1.7 A	4.3 P	7.5 P	31 P
29	17 A:e		30 A	26 A	8.6 A	42 A	3.9 A	3.4 A	1.8 A	52 P	8.0 P	30 P
30	16 A:e		26 A	25 A	6.7 A	24 A	4.5 A	3.0 A	42 A	25 P	6.9 P	26 P
31	16 A:e		25 A		5.7 A		6.3 A	2.8 A		14 P		27 P
MAX	**87**	**15**	**36**	**90**	**23**	**46**	**74.0**	**23.0**	**42**	**52**	**33**	**72**
MIN	**15**	**11**	**9.3**	**25**	**5.7**	**6.0**	**3.9**	**2.8**	**1.6**	**2.8**	**4.4**	**6.6**
MEAN	**24.4**	**12.8**	**16.5**	**53.5**	**11.5**	**15.6**	**13.8**	**5.5**	**4.5**	**7.5**	**8.3**	**19.2**
DEPARTURE FROM NORM	-4	-13	-26	7	-16	-8	2	-3	-5	-11	-14	-11
1984-2014	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1984 - 2014**											
MEAN	28.1	26.2	42.1	46.6	27.9	23.2	12.0	8.4	9.9	18.6	22.5	29.8
MIN	2.6	7.2	13.5	15.3	10.5	3.7	2.0	1.5	1.0	1.8	1.7	4.1
MAX	68.6	86.3	103.2	83.0	78.1	53.0	32.0	29.3	52.9	115.3	54.5	75.3

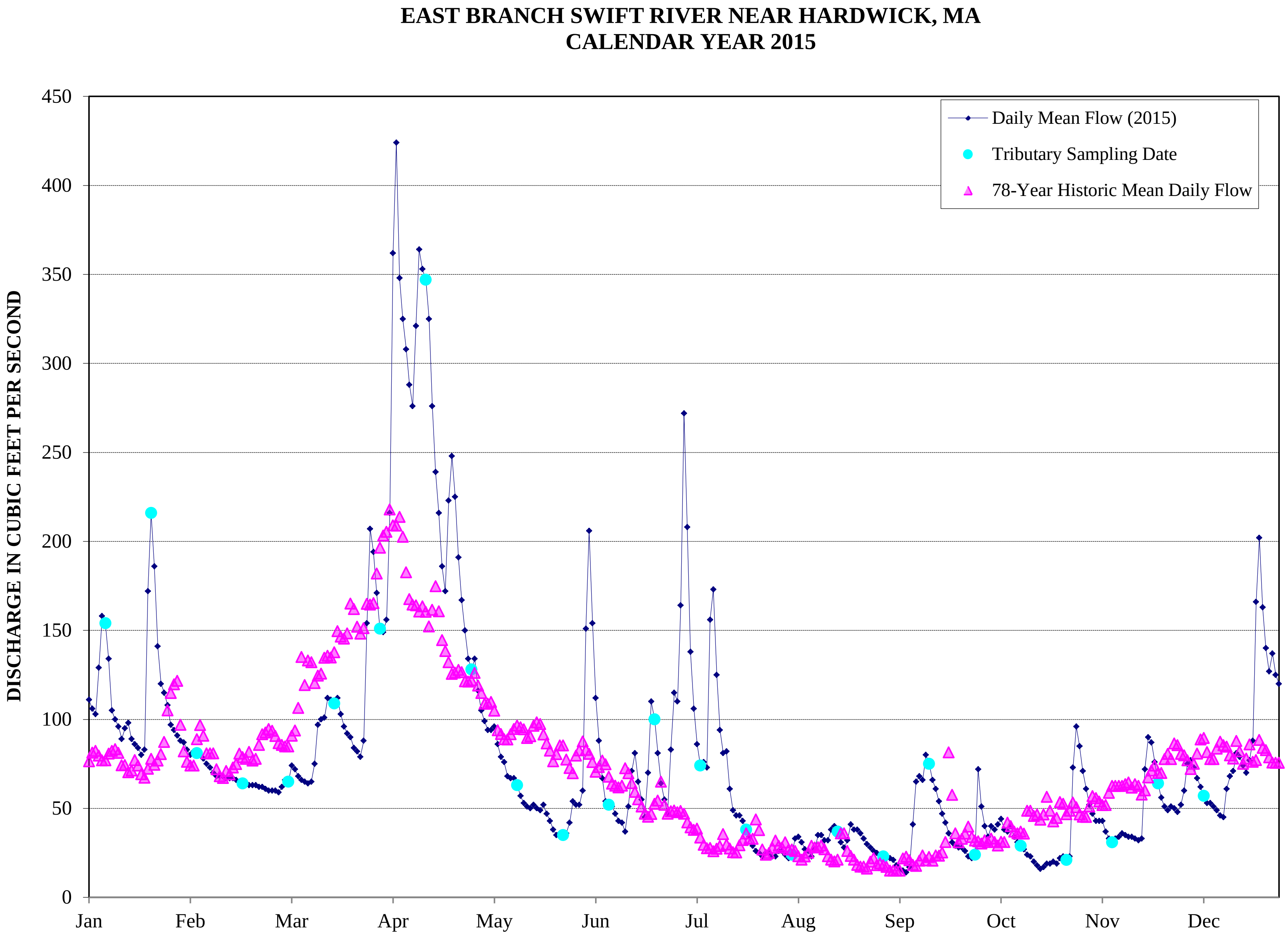
Notes:

Source: U.S. Geological Survey website (accessed August 11, 2016)

A = Approved data.

e = Estimated value.

P = Provisional data, subject to revision.



Source: U.S. Geological Survey website (provisional data accessed August 9, 2016)

USGS 01174500: EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
JANUARY 1, 2015 - DECEMBER 31, 2015
Daily Mean Discharge, cubic feet per second

DATE	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015
1	111 A	80 A:e	62 A	149 A	105 A	60 A	164 A	26 A	23 A	51 A	71 A	52 A
2	106 A	82 A:e	66 A	156 A	99 A	151 A	272 A	24 A	23 A	40 A	61 A	60 A
3	103 A	81 A:e	65 A	216 A	94 A	206 A	208 A	22 A	22 A	34 A	52 A	75 A
4	129 A	80 A:e	74 A	362 A	94 A	154 A	138 A	24 A	21 A	40 A	47 A	77 A
5	158 A	78 A:e	72 A	424 A	96 A	112 A	106 A	33 A	18 A	38 A	43 A	73 A
6	154 A	75 A:e	68 A	348 A	86 A	88 A	86 A	34 A	16 A	41 A	43 A	67 A
7	134 A	73 A:e	66 A	325 A	79 A	67 A	74 A	31 A	15 A	44 A	43 A	62 A
8	105 A	70 A:e	65 A	308 A	76 A	54 A	76 A	27 A	14 A	38 A	37 A	57 A
9	100 A	68 A:e	64 A	288 A	68 A	52 A	73 A	26 A	17 A	37 A	33 A	53 A
10	96 A	68 A:e	65 A	276 A	67 A	51 A	156 A	23 A	41 A	40 A	31 A	53 A
11	89 A	68 A:e	75 A	321 A	67 A	47 A	173 A	27 A	65 A	34 A	33 A	51 A
12	95 A	67 A:e	97 A	364 A	63 A	43 A	125 A	35 A	68 A	31 A	34 A	49 A
13	98 A	67 A:e	100 A	353 A	57 A	42 A	94 A	35 A	66 A	29 A	36 A	46 A
14	89 A	67 A:e	101 A	347 A	53 A	37 A	81 A	32 A	80 A	27 A	35 A	45 A
15	86 A	66 A:e	112 A	325 A	51 A	51 A	82 A	32 A	75 A	24 A	34 A	61 A
16	84 A	65 A:e	111 A	276 A	50 A	71 A	61 A	38 A	66 A	23 A	34 A	68 A
17	80 A	64 A:e	109 A	239 A	52 A	81 A	49 A	40 A	61 A	20 A	33 A	71 A
18	83 A	63 A:e	112 A	216 A	50 A	65 A	46 A	37 A	54 A	18 A	32 A	81 A
19	172 A	63 A:e	103 A	186 A	49 A	55 A	46 A	31 A	47 A	16 A	33 A	79 A
20	216 A	63 A:e	96 A	172 A	52 A	45 A	43 A	28 A	42 A	17 A	72 A	74 A
21	186 A	63 A:e	92 A	223 A	47 A	70 A	38 A	32 A	36 A	19 A	90 A	70 A
22	141 A	62 A:e	90 A	248 A	43 A	110 A	34 A	41 A	31 A	19 A	87 A	77 A
23	120 A	62 A:e	84 A	225 A	38 A	100 A	29 A	38 A	29 A	20 A	76 A	88 A
24	115 A	61 A:e	82 A	191 A	35 A	81 A	26 A	38 A	28 A	19 A	64 A	166 A
25	108 A	60 A:e	79 A	167 A	36 A	64 A	25 A	36 A	28 A	22 A	56 A	202 A
26	97 A	60 A:e	88 A	150 A	35 A	55 A	23 A	33 A	26 A	23 A	51 A	163 A
27	94 A:e	60 A:e	154 A	134 A	36 A	47 A	25 A	30 A	23 A	21 A	49 A	140 A
28	91 A:e	59 A:e	207 A	128 A	42 A	83 A	25 A	28 A	22 A	23 A	51 A	127 A
29	88 A:e		194 A	134 A	54 A	115 A	23 A	26 A	24 A	73 A	50 A	137 A
30	87 A:e		171 A	116 A	52 A	110 A	23 A	25 A	72 A	96 A	48 A	125 A
31	83 A:e		151 A		52 A		26 A	24 A		85 A		120 A
MAX	**216**	**82**	**207**	**424**	**105**	**206**	**272**	**41**	**80**	**96**	**90**	**202**
MIN	**80**	**59**	**62**	**116**	**35**	**37**	**23**	**22**	**14**	**16**	**31**	**45**
MEAN	**113**	**67.7**	**99.2**	**246**	**60.6**	**78.9**	**79.0**	**30.8**	**38.4**	**34.3**	**48.6**	**86.1**
DEPARTURE FROM NORM	30	-13	-37	85	-31	17	47	7	11	-8	-15	5
1937-2014	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1937 - 2014**											
MEAN	82.7	81.1	136	160	91.2	62.3	32.5	24.2	27.3	42.0	63.8	80.7
MIN	5.3	18.5	46.4	34.8	30.5	6.9	3.2	0	0	0.7	4.2	15.6
MAX	239.5	258.3	291.8	424.0	188.5	206.0	272.0	127.3	389.8	244.1	177.0	263.7

Notes:

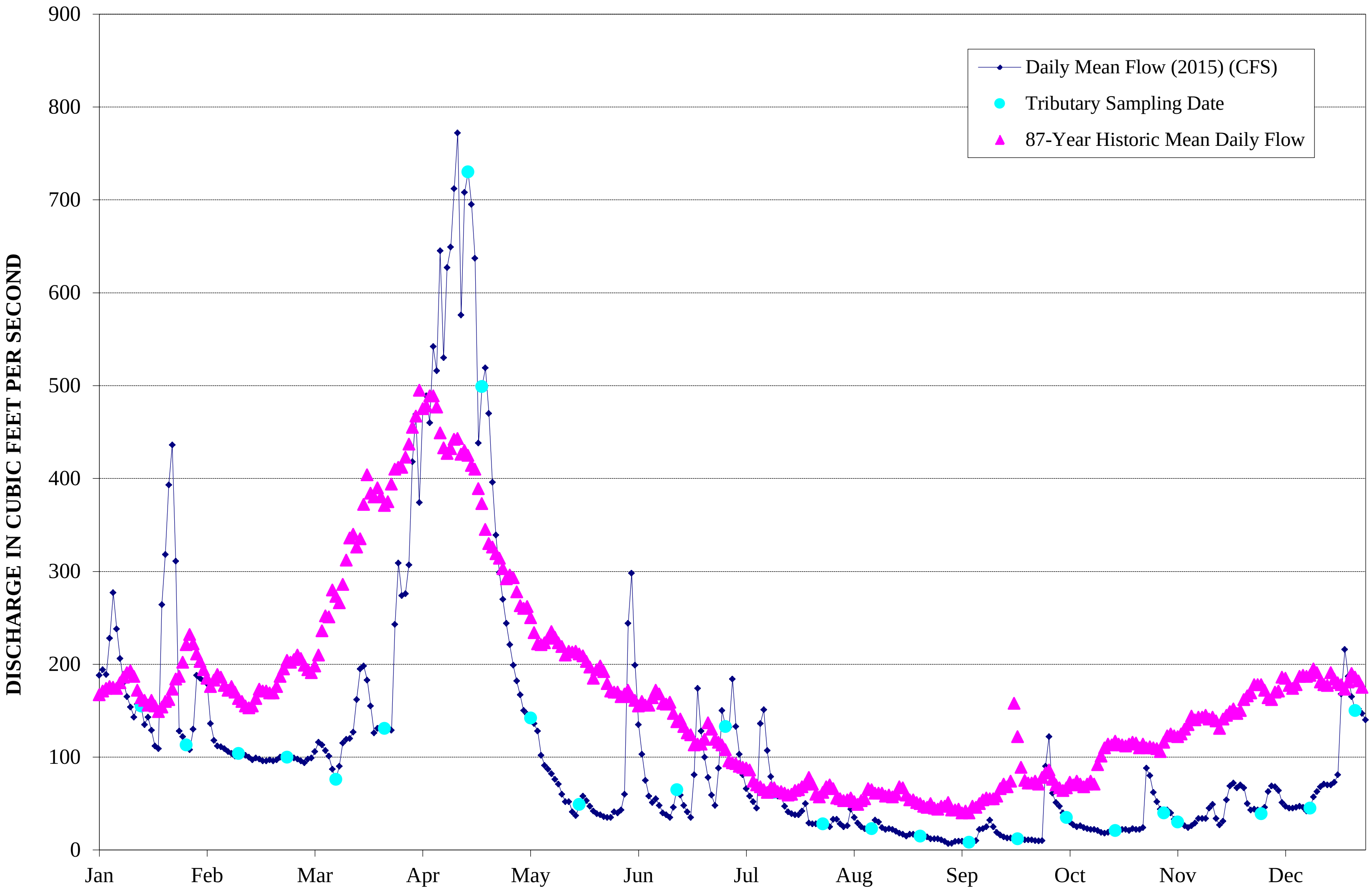
Source: U.S. Geological Survey website (accessed August 9, 2016)

A = Approved for publication -- Processing and review completed.

e = Value has been estimated.

P = Provisional data subject to revision.

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
CALENDAR YEAR 2015



Source: U.S. Geological Survey website (provisional data for new location, accessed August 12, 2016).

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
JANUARY 1, 2015 - DECEMBER 31, 2015
Daily Mean Discharge, cubic feet per second

DATE	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015
1	188 A	179 A:e	94 A	418 A	182 A	60 A	132 A	33 A	9.1 A	122 A	52 P	39 P
2	194 A	136 A:e	98 A	469 A	167 A	244 A	184 A	28 A	7 A	61 A	44 P	46 P
3	189 A	118 A:e	99 A	374 A	150 A	298 A	133 A	25 A	7.3 A:e	51 A	40 P	63 P
4	228 A	112 A	106 A	473 A	146 A	199 A	103 A	26 A	9.1 A	47 A	43 P	69 P
5	277 A	111 A	116 A	489 A	142 A	135 A	81 A	44 A	9.6 A	40 A	40 P	68 P
6	238 A	109 A:e	113 A	460 A	136 A	103 A	66 A	35 A	9.5 A	35 P	33 P	64 P
7	206 A	106 A	107 A	542 A	128 A	75 A	58 A	29 A	9 A	30 P	30 P	51 P
8	180 A:e	104 A	101 A	516 A	102 A	58 A	52 A	25 A	8.4 A	27 P	29 P	47 P
9	165 A:e	101 A	87 A	645 A	91 A	51 A	45 A	23 A	7.9 A	25 P	26 P	45 P
10	154 A:e	104 A	76 A	530 A	87 A	55 A	136 A	21 A	10 A	26 P	24 P	45 P
11	143 A:e	104 A	90 A	627 A	82 A	48 A	151 A	23 A	22 A:e	24 P	26 P	46 P
12	157 A	102 A	115 A	649 A	76 A	40 A	107 A	32 A	23 A:e	23 P	29 P	47 P
13	155 A	100 A	119 A	712 A	71 A	38 A	79 A	30 A	25 A:e	22 P	34 P	46 P
14	135 A	97 A:e	120 A	772 A	60 A	35 A	62 A	24 A	32 A:e	22 P	34 P	42 P
15	143 A	99 A:e	127 A	576 A	52 A	46 A	58 A	22 A	25 A:e	21 P	34 P	45 P
16	129 A	98 A:e	162 A	708 A	52 A	65 A	58 A	23 A	19 A:e	19 P	45 P	57 P
17	112 A	96 A	195 A	730 A	41 A	59 A	47 A	22 A	16 A:e	18 P	49 P	63 P
18	109 A	96 A:e	198 A	695 A	37 A	48 A	41 A	20 A	14 A	19 P	34 P	68 P
19	264 A	97 A	183 A	637 A	49 A	41 A	39 A	18 A	13 A	22 P	27 P	71 P
20	318 A	96 A:e	155 A	438 A	58 A	35 A	38 A	17 A	13 A	21 P	31 P	70 P
21	393 A	97 A:e	126 A	499 A	53 A	81 A	38 A	15.0 A	12.0 A:e	21 P	54 P	70 P
22	436 A	100 A	131 A	519 A	47 A	174 A	42 A	17 A	12.0 A:e	22 P	69 P	73 P
23	311 A	102 A	133 A	470 A	42 A	128 A	50 A	17 A	11 A	22 P	72 P	81 P
24	128 A	100 A:e	131 A	396 A	39 A	100 A	29 A	17 A	11 A	21 P	67 P	168 P
25	122 A	100 A	132 A:e	339 A	38 A	78 A	28 A	15 A	11 A	23 P	70 P	216 P
26	113 A	99 A	129 A:e	299 A	36 A	59 A	28 A	15 A	11 A	22 P	67 P	187 P
27	108 A	98 A	243 A	270 A	35 A	48 A	29 A	14 A	10 A	22 P	50 P	165 P
28	130 A:e	96 A:e	309 A	244 A	35 A	88 A	28 A	12 A	9.8 A	24 P	43 P	150 P:e
29	188 A:e		274 A	221 A	41 A	150 A	26 A	12 A	9.9 A	88 P	44 P	152 P:e
30	185 A:e		276 A	199 A	40 A	133 A	25 A	12.0 A	90 A	80 P	43 P	147 P
31	182 A:e		307 A		43 A		33 A	11 A		62 P		140 P
MAX	**436**	**179**	**309**	**772**	**182**	**298**	**184**	**44**	**36**	**49**	**41**	**114**
MIN	**108**	**96**	**76.0**	**199**	**35**	**35**	**25.0**	**11.0**	**1.8**	**9.2**	**12**	**22**
MEAN	**193**	**106**	**150**	**497**	**76**	**92**	**65**	**22**	**16**	**35**	**43**	**85**
DEPARTURE FROM NORM	12	-74	-175	94	-140	-50	-6	-34	-49.4	-58.2	-98	-95
1928-2014	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1928 - 2014**											
MEAN	180	179	326	403	216	143	71.6	55.5	65.3	93.1	141	180
MIN	17.2	37.5	118	117	73.8	18.2	9.0	4.9	6.1	7.9	13.9	29.1
MAX	499	546	1066	963	438	503	337	319	893	467	497	570

Notes:

Source: U.S. Geological Survey website (accessed August 12, 2016)

A = Approved for publication -- Processing and review completed.

e = Value has been estimated.

P = Provisional data subject to revision.

APPENDIX C

Water Quality Data Tables

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Units of measure, unless noted otherwise on each table:
Temperature (Celsius)
Dissolved Oxygen: DOPPM (milligrams per liter, mg/L) or DOSAT (% saturation)
Specific Conductance (microsiemens per centimeter, uS/cm)
Turbidity (nephelometric turbidity units, NTU)
Alkalinity (mg/L as CaCO3)
Fecal Coliform Bacteria (colony forming units per 100 milliliters, CFU/100mL)
E. coli (most probable number per 100 mL, MPN/100mL)
Total Coliform Bacteria (most probable number per 100 mL, MPN/100mL)
Nutrients (mg/L), except Calcium (ug/L)
UV254 (absorbance per centimeter, 1/cm)
Depth (meters) and Elevation (feet, Boston City Base)

QUABBIN LABORATORY RECORDS 2015
(211) WEST BR. SWIFT RIVER, ROUTE 202

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.02	17.69	123	5.78	39.0	0.260			8	10	583						1550	
1/20/2015	0.11	21.46	151	5.49	37.2	0.362			6	10	1310						1440	
2/3/2015	0.01	13.85	97	6.20	46.4	0.188			*0*	*0*	305						1990	
2/17/2015	0.09	23.14	161	6.17	48.7	0.180			*0*	*0*	213						2060	
3/3/2015	0.08	21.57	150	6.41	49.9	0.180			*0*	*0*	173						1950	
3/17/2015	0.72	18.64	132	6.12	47.9	0.203			2	20	265		0.0131	0.0712	*0*	0.083630	1990	*0*
3/31/2015	0.76	18.95	136	6.25	48.1	0.177			*0*	10	384						1840	
4/14/2015	4.85	14.29	112	5.20	32.2	0.290			*0*	*0*	420						1400	
4/28/2015	6.74	9.13	77	6.65	46.4	0.213			12	*0*	620						1910	
5/12/2015	16.15	6.45	66	5.96	58.2	0.332			4	10	2050						2400	
5/26/2015	14.19	7.87	78	5.98	70.4	0.464			32	41	2360						2620	
6/9/2015	15.13	7.27	74	5.78	58.5	0.354			30	20	2600						2580	
6/23/2015	17.29	7.07	75	5.60	44.6	0.353			30	110	3450		0.0152	0.0200	0.160	0.21690	1720	*0*
7/7/2015	17.43	12.24	128	5.68	60.0	0.353			*0*	20	2250						2080	
7/21/2015	19.05	5.86	65	6.16	64.1	0.580			50	62	3870						2720	
8/4/2015	19.30	5.91	66	6.02	78.3	0.811			*0*	41	14100						2820	
8/18/2015	19.37	6.64	73	5.91	67.8	0.570			60	31	5790						2500	
9/1/2015	17.52	5.76	61	5.94	82.9	0.736			40	75	2030						2790	
9/15/2015	13.88	6.69	66	5.78	52.8	0.552			60	134	6490						1960	
9/29/2015	13.78	6.50	63	6.04	96.8	0.727			10	10	2480		0.0180	0.0867	0.166	0.088560	3630	*0*
10/13/2015	10.39	10.37	94	6.22	81.0	0.546			10	10	1520						2570	
10/27/2015	5.09	12.13	96	6.12	75.4	0.497			10	*0*	1380						2800	
11/10/2015	4.66	13.15	102	6.25	73.7	0.476			*0*	*0*	960						2610	
11/24/2015	0.92	15.35	110	6.07	58.0	0.331			*0*	10	771						2140	
12/8/2015	2.21	14.58	107	6.12	57.0	0.294			2	*0*	657		0.0143	0.0197	*0*	0.12271	2200	*0*
12/21/2015	1.26	18.16	132	6.12	54.5	0.295			*0*	*0*	504						2160	
AVG.	8.50	12.34	100	6.00	58.8	0.397			14	24	2210		0.0152	0.0494	0.082	0.12795	2250	*<0.005*
MAX.	19.37	23.14	161	6.65	96.8	0.811			60	134	14100		0.0180	0.0867	0.166	0.21690	3630	*<0.005*
MIN.	0.01	5.76	61	5.20	32.2	0.177			*<10*	*<10*	173		0.0131	0.0197	*<0.100*	0.083630	1400	*<0.005*
MEDIAN	5.92	12.19	96	6.06	57.5	0.353			5	10	1345		0.0148	0.0456	0.080	0.10564	2150	*<0.005*

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
(212) HOP BROOK, GATE 22 ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.01	17.78	124	6.25	99.8	0.415			10	31	563						3190	
1/20/2015	0.02	21.51	151	5.97	111.5	0.638			12	10	583						3040	
2/3/2015	0.02	13.62	96	6.45	96.8	0.393			*0*	10	175						3670	
2/17/2015	0.07	22.48	157	6.42	93.7	0.421			*0*	*0*	110						3900	
3/3/2015	0.06	21.19	148	6.74	96.3	0.473			2	*0*	84						3970	
3/17/2015	0.82	18.41	131	6.56	188.9	0.398			32	10	175		0.0137	0.122	0.115	0.068355	5050	0.0137
3/31/2015	0.80	19.00	136	6.53	166.3	0.389			36	30	109						4370	
4/14/2015	6.79	12.77	105	5.95	92.2	0.388			4	10	213						2960	
4/28/2015	6.88	8.87	75	6.82	119.7	0.402			36	41	487						3740	
5/12/2015	16.77	6.26	65	6.31	119.0	0.584			116	52	1780						4550	
5/26/2015	15.51	7.42	76	6.40	128.9	0.841			16	20	1400						4760	
6/9/2015	14.95	7.52	76	6.35	113.1	0.843			20	110	4610						4410	
6/23/2015	17.27	7.04	75	6.41	116.8	0.710			40	110	2700		0.0187	0.0522	0.196	0.18550	4360	0.00774
7/7/2015	17.87	11.82	125	6.32	120.0	0.904			610	414	4350						4250	
7/9/2015									320	474	4160							
7/21/2015	19.34	5.79	64	6.62	159.6	1.50			60	20	5790						6040	
8/4/2015	20.10	6.00	68	6.45	166.6	1.51			20	30	17300						5730	
8/18/2015	19.54	6.98	77	6.49	151.8	2.05			700	987	15500						5100	
8/20/2015									480	620	17300							
9/1/2015	18.17	6.00	65	6.49	114.2	1.88			40	84	11200						4780	
9/15/2015	14.79	7.27	73	6.40	124.0	1.42			90	109	5480						4580	
9/29/2015	14.56	6.59	65	6.48	144.1	1.46			10	10	6130		0.0195	0.0785	0.236	0.082620	6080	0.0162
10/13/2015	10.81	11.19	103	6.41	132.2	1.12			60	52	1510						5210	
10/27/2015	4.68	12.79	100	6.62	131.2	0.887			65	146	1620						5470	
11/10/2015	4.94	12.95	102	6.82	139.9	0.762			12	*0*	959						5550	
11/24/2015	0.56	15.60	110	6.73	124.3	0.599			6	41	576						4770	
12/8/2015	2.41	14.53	107	6.64	120.5	0.624			4	*0*	439		0.0126	0.045	*0*	0.082740	4740	*0*
12/21/2015	1.04	18.44	133	6.66	115.4	0.521			32	75	399						4440	
AVG.	8.80	12.30	100	6.47	126.4	0.851			101	125	3780		0.0161	0.0744	0.137	0.10480	4570	0.00941
MAX.	20.10	22.48	157	6.82	188.9	2.05			700	987	17300		0.0195	0.122	0.236	0.18550	6080	0.0162
MIN.	0.01	5.79	64	5.95	92.2	0.388			*<10*	*<10*	84		0.0126	0.045	*<0.100*	0.068355	2960	*<0.005*
MEDIAN	6.84	12.30	101	6.47	120.3	0.674			32	36	1455		0.0162	0.0654	0.156	0.082680	4570	0.0107

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(213) MIDDLE BR. SWIFT RIVER, GATE 30

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.09	15.72	110	6.09	90.0	0.468			4	31	331						3050	
1/20/2015	0.06	18.74	132	5.96	90.6	0.635			18	20	676						2750	
2/3/2015	0.04	11.69	82	6.15	97.6	0.514			36	41	148						3970	
2/17/2015	0.07	19.38	135	6.25	101.4	0.531			10	20	146						4060	
3/3/2015	0.10	17.99	125	6.75	103.4	0.644			16	10	110						3970	
3/17/2015	0.18	17.07	119	6.25	107.1	0.587			16	20	109		0.0159	0.186	0.165	0.10400	3880	0.0326
3/31/2015	0.30	16.05	114	6.58	104.7	0.578			12	31	98						3580	
4/14/2015	7.78	11.12	94	5.74	80.9	0.461			*0*	*0*	228						2910	
4/28/2015	8.53	7.09	62	6.40	117.4	0.521			28	10	488						4000	
5/12/2015	20.98	3.63	41	5.93	134.4	1.41			96	62	4880						5460	
5/26/2015	17.65	5.27	57	5.99	135.4	1.23			12	10	1620						5270	
6/9/2015	18.18	5.24	57	5.87	125.1	1.01			80	183	4350						5280	
6/23/2015	20.24	4.44	50	5.71	87.2	1.15			170	160	4110		0.0219	0.00820	0.347	0.35700	3960	0
7/7/2015	20.81	9.95	112	5.74	113.5	1.07			50	63	3870						4300	
7/21/2015	23.32	4.01	48	5.87	125.9	1.28			*0*	10	4880						5960	
8/4/2015	22.62	4.54	54	5.99	128.0	1.21			10	31	2480						5550	
8/18/2015	23.06	4.80	57	5.93	107.3	1.08			30	52	2990						5100	
9/1/2015	20.28	4.17	47	5.99	124.5	1.10			20	41	3450						5600	
9/15/2015	16.32	4.94	51	5.64	91.8	1.03			280	246	6130						3810	
9/29/2015	15.58	5.18	52	6.00	121.4	0.831			150	203	3260		0.0208	0.00953	0.368	0.23040	5330	0.0083
10/13/2015	11.33	9.81	91	6.56	111.0	0.699			80	134	1860						4600	
10/27/2015	6.12	9.90	80	6.25	119.6	0.653			35	121	1100						5290	
11/10/2015	6.37	9.60	78	6.18	107.8	0.871			8	20	2100						4770	
11/24/2015	2.41	12.03	90	6.00	91.2	0.722			30	98	1470						3940	
12/8/2015	1.57	12.76	92	6.09	98.9	0.547			6	20	855		0.0131	0.0744	0.117	0.15424	4070	0
12/21/2015	1.33	16.02	117	6.14	91.5	0.609			2	10	644						3860	
AVG.	10.20	10.04	83	6.08	108.0	0.825			46	63	2010		0.0179	0.0695	0.249	0.21141	4400	0.0102
MAX.	23.32	19.38	135	6.75	135.4	1.41			280	246	6130		0.0219	0.186	0.368	0.35700	5960	0.0326
MIN.	0.04	3.63	41	5.64	80.9	0.461			<10	*<10*	98		0.0131	0.00820	0.117	0.10400	2750	*<0.005*
MEDIAN	8.16	9.86	81	6.00	107.2	0.711			19	31	1545		0.0184	0.0420	0.256	0.19232	4070	0.0042

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(215) EAST BR. FEVER BROOK, WEST STREET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.52	15.46	109	5.31	68.7	0.515			*0*	*0*	771						1370	
1/20/2015	0.14	18.13	128	5.93	114.9	0.559			8	*0*	860						2200	
2/3/2015	0.07	12.13	85	5.96	69.8	0.357			2	*0*	359						1900	
2/17/2015	0.08	18.63	130	5.61	88.7	0.400			*0*	*0*	299						2090	
3/3/2015	0.06	16.35	114	5.79	97.5	0.636			*0*	*0*	173						2440	
3/17/2015	0.20	16.43	115	5.96	103.7	0.720			*0*	*0*	336		0.0158	0.0597	0.200	0.21115	2340	0.0437
3/31/2015	0.97	16.21	117	6.31	101.5	0.379			*0*	*0*	292						2010	
4/14/2015	6.98	11.66	97	5.36	72.2	0.343			*0*	*0*	836						1560	
4/28/2015	9.76	7.24	66	5.90	97.7	0.510			*0*	*0*	2610						1910	
5/12/2015	19.93	3.85	43	5.38	106.6	0.773			8	*0*	12000						2400	
5/26/2015	18.61	5.42	59	5.57	124.2	0.940			28	20	7700						2340	
6/9/2015	19.10	5.13	57	5.31	125.3	0.641			60	41	2610						2300	
6/23/2015	21.98	4.60	54	5.26	121.5	0.744			20	63	3650		0.0260	*0*	0.425	0.35575	2310	0.0104
7/7/2015	21.85	9.32	107	5.20	107.0	1.05			30	31	4610						2000	
7/21/2015	22.61	3.88	46	5.51	105.9	1.15			10	61	6490						2650	
8/4/2015	22.32	4.24	50	5.56	117.8	0.958			70	63	4350						2680	
8/18/2015	23.98	4.36	52	5.52	119.3	0.819			50	41	4880						2530	
9/1/2015	20.31	4.14	47	5.46	122.7	0.903			30	20	2600						2360	
9/15/2015	15.87	5.88	61	5.29	121.4	0.915			80	52	6130						2300	
9/29/2015	15.98	5.08	52	5.76	129.1	0.688			*0*	20	1110		0.0206	0.0496	0.325	0.21400	2760	0.0199
10/13/2015	12.43	7.64	73	6.31	139.5	0.773			*0*	10	833						2670	
10/27/2015	5.41	9.04	72	6.19	143.0	0.730			*0*	*0*	906						3020	
11/10/2015	5.70	9.77	78	5.88	132.1	0.727			2	*0*	813						2500	
11/24/2015	2.15	14.29	106	5.69	126.5	0.691			2	10	1470						2350	
12/8/2015	3.32	12.17	92	5.61	116.3	0.476			*0*	*0*	512		0.0159	*0*	0.238	0.32835	2300	*0*
12/21/2015	2.02	18.30	136	5.58	74.3	0.383			*0*	*0*	565						1760	
AVG.	10.48	9.98	82	5.66	109.5	0.684			15	17	2610		0.0196	0.02733	0.297	0.27731	2270	0.0185
MAX.	23.98	18.63	136	6.31	143.0	1.15			80	63	12000		0.0260	0.0597	0.425	0.35575	3020	0.0437
MIN.	0.06	3.85	43	5.20	68.7	0.343			*<10*	*<10*	173		0.0158	*<0.005*	0.200	0.21115	1370	*<0.005*
MEDIAN	8.37	9.18	75	5.60	115.6	0.706			2	*<10*	1008		0.0183	0.0248	0.282	0.27118	2330	0.0152

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(216C) CARTER POND BELOW OUTLET, AT GLEN VALLEY ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	2.19	16.33	121	6.51	97.5	0.531	9.38	7.52	2	*0*	285		0.0155	0.0494	0.154	0.14150	4560	0.0128
1/20/2015	0.90	19.51	140	6.41	94.6	0.867	8.64	6.70	2	63	794		0.0172	0.0977	0.115	0.13781	4090	0.0394
2/3/2015	0.02	14.01	98	6.50	100.6	0.640	11.4	9.71	*0*	*0*	218		0.0266	0.119	0.230	0.11119		0.0784
2/17/2015	0.04	21.23	148	6.72	102.3	0.718	11.2	9.34	*0*	10	197		0.0281		0.259	0.11037	5510	
3/3/2015	0.04	19.40	135	6.86	104.1	0.862	12.6	10.8	*0*	*0*	146		0.0171	0.152	0.319	0.11682	5700	0.131
3/17/2015	0.97	17.76	127	6.58	110.1	0.869	10.4	8.57	4	*0*	183		0.0172	0.160	0.174	0.14022	4920	0.0562
3/31/2015	1.70	19.63	144	6.37	100.4	0.548	8.00	6.24	*0*	*0*	175		0.0165	0.106	0.196	0.14390	4320	0.0325
4/14/2015	10.49	11.56	104	6.01	80.1	0.772	10.9	3.78	4	31	399		0.0207	0.0254	0.145	0.13286	3150	*0*
4/28/2015	9.75	8.20	74	6.39	81.7	0.530	6.78	4.96	*0*	*0*	480		0.020	0.0181	0.152	0.12042	3530	0.00926
5/12/2015	20.49	5.39	61	6.19	92.4	0.782	8.04	6.10	16	10	2280		0.0258	0.0250	0.255	0.13705	4240	0.00625
5/26/2015	17.70	6.73	72	6.32	97.2	0.960	9.23	7.37	16	10	2480		0.0243	0.0301	0.239	0.14874	4280	0.00700
6/9/2015	17.33	6.83	73	6.42	92.6	0.757	10.1	8.43	740	457	9210		0.0203	0.0855	0.213	0.16784	4690	0.0129
6/12/2015									130	75	9210							
6/23/2015	22.78	5.97	71	6.49	94.4	0.684	11.5	9.77	*0*	41	3260		0.0218	0.0222	0.282	0.20690	4890	*0*
7/7/2015	21.44	9.58	109	6.42	85.7	0.684	10.1	8.45	20	31	4110		0.020	0.0483	0.396	0.24900	4020	0.00883
7/21/2015	22.55	5.54	66	6.59	86.5	0.552	11.0	9.18	*0*	*0*	6870		0.0142	0.0419	0.276	0.24885	4780	*0*
8/4/2015	23.06	5.82	70	6.53	89.2	0.343	11.5	9.56	20	*0*	1900		0.0138	0.0309	0.328	0.19235	4660	*0*
8/18/2015	21.71	7.30	84	6.47	88.6	0.295	10.5	8.78	70	134	4880		0.0149	0.0813	0.225	0.13955	4300	*0*
9/1/2015	18.70	5.79	63	6.47	85.9	0.244	11.4	9.45	10	20	3450		0.0126	0.0817	0.274	0.10254	4070	*0*
9/15/2015	17.92	6.91	74	6.50	92.8	0.381	11.4	9.52	30	20	1720		0.0108	0.00950	0.246	0.12646	4420	*0*
9/29/2015	17.99	6.26	67	6.57	96.0	0.476	11.3	9.38	10	20	1210		0.0102	0.00501	0.335	0.11779	4750	*0*
10/13/2015	12.65	10.09	97	6.40	90.8	0.287	11.1	9.23	10	20	657		0.00897	0.00578	0.207	0.11890	4920	*0*
10/27/2015	6.05	12.28	99	6.60	99.9	0.292	11.0	9.22	40	20	749		0.00945	*0*	0.180	0.13216	5410	*0*
11/10/2015	6.64	11.69	96	6.74	99.4	0.532	11.6	9.75	*0*	*0*	1040		0.0138	*0*	0.127	0.10736	5480	*0*
11/24/2015	2.80	13.88	104	6.64	113.5	0.552	11.4	9.51	*0*	*0*	670		0.0183	*0*	0.209	0.14831	6140	*0*
12/8/2015	3.61	14.35	109	6.63	111.1	0.399	11.8	9.83	2	*0*	767		0.0112	*0*	0.311	0.14282	5870	*0*
12/21/2015	1.70	16.60	122	6.68	112.0	0.547	11.4	9.56	16	20	836		0.0152	*0*	0.268	0.14049	6170	*0*
AVG.	10.82	11.49	97	6.50	96.1	0.581	10.5	8.49	42	36	2150		0.0171	0.0478	0.235	0.14547	4750	0.0158
MAX.	23.06	21.23	148	6.86	113.5	0.960	12.6	10.8	740	457	9210		0.0281	0.160	0.396	0.24900	6170	0.131
MIN.	0.02	5.39	61	6.01	80.1	0.244	6.78	3.78	*<10*	*<10*	146		0.00897	*<0.005*	0.115	0.10254	3150	*<0.005*
MEDIAN	10.12	10.83	97	6.50	95.3	0.550	11.1	9.23	4	10	840		0.0168	0.0301	0.235	0.13868	4690	*<0.005*

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(216D) CONNOR POND OUTLET AT DAM, NEAR PAT CONNOR ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.28	17.29	122	6.15	63.3	0.641	5.12	3.32	18	20	464		0.0169	0.0588	0.143	0.17603	2360	*0*
1/20/2015	0.13	20.28	143	6.19	70.2	0.772	4.94	3.20	10	10	1200		0.0203	0.0673	0.180	0.19030	2510	0.0259
2/3/2015	0.17	13.37	94	6.26	67.2	0.570	6.03	4.25	4	*0*	341		0.0225	0.0949	0.270	0.17826	2790	0.0395
2/17/2015	0.19	20.42	143	6.43	68.6	0.578	6.72	4.89	*0*	10	201		0.0241		0.299	0.19650	2890	
3/3/2015	0.26	18.93	133	6.62	68.8	0.660	6.99	5.17	4	*0*	135		0.0197	0.121	0.339	0.19030	2910	0.111
3/17/2015	0.26	17.63	124	6.45	81.8	0.630	6.60	4.84	10	10	292		0.0301	0.146	0.232	0.17510	2830	0.0692
3/31/2015	0.50	17.64	126	6.50	78.1	0.499	5.43	3.71	*0*	10	197		0.0258	0.108	0.233	0.17572	2640	0.0377
4/14/2015	6.34	12.90	105	5.66	46.2	0.483	12.1	3.47	*0*	*0*	323		0.0258	0.0309	0.110	0.16137	1700	0.00698
4/28/2015	9.12	8.31	74	6.33	64.5	0.959	4.56	2.84	36	10	520		0.0253	0.0212	0.172	0.17865	2170	0.00679
5/12/2015	21.19	5.38	61	6.03	74.5	1.13	6.46	4.63	16	*0*	1990		0.0311	0.00858	0.301	0.21760	2740	*0*
5/26/2015	17.60	6.46	69	6.05	76.8	1.51	7.24	5.26	24	30	816		0.0323	*0*	0.293	0.20885	2660	*0*
6/9/2015	18.42	6.49	70	5.91	62.6	1.35	6.01	4.46	30	31	1180		0.0304	0.0133	0.337	0.33130	2630	0.00895
6/23/2015	20.53	6.25	71	5.92	57.8	1.31	6.48	4.90	150	173	6130		0.0395	0.0194	0.428	0.39670	2570	0.00502
7/7/2015	21.10	9.97	113	5.82	57.7	0.984	5.82	4.27	40	10	2490		0.0328	0.0111	0.397	0.40855	2360	0.00913
7/21/2015	24.92	5.19	64	6.14	67.8	1.06	7.71	5.97	20	10	2100		0.0278	*0*	0.394	0.37830	3120	*0*
8/4/2015	24.66	5.42	67	6.14	69.7	1.26	8.55	6.61	*0*	*0*	2610		0.0255	*0*	0.325	0.30755	3000	0.00551
8/18/2015	24.91	6.40	78	6.17	72.0	1.08	8.16	6.47	20	*0*	1460		0.0292	*0*	0.352	0.27855	3000	*0*
9/1/2015	22.88	5.16	61	6.30	72.9	0.976	9.19	7.26	*0*	*0*	2720		0.0259	0.00640	0.606	0.26785	2860	*0*
9/15/2015	17.97	7.03	76	6.10	70.4	1.61	8.32	6.40	50	52	5480		0.0329	0.0152	0.390	0.28570	2740	0.00942
9/29/2015	17.42	6.46	68	6.39	70.8	1.05	8.43	6.51	*0*	*0*	2140		0.0227	*0*	0.433	0.23885	2930	0.00574
10/13/2015	12.73	9.46	91	6.18	62.4	0.860	6.57	4.64	*0*	*0*	546		0.0227	0.00937	0.356	0.38725	2820	*0*
10/27/2015	7.69	10.97	92	6.34	69.4	1.11	7.28	5.39	*0*	*0*	703		0.0244	*0*	0.292	0.30510	3110	*0*
11/10/2015	7.98	11.15	94	6.26	70.9	0.859	6.46	4.53	2	*0*	591		0.0270	0.0113	0.323	0.34640	3070	0.00826
11/24/2015	3.63	13.34	103	6.13	73.4	0.723	5.66	3.88	42	31	1170		0.0282	0.0124	0.339	0.35935	3110	0.0055
12/8/2015	3.20	13.74	103	6.17	73.2	0.536	6.15	4.24	8	*0*	448		0.0195	0.0280	0.398	0.30230	3040	0.00524
12/21/2015	1.84	17.69	131	6.21	69.7	0.615	5.65	3.74	*0*	*0*	624		0.0241	0.0250	0.325	0.32485	2900	*0*
AVG.	11.00	11.28	95	6.19	68.5	0.916	6.87	4.80	19	16	1420		0.0264	0.0323	0.318	0.26797	2750	0.0144
MAX.	24.92	20.42	143	6.62	81.8	1.61	12.1	7.26	150	173	6130		0.0395	0.146	0.606	0.40855	3120	0.111
MIN.	0.13	5.16	61	5.66	46.2	0.483	4.56	2.84	*<10*	*<10*	135		0.0169	*<0.005*	0.110	0.16137	1700	*<0.005*
MEDIAN	8.55	10.47	93	6.18	69.7	0.910	6.53	4.64	9	5	760		0.0258	0.0133	0.325	0.27320	2830	0.00551

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(216E-1) NORTH TRIBUTARY OF 216E, AT SOUTH STREET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.39	16.46	116	6.26	195.4	0.779	11.9	9.95	34	63	537		0.0193	0.919	0.209	0.067560	7350	0.0129
1/20/2015	1.00	18.86	136	6.35	186.1	1.05	10.0	8.23	456	855	1600		0.0223	0.906	0.151	0.075710	6710	0.0146
2/3/2015	0.30	13.04	92	6.23	226.1	0.684	12.1	10.3	32	31	809		0.0200	0.955	0.233	0.053930	8220	0.0177
2/17/2015	0.39	19.90	140	6.38	200.9	0.787	12.7	11.0	20	98	776		0.0241		0.172	0.057850	8630	
3/3/2015	0.90	19.10	136	6.80	219.3	1.19	13.2	11.4	16	63	1160		0.0212	0.952	0.254	0.058660	9170	0.0279
3/17/2015	1.78	17.48	128	6.49	331.7	2.37	12.3	10.5	18	122	1020		0.0313	0.883	0.260	0.082380	9260	0.0190
3/31/2015	2.10	16.95	126	6.55	289.0	0.452	10.8	9.23	96	98	733		0.0202	0.847	0.210	0.075465	9330	0.0126
4/14/2015	6.75	12.45	103	6.17	168.8	0.707	17.0	8.79	24	20	565		0.0263	0.565	0.188	0.11457	6370	*0*
4/28/2015	6.75	8.99	76	6.62	211.3	0.346	11.7	9.92	44	41	613		0.0213	0.577	0.140	0.077960	7370	0.00797
5/12/2015	13.70	6.49	63	6.29	238.7	0.455	15.6	13.7	8	*0*	3450		0.0258	0.492	0.200	0.11685	9220	0.00620
5/26/2015	12.88	7.58	73	6.31	279.2	0.714	16.2	14.2	20	*0*	1790		0.0239	0.724	0.125	0.081745	11300	0.00892
6/9/2015	12.83	7.37	71	6.51	299.4	0.537	15.8	14.2	10	10	3450		0.0234	0.660	0.170	0.10458	11300	0.0123
6/23/2015	14.93	7.13	72	6.58	323.3	0.571	16.4	14.6	80	97	4110		0.0306	0.630	0.192	0.14437	11200	0.00681
7/7/2015	14.59	12.57	124	6.48	330.9	0.664	16.4	14.8	10	63	2190		0.0280	0.746	0.178	0.12001	11000	0.0104
7/21/2015	15.44	6.46	66	6.72	349.9	0.580	18.2	16.3	30	31	5480		0.0242	0.903	0.233	0.11082	13500	0.0104
8/4/2015	16.70	6.25	66	6.66	406.6	0.636	20.1	20.1	230	75	3130		0.0190	1.10	0.252	0.070330	17400	0.00657
8/18/2015	17.97	6.86	73	6.43	375.6	0.552	21.0	21.0	60	41	5790		0.0247	0.596	0.252	0.13607	12900	0.0113
9/1/2015	16.69	5.75	60	6.46	405.5	1.06	21.4	21.4	50	20	3080		0.0252	0.858	0.170	0.099680	13600	0.0145
9/15/2015	14.75	7.24	73	6.33	300.3	0.687	18.6	16.6	80	41	4350		0.0320	0.571	0.189	0.15876	10000	0.0110
9/29/2015	14.95	6.40	64	6.63	379.1	1.40	21.7	21.7	120	63	2700		0.0298	0.931	0.325	0.069700	14600	0.00970
10/13/2015	11.89	10.48	99	6.59	306.5	0.832	17.8	15.8	*0*	20	2140		0.0203	1.01	0.200	0.076650	12200	0.00619
10/27/2015	6.39	11.76	96	6.57	324.0	0.492	17.7	15.8	25	86	1300		0.0182	1.06	0.170	0.069355	12700	*0*
11/10/2015	7.64	11.51	97	6.66	317.1	0.699	17.6	15.7	6	10	1150		0.0150	0.998	0.139	0.072675	12100	0.00601
11/24/2015	3.30	13.60	104	6.54	295.8	0.657	16.3	14.4	10	*0*	689		0.0207	1.07	0.161	0.070805	11400	0.00974
12/8/2015	4.44	12.48	97	6.54	273.4	0.607	15.5	13.6	10	20	556		0.0165	1.05	0.252	0.069600	10900	0.0105
12/21/2015	2.92	15.69	119	6.59	267.7	0.788	15.1	13.4	4	*0*	789		0.0208	1.12	0.179	0.072635	10200	0.0120
AVG.	8.55	11.49	95	6.49	288.5	0.781	15.9	14.1	57	76	2080		0.0232	0.845	0.200	0.088797	10690	0.0106
MAX.	17.97	19.90	140	6.80	406.6	2.37	21.7	21.7	456	855	5790		0.0320	1.12	0.325	0.15876	17400	0.0279
MIN.	0.30	5.75	60	6.17	168.8	0.346	10.0	8.23	*<10*	*<10*	537		0.0150	0.492	0.125	0.053930	6370	*<0.005*
MEDIAN	7.20	11.64	96	6.53	297.6	0.686	16.3	14.2	25	41	1450		0.0229	0.903	0.191	0.076180	10950	0.0104

NOTES

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EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(216G) ROARING BROOK, EAST STREET, PETERSHAM CENTER

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.80	16.99	121	6.53	253.8	0.460	8.01	6.10	14	*0*	341		0.0132	0.159	0.135	0.12604	5100	0.00879
1/20/2015	0.18	20.09	142	6.44	215.3	0.701	6.16	4.37	8	20	1330		0.0160	0.164	0.228	0.15404	4130	0.0263
2/3/2015	0.04	13.46	95	6.44	273.7	0.521	8.58	6.78	*0*	*0*	169		0.0246	0.214	0.244	0.11218	5970	0.0760
2/17/2015	0.07	20.66	144	6.47	243.2	0.715	9.62	7.78	26	86	364		0.0217		0.271	0.11802	5810	
3/3/2015	0.09	19.20	134	6.82	249.8	0.654	9.34	7.44	*0*	*0*	305		0.0147	0.226	0.406	0.10523	5920	0.137
3/17/2015	0.71	17.64	125	6.60	330.5	0.587	7.62	5.99	2	*0*	295		0.0162	0.239	0.163	0.10960	5820	0.0364
3/31/2015	1.15	17.83	129	6.70	353.3	0.343	6.87	5.19	12	10	108		0.0150	0.221	0.186	0.11203	6200	0.0258
4/14/2015	7.51	12.73	107	6.29	184.9	0.440	12.1	4.57	8	10	262		0.0165	0.100	0.132	0.13486	3730	*0*
4/28/2015	9.26	8.33	75	6.67	237.9	0.467	7.37	5.75	4	10	1020		0.0185	0.0514	0.172	0.13465	5040	0.00833
5/12/2015	19.45	5.58	62	6.49	259.5	1.18	12.0	9.98	12	20	2810		0.0321	0.0497	0.459	0.22295	6050	0.0132
5/26/2015	16.93	6.57	69	6.56	277.3	1.54	11.7	9.68	8	10	1990		0.0320	0.139	0.308	0.22970	5990	0.0296
6/9/2015	17.17	6.85	72	6.59	217.5	1.17	10.2	8.51	30	52	1940		0.0274	0.0993	0.375	0.32095	5360	0.0312
6/23/2015	19.00	6.68	74	6.57	211.9	1.36	9.75	8.01	110	95	5480		0.0347	0.0312	0.388	0.35635	4680	0.0163
7/7/2015	18.56	10.81	116	6.51	220.6	1.14	10.1	8.44	30	74	1840		0.0269	0.0399	0.479	0.35605	4820	0.0208
7/21/2015	20.42	5.84	67	6.75	258.8	1.62	14.0	12.2	50	31	2100		0.0284	0.119	0.343	0.36095	7150	0.0391
8/4/2015	20.77	6.03	69	6.81	265.3	1.43	14.9	12.9	20	41	2700		0.0365	0.286	0.382	0.27435	6980	0.00601
8/18/2015	21.23	7.00	80	6.65	257.5	1.30	15.4	13.6	40	85	8160		0.0311	0.0606	0.439	0.32270	6540	0.0480
9/1/2015	18.53	5.84	63	6.72	270.3	1.53	15.1	12.7	50	31		>24200	0.0336	0.179	0.620	0.29475	6400	0.0564
9/15/2015	16.21	7.41	77	6.60	256.1	1.22	11.2	9.25	90	98	7700		0.0320	0.0346	0.409	0.25075	5530	0.0199
9/29/2015	15.17	6.66	67	6.79	279.6	0.603	13.2	11.3	*0*	20	743		0.0150	0.235	0.348	0.15645	7520	0.00636
10/13/2015	11.47	9.81	92	6.89	258.6	0.617	10.3	8.27	30	10	563		0.0157	0.0788	0.238	0.21820	6890	0.00750
10/27/2015	4.58	13.16	102	6.80	296.2	0.696	10.1	8.23	5	*0*	341		0.0140	0.0211	0.232	0.19160	7280	*0*
11/10/2015	6.31	12.48	101	6.83	295.9	0.841	11.2	9.14	*0*	*0*	482		0.0185	0.0606	0.228	0.24385	7540	0.0140
11/24/2015	2.29	14.45	107	6.63	282.5	0.727	9.33	7.55	6	41	616		0.0215	0.0523	0.262	0.24010	6940	0.00810
12/8/2015	3.27	14.27	107	6.66	274.9	0.540	9.42	7.47	4	20	457		0.0147	0.118	0.321	0.15669	7110	0.0102
12/21/2015	1.39	17.65	129	6.71	264.2	0.677	9.09	7.23	6	*0*	259		0.0184	0.0863	0.245	0.17214	6590	0.0120
AVG.	10.07	11.48	96	6.64	261.1	0.888	10.5	8.40	22	29	1700		0.0227	0.123	0.308	0.21058	6040	0.0263
MAX.	21.23	20.66	144	6.89	353.3	1.62	15.4	13.6	110	98	8160		0.0365	0.286	0.620	0.36095	7540	0.137
MIN.	0.04	5.58	62	6.29	184.9	0.343	6.16	4.37	*<10*	*<10*	108		0.0132	0.0211	0.132	0.10523	3730	*<0.005*
MEDIAN	9.26	10.81	95	6.64	259.2	0.708	10.1	8.12	10	20	616		0.0200	0.100	0.290	0.20490	6020	0.0163

NOTES

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Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

(216I-X) MOCASSIN BROOK, ABOVE QUAKER ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.01	18.08	126	5.95	36.9	0.469	4.64	2.71	4	20	473		0.0175	0.0457	0.237	0.30970	1900	*0*
1/20/2015	0.02	20.50	144	6.03	39.6	0.870	4.41	2.40	12	10	663		0.0260	0.0657	0.260	0.33740	1890	0.0302
3/17/2015	0.11	18.84	132	6.14	46.2	0.653	5.97	4.05	6	*0*	231		0.0276	0.132	0.400	0.31420	2140	0.0846
3/31/2015	0.46	17.30	123	6.45	39.0	0.676	4.88	3.13	*0*	*0*	399		0.0228	0.0898	0.291	0.28175	1840	0.0361
4/14/2015	6.72	13.26	109	5.59	27.2	0.499	16.9	14.7	4	*0*	459		0.0213	0.0235	0.215	0.23770	1340	*0*
4/28/2015	8.34	8.51	75	6.14	32.6	0.509	4.36	2.49	*0*	10	1040		0.0219	0.0413	0.246	0.31050	1690	0.00762
5/12/2015	18.71	5.61	61	6.09	39.7	1.17	7.53	5.54	40	31	4880		0.0414	0.0368	0.376	0.42815	2500	0.00827
5/26/2015	16.20	6.97	73	6.26	40.9	1.16	8.36	6.30	16	20	1970		0.0374	0.0616	0.306	0.36805	2560	0.00958
6/9/2015	17.19	6.89	73	5.99	35.5	0.977	6.83	5.05	60	243	4350		0.0342	0.0517	0.340	0.47280	2250	0.0162
6/23/2015	20.15	6.28	71	5.83	31.2	1.07	5.71	3.92	200	279	4880		0.0418	0.0178	0.501	0.58970	2020	0.00696
7/7/2015	20.18	10.40	115	5.76	32.4	1.06	5.99	4.38	10	75	5790		0.0379	0.0341	0.441	0.62420	1990	0.0117
7/21/2015	21.69	5.62	66	6.26	38.6	1.68	8.72	6.73	20	63	6130		0.0452	0.0459	0.522	0.61615	2940	0.00504
8/4/2015	21.30	5.89	68	6.34	40.9	1.53	9.72	7.64	110	134	4350		0.0400	0.0455	0.548	0.47405	3060	*0*
8/18/2015	21.56	7.01	81	6.24	40.1	1.29	9.46	7.52	80	96	7700		0.0443	0.0259	0.407	0.50725	2850	*0*
9/1/2015	18.42	5.71	62	6.46	42.1	1.15	10.9	8.99	20	31	4610		0.0364	0.0402	0.436	0.38890	2950	*0*
9/15/2015	15.03	7.50	76	6.16	41.0	0.934	7.72	5.78	90	41	4360		0.0360	0.0288	0.341	0.43880	2540	*0*
9/29/2015	15.18	6.80	68	6.46	40.3	0.867	9.89	7.73	10	10	1550		0.0274	0.0337	0.498	0.32050	2860	*0*
10/13/2015	11.02	10.51	97	6.52	37.8	0.852	6.67	4.57	10	20	2490		0.0330	0.0168	0.482	0.52995	2540	0.00584
10/27/2015	4.81	13.89	109	6.32	41.6	0.668	7.60	5.61	*0*	20	749		0.0269	0.00733	0.312	0.44660	2730	*0*
11/10/2015	5.46	12.66	101	6.28	40.7	0.636	6.68	4.60	6	*0*	1620		0.0280	0.0217	0.345	0.53910	2570	*0*
11/24/2015	1.04	15.28	110	5.95	39.3	0.752	5.06	3.07	8	20	2720		0.0264	0.0229	0.405	0.56540	2330	*0*
12/8/2015	2.10	14.50	106	6.27	41.0	0.574	5.86	3.75	2	*0*	767		0.0211	0.0503	0.418	0.46305	2460	0.00633
12/21/2015	0.90	17.04	123	6.04	39.6	0.643	4.92	2.92	6	10	1050		0.0265	0.0370	0.534	0.46555	2130	0.00570
AVG.	10.72	11.09	94	6.15	38.4	0.900	7.34	5.37	31	49	2750		0.0313	0.0424	0.385	0.43606	2350	0.0102
MAX.	21.69	20.50	144	6.52	46.2	1.68	16.9	14.7	200	279	7700		0.0452	0.132	0.548	0.62420	3060	0.08460
MIN.	0.01	5.61	61	5.59	27.2	0.469	4.36	2.40	*<10*	*<10*	231		0.0175	0.00733	0.215	0.23770	1340	*<0.005*
MEDIAN	11.02	10.40	97	6.16	39.6	0.867	6.68	4.60	10	20	1970		0.0280	0.0370	0.400	0.44660	2460	0.00570

NOTES

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EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
(216) EAST BR. SWIFT RIVER, ROUTE 32A

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.02	17.72	124	6.40	78.3	0.529			8	31	488						2750	
1/20/2015	0.02	20.18	142	6.46	85.9	0.852			8	*0*	985						2740	
2/3/2015	0.03	14.70	103	6.51	86.1	0.451			*0*	*0*	121						3220	
2/17/2015	0.02	20.49	143	6.43	84.6	0.511			4	10	135						3450	
3/3/2015	0.04	19.76	138	6.86	84.6	0.548			*0*	*0*	185						3340	
3/17/2015	0.23	18.62	131	6.61	94.2	0.689			*0*	*0*	119		0.0186	0.133	0.221	0.16665	3370	0.0542
3/31/2015	1.28	19.04	139	6.48	91.2	0.534			4	*0*	122						2850	
4/14/2015	7.10	12.77	106	5.82	59.4	0.514			8	*0*	292						1910	
4/28/2015	9.56	8.60	78	6.52	78.3	0.511			8	*0*	548						2460	
5/12/2015	19.54	5.77	64	6.29	92.1	0.609			16	*0*	1440						3100	
5/26/2015	17.03	6.88	73	6.34	97.1	0.551			144	187	5170						3190	
6/9/2015	17.34	6.87	73	6.33	84.2	0.547			30	20	1210						3240	
6/23/2015	20.98	6.45	74	6.37	75.4	0.996			80	74	3440		0.0315	0.0220	0.384	0.34130	2920	*0*
7/7/2015	21.08	10.19	115	6.29	79.9	0.732			30	31	2910						2690	
7/21/2015	22.06	5.86	69	6.55	87.3	0.663			10	31	3450						3390	
8/4/2015	22.38	6.01	71	6.62	86.8	0.526			90	97	2990						3270	
8/18/2015	23.15	6.89	82	6.58	85.3	0.468			20	31	2360						3140	
9/1/2015	19.68	5.71	63	6.57	90.6	0.442			30	*0*	1080						3370	
9/15/2015	16.70	7.14	75	6.57	91.3	0.783			10	31	2700						3260	
9/29/2015	16.30	6.68	69	6.65	98.3	0.430			20	*0*	836		0.0116	0.00690	0.302	0.13986	4080	*0*
10/13/2015	11.57	10.89	102	6.56	80.5	0.489			10	20	663						3350	
10/27/2015	5.31	12.42	98	6.62	88.1	0.329			10	10	359						3770	
11/10/2015	6.22	13.22	107	6.63	87.5	0.422			4	20	435						3460	
11/24/2015	2.07	15.73	116	6.42	88.7	0.515			14	10	576						3480	
12/8/2015	3.00	14.19	106	6.54	88.3	0.426			2	*0*	295		0.0157	0.0171	0.337	0.26570	3430	*0*
12/21/2015	1.90	17.18	127	6.50	103.0	0.546			4	*0*	383						3750	
AVG.	10.18	11.92	99	6.48	86.4	0.562			22	23	1280		0.0194	0.0448	0.311	0.22838	3190	0.01355
MAX.	23.15	20.49	143	6.86	103.0	1.00			144	187	5170		0.0315	0.133	0.384	0.34130	4080	0.0542
MIN.	0.02	5.71	63	5.82	59.4	0.329			*<10*	*<10*	119		0.0116	0.0069	0.221	0.13986	1910	*<0.005*
MEDIAN	8.33	11.66	102	6.52	87.1	0.528			10	10	620		0.0172	0.0196	0.320	0.21618	3270	*<0.005*

NOTES

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Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
GATES BROOK, AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.11	20.75	145	5.59	22.2	0.186			*0*	*0*	292						1060	
1/20/2015	0.88	23.47	169	4.99	21.3	0.266			*0*	31	262						1060	
2/17/2015	0.14	23.24	162	5.97	23.5	0.127			*0*	*0*	259						1250	
3/3/2015	0.05	23.02	160	6.45	24.3	0.148			*0*	*0*	216						1270	
3/17/2015	2.41	23.33	174	5.98	22.0	0.306			4	*0*	231		0.0124	0.00552	*0*	0.069080	1140	*0*
3/31/2015	2.06	25.17	187	5.86	21.1	0.291			*0*	*0*	211						1060	
4/14/2015	6.61	17.25	142	4.84	19.4	0.190			*0*	*0*	609						1000	
4/28/2015	6.29	9.78	81	6.04	20.4	0.122			*0*	*0*	496						1150	
5/12/2015	13.87	6.88	67	5.86	21.7	0.153			*0*	*0*	2050						1130	
5/26/2015	13.09	8.24	80	5.99	23.5	0.124			*0*	10	1720						1260	
6/9/2015	13.49	8.00	78	5.69	22.5	0.113			*0*	*0*	1290						1310	
6/23/2015	15.38	7.86	80	5.75	21.3	0.213			30	74	2760		0.0153	*0*	0.120	0.15837	1280	*0*
7/7/2015	16.25	13.06	134	5.66	23.3	0.217			10	41	3260						1280	
7/21/2015	17.47	6.43	69	6.00	24.1	0.227			20	52	4110						1340	
8/4/2015	19.24	6.40	71	6.22	25.9	0.211			10	20	6490						1360	
8/18/2015	19.38	6.86	75	6.03	26.6	0.136			60	75	6130						1330	
9/1/2015	18.14	6.06	65	6.09	27.2	0.170			10	41	5170						1390	
9/15/2015	14.45	7.23	72	6.26	32.5	0.210			140	226	3440						1760	
9/29/2015	15.46	6.52	66	6.26	28.3	0.180			30	20	2600		0.0199	0.0161	0.191	0.067560	1490	*0*
10/13/2015	12.45	11.38	109	6.51	29.8	0.196			10	10	1990						1570	
10/27/2015	5.76	15.60	125	6.40	31.4	0.186			*0*	10	1860						1500	
11/10/2015	6.61	12.08	99	6.50	31.3	0.446			2	*0*	657						1550	
11/24/2015	0.96	14.95	107	6.40	32.1	0.261			2	10	404						1640	
12/8/2015	3.45	14.16	107	6.50	30.8	0.138			2	10	313		0.0111	*0*	0.244	0.077150	1690	*0*
12/21/2015	1.86	19.71	146	6.48	30.5	0.113			2	*0*	464						1680	
AVG.	9.03	13.50	111	6.01	25.5	0.197			13	25	1890		0.0147	0.0054	0.139	0.093040	1340	*<0.005*
MAX.	19.38	25.17	187	6.51	32.5	0.446			140	226	6490		0.0199	0.0161	0.244	0.15837	1760	*<0.005*
MIN.	0.05	6.06	65	4.84	19.4	0.113			*<10*	*<10*	211		0.0111	*<0.005*	*<0.100*	0.067560	1000	*<0.005*
MEDIAN	6.61	12.08	107	6.03	24.1	0.186			2	10	1290		0.0139	0.0028	0.156	0.073115	1310	*<0.005*

NOTES

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NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
BOAT COVE BROOK, NEAR MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/6/2015	0.05	16.82	117	6.40	56.3	1.79			8	20	282						4770	
1/20/2015	0.21	19.67	139	6.23	50.8	3.17			4	52	836						4210	
2/3/2015	0.18	15.31	108	6.48	64.2	0.781			*0*	20	364						5660	
2/17/2015	0.27	19.32	135	6.78	69.9	0.657			2	*0*	145						6130	
3/3/2015	0.36	19.97	140	6.70	75.3	0.495			2	*0*	86						6470	
3/17/2015	1.84	17.91	131	6.59	51.2	3.03			86	86	538		0.0264	0.0402	0.177	0.22255	4180	*0*
3/31/2015	3.53	16.92	131	6.43	46.2	1.66			*0*	*0*	218						3810	
4/14/2015	9.72	11.82	105	6.16	50.2	0.934			12	10	309						4500	
4/28/2015	10.70	8.32	77	6.65	59.1	0.621			24	31	1010						5340	
5/12/2015	18.69	6.02	65	6.49	76.1	0.650			8	20	4110						7170	
5/26/2015	15.78	7.48	77	6.64	88.1	0.561			40	20	1870						8370	
6/9/2015	15.42	7.60	77	6.76	85.9	0.718			30	52	2910						8620	
6/23/2015	17.49	6.95	74	6.74	78.1	1.15			120	228	8660		0.0254	0.0406	0.236	0.21705	7820	*0*
7/7/2015	17.90	11.39	121	6.68	87.9	1.49			20	20	4350						8160	
7/21/2015	19.20	6.06	67	7.01	93.0	0.605			70	98	7700						9750	
8/4/2015	20.98	6.05	69	6.99	105.1	0.589			80	86	5480						10800	
8/18/2015	20.92	6.84	78	6.95	110.5	0.449			110	142	9210						11500	
9/1/2015	19.36	5.67	63	6.95	115.2	0.332			390	373	14100						10800	
9/15/2015	16.19	6.83	71	6.68	101.4	0.433			1100	1610	12000						9900	
9/18/2015						0.331			150	160	5480							
9/29/2015	17.22	6.28	66	6.81	116.2	0.260			40	122	8160		0.0211	*0*	0.213	0.080010	11700	*0*
10/13/2015	13.29	9.63	94	6.62	112.2	0.351			20	10	3450						11300	
10/27/2015	7.94	10.01	85	6.77	116.4	0.213			5	*0*	2250						12400	
11/10/2015	8.10	12.08	103	7.11	110.9	0.368			2	*0*	495						11300	
11/24/2015	2.61	14.81	111	6.94	99.5	0.218			2	10	480						9860	
12/8/2015	4.46	14.82	115	6.88	94.8	0.297			2	*0*	546		0.0169	0.00606	0.214	0.11729	9760	*0*
12/21/2015	3.08	17.17	131	6.90	87.6	0.369			22	10	345						8770	
AVG.	10.21	11.61	98	6.71	84.7	0.834			87	118	3530		0.0225	0.0217	0.210	0.15923	8190	*<0.005*
MAX.	20.98	19.97	140	7.11	116.4	3.17			1100	1610	14100		0.0264	0.0406	0.236	0.22255	12400	*<0.005*
MIN.	0.05	5.67	63	6.16	46.2	0.213			*<10*	*<10*	86		0.0169	*<0.005*	0.177	0.080010	3810	*<0.005*
MEDIAN	10.21	10.70	98	6.72	87.8	0.589			20	20	1870		0.0233	0.0231	0.214	0.16717	8500	*<0.005*

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(101) WARE RIVER, AT SHAFT 8

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.08	17.10	118	6.45	100.3	0.607			4	*0*	305					0.17513	3690	
1/26/2015	0.07	19.35	134	6.48	101.7	0.583			4	10	318					0.16051	3330	
2/10/2015	0.08	18.53	129	6.20	100.9	0.690			8	*0*	199					0.16990	3550	
2/24/2015	0.02	26.41	182	6.25	98.8	0.773			*0*	*0*	189					0.19020	3570	
3/10/2015	0.16	27.44	191	6.67	103.3	0.902			4	31	199					0.16708	3680	
3/24/2015	0.08	21.45	150	6.49	116.8	0.672			8	10	241		0.0222	0.105	0.222	0.16664	3660	0.0306
4/7/2015	2.17	29.51	216	6.28	83.1	0.677			*0*	*0*	432					0.16777	2460	
4/21/2015	8.81	14.33	125	6.21	80.0	1.01			12	20	908					0.19670	2670	
5/5/2015	16.46	9.29	96	6.11	91.9	1.20			8	*0*	1220					0.20745	2920	
5/19/2015	18.96	9.61	104	6.01	101.4	2.11			30	20	2360					0.24370	3670	
6/2/2015	13.78	8.92	87	6.01	97.3	3.46			410	473	6290					0.30910	3920	
6/16/2015	18.92	7.25	79	5.97	107.1	3.05			120	189	6870		0.0334	0.0372	0.321	0.33695	4080	0.0251
6/30/2015	17.76	7.21	78	5.85	91.8	2.31			110	86	5170					0.41960	3400	
7/14/2015	23.85	6.10	74	6.07	93.5	2.91			40	63	6490					0.42520	3340	
7/28/2015	21.85	5.85	68	6.11	100.8	3.91			60	52	3260					0.29950	3650	
8/11/2015	21.05	5.57	64	6.30	98.6	2.93			120	41	3450					0.25205	3820	
8/25/2015	22.61	5.24	62	6.28	102.7	2.67			60	110	5480					0.24715	3900	
9/8/2015	20.69	7.26	81	6.59	114.6	1.67			40	52	3870					0.16052	3950	
9/22/2015	17.93			6.14	112.6	1.79			40	30	2600		0.0284	0.0131	0.278	0.22995	4260	0.00774
10/6/2015	11.43	9.61	89	6.00	91.9	1.55			60	10	1480					0.33485	3500	
10/20/2015	8.18	6.70	57	6.32	93.2	1.63			*0*	*0*	496					0.24255	3630	
11/3/2015	7.73	11.33	97	6.18	91.4	1.20			2	*0*	712					0.31375	3600	
11/17/2015	4.64	15.53	121	6.59	96.9	1.79			4	*0*	909					0.26540	3870	
12/1/2015	1.92	15.48	112	6.53	99.0	1.24			8	20	529					0.23160	3570	
12/15/2015	6.96	13.20	111	6.42	97.8	1.50			8	10	594		0.0175	0.0120	0.336	0.21195	3680	0.00546
12/28/2015	5.79	13.16	106	6.15	88.2	1.07			12	*0*	1020					0.29080	3430	
AVG.	10.46	13.26	109	6.26	98.3	1.69			45	47	2140		0.0254	0.0418	0.289	0.24677	3570	0.0172
MAX.	23.85	29.51	216	6.67	116.8	3.91			410	473	6870		0.0334	0.105	0.336	0.42520	4260	0.0306
MIN.	0.02	5.24	57	5.85	80.0	0.583			*<10*	*<10*	189		0.0175	0.0120	0.222	0.16051	2460	0.00546
MEDIAN	8.50	11.33	104	6.23	98.7	1.53			10	15	964.5		0.0253	0.0252	0.300	0.23708	3640	0.0164

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
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Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(103A) BURNSHIRT RIVER, AT RIVERSIDE CEMETERY

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.14	16.53	114	6.09	82.7	0.397			*0*	10	327					0.15334	2780	
1/26/2015	0.19	17.45	122	6.19	88.6	0.462			*0*	10	256					0.14029	2710	
3/24/2015	0.15	18.57	130	6.18	94.2	0.569			*0*	*0*	110		0.0216	0.115	0.168	0.15218	2780	0.0242
4/7/2015	2.12	19.08	139	5.89	71.0	0.400			4	10	279					0.15539	1990	
4/21/2015	8.40	11.53	100	5.61	69.0	0.584			164	185	908					0.17607	2140	
5/5/2015	14.33	9.48	94	5.83	78.4	1.13			16	41	3260					0.19595	2460	
5/19/2015	15.96	8.37	86	5.68	77.1	2.09			170	213	3260					0.25010	2620	
6/2/2015	11.68	9.05	84	5.63	69.9	2.67			830	1420	24200					0.39585	2430	
6/16/2015	16.27	6.54	68	5.55	70.4	2.23			250	158	3650		0.0374	0.0219	0.971	0.41580	2470	0.0266
6/30/2015	16.19	6.09	63	5.47	72.1	1.36			50	95	4110					0.35640	2340	
7/14/2015	21.08	5.21	60	5.69	69.0	2.95			130	134	5790					0.47520	2480	
7/28/2015	20.53	4.94	56	5.72	67.8	2.98			120	52	4610					0.34965	2450	
8/11/2015	20.46	4.88	55	6.04	96.4	2.42			130	41	4350					0.27975	4390	
8/25/2015	21.28	4.16	48	5.73	71.9	2.69			140	86	7270					0.30350	2720	
9/8/2015	19.60	6.15	68	6.36	127.9	1.48			60	86	3650					0.20935	2610	
9/22/2015	13.82			6.31	113.8	1.90			30	20	2720		0.0267	0.0111	0.264	0.24540	3220	0.00584
10/6/2015	9.57	8.75	77	5.50	64.9	0.968			50	63	1620					0.26880	2180	
10/20/2015	5.01	6.80	53	5.78	67.0	1.11			30	20	1870					0.25650	2550	
11/3/2015	6.31	8.93	73	5.80	67.0	0.672			8	10	1250					0.29580	2430	
11/17/2015	3.03	15.95	119	6.30	72.8	0.979			2	10	855					0.25965	2720	
12/1/2015	0.99	13.60	96	6.16	70.8	0.997			4	10	1120					0.27350	2380	
12/15/2015	6.95	11.19	94	5.91	68.7	0.863			20	*0*	1110		0.0155	0.0164	0.208	0.23995	2480	*0*
12/28/2015	4.66	12.02	94	5.71	68.3	0.604			16	10	908					0.27700	2350	
AVG.	10.38	10.24	86	5.88	78.2	1.41			97	117	3370		0.0253	0.0411	0.403	0.26632	2590	0.0142
MAX.	21.28	19.08	139	6.36	127.9	2.98			830	1420	24200		0.0374	0.115	0.971	0.47520	4390	0.0266
MIN.	0.14	4.16	48	5.47	64.9	0.397			*<10*	*<10*	110		0.0155	0.0111	0.168	0.14029	1990	*<0.005*
MEDIAN	9.57	8.99	85	5.80	71.0	1.11			30	41	1870		0.0242	0.0192	0.236	0.25965	2480	0.0150

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(107A) WEST BR. WARE RIVER, AT BRIGHAM ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.14	16.44	114	5.77	86.7	0.475			*0*	*0*	537					0.24525	2860	
1/26/2015	0.20	18.09	126	6.07	103.4	0.506			4	10	565					0.22515	3040	
2/24/2015	0.08	20.24	140	5.79	102.8	0.552			*0*	*0*	216					0.22100	2990	
3/10/2015	0.10	20.16	140	6.10	110.2	0.637			18	20	266					0.23065	3280	
3/24/2015	0.06	17.59	123	5.98	122.4	0.617			8	*0*	309		0.0215	0.132	0.275	0.23905	3110	0.0460
4/7/2015	1.96	17.70	129	5.77	80.5	0.481			*0*	*0*	336					0.24840	2170	
4/21/2015	8.54	11.56	100	5.58	69.6	0.514			36	10	884					0.29475	2090	
5/5/2015	14.74	9.30	93	5.88	78.1	0.709			28	10	2380					0.28960	2480	
5/19/2015	17.26	9.22	97	5.90	87.6	1.19			10	51	2610					0.33695	2990	
6/2/2015	11.67	9.47	88	5.57	98.6	2.84			860	1400		>24200				0.53120	3300	
6/16/2015	17.12	6.82	72	5.86	103.0	1.68			170	187	4110		0.0299	0.00875	0.926	0.50465	3320	0.0115
6/30/2015	17.49	6.87	74	5.67	84.7	1.26			90	63	2760					0.57390	2920	
7/14/2015	22.64	5.77	68	5.86	93.9	1.90			10	20	2990					0.66560	3580	
7/28/2015	21.36	5.71	66	6.08	105.9	1.45			40	110	2190					0.36350	3310	
8/11/2015	20.37	5.34	60	6.17	93.1	1.57			60	52	7270					0.35265	3530	
8/25/2015	21.33	4.91	56	6.20	141.6	1.84			20	41	3450					0.52305	4200	
9/8/2015	19.50	7.18	79	6.44	119.9	1.53			40	20	1920					0.29915	3640	
9/22/2015	13.63			6.26	111.3	1.79			10	10	1260		0.0296	0.0191	0.355	0.33065	3350	*0*
10/6/2015	10.00	9.86	88	5.85	80.6	0.890			30	52	2360					0.34320	2640	
10/20/2015	5.78	8.11	65	6.15	95.0	0.641			80	109	833					0.26700	3150	
11/3/2015	6.65	10.12	84	5.78	92.6	0.558			8	*0*	882					0.35655	3150	
11/17/2015	1.83	17.38	126	6.42	105.8	0.753			2	10	771					0.28635	3270	
12/1/2015	0.62	14.57	101	6.27	112.8	0.461			4	20	880					0.29900	3270	
12/15/2015	6.98	11.87	100	6.08	96.9	0.634			2	10	1050		0.0136	0.0109	0.315	0.29600	3320	*0*
12/28/2015	4.35	12.76	99	5.71	92.4	0.799			46	41	865					0.43335	3240	
AVG.	9.78	11.54	95	5.97	98.8	1.05			63	90	1740		0.0237	0.0427	0.468	0.35026	3130	0.0144
MAX.	22.64	20.24	140	6.44	141.6	2.84			860	1400	7270		0.0299	0.132	0.926	0.66560	4200	0.0460
MIN.	0.06	4.91	56	5.57	69.6	0.461			*<10*	*<10*	216		0.0136	0.00875	0.275	0.22100	2090	*<0.005*
MEDIAN	8.54	9.99	95	5.90	96.9	0.753			18	20	967		0.0256	0.0150	0.335	0.29915	3240	######

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(108) EAST BR. WARE RIVER, AT NEW BOSTON (INTERVALE ROAD)

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.04	15.04	104	6.15	94.6	0.538			2	*0*	399					0.15950	3780	
1/26/2015	0.03	16.65	116	6.08	91.1	0.547			*0*	10	295					0.14454	3430	
2/10/2015	0.02	17.66	122	5.89	88.3	0.655			*0*	*0*	201					0.15813	3550	
2/24/2015	0.02	18.21	126	5.95	90.5	0.686			*0*	*0*	75					0.16468	3550	
3/10/2015	0.04	20.61	143	6.49	97.3	0.740			2	*0*	146					0.16173	4100	
3/24/2015	0.06	17.18	120	6.16	110.7	0.593			*0*	10	313		0.0164	0.122	0.228	0.15261	3730	0.0389
4/7/2015	3.26	15.98	120	6.07	81.1	0.499			28	31	345					0.15746	2660	
4/21/2015	8.84	11.08	97	5.88	81.8	0.698			20	31	663					0.17477	2890	
5/5/2015	15.20	8.62	87	5.92	92.6	1.08			20	20	1720					0.19255	3340	
5/19/2015	17.70	7.90	84	5.86	104.2	2.89			30	41	2600					0.29530	4340	
6/2/2015	12.23	8.87	84	6.01	103.6	2.68			990	905	19900					0.29260	4270	
6/16/2015	17.34	6.71	71	5.96	114.1	2.08			160	272	6490		0.0256	0.0511	0.284	0.30595	4710	0.0271
6/30/2015	17.04	6.96	74	5.84	84.2	1.87			90	98	4350					0.35490	3430	
7/14/2015	23.12	5.00	60	5.78	103.9	2.36			40	97	4110					0.40035	4260	
7/28/2015	22.65	4.83	57	5.88	99.7	3.15			60	63	3650					0.30860	4160	
8/11/2015	21.39	4.95	57	6.06	102.6	2.49			30	52	2760					0.25995	4520	
8/25/2015	22.41	4.48	53	6.12	110.7	3.03			100	41	2720					0.27935	4990	
9/8/2015	21.23	6.18	70	6.35	109.6	2.58			20	*0*	2060					0.24895	4570	
9/22/2015	15.90			6.25	111.2	2.63			30	20	1310		0.0262	0.00627	0.296	0.24590	4760	0.00662
10/6/2015	10.45	8.66	78	6.12	109.7	1.56			70	41	1470					0.22215	4530	
10/20/2015	6.17	7.59	61	6.10	106.8	1.51			*0*	10	1520					0.24965	4530	
11/3/2015	7.30	8.93	75	6.12	109.4	1.07			12	52	776					0.19340	4780	
11/17/2015	3.24	14.79	111	6.72	114.8	1.55			6	20	833					0.23170	5010	
12/1/2015	1.38	13.52	96	6.46	114.3	0.788			6	*0*	717					0.19730	4860	
12/15/2015	7.26	10.89	92	6.24	103.6	0.964			24	31	988		0.0168	0.0216	0.290	0.20505	4740	0.00944
12/28/2015	4.45	12.84	100	6.05	93.7	0.875			4	20	1190					0.27535	4080	
AVG.	9.95	10.97	90	6.10	100.9	1.54			67	72	2370		0.0213	0.0502	0.275	0.23202	4140	0.0205
MAX.	23.12	20.61	143	6.72	114.8	3.15			990	905	19900		0.0262	0.122	0.296	0.40035	5010	0.0389
MIN.	0.02	4.48	53	5.78	81.1	0.499			*<10*	*<10*	75		0.0164	0.00627	0.228	0.14454	2660	0.00662
MEDIAN	8.07	8.93	87	6.08	103.6	1.30			20	26	1250		0.0212	0.0364	0.287	0.22693	4270	0.0183

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(108A) EAST BRANCH WARE RIVER, AT ROUTE 68

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.03	14.65	101	5.98	77.2	0.526	6.45	4.53	*0*	*0*	309		0.0126	0.0682	0.127	0.14722	3200	0.0563
1/26/2015	0.03	15.86	110	5.89	77.2	0.567	5.78	3.95	*0*	*0*	309		0.0114	0.0696	0.119	0.14231	2780	
2/10/2015	0.02	16.98	118	5.70	73.9	0.675	6.49	4.63	*0*	*0*	213		0.0207	0.0740	0.333	0.15363	2890	0.0617
2/24/2015	0.02	16.56	114	5.68	77.9	0.725	7.26	5.37	*0*	*0*	173		0.0136	0.0852	0.278	0.16268	3110	0.0828
3/10/2015	0.03	17.45	121	5.84	85.4	0.768	7.82	5.93	*0*	*0*	148		0.0180	0.0921	0.326	0.16319	3550	0.103
3/24/2015	0.13	15.34	107	5.83	97.0	0.630	6.69	4.90	*0*	*0*	173		0.0172	0.102	0.254	0.15553	3210	0.0411
4/7/2015	3.23	15.85	119	5.72	71.6	0.463	4.99	2.90	*0*	*0*	520		0.0148	0.0659	0.204	0.16322	2250	
4/21/2015	8.42	10.93	95	5.71	69.2	0.551	4.85	2.97	20	20	855		0.0149	0.0323	0.162	0.16650	2460	0.00648
5/5/2015	16.77	8.43	88	5.88	80.2	0.972	6.32	4.56	4	10	2100		0.0192	0.0106	0.202	0.18730	2870	0.00680
5/19/2015	18.56	7.32	79	5.81	93.8	1.82	9.32	7.53	10	*0*	5170		0.0309	0.0156	0.278	0.26145	3840	0.0141
6/2/2015	13.69	7.36	72	5.84	94.2	2.53	10.9	9.04	170	185	7700		0.0364	0.0265	0.357	0.30065	4340	0.0275
6/16/2015	19.60	5.22	58	5.80	91.2	1.62	9.49	7.76	60	41	3870		0.0282	0.00954	0.347	0.31915	3980	
6/30/2015	18.03	6.16	67	5.49	75.0	1.48	7.05	5.04	120	86	2220		0.0252	*0*	0.374	0.36615	3070	0.00547
7/14/2015	24.11	4.64	56	5.58	77.8	1.66	8.68	6.59	50	31	2760		0.0319	0.00836	0.698	0.40325	3220	0.0151
7/28/2015	22.58	4.35	51	5.88	91.4	1.67	10.9	9.20	160	148	3870		0.0233	0.0111	0.321	0.31285	3870	0.0111
8/11/2015	21.43	4.56	52	5.95	99.8	2.03	11.6	9.64	1060	1190	4610		0.0223	0.0135	0.421	0.27990	4310	0.0106
8/14/2015									170	144	2500							
8/25/2015	22.88	4.04	48	5.96	106.9	1.94	12.2	10.5	90	97	3870		0.0932	0.0131	0.309	0.26985	4520	0.00956
9/8/2015	21.95	6.23	72	6.26	116.1	1.86	12.7	10.8	270	173	2720		0.0241	0.0263	0.391	0.24830	4440	0.0138
9/22/2015	15.67			6.20	106.0	1.63	13.5	11.6	120	97	2250		0.0213	0.0184	0.341	0.26475	4580	0.0154
10/6/2015	10.61	8.53	77	5.94	97.5	1.10	9.66	7.97	30	41	1110		0.0207	0.00564	0.491	0.24125	4090	*0*
10/20/2015	6.85	7.30	60	6.06	112.6	1.09	9.21	7.27	40	63	789		0.0176	0.00538	0.29	0.25575	4740	*0*
11/3/2015	7.34	9.80	83	6.01	101.6	0.866	9.57	7.76	2	20	884		0.0174	*0*	0.331	0.22475	4660	*0*
11/17/2015	3.53	14.19	107	6.56	105.1	1.16	8.89	6.89	314	272	738		0.0158	0.00981	0.223	0.22730	4680	0.00668
12/1/2015	2.44	11.52	84	6.24	102.1	0.681	8.26	6.36	30	*0*	933		0.0175	0.00516	0.226	0.20895	4170	*0*
12/15/2015	6.89	10.38	87	6.10	92.0	0.921	8.32	6.42	14	10	717		0.0168	0.0181	0.292	0.20595	4160	0.00613
12/28/2015	4.96	11.00	87	5.77	79.6	0.844	6.37	4.35	10	20	1310		0.0183	*0*	0.29	0.28695	3500	0.0303
AVG.	10.38	10.19	84	5.91	90.5	1.18	8.59	6.71	102	98	1960		0.0232	0.0302	0.307	0.23534	3710	0.0228
MAX.	24.11	17.45	121	6.56	116.1	2.53	13.5	11.6	1060	1190	7700		0.0932	0.102	0.698	0.40325	4740	0.103
MIN.	0.02	4.04	48	5.49	69.2	0.463	4.85	2.90	*<10*	*<10*	148		0.0114	*<0.005*	0.119	0.14231	2250	*<0.005*
MEDIAN	7.88	9.80	84	5.88	91.7	1.03	8.50	6.51	30	20	1110		0.0188	0.0146	0.301	0.23428	3855	0.0111

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(108B) CUSHING POND OUTLET, AT BEMIS ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	1.81	13.45	97	5.91	90.7	0.572	5.61	3.78	*0*	*0*	644		0.0150	0.0712	0.239	0.17546	2830	0.148
1/26/2015	2.02	15.20	112	5.86	110.5	0.672	5.51	3.74	*0*	*0*	448		0.0148	0.0956	0.267	0.15674	2980	
2/10/2015	0.70	15.84	112	5.64	93.6	0.892	7.09	5.21	*0*	10	441		0.0239	0.0678	0.446	0.21995	2800	0.193
2/24/2015	0.32	15.45	108	5.69	98.4	1.09	8.52	6.83	*0*	*0*	259		0.0199	0.0935	0.489	0.21030	2980	0.286
3/10/2015	0.77	16.11	114	5.96	122.2	1.19	9.31	7.31	*0*	*0*	161		0.0305	0.139	0.678	0.20820	3670	0.354
3/24/2015	0.34	12.96	91	5.85	184.8	0.659	8.34	6.56	*0*	*0*	990		0.0461	0.543	0.550	0.10175	4560	0.160
4/7/2015	4.32	15.40	119	5.50	97.4	0.635	4.99	3.00	*0*	*0*	262		0.0160	0.122	0.250	0.11015	2360	
4/21/2015	11.46	10.38	97	5.59	84.6	0.480	4.14	2.44	*0*	*0*	813		0.0143	0.0679	0.165	0.10769	2130	0.0124
5/5/2015	16.71	8.39	87	5.65	97.0	0.334	3.99	2.45	*0*	10	9210		0.0135	0.0260	0.212	0.11496	2430	0.0296
5/19/2015	17.86	7.87	84	5.63	112.0	0.705	5.39	3.80	*0*	*0*	15500		0.0217	0.0858	0.239	0.15470	2990	0.0440
6/2/2015	15.85	7.77	79	5.58	105.9	1.63	5.26	3.59	10	31	4880		0.0332	0.0245	0.484	0.24215	2940	0.0317
6/16/2015	19.70	5.95	66	5.65	115.6	0.790	5.52	4.06	*0*	10	1520		0.0207	0.0751	0.273	0.18395	3090	
6/30/2015	20.81	6.96	80	5.66	98.4	0.985	5.31	3.53	20	*0*	1940		0.224	0.0157	0.352	0.21595	2460	0.0145
7/14/2015	23.90	5.15	62	5.72	105.9	1.43	5.99	4.15	10	10	8160		0.0274	0.102	0.358	0.20390	2620	0.0473
7/28/2015	22.90	4.92	58	5.76	116.2	0.934	6.59	5.01	*0*	10	3450		0.0207	0.174	0.790	0.19240	3130	
8/11/2015	20.43	4.60	52	5.80	118.2	7.31	7.32	5.31	500	262	11200		0.119	0.117	0.923	0.19105	3880	0.0420
8/14/2015									*0*	30	2060							
8/25/2015	22.55	4.51	53	5.95	122.6	1.25	7.33	5.70	70	41	1530		0.0245	0.0836	0.522	0.17707	3500	0.0271
9/8/2015	22.30	5.85	68	6.11	125.7	1.02	7.43	5.64	10	*0*	1070		0.0224	0.0883	0.312	0.15411	3490	0.0272
9/22/2015	17.00			6.14	127.1	1.16	7.67	5.99	*0*	*0*	1480		0.0168	0.127	0.235	0.12240	3710	0.0314
10/6/2015	12.36	7.70	73	6.13	135.1	1.39	7.68	6.05	*0*	20	450		0.0162	0.0638	0.345	0.09575	3800	0.0383
10/20/2015	9.22	6.48	57	5.91	143.7	0.890	8.17	6.30	*0*	*0*	355		0.0108	0.0544	0.172	0.09258	4300	0.0234
11/3/2015	9.80	9.05	81	5.89	109.7	0.812	5.70	4.05	2	*0*	1330		0.0127	0.0284	0.242	0.11416	2970	0.0148
11/17/2015	5.54	13.79	110	6.45	107.4	0.981	5.84	3.96	*0*	*0*	1720		0.0133	0.123	0.258	0.11792	3110	0.0170
12/1/2015	4.10	11.88	91	6.12	106.4	0.924	5.71	3.95	4	*0*	2140		0.0170	0.0198	0.167	0.10487	2640	0.0187
12/15/2015	6.60	11.37	94	6.05	101.5	1.13	5.36	3.65	4	20	1140		0.0122	0.0189	0.384	0.10923	2610	0.0134
12/28/2015	4.82	13.17	104	6.02	96.5	0.961	5.46	3.60	*0*	*0*	556		0.0138	0.0130	0.275	0.10746	2490	0.0107
AVG.	11.32	10.01	86	5.85	112.6	1.19	6.36	4.60	23	17	2730		0.0316	0.0939	0.370	0.15326	3100	0.0720
MAX.	23.90	16.11	119	6.45	184.8	7.31	9.31	7.31	500	262	15500		0.224	0.543	0.923	0.24215	4560	0.354
MIN.	0.32	4.51	52	5.50	84.6	0.334	3.99	2.44	*<10*	*<10*	161		0.0108	0.0130	0.165	0.09258	2130	0.0107
MEDIAN	10.63	9.05	87	5.86	108.6	0.948	5.78	4.06	*<10*	*<10*	1330		0.0185	0.0794	0.294	0.15441	2980	0.0305

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015

WARE RIVER AND TRIBUTARIES

(108C) EAST BRANCH WARE RIVER, BICKFORD POND OUTLET, AT LOMBARD ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	1.34	15.37	110	6.23	49.3	0.435	5.08	3.35	*0*	*0*	86		0.00885	0.0249	0.119	0.12003	2090	0.0444
1/26/2015	2.00	17.28	127	6.18	50.2	0.538	4.85	3.10	*0*	*0*	122		0.00881	0.0286	0.155	0.11898	2050	
2/10/2015	1.61	18.13	131	6.00	53.0	0.358	5.05	3.42	*0*	*0*	63		0.0106	0.0300	0.226	0.12111	2120	0.0199
2/24/2015	0.01	18.40	127	5.92	51.4	0.494	5.27	3.61	*0*	*0*	86		0.0136	0.0350	0.228	0.13152	2140	0.0392
3/10/2015	1.17	18.69	134	6.04	55.3	0.422	5.65	3.85	*0*	*0*	97		0.0109	0.0399	0.269	0.12471	2370	0.0509
3/24/2015	2.68	16.29	122	5.96	54.4	0.343	5.32	3.70	*0*	*0*	144		0.0109	0.0584	0.204	0.10775	2110	0.0214
4/7/2015	4.08	15.98	123	5.74	46.3	0.359	5.37	2.86	*0*	*0*	148		0.0106	0.0492	0.198	0.10643	1780	
4/21/2015	7.32	12.14	102	5.68	50.5	0.452	4.55	2.77	*0*	10	119		0.0108	0.0474	0.256	0.08948	1990	0.0151
5/5/2015	14.06	9.69	95	5.86	53.8	0.406	4.30	2.78	*0*	*0*	733		0.0128	0.0424	0.136	0.084305	1950	0.00612
5/19/2015	15.98	9.24	94	5.83	56.0	0.456	5.79	4.28	*0*	*0*	3650		0.0142	0.0457	0.168	0.071595	2340	0.0126
6/2/2015	16.61	8.50	88	5.79	53.5	0.959	4.76	3.11	50	63	2720		0.0141	0.00901	0.237	0.080195	2400	*0*
6/16/2015	19.05	6.74	74	5.91	54.0	0.482	5.14	3.65	10	*0*	2910		0.00902	0.0147	*0*	0.065275	2250	
6/30/2015	20.59	7.83	89	5.89	52.5	0.511	5.06	3.43	10	10	2100		0.00963	*0*	0.119	0.069530	2060	*0*
7/14/2015	21.99	6.14	71	5.97	52.6	0.573	6.35	4.57	60	75	5790		0.0115	0.0357	0.218	0.065645	2290	0.0143
7/28/2015	19.41	6.26	69	6.32	59.7	0.786	12.3	10.7	*0*	*0*	2990		0.00969	0.227	0.220	0.051525	3800	
8/11/2015	18.01	5.90	63	6.24	54.4	1.49	11.9	10.1	290	148	15500		0.0164	0.182	0.259	0.075825	3720	*0*
8/25/2015	19.12	5.49	60	6.49	63.3	1.05	13.7	12.0	20	10	1140		0.0135	0.168	*0*	0.053525	4230	*0*
9/8/2015	19.09	7.08	77	6.63	65.4	1.19	13.8	12.0	10	10	1550		0.0133	0.192	0.126	0.052500	4300	*0*
9/22/2015	12.99			6.52	63.1	1.48	12.8	11.1	20	*0*	933		0.0107	0.106	*0*	0.056065	4410	*0*
10/6/2015	9.64	8.94	79	6.30	59.8	1.26	11.7	10.1	30	41	1140		0.00903	0.0749	*0*	0.055040	3750	*0*
10/20/2015	6.15	7.76	63	6.53	64.4	1.76	14.8	13.0	*0*	*0*	1310		0.0104	0.00582	*0*	0.11580	4720	*0*
11/3/2015	8.52	10.13	88	6.00	56.3	0.929	8.03	6.37	*0*	*0*	959		0.00731	0.0133	0.149	0.058525	3090	*0*
11/17/2015	4.27	15.10	117	6.67	56.2	1.42	8.65	6.85	*0*	*0*	496		0.0121	0.0257	0.104	0.051535	3150	0.0142
12/1/2015	4.30	12.71	98	6.41	55.4	0.897	6.88	5.12	*0*	*0*	414		0.0108	0.0100	0.146	0.051235	2460	0.00946
12/15/2015	6.09	12.51	103	6.30	52.9	1.01	5.76	4.06	*0*	*0*	383		0.00770	0.00722	0.276	0.060365	2290	*0*
12/28/2015	4.03	13.32	103	6.07	52.1	0.590	5.60	3.77	*0*	*0*	341		0.00667	*0*	0.192	0.059320	2170	*0*
AVG.	10.00	11.42	96	6.13	55.2	0.794	7.63	5.91	19	14	1770		0.0109	0.0566	0.154	0.08069	2770	0.0113
MAX.	21.99	18.69	134	6.67	65.4	1.76	14.8	13.0	290	148	15500		0.0164	0.227	0.276	0.13152	4720	0.0509
MIN.	0.01	5.49	60	5.68	46.3	0.343	4.30	2.77	*<10*	*<10*	63		0.00667	*<0.005*	*<0.100*	0.05124	1780	*<0.005*
MEDIAN	7.92	10.13	95	6.06	54.2	0.582	5.71	3.96	*<10*	*<10*	830		0.0108	0.0354	0.162	0.07056	2315	0.0031

NOTES

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Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(116) COMET POND AT OUTLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	1.39	16.76	120	6.18	50.2	0.418	5.10	3.29	*0*	*0*	20		0.00797	0.0132	0.110	0.061370	1880	0.0351
1/26/2015	1.61	17.55	127	6.04	47.5	0.574	5.28	3.68	*0*	*0*	0		0.0103	0.0146	0.174	0.060370	1760	
2/10/2015	1.63	17.81	129	5.67	42.6	0.231	5.16	3.52	*0*	*0*	20		0.0246	0.0155	0.319	0.057080	1620	0.0214
2/24/2015	1.00	18.14	129	5.85	41.7	0.174	4.95	3.35	*0*	*0*	0		0.00646	0.0170	0.192	0.056525	1630	
3/10/2015	0.94	18.22	130	5.97	42.9	0.151	5.22	3.34	*0*	*0*	0		0.00747	0.0199	0.223	0.055040	1660	0.0220
3/24/2015	3.05	15.10	114	5.76	42.2	0.200	5.03	3.35	*0*	*0*	10		0.00694	0.0269	0.170	0.054830	1560	*0*
4/7/2015	4.02	16.30	125	5.72	37.7	0.229	4.50	2.58	*0*	*0*	31		0.00695	0.0247	0.129	0.049345	1360	
4/21/2015	7.35	12.76	108	5.71	40.3	0.457	4.61	2.79	*0*	*0*	85		0.00681	0.0182	0.143	0.063845	1580	*0*
5/5/2015	13.07	10.76	103	5.96	41.8	0.496	4.62	3.02	*0*	*0*	62		0.0113	*0*	0.151	0.058200	1560	0.00780
5/19/2015	17.65	9.30	98	5.98	42.4	0.324	4.58	3.07	*0*	*0*	231		0.00958	*0*	0.157	0.055005	1590	*0*
6/2/2015	17.98	8.18	87	5.82	41.9	0.371	4.39	2.77	*0*	*0*	364		0.00695	*0*	0.171	0.050575	1720	*0*
6/16/2015	20.79	6.39	73	5.96	42.3	0.399	4.30	2.85	*0*	*0*	712		0.00756	*0*	0.180	0.051500	1600	
6/30/2015	21.38	6.96	80	5.94	42.0	0.442	4.53	2.82	*0*	*0*	448		0.00695	*0*	0.123	0.053515	1570	*0*
7/14/2015	25.10	6.03	74	6.07	41.7	0.378	4.95	3.19	*0*	10	1780		0.00830	*0*	0.223	0.053325	1450	0.00521
7/28/2015	24.69	5.47	67	6.16	42.6	0.352	4.34	2.74	*0*	*0*	727		*0*	*0*	0.164	0.050300	1560	
8/11/2015	23.91	5.31	64	6.02	42.1	0.387	4.55	2.75	*0*	*0*	1780		0.00599	*0*	0.211	0.047545	1560	*0*
12/15/2015	7.54	11.17	95	6.04	42.6	0.640	4.95	3.17	2	10	504		0.00668	0.00826	0.340	0.048385	1680	*0*
12/28/2015	5.52	11.60	93	6.00	42.8	0.428	5.30	3.50	*0*	10	135		0.00539	0.00758	0.156	0.046520	1590	0.00592
AVG.	11.03	11.88	101	5.94	42.6	0.370	4.80	3.10	0	2	380		0.00812	0.00921	0.185	0.054071	1610	0.0075
MAX.	25.10	18.22	130	6.18	50.2	0.64	5.30	3.68	2	10	1780		0.0246	0.0269	0.340	0.063845	1880	0.0351
MIN.	0.94	5.31	64	5.67	37.7	0.151	4.30	2.58	*<10*	*<10*	*<10*		*<0.005*	*<0.005*	0.110	0.046520	1360	*<0.005*
MEDIAN	7.45	11.39	101	5.97	42.3	0.383	4.79	3.12	*<10*	*<10*	110		0.00695	0.00792	0.171	0.054173	1590	*<0.005*

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
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Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(116B) COMET POND OUTLET AT ROUTE 62 NEAR CLARK ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.20	12.40	86	5.71	62.5	0.407	4.92	2.91	*0*	*0*	905		0.0137	0.0285	0.138	0.16062	2330	0.0409
1/26/2015	0.14	14.91	104	5.62	59.9	0.432	4.54	2.57	*0*	*0*	609		0.0103	0.0256	0.225	0.15005	2010	
2/10/2015	0.06	17.41	121	5.58	54.4	0.318	4.50	2.63	*0*	*0*	410		0.0118	0.0268	0.303	0.13248	1810	0.0364
2/24/2015	0.10	14.34	99	5.40	61.3	0.378	4.93	3.06	*0*	*0*	521		0.0142	0.0325	0.294	0.16433	2020	
3/10/2015	0.21	15.07	105	5.79	69.3	0.402	5.07	3.10	*0*	*0*	448		0.0172	0.0374	0.305	0.19975	2410	0.0678
3/24/2015	0.34	13.72	96	5.41	77.9	0.371	4.34	2.50	*0*	*0*	448		0.0156	0.0389	0.266	0.20800	2040	0.0336
4/7/2015	2.68	14.18	105	5.22	58.3	0.356	3.67	1.58	*0*	*0*	717		0.0148	0.0187	0.148	0.22175	1500	
4/21/2015	8.04	10.57	91	5.24	58.6	0.526	3.40	1.57	*0*	10	1660		0.0149	0.0170	0.231	0.26430	1710	0.0108
5/5/2015	15.67	6.04	61	5.25	66.7	0.676	4.42	2.73	*0*	10	3970		0.0198	*0*	0.308	0.28780	1900	0.0113
5/19/2015	18.12	4.12	44	5.28	86.3	1.10	6.49	4.62	20	20	4350		0.0392	*0*	0.408	0.35550	2610	0.0281
6/2/2015	11.02	7.52	69	5.17	101.8	0.768	4.09	2.16	1590	1050	13000		0.0264	*0*	0.485	0.66485	3190	0.0224
6/16/2015	17.61	4.34	46	5.09	74.3	0.621	5.49	3.79	60	63	5170		0.0244	*0*	0.350	0.37235	2410	
6/30/2015	18.17	5.38	58	4.74	63.0	0.439	4.11	2.18	40	75	5480		0.0197	*0*	0.413	0.61740	2050	0.00552
7/14/2015	23.25	3.18	38	5.06	60.0	0.758	5.50	3.53	*0*	*0*	7700		0.0234	*0*	0.417	0.44480	1930	0.0159
7/28/2015	22.21	2.80	33	5.10	70.7	1.08	6.54	4.85	*0*	20	5480		0.0228	0.00776	0.448	0.28540	2140	
8/11/2015	19.34	3.47	38	5.43	98.6	1.25	5.58	3.62	20	146	11200		0.0309	0.0258	0.525	0.26285	2400	0.0516
10/6/2015	10.94	6.57	60	5.42	132.5	0.466	8.24	6.30	20	20	2100		0.0212	*0*	0.465	0.48840	4340	0.0246
11/3/2015	8.19	8.40	72	5.49	132.0	0.702	6.84	4.78	4	*0*	1940		0.0224	*0*	0.434	0.61250	4510	0.0175
11/17/2015	4.44	10.16	79	5.93	117.5	1.070	7.32	4.95	*0*	*0*	2010		0.0252	*0*	0.557	0.67455	4050	0.0220
12/1/2015	2.91	6.19	46	5.68	120.1	1.420	8.43	6.04	*0*	*0*	2060		0.0314	*0*	0.522	0.79885	4300	0.0126
12/15/2015	8.01	6.93	60	5.54	97.9	1.610	6.91	4.61	2	*0*	3130		0.0307	*0*	0.473	0.72325	4010	0.00922
12/28/2015	4.00	9.46	73	4.96	62.6	0.456	3.52	1.44	8	10	1480			*0*		0.50330	2220	*0*
AVG.	8.89	8.96	72	5.37	81.2	0.709	5.40	3.43	80	65	3400		0.0214	0.0118	0.367	0.390595	2630	0.0241
MAX.	23.25	17.41	121	5.93	132.5	1.61	8.43	6.30	1590	1050	13000		0.0392	0.0389	0.557	0.798850	4510	0.0678
MIN.	0.06	2.80	33	4.74	54.4	0.318	3.40	1.44	*<10*	*<10*	410		0.0103	*<0.005*	0.138	0.132480	1500	*<0.005*
MEDIAN	8.03	7.96	71	5.41	70.0	0.574	5.00	3.08	*<10*	*<10*	2040		0.0212	*<0.005*	0.408	0.321650	2275	0.0220

NOTES

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Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
WARE RIVER AND TRIBUTARIES
(121B) THAYER POND, AT INLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/13/2015	0.36	12.16	84.7	6.53	323.6	0.418			*0*	*0*	364					0.14547	11400	
1/26/2015	0.36	14.40	100.9	6.51	288.2	0.601			*0*	*0*	262					0.13811	11000	
2/10/2015	0.07	14.33	99.5	6.05	313.8	0.552			*0*	*0*	262					0.13275	11600	
2/24/2015	0.06	12.52	86.5	6.10	307.4	0.813			*0*	*0*	213					0.12560	12200	
3/10/2015	0.06	12.90	89.6	6.22	312.4	0.923			2	*0*	243					0.11755	13100	
3/24/2015	0.41	12.11	85.3	6.23	346.9	0.920			*0*	*0*	216		0.0179	0.107	0.303	0.16659	11400	0.0910
4/7/2015	3.75	13.49	102.8	6.08	217.8	0.549			*0*	*0*	156					0.12957	7700	
4/21/2015	9.84	7.51	67.3	6.00	249.4	0.383			176	185	1480					0.13446	8800	
5/5/2015	15.80	3.54	36.1	5.91	277.6	0.622			752	906	6490					0.15968	10400	
5/19/2015	18.57	2.98	32.1	5.87	285.2	1.51			50	*0*	9800					0.19745	12000	
6/2/2015	12.80	2.96	28.3	5.91	272.6	2.16			80	135	5790					0.14970	11000	
6/16/2015	17.85	2.43	26.0	5.90	265.0	1.87			180	193	6490		0.0251	*0*	0.300	0.15459	11500	0.00573
6/30/2015	17.33	2.50	26.7	5.86	248.7	1.12			*0*	41	5790					0.18765	10500	
7/14/2015	22.79	2.13	25.2	5.82	250.9	2.15			30	30	11200					0.16471	12200	
7/28/2015	20.91	1.54	17.5	5.80	260.3	1.94			20	41	17300					0.18165	11000	
8/11/2015	19.83	1.43	15.9	5.89	256.5	1.04			60	74	24200					0.20105	10900	
8/25/2015	21.76	1.74	20.2	5.89	257.5	1.57			40	52		>24200				0.20445	11400	
9/8/2015	19.99	2.58	28.6	5.91	261.9	1.25			10	31		>24200				0.16776	11000	
9/22/2015	15.36			5.88	255.1	1.23			60	148	24200		0.0190	*0*	0.500	0.15245	10400	0.0184
10/6/2015	10.12	5.84	52.4	5.87	268.8	0.580			20	73	9800					0.12559	12400	
10/20/2015	5.52	5.37	42.8	6.10	271.9	0.692			*0*	*0*	2600					0.12157	12200	
11/3/2015	6.95	7.11	59.4	6.04	274.5	0.736			4	20	3260					0.14125	13000	
11/17/2015	3.94	8.42	64.4	6.39	275.4	1.52			8	31	2140					0.11898	12800	
12/1/2015	3.86	6.72	51.1	6.18	259.7	0.686			4	20	1620					0.14479	11800	
12/15/2015	6.07	4.75	38.9	6.04	254.5	0.714			28	73	2380		0.00864	0.00776	0.371	0.19750	12100	*0*
12/28/2015	3.88	9.22	71.0	6.13	246.8	0.643			2	*0*	798					0.11721	12000	
AVG.	9.93	6.83	54	6.04	273.2	1.05			59	79	5710		0.0177	0.0287	0.369	0.15301	11380	0.0288
MAX.	22.79	14.40	103	6.53	346.9	2.16			752	906	24200		0.0251	0.107	0.500	0.20445	13100	0.0910
MIN.	0.06	1.43	16	5.80	217.8	0.383			*<10*	*<10*	156		0.00864	*<0.005*	0.300	0.11721	7700	*<0.005*
MEDIAN	8.40	5.84	51	6.02	266.9	0.867			9	31	2490		0.0185	0.00388	0.337	0.14759	11450	0.0121

NOTES

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TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	1/1/2015	6.5	6.67	*0*	7	*0*	
WABWTF	1/2/2015	6.4	6.65	*0*	6	3.1	
WABWTF	1/3/2015	6.3	6.61	*0*	15	*0*	
WABWTF	1/4/2015	6.1	6.63	1	15	*0*	
WABWTF	1/5/2015	6.1	6.63	2	6	*0*	
WABWTF	1/6/2015	4.9	6.90	*0*	9	1	
WABWTF	1/7/2015	5.7	6.61	*0*	6	1	
WABWTF	1/8/2015	5.0	6.60	3	12	*0*	
WABWTF	1/9/2015	5.2	6.54	1	3	1	
WABWTF	1/10/2015	4.8	6.57	1	4	1	
WABWTF	1/11/2015	4.7	6.60	1	10	*0*	
WABWTF	1/12/2015	4.8	6.60	*0*	4	*0*	
WABWTF	1/13/2015	3.3	6.75	1	26	2	
WABWTF	1/14/2015	3.9	6.62	2	4	1	
WABWTF	1/15/2015	3.1	6.61	*0*	9	*0*	
WABWTF	1/16/2015	3.7	6.65	1	5	2	
WABWTF	1/17/2015	3.2	6.60	*0*	1	*0*	
WABWTF	1/18/2015	3.1	6.55	*0*	5	*0*	
WABWTF	1/19/2015	3.6	6.58	*0*	6	1	
WABWTF	1/20/2015	2.5	6.79	*0*	4	*0*	
WABWTF	1/21/2015	2.5	6.56	*0*	2	*0*	
WABWTF	1/22/2015	2.4	6.60	*0*	3	*0*	
WABWTF	1/23/2015	2.4	6.62	*0*	1	*0*	
WABWTF	1/24/2015	3.2	6.59	*0*	1	*0*	
WABWTF	1/25/2015	2.1	6.54	*0*	3	*0*	
WABWTF	1/26/2015	2.0	6.51	*0*	2	*0*	
WABWTF	1/27/2015	1.3	6.65	3	9	3.1	
WABWTF	1/28/2015	1.3	6.51	2	7	1	
WABWTF	1/29/2015	0.9	6.62	1	1	*0*	
WABWTF	1/30/2015	1.7	6.60	1	3	1	
WABWTF	1/31/2015	1.9	6.60	*0*	3	1	
WABWTF	2/1/2015	1.4	6.61	*0*	1	1	
WABWTF	2/2/2015	1.4	6.60	*0*	*0*	*0*	
WABWTF	2/3/2015	1.6	6.80	*0*	1	*0*	
WABWTF	2/4/2015	1.6	6.53	*0*	1	*0*	
WABWTF	2/5/2015	1.6	6.53	*0*	*0*	*0*	
WABWTF	2/6/2015	1.9	6.53	1	4	1	
WABWTF	2/7/2015	1.8	6.51	*0*	1	*0*	
WABWTF	2/8/2015	1.7	6.47	*0*	3	*0*	
WABWTF	2/9/2015	1.8	6.51	*0*	2	*0*	
WABWTF	2/10/2015	1.8	6.86	*0*	1	1	
WABWTF	2/11/2015	1.8	6.41	*0*	1	1	
WABWTF	2/12/2015	1.9	6.57	*0*	2	*0*	
WABWTF	2/13/2015	1.9	6.51	*0*	1	1	
WABWTF	2/14/2015	1.9	6.41	1	1	1	
WABWTF	2/15/2015	1.9	6.46	1	5	*0*	
WABWTF	2/16/2015	1.9	6.49	*0*	1	*0*	
WABWTF	2/17/2015	1.8	6.78	*0*	*0*	*0*	
WABWTF	2/18/2015	1.9	6.38	*0*	2	1	
WABWTF	2/19/2015	1.9	6.52	*0*	*0*	*0*	
WABWTF	2/20/2015	2.0	6.50	1	2	*0*	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	2/21/2015	2.1	6.45	1	*0*	*0*	
WABWTF	2/22/2015	1.9	6.39	*0*	1	*0*	
WABWTF	2/23/2015	1.7	6.43	*0*	*0*	*0*	
WABWTF	2/24/2015	2.4	6.75	*0*	2	*0*	
WABWTF	2/25/2015	1.9	6.44	*0*	1	*0*	
WABWTF	2/26/2015	1.9	6.42	1	1	1	
WABWTF	2/27/2015	2.1	6.72	*0*	*0*	*0*	
WABWTF	2/28/2015	2.0	6.60	*0*	1	*0*	
WABWTF	3/1/2015	2.0	6.61	*0*	*0*	*0*	
WABWTF	3/2/2015	1.9	6.60	*0*	*0*	*0*	
WABWTF	3/3/2015	1.8	6.61	*0*	1	*0*	
WABWTF	3/4/2015	2.0	6.63	*0*	1	*0*	
WABWTF	3/5/2015	2.1	6.51	*0*	*0*	*0*	
WABWTF	3/6/2015	1.9	6.53	*0*	1	1	
WABWTF	3/7/2015	2.1	6.37	*0*	1	*0*	
WABWTF	3/8/2015	2.1	6.48	*0*	1	*0*	
WABWTF	3/9/2015	1.6	6.83	*0*	1	*0*	
WABWTF	3/10/2015	2.1	6.72	*0*	1	*0*	
WABWTF	3/11/2015	2.1	6.55	*0*	*0*	*0*	
WABWTF	3/12/2015	2.2	6.53	*0*	*0*	*0*	
WABWTF	3/13/2015	1.7	6.64	*0*	*0*	*0*	
WABWTF	3/14/2015	2.1	6.61	*0*	1	*0*	
WABWTF	3/15/2015	2.1	6.62	*0*	1	*0*	
WABWTF	3/16/2015	2.0	6.60	*0*	*0*	*0*	
WABWTF	3/17/2015	1.8	6.76	*0*	1	*0*	
WABWTF	3/18/2015	2.1	6.52	*0*	*0*	*0*	
WABWTF	3/19/2015	2.3	6.50	*0*	1	*0*	
WABWTF	3/20/2015	2.1	6.82	*0*	1	*0*	
WABWTF	3/21/2015	2.5	6.46	*0*	2	*0*	
WABWTF	3/22/2015	2.3	6.43	*0*	*0*	*0*	
WABWTF	3/23/2015	1.9	6.84	*0*	*0*	*0*	
WABWTF	3/24/2015	2.2	6.81	*0*	*0*	*0*	
WABWTF	3/25/2015	2.6	6.57	*0*	2	*0*	
WABWTF	3/26/2015	2.6	6.49	*0*	1	*0*	
WABWTF	3/27/2015	2.2	6.81	*0*	3	*0*	
WABWTF	3/28/2015	2.8	6.55	*0*	*0*	*0*	
WABWTF	3/29/2015	2.6	6.56	1	3	*0*	
WABWTF	3/30/2015	2.6	6.55	*0*	1	*0*	
WABWTF	3/31/2015	2.3	6.79	*0*	1	*0*	
WABWTF	4/1/2015	2.7	6.49	1	3	*0*	
WABWTF	4/2/2015	2.6	6.47	*0*	2	1	
WABWTF	4/3/2015	2.9	6.48	*0*	2	*0*	
WABWTF	4/4/2015	3.0	6.45	*0*	*0*	*0*	
WABWTF	4/5/2015	2.7	6.49	*0*	1	*0*	
WABWTF	4/6/2015	3.0	6.52	*0*	1	*0*	
WABWTF	4/7/2015	2.7	6.81	*0*	1	*0*	
WABWTF	4/8/2015	3.1	6.63	*0*	1	*0*	
WABWTF	4/9/2015	3.3	6.47	*0*	2	*0*	
WABWTF	4/10/2015	3.3	6.45	*0*	4	*0*	
WABWTF	4/11/2015	3.4	6.50	*0*	1	*0*	
WABWTF	4/12/2015	3.3	6.55	*0*	1	*0*	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	4/13/2015	3.3	6.45	0	0	0	
WABWTF	4/14/2015	3.8	6.70	0	1	0	
WABWTF	4/15/2015	4.0	6.52	0	2	0	
WABWTF	4/16/2015	4.0	6.28	0	0	0	
WABWTF	4/17/2015	4.3	6.36	0	3	1	
WABWTF	4/18/2015	4.6	6.35	0	1	0	
WABWTF	4/19/2015	5.1	6.30	1	7	0	
WABWTF	4/20/2015	4.9	6.32	0	3	0	
WABWTF	4/21/2015	4.2	6.64	0	2	0	
WABWTF	4/22/2015	5.5	6.36	0	4	0	
WABWTF	4/23/2015	5.2	6.37	0	1	0	
WABWTF	4/24/2015	5.4	6.49	0	2	0	
WABWTF	4/25/2015	5.3	6.45	0	1	0	
WABWTF	4/26/2015	5.7	6.46	0	0	0	
WABWTF	4/27/2015	5.9	6.50	0	2	0	
WABWTF	4/28/2015	5.7	6.84	0	3	0	
WABWTF	4/29/2015	6.1	6.50	0	2	0	
WABWTF	4/30/2015	6.2	6.40	0	5	0	
WABWTF	5/1/2015	6.2	6.44	0	3	0	
WABWTF	5/2/2015	6.3	6.40	0	5	0	
WABWTF	5/3/2015	6.3	6.41	0	2	0	
WABWTF	5/4/2015	6.2	6.48	0	4	0	
WABWTF	5/5/2015	5.1	6.53	0	6	1	
WABWTF	5/6/2015	6.5	6.44	0	5	0	
WABWTF	5/7/2015	7.1	6.46	0	3	0	
WABWTF	5/8/2015	6.4	6.48	0	3	0	
WABWTF	5/9/2015	7.7	6.42	1	6	0	
WABWTF	5/10/2015	6.2	6.43	1	2	0	
WABWTF	5/11/2015	6.5	6.43	0	5	0	
WABWTF	5/12/2015	7.8	6.87	0	5	0	
WABWTF	5/13/2015	8.6	6.53	0	11	0	
WABWTF	5/14/2015	8.2	6.57	0	12	0	
WABWTF	5/15/2015	7.8	6.55	0	6	0	
WABWTF	5/16/2015	7.8	6.54	0	5	0	
WABWTF	5/17/2015	8.1	6.56	0	7	0	
WABWTF	5/18/2015	8.5	6.56	0	19	0	
WABWTF	5/19/2015	7.1	6.71	0	8	1	
WABWTF	5/20/2015	8.5	6.52	0	19	0	
WABWTF	5/21/2015	8.1	6.57	0	23	0	
WABWTF	5/22/2015	7.8	6.52	0	4	0	
WABWTF	5/23/2015	8.3	6.56	0	10	0	
WABWTF	5/24/2015	8.4	6.65	0	14	0	
WABWTF	5/25/2015	7.9	6.59	0	9	0	
WABWTF	5/26/2015	7.8	6.88	0	8	0	
WABWTF	5/27/2015	8.9	6.61	0	12	0	
WABWTF	5/28/2015	8.6	6.63	0	5	0	
WABWTF	5/29/2015	9.0	6.54	0	9	0	
WABWTF	5/30/2015	8.6	6.53	0	16	0	
WABWTF	5/31/2015	8.3	6.63	0	5	0	
WABWTF	6/1/2015	9.5	6.54	0	15	0	
WABWTF	6/2/2015	10.9	6.91	0	37	1	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	6/3/2015	9.1	6.55	*0*	5	*0*	
WABWTF	6/4/2015	8.9	6.62	*0*	5	*0*	
WABWTF	6/5/2015	9.3	6.53	*0*	8	*0*	
WABWTF	6/6/2015	9.3	6.51	*0*	15	*0*	
WABWTF	6/7/2015	9.3	6.57	*0*	25	*0*	
WABWTF	6/8/2015	8.7	6.59	*0*	6	*0*	
WABWTF	6/9/2015	10.2	6.81	*0*	6	1	
WABWTF	6/10/2015	10.3	6.61	*0*	9	*0*	
WABWTF	6/11/2015	9.1	6.53	*0*	11	*0*	
WABWTF	6/12/2015	10.2	6.54	*0*	10	*0*	
WABWTF	6/13/2015	9.4	6.51	*0*	6	*0*	
WABWTF	6/14/2015	10.0	6.55	*0*	5	*0*	
WABWTF	6/15/2015	9.6	6.55	*0*	6	*0*	
WABWTF	6/16/2015	10.2	6.82	*0*	8	*0*	
WABWTF	6/17/2015	10.1	6.54	*0*	10	*0*	
WABWTF	6/18/2015	10.1	6.54	*0*	4	*0*	
WABWTF	6/19/2015	9.9	6.55	*0*	4	*0*	
WABWTF	6/20/2015	11.1	6.62	*0*	7	*0*	
WABWTF	6/21/2015	10.1	6.54	*0*	8	*0*	
WABWTF	6/22/2015	10.3	6.64	*0*	5	*0*	
WABWTF	6/23/2015	9.8	6.76	*0*	8	*0*	
WABWTF	6/24/2015	12.0	6.73	*0*	20	*0*	
WABWTF	6/25/2015	10.0	6.64	*0*	10	*0*	
WABWTF	6/26/2015	10.7	6.65	*0*	16	*0*	
WABWTF	6/27/2015	10.9	6.67	*0*	13	*0*	
WABWTF	6/28/2015	11.7	6.64	*0*	34	*0*	
WABWTF	6/29/2015	10.4	6.63	*0*	20	*0*	
WABWTF	6/30/2015	11.1	6.78	*0*	12	*0*	
WABWTF	7/1/2015	10.7	6.68	*0*	25	*0*	
WABWTF	7/2/2015	10.9	6.67	*0*	20	*0*	
WABWTF	7/3/2015	11.1	6.59	*0*	12	*0*	
WABWTF	7/4/2015	10.7	6.64	*0*	20	*0*	
WABWTF	7/5/2015	11.0	6.67	*0*	25	*0*	
WABWTF	7/6/2015	11.2	6.68	*0*	17	*0*	
WABWTF	7/7/2015	11.0	6.74	*0*	11	*0*	
WABWTF	7/8/2015	10.9	6.60	*0*	16	*0*	
WABWTF	7/9/2015	11.3	6.66	*0*	18	*0*	
WABWTF	7/10/2015	11.1	6.62	*0*	22	*0*	
WABWTF	7/11/2015	11.3	6.51	*0*	23	*0*	
WABWTF	7/12/2015	11.4	6.65	*0*	23	*0*	
WABWTF	7/13/2015	11.8	6.72	*0*	20	*0*	
WABWTF	7/14/2015	11.0	6.66	*0*	17	*0*	
WABWTF	7/15/2015	11.5	6.65	*0*	22	*0*	
WABWTF	7/16/2015	11.7	6.52	*0*	24	*0*	
WABWTF	7/17/2015	10.9	6.60	*0*	26	*0*	
WABWTF	7/18/2015	11.3	6.61	*0*	38	*0*	
WABWTF	7/19/2015	11.3	6.58	*0*	48	*0*	
WABWTF	7/20/2015	11.7	6.59	*0*	86	*0*	
WABWTF	7/21/2015	11.5	6.76	*0*	83	*0*	
WABWTF	7/22/2015	11.7	6.60	*0*	236	*0*	
WABWTF	7/23/2015	11.1	6.52	*0*	111	*0*	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	7/24/2015	11.7	6.56	0	187	0	
WABWTF	7/25/2015	12.0	6.55	0	96	0	
WABWTF	7/26/2015	11.5	6.58	0	101	0	
WABWTF	7/27/2015	11.7	6.67	0	182	0	
WABWTF	7/28/2015	11.4	6.72	0	429	0	
WABWTF	7/29/2015	12.1	6.59	0	222	0	
WABWTF	7/30/2015	11.7	6.46	0	271	0	
WABWTF	7/31/2015	12.1	6.59	0	374	0	
WABWTF	8/1/2015	12.0	6.56	0	247	0	
WABWTF	8/2/2015	12.1	6.58	0	403	0	
WABWTF	8/3/2015	12.3	6.61	0	323	0	
WABWTF	8/4/2015	12.1	6.73	0	456	0	
WABWTF	8/5/2015	12.2	6.49	0	437	0	
WABWTF	8/6/2015	12.7	6.47	0	615	0	
WABWTF	8/7/2015	12.5	6.52	0	1370	0	
WABWTF	8/8/2015	13.1	6.44	0	977	0	
WABWTF	8/9/2015	12.3	6.57	0	345	0	
WABWTF	8/10/2015	12.5	6.56	0	370	0	
WABWTF	8/11/2015	12.4	6.77	0	731	0	
WABWTF	8/12/2015	13.3	6.67	0	551	0	
WABWTF	8/13/2015	12.7	6.65	0	731	0	
WABWTF	8/14/2015	12.3	6.62	0	300	0	
WABWTF	8/15/2015	12.5	6.56	0	472	0	
WABWTF	8/16/2015	11.9	6.56	0	332	0	
WABWTF	8/17/2015	12.7	6.58	0	731	0	
WABWTF	8/18/2015	12.5	6.75	0	333	0	
WABWTF	8/19/2015	12.5	6.58	0	409	0	
WABWTF	8/20/2015	12.7	6.49	0	374	0	
WABWTF	8/21/2015	13.1	6.45	0	384	0	
WABWTF	8/22/2015	13.2	6.55	0	372	0	
WABWTF	8/23/2015	13.1	6.52	0	403	0	
WABWTF	8/24/2015	12.9	6.59	0	403	0	
WABWTF	8/25/2015	13.4	6.80	0	651	0	
WABWTF	8/26/2015	13.5	6.52	0	498	0	
WABWTF	8/27/2015	13.5	6.50	0	1100	0	
WABWTF	8/28/2015	13.5	6.51	0	496	0	
WABWTF	8/29/2015	13.0	6.51	0	284	0	
WABWTF	8/30/2015	12.9	6.56	0	449	0	
WABWTF	8/31/2015	13.3	6.51	0	472	0	
WABWTF	9/1/2015	13.8	6.79	0	420	0	
WABWTF	9/2/2015	13.5	6.55	0	521	0	
WABWTF	9/3/2015	14.3	6.56	0	690	0	
WABWTF	9/4/2015	14.4	6.52	0	775	2	
WABWTF	9/5/2015	13.6	6.55	0	977	0	
WABWTF	9/6/2015	12.8	6.52	0	775	0	
WABWTF	9/7/2015	13.0	6.56	0	690	0	
WABWTF	9/8/2015	13.4	6.76	0	922	0	
WABWTF	9/9/2015	13.3	6.58	0	775	0	
WABWTF	9/10/2015	14.7	6.55	0	2410	0	
WABWTF	9/11/2015	16.6	6.52	1	1840	2	
WABWTF	9/12/2015	13.5	6.53	0	1730	0	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	9/13/2015	14.2	6.60	*0*	1730	*0*	
WABWTF	9/14/2015	14.1	6.58	1	2240	*0*	
WABWTF	9/15/2015	13.4	6.69	*0*	1450	*0*	
WABWTF	9/16/2015	13.6	6.60	*0*	1960	*0*	
WABWTF	9/17/2015	13.3	6.56	*0*	2240	*0*	
WABWTF	9/18/2015	13.9	6.58	*0*	1630	*0*	
WABWTF	9/19/2015	14.2	6.53	*0*		*0*	>4840
WABWTF	9/20/2015	13.8	6.52	*0*	2830	*0*	
WABWTF	9/21/2015	13.5	6.53	*0*	2320	*0*	
WABWTF	9/22/2015	15.8	6.77	*0*	2910	*0*	
WABWTF	9/23/2015	13.9	6.58	*0*	3270	4	
WABWTF	9/24/2015	13.6	6.52	*0*	2320	*0*	
WABWTF	9/25/2015	14.3	6.49	*0*	2070	*0*	
WABWTF	9/26/2015	14.1	6.50	*0*	4810	*0*	
WABWTF	9/27/2015	14.3	6.53				
WABWTF	9/28/2015	13.9	6.50	*0*	2070	*0*	
WABWTF	9/29/2015	14.2	6.68	*0*	3920	*0*	
WABWTF	9/30/2015	15.0	6.51	*0*	1840	*0*	
WABWTF	10/1/2015	21.0	6.56	2	1640	*0*	
WABWTF	10/2/2015	20.3	6.56	*0*	1950	4	
WABWTF	10/3/2015	19.9	6.63	1	1840	4	
WABWTF	10/4/2015	19.4	6.60	*0*	2070	*0*	
WABWTF	10/5/2015	19.1	6.74	*0*	1460	*0*	
WABWTF	10/6/2015	17.2	6.81	5	1300	4	
WABWTF	10/7/2015	16.5	6.55	1	1300	*0*	
WABWTF	10/8/2015	17.4	6.51	1	2320	*0*	
WABWTF	10/9/2015	15.2	6.45	*0*	1640	*0*	
WABWTF	10/10/2015	18.4	6.54	*0*	774	*0*	
WABWTF	10/11/2015	16.4	6.46	*0*	1190	*0*	
WABWTF	10/12/2015	14.7	6.31	1	1840	*0*	
WABWTF	10/13/2015	15.8	6.56	*0*	1840	*0*	
WABWTF	10/14/2015	15.8	6.36	*0*	3920	*0*	
WABWTF	10/15/2015	17.1	6.39	1	2450	*0*	
WABWTF	10/16/2015	14.9	6.41	*0*	2600	*0*	
WABWTF	10/17/2015	16.2	6.38	1	1640	*0*	
WABWTF	10/18/2015	16.9	6.45	*0*	875	*0*	
WABWTF	10/19/2015	16.3	6.55	*0*	568	*0*	
WABWTF	10/20/2015	14.0	6.58	*0*	580	*0*	
WABWTF	10/21/2015	15.6	6.42	*0*	417	*0*	
WABWTF	10/22/2015	15.7	6.45	*0*	516	4	
WABWTF	10/23/2015	15.5	6.51	*0*	494	*0*	
WABWTF	10/24/2015	15.2	6.52	*0*	395	*0*	
WABWTF	10/25/2015	14.7	6.51	*0*	316	*0*	
WABWTF	10/26/2015	14.6	6.45	*0*	293	*0*	
WABWTF	10/27/2015	14.1	6.82	*0*	333	*0*	
WABWTF	10/28/2015	14.3	6.54	*0*	472	*0*	
WABWTF	10/29/2015	12.9	6.28	*0*	284	*0*	
WABWTF	10/30/2015	13.9	6.43	*0*	260	*0*	
WABWTF	10/31/2015	13.9	6.52	*0*	280	*0*	
WABWTF	11/1/2015	13.5	6.51	*0*	182	*0*	
WABWTF	11/2/2015	13.5	6.40	*0*	326	*0*	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	11/3/2015	13.6	6.76	0	770	0	
WABWTF	11/4/2015	13.4	6.44	0	192	0	
WABWTF	11/5/2015	13.5	6.41	0	166	0	
WABWTF	11/6/2015	13.1	6.31	0	167	0	
WABWTF	11/7/2015	13.2	6.32	1	142	0	
WABWTF	11/8/2015	13.1	6.43	0	179	0	
WABWTF	11/9/2015	12.9	6.75	0	261	0	
WABWTF	11/10/2015	13.0	6.73	0	261	0	
WABWTF	11/11/2015	12.8	6.50	0	155	0	
WABWTF	11/12/2015	12.7	6.41	0	93	0	
WABWTF	11/13/2015	12.7	6.43	0	135	0	
WABWTF	11/14/2015	12.5	6.47	0	117	1	
WABWTF	11/15/2015	11.9	6.45	0	96	0	
WABWTF	11/16/2015	11.8	6.44	0	133	0	
WABWTF	11/17/2015	11.9	6.78	0	105	0	
WABWTF	11/18/2015	11.5	6.38	0	79	0	
WABWTF	11/19/2015	11.7	6.43	0	67	0	
WABWTF	11/20/2015	11.7	6.45	1	111	0	
WABWTF	11/21/2015	11.5	6.40	0	99	0	
WABWTF	11/22/2015	11.3	6.47	0	83	0	
WABWTF	11/23/2015	11.0	6.76	0	86	0	
WABWTF	11/24/2015	10.9	6.42	0	88	0	
WABWTF	11/25/2015	10.7	6.30	0	58	0	
WABWTF	11/26/2015	10.7	6.41	0	99	0	
WABWTF	11/27/2015	10.7	6.40	0	82	0	
WABWTF	11/28/2015	10.7	6.39	0	93	1	
WABWTF	11/29/2015	10.5	6.34	1	147	1	
WABWTF	11/30/2015	10.2	6.47	0	68	0	
WABWTF	12/1/2015	10.5	6.74	0	58	1	
WABWTF	12/2/2015	10.1	6.31	0	114	0	
WABWTF	12/3/2015	10.1	6.36	0	81	0	
WABWTF	12/4/2015	10.0	6.40	0	115	1	
WABWTF	12/5/2015	9.9	6.38	0	93	0	
WABWTF	12/6/2015	9.7	6.52	0	115	0	
WABWTF	12/7/2015	9.7	6.60	0	93	0	
WABWTF	12/8/2015	9.6	6.75	1	75	0	
WABWTF	12/9/2015	9.6	6.56	0	225	0	
WABWTF	12/10/2015	9.5	6.51	0	81	0	
WABWTF	12/11/2015	9.5	6.60	0	99	0	
WABWTF	12/12/2015	9.5	6.57	0	82	0	
WABWTF	12/13/2015	9.4	6.55	0	147	0	
WABWTF	12/14/2015	9.4	6.57	0	150	0	
WABWTF	12/15/2015	9.4	6.69	0	88	0	
WABWTF	12/16/2015	9.5	6.65	0	66	0	
WABWTF	12/17/2015	9.3	6.62	0	127	0	
WABWTF	12/18/2015	9.3	6.63	1	105	2	
WABWTF	12/19/2015	9.3	6.62	0	73	0	
WABWTF	12/20/2015	8.8	6.63	0	727	1	
WABWTF	12/21/2015	8.5	6.78	0	62	0	
WABWTF	12/22/2015	8.8	6.67	0	47	0	
WABWTF	12/23/2015	8.7	6.64	4	76	5.2	

QUABBIN LABORATORY RECORDS 2015
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	12/24/2015	8.8	6.55	5	54	1	
WABWTF	12/25/2015	8.9	6.62	1	56	*0*	
WABWTF	12/26/2015	8.9	6.56	*0*	105	*0*	
WABWTF	12/27/2015	8.7	6.58	*0*	62	*0*	
WABWTF	12/28/2015	8.6	6.55	*0*	84	*0*	
WABWTF	12/29/2015	8.3	6.84	*0*	48	*0*	
WABWTF	12/30/2015	8.2	6.56	*0*	35	*0*	
WABWTF	12/31/2015	8.3	6.65	*0*	55	*0*	
	AVG.	8.8	6.56	*<1*	320	*<1 - <4*	
	MAX.	21.0	6.91	5	4810	5.2	
	MIN.	0.9	6.28	*<1*	*<1*	*<1 - <4*	
	MEDIAN	9.6	6.55	*<1*	20	*<1 - <4*	

Notes:
Detection limit of 1 CFU/100 mL for Fecal Coliform.
For Total Coliform, only presumptive results are presented here. Detection limit of 1 MPN/100 mL.
For *E. coli* , detection limit varied from 1 to 4 MPN/100 mL based on dilution.

QUABBIN LABORATORY RECORDS 2015
OTHER SAMPLING RESULTS

DRINKING WATER WELL SAMPLES FOR PUBLIC WATER SYSTEM (PWS) COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
4/13/15	Administration Building Well	Nitrate	0.323	mg/L	Samples analyzed at MWRA Deer Island Laboratory.
7/14/15	Administration Building Well	Volatile Organic Contaminants (All Constituents)	<0.5	ug/L	Sample analyzed at MWRA Deer Island Laboratory. (All results were less than method detection limits.)
7/16/15	Administration Building Kitchen	Lead	30.3	ug/L	Samples analyzed at MWRA Deer Island Laboratory.
		Copper	100	ug/L	
	Visitors Center Fountain	Lead	1.76	ug/L	
		Copper	264	ug/L	
	Laboratory Tap	Lead	1.30	ug/L	
		Copper	473	ug/L	
	Garage Fountain	Lead	96.1	ug/L	
		Copper	229	ug/L	
	3rd Floor Service Sink	Lead	3.27	ug/L	
		Copper	63.5	ug/L	
Additional water quality testing was performed in September and October, 2015, to assess elevated lead levels detected at the kitchen sink and garage fountain. See memo dated December 10, 2015, in Appendix A for results and more information.					

DRINKING WATER WELL SAMPLES - NOT FOR PWS COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
April 2015	Stockroom	Multiple	-	-	See memo dated May 11, 2015, in Appendix A.

OTHER DRINKING WATER WELL SAMPLES - LEAD AND COPPER TESTING (NOT FOR PWS COMPLIANCE)

DATE	LOCATION	Sample Type	LEAD (ug/L)	COPPER (ug/L)	REMARKS
10/22/15	New Salem, Bathroom Sink	First Draw	2.34	544	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	0.563	89.7	
10/21/15	45	First Draw	9.39	6.08	Sample analyzed at MWRA Deer Island Laboratory.
		RO Tap	0.335	4.21	
10/21/15	Residence #1 (Forestry Office), Kitchen Sink	First Draw	5.77	321	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.47	50.6	
10/22/15	Residence #2 (Conference Center), Kitchen Sink	First Draw	2.49	51.5	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.34	17.9	
10/21/15	Residence #3 (Ranger Station), Kitchen Sink	First Draw	6.69	1570	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.57	915	
		POU Filter	<0.0500	<3.00	

QUABBIN LABORATORY RECORDS 2014
ADMINISTRATION BUILDING BACTERIOLOGICAL ANALYSIS RESULTS

DATE	***E. coli*** **RESULT**	**TOTAL COLIFORM RESULT**
	Visitor Center Fountain	Visitor Center Fountain
1/5/2015	A	A
2/2/2015	A	A
3/2/2015	A	A
4/6/2015	A	A
5/4/2015	A	A
6/1/2015	A	A
7/6/2015	A	A
8/3/2015	A	A
9/14/2015	A	A
10/5/2015	A	A
11/2/2015	A	A
12/7/2015	A	A

NOTE: A = ABSENT
P = PRESENT

QUABBIN LABORATORY RECORDS 2015
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/23	0.5	9.2	3.95	21.10	163.1	6.41	46.0	202S	4/23/15	0.194	5.35	3.64	0	0	0									528.28
4/23	3		3.95	20.47	158.3	6.37	46.1																	
4/23	6		3.95	20.07	155.1	6.33	46.2	202M	4/23/15				0	0	0									
4/23	9		3.96	19.82	153.3	6.32	46.2																	
4/23	10		3.96	19.72	152.6	6.30	46.3																	
4/23	12		4.00	19.59	151.7	6.27	46.0																	
4/23	15		4.01	19.40	150.2	6.26	46.1																	
4/23	18		4.01	19.30	149.4	6.25	46.1	202D	4/23/15				0	0	0									
4/23	20		4.03	19.25	149.2	6.22	46.2	202M	4/23/15	0.193	5.21	3.22												
4/23	21		4.04	19.40	150.4	6.23	46.1																	
4/23	24		4.04	19.46	150.8	6.22	46.2																	
4/23	27		4.05	19.40	150.4	6.21	46.2																	
4/23	30		4.03	19.29	149.5	6.23	46.2																	
4/23	33		4.06	19.29	149.6	6.20	46.1																	
4/23	36		4.05	19.18	148.7	6.19	46.1																	
4/23	39		4.06	18.98	147.1	6.19	46.0	202D	4/23/15	0.194	5.46	3.81												
4/23	40		4.05	18.88	146.4	6.19	46.3																	
5/14	0.5	10.4	12.21	10.41	98.3	6.34	45.2	202S	5/14/15	0.270	5.13	3.55	0	0	0		0.0134	0.00662	0.318	0.00944	2290	0.023595		528.09
5/14	1.5		12.20	10.91	102.9	6.34	45.0																	
5/14	2.5		12.20	10.84	102.3	6.31	44.9																	
5/14	3.5		12.11	10.67	100.4	6.32	45.1																	
5/14	4.5		12.02	10.63	99.9	6.29	45.0																	
5/14	5.5		11.94	10.44	97.9	6.29	44.9																	
5/14	6.5		11.91	10.20	95.6	6.29	45.0	202M	5/14/15				0	0	10									
5/14	7.5		11.86	10.04	94.0	6.28	45.0																	
5/14	8.5		11.82	10.03	93.8	6.29	45.0																	
5/14	9.5		11.80	9.86	92.2	6.22	45.0																	
5/14	10.5		11.76	9.88	92.3	6.25	45.1																	
5/14	11.5		11.50	9.97	92.6	6.32	45.0																	
5/14	12.5		11.02	10.10	92.7	6.27	45.0																	
5/14	13.5		10.36	10.32	93.3	6.24	45.1																	
5/14	14.5		9.78	10.47	93.4	6.26	45.1																	
5/14	15.5		8.68	10.80	93.9	6.21	45.1																	
5/14	16.5		6.55	11.43	94.3	6.19	45.1																	
5/14	17.5		6.35	11.40	93.5	6.23	45.1																	
5/14	18.5		5.77	11.43	92.4	6.22	45.1	202D	5/14/15				0	0	0									
5/14	19.5		5.62	11.50	92.6	6.19	45.2																	
5/14	20.5		5.51	11.58	93.0	6.20	45.4	202M	5/14/15	0.215	5.24	3.74					0	0.0111	0.250	0.00819	2340	0.023640	1960	
5/14	21.5		5.47	11.62	93.2	6.20	45.2																	
5/14	22.5		5.45	11.64	93.3	6.19	45.3																	
5/14	23.5		5.27	11.74	93.7	6.18	45.2																	
5/14	24.5		5.23	11.85	94.4	6.17	45.3																	
5/14	25.5		5.17	11.89	94.6	6.17	45.4																	
5/14	26.5		5.17	11.89	94.6	6.18	45.4																	
5/14	27.5		5.17	11.92	94.9	6.17	45.3																	
5/14	28		5.17	12.08	96.1	6.14	45.3																	
5/14	29		5.14	12.11	96.3	6.14	45.2																	
5/14	30		5.07	12.16	96.5	6.17	45.3																	
5/14	31		5.05	12.17	96.6	6.16	45.3																	
5/14	32		5.03	12.16	96.4	6.12	45.4																	
5/14	33		5.02	12.14	96.3	6.12	45.2																	
5/14	34		5.01	12.13	96.1	6.12	45.4																	
5/14	35		4.99	12.11	96.0	6.14	45.5																	
5/14	36		4.99	12.07	95.6	6.10	45.4																	
5/14	37		4.98	11.99	95.0	6.10	45.4																	
5/14	38		4.97	11.94	94.6	6.12	45.3																	
5/14	39		4.95	11.92	94.3	6.10	45.4	202D	5/14/15	0.219	5.17	3.63	0	0	0		0	0.0124	0.221	0.00846	2260	0.023560		
5/14	40		4.89	11.91	94.1	6.12	45.4																	

QUABBIN LABORATORY RECORDS 2015
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
6/17	0.5	11.8	18.89	7.29	79.6	6.28	45.3	202S	6/17/15	0.208	5.01	3.59	0	10	52									527.68
6/17	1		18.89	7.26	79.3	6.24	45.4																	
6/17	2		18.90	7.27	79.4	6.26	45.2																	
6/17	3		18.89	7.17	78.3	6.23	45.2																	
6/17	4		18.89	7.19	78.5	6.22	45.3																	
6/17	5		18.89	7.17	78.3	6.22	45.4																	
6/17	6		18.87	7.20	78.6	6.23	45.5	202M	6/17/15				1	0	31									
6/17	7		18.84	7.21	78.7	6.21	45.5																	
6/17	8		18.84	7.23	78.9	6.22	45.4																	
6/17	9		18.78	7.27	79.2	6.22	45.5																	
6/17	10		18.60	7.33	79.6	6.22	45.5																	
6/17	11		15.82	8.37	85.8	6.26	45.5																	
6/17	12		14.61	9.18	91.7	6.26	45.5																	
6/17	13		12.26	11.47	108.7	6.26	45.4	202M	6/17/15	0.215	4.96	3.60												
6/17	14		11.21	11.54	106.8	6.23	45.2																	
6/17	15		10.15	12.90	116.4	6.22	45.5																	
6/17	16		9.52	13.32	118.4	6.21	45.5																	
6/17	17		9.01	14.18	124.5	6.19	45.6																	
6/17	18		8.77	14.38	125.5	6.17	45.5	202D	6/17/15				0	0	0									
6/17	19		8.57	14.26	123.9	6.15	45.6																	
6/17	20		8.40	14.20	122.9	6.13	45.4																	
6/17	21		8.20	14.18	122.1	6.12	45.5																	
6/17	22		8.01	14.19	121.6	6.13	45.4																	
6/17	23		7.79	14.24	121.4	6.11	45.6																	
6/17	24		7.64	14.08	119.6	6.10	45.4																	
6/17	25		7.52	14.04	118.9	6.10	45.4																	
6/17	26		7.32	14.01	118.0	6.08	45.7																	
6/17	27		7.08	13.96	116.9	6.08	45.5																	
6/17	28		6.97	13.85	115.7	6.05	45.7																	
6/17	29		6.88	13.81	115.1	6.04	45.5																	
6/17	30		6.80	13.68	113.8	6.01	45.6																	
6/17	31		6.73	13.67	113.5	6.00	45.6																	
6/17	32		6.59	13.61	112.6	5.98	45.8																	
6/17	33		6.49	13.71	113.2	5.99	45.8																	
6/17	34		6.43	13.56	111.8	5.96	45.9																	
6/17	35		6.40	13.55	111.6	5.96	45.8																	
6/17	36		6.36	13.49	111.0	5.94	45.7																	
6/17	37		6.29	13.41	110.2	5.92	45.9																	
6/17	38		6.28	13.39	109.9	5.92	45.9	202D	6/17/15	0.174	5.19	3.85												
6/17	39		6.25	13.31	109.2	5.89	45.8																	
6/17	40		6.21	13.17	108.0	5.86	45.8																	
7/22	0.5	12.2	24.15	10.87	132.7	6.53	45.6	202S	7/22/15	0.214	5.07	3.57	0	0	275		0	0	0.128	0	2140	0.020550		527.48
7/22	1		24.16	10.53	128.6	6.50	45.5																	
7/22	2		24.16	10.16	124.1	6.48	45.6																	
7/22	3		24.16	10.02	122.4	6.43	45.8																	
7/22	4		24.15	9.82	119.9	6.48	45.5																	
7/22	5		24.13	9.67	118.1	6.43	45.5																	
7/22	6		23.78	9.09	110.3	6.41	45.7	202M	7/22/15				0	0	556									
7/22	7		23.72	9.04	109.6	6.45	45.7																	
7/22	8		23.27	9.14	109.8	6.41	45.5																	
7/22	9		22.90	9.29	110.8	6.41	45.5																	
7/22	10		21.76	9.56	111.6	6.36	45.5																	
7/22	11		19.73	10.31	115.6	6.41	45.4																	
7/22	12		17.17	10.98	116.8	6.40	45.5	202M	7/22/15	0.311	5.01	3.62					0	0	0.163	0	2110	0.021565	1940	
7/22	13		15.01	11.53	117.2	6.36	45.3																	
7/22	14		12.96	11.83	114.9	6.33	45.1																	
7/22	15		12.09	12.02	114.6	6.34	45.2																	
7/22	16		11.53	12.04	113.3	6.30	45.0																	

QUABBIN LABORATORY RECORDS 2015
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
7/22	17		11.05	11.95	111.2	6.28	45.1																	
7/22	18		10.65	12.03	110.9	6.27	45.3	202D	7/22/15				*0*	*0*	75									
7/22	19		10.30	11.98	109.5	6.26	45.2																	
7/22	20		10.09	11.97	108.8	6.23	45.4																	
7/22	21		9.88	11.90	107.7	6.19	45.3																	
7/22	22		9.67	11.80	106.3	6.16	45.1																	
7/22	23		9.43	11.83	106.0	6.17	45.1																	
7/22	24		9.28	11.87	105.9	6.14	45.1																	
7/22	25		9.13	11.75	104.5	6.13	45.4																	
7/22	26		9.01	11.75	104.2	6.13	45.3																	
7/22	27		8.79	11.74	103.5	6.10	45.2																	
7/22	28		8.63	11.73	103.0	6.09	45.4																	
7/22	29		8.37	11.73	102.4	6.08	45.2																	
7/22	30		8.12	11.74	101.8	6.05	45.4																	
7/22	31		7.97	11.71	101.2	6.04	45.3																	
7/22	32		7.78	11.64	100.2	5.99	45.6																	
7/22	33		7.42	11.56	98.6	5.96	45.7																	
7/22	34		7.22	11.54	97.9	5.96	45.8																	
7/22	35		7.07	11.49	97.2	5.94	45.8																	
7/22	36		7.02	11.42	96.4	5.92	45.8																	
7/22	37		6.99	11.46	96.7	5.93	45.7																	
7/22	38		6.97	11.40	96.1	5.91	45.8																	
7/22	39		6.90	11.29	95.0	5.89	45.6																	
7/22	40		6.83	11.16	93.8	5.86	45.7	202D	7/22/15	0.190	5.25	3.75					0.0162	0.0168	0.156	*0*	2500	0.022760		
8/12	0.5	11.1	23.96	9.28	111.8	6.50	45.8	202S	8/12/15	0.228	5.49	3.74	*0*	*0*	836									526.72
8/12	1		23.96	9.21	111.0	6.43	45.8																	
8/12	2		23.96	9.14	110.2	6.47	46.0																	
8/12	3		23.95	8.94	107.7	6.40	45.8																	
8/12	4		23.95	8.85	106.6	6.40	45.7																	
8/12	5		23.94	8.63	104.0	6.39	45.9																	
8/12	6		23.94	8.55	103.0	6.36	45.7	202M	8/12/15				*0*	*0*	789									
8/12	7		23.94	8.59	103.5	6.36	45.7																	
8/12	9		23.29	8.83	105.1	6.36	45.7																	
8/12	10		21.94	9.43	109.3	6.37	45.4																	
8/12	11		20.92	9.61	109.3	6.35	45.6																	
8/12	12		18.58	10.34	112.2	6.38	45.0																	
8/12	13		16.62	10.90	113.6	6.39	45.0	202M	8/12/15	0.312	5.50	3.78												
8/12	14		14.90	11.20	112.5	6.35	45.1																	
8/12	15		13.11	11.57	111.7	6.33	45.0																	
8/12	16		12.06	11.78	111.1	6.32	45.1																	
8/12	17		10.95	11.86	109.0	6.21	45.1																	
8/12	18		10.64	11.75	107.3	6.19	45.2	202D	8/12/15				*0*	*0*	744									
8/12	19		10.35	11.75	106.6	6.14	45.2																	
8/12	20		10.05	11.69	105.2	6.13	45.0																	
8/12	21		9.84	11.67	104.5	6.09	45.2																	
8/12	22		9.62	11.66	103.9	6.09	45.2																	
8/12	23		9.45	11.49	102.0	6.03	45.0																	
8/12	24		9.25	11.57	102.2	6.05	45.2																	
8/12	25		9.07	11.59	101.9	6.06	45.1																	
8/12	26		8.90	11.55	101.1	6.05	45.0																	
8/12	27		8.59	11.54	100.4	6.00	45.1																	
8/12	28		8.27	11.53	99.4	5.98	45.2																	
8/12	29		8.09	11.44	98.2	5.93	45.4																	
8/12	30		7.93	11.44	97.9	5.94	45.4																	
8/12	31		7.73	11.37	96.8	5.93	45.5																	
8/12	32		7.68	11.27	95.8	5.89	45.5																	
8/12	33		7.57	11.25	95.4	5.89	45.3																	
8/12	34		7.43	11.22	94.8	5.86	45.4																	

QUABBIN LABORATORY RECORDS 2015
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
8/12	35		7.24	11.13	93.6	5.86	45.7																	
8/12	36		7.22	11.04	92.8	5.82	45.8																	
8/12	37		7.19	10.95	92.0	5.80	45.8																	
8/12	38		7.17	10.92	91.7	5.79	45.8	202D	8/12/15	0.183	5.48	3.73												
8/12	39		7.12	10.90	91.4	5.79	45.7																	
8/12	40		7.09	10.80	90.5	5.78	45.8																	
9/17	0.5	9.0	23.34	9.22	110.4	6.47	46.2	202S	9/17/15	0.244	5.25	3.66	0	0	1940									525.52
9/17	1		23.36	9.49	113.7	6.47	46.0																	
9/17	2		23.35	9.84	117.9	6.43	46.1																	
9/17	3		23.35	9.86	118.2	6.46	46.1																	
9/17	4		23.36	9.80	117.4	6.45	46.1																	
9/17	5		23.37	9.66	115.7	6.44	46.0																	
9/17	6		23.35	9.51	113.9	6.42	46.0	202M	9/17/15				0	0	1860									
9/17	7		23.32	9.38	112.3	6.41	46.2																	
9/17	8		23.31	9.29	111.2	6.41	46.1																	
9/17	9		23.30	9.11	109.0	6.42	46.1																	
9/17	10		23.27	9.03	108.0	6.41	46.1																	
9/17	11		23.22	8.95	107.0	6.40	45.9																	
9/17	12		22.45	9.19	108.3	6.46	46.0																	
9/17	13		18.18	10.80	116.9	6.45	45.8																	
9/17	14		15.69	11.24	115.5	6.48	45.6																	
9/17	15		13.82	11.39	112.3	6.35	45.3	202M	9/17/15	0.290	5.30	3.82												
9/17	16		12.92	10.88	105.2	6.19	45.6																	
9/17	17		12.34	10.94	104.4	6.19	45.5																	
9/17	18		11.67	10.83	101.8	6.06	45.5	202D	9/17/15				0	0	2250									
9/17	19		11.01	11.00	101.8	6.09	45.2																	
9/17	20		10.59	11.01	100.9	6.03	45.3																	
9/17	21		10.30	11.09	100.9	6.03	45.3																	
9/17	22		10.13	11.01	99.9	5.98	45.3																	
9/17	23		9.90	10.99	99.1	5.97	45.3																	
9/17	24		9.71	10.95	98.3	5.92	45.4																	
9/17	25		9.48	10.93	97.6	5.91	45.6																	
9/17	26		9.28	10.96	97.4	5.91	45.4																	
9/17	27		9.08	10.93	96.7	5.86	45.6																	
9/17	28		8.82	10.92	96.0	5.85	45.5																	
9/17	29		8.51	10.95	95.5	5.83	45.6																	
9/17	30		8.24	10.92	94.7	5.79	45.6																	
9/17	31		8.05	10.95	94.5	5.79	45.8																	
9/17	32		7.88	10.94	93.9	5.76	45.8																	
9/17	33		7.71	10.89	93.2	5.68	45.9																	
9/17	34		7.56	10.89	92.8	5.70	45.9																	
9/17	35		7.46	10.86	92.3	5.68	45.9																	
9/17	36		7.39	10.84	92.0	5.66	46.1																	
9/17	37		7.35	10.78	91.4	5.67	46.2																	
9/17	38		7.29	10.73	90.9	5.63	46.2																	
9/17	39		7.27	10.73	90.8	5.63	46.2	202D	9/17/15	0.204	5.13	3.61												
9/17	40		7.24	10.58	89.4	5.62	46.4																	
9/17	41		7.23	10.53	89.1	5.58	46.4																	
10/22	0.5	10.2	15.31	7.47	74.8	6.47	45.7	202S	10/22/15	0.370	6.01	4.25	0	0	399		0	0	0	0	1970	0.018915		524.36
10/22	1		15.31	7.45	74.6	6.43	45.6																	
10/22	2		15.31	7.41	74.2	6.41	45.8																	
10/22	3		15.31	7.38	73.9	6.43	45.9																	
10/22	4		15.31	7.32	73.3	6.39	45.9																	
10/22	5		15.31	7.32	73.3	6.36	45.6																	
10/22	6		15.30	7.34	73.5	6.38	45.7	202M	10/22/15				0	0	309									
10/22	7		15.30	7.35	73.6	6.37	45.6																	
10/22	8		15.30	7.33	73.4	6.35	45.8																	
10/22	9		15.30	7.35	73.5	6.38	45.8																	

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/22	10		15.30	7.42	74.3	6.35	45.7																	
10/22	11		15.30	7.46	74.7	6.34	45.6																	
10/22	12		15.29	7.51	75.2	6.34	45.9																	
10/22	13		15.29	7.58	75.9	6.35	45.7																	
10/22	14		15.29	7.60	76.1	6.34	45.5																	
10/22	15		15.29	7.63	76.4	6.33	45.5																	
10/22	16		15.19	7.62	76.1	6.36	45.6																	
10/22	17		14.54	7.79	76.7	6.25	45.8																	
10/22	18		12.96	8.07	76.8	6.06	45.4	202M	10/22/15	0.338	5.44	3.75					*0*	*0*	0.118	*0*	1780	0.019660	1980	
10/22	18							202D	10/22/15				*0*	*0*	631									
10/22	19		11.88	8.23	76.3	6.02	45.4																	
10/22	20		11.54	8.20	75.5	5.83	45.3																	
10/22	21		11.19	8.16	74.5	5.74	45.6																	
10/22	22		10.98	8.19	74.5	5.75	45.6																	
10/22	23		10.70	8.12	73.3	5.73	45.6																	
10/22	24		10.36	8.25	73.9	5.72	45.5																	
10/22	25		10.23	8.29	74.0	5.74	45.3																	
10/22	26		10.01	8.21	73.0	5.72	45.6																	
10/22	27		9.66	8.21	72.4	5.72	45.5																	
10/22	28		9.33	8.30	72.6	5.73	45.4																	
10/22	29		9.09	8.17	71.0	5.70	45.5																	
10/22	30		8.91	8.23	71.3	5.70	45.7																	
10/22	31		8.68	8.22	70.7	5.68	45.6																	
10/22	32		8.54	8.22	70.5	5.66	45.8																	
10/22	33		8.40	8.22	70.3	5.67	45.8																	
10/22	34		8.25	8.26	70.4	5.67	45.7																	
10/22	35		8.03	8.20	69.5	5.65	45.9																	
10/22	36		7.89	8.13	68.7	5.63	45.9																	
10/22	37		7.80	8.09	68.2	5.63	45.8																	
10/22	38		7.68	8.00	67.2	5.62	46.0																	
10/22	39		7.60	7.90	66.2	5.60	46.3	202D	10/22/15	0.368	5.52	3.75					*0*	0.0148	0.121	0.00739	2420	0.021395		
10/22	40		7.55	7.88	65.9	5.56	46.2																	
10/22	41		7.52	7.77	65.0	5.56	46.7																	
11/9	0.5	7.9	12.52	10.73	101.0	6.36	46.6	202S	11/9/15	0.325	5.69	3.93	*0*	*0*	86									523.94
11/9	1		12.53	10.29	96.9	6.36	46.6																	
11/9	2		12.53	10.32	97.2	6.37	46.6																	
11/9	3		12.53	10.04	94.6	6.35	46.6																	
11/9	4		12.52	9.87	92.9	6.36	46.5																	
11/9	5		12.52	9.77	92.0	6.35	46.6																	
11/9	6		12.53	9.73	91.7	6.35	46.4	202M	11/9/15				*0*	*0*	85									
11/9	7		12.53	9.66	91.0	6.33	46.5																	
11/9	8		12.53	9.62	90.6	6.33	46.3																	
11/9	9		12.53	9.56	90.0	6.32	46.5																	
11/9	10		12.53	9.55	89.9	6.32	46.5																	
11/9	11		12.53	9.51	89.5	6.31	46.6																	
11/9	12		12.52	9.49	89.4	6.31	46.5																	
11/9	13		12.52	9.42	88.7	6.30	46.5																	
11/9	14		12.53	9.41	88.6	6.29	46.4																	
11/9	15		12.53	9.41	88.6	6.29	46.4																	
11/9	16		12.53	9.36	88.2	6.30	46.4																	
11/9	17		12.52	9.34	87.9	6.29	46.4																	
11/9	18		12.51	9.32	87.7	6.29	46.5	202D	11/9/15				*0*	*0*	148									
11/9	19		12.51	9.31	87.6	6.28	46.3																	
11/9	20		12.50	9.27	87.2	6.27	46.3	202M	11/9/15	0.316	5.68	4.06												
11/9	21		12.41	9.15	85.9	6.22	46.5																	
11/9	22		11.97	8.76	81.5	6.02	46.4																	
11/9	23		11.68	8.67	80.0	5.97	46.7																	
11/9	24		10.86	8.68	78.7	5.87	46.5																	

QUABBIN LABORATORY RECORDS 2015
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
11/9	25		10.54	8.52	76.6	5.83	46.6																	
11/9	26		10.24	8.54	76.3	5.81	46.5																	
11/9	27		9.93	8.45	74.9	5.78	46.5																	
11/9	28		9.75	8.25	72.9	5.77	46.6																	
11/9	29		9.44	8.46	74.1	5.76	46.5																	
11/9	30		9.33	8.40	73.4	5.74	46.5																	
11/9	31		9.23	8.37	73.0	5.74	46.5																	
11/9	32		8.92	8.42	72.9	5.75	46.6																	
11/9	33		8.74	8.36	72.1	5.75	46.5																	
11/9	34		8.53	8.21	70.4	5.72	46.6																	
11/9	35		8.35	8.15	69.6	5.72	46.6																	
11/9	36		8.11	8.09	68.7	5.70	46.9																	
11/9	37		8.00	7.94	67.2	5.69	46.8																	
11/9	38		7.87	7.76	65.4	5.66	46.9																	
11/9	39		7.81	7.66	64.6	5.67	46.8	202D	11/9/15	0.329	5.69	3.87												
11/9	40		7.78	7.62	64.1	5.67	46.9																	
11/9	41		7.76	7.53	63.4	5.66	47.1																	
12/2	0.5	10.0	9.53	10.90	95.5	6.46	46.5	202S	12/2/15	0.377	5.47	3.95	1	*0*	10		*0*	*0*	*0*	0.00564	1900	0.018465		523.59
12/2	3		9.53	10.81	94.7	6.40	46.7																	
12/2	6		9.53	10.69	93.6	6.40	46.7	202M	12/2/15				*0*	*0*	31									
12/2	9		9.53	10.80	94.6	6.38	46.5																	
12/2	12		9.52	10.62	93.0	6.38	46.5																	
12/2	15		9.52	10.59	92.7	6.37	46.5																	
12/2	18		9.52	10.54	92.3	6.33	46.5	202D	12/2/15				*0*	*0*	*0*									
12/2	20		9.52	10.16	89.0	6.34	46.7	202M	12/2/15	0.375	5.59	4.00					*0*	*0*	*0*	0.00508	2080	0.018625	2140	
12/2	21		9.50	10.55	92.4	6.34	46.7																	
12/2	24		9.50	10.67	93.4	6.35	46.5																	
12/2	27		9.47	10.52	92.1	6.33	46.7																	
12/2	30		9.48	10.44	91.4	6.27	46.5																	
12/2	33		9.45	10.44	91.3	6.27	46.5																	
12/2	36		9.43	10.32	90.2	6.25	46.7																	
12/2	39		9.43	10.31	90.1	6.23	46.7	202D	12/2/15	0.322	5.60	4.03					*0*	*0*	0.202	0.00830	2180	0.018630		
12/2	40		9.41	10.33	90.2	6.22	46.7																	
	AVG.	10.2	11.25	10.78	98.2	6.13	45.7			0.266	5.37	3.76	<1	0	397	N/A	<0.005	0.00514	0.140	<0.005	2160	0.020947	2010	
	MAX.	12.2	24.16	21.10	163.1	6.53	47.1			0.377	6.01	4.25	1	10	2250	N/A	0.0162	0.0168	0.318	0.00944	2500	0.023640	2140	
	MIN.	7.9	3.95	7.17	63.4	5.56	44.9			0.174	4.96	3.22	<1	<10	<10	N/A	<0.005	<0.005	<0.005	<0.005	1780	0.018465	1940	
	MEDIAN	10.2	9.53	10.73	95.9	6.20	45.6			0.244	5.35	3.75	<1	<10	80	N/A	<0.005	0.00000	0.142	0.00536	2160	0.020973	1970	

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = 1 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
(206) SHAFT 12 --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/23	0.5	10.4	4.33	17.99	140.5	6.31	45.7	206S	4/23/15	0.209	5.45	3.76	0	0	10									528.28
4/23	Rough reservoir conditions - profile data NOT collected, only 0.5-meter samples collected.																							
5/14	0.5	8.7	12.08	9.07	85.4	6.54	45.3	206S	5/14/15	0.257	5.40	3.83	0	0	0		0	0	0.185	0.00848	2040	0.023220		528.09
5/14	1		12.05	9.16	86.1	6.46	45.3																	
5/14	2		11.95	9.23	86.6	6.45	45.1																	
5/14	3		11.82	9.29	86.9	6.42	45.2																	
5/14	4		11.65	9.37	87.3	6.45	45.1																	
5/14	5		11.50	9.43	87.6	6.42	45.3																	
5/14	6		11.47	9.40	87.2	6.41	45.3	206M	5/14/15				0	0	0									
5/14	7		11.46	9.45	87.7	6.42	45.4																	
5/14	8		11.33	9.52	88.1	6.42	45.3																	
5/14	9		11.21	9.57	88.3	6.38	45.2																	
5/14	10		11.06	9.65	88.7	6.42	45.3																	
5/14	11		10.88	9.73	89.1	6.40	45.3																	
5/14	12		10.74	9.72	88.7	6.40	45.3																	
5/14	13		9.99	10.01	89.7	6.48	45.2	206M	5/14/15	0.269	5.37	3.84					0	0	0.282	0.0108	1910	0.023695	1920	
5/14	14		9.00	10.32	90.3	6.35	45.3																	
5/14	15		7.79	10.65	90.5	6.37	45.0																	
5/14	16		7.13	10.73	89.8	6.35	45.2																	
5/14	17		7.06	10.74	89.7	6.37	45.2																	
5/14	18		6.92	10.75	89.4	6.36	44.9																	
5/14	19		6.56	10.86	89.5	6.42	45.0																	
5/14	20		6.31	10.87	89.1	6.36	45.0																	
5/14	21		6.12	10.86	88.5	6.35	44.9																	
5/14	22		6.03	10.85	88.3	6.32	45.0																	
5/14	23		5.94	10.84	88.0	6.35	45.0																	
5/14	24		5.89	10.81	87.6	6.30	45.1	206S	5/14/15				0	0	0									
5/14	25		5.88	10.78	87.4	6.27	45.1																	
5/14	26		5.87	10.78	87.4	6.26	45.3	206S	5/14/15	0.265	5.37	3.79					0	0.00674	0.194	0.00875	1990	0.022705		
5/14	27		5.84	10.78	87.3	6.27	45.0																	
6/17	0.5	10.8	19.19	9.06	99.5	6.43	45.7	206S	6/17/15	0.219	5.15	3.79	0	0	20									527.68
6/17	1		19.16	9.11	100.0	6.39	45.6																	
6/17	2		18.99	9.22	100.9	6.33	45.8																	
6/17	3		18.82	9.28	101.2	6.32	45.7																	
6/17	4		17.83	9.64	103.1	6.32	45.7																	
6/17	5		17.16	9.84	103.7	6.30	45.4																	
6/17	6		16.81	9.99	104.5	6.28	45.4	206M	6/17/15				0	0	0									
6/17	7		16.18	10.16	104.8	6.28	45.6																	
6/17	8		15.75	10.25	104.9	6.28	45.5																	
6/17	9		15.16	10.40	105.0	6.26	45.3																	
6/17	10		14.51	10.59	105.5	6.24	45.4																	
6/17	11		12.41	11.46	108.9	6.23	45.3																	
6/17	12		11.50	11.83	110.2	6.22	45.3	206M	6/17/15	0.278	5.21	3.82												
6/17	13		10.84	11.99	110.0	6.20	45.2																	
6/17	14		10.29	12.17	110.2	6.19	45.2																	
6/17	15		9.79	12.21	109.3	6.17	45.5																	
6/17	16		9.43	12.13	107.6	6.09	45.5																	
6/17	17		9.18	12.11	106.8	6.08	45.5																	
6/17	18		8.93	12.10	106.0	6.07	45.5																	
6/17	19		8.85	12.04	105.4	6.06	45.4																	
6/17	20		8.82	11.93	104.3	6.05	45.3																	
6/17	21		8.42	12.00	103.9	6.05	45.4																	
6/17	22		8.25	11.96	103.1	6.04	45.6																	
6/17	23		8.21	11.93	102.8	6.04	45.3																	
6/17	24		8.12	11.95	102.7	6.03	45.4	206D	6/17/15				0	0	10									
6/17	25		7.97	11.96	102.4	6.02	45.4																	
6/17	26		7.85	11.95	102.0	6.01	45.5	206D	6/17/15	0.210	5.22	3.76												
6/17	27		7.81	11.86	101.1	5.98	45.4																	

QUABBIN LABORATORY RECORDS 2015
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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
7/22	0.5	9.9	24.61	10.23	126.0	6.39	45.8	206S	7/22/15	0.193	5.19	3.71	0	10	148		0	0	0.131	0	1970	0.019895		527.48
7/22	1		24.63	10.11	124.5	6.35	45.7																	
7/22	2		24.60	9.95	122.5	6.39	45.9																	
7/22	3		24.55	9.86	121.4	6.39	45.6																	
7/22	4		24.49	9.79	120.3	6.38	45.8																	
7/22	5		23.60	10.06	121.6	6.43	45.7																	
7/22	6		23.25	10.09	121.2	6.40	45.7	206M	7/22/15				0	0	794									
7/22	7		22.85	10.04	119.6	6.35	46.0																	
7/22	8		21.94	10.20	119.4	6.36	45.8																	
7/22	9		21.34	10.17	117.8	6.33	45.7																	
7/22	10		20.06	10.46	118.1	6.34	45.7																	
7/22	11		18.81	10.67	117.4	6.30	45.4																	
7/22	12		16.62	10.95	115.2	6.24	45.5	206M	7/22/15	0.325	5.19	3.81					0	0	0	0	1780	0.022855	2070	
7/22	13		14.36	11.19	112.2	6.18	45.4																	
7/22	14		12.66	11.45	110.5	6.17	45.5																	
7/22	15		11.86	11.30	107.1	6.10	45.4																	
7/22	16		11.16	11.11	103.6	6.07	45.4																	
7/22	17		10.73	11.07	102.2	6.06	45.4																	
7/22	18		10.47	10.97	100.7	6.04	45.4																	
7/22	19		10.16	10.86	99.0	5.99	45.4																	
7/22	20		9.99	10.74	97.5	5.96	45.5																	
7/22	21		9.68	10.78	97.1	5.98	45.4																	
7/22	22		9.45	10.53	94.4	5.94	45.4																	
7/22	23		9.28	10.50	93.7	5.91	45.6																	
7/22	24		9.19	10.39	92.5	5.92	45.6	206D	7/22/15				0	0	98									
7/22	25		9.07	10.36	92.0	5.90	45.4																	
7/22	26		8.93	10.35	91.6	5.89	45.5	206D	7/22/15	0.259	5.18	3.71					0	0	0.108	0.00594	2150	0.023530		
8/12	0.5	9.5	24.32	9.30	112.9	6.48	46.1	206S	8/12/15	0.243	5.51	3.81	0	0	201									526.72
8/12	1		24.31	9.19	111.5	6.45	46.0																	
8/12	2		24.28	8.99	109.0	6.40	46.2																	
8/12	3		24.28	8.89	107.8	6.44	46.1																	
8/12	4		24.24	8.88	107.5	6.41	46.1																	
8/12	5		24.22	8.83	107.0	6.38	45.9																	
8/12	6		24.19	8.85	107.1	6.38	46.1	206M	8/12/15				0	0	281									
8/12	7		24.18	8.85	107.1	6.37	46.1																	
8/12	8		24.17	8.86	107.2	6.36	45.9																	
8/12	9		24.16	8.87	107.3	6.38	46.0																	
8/12	10		23.83	8.90	107.0	6.32	45.4																	
8/12	11		17.87	10.96	117.2	6.28	45.6																	
8/12	12		16.03	11.21	115.4	6.24	45.5																	
8/12	13		15.43	11.01	111.9	6.20	45.2	206M	8/12/15	0.280	5.37	3.61												
8/12	14		15.23	10.93	110.6	6.17	45.5																	
8/12	15		13.98	11.15	109.8	6.18	45.3																	
8/12	16		12.64	11.28	107.8	6.13	45.3																	
8/12	17		12.08	11.22	105.8	6.09	45.1																	
8/12	18		11.36	11.18	103.8	6.07	45.2																	
8/12	19		10.75	11.17	102.2	6.06	45.2																	
8/12	20		10.44	11.01	100.0	6.02	45.4																	
8/12	21		10.14	10.91	98.4	5.99	45.3																	
8/12	22		9.91	10.78	96.7	5.96	45.4																	
8/12	23		9.75	10.75	96.1	5.93	45.4																	
8/12	24		9.49	10.59	94.1	5.89	45.3	206D	8/12/15				0	0	187									
8/12	25		9.33	10.35	91.6	5.85	45.3	206D	8/12/15	0.296	5.43	3.73												
8/12	26		9.24	10.31	91.0	5.85	45.5																	
8/12	27		9.03	10.15	89.2	5.78	45.6																	
9/17	0.5	9.2	23.59	9.57	115.2	6.38	46.3	206S	9/17/15	0.272	5.25	3.70	0	0	1080									525.52
9/17	1		23.53	9.61	115.5	6.39	46.4																	
9/17	2		23.49	9.61	115.4	6.44	46.3																	

QUABBIN LABORATORY RECORDS 2015
(206) SHAFT 12 --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
9/17	3		23.46	9.55	114.6	6.42	46.3																	
9/17	4		23.45	9.54	114.5	6.40	46.3																	
9/17	5		23.39	9.55	114.4	6.41	46.3																	
9/17	6		23.34	9.53	114.1	6.41	46.2	206M	9/17/15				0	0	1470									
9/17	7		23.32	9.51	113.9	6.39	46.1																	
9/17	8		23.28	9.52	113.9	6.40	46.4																	
9/17	9		23.26	9.54	114.1	6.42	46.1																	
9/17	10		23.24	9.55	114.2	6.39	46.3																	
9/17	11		23.20	9.53	113.9	6.36	46.3																	
9/17	12		22.72	9.64	114.1	6.38	46.0																	
9/17	13		17.49	11.45	122.1	6.19	45.9																	
9/17	14		15.67	11.67	119.9	6.16	45.8	206M	9/17/15	0.326	5.37	3.86												
9/17	15		14.14	11.61	115.4	6.03	45.7																	
9/17	16		12.96	11.69	113.2	6.00	45.6																	
9/17	17		12.29	11.57	110.3	5.94	45.6																	
9/17	18		11.66	11.43	107.4	5.87	45.5																	
9/17	19		11.24	11.32	105.3	5.87	45.8																	
9/17	20		10.91	11.16	103.1	5.84	45.7																	
9/17	21		10.56	10.91	99.9	5.78	45.5																	
9/17	22		10.26	10.79	98.1	5.75	45.8																	
9/17	23		10.09	10.72	97.1	5.76	45.6																	
9/17	24		9.83	10.62	95.6	5.73	45.8	206D	9/17/15				0	0	146									
9/17	25		9.63	10.47	93.8	5.70	45.8	206D	9/17/15	0.328	5.42	3.84												
9/17	26		9.52	10.37	92.7	5.66	45.8																	
9/17	27		9.35	10.05	89.5	5.63	46.0																	
10/22	0.5	7.4	14.85	8.01	79.4	6.57	45.9	206S	10/22/15	0.405	5.71	3.93	0	0	31		0	0	0.127	0	1710	0.019115		524.36
10/22	1		14.85	8.01	79.4	6.51	45.9																	
10/22	2		14.85	8.00	79.3	6.43	45.9																	
10/22	3		14.85	8.00	79.3	6.41	45.9																	
10/22	4		14.85	8.01	79.4	6.40	45.9																	
10/22	5		14.85	8.03	79.6	6.38	45.9																	
10/22	6		14.85	8.02	79.5	6.35	45.7	206M	10/22/15				0	0	10									
10/22	7		14.85	8.05	79.7	6.35	45.9																	
10/22	8		14.85	8.05	79.8	6.33	45.9																	
10/22	9		14.84	8.07	79.9	6.31	46.0																	
10/22	10		14.83	8.09	80.2	6.31	45.9																	
10/22	11		14.83	8.14	80.6	6.30	45.7																	
10/22	12		14.83	8.15	80.8	6.31	45.8																	
10/22	13		14.83	8.18	81.1	6.29	45.7	206M	10/22/15	0.377	5.64	3.94					0	0	0.101	0	1800	0.018870	2040	
10/22	14		14.83	8.14	80.6	6.28	46.0																	
10/22	15		14.82	8.19	81.1	6.27	46.0																	
10/22	16		14.82	8.16	80.8	6.27	46.0																	
10/22	17		14.82	8.23	81.5	6.28	45.9																	
10/22	18		14.81	8.23	81.5	6.25	45.9																	
10/22	19		14.81	8.26	81.8	6.26	45.7																	
10/22	20		14.79	8.27	81.9	6.24	46.0																	
10/22	21		14.67	8.28	81.7	6.24	45.8																	
10/22	22		13.72	8.41	81.4	6.30	45.8																	
10/22	23		11.51	8.63	79.5	6.16	45.7																	
10/22	24		10.84	8.29	75.1	5.65	45.9	206D	10/22/15				0	0	31									
10/22	25		10.56	8.29	74.6	5.64	45.7	206D	10/22/15	0.399	5.77	4.07					0	0	0.136	0	2030	0.019375		
10/22	26		10.48	8.22	73.9	5.60	45.9																	
11/9	0.5	8.3	12.68	9.63	91.0	6.43	46.5	206S	11/9/15	0.358	5.72	3.96	0	0	10									523.94
11/9	1		12.68	9.50	89.7	6.41	46.4																	
11/9	2		12.67	9.42	89.0	6.38	46.5																	
11/9	3		12.68	9.33	88.2	6.37	46.6																	
11/9	4		12.67	9.24	87.3	6.35	46.6																	
11/9	5		12.67	9.19	86.8	6.37	46.5																	

QUABBIN LABORATORY RECORDS 2015
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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
11/9	6		12.67	9.16	86.6	6.35	46.6	206M	11/9/15				*0*	*0*	20									
11/9	7		12.63	9.14	86.3	6.35	46.4																	
11/9	8		12.62	9.11	85.9	6.35	46.7																	
11/9	9		12.61	9.08	85.6	6.37	46.6																	
11/9	10		12.61	9.03	85.1	6.33	46.7																	
11/9	11		12.61	9.00	84.9	6.31	46.6																	
11/9	12		12.60	9.00	84.9	6.32	46.7																	
11/9	13		12.57	8.98	84.7	6.30	46.6	206M	11/9/15	0.367	5.84	4.15												
11/9	14		12.59	8.95	84.4	6.30	46.4																	
11/9	15		12.56	9.00	84.8	6.32	46.4																	
11/9	16		12.56	8.96	84.4	6.31	46.7																	
11/9	17		12.56	8.96	84.4	6.32	46.5																	
11/9	18		12.56	8.94	84.2	6.33	46.5																	
11/9	19		12.56	8.95	84.3	6.30	46.6																	
11/9	20		12.55	8.98	84.6	6.33	46.5																	
11/9	21		12.56	8.97	84.5	6.35	46.6																	
11/9	22		12.50	8.91	83.8	6.30	46.6																	
11/9	23		12.51	8.89	83.7	6.29	46.6																	
11/9	24		12.51	8.88	83.6	6.27	46.4	206D	11/9/15				*0*	*0*	31									
11/9	25		12.35	8.66	81.2	6.20	46.5	206D	11/9/15	0.369	5.77	3.83												
11/9	26		11.85	8.22	76.2	6.03	46.6																	
12/2	0.5	10.1	9.06	10.92	94.6	6.50	46.8	206S	12/2/15	0.449	5.55	3.95	*0*	*0*	*0*		*0*	*0*	0.177	0.00798	1750	0.018015		523.59
12/2	3		9.07	10.77	93.4	6.48	46.6																	
12/2	6		9.06	10.86	94.1	6.46	46.6	206M	12/2/15				*0*	*0*	10									
12/2	9		9.06	10.72	92.9	6.44	46.7																	
12/2	10		9.06	10.72	92.8	6.44	46.5																	
12/2	12		9.06	10.56	91.5	6.43	46.8																	
12/2	13		9.06	10.72	92.9	6.43	46.8	206M	12/2/15	0.475	5.52	3.90					*0*	*0*	0.150	0.00705	1800	0.018140	1920	
12/2	15		9.06	10.73	93.0	6.43	46.8																	
12/2	18		9.05	10.73	93.0	6.45	46.6																	
12/2	21		9.05	10.75	93.2	6.43	46.5																	
12/2	24		9.05	10.79	93.5	6.40	46.5	206D	12/2/15				*0*	*0*	30									
12/2	25		9.05	11.11	96.2	6.41	46.7	206D	12/2/15	0.435	5.43	3.87					*0*	*0*	0.138	0.00680	1810	0.018255		
12/2	26		9.04	11.15	96.6	6.41	46.8																	
	AVG.	9.4	13.66	10.02	97.4	6.24	45.8			0.315	5.44	3.84	<1	0	185	N/A	<0.005	<0.005	0.144	<0.005	1900	0.020639	1990	
	MAX.	10.8	24.63	17.99	140.5	6.57	46.8			0.475	5.84	4.15	<1	10	1470	N/A	<0.005	0.0067	0.282	0.0108	2150	0.023695	2070	
	MIN.	7.4	4.33	8.00	73.9	5.60	44.9			0.193	5.15	3.61	<1	<10	<10	N/A	<0.005	<0.005	<0.005	<0.005	1710	0.018015	1920	
	MEDIAN	9.5	12.56	10.05	94.4	6.31	45.7			0.296	5.42	3.83	<1	<10	30	N/A	<0.005	<0.005	0.137	0.00637	1860	0.019635	1980	

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = 1 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2015
DEN HILL --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/23	0.5	6.5	6.27	15.75	129.3	6.66	50.5	DENS	4/23/2015	0.349	5.66	3.91	0	0	20									528.28
4/23	3		6.13	15.74	128.8	6.51	50.6																	
4/23	6		6.06	16.01	130.7	6.39	50.4	DENM	4/23/2015				0	0	10									
4/23	9		5.90	16.06	130.6	6.28	50.5	DENM	4/23/2015	0.367	5.50	3.78												
4/23	12		5.68	16.31	131.9	6.23	50.6																	
4/23	13		5.64	16.20	130.8	6.17	50.4	DEND	4/23/2015				1	0	20									
4/23	15		5.61	16.11	130.1	6.13	50.5																	
4/23	18		5.42	15.98	128.4	6.12	50.6	DEND	4/23/2015	0.339	5.62	3.88												
4/23	19		5.25	15.87	126.9	6.06	51.1																	
5/14	0.5	5.9	15.57	8.47	86.1	6.40	48.1	DENS	5/14/2015	0.413	5.29	3.74	0	0	146		0	0	0.299	0.00966	2770	0.040485		528.09
5/14	1		15.40	8.58	86.9	6.43	48.3																	
5/14	2		15.25	8.71	87.9	6.43	48.3																	
5/14	3		15.10	8.76	88.1	6.42	47.8																	
5/14	4		14.91	8.94	89.6	6.43	47.9																	
5/14	5		14.86	8.91	89.2	6.39	47.8																	
5/14	6		14.54	9.04	89.8	6.38	47.5	DENM	5/14/2015				1	0	317									
5/14	7		14.16	9.13	90.0	6.39	47.3																	
5/14	8		12.15	9.85	92.8	6.44	47.5																	
5/14	9		9.55	10.60	94.1	6.35	47.3																	
5/14	10		8.85	10.51	91.7	6.33	48.1	DENM	5/14/2015	0.392	5.26	3.70					0	0.00510	0.265	0.0101	2520	0.038275	2020	
5/14	11		7.90	10.55	90.0	6.29	48.8																	
5/14	12		7.46	10.28	86.7	6.18	48.9																	
5/14	13		7.24	10.22	85.7	6.11	49.0	DEND	5/14/2015				0	0	74									
5/14	14		7.20	10.21	85.5	6.09	49.1																	
5/14	15		7.18	10.22	85.6	6.05	49.2																	
5/14	16		7.04	10.22	85.3	6.04	49.2																	
5/14	17		7.00	10.20	85.0	6.02	49.3																	
5/14	18		6.98	10.20	85.0	6.02	49.1	DEND	5/14/2015	0.310	5.38	3.81					0.00622	0.0304	0.281	0.00970	3300	0.045315		
5/14	19		6.92	10.19	84.8	6.01	49.4																	
6/17	0.5	7.1	20.69	8.17	92.5	6.15	47.6	DENS	6/17/2015	0.322	5.24	3.80	0	0	86									527.68
6/17	1		20.64	8.16	92.3	6.13	47.5																	
6/17	2		20.55	8.13	91.8	6.14	47.5																	
6/17	3		20.44	8.27	93.1	6.14	47.7																	
6/17	4		20.26	8.33	93.4	6.14	47.6																	
6/17	5		19.17	8.67	95.2	6.15	47.1																	
6/17	6		18.97	8.64	94.5	6.11	47.2	DENM	6/17/2015				0	0	132									
6/17	7		18.46	8.79	95.1	6.13	47.1																	
6/17	8		17.82	8.91	95.2	6.12	47.1	DENM	6/17/2015	0.379	5.14	3.69												
6/17	9		16.69	9.17	95.7	6.12	47.0																	
6/17	10		15.38	9.38	95.2	6.05	46.9																	
6/17	11		13.06	9.78	94.3	5.97	47.2																	
6/17	12		11.62	9.85	91.9	5.88	47.8																	
6/17	13		10.90	10.12	92.9	5.85	48.0	DEND	6/17/2015				0	0	0									
6/17	14		10.22	10.26	92.7	5.83	48.0																	
6/17	15		9.40	10.20	90.4	5.74	48.6																	
6/17	16		8.87	10.11	88.5	5.70	48.7																	
6/17	17		8.58	10.08	87.6	5.66	48.8																	
6/17	18		8.23	10.17	87.7	5.66	49.4	DEND	6/17/2015	0.279	5.28	3.83												
6/17	19		7.80	10.09	86.1	5.64	49.5																	
7/22	0.5	8.4	25.71	9.74	122.5	6.40	48.6	DENS	7/22/2015	0.302	5.35	3.91	0	0	6130		0	0	0.124	0.00764	1850	0.033020		527.48
7/22	1		25.59	9.58	120.2	6.42	48.6																	
7/22	2		25.04	9.57	118.8	6.39	48.1																	
7/22	3		24.90	9.51	117.7	6.39	48.1																	
7/22	4		24.62	9.54	117.6	6.40	48.0																	
7/22	5		24.28	9.60	117.5	6.41	47.7																	
7/22	6		24.13	9.55	116.6	6.38	47.3	DENM	7/22/2015				0	0		>24200								
7/22	7		23.76	9.49	115.1	6.35	47.4																	
7/22	8		22.99	9.67	115.5	6.34	47.0																	
7/22	9		21.81	9.93	116.0	6.31	46.8																	
7/22	10		19.71	10.39	116.5	6.26	46.8																	
7/22	11		18.14	10.64	115.5	6.19	46.8	DENM	7/22/2015	0.386	5.18	3.71					0	0	0.194	0.00765	1830	0.028275	2020	
7/22	12		15.69	11.15	115.0	6.18	46.7																	
7/22	13		14.00	10.78	107.2	5.97	46.9	DEND	7/22/2015				0	0	3650									

QUABBIN LABORATORY RECORDS 2015
DEN HILL --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
7/22	14		12.18	11.07	105.7	5.93	47.2																	
7/22	15		10.56	10.69	98.3	5.82	48.3																	
7/22	16		9.81	10.58	95.6	5.76	48.6																	
7/22	17		9.23	10.50	93.6	5.72	48.8																	
7/22	18		9.02	10.10	89.6	5.68	48.9	DEND	7/22/2015	0.385	5.29	3.81					0	0.00637	0.151	0.00928	1890	0.037120		
7/22	19		8.75	9.57	84.3	5.62	49.2																	
8/12	0.5	7.2	25.06	9.00	110.8	6.46	47.7	DENS	8/12/2015	0.339	5.59	3.85	0	0	605									526.72
8/12	1		25.04	8.94	110.0	6.45	47.6																	
8/12	2		25.01	8.85	108.8	6.42	47.7																	
8/12	3		24.88	8.87	108.7	6.41	47.6																	
8/12	4		24.85	8.84	108.3	6.42	47.9																	
8/12	5		24.84	8.79	107.7	6.40	47.9																	
8/12	6		24.83	8.79	107.6	6.38	47.6	DENM	8/12/2015				1	0	703									
8/12	7		24.78	8.77	107.3	6.36	47.7																	
8/12	8		24.71	8.80	107.5	6.35	47.8																	
8/12	9		23.06	9.12	108.1	6.13	46.9																	
8/12	10		22.17	9.00	104.9	6.07	46.9																	
8/12	11		19.59	9.58	106.1	6.01	46.6																	
8/12	12		17.30	9.79	103.4	6.02	46.6																	
8/12	13		14.86	10.16	102.0	6.03	46.8	DENM	8/12/2015	0.549	5.63	3.83												
8/12	13							DEND	8/12/2015				0	0	288									
8/12	14		13.38	9.61	93.3	5.83	47.3																	
8/12	15		11.53	9.21	85.8	5.71	48.1																	
8/12	16		10.23	8.75	79.1	5.65	48.3																	
8/12	17		9.58	8.33	74.2	5.59	48.8																	
8/12	18		9.31	8.25	73.0	5.59	48.9	DEND	8/12/2015	0.533	5.72	3.89												
8/12	19		8.88	7.94	69.5	5.55	49.1																	
9/17	0.5	8.5	24.07	9.92	120.5	6.46	47.9	DENS	9/17/2015	0.417	5.65	4.07	2	0	2140									525.52
9/17	1		23.71	9.87	119.1	6.43	47.6																	
9/17	2		23.62	9.70	116.8	6.41	47.6																	
9/17	3		23.58	9.50	114.4	6.38	47.7																	
9/17	4		23.55	9.40	113.1	6.36	47.6																	
9/17	5		23.50	9.32	112.0	6.34	47.6																	
9/17	6		23.43	9.28	111.4	6.33	47.5	DENM	9/17/2015				0	0	3260									
9/17	7		23.41	9.24	110.8	6.28	47.5																	
9/17	8		23.39	9.21	110.4	6.32	47.6																	
9/17	9		23.34	9.12	109.3	6.27	47.4																	
9/17	10		23.03	9.11	108.5	6.23	47.6																	
9/17	11		22.57	9.05	106.9	6.11	48.2																	
9/17	12		21.60	9.13	105.8	5.94	47.9																	
9/17	13		17.34	10.15	108.0	5.81	47.7	DEND	9/17/2015				1	0	2910									
9/17	14		13.85	10.36	102.3	5.71	47.8	DENM	9/17/2015	0.537	5.59	3.95												
9/17	15		12.14	9.69	92.0	5.58	48.7																	
9/17	16		10.76	9.16	84.3	5.50	49.4																	
9/17	17		9.96	8.42	76.1	5.44	49.6	DEND	9/17/2015	0.546	5.65	3.99												
9/17	18		9.64	8.04	72.1	5.43	50.4																	
10/22	0.5	6.2	14.38	8.56	84.0	6.42	47.9	DENS	10/22/2015	0.472	5.93	4.24	1	0	63		0	0	0.128	0.00624	1910	0.027790		524.36
10/22	1		14.37	8.59	84.2	6.33	47.6																	
10/22	2		14.35	8.54	83.7	6.27	47.9																	
10/22	3		14.33	8.49	83.2	6.24	47.7																	
10/22	4		14.32	8.44	82.7	6.21	47.6																	
10/22	5		14.28	8.34	81.7	6.18	47.8																	
10/22	6		14.26	8.35	81.7	6.17	47.9	DENM	10/22/2015				0	0	63									
10/22	7		14.25	8.34	81.6	6.16	47.6																	
10/22	8		14.24	8.32	81.4	6.16	47.8																	
10/22	9		14.24	8.30	81.2	6.15	47.7	DENM	10/22/2015	0.510	6.09	4.47					0	0	0.119	0.00508	1760	0.027885	1890	
10/22	10		14.22	8.28	81.0	6.13	47.6																	
10/22	11		14.16	8.31	81.2	6.12	47.8																	
10/22	12		14.11	8.29	80.9	6.12	48.1																	
10/22	13		13.97	8.29	80.7	6.14	48.2	DEND	10/22/2015				0	0	75									
10/22	14		13.84	8.34	80.9	6.15	48.0																	
10/22	15		13.64	8.36	80.7	6.13	48.2																	
10/22	16		13.59	8.36	80.6	6.10	48.2	DEND	10/22/2015	0.782	9.54	7.50					0	0	0.129	0.00881	1910	0.028145		

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/22	17		12.71	7.71	72.9	6.04	49.0																	
11/9	0.5	8.1	12.01	10.09	93.9	6.39	48.9	DENS	11/9/2015	0.491	6.22	4.49	*0*	*0*	10									523.94
11/9	1		12.01	9.76	90.8	6.37	48.9																	
11/9	2		12.01	9.63	89.7	6.36	48.9																	
11/9	3		11.98	9.38	87.2	6.36	48.8																	
11/9	4		11.96	9.27	86.2	6.37	48.8																	
11/9	5		11.95	9.10	84.5	6.34	48.6																	
11/9	6		11.89	8.72	80.9	6.31	48.8	DENM	11/9/2015				*0*	*0*	*0*									
11/9	7		11.89	8.95	83.1	6.31	48.6																	
11/9	8		11.88	8.92	82.8	6.28	48.6																	
11/9	9		11.87	8.91	82.7	6.31	48.7	DENM	11/9/2015	0.494	6.09	4.37												
11/9	10		11.87	9.01	83.6	6.31	48.7																	
11/9	11		11.86	8.91	82.6	6.32	48.6																	
11/9	12		11.86	8.88	82.3	6.30	48.6																	
11/9	13		11.85	8.88	82.3	6.30	48.8	DEND	11/9/2015				*0*	*0*	41									
11/9	14		11.85	8.86	82.1	6.31	48.8																	
11/9	15		11.84	8.84	82.0	6.31	48.7																	
11/9	16		11.83	8.84	81.9	6.30	48.8	DEND	11/9/2015	0.452	6.01	4.23												
11/9	17		11.82	8.84	81.9	6.30	48.9																	
12/2	0.5	6.0	7.81	12.22	102.7	6.61	49.0	DENS	12/2/2015	0.465	5.89	4.26	*0*	*0*	*0*		*0*	0.00640	0.151	0.00775	1890	0.045650		523.59
12/2	3		7.81	11.92	100.2	6.55	48.9																	
12/2	6		7.80	11.78	99.0	6.49	48.9	DENM	12/2/2015				*0*	*0*	20									
12/2	9		7.79	11.60	97.4	6.44	49.0	DENM	12/2/2015	0.417	5.91	4.29					*0*	0.00670	0.113	0.00911	1970	0.029775	2000	
12/2	10		7.78	11.50	96.6	6.46	48.9																	
12/2	12		7.76	11.48	96.4	6.45	49.0																	
12/2	13		7.75	11.36	95.4	6.45	49.2	DEND	12/2/2015				*0*	*0*	*0*									
12/2	15		7.53	11.38	95.0	6.48	49.5																	
12/2	16		7.41	11.39	94.8	6.47	49.9																	
12/2	17		7.39	11.40	94.8	6.47	49.7	DEND	12/2/2015	0.402	5.88	4.21					0.00540	0.00637	0.119	0.00904	2030	0.031050		
12/2	18		7.40	11.44	95.2	6.44	50.1																	
	AVG.	7.1	14.50	9.83	96.7	6.18	48.3			0.431	5.76	4.12	<1	<10	799	N/A	<0.005	0.00511	0.173	0.00834	2140	0.034399	1980	
	MAX.	8.5	25.71	16.31	131.9	6.66	51.1			0.782	9.54	7.50	2	<10	6130	>24200	0.0062	0.0304	0.299	0.0101	3300	0.045650	2020	
	MIN.	5.9	5.25	7.71	69.5	5.43	46.6			0.279	5.14	3.69	<1	<10	<10	N/A	<0.005	<0.005	0.113	0	1760	0.027790	1890	
	MEDIAN	7.1	13.64	9.38	93.3	6.26	48.1			0.413	5.63	3.91	<1	<10	74.5	N/A	<0.005	0.00255	0.140	0.00893	1910	0.032035	2010	

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.
STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = 1 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.