Water Quality Report: 2014
Quabbin Reservoir Watershed
Ware River Watershed

Quabbin Reservoir from Rattlesnake Hill (Peter Deslauriers, May 21, 2014)

June 2015

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 24 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 2014 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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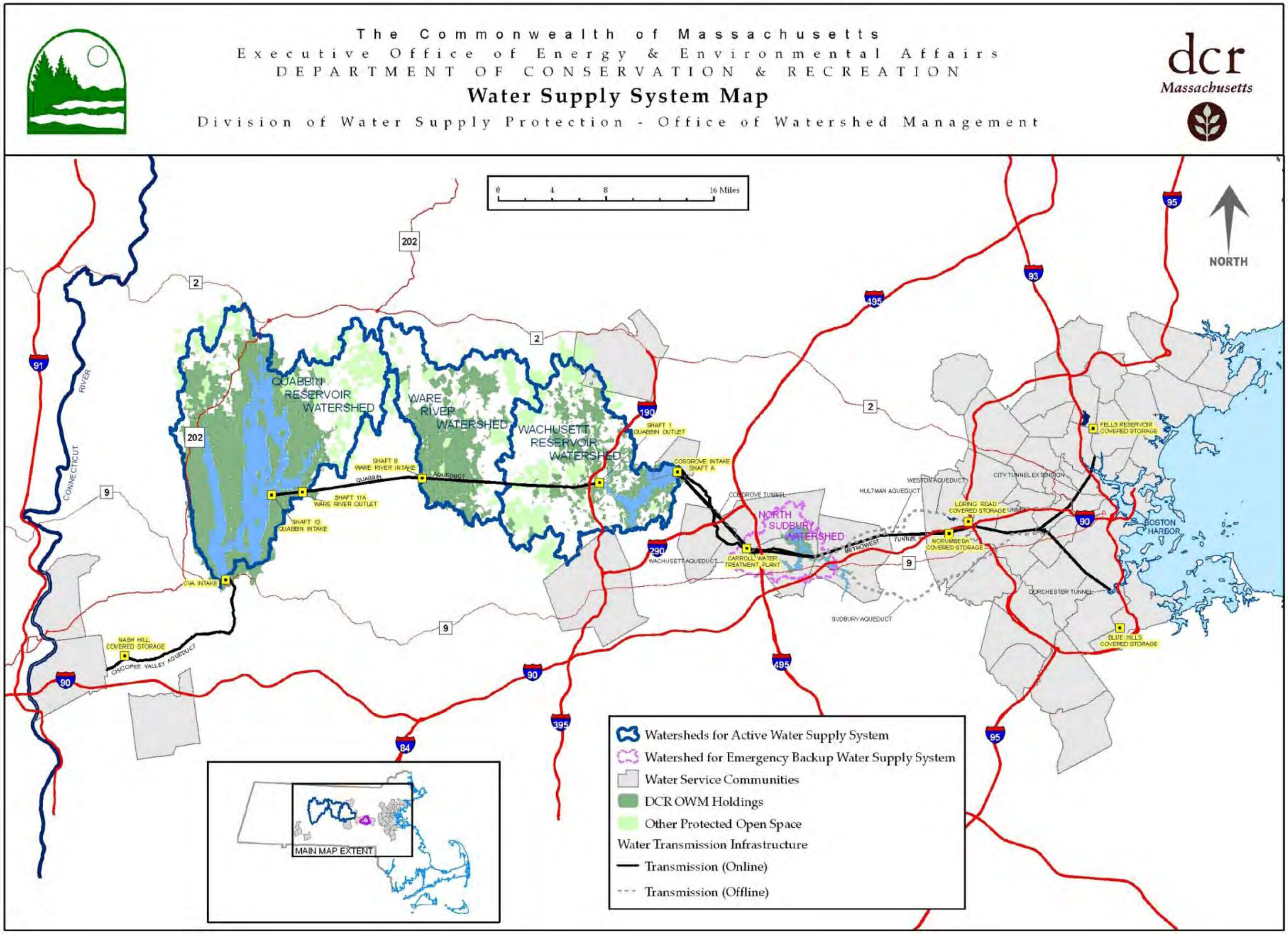


Figure 1. Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed System

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 2014; a separate report summarizes the monitoring performed during 2014 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 2014, transfers to Wachusett Reservoir totaled 47,263.56 million gallons (MG). In the 224 days that transfers occurred, the Quabbin Aqueduct delivered an average of 211.00 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 2014, the CVA delivered on average 7.54 MGD of flow to the CVA communities. The reservoir maintained a normal operating level throughout 2014. In 2014, the reservoir had a net storage gain of 20,400 MG, and operating levels experienced a maximum fluctuation of 5.63 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:	***2014***	***2013***	***2012***
Maximum Reservoir Elevation (ft)	529.26 on May 28	528.15 on July 9	530.21 on January 2 & 3
Minimum Reservoir Elevation (ft)	523.63 (DWSP data) on January 1	522.60 (DWSP data) on January 11	522.57 (DWSP data) on December 9, 10, 14
Total Diversions to Wachusett Reservoir	47,263.56 MG (224 days: 211.00 MGD)	48,906.31 MG (230 days: 212.64 MGD)	63,975.32 MG (300 days: 213.25 MGD)
Total Diversions to CVA	2,754 MG (365 days: 7.54 MGD)	2,820 MG (365 days: 7.73 MGD)	2,936 MG (366 days: 8.02 MGD)
Ware River Transfers	1,360.8 MG (8 days: 170.1 MGD)	3,218.7 MG (22 days: 146.3 MGD)	168.6 MG (2 days: 84.3 MGD)
Spillway Discharges	2,593 MG (55 days: 47.1 MGD)	2.8 MG (3 days: 0.93 MGD)	9,585 MG (160 days: 59.9 MGD)
Total Diversions to Swift River	12,460 MG (34.1 MGD)	9,034 MG (24.75 MGD)	27,678 MG (75.6 MGD)
Reservoir Ice Cover	Hl00% on January 23, complete ice cover on February 5, ice out on April 13.	Full reservoir ice cover not obtained.	Full reservoir ice cover not obtained.

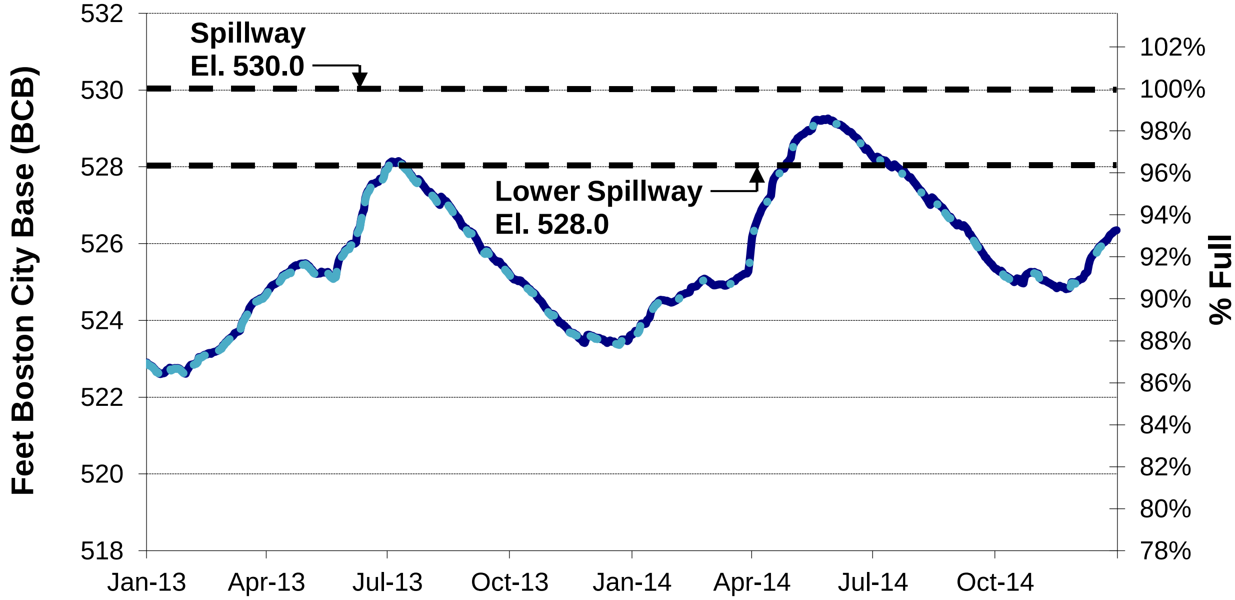
Notes:

[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 daily flow.

Sources: Watershed Protection Plan Update (DWSP, 2013a), DWSP Civil Engineering Yield Data 2012-2014, MWRA Flow Data



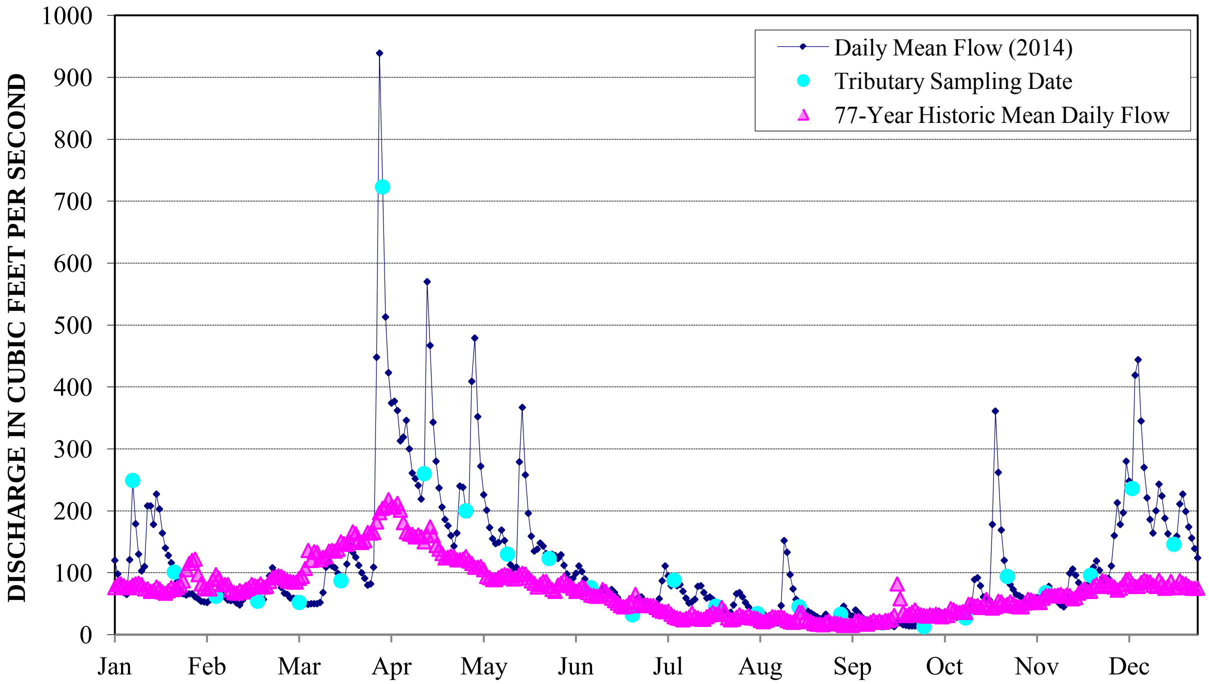
Source: DCR Civil Engineering '13-'14

Figure 2. Quabbin Reservoir Daily Elevation, January 2013 - December 2014

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 2014, mean daily flows for the East Branch Swift River in Hardwick averaged 113 cubic feet per second (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 lower than the 77-year historical mean daily flow in late January until late March, and then rose with snowmelt and above-average precipitation in late winter and early spring. Stream flow fell below the historical mean daily flow with drier conditions in September. Except for May, when a new maximum was recorded, monthly mean flows remained within the 77-year historical ranges.

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



Source: U.S. Geological Survey website (provisional data accessed May 21, 2015).

Figure 3. East Branch Swift River near Hardwick, MA, January - December 2014

generate runoff that is extremely quick, and stream flows are typically characterized as flashy. In 2014, mean daily flows for the West Branch Swift River averaged 28.2 cfs. Monthly mean flows remained within historical ranges.

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 2014, Ware River transfers to Quabbin Reservoir totaled 1,360.8 MG over 8 days, intermittently in January through early April. At the USGS stream gage near the Shaft 8 intake works, mean daily flows averaged 177 cfs in 2014.

Daily precipitation has been recorded at the Belchertown monitoring station for 76 years. In 2014, the annual precipitation of 50.48 was above the 75-year annual average of 46.25 inches (DWSP, 2014). Precipitation totals for June (1.80 inches) and September (1.59 inches) were abnormally low, ranking among the lowest 20 percentile compared to the 75-year period-of-record for each respective month. Six months in 2014 ranked among the highest 20 percentile for each month's historical record: February (3.87 inches), March (5.21 inches), May (5.51 inches), July (6.68 inches), October (5.84 inches), and December (5.37 inches). The highest 24-

hour rainfall of 2.24 inches occurred on March 30 (DWSP, 2014). Snowfall, with a total of 62.9 inches, was above the 36-year historical average of 48.5 inches (DWSP, 2014). Temperature and total precipitation in Massachusetts were above average for the year 2014 compared to the 120-year period of record (NCDC, 2015; NRCC, 2015). Winter 2014 (December 2013 - February 2014) was slightly cooler than average, with above average precipitation state-wide for the season (NRCC, 2015). Temperature and precipitation were slightly below normal for Spring (March - May) 2014, and above average in Summer (June - August) 2014 (NRCC, 2015). Autumn (September - November) 2014 had above average temperatures, with precipitation slightly above average. Abnormally dry to moderate drought conditions in portions of Massachusetts were observed during most months of the year (DWSP, 2015). The 2014 North Atlantic hurricane season was relatively mild, with a total of 8 tropical storms, six hurricanes, and two major hurricanes (NCDC, 2015).

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 2014, 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 stations were located within the Quabbin Reservoir watershed, and 9 tributary stations 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
2014 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.

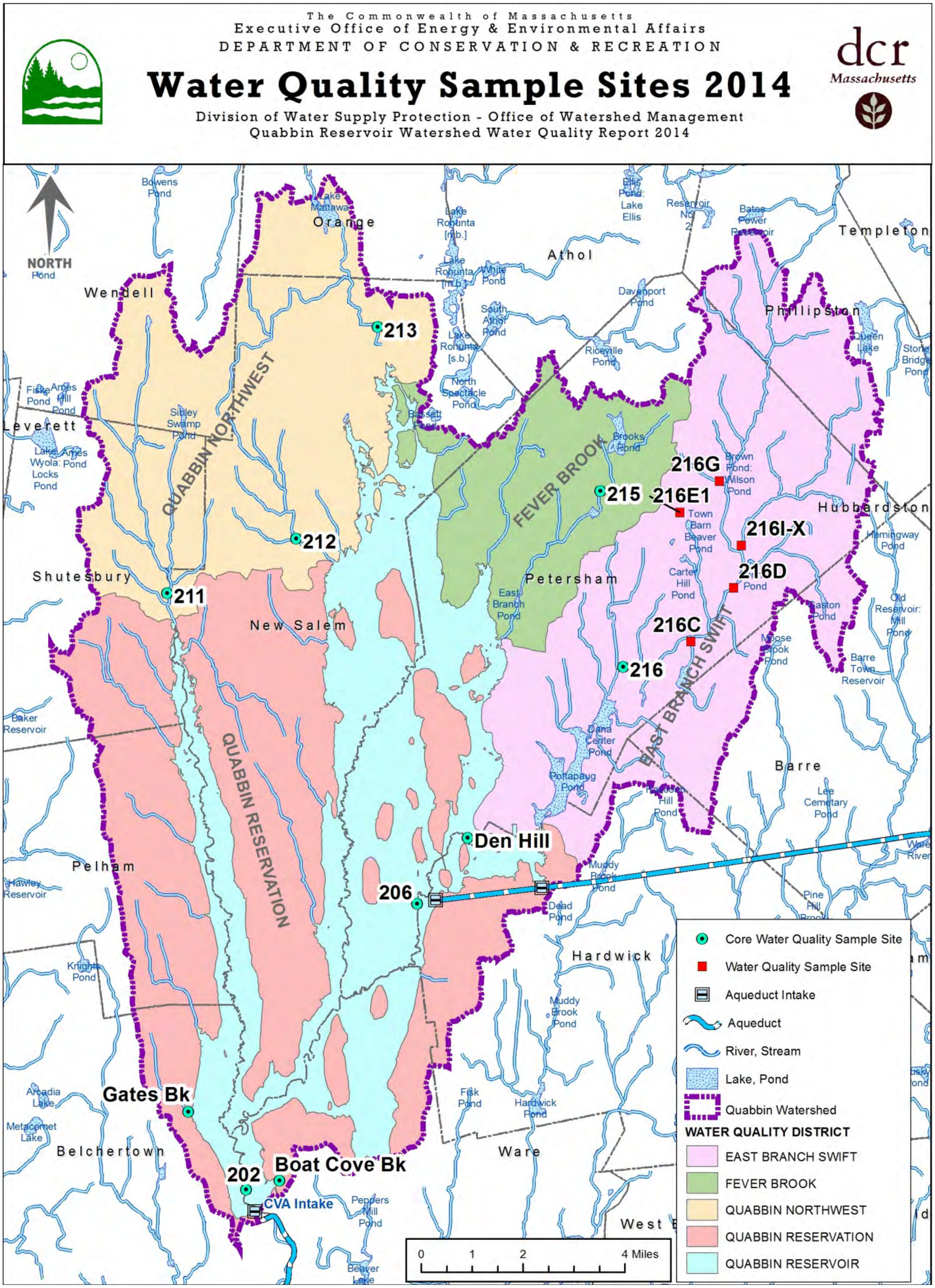


Figure 4. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2014 in the Quabbin Reservoir Watershed

Table 3. Ware River Tributaries
2014 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%
WEST BRANCH WARE RIVER SANITARY DISTRICT EQA SITES [3]				
Waite Pond at outlet	127	0.93	10.0%	0%
Lovewell Pond at outlet	128	1.84	21.1%	<1%
Moosehorn Pond at outlet	126A	6.59	18.3%	38.9%
Brigham Pond at outlet	115	11.4	15.4%	37.7%

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, January 2009 revision).

[6]Source: DWSP Office of Watershed Management Geographic Information System, January 2014 revision.

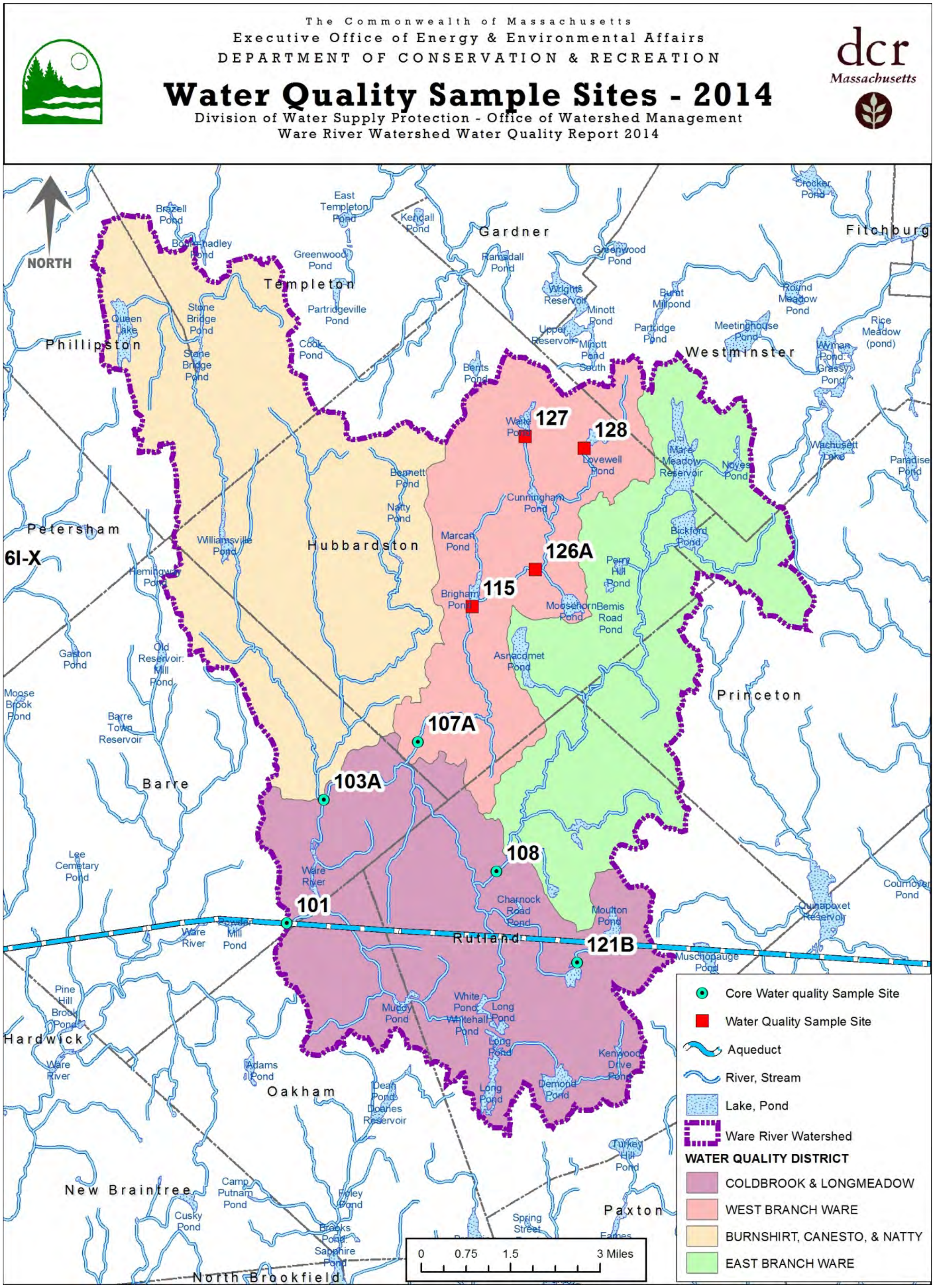


Figure 5. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2014 in the Ware River Watershed

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 2014, Environmental Quality staff collected 2,880 source water (tributary and reservoir) samples. Of those samples, 623 (22 percent) were collected for microbial analysis, 626 (22 percent) for physicochemical properties, and the remaining 1,631 samples (56 percent) were collected for nutrient analysis. Over 5,400 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 (1,256) and 60 percent bacterial analyses (1,867) 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 or Winsor Power Station. In addition, over 2,100 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 2014 focused on the East Branch Swift River Sanitary District in the Quabbin watershed, as well as the West Branch Ware River Sanitary District in the Ware River watershed. The EQA sites for 2014, 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.

2.6 Special Sampling During 2014

In 2014, special sampling was conducted to provide turbidity levels prior to, during, and/or after logging operations. See Section 3.3 for description of water quality monitoring for forestry operations. Summary reports for lots FL2042, FL2043, and FL4380 are included in **Appendix A**.

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 2013 through December 2014.

In 2014, fecal coliform bacteria averaged less than one colony per 100 mL and were not detected 86 percent of the time; median concentration was less than one colony per 100 mL. The maximum level, 11 colonies per 100 mL, occurred on January 4, most likely from gulls roosting on the reservoir. Fecal coliform concentrations remained below 20 colonies per 100 mL throughout 2014.

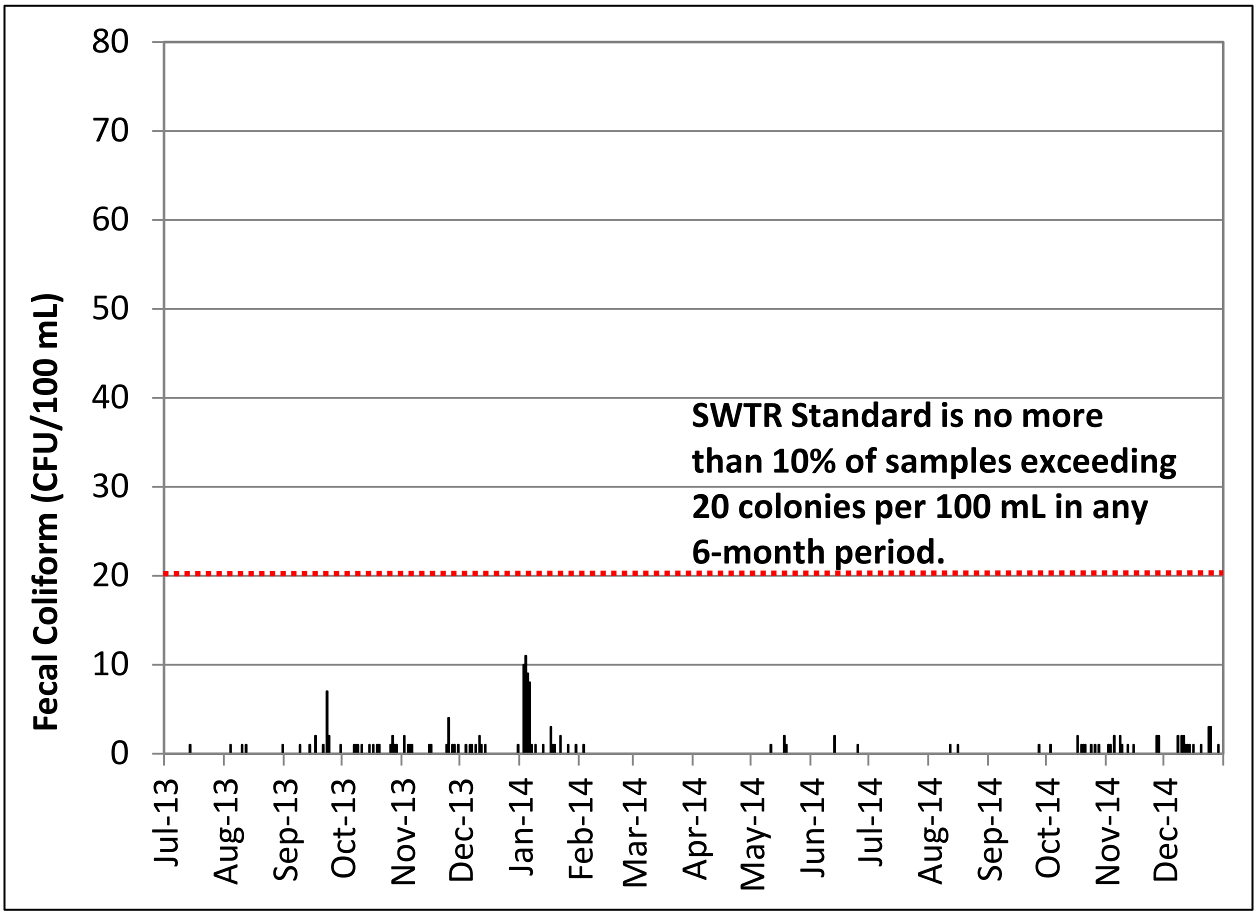


Figure 6. Fecal Coliform Bacteria Concentration prior to Disinfection, Quabbin Reservoir Source Water

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 2014 and includes a horizontal line marking the 1.0 NTU performance standard. For 2014, turbidity levels averaged 0.26 NTU, with the maximum turbidity of 0.61 NTU observed on May 27 (MWRA, 2014). Turbidity at the William A. Brutsch Water Treatment Facility remained below 1.0 NTU and met source water requirements throughout 2014.

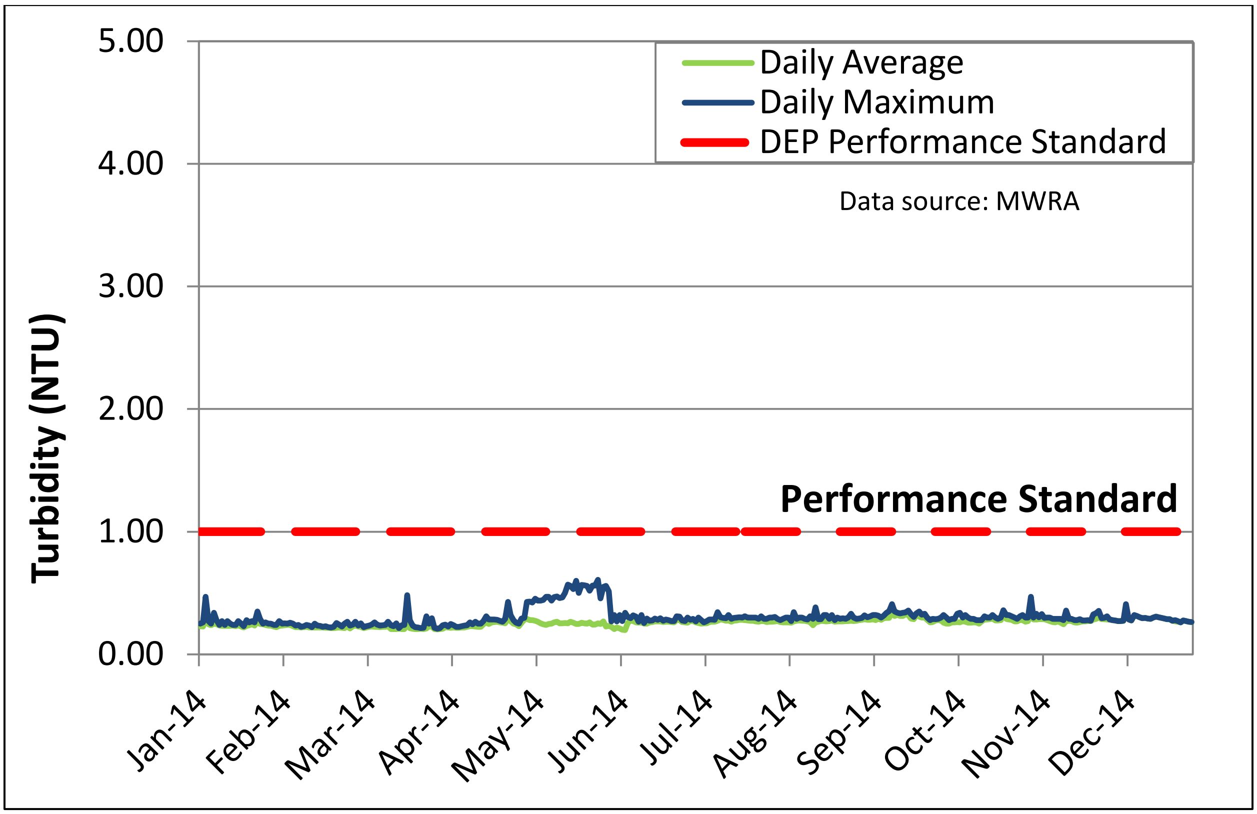


Figure 7. Quabbin Reservoir Source Water Turbidity (at William A. Brutsch Water Treatment Facility)

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 2014, 26 samples were collected by MWRA staff, and *Giardia* and *Cryptosporidium* were not detected in any samples. MWRA maintains a 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, collected by Environmental Quality staff, 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 monthly except during periods of adverse weather and ice conditions in the winter. Three sampling stations that were routinely sampled in 2014 are profiled in **Table 5**. **Figure 4** may be referenced for the specific locations of each sample site.

Table 5. 2014 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°17.115′ W 72°20.938′	42 meters
Shaft 12 (QR206)	Quabbin Reservoir at site of former Quabbin Lake, off shore of Shaft 12.	N 42°22.268′ W 72°17.015′	30 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 to 3 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 to 3 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.

Table 6 presents an overview of reservoir water quality conditions at three stations routinely monitored in 2014. The complete data for individual stations are included in **Appendix C**. Provided below is a brief discussion of selected monitoring parameters and their significance to reservoir water quality conditions.

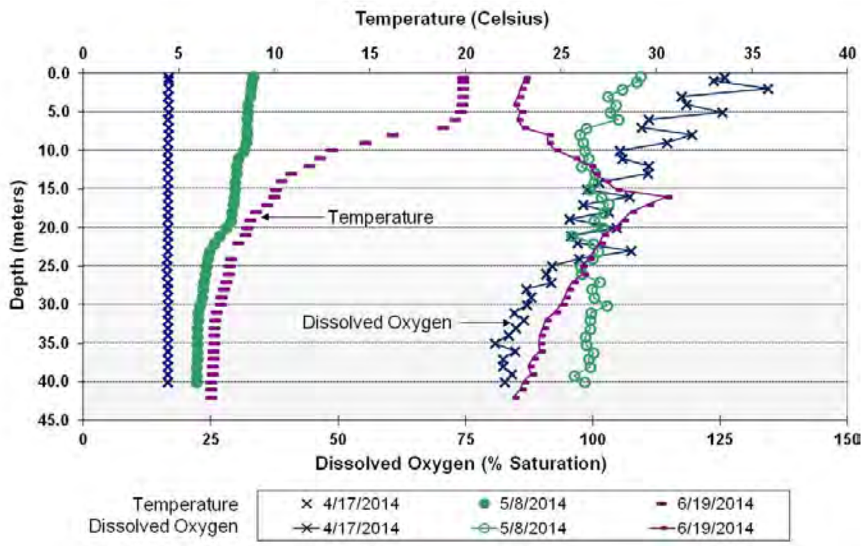
Table 6. General Water Chemistry Ranges, 2014 Quabbin Reservoir Monitoring Stations.

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)	5.6-7.1	0.16-0.35	81-167	8.4-12.8	<10-6,870	<1-1
Shaft 12 (QR206)	5.6-7.1	0.21-0.38	56-152	7.8-12.7	<10-4,350	<1-1
Den Hill (QR10)	5.4-7.2	0.28-0.56	54-137	4.0-9.9	<10-2,380	<1-2

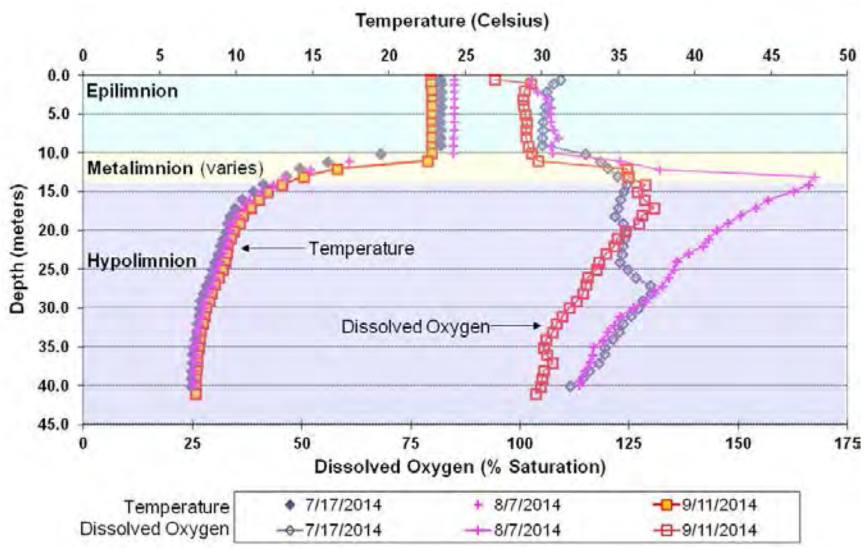
Source: Environmental Quality Database, 2014

3.1.1 Temperature

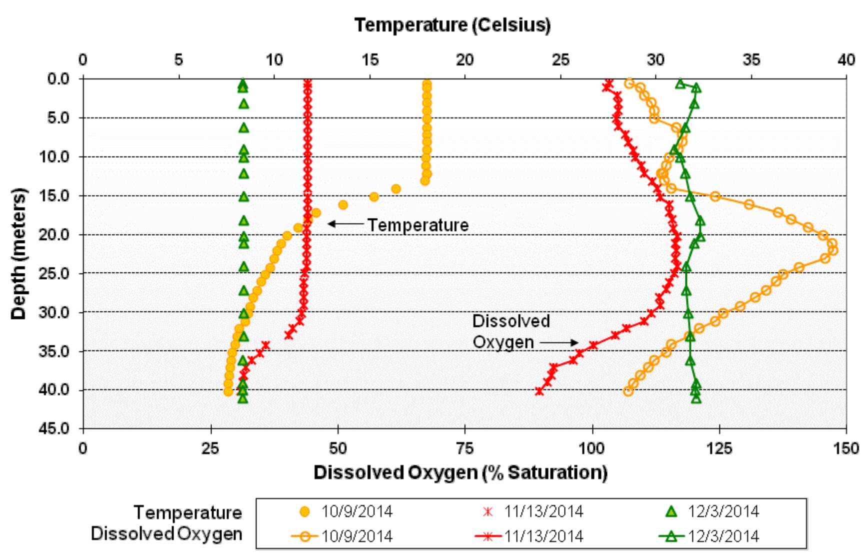
The thermal stratification that occurs in the reservoir has a profound impact on many of the parameters monitored across the reservoir profile. The temporal zones that develop within the reservoir during the warmer months of spring and summer, known as the epilimnion, metalimnion and hypolimnion (listed 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. Profile data collected at Station 202 (Winsor Dam) are shown in **Figure 8** to graphically portray the thermal mixing and transition that occurs between isothermal and fully mixed to fully stratified conditions. Fall turnover probably occurred in mid- to late November, based on the temperature profiles for Station 202 and Station 206 (Shaft 12). The water column at each location was completely mixed to 13-15 meters depth on October 9 and 26-30 meters depth (fully mixed at Station 206) on November 13. Station 202 was fully mixed by December 3.



(a) April - June 2014



(b) July - September 2014



(c) October - December 2014

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

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 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. In 2014, minimum levels of oxygen reached in the hypolimnion ranged from a low of 54 percent saturation at the Den Hill station to 81 percent saturation at the bottom depths at Station 202. Depletion levels are generally most pronounced in the latter stages of stratification (typically August through October). In 2014, however, the minimum dissolved oxygen levels were measured in different months, depending on site. Dissolved oxygen reached a minimum of 7.63 mg/L at Station 202 (June 19, epilimnion), 7.06 mg/L at Station 206 (April 17, unstratified), and 6.18 mg/L at Den Hill (October 9, hypolimnion). 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 2014 ranged from 0.16 to 0.56 NTU. The highest turbidity measurement occurred in the near-surface sampling station at Den Hill, on April 17. Storm activity may have increased turbidity, with 1.39 inches of precipitation recorded at Barre Falls Dam two days prior to reservoir sampling. Other typical causes of turbidity in the reservoir include algal blooms or shoreline erosion. 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 6.26 across the three stations monitored in 2014.

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 will 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 3.89 mg/L as $CaCO_3$ across the three reservoir stations with very little variation observed at depth. (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, which was the method used historically, reservoir alkalinity averaged 5.74 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 2014, transparency was measured at a maximum of 12.8 meters at Site 202 on June 19.

Transparency at the Den Hill station is characteristically much lower, typically reflecting the contribution of large, nearby river inputs of the East Branch Swift 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 2014, transparency was measured at a minimum of 4.0 meters at Den Hill on April 17. 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 2014, Quabbin Reservoir Site 202 (Winsor Dam).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 17, 2014	8.9	Green	Most sunny, 4°C (39°F), NE/E wind 4 mph, 6" chop.
May 8, 2014	10.5	Green	Mostly sunny, 12°C (54°F), N wind 1 mph, slight ripple.
June 19, 2014	12.8	Green	Mostly cloudy, 24°C (75°F), calm wind, calm water surface.
July 17, 2014	10.1	Blue	Partly sunny, 21°C (70°F), N wind 2 mph, 4" ripple.
August 7, 2014	12.6	Green	Partly sunny, 20°C (68°F), N wind 1 mph, slight ripple.
September 11, 2014	8.4	Light blue-green	Overcast, 19°C (66°F), S wind 6 mph, 8" chop.
October 9, 2014	8.7	Green	Sunny, 10°C (50°F), W wind 1 mph, 2" ripple.
November 13, 2014	9.7	Green	Mostly cloudy, 5°C (41°F), W wind 1 mph, slight ripple.
December 3, 2014	9.0	Green	Overcast with fog, 3°C (37°F), S wind 1 mph, slight ripple.

Table 8. Transparency Measurements and Weather and Water Surface Observations in 2014, Quabbin Reservoir Site 206 (Shaft 12).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 17, 2014	8.1	Green	Sunny, 6°C (43°F), NE wind 4 mph, 4" ripple.
May 8, 2014	9.8	Blue-green	Cloudy, 14°C (57°F), N wind 0-1 mph, slight ripple.
June 19, 2014	12.0	Green	Mostly cloudy, 25°C (77°F), calm wind, calm water surface.
July 17, 2014	10.9	Blue-green	Partly sunny, 24°C (75°F), NE wind 1 mph, 2" ripple.
August 7, 2014	12.7	Blue-green	Partly sunny, 23°C (73°F), calm wind, calm water surface.
September 11, 2014	Not measured, rough waves.	Light blue-green	Overcast, 20°C (68°F), S wind 10-15 mph, 1-1½' waves.
October 9, 2014	8.4	Green	Mostly sunny, 16°C (61°F), SW/W wind 7-12 mph, 10-14" chop.
November 13, 2014	8.3	Blue-green	Mostly cloudy, 6°C (43°F), W/NW wind 2 mph, 4" chop.
December 3, 2014	7.8	Green	Overcast with fog, 4°C (39°F), S wind 5-10 mph, 10-12" chop.

Table 9. Transparency Measurements and Weather and Water Surface Observations in 2014, Quabbin Reservoir Site Den Hill

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 17, 2014	4.0	Brown	Mostly sunny, 7°C (45°F), NE wind 3 mph, 3" ripple.
May 8, 2014	5.3	Olive green	Cloudy, 15°C (59°F), SW wind 1 mph, slight ripple.
June 19, 2014	6.1	Yellow-green	Mostly cloudy, 28°C (82°F), N wind 2 mph, 3" ripple.
July 17, 2014	9.9	Blue-green	Partly sunny, 25°C (77°F), NW wind 1 mph, 1" ripple.
August 7, 2014	8.1	Green	Partly sunny, 24°C (75°F), NW wind 2 mph, slight ripple.
September 11, 2014	*No data, no samples - rough reservoir conditions.*		
October 9, 2014	5.9	Blue-green	Mostly sunny, 16°C (61°F), SW/W wind 10 mph, 6-10" chop.
November 13, 2014	7.5	Olive green	Mostly cloudy, 8°C (46°F), N wind 1 mph, slight ripple.
December 3, 2014	6.9	Brownish green	Overcast with fog, 5°C (41°F), S wind 5 mph, 6-10" chop.

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 2014, in-reservoir coliform bacteria levels were monitored monthly at the routine reservoir stations beginning on April 17 and ending on December 3. 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 (Shaft 12 and Winsor Dam). At Den Hill, the deep sample is collected at 13 meters. In 2014, fecal coliform bacteria were detected in several reservoir samples, almost all at a concentration of 1 colony per 100 mL. For Station 202, fecal coliform bacteria were detected in the 6-meter sample in April and December, as well as the 0.5-meter sample in July. For Station 206, fecal coliforms were detected in the 6-meter sample in November and otherwise were not detected. For the Den Hill station, fecal coliforms were detected in the 0.5-meter and 6-meter samples in April, the 6-meter sample in October, and the deep sample (13 meters) in December. Only the Den Hill 6-meter sample in April was the fecal coliform concentration over 1 colony per 100 mL, with 2 CFU/100 mL. *E. coli* were detected once at the detection limit of 10 MPN/100 mL, for the Station 202 sample at 18 meters in December. A seasonal gull population that roosts on the reservoir overnight has been identified as the primary contributor of fecal coliform 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 (reported on the magnitude of several years), fecal coliform and *E. coli* bacteria levels are normally very low, reflecting die-off and predation that occurs naturally.

Reservoir total coliform bacteria concentrations are much more dynamic, ranging from not detected (less than 10) to 6,870 colonies per 100 mL in 2014. The total coliform concentration of 6,870 MPN/100 mL was measured in the 6-meter sample from Station 202 on September 11, 2014. 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 2013 is used as a basis for interpreting data generated in 2014 (see **Table 10**). Results of quarterly nutrient sampling in 2014 generally registered near the lower end of historical ranges. In particular, ammonia concentrations were near or below the detection limit of 5 µg/L (0.005 mg/L) in epilimnion and metalimnion samples at Station 202, all three depths at Station 206, and most epilimnion and metalimnion samples at Den Hill. Total phosphorus concentrations were generally just above the detection limit of 5 µg/L (0.005 mg/L), with a maximum of 12 µg/L (0.012 mg/L) detected at Station 206 in July. Such low ammonia and phosphorus concentrations may be factors limiting growth of phytoplankton in 2014, 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 2014 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

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

Sampling Station	Ammonia (NH_3; ug/L)		Nitrate (NO_3; ug/L)		Silica (SiO_2; mg/L)		Total Phosphorus (ug/L)		UV254 (Absorbance/cm)	
	1998-2013	Quarterly 2014	1998-2013	Quarterly 2014	1998-2013	Quarterly 2014	1998-2013	Quarterly 2014	1998-2013	Quarterly 2014
WD/202 (E)	<5 - 16	<5	<5 - 23	<5 - 8	0.84 - 2.40	1.69 - 2.00	<5 - 20	<5 - 7	0.017 - 0.029	0.021 - 0.023
WD/202 (M)	<5 - 29	<5	<5 - 27	<5 - 7	0.83 - 2.42	1.71 - 1.98	<5 - 13	<5 - 7	0.017 - 0.031	0.020 - 0.024
WD/202 (H)	<5 - 53	<5 - 13	<5 - 54	<5 - 28	1.08 - 2.86	1.86 - 2.62	<5 - 44	<5 - 6	0.017 - 0.026	0.020 - 0.022
MP/206 (E)	<5 - 10	<5	<5 - 20	<5	0.84 - 2.24	1.55 - 1.80	<5 - 12	<5 - 7	0.017 - 0.031	0.020 - 0.023
MP/206 (M)	<5 - 34	<5	<5 - 44	<5 - 5	0.84 - 2.25	1.54 - 1.95	<5 - 12	<5 - 12	0.017 - 0.031	0.020 - 0.026
MP/206 (H)	<5 - 105	<5 - 5	<5 - 130	<5 - 10	1.02 - 3.27	1.70 - 1.97	<5 - 19	<5 - 8	0.018 - 0.031	0.020 - 0.024
Den Hill (E)	<5 - 19	<5	<5 - 45	<5 - 13	0.74 - 4.64	1.36 - 3.29	<5 - 27	<5 - 10	0.025 - 0.122	0.028 - 0.078
Den Hill (M)	<5 - 28	<5	<5 - 58	<5 - 13	0.84 - 4.37	1.38 - 3.07	<5 - 15	<5 - 10	0.027 - 0.139	0.028 - 0.062
Den Hill (H)	<5 - 84	<5 - 11	<5 - 78	6 - 20	0.83 - 4.25	1.82 - 2.85	<5 - 15	6 - 10	0.028 - 0.171	0.029 - 0.052

Notes: (1) 1998-2013 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling conducted through December 2013, except for measurement of UV254 initiated in 2000 quarterly sampling.
(2) 2014 quarterly sampling conducted May, July, October, and December.
(3) Water column locations are as follows: E = epilimnion/surface, M = metalimnion/middle, H = hypolimnion/bottom

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 2014, samples were collected according to this schedule, and the most prevalent phytoplankton included the diatoms *Asterionella*, *Cyclotella, Tabellaria*, 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 2014, averaging 163 ASUs per mL at Site 202 and 167 ASUs per mL at Site 206 (Packard, 2015; see **Appendix A**). Diatoms dominated early in the year, reaching 464 ASUs per mL at Site 206 on April 17, and declined steadily thereafter. Similar to the past few summers, phytoplankon densities were very low in July 2014 at Site 202, with a minimum of 22 ASUs per mL. Cyanophyte density began increasing at both sites in late July, reaching a maximum of 375 ASUs per mL at Site 202 in November. Plankton monitoring is proposed to continue with the same schedule and locations in 2015.

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 2014, calcium concentrations ranged from 1.85 mg/L to 2.07 mg/L at the three reservoir sites. See **Appendix C** for all reservoir data in 2014.

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 ponds within the Quabbin and Ware River watersheds, as well as occasionally at ponds 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. Once the discovery of brittle naiad was confirmed, private boats were prevented from launching on O'Loughlin Pond, and an additional fragment barrier was installed to ensure fragments were not migrating into the main body of the reservoir. DCR staff surveyed the pond and the area where the pond flows into the main body of the reservoir, to delineate areas of brittle naiad. Diver assisted suction harvesting was employed to remove brittle naiad from O'Loughlin Pond, and follow-up surveys have found no rooted plants and very few fragments following brittle naiad harvesting and disposal. See **Appendix A** for further information on the DCR/MWRA response to the discovery of brittle naiad. Monitoring will be ongoing to prevent the spread of this AIS into the main body of Quabbin Reservoir. Management options may include hand harvesting, diver assisted suction harvesting, and fragment barriers (ESS Group, 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 2014, the E. coli results ranged from less than 10 MPN/100 mL to 754 MPN/100 mL. The maximum concentration, recorded for Connor Pond on April 15, occurred during rainfall (1.20 inches within 24 hours reported at Barre Falls Dam, 1.76 inches reported at Belchertown) and high flow on the day of sampling, which likely flushed bacteria into the pond. Bacterial counts were elevated at several other sites during this storm, including Sites 216C, 216E-1, and Boat Cove Brook, where turbidities were also elevated. The 754 MPN/100 mL result exceeded the previous maximum at Connor Pond of 554 MPN/100 mL in November 2010.

A new historical maximum for *E. coli* was recorded at Site 127 (Waite Pond) in the Ware River watershed, with 110 MPN/100 mL on July 29, 2014. This result was just slightly higher than the 108 MPN/100 mL recorded in September 2010. Rainfall of 0.68 inch was reported at Barre Falls Dam in the two days prior to sampling, and Waite Pond was reported to be high pool with slow flow at the outlet.

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 4 of 9 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 Gates Brook, Boat Cove Brook, and Sites 213, 216D, 216G, and 216I-X. The individual standard was exceeded on a total of seven dates: Site 216G on March 4, Site 216D and Boat Cove Brook on April 15, Site 216I-X on June 24, Boat Cove Brook on July 8 and September 2, Gates Brook on October 28, and Site 213 on November 25. Of the Quabbin tributary sites, Boat Cove Brook exceeded the individual standard three times, as listed above, with *E. coli* concentrations ranging from 265 to 471 MPN/100 mL. In the Ware River watershed, the Class A standard of 235 colonies per 100 mL was exceeded at Sites 101, 103A, 107A, and 121B over five dates: Site 121B on July 15, Site 103A on July 29 and August 26, Site 101 on September 23, and Sites 103A and 107A on November 18. Site 103A exceeded this standard most frequently, with three occurrences ranging from 256 to 708 MPN/100 mL.

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 2014 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. As noted in the tables, monitoring of the Quabbin EQA sites in 2007 began in May that year, while Site 121B in the Ware River watershed started in May that year, so the geometric means for 2007 may not be representative of the full year.

Overall, the *E. coli* geometric means for Quabbin tributary core sites have generally been comparable from 2010 through 2014, but slightly higher than in 2006-2009. As shown in **Table 11**, Site 213 has recorded the highest geometric means of the Quabbin core sites, possibly related to storms and beaver activity. The geometric means at Quabbin EQA sites in 2014 were generally comparable to those in previous sampling (2007-2008, 2010). In the Ware River watershed, the geometric means for the core sites 103A and 107A were generally comparable in 2009 through 2014 and slightly lower than in 2007-2008, while Sites 101 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 2014 were comparable to previous monitoring in 2010.

As shown in **Table 12**, most samples in the Quabbin and Ware River watersheds were below 126 MPN/100 mL. At most, 24 percent of samples at Site 103A exceeded 126 MPN/100 mL during 2014, representing 6 of 25 samples collected. In **Table 13**, the highest percentage (12 percent) represents 3 out of 25 samples at Site 103A exceeding the single-sample Class A standard of 235 colonies per 100 mL.

Table 11. Annual Geometric Means of *E.* coli for 2014 Tributary Sites

Site #	Monitoring Station Description	Geometric Mean (MPN/100 mL)							
		2014	2013	2012	2011	2010	2009	2008	2007
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	18.5	17.6	19.3	16.8	23.2	14.3	15.3	18.0
212	Hop Brook inside Gate 22	23.3	21.4	27.6	27.4	28.6	16.5	18.0	23.0
213	M. Br. Swift River at Gate 30	43.3	42.7	49.3	48.3	60.5	35.6	22.4	28.2
215	E. Br. Fever Brook at West St.	22.0	20.7	22.8	21.5	23.5	18.6	14.5	19.8
216	E. Br. Swift River at Rte. 32A	18.6	20.4	18.7	31.1	23.0	16.6	22.7	24.8
Gates	Gates Brook at mouth	16.1	18.5	24.1	18.2	25.7	16.0	14.2	18.1
BC	Boat Cove Brook at mouth	31.8	24.6	31.8	19.9	34.4	17.6	23.3	21.8
Quabbin Reservoir Watershed EQA Sites									
216G*	Roaring Brook, Petersham Center	21.0	N/A	N/A	N/A	19.6	N/A	21.8	17.9
216I-X*	Moccasin Brook above Quaker Rd.	28.9	N/A	N/A	N/A	32.9	N/A	21.6	48.3
216D	Connor Pond outlet at dam	23.7	N/A	N/A	N/A	26.0	N/A	N/A	N/A
216E-1	N. Trib of 216E at South St.	24.6	N/A	N/A	N/A	33.7	N/A	N/A	N/A
216C	Carter Pond outlet, Glen Valley Rd.	13.2	N/A	N/A	N/A	20.1	N/A	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	22.5	30.0	32.7	33.8	23.6	27.1	33.3	26.4
103A	Burnshirt River at Riverside Cemetery	39.9	28.9	25.1	28.7	39.0	23.8	43.6	42.0
107A	W. Br. Ware River at Brigham Rd.	21.9	24.6	21.8	20.9	24.1	24.2	47.5	49.0
108	E. Br. Ware at Intervale Rd.	25.4	32.1	23.6	35.4	34.3	26.4	33.1	28.4
121A**	Thayer Pond at outlet	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11.2
121B**	Thayer Pond at inlet	24.7	27.6	47.3	31.3	60.3	22.7	43.8	47.2
Ware River Watershed EQA Sites									
127	Waite Pond outlet	16.0	N/A	N/A	N/A	14.8	N/A	N/A	N/A
128	Lovewell Pond outlet	12.0	N/A	N/A	N/A	11.1	N/A	N/A	N/A
126A	Moosehorn Pond outlet	17.1	N/A	N/A	N/A	22.1	N/A	N/A	N/A
115	Brigham Pond outlet	11.7	N/A	N/A	N/A	14.6	N/A	N/A	N/A

N/A Data not available.
* In 2007, monitoring at this site began May 2007.
** Site 121A was monitored through April 2007, replaced by Site 121B (May 2007 - current).

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							
		2014	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	4%	8%	12%	7%	12%	0%	4%	4%
212	Hop Brook inside Gate 22	4%	8%	12%	12%	12%	0%	4%	12%
213	M. Br. Swift River at Gate 30	12%	15%	19%	30%	31%	12%	7%	7%
215	E. Br. Fever Brook at West St.	4%	4%	8%	4%	8%	4%	4%	8%
216	E. Br. Swift River at Rte. 32A	4%	8%	4%	7%	8%	4%	7%	4%
Gates	Gates Brook at mouth	4%	4%	15%	8%	8%	4%	0%	4%
BC	Boat Cove Brook at mouth	22%	12%	15%	8%	25%	4%	15%	10%
Quabbin Reservoir Watershed EQA Sites									
216G*	Roaring Brook, Petersham Center	8%	N/A	N/A	N/A	8%	N/A	11%	12%
216I-X*	Moccasin Brook above Quaker Rd.	12%	N/A	N/A	N/A	27%	N/A	11%	24%
216D	Connor Pond outlet at dam	4%	N/A	N/A	N/A	15%	N/A	N/A	N/A
216E-1	N. Trib of 216E at South St.	12%	N/A	N/A	N/A	8%	N/A	N/A	N/A
216C	Carter Pond outlet, Glen Valley Rd.	0%	N/A	N/A	N/A	15%	N/A	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	12%	15%	15%	19%	4%	4%	19%	4%
103A	Burnshirt River at Riverside Cemetery	24%	17%	4%	10%	23%	5%	24%	17%
107A	W. Br. Ware River at Brigham Rd.	12%	4%	4%	8%	8%	9%	30%	27%
108	E. Br. Ware at Intervale Rd.	12%	11%	0%	8%	4%	8%	8%	12%
121A**	Thayer Pond at outlet	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0%
121B**	Thayer Pond at inlet	19%	7%	23%	12%	38%	12%	19%	17%
Ware River Watershed EQA Sites									
127	Waite Pond outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
128	Lovewell Pond outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
126A	Moosehorn Pond outlet	0%	N/A	N/A	N/A	12%	N/A	N/A	N/A
115	Brigham Pond outlet	0%	N/A	N/A	N/A	4%	N/A	N/A	N/A

N/A Data not available.
* In 2007, monitoring at this site began May 2007.
** Site 121A was monitored through April 2007, replaced by Site 121B (May 2007 - current).

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

Site #	Monitoring Station Description	Samples > 235 MPN/100 mL							
		2014	2013	2012	2011	2010	2009	2008	2007
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	0%	8%	0%	4%	0%	0%	4%	0%
212	Hop Brook inside Gate 22	0%	8%	12%	4%	4%	0%	4%	0%
213	M. Br. Swift River at Gate 30	4%	12%	8%	7%	12%	0%	4%	4%
215	E. Br. Fever Brook at West St.	0%	4%	0%	4%	0%	4%	0%	4%
216	E. Br. Swift River at Rte. 32A	0%	8%	4%	7%	4%	4%	7%	4%
Gates	Gates Brook at mouth	4%	4%	8%	4%	8%	0%	0%	0%
BC	Boat Cove Brook at mouth	11%	4%	15%	4%	8%	4%	11%	5%
Quabbin Reservoir Watershed EQA Sites									
216G*	Roaring Brook, Petersham Center	4%	N/A	N/A	N/A	8%	N/A	7%	6%
216I-X*	Moccasin Brook above Quaker Rd.	4%	N/A	N/A	N/A	15%	N/A	7%	6%
216D	Connor Pond outlet at dam	4%	N/A	N/A	N/A	12%	N/A	N/A	N/A
216E-1	N. Trib of 216E at South St.	0%	N/A	N/A	N/A	4%	N/A	N/A	N/A
216C	Carter Pond outlet, Glen Valley Rd.	0%	N/A	N/A	N/A	4%	N/A	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	4%	7%	4%	8%	4%	0%	8%	0%
103A	Burnshirt River at Riverside Cemetery	12%	8%	4%	5%	4%	0%	8%	4%
107A	W. Br. Ware River at Brigham Rd.	4%	4%	0%	4%	8%	5%	15%	18%
108	E. Br. Ware at Intervale Rd.	0%	7%	0%	4%	4%	0%	4%	4%
121A**	Thayer Pond at outlet	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0%
121B**	Thayer Pond at inlet	4%	4%	8%	8%	23%	0%	12%	11%
Ware River Watershed EQA Sites									
127	Waite Pond outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
128	Lovewell Pond outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
126A	Moosehorn Pond outlet	0%	N/A	N/A	N/A	8%	N/A	N/A	N/A
115	Brigham Pond outlet	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A

N/A Data not available.
* In 2007, monitoring at this site began May 2007.
** Site 121A was monitored through April 2007, replaced by Site 121B (May 2007 - current).

3.2.1.2 Fecal Coliform Bacteria

In 2014, fecal coliform bacteria concentrations fell within the historical range for each respective station, and no new maximum values were recorded. Concentrations ranged from not detected (less than 1 CFU/100 mL) to 490 CFU/100 mL. The highest result was reported for Site 103A on July 29, following 2-day rainfall of 0.68 inch (as reported at Barre Falls Dam) and high flow conditions. Beaver activity upstream and downstream of this site was reported on this date as well.

3.2.1.3 Total Coliform Bacteria

During 2014, 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. In 2014, a new maximum value was recorded at Site 103A on July 29, with a total coliform result of 19,900 MPN/100 mL. As noted earlier, *E. coli* and fecal coliform counts were also elevated on this date at Site 103A. Median values in 2014 exceeded the historical medians in ten of twelve Quabbin watershed sites and in four of nine 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 2014, specific conductance values were generally comparable to the historical range. Some increases in maximum value were noted at Waite Pond (Site 127), Lovewell Pond (Site 128), Moosehorn Pond (Site 126A), and Thayer Pond (Site 121B) in the Ware River watershed. For 2014, maximum values by watershed were recorded at Site 216E-1, with a specific conductance of 447 µS/cm on September 30, and at Thayer Pond, with 359 µS/cm on March 11.

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 2014, dissolved oxygen concentrations ranged between 1.38 mg/L and 24.5 mg/L. The lowest concentrations were recorded at Sites 121B and 127 in the Ware River watershed and at Sites 213 and 215 in the Quabbin watershed. Dissolved oxygen levels were measured below the 6.0 mg/L threshold in 9.4 percent of the samples monitored within the Ware River watershed and 1.6 percent of the samples monitored within the Quabbin Reservoir watershed.

3.2.4 Temperature

In tributaries of the Quabbin Reservoir and Ware River watersheds, temperatures ranged between 0 and 25.2˚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 2014, no source water samples at the intake exceeded 1 NTU. For non-intake samples, turbidity exceeded the 5 NTU standard at Site 216E-1 on April 15 (9.3 NTU), in the Quabbin watershed. None of the samples from the Ware River watershed exceeded 5 NTU in 2014.

Turbidity of 9.3 NTU marked a new maximum value at Site 216E-1, where the previous high value of 5.36 NTU was recorded in May 2010. Rainfall flushing and high flows were suspected causes of the elevated turbidity at Site 216E-1 in 2014. All other sites monitored in 2014 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 2014 were below the Class A water quality threshold of 6.5 units at 19 of 21 monitoring stations. Four sites in the Quabbin Reservoir watershed had median levels below 6.0, including Gates Brook, West Branch Swift River (Site 211), Middle Branch Swift River (Site 213), and 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, Waite Pond (Site 127), Lovewell Pond (Site 128), Moosehorn Pond (Site 126A), and Brigham Pond (Site 115).

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 2014. 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 2014, the alkalinity concentrations were below the ARM endangered threshold value of 5 mg/L as $CaCO_3$ at four of five EQA sites in the Quabbin watershed (Sites 216C, 216D, 216G, and 216I-X) and all four EQA sites (Sites 115, 126A, 127, and 128) in the Ware River watershed. Alkalinity tended to peak around July through October, with maximum values ranging from 5.60 mg/L (Site 126A) to 26.8 mg/L (Site 216E-1). New maximum values were set at Roaring Brook (Site 216G) in the Quabbin Reservoir watershed and Moosehorn Pond (Site 126A) and Lovewell Pond (Site 128) 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 2014, 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 2014 included four EQA sites in the West Branch Ware Sanitary District, also biweekly for nutrients and UV_{254}. These EQA sites, in both watersheds, were previously monitored in 2010. Two sites in the Quabbin watershed, Sites 216G and 216I-X, were also previously monitored in May 2007 through December 2008. Core tributary stations have been monitored on a quarterly basis since March 2005. **Table 14** summarizes median values and range of 2014 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 2014, 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 1,230 µg/L (<0.005 to 1.23 mg/L) at the EQA sites, compared to a maximum of 160 µg/L (0.160 mg/L) at the core sites. New maximum nitrate concentrations were recorded at Sites 216G, 216D, and 216E-1. At Site 216G, the nitrate concentration of 0.419 mg/L on September 2 exceeded the previous maximum of 0.379 mg/L in September 2007. Site 216D exceeded its previous maximum of 0.117 mg/L from February 2010, with 0.123 mg/L on March 18, 2014. The highest nitrate concentration in 2014 was recorded for Site 216E-1, 1.23 mg/L on December 9, compared to the site's previous maximum of 1.16 mg/L in Dec 2010.

TKN, a measure of organic nitrogen plus ammonia, often constitutes a significant proportion of the total nitrogen present in a natural water body. In 2014, TKN concentrations at the Quabbin EQA sites ranged from 106 to 733 µg/L (0.106 to 0.733 mg/L), compared to a maximum of 521 µg/L (0.521 mg/L) at the core sites. New maximum values were recorded at two Quabbin EQA sites, Sites 216D and 216C. The TKN concentration of 0.469 mg/L at Site 216D occurred on August 19, exceeding the previous maximum of 0.456 mg/L in October 2010. Site 216C recorded a TKN of 0.468 mg/L on July 8, higher than the 0.447 mg/L recorded in March 2010.

Table 14. Quabbin Reservoir Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2014 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	150	<5 - 419	285	156 - 448	13	<5 - 124	20	9 - 36	0.174	0.090 - 0.331	5140	3570 - 6660
216I-X Moccasin Brook above Quaker Rd.	46	10 - 138	362	230 - 493	6	<5 - 76	26	12 - 47	0.350	0.231 - 0.580	2320	1150 - 2940
216D Connor Pond outlet below dam	26	<5 - 123	319	161 - 469	8	<5 - 76	26	17 - 126	0.245	0.162 - 0.450	2600	1710 - 3210
216E-1 N. trib of 216E, at South St.	952	503 - 1230	240	174 - 733	8	<5 - 38	27	13 - 134	0.097	0.050 - 0.233	8880	5780 - 20800
216C Carter Pond outlet, at Glen Valley Rd.	43	<5 - 146	255	106 - 468	6	<5 - 64	19	10 - 38	0.156	0.087 - 0.302	4510	2120 - 6220
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)	59	16 - 70	156	<100 - 200	<5	<5 - 6	16	15 - 17	0.110	0.071 - 0.122	1960	1260 - 2820
212 (Hop)	78	55 - 109	113	111 - 266	9	<5 - 16	18	16 - 21	0.085	0.058 - 0.125	3890	2500 - 4990
213 (M. Swift)	45	13 - 160	210	176 - 314	9	<5 - 23	19	15 - 24	0.164	0.093 - 0.182	4040	2200 - 5570
215 (E. Fever)	32	<5 - 47	340	176 - 521	19	<5 - 29	25	14 - 30	0.270	0.202 - 0.319	2080	1170 - 2730
216 (E. Swift)	45	12 - 127	241	187 - 309	5	<5 - 29	20	17 - 25	0.185	0.145 - 0.270	3040	1720 - 3730
Gates Brook	<5	<5 - 16	111	<100 - 145	<5	<5	15	12 - 22	0.062	0.050 - 0.089	1220	776 - 1450
Boat Cove Brook	44	22 - 70	130	<100 - 374	<5	<5	26	19 - 31	0.096	0.087 - 0.283	6730	2850-12000

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December. Biweekly for calcium in 2014.

Table 15. Ware River Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2014 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												
127 Waite Pond outlet	21	<5 - 103	368	169 - 613	23	<5 - 76	16	8 - 27	0.233	0.126 - 0.348	2120	1590 - 2760
128 Lovewell Pond outlet	46	<5 - 144	370	<100 - 509	32	<5 - 129	19	12 - 42	0.317	0.219 - 0.406	2190	1860 - 4460
126A Moosehorn Pond below Healdville Rd.	30	<5 - 67	345	180 - 486	6	<5 - 112	19	9 - 44	0.295	0.197 - 0.432	2020	1650 - 2550
115 Brigham Pond outlet	14	<5 - 122	336	144 - 449	7	<5 - 87	19	8 - 29	0.287	0.184 - 0.452	2500	1880 - 3160
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)	27	8 - 78	271	153 - 384	8	<5 - 8	22	17 - 29	0.247	0.158 - 0.583	3510	1970 - 4330
103A (Burnshirt)	42	9 - 90	236	116 - 525	6	<5 - 11	21	15 - 31	0.238	0.122 - 0.375	2490	1760 - 4090
107A (W. Ware)	30	12 - 117	308	219 - 486	<5	<5 - 12	22	15 - 23	0.323	0.214 - 0.588	3050	1810 - 3640
108 (E. Ware)	46	12 - 87	342	208 - 452	15	<5 - 18	22	12 - 26	0.223	0.140 - 0.424	3690	2380 - 5250
121B (Thayer)	45	<5 - 81	383	236 - 526	11	<5 - 20	17	13 - 35	0.186	0.120 - 0.398	10200	5910-13800

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December. Biweekly for UV_{254} and calcium in 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 124 µg/L (<0.005 to 0.124 mg/L) in 2014. The maximum concentration of 0.124 mg/L was detected on February 18 at Site 216G; this site was not monitored previously for ammonia, so no comparison to historical data can be made. At core sites, however, new maximum values were recorded at Sites 215 and 216, both at 29 µg/L (0.029 mg/L).

In many freshwater systems, phosphorus is the limiting nutrient in algal growth and can be a concern when excessive. Phosphorus concentrations ranged higher at the Quabbin EQA sites, up to 134 µg/L (0.134 mg/L), compared to the core sites with 30 µg/L (0.030 mg/L) or less. New maximum values were recorded at two EQA sites. Site 216D, with 126 µg/L (0.126 mg/L) on April 15, exceeded the previous maximum of 62.9 µg/L (0.0629 mg/L) from November 2010. At Site 216C, the 37.9 µg/L (0.0379 mg/L) recorded on July 8 marked a slight increase from 35.5 µg/L (0.0355 mg/L) in January 2010. Both instances may have been influenced by recent rainfall and stormwater flow, and slight increases (though not historical maximum) in phosphorus concentration were noted at several EQA sites on both April 15 and July 8. Except for Sites 216D and 216C, all other Quabbin tributary sites remained within range of previous monitoring.

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, it appears that UV_{254} values tended to range slightly higher at core sites in 2009-2014, 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 2009-2014 do not necessarily mean any degradation of water quality. As shown in **Table 14**, UV_{254} values for 2014 ranged from 0.050 cm^{-1} (Gates Brook, on March 18) to 0.580 cm^{-1} (Site 216I-X, on October 28). This range reflects the different quality of waters, from oligotrophic to eutrophic, including productive wetlands (Reckhow, personal communication). New maximum UV_{254} values were recorded at Site 216D (0.450 cm^{-1}) and Site 216C (0.302 cm^{-1}).

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 2014 ranged from 776 to 12,000 µg/L (0.776 to 12.0 mg/L) in core sites and from 1,150 to 20,800 µg/L (1.15 to 20.8 mg/L) in EQA sites. Except for Site 216E-1, 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 20.8 mg/L on September 30, 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 2014. As shown in **Table 15**, nitrate concentrations were generally comparable between EQA sites and core sites, ranging up to 144 µg/L (0.144 mg/L) in 2014. The maximum nitrate concentration of 0.144 mg/L occurred at Site 128 on March 25, which also marked a new historical maximum for this site. Increases in nitrate concentration were also detected at EQA Sites 127 and 115 and core Sites 103A, and 107A.

TKN concentrations in Ware River core sites ranged from 116 to 526 µg/L (0.116 to 0.526 mg/L) during 2014, and less than 100 to 613 µg/L (<0.100 to 0.613 mg/L) in the EQA sites. New maximum TKN concentrations were observed in 2014 at Sites 127 and 128. At Site 127, the TKN of 0.613 mg/L on September 9 exceeded the previous maximum of 0.482 mg/L in October 2010, while at Site 128, the TKN of 0.509 mg/L on November 18 and December 2 exceeded the 0.450 mg/L measured in December 2010.

Ammonia ranged from less than 5 to 129 µg/L (<0.005 to 0.129 mg/L) during 2014 in the Ware River watershed, with the higher concentrations found at the EQA sites. The maximum result of 0.129 mg/L was detected at Site 128 on November 18. 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 2010. For core sites, most sites remained within the range previously detected except for Site 107A, where ammonia concentration of 0.0122 mg/L on March 25, 2014, exceeded the previous maximum of 0.0107 mg/L in March 2012.

Total phosphorus concentrations were generally comparable between Ware River EQA sites and core sites, with an overall range of 8 to 44 µg/L (0.008 to 0.044 mg/L) in 2014. The highest concentration, 0.044 mg/L, occurred on June 3 at Site 126A and is within the range previously observed for this location. New maximum phosphorus concentrations were observed in 2014 at EQA Sites 127 and 128, and a slight increase was recorded at core Site 121B. At Site 127, phosphorus concentrations peaked at 0.0267 mg/L on July 15, exceeding the previous maximum of 0.0181 mg/L in August 2010. The new maximum value at Site 128, 0.0424 mg/L, was recorded on July 15, 2014, exceeding the previous high of 0.0242 mg/L from July 2010. At Site 121B, phosphorus measured 0.035 mg/L on September 9, 2014, slightly above the historical high of 0.0347 mg/L measured in June 2012.

UV_{254} values were similar at core sites and EQA sites in the Ware River watershed. The highest value was observed at Site 107A (0.588 cm^{-1}), and the highest value at an EQA site (0.452 cm^{-1}) marked a new historical maximum for Site 115. New maximum values were also noted in 2014 at Sites 101, 127, and 128. UV_{254} at Site 101 reached 0.5827 cm^{-1} on October 21, exceeding the previous high value of 0.56075 cm^{-1} from September 2011. At Site 127, UV_{254} peaked at 0.3481 cm^{-1} on September 9, 2014, above the previous high of 0.24045 cm^{-1} in March 2010. For Site 128, the maximum values recorded were recorded in January 2010, 0.38045 cm^{-1}, and January 2014, 0.4064 cm^{-1}.

Calcium concentrations in the Ware River watershed ranged between 1.59 and 13.8 mg/L. Calcium concentrations at Thayer Pond inlet (Site 121B) in 2014 ranged from 5,910 µg/L (5.91 mg/L), to 13,800 µg/L (13.8 mg/L), a new historical high value for this site. 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 10.2 mg/L in 2014 was higher than in previous years: 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 2010, at the West Branch Ware River EQA sites. In two years of monitoring, 2010 and 2014, concentrations in this sanitary district generally fluctuated between 2 and 4 mg/L in 2014, with an initial peak in winter, decreasing in late winter or early spring, and one or more peaks in summer. The median and range of concentrations were slightly higher in 2014 compared to 2010, which may be related to 2014's higher-than-average rainfall and snowfall totals, through increased leaching and possibly greater inputs from road deicing. 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 the two EQA sites near Petersham center in the Quabbin Reservoir watershed, where the highest nitrate concentrations were detected. TKN ranged slightly higher in the Ware River sites, with slightly higher median TKN concentrations. Ammonia was generally higher in the Ware River EQA sites, while core sites were somewhat comparable between the two watersheds. The range and median values of total phosphorus concentrations were slightly higher in Quabbin EQA sites and generally comparable among the core sites of both watersheds. UV_{254} median values were higher in the Ware River watershed, while the highest values were detected in the Quabbin EQA sites; these UV_{254} values are 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 2 to 6 mg/L. The highest calcium concentrations in 2014 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 Invasive Diatom *Didymosphenia geminata*

In response to alerts about new infestations of the 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 2014, artificial substrates were not used in the West, Middle or East Branches of the Swift River. Rock scrapings were taken instead 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 will continue in 2015 and likely for years to come. This monitoring program will 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 2014, 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 and field inspection occurred on two lots in Quabbin watershed and on one lot in Ware River watershed in 2014. Please see **Appendix A** for the summary field reports for lots FL2042, FL2043, and FL4380.

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 2014.

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 2014 in order to implement the long-term forestry water quality monitoring were: installation of water level loggers and precipitation gauges; downloading of field data; monitoring of weather forecasts and staff availability; purchase of additional field equipment; development of field procedures; sample and data collection for two storms; and preliminary evaluation of field data. Storm water sampling for up to three events is scheduled for 2015.

4 PROPOSED SCHEDULE FOR 2015

Water sampling protocols, including field and analytical methods, will remain the same for 2015. 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 2015, monitoring in the Quabbin Reservoir watershed continues in the East Branch Swift River Sanitary District. Ware River watershed monitoring shifts to the East Branch Ware River Sanitary District, which was previously monitored in 2011.

Reservoir monitoring will continue on a monthly schedule in 2015 (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 2015, and the plankton sampling program initiated in September 2007 will also be continued through 2015.

5 REFERENCES

American Public Health Association. 1998. Standard Methods for the Examination of Water and Wastewater - 20th Edition. Washington, D.C.

Biodrawversity, 2010. Zebra Mussel Phase II Assessment: Physical, Chemical, and Biological Evaluation of Waterbodies in the Connecticut River Watershed of Massachusetts. November 2010. Biodrawversity LLC, Amherst, Massachusetts.

Costa, J. 2007. Geometric Mean Calculations, on the Buzzards Bay National Estuary Program website. http://www.buzzardsbay.org/geomean.htm, accessed on April 30, 2007.

DWSP. 2006. Water Quality Report: 2005 – Quabbin Reservoir Watershed, Ware River Watershed. DCR, Division Water Supply Protection, Office of Watershed Management, Quabbin/Ware River Section, Belchertown, Massachusetts.

DWSP, 2008. 2008 Watershed Protection Plan Update, Volume IIA: Quabbin Reservoir Watershed System. December 2008. DCR, Division Water Supply Protection, Office of Watershed Management, Massachusetts.

DWSP, 2010. Aquatic Invasive Species Assessment and Management Plan. October 2010. DCR, Division Water Supply Protection, Office of Watershed Management, Massachusetts.

DWSP, 2011. Quabbin Reservoir and Ware River Watersheds Ten-Year Water Quality Data Review, 2000-2009. DCR, Division Water Supply Protection, Office of Watershed Management, Massachusetts.

DWSP, 2013a. 2013 Watershed Protection Plan Update. July 2013. DCR, Division Water Supply Protection, Office of Watershed Management, Massachusetts.

DWSP, 2013b. Increases in Total Coliform Concentrations at the Ware Disinfection Facility. Report appended to Water Quality Report: 2012 – Quabbin Reservoir Watershed, Ware River Watershed. DCR, Division of Water Supply Protection, Office of Watershed Management, Quabbin/Ware River Section, Belchertown, Massachusetts.

DWSP, 2014. Meteorological and Yield Data Records. DCR unpublished data.

DWSP, 2015. Water Conditions statements. http://www.mass.gov/eea/agencies/dcr/water-res-protection/water-data-tracking/precipitation-composite-current-conditions.html, accessed on April 24, 2015.

Dutka, B.J., and Kwan, K.K. 1980. Bacterial Die-off and Stream Transport Studies. *Water Research*, 14:909-915.

ESS Group, 2015. Aquatic Macrophyte Surveys: MWRA/DCR Source and Emergency Reservoirs, 2014. Report dated March 26, 2015. ESS Group, Inc., Waltham, Massachusetts.

Garvey, E.A., Tobiason, J.E., Reckhow, D.A. and Edzwald, J.K. 2001. Natural Organic Matter Fate and Transport in Quabbin Reservoir. Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, Massachusetts.

Godfrey, P.J., Mattson, M.D., Walk, M.-F., Kerr, P.A., Zajicek, O.T., Ruby III, A. 1996. The Massachusetts Acid Rain Monitoring Project: Ten Years of Monitoring Massachusetts Lakes and Streams with Volunteers. Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts. Publication No. 171.

Kelly, V.R., Lovett, G.M., Weathers, K.C., Findlay, S.E.G., Strayer, D.L., Burns, D.J., and Likens, G.E. 2008. Long-Term Sodium Chloride Retention in a Rural Watershed: Legacy Effects of Road Salt on Streamwater Concentration. *Environmental Science & Technology*, 42(2):410-415.

Leclerc, H., Mossel, D.A.A., Edberg, S.C., and Struijk, C.B. 2001. Advances in the Bacteriology of the Coliform Group: Their Suitability as Markers of Microbial Water Safety. *Annual Review of Microbiology*, 55:201-234.

Lent, R.M., Waldron, M.C., and Rader, J.C. 1998. Multivariate Classification of Small Order Watersheds in the Quabbin Reservoir Basin, Massachusetts. *Journal of the American Water Resources Association*, 34(2):439-450.

Likens, G.E., Bormann, F.H., Pierce, R.S., Eaton, J.S., Johnson, N.M. 1977. Biogeochemistry of a Forested Ecosystem. Springer-Verlag, New York, NY.

Massachusetts Water Resources Authority (MWRA). 2014. Turbidity data. MWRA unpublished data.

NOAA National Climatic Data Center (NCDC), 2015. State of the Climate: National Overview for Annual 2014, issued January 12, 2015, retrieved on April 24, 2015, from http://www.ncdc.noaa.gov/sotc/national/2014/13.

Northeast Regional Climate Center (NRCC), 2015. Climate Summaries. http://www.nrcc.cornell.edu/page_summaries.html, accessed on April 24, 2015.

Reckhow, D.A. Professor, Department of Civil and Environmental Engineering, 18 Marston Hall, University of Massachusetts, Amherst, Massachusetts.

Shanley, J.B. 1994. Effects of Ion Exchange on Stream Solute Fluxes in a Basin Receiving Highway Deicing Salts. *Journal of Environmental Quality*, 23:977-986.

Toranzos, G. A., and McFeters, G. A. 1997. Detection of Indicator Microorganisms in Environmental Freshwaters and Drinking Waters. In Manual of Environmental Microbiology, edited by C.J. Hurst, G.R. Knudsen, M.J. McInerney, L.D. Stetzenbach, and M.V. Walter. ASM Press, Washington, D.C. pp. 184-194.

Wittmann, M., Reuter, J., Schladow, G., Hackley, S., Allen, B., Chandra, S., and Caires, A. 2009. Asian clam (*Corbicula fluminea*) of Lake Tahoe: Preliminary scientific findings in support of a management plan, December 2008. http://terc.ucdavis.edu/research/AsianClam2009.pdf, accessed on August 27, 2010.

Wolfram, E. 1996. Determination of the Decay Rate For Indicator Bacteria Introduced by Sea Gulls to an Oligotrophic Drinking Water Reservoir. M.S. Thesis, Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, Massachusetts.

Worden, D. 2000. Nutrient and Plankton Dynamics in Quabbin Reservoir: Results of the MDC/DWM's 1998-99 Sampling Program. Metropolitan District Commission, Division of Watershed Management.

Worden, D. 2013. Results of 2012 Quarterly Nutrient Sampling at Quabbin Reservoir. Memorandum dated February 21, 2013. DCR, Division of Water Supply Protection, Office of Watershed Management, Wachusett/Sudbury Section, West Boylston, Massachusetts.

APPENDIX A

Investigative Reports and Data

FL2042 Forestry Lot Final Sampling Report

FL2043 Forestry Lot Final Sampling Report

FL4380 Forestry Final Monitoring Report

2014 Phytoplankton Monitoring at Quabbin Reservoir

2014 Quabbin Boat Inspection Programs

2014 Quabbin Boat Ramp Monitor Program

2014 Aquatic Macrophyte Assessments

Najas minor (Brittle naiad) in Regulating Pond, Fishing Area II

Field Report for Lovewell Pond Outlet Flow, 3/25/14

Water Quality Results for Stockroom, May 2014

MEMORANDUM

To: Yuehlin Lee, Environmental Engineer III
From: Paul Reyes
Date: April 17, 2015
Subject: FL2042 Forestry Lot Final Sampling Report

The Massachusetts Department of Conservation and Recreation manages forested lands through its Division of Watershed Protection (DWSP). The DWSP Forest Management Program allows silvicultural activities that focus on forest diversity (in terms of age and tree type) and regeneration so as to maximize water quality and quantity.

At the Quabbin Reservoir and Ware River Watersheds, Environmental Quality staff members are charged with monitoring the effects of forestry on soil and water by conducting periodic inspections of forestry lots and collecting water samples for turbidity measurements from streams affected by logging. Turbidity is a measure of suspended matter in water, and the affected streams are those which are spanned by a temporary bridge used for transporting equipment and lumber.

Normally, background samples are collected downstream from the stream crossing prior to logging in order to set a baseline, while downstream and upstream samples are collected to measure the effects of ongoing logging operations, and after, to determine whether there are any lasting effects.

This memorandum covers lot FL2042, inside of Gate 12 in Pelham, and in which one bridged stream crossing was planned but never used during 2013. However, the bridge was in place during 2012 from October to November. The bridge was then removed when the harvester pulled out of the lot due to a disagreement with the purchaser of the wood. By this time, logging was completed in that section of the lot, and the crossing was not used again. A second harvester came in August of 2013, but harvesting stopped once more in October due to mechanical problems with heavy machinery. The lot was not completely cut.

Background Phase

There was no background sampling of lot FL2042, which was first inspected on August 25, 2013, after the beginning of active logging. At that time, the section of the lot where a bridge was used had been harvested.

Active Logging Phase

There was no sampling done during the active logging phase of the section inspected.

Post Logging Phase

The lot was inspected from August of 2013 through December of 2014 a total of 14 times. A sample from downstream site S2 was collected on 5 of those occasions, while no samples were collected during the other 9 visits. On one of the occasions when a sample was collected (9/13/2013), the result was invalidated because sediments were stirred during collection.

Assessment

The table below lists the dates when Lot 2042 was visited and whether any samples were collected.

Forestry Lot 2042

Sample Date	Sample Site	Type of Sample	Flow (Y/n)	Turbidity (NTU)	Comments
8/25/13		Post Harvesting	N		
9/13/13	S2	Post Harvesting	Y	7.660 (Invalidated)	Extremely low flow
9/19/13		Post Harvesting	N		
10/8/13		Post Harvesting	N		
11/18/13		Post Harvesting	N		
12/30/13	S2	Post Harvesting	Y	0.345	Low flow
5/29/14	S2	Post Harvesting	Y	0.613	Low flow
6/25/14		Post Harvesting	N		
7/25/14	S2	Post Harvesting	Y	2.740	Low flow
8/14/14	S2	Post Harvesting	y	0.636	Low flow
10/9/14		Post Harvesting	N		
10/30/14	S2	Post Harvesting	N		
11/12/14	S2	Post Harvesting	N		
12/29/14		Post Harvesting	N		

Conclusions: It is hard to make an assessment about how water quality in Lot 2042 was impacted by logging operations, both because of the lack of background data and because the stream was frequently dry. The low numbers in the post logging data are very low even when compared to Connecticut Valley Aqueduct (as measured at the Ware Disinfection Facility) turbidity which averages 0.262 NTU.

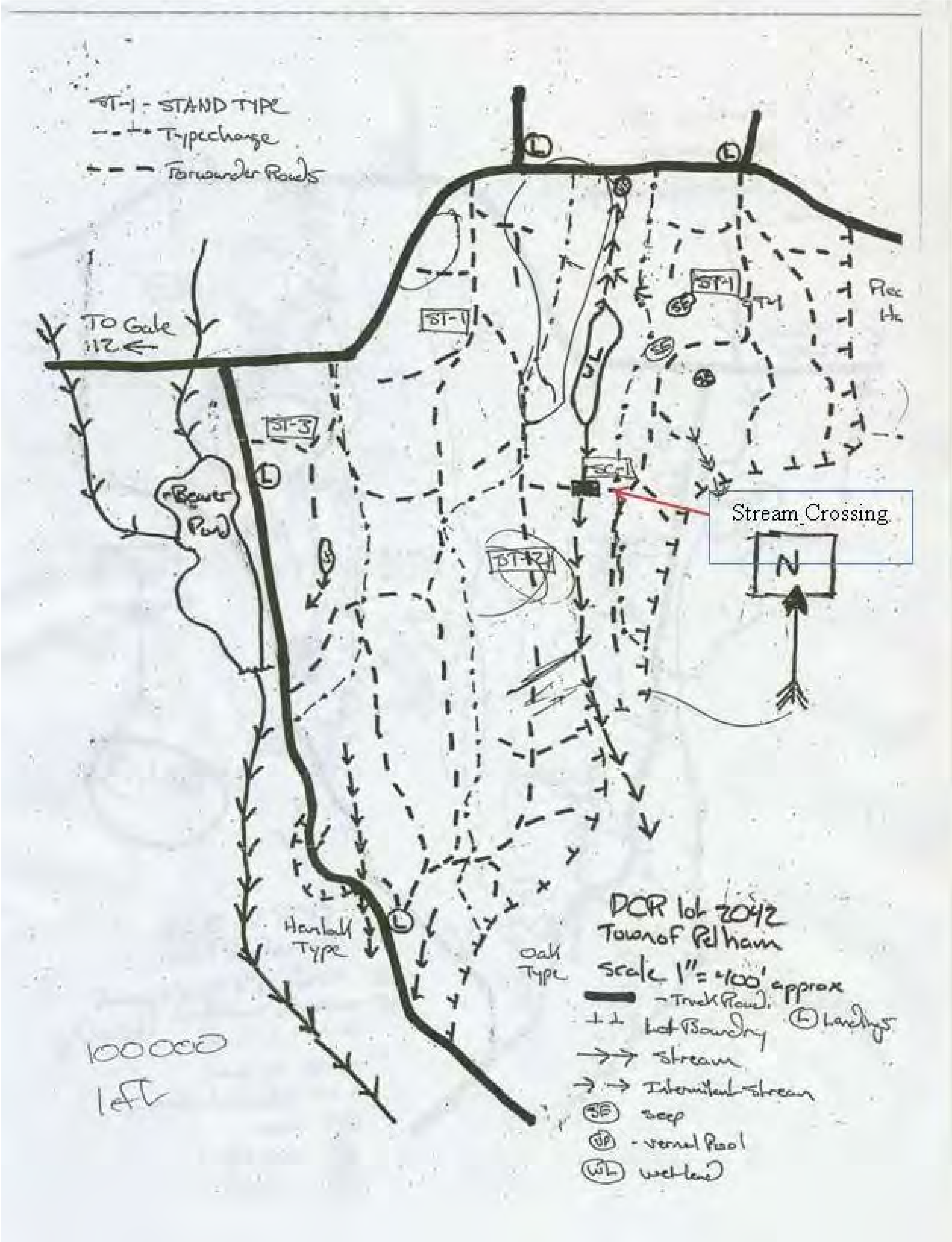


Figure 1. Stream Crossing for Forestry Lot 2042.

MEMORANDUM

To: Yuehlin Lee, Environmental Engineer III
From: Paul Reyes
Date: April 17, 2015
Subject: FL2043 Forestry Lot Final Sampling Report

The Massachusetts Department of Conservation and Recreation manages forested lands through its Division of Watershed Protection (DWSP). The DWSP Forest Management Program allows silvicultural activities that focus on forest diversity (in terms of age and tree type) and regeneration so as to maximize water quality and quantity.

At the Quabbin Reservoir and Ware River Watersheds, Environmental Quality staff members are charged with monitoring the effects of forestry on soil and water by conducting periodic inspections of forestry lots and collecting water samples for turbidity measurements from streams affected by logging. Turbidity is a measure of suspended matter in water, and the affected streams are those which are spanned by a temporary bridge used for transporting equipment and lumber.

Normally, background samples are collected downstream from the stream crossing prior to logging in order to set a baseline, while downstream and upstream samples are collected to measure the effects of ongoing logging operations, and after, to determine whether there are any lasting effects.

This memorandum covers lot FL2043, inside of Gate 12 in Pelham, and in which two stream crossings were used.

Background Phase

There was no background sampling of lot FL2043, which was first inspected on August 25, 2013, before the beginning of active logging. On that date, both of the two streams with planned crossings were dry and neither had a bridge across it.

Active Logging Phase

During the active logging phase, the lot was inspected 4 times from September through November. During that period of time, there was very little precipitation, with the exception of early October when 2.26" of rain fell over four days, and in late November when 2.33" again fell over two days, and on December 29 when 1.25" fell. Following these rain events, there was flow on either stream only once when the site was inspected on December 30, 2013. By then the ground was frozen and most of the precipitation ended up on the streams.

Post Logging Phase

The lot was inspected from December 2013 through December 2014 a total of 9 times. At least one sample was collected on 5 of those occasions, while no samples were collected during the other 4 visits.

Assessment

The table below lists the dates when Lot 2043 was visited and whether any samples were collected.

Forestry Lot 2043

Sample Date	Sample Site	Type of Sample	Flow (Y/n)	Turbidity (NTU)	Comments
8/25/13		Background	N		
9/13/13		Active Lot	N		
9/19/13		Active Lot	N		
10/8/13		Active Lot	N		
11/18/13		Active Lot	N		
12/30/13	S1	Post Harvesting	Y	0.043	Low flow
12/30/13	S2	Post Harvesting	Y	0.375	Low flow
12/30/13	S3	Post Harvesting	Y	0.040	Low flow
12/30/13	S4	Post Harvesting	Y	0.070	Low flow
5/29/14	S2	Post Harvesting	Y	0.151	Low flow
5/29/14	S4	Post Harvesting	Y	0.478	Low flow
6/25/14		Post Harvesting	N		
7/25/14		Post Harvesting	N		
8/14/14	S2	Post Harvesting	y	0.076	Low flow
10/9/14		Post Harvesting	N		
10/30/14	S2	Post Harvesting	y	0.056	Low flow
11/12/14	S2	Post Harvesting	y	0.112	Low flow
12/29/14		Post Harvesting	N		

Conclusions: It is hard to make an assessment about how water quality in Lot 2043 was impacted by logging operations, both because of the lack of background data and because the streams were frequently dry. The low numbers in the post logging data are very low even when compared to Connecticut Valley Aqueduct (as measured at the Ware Disinfection Facility) turbidity which averages 0.262 NTU.

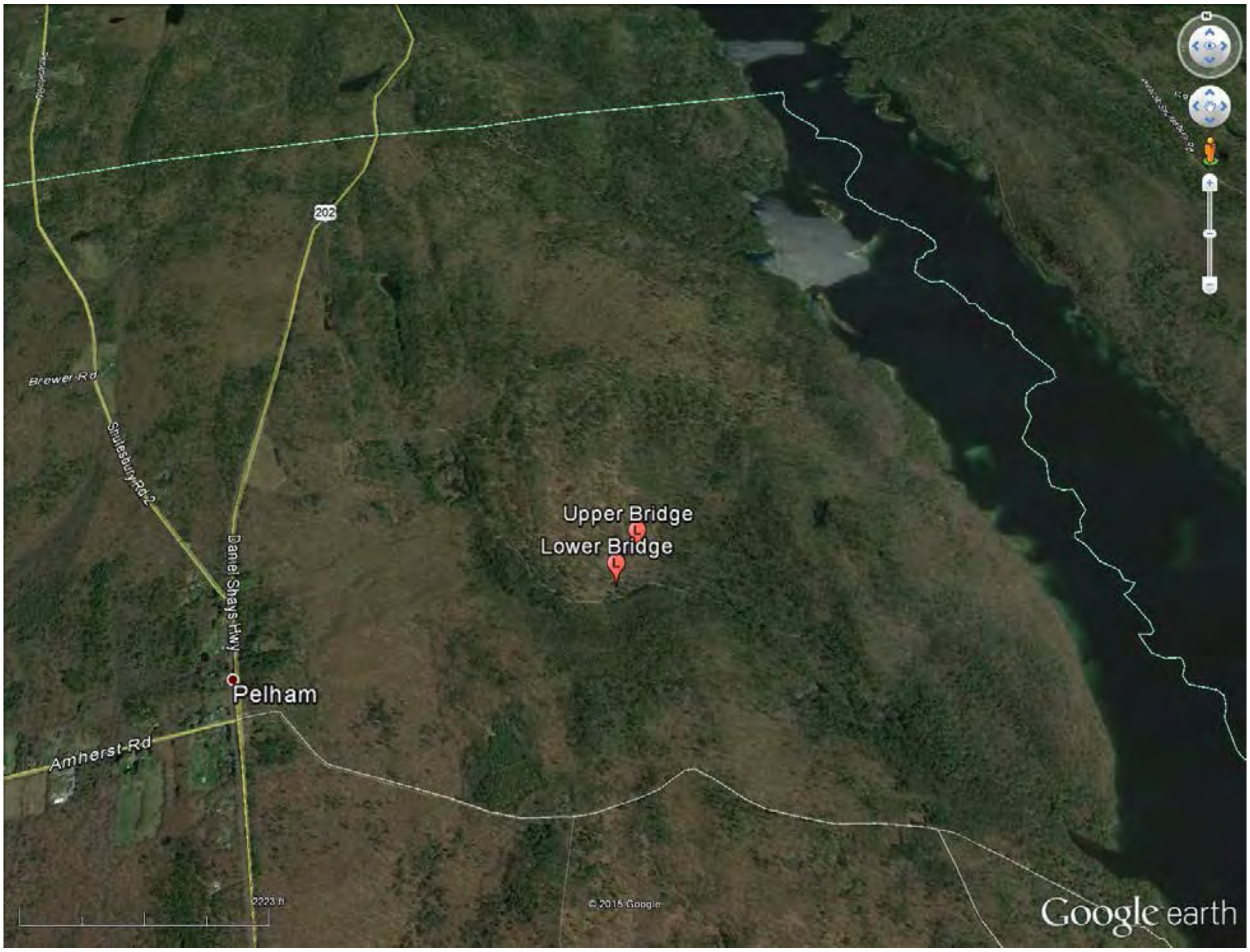


Figure 1. Site Locus for Forestry Lot 2043.

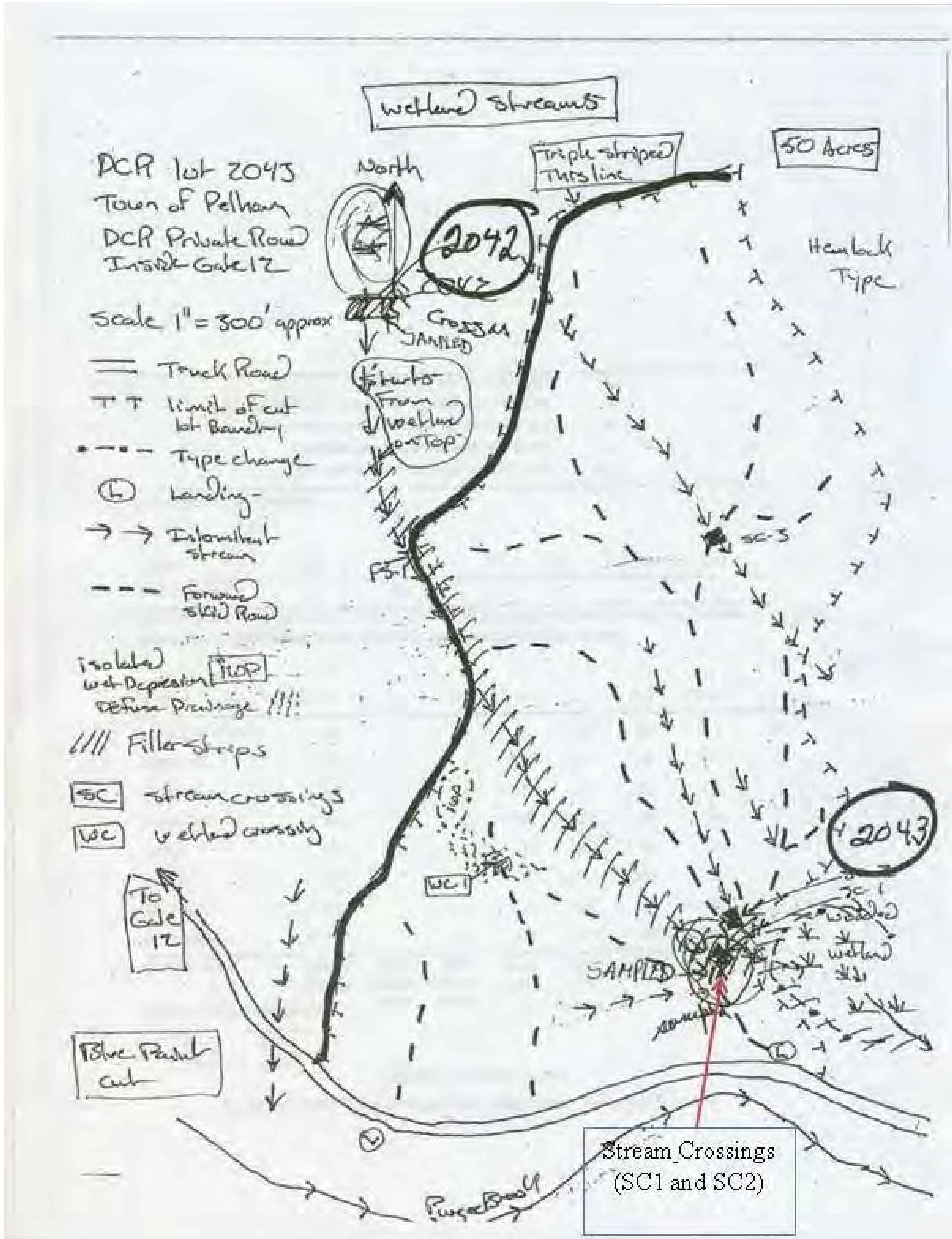


Figure 2. Stream Crossings for Forestry Lot 2043.

MEMORANDUM

To: Yuehlin Lee, Environmental Engineer III
From: Bernadeta Susianti-Kubik
Date: April 14, 2015
Subject: FL4380 Forestry Final Monitoring Report

The purpose of the DWSP forest management program on Ware River watershed is to conduct silviculture that supports and maximizes water quality. Present management focuses on forest diversity and regeneration.

As a compliance measure to protect soil and water quality, EQ section staff collected water samples to measure and monitor turbidity at the stream affected by the logging activities at this specific lot. Turbidity is a measure of the amount of suspended sediment in water column. These samplings were conducted prior, during and after logging work.

A. Monitoring During Active Logging Work

The monitoring during active logging work happened between December 2012 and March 2013. The results of the turbidity sampling (in NTU) are shown on Table 1 below. The locations of the sampling sites are shown on Figure 1.

Table 1. Turbidity results

Sampling Date	Turbidity (NTU)			Comment
	Site 1 Far Downstream	Site 2 Upstream	Site 3 Downstream	
Dec 11, 2012	0.24	0.60	1.22	Preliminary sampling.
Dec 20, 2012	0.10	0.35	0.34	Sampling w/ R. Bishop. Bridge is not in yet @S-3.
Jan 10, 2013	0.07	0.36	0.26	Bridge in @S-3, no work.
Jan 17, 2013	0.15	0.90	1.80	Skidder on bridge. Sampling with S. Wood.
Feb 1, 2013	0.32	0.73	0.64	No work. Site received 2 inches of rain in the last 3 days (1/30 thru 2/1) and temperature was high of 56F on two days (1/31 and 2/1).
March 1, 2013	0.14	0.30	0.34	Bridge was removed. Cutting work was done.

The lowest turbidity was measured at S1 at Gilbert Rd on January 10, 2013, when the bridge was already installed on the upstream side of this sampling site.

The highest turbidity was observed at S3, just downstream of the bridge, at 1.80 NTU. This sample was taken as the equipment was crossing the bridge on January 17, 2013 (as shown in Photo 2).

The March 1, 2013, sampling was conducted when all cutting work was completed and the bridge was removed. The turbidity result of this sampling event was lower than the preliminary sampling conducted on December 11, 2012.

B. Post Logging Monitoring

The post monitoring sampling was conducted for a 12-month period after the logging work was finished. For this specific lot, water was sampled starting April 2014, excluding January, February and March 2015 because of difficulty of accessing the site. The results of the turbidity sampling (in NTU) are shown on Table 2 below. The locations of the sampling sites are shown on Figure 1.

Table 2. Turbidity results

Sampling Date	Turbidity (NTU)			Comment
	Site 1 Far Downstream	Site 2 Upstream	Site 3 Downstream	
04-30- 2014	0.16	0.68	0.25	Temperature was 41F with light rain.
05-28- 2014	0.19	0.30	0.30	Temperature was 48F with light rain.
06-26- 2014	0.99	8.13	1.11	The area received 0.5 inch of rain the night before, water level was very low.
07-31- 2014	0.22	0.55	0.68	Temperature was warm at 70F, water level was low.
08-28- 2014	0.26	0.73	0.55	Temperature was 64F, water level was low.
09-24- 2014	Not sampled	1.09	0.36	S1 was not collected because of the low water level.
10-30-2014	0.13	0.20	0.69	Temperature was 41F, water level was normal.
11-21-2014	0.09	0.15	0.13	Temperature was 23F, water level was slightly higher than normal.
12-18-2014	0.12	0.15	0.15	Temperature was 33F, water level was higher than normal.

The lowest turbidity was measured at S1 at Gilbert Rd on November 11, 2014.

The highest turbidity level was observed at S2 on June 26, 2014 (Photo 4). S2 is upstream of the crossing so the high turbidity observed that day could not be attributed to the past logging activity. Road washout from rain the night before was the most likely cause. Field observations found no other causes that could contribute to the high turbidity at S2 at that specific time.

Based on the turbidity results, the active logging work did not significantly change the turbidity level on the affected stream.

For comparison purposes, turbidity at Shaft 8 in December 2012 and January 2013 ranged from 0.78 to 1.25 NTU. The highest turbidity for year 2011 was 4.90 NTU which was recorded in July 2011. For years 2012-2014, the maximum turbidities of 3.14 NTU (in 2012), 4.81 NTU (in 2013), and 4.12 (in 2014) NTU were also recorded in July of each year. Based on the Ten Year Water Quality Data Review 2000-2009 report, the lowest turbidity observed in Ware River Sampling Sites was 0.15 NTU at Asnacomet Pond outlet and the highest was 55 NTU at Moulton Pond Tributary at Britney Dr during the 10 year period. Variations in turbidity can be affected by many factors such as storm events, beaver dam breach, construction works, etc.

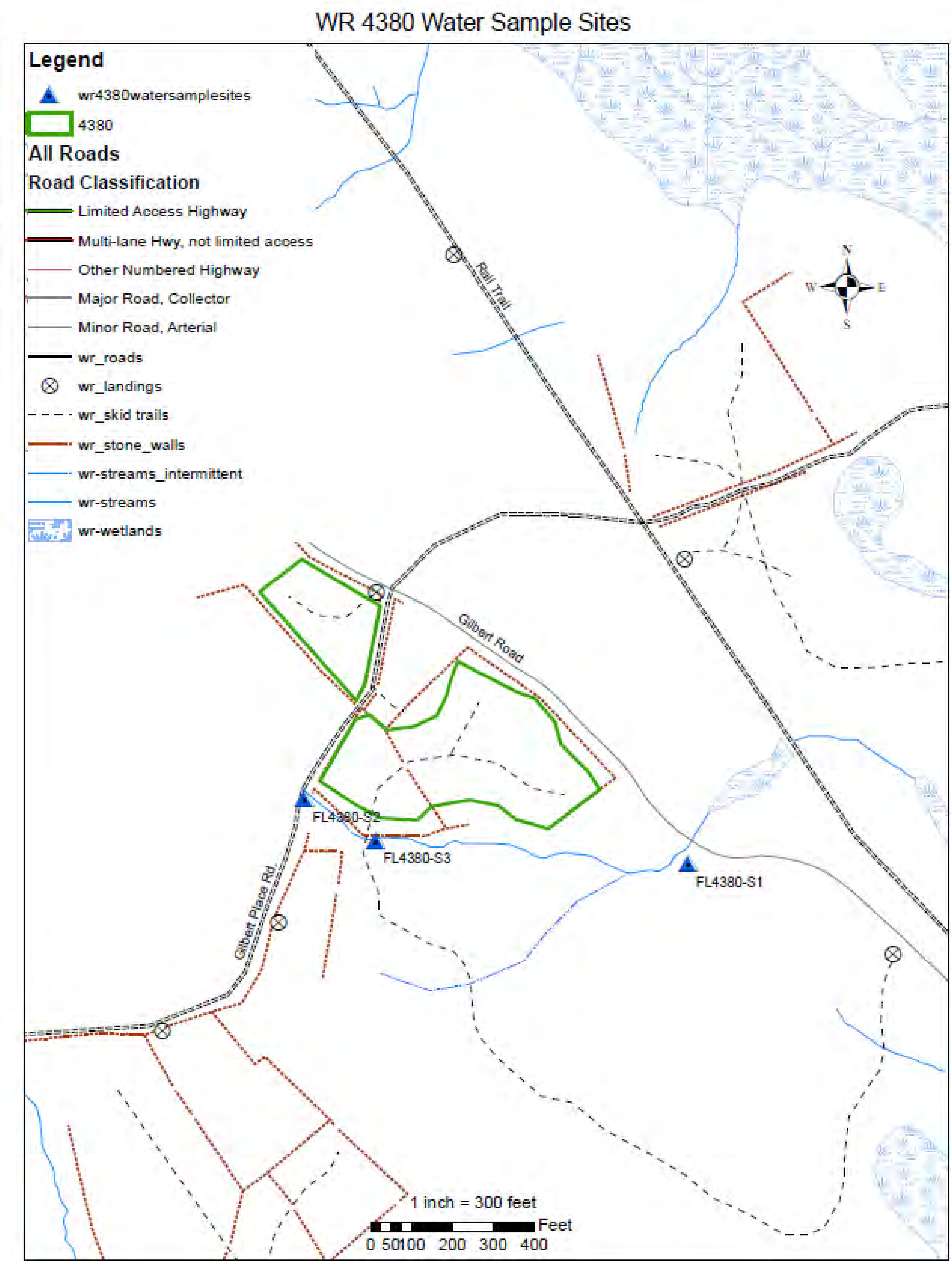


Figure 1. FL 4380 Sampling Sites

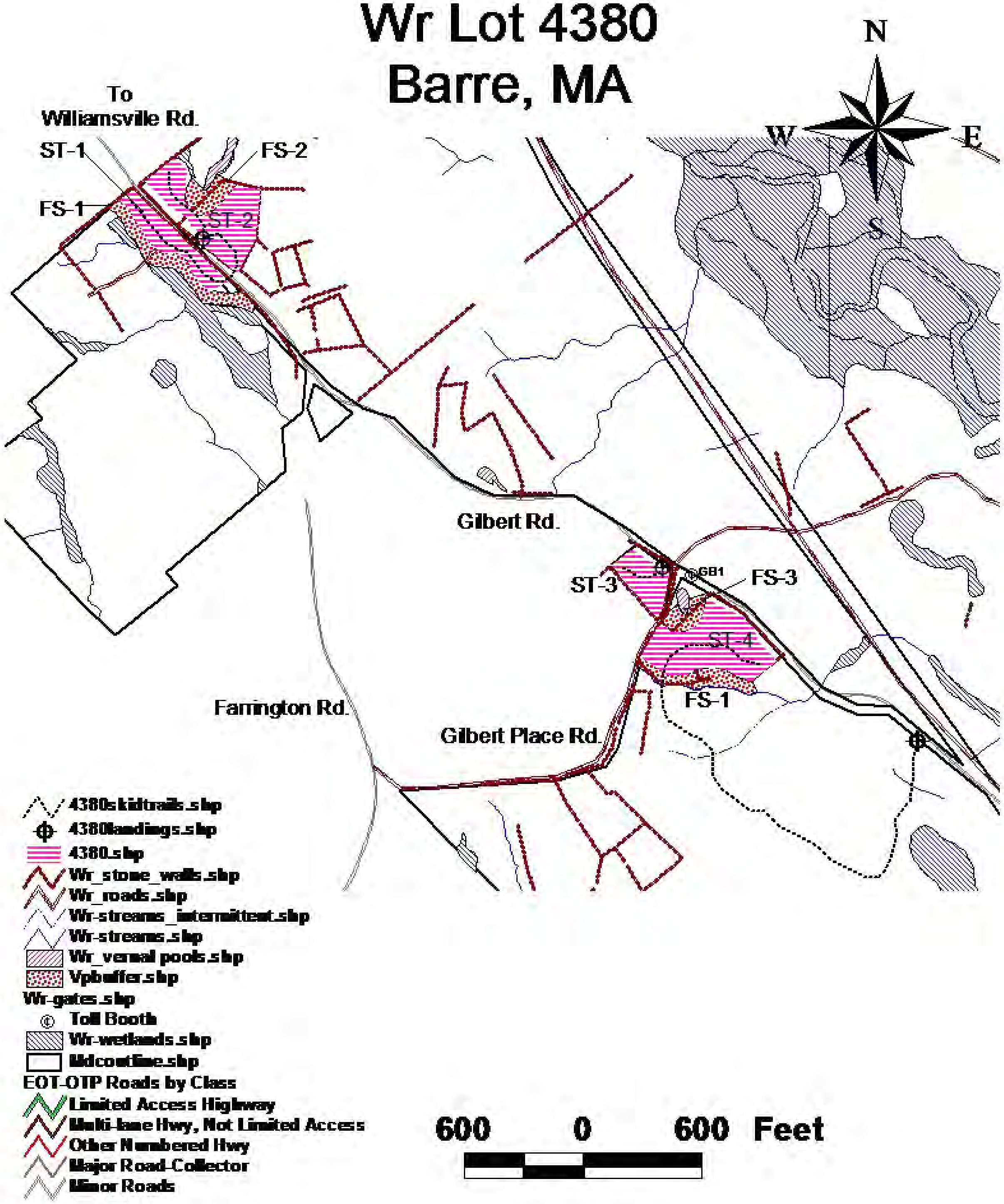


Figure 2. FL 4380 ArcView Map

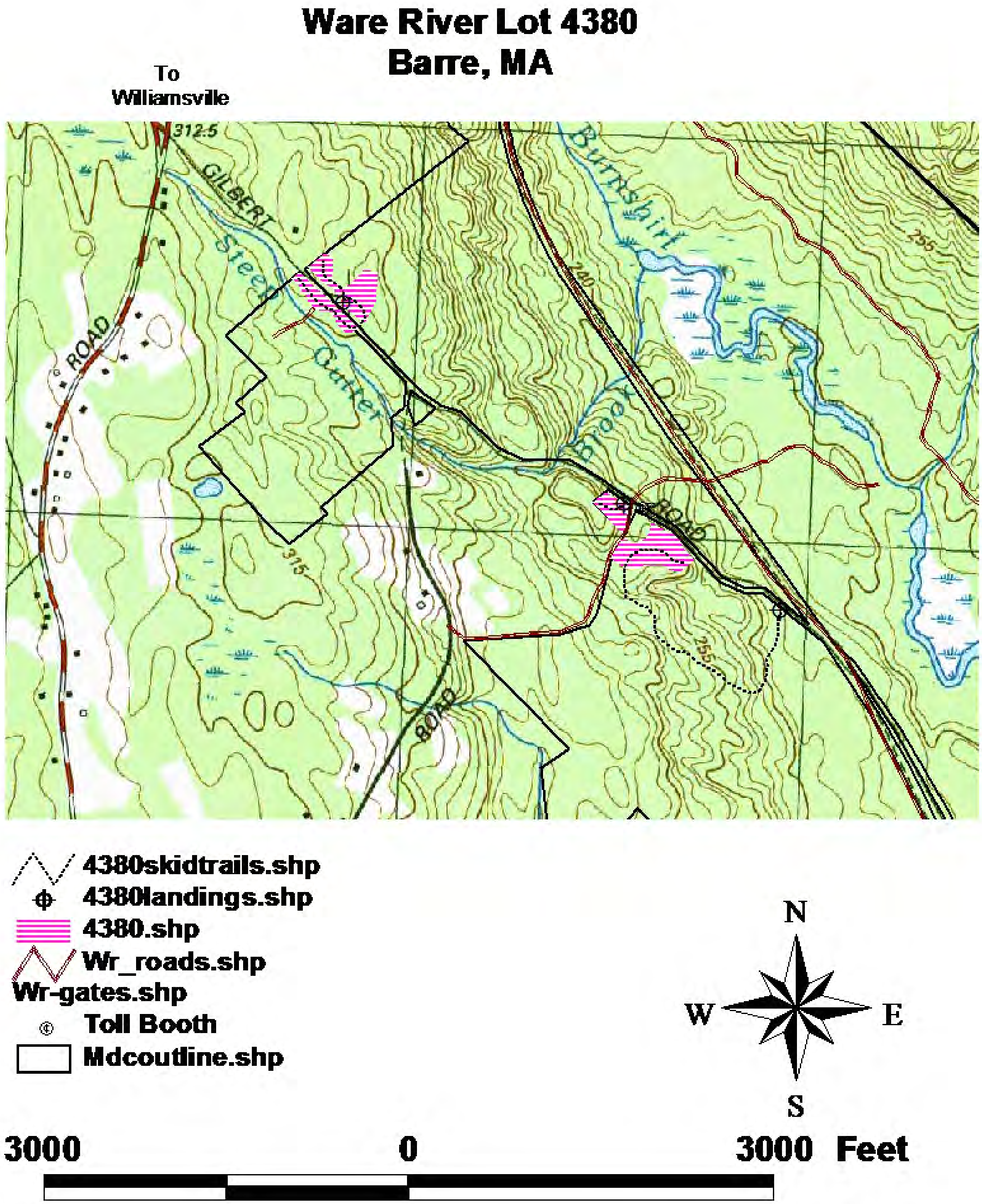


Figure 3. FL4380 Topo Map

Photos

Photo 1. The bridge at S3 during active logging activity

Photo 2. Sampling S3 on January 17th, 2013, as the equipment crossed the bridge

Photo 3. The stream condition after the bridge removal

Photo 4. S2 Low water level on June 26, 2014

Photo 5. S3 at the crossing on December 18, 2014.
Water level was higher than normal.

2014 Quabbin Reservoir Phytoplankton Monitoring

Paula Packard (January 29, 2015)

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 2014 Wachusett annual report for details), however the method used for microscopic analysis and enumeration of phytoplankton at the Wachusett Reservoir has been changed. 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 February and March.

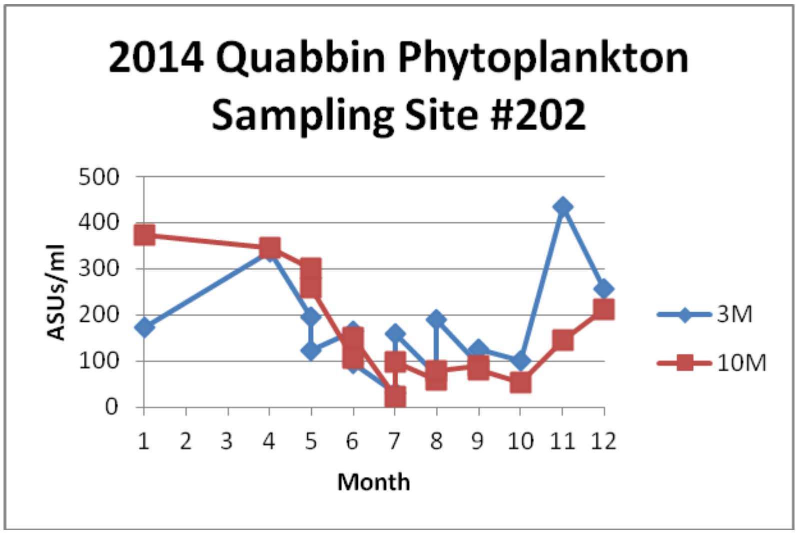
TABLE 1 - QUABBIN PLANKTON MONITORING PROGRAM		
Sampling Stations	**Sampling Frequency**	**Field Tasks**
1) CVA/#202 (Winsor Dam) 2) Shaft 12/#206 (Mt. Pomeroy)	Twice per month from May - Sept. (weather permitting); then decreasing to Once per month from Oct. – April (weather and ice conditions permitting)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

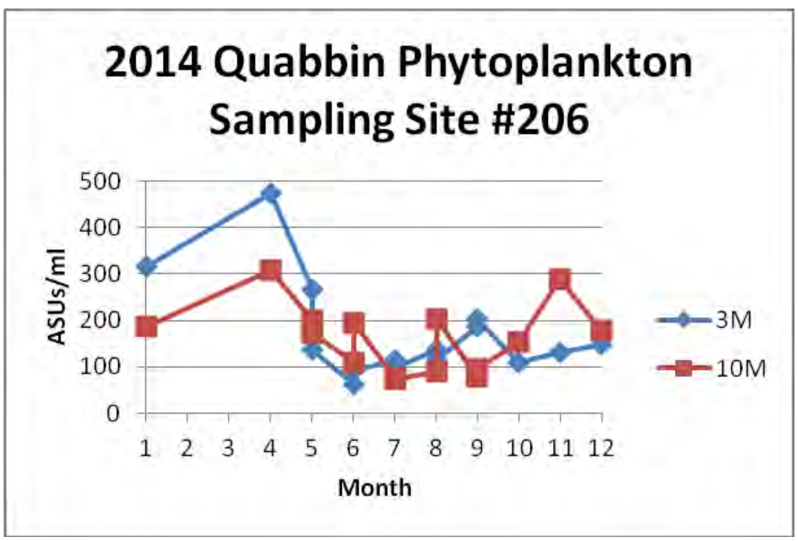
Results show that the Quabbin Reservoir supports a phytoplankton community typical of many oligotrophic systems located in the temperate zone. The most common organisms observed consisted of the diatoms *Asterionella*, *Cyclotella, Tabellaria* and *Rhizosolenia,* the chlorophytes (green alga) *Gloeocystis* 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 2014 being slightly lower at both sites than those documented in 2013. Sampling site #202 averaged 163 ASUs/ml (down from 197 ASUs/ml), and sampling site #206 averaged 167 ASUs/ml (down slightly from 171 ASUs/ml in 2013). See graphs below.

Diatoms dominated the phytoplankton community until mid-July. The highest diatom numbers (464 ASUs/ml) of the year were observed in April at sampling site #206. Highest total phytoplankton numbers (473 ASUs/ml) were observed during this month. Diatom numbers declined steadily from then on, reaching their lowest point in August and remaining low throughout the remainder of the year.

At the end of July, cyanophyte densities began to increase, continuing the trend seen for the last several years where a proliferation of *Aphanocapsa* and *Microcystis*, occurred during that month. In 2014, this trend continued through to the end of the year. Cyanophyte densities, especially *Microcystis*, were observed to peak on November 13th at 375 ASUs/ml in the 3 meter sample collected at sampling site #202 bringing the total phytoplankton value for that sample to 435 ASUs/ml, the second highest number for the year. This peak was slightly lower than numbers observed in 2013. Subsequent sampling showed a decline of this alga. By mid-November, numbers for organisms were more evenly distributed among all taxa with diatom numbers increasing slightly over those found during the late summer/early fall months.

There were no taste and odor complaints during the year and interestingly, again in 2014, exceptionally low levels of plankton were documented. July samples collected at site #202 at 3 meters had a density of 31 ASU/ml while the 10 meter sample had a density of 22 ASU/ml. Plans for plankton monitoring in 2015 call for a continuation of the program outlined above.





Reference Cited

Wetzel, R.G. 1983. Limnology, Second Edition. CBS College Publishing.

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
1/16/2014	**3**	96	7	0	0	0	0	0	69	0	0	0	**172**
1/16/2014	**10**	358	0	14	0	14	0	0	0	0	0	0	**372**
4/17/2014	**3**	321	0	0	0	0	0	0	0	0	17	0	**338**
4/17/2014	**10**	262	84	0	0	0	0	0	0	0	0	0	**346**
5/8/2014	**3**	108	50	29	0	0	0	29	7	0	0	0	**194**
5/8/2014	**10**	180	8	83	0	23	0	60	0	0	30	0	**300**
5/22/2014	**3**	89	0	33	0	33	0	0	0	0	0	0	**122**
5/22/2014	**10**	219	16	0	0	0	0	0	0	0	23	0	**258**
6/9/2014	**3**	112	53	0	0	0	0	0	0	0	0	0	**164**
6/9/2014	**6**	59	46	0	0	0	0	0	0	0	0	0	**105**
6/23/2014	**3**	73	23	0	0	0	0	0	0	0	0	0	**96**
6/23/2014	**10**	98	38	8	0	0	0	0	8	0	0	0	**150**
7/17/2014	**3**	6	13	0	0	0	0	0	13	0	0	0	**31**
7/17/2014	**10**	7	0	0	0	0	0	0	14	0	0	0	**22**
7/28/2014	**3**	15	0	0	0	0	0	0	143	0	0	0	**158**
7/28/2014	**10**	0	0	0	0	0	0	0	98	0	0	0	**98**
8/14/2014	**3**	7	0	0	0	0	0	0	55	0	0	7	**69**
8/14/2014	**10**	0	0	0	0	0	0	0	58	0	0	0	**58**
8/28/2014	**3**	53	23	0	0	0	0	0	113	0	0	0	**188**
8/28/2014	**10**	0	12	0	0	0	0	0	65	0	0	0	**77**
9/11/2014	**3**	0	20	0	0	0	0	0	72	0	0	0	**92**
9/11/2014	**10**	15	0	0	0	0	0	0	75	0	0	0	**90**
9/24/2014	**3**	45	0	0	0	0	0	0	79	0	0	0	**124**
9/24/2014	**10**	0	0	0	0	0	0	0	80	0	0	0	**80**
10/20/2014	**3**	68	0	0	0	0	0	0	34	0	0	0	**101**
10/20/2014	**10**	11	16	16	0	5	0	0	11	0	0	0	**53**
11/13/2014	**3**	60	0	0	0	0	0	0	375	0	0	0	**435**
11/13/2014	**10**	0	14	0	0	0	0	0	129	0	0	0	**144**
12/3/2014	**3**	92	13	20	0	20	0	0	131	0	0	0	**256**
12/3/2014	**10**	24	0	0	0	0	0	0	187	0	0	0	**211**

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
1/16/2014	**3**	255	15	0	0	0	0	0	45	0	0	0	**315**
1/16/2014	**10**	93	51	34	0	34	0	0	8	0	0	0	**186**
4/17/2014	**3**	464	8	0	0	0	0	0	0	0	0	0	**473**
4/17/2014	**10**	285	15	0	0	0	0	0	8	0	0	0	**308**
5/8/2014	**3**	209	36	0	0	0	0	0	0	0	22	0	**266**
5/8/2014	**10**	165	14	14	0	14	0	0	7	0	0	0	**201**
5/22/2014	**3**	125	13	0	0	0	0	0	0	0	0	0	**138**
5/22/2014	**10**	144	0	29	0	0	0	29	0	0	0	0	**173**
6/9/2014	**3**	47	0	0	0	0	0	0	16	0	0	0	**63**
6/9/2014	**6**	39	70	0	0	0	0	0	0	0	0	0	**109**
6/23/2014	**3**	66	20	0	0	0	0	0	7	0	0	0	**92**
6/23/2014	**10**	102	78	16	0	16	0	0	0	0	0	0	**195**
7/17/2014	**3**	18	0	0	0	0	0	0	96	0	0	0	**114**
7/17/2014	**10**	23	0	0	0	0	0	0	53	0	0	0	**75**
7/28/2014	**3**	8	0	0	0	0	0	0	90	0	0	0	**98**
7/28/2014	**10**	0	22	0	0	0	0	0	50	0	0	0	**72**
8/14/2014	**3**	14	0	7	0	7	0	0	115	0	0	0	**137**
8/14/2014	**10**	0	0	0	0	0	0	0	91	0	0	0	**91**
8/28/2014	**3**	14	14	0	0	0	0	0	86	0	0	0	**115**
8/28/2014	**10**	11	23	11	0	0	0	0	158	0	0	0	**203**
9/11/2014	**3**	36	22	0	0	0	0	0	129	0	0	0	**187**
9/11/2014	**10**	20	33	0	0	0	0	0	26	0	0	0	**79**
9/24/2014	**3**	33	20	0	0	0	0	0	151	0	0	0	**204**
9/24/2014	**10**	21	21	0	0	0	0	0	55	0	0	0	**96**
10/20/2014	**3**	9	18	9	0	9	0	0	73	0	0	0	**109**
10/20/2014	**10**	27	11	37	0	16	0	0	80	0	0	0	**154**
11/13/2014	**3**	0	0	0	0	0	0	0	131	0	0	0	**131**
11/13/2014	**10**	70	26	88	0	70	0	0	105	0	0	0	**289**
12/3/2014	**3**	83	12	0	0	0	0	0	53	0	0	0	**149**
12/3/2014	**10**	98	16	0	0	0	0	0	65	0	0	0	**179**

2014 Quabbin Boat Inspection Programs

Paula Packard

January 30, 2015

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 boat washing program and the cold weather quarantine processes are in place to reduce the risks associated with boats being used in multiple locations, some of which may be infested with invasive species.

In 2014, 182 boaters were inspected and decontaminated through the wash process. This is down slightly from previous years. Four boaters have been through our decontamination program six times. Fifteen have been through five times. One boat failed our inspection and did not return for reinspection because of carpeted bunks. Several other boaters with carpeted bunks removed the carpet and then passed upon reinspection. One boater failed because the boat motor exceeded the horse power rating regulations. No boats were failed due to motor issues.

One hundred and twelve boats took advantage of our Cold Weather Quarantine Program (CWQ) in anticipation of the 2015 fishing season. CWQ was held on November 1st and 15th in New Salem and in Belchertown on November 8th and December 13th and 17th. 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. This year, we received very few complaints 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 2014 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 2014, some of the boaters who utilized the wash process 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 boaters, who had never participated in CWQ, took advantage of this program this year.

Quabbin Fishing areas had a total of 42,700 visits since the start of our boat decontamination program with 8,011 during the 2014 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 on site and were determined to be desiccated portions of terrestrial plants such as pine needles, bits of grass, as well as spider webs, exoskeletons of insects and leaves. 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 that there is sufficient water pressure to ensure that all areas of the boat's hull, rollers, bunks and difficult-to-reach places of the trailer are effectively washed. 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.

2014 Quabbin Self-Certification/Boat Ramp Monitor Program

P. Packard

June 9, 2015

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 was only several hours per week, our efforts were still concentrated at Comet and Long Ponds. These two ponds have the highest number of boaters and therefore pose the greatest risks for the introduction of aquatic invasive species. Comet Pond in Hubbardston is pristine with no AIS so most boaters were in complete agreement with our program and were 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 is 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 and their stems fragment. Fragments grow roots in a short period of time and can colonize other locations with suitable substrate, displacing and competing with 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. As in previous years, many boaters argued that it was too late to protect Long Pond from invasive species. To combat these arguments, the impacts created from the introduction of spiny water flea, Eurasian milfoil, hydrilla or many other aquatic invasive species were described. Very often people focus on the species they know about and do not consider the impacts associated with things they have never heard of, so education continues to be the key to the success of 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.

New regulations regarding the transporting of aquatic invasive species are currently being addressed. If enacted, violations may lead to fines being assessed, providing us with some leverage as we try to prevent the dispersal of AIS. Overall, the self-certification program was successful.

2014 Quabbin and Ware River Aquatic Macrophyte Assessments

Paula D. Packard

June 9, 2015

During the 2014 field season, a total of 19 water bodies were assessed for the presence of aquatic invasive species (AIS). Of the 19, 9 were in the Quabbin watershed and 10 were located within the Ware River watershed. Sections of the reservoir were also surveyed as well as some small water bodies on Prescott Peninsula. Surveys were conducted beginning on May 29, 2014, and ending on September 15, 2014. Many of the water bodies are monitored yearly while others are done as a component of the current Environmental Quality Assessment. Approximately 60 miles of 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 assessed in 2014.

Ten water bodies contained *Myriophyllum hetrophyllum* (variable water milfoil). In these 10 water bodies, this plant was abundant and widely distributed. It is also well established in sections of the reservoir. Variable water milfoil is a plant that has expanded its range from more southern areas into New England. There are three subtypes of this milfoil. The Atlantic type tends to be slightly less aggressive, the southern type is very aggressive, and there is believed to be a hybrid with characteristics somewhere between the two types. The types found at Quabbin and other water bodies within the watersheds, have not yet been determined. Monitoring and assessment of this plant is ongoing but at this point, it is well established, and removal or eradication would be very difficult.

Four water bodies had stands of common reed (*Phragmites australis*). In the reservoir, it is widely distributed. In the watershed, small patches of this invasive are cropping up in locations where they had not been found previously. Most new infestations seem to be initially established be occurring along roadways and then spread to other areas of the water body. In some ponds, its numbers appear to be lower than in previous years. *Phragmites*, once established, aggressively colonizes the shoreline and is impossible to eradicate using methods such as cutting below the surface of the water, hand pulling or covering with black plastic. Other methods are being researched, but to date, the only method that seems to be effective is to use herbicides. *Phragmites* is apparently spreading through seed dispersal. As more plants mature to reproductive age, seed production and dispersal will increase. Not only will plant numbers within a pond increase as seeds are spread but the likelihood of seeds being carried to other water bodies also increases. Ideally, small, isolated populations should be eradicated before they become firmly established. 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 biodiversity.

In 2011, the presence of several pink water lily plants was documented along the northern shoreline of Comet Pond. Many biologists believe that pink water lilies are a color variation of *Nymphaea odorata*, the native white water lily very common to many of our ponds and lakes. USGS does not list the pink color phase of this plant in its invasive species data base. This population does not seem to be changing significantly. Plants have not spread to other areas, and numbers have remained consistently low.

Monitoring will be ongoing and if the status of this plant changes, recommendations for its removal will be made before numbers increase to levels where eradication by hand harvesting becomes difficult.

This year, Queen Lake in Phillipston was the only water body surveyed that was infested with fanwort (*Cabomba caroliniana*). In the northernmost end of the lake, several small patches of fanwort were documented. Queen Lake was treated for this invasive species as well as for variable leaf water milfoil several years ago. The treatment appears to be successful because during the 2011 assessment, no milfoil was found and only two small fragments of fanwort were noted. In 2012 and 2013, variable leaf water milfoil continued to be notably absent but fanwort numbers were greater. In 2014, variable leaf milfoil was not documented however several floating fragments of fanwort were found in the beach area and along the shoreline but overall, distribution was sparse. An increase in the presence of fanwort was expected; however, to date, results have been surprisingly good with fewer-than-expected plants observed. There are no plans to treat again in the near future.

It was reported that fanwort had been documented in White Hall Pond but neither Dave Worden (former limnologist at Wachusett) nor I found any in 2009 or 2010. Michelle Robinson, formerly of DCR Lakes & Ponds, had documented and reported to MA Natural Heritage Endangered Species Program, a rare species of plant that closely resembles this invasive. The presence of the rare species and the absence of the aquatic invasive species, were confirmed in the 2011 survey. In the 2013 assessment, the rare plant was found in abundance. During the 2014 macrophyte survey, it was found to be widely distributed in both White Hall Pond and in the middle sections of Long Pond. This state-listed species appears to be doing very well in these water bodies.

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 White Hall Pond in Rutland. A small patch of this AIS was found near the access road, a sample taken and identification confirmed. Tom Flannery, from the DCR Lakes & Ponds Program, removed the plants soon after they were found. Using dive gear, 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 then towards fall, has a moderate growth spurt. As expected, we saw additional plants coming up in the spring of 2014. Staff from the Lakes and Ponds Program hand harvested observed plants. Plans are in place for 2015 to assess and mark each location of the plants early in the season and then again in the late summer or early fall. Lakes & Ponds staff will continue to hand harvest the plants at our request. This effort will be ongoing until we are confident that *P. crispus* has been eradicated.

This AIS had not been observed during macrophyte assessments conducted prior to 2013. The fact that it was found before the infestation became widespread will make eradication possible as long as efforts are sustained. Over the last several years, 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.

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 2014, snails were still abundant at Area 1 high however many empty shells were found. Apparently the ducks have been feeding heavily on the snails. This may help keep numbers in check. In 2012, additional snails were found near the hangar at the Quabbin Administration Building in Belchertown. No new infestations have been documented. 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, although there is anecdotal evidence that they are an intermediate host for a fish parasite that has been recently observed.

In field notes from previous surveys done at Connor Pond in Petersham, it was noted that Blue Flag Iris plants seemed to be rapidly colonizing the western shoreline of this water body. While Blue Flag Iris is present at Connor Pond, many of the plants initially identified as Blue Flag were documented in 2013 as actually Yellow Flag Iris, a relatively aggressive invasive species. It is difficult to distinguish between the two different plants when not in bloom. This plant is spreading at an accelerated rate. To date, the only other location where this particular plant has been found is at the boat launch at Fishing Area 3 in Hardwick. Those plants were hand pulled. They have reappeared periodically and are removed as quickly as possible.

Lithrum salicaria (Purple Loosestrife) was found at six 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 six 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 or One Row Yellowcress, had been previously found at Pepper Mill Pond, the east branch of the Swift River, and in a small tributary inside gate 16. It is now being found in many locations 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 seems to be established. It is edible and may be kept in check by herbivory. Also, 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 (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 2014, additional plants were documented at much lower numbers than in the previous year. Forget-me-nots were also found in the middle section of Long Pond. Populations will be monitored and removed as they are documented. 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. 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. Plans are in place for 2015 to deal with an ongoing problem. Please refer to the 2014 complete report on this finding (Packard, 2014).

No additional aquatic invasive species were documented in 2014. Plans to assess water bodies in the Ware River and Quabbin watersheds are in place for the 2015 field season.

Literature cited

ESS Group, 2014. Aquatic Macrophyte Surveys: MWRA/DCR Source and Emergency Reservoirs, 2013. Report dated January 16, 2014. ESS Group, Inc., East Providence, Rhode Island.

Packard, 2014. *Najas minor* (Brittle naiad) in Regulating Pond, Fishing Area II. Report dated October 8, 2014.

Water Body	Location
Bassett Pond	New Salem
Brigham Pond	Hubbardston
Comet Pond	Hubbardston
Connor	Petersham
Cunningham	Hubbardston
Demond Pond	Rutland
Fishing Area 2	New Salem
Harvard Pond	Petersham
Long Pond (north)	Rutland
Long Pond	Rutland
Lake Mattawa	Orange
Middle Swift Impoundment	New Salem
Moosehorn Pond	Hubbardston
Pepper's Mill Pond	Ware
Pottapaug Pond (East Swift Impoundment)	Petersham & Hardwick
Prescott Peninsula	
Queen Lake	Phillipston
Stone Bridge Pond	Templeton
Ware River- Route 122 to Bridge	Barre
White Hall Pond	Rutland

***Najas minor* (Brittle naiad) in Regulating Pond, Fishing Area II**
October 8, 2014

Prepared by Paula D. Packard
DCR Aquatic Biologist, Quabbin Reservoir

Brief summary

Najas minor, commonly known as brittle naiad, was found in the Regulating Pond at Fishing Area II by ESS Consulting Group on August 14, 2014. The presence of this plant was confirmed by DCR Aquatic Biologists. Coordinated efforts between DCR and MWRA culminated with DASH (Diver Assisted Suction Harvesting) of plants on September 22, 2014.

Means of introduction and historical information

Najas minor is a plant native to Europe and Asia. It has been found in the United States since the 1930s, first being documented in Massachusetts in 1974. It is now found in 26 states including New Hampshire, Vermont and Connecticut. It is believed that the first introductions were intentional. Plants were propagated to provide food for waterfowl (Global Invasive Species Database).

Waterfowl continue to be the predominant vector in the transport of *N. minor*. Naiads, both native and introduced, are a preferred food for numerous birds (see Table 1). Birds feed on large numbers of naiad seed pods, travel to other locations, often flying long distances. The naiad seeds remain viable through the gut of the bird (Hilty, 2014). Hundreds of thousands, to millions of seeds, are dispersed by these means. (T. Flannery, personal communication). Quabbin is part of the Atlantic flyway (Atlantic Flyway Council), providing an ideal stopover location for large numbers of migratory birds. These birds have the potential to carry and therefore disperse large numbers of *N. minor* seeds.

Boats, trailers and vehicles may harbor seeds in inconspicuous places, transporting seeds long distances, ultimately infesting new water bodies. Once established, water and wind currents may carry fragments with attached seeds to suitable areas as well as to downstream locations.

Biology/Life History Strategy

N. minor is an annual plant which forms dense monocultures and has a bushy growth habit. Plants prefer to grow in quiet waters and have the ability to outcompete native plants especially other Najas species. They may grow in water from 0.6 meters to a maximum of 5 meters. Plants do not top out like *M. heterophyllum* or *Cabomba* but are relatively small. Specimens collected from the Regulating Pond had attained a height of approximately 12 inches. Each leaf has between 7 and 15 tooth like spines along the leaf margin. The literature says that these spines are conspicuous but in the field, they were difficult to readily discern. Leaves appear to be curved under, slightly heavier than those found in the native naiad and also are darker in color than *Najas flexilis*.

Seeds are produced in the axils of leaves and are very firmly attached. Seed production begins in July with maximum production occurring in September and October (Global Invasive Species Database). When late summer and early fall approaches, the plants begin to become brittle. Fragments break off easily and float with intact seeds to new locations. Seeds germinate from early spring until late summer. Each fruit contains a single seed but each plant produces numerous seeds. Therefore, once established, *N. minor* may quickly colonize suitable habitat within the pond. As numbers increase, so does the potential for spreading to other water bodies.

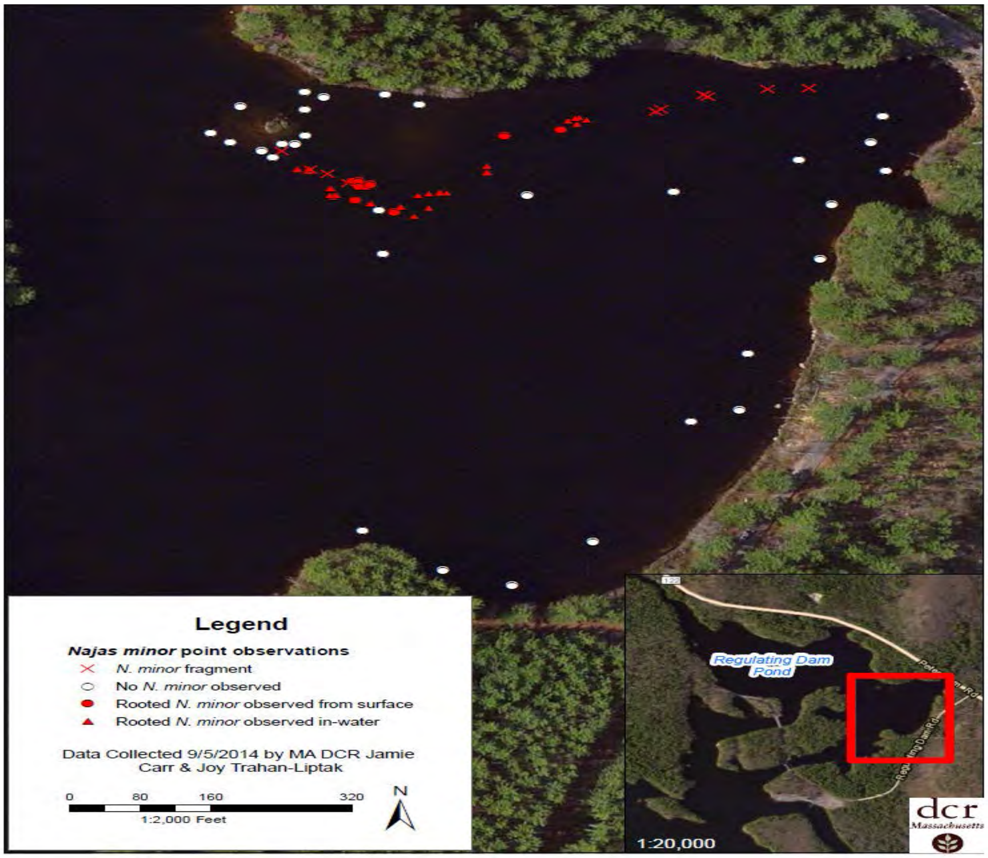
Potential Impacts

N. minor may form dense monocultures by displacing native species. At high densities, plants may make fishing and boating less appealing. Brittle naiad may form large floating mats which could impact water flow. The aesthetic value of the water body may be reduced. In the literature, there is a reference which claims that this plant may induce adverse conditions for fish and waterfowl (Robinson, 2004). However, this claim could not be substantiated. Possibly this could be referring to low dissolved oxygen levels which would occur if large volumes of plants were to decompose in a relatively short period of time. This would affect fish but would probably not significantly impact waterfowl.

Plant documentation

The initial finding of *Najas minor* was by ESS Group on August 14, 2014. Samples were collected by their field biologist and sent back to a senior biologist at ESS for confirmation. MWRA and DCR were notified of the finding on August 20th. Private boats were disallowed on the Regulating Pond as of August 21, 2014. An additional fragment barrier was installed above the existing barrier to further ensure no fragments could be carried into the main body of the reservoir.

On August 26, 2014, DCR staff conducted an additional assessment of the main reservoir primarily focusing on the area where the Regulating Pond flows into the main body of Quabbin Reservoir. Another thorough survey of the pond was done using an Aqua View and throw rake. Points were chosen as to not duplicate the survey done by ESS. DCR staff were also cautious to avoid the area where *N. minor* had been found to reduce the amount of disturbance and fragmentation of plants. Two small, dense patches and one larger patch with plants intermixed with native species, were located. No plants were found in the reservoir and only two, isolated plants were found outside of the area documented by ESS.



Plant removal
MWRA contracted with A&E Professional Divers to use DASH to remove the *N. minor* on September 22, 2014. A&E divers had never harvested this particular plant so several changes were implemented to enhance their normal harvesting method. *N. minor* produces small seeds so initially there was some concern about the mesh size of the screen which separates the water from the harvested vegetation. Mesh size was reduced by the addition of a finer screen over the existing one. Also, when divers harvest Cabomba or Milfoil, they first use one hand to scoop up the roots of the plant and then they place the suction harvester over the top, removing both roots and vegetation. Because *N. minor* is an annual and because we were so concerned about fragmentation, the diver did not use the typical method of removal. He used two hands on the suction harvester and carefully sucked up the entire plant, beginning at the top, so that any fragmentation resulting from this disturbance would be contained. The diver reported that the roots were barely anchored and therefore were easily removed anyway. This method seemed to be very successful. Very few floating fragments were seen and were retrieved using a long handled net.

Plants were mixed in with predominantly *Utricularia spp.*, *Potamogeton spp*. and *Myriophyllum heterophyllum*. The actual number of harvested *N. minor* plants was not determined because individual plants fragmented as they were being harvested. Harvested materials also included one species of native mussel, fingernail clams, small fish, dragonfly nymphs, leeches as well as small specimens of other native plants.

After all observed *N. minor* plants were removed, the diver snorkeled in an area larger than where harvesting was done to ensure that there were no additional rooted plants that missed detection. None were found. A total of two trash bags of vegetation were collected and disposed of in a dumpster.

The following day, a supplemental shoreline survey of the Regulating Pond was conducted. Plant fragments were found along the edge of the harvest area as well as scattered between the island, the inlet cove area and along a short stretch of the eastern shoreline. The prevailing winds tend to blow materials in this direction. Fragment numbers were low and none were found in any other locations within the pond or on the fragment barriers upstream of the pond outlet at the horseshoe dam. These fragments were not necessarily a result of disturbances due to DASH. Plants were extremely brittle at the time of harvesting and were already dispersing.

Looking ahead

There was a three week delay between detection and harvesting, and plants had become increasingly brittle. The likelihood that every single plant and fragment was successfully harvested is very low. Utilizing DASH has reduced the number of potential seeds left to germinate in the future.

Najas minor will be monitored very closely in 2015. DASH should be conducted early in the growing season and then again towards the end of the growing season, in August or early September, because seeds germinate throughout the summer months. The fragment barriers will be maintained in good condition and checked frequently to be sure any fragments are removed and disposed of correctly. Monitoring efforts will be stepped up in the main body of the reservoir as well.


Photo shows plants collecting on double mesh screens. Water flowed back into the Regulating Pond as vegetation was pulled into buckets for safe disposal.

A complete survey of the Regulating Pond was done on the day after DASH occurred. Floating fragments were collected using a long handled net. This bucket contains fragments collected that day.

Table 1. Birds that readily feed on *Najas minor* seeds

Wetland Bird Species Common Name	
Greater Scaup	Northern Pintail
Canvasback	American Wigeon
Canada Goose	Northern Shoveler
Bufflehead	Green-Winged Teal
American Coot	Blue-Winged Teal
Redhead	Mallard
Ring-Necked Deck	Black Duck
	Lesser Scaup

References Cited

Atlantic Flyway Council _ Flyways.us.htm
http://www.flyways.us/ Retrieved September 29, 2014

Global Invasive Species Database (http://www.issg.org/database)

Hilty, J., 2014 Brittle Naiad (**Najas minor**) - Illinois Wildflowers retrieved from www.illinoiswildflowers.info/wetland/**plants**/br_naiad.html [Accessed August 25, 2014]
#
Robinson, Michelle, 2004. European Naiad: An Invasive Aquatic Plant: *Najas minor*. Commonwealth of Massachusetts Department of Conservation and Recreation. D.C.R Office of Water Resources, Lakes and Ponds Program.
Available from:
http://www.mass.gov/dcr/watersupply/lakepond/factsheet/European%20Naiad.pdf [Accessed August 26, 2014]

From: Deslauriers, Peter (DCR)
Sent: Wednesday, March 26, 2014 9:08 AM
To: Susianti-Kubik, Bernadeta (DCR)
Cc: Budaj, Rebecca (DCR); Lee, Yuehlin (DCR)
Subject: Lovewell Pond Outlet Flow 3 25 2014

Good morning,

On the March 25, 2014 Ware River run we listed flow as Very Slow Flow. Previous 2014 collections were listed as Very Good Flow or Good Flow. I took a quick walk upstream to the outlet to check it out. Having never been there before and with all the snow and ice covering everything it was difficult to see what was going on. I believe most of the water entering the brook comes from an approximately 15 inch diameter pipe at the base of the dam. Rebecca though the flows might be related to the way the Lovewell Pond Sporting Club is regulating flow. Quarterly samples were collected and Eureka field
readings were similar to past, except the conductivity was slightly elevated. Will keep you posted on flows.

Lovewell Pond Dam looking west towards Streeter Road.


Outlet flow from metal pipe.

dcr
Massachusetts

MEMORANDUM

To: Bill Pula, Lisa Gustavsen

cc: Scott Campbell, Bob Bishop

From: Yuehlin Lee

Date: May 13, 2014

Subject: Water Quality Results for Stockroom

Water samples were collected at the Stockroom on Blue Meadow Road on April 7-8, 2014. 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 April 17, 2013. This year's testing was arranged to assess RO effectiveness just prior to annual maintenance.

Samples were analyzed for bacteria, volatile organic compounds (VOCs), nitrate, copper, lead, iron, manganese, sodium, total dissolved solids, and turbidity, as well as alkalinity, calcium, magnesium, and hardness. 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 sodium, all contaminant concentrations met drinking water standards and guidelines in both **untreated** and **RO-treated** water. The RO unit effectively reduced sodium over 80 percent, below the guideline limit of 20 mg/L, as well as further decreasing levels of nitrate, copper, lead, sodium, total dissolved solids, and turbidity. Copper and lead in the untreated water were below action levels, and RO treatment reduced their levels by a factor of 100. RO treatment decreased calcium and magnesium levels, both of which contribute to hardness in water. 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, and 0.61 µg/L in April 2013. 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 4/7 - 4/8/14

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	28.8	2.48	-	
Hardness	mg/L	170	3.96	-	
Total Dissolved Solids	mg/L	436	30.0	500 mg/L	SDWR, SMCL
Turbidity	NTU	0.469	0.0310	1 NTU	MCL
Inorganic Compounds					
Calcium	ug/L	43700	1040	-	
Copper	ug/L	795	4.01	1,000 ug/L	SDWR, SMCL
Iron	ug/L	15.8	<6.00	300 ug/L	SDWR, SMCL
Lead	ug/L	14.2	0.985	15 ug/L	MCL (Action Level)
Magnesium	ug/L	14800	330	-	
Manganese	ug/L	5.55	<1.00	50 ug/L	SDWR, SMCL
Nitrate	mg/L	0.440	<0.00500	10 mg/L	MCL
Sodium	ug/L	27700	5230	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

Water Quality at Stockroom
Samples Collected 4/7 - 4/8/14

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO	Drinking Water Standard or Guideline [1]	Remarks [2]
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	-	
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	-	

Water Quality at Stockroom
Samples Collected 4/7 - 4/8/14

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO	Drinking Water Standard or Guideline [1]	Remarks [2]
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
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

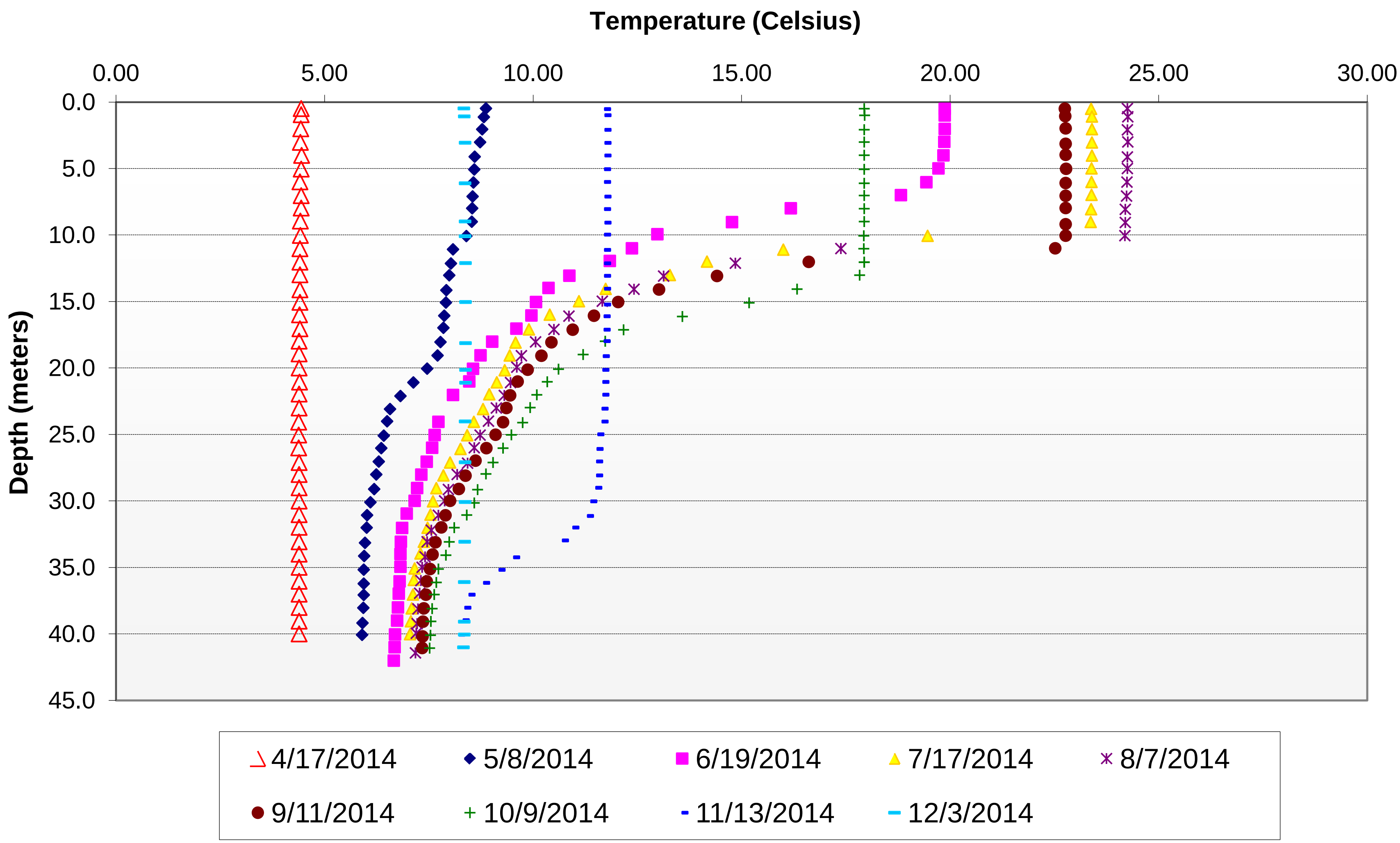
APPENDIX B

Selected Plots and Graphs

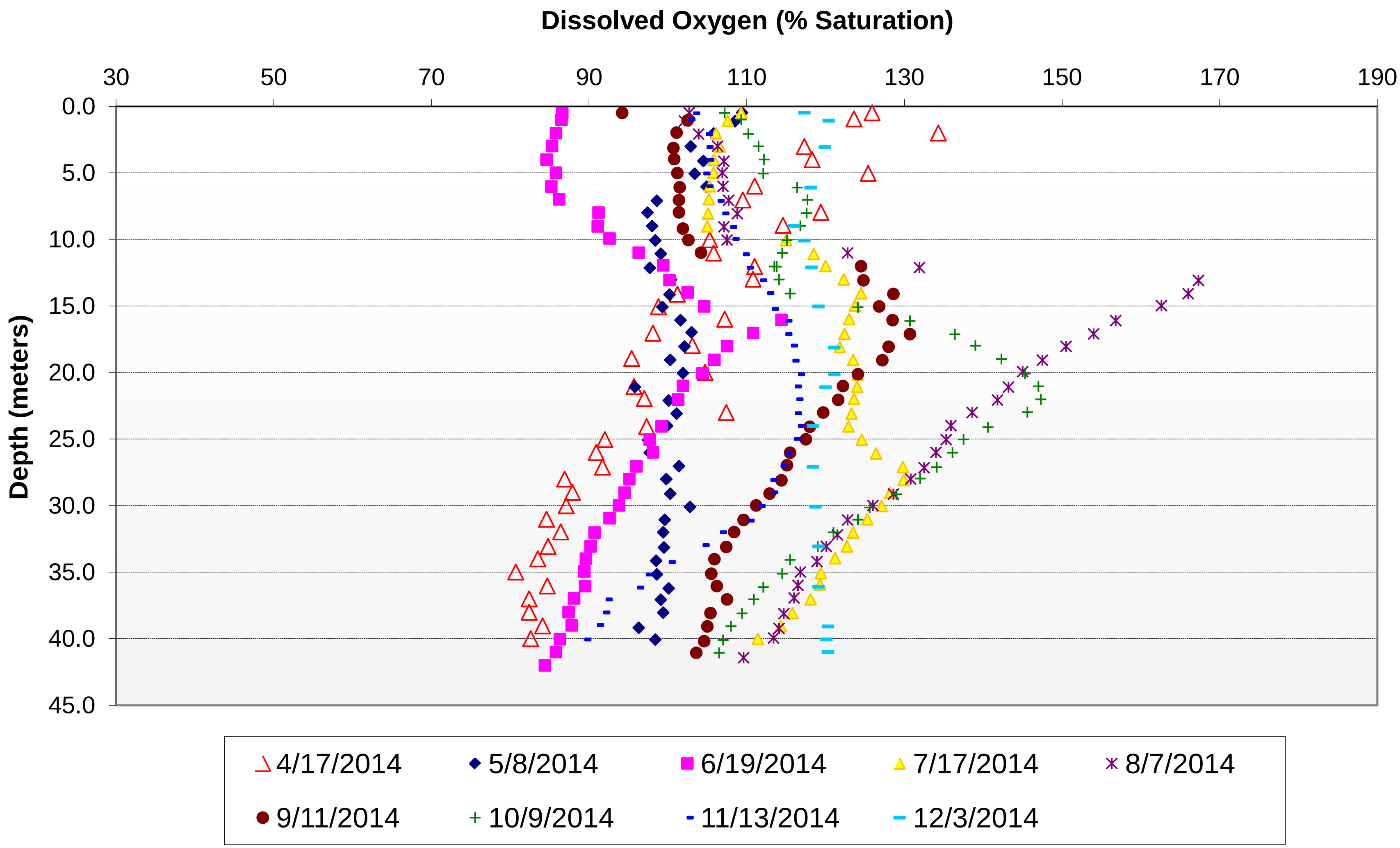
Quabbin Reservoir Profiles

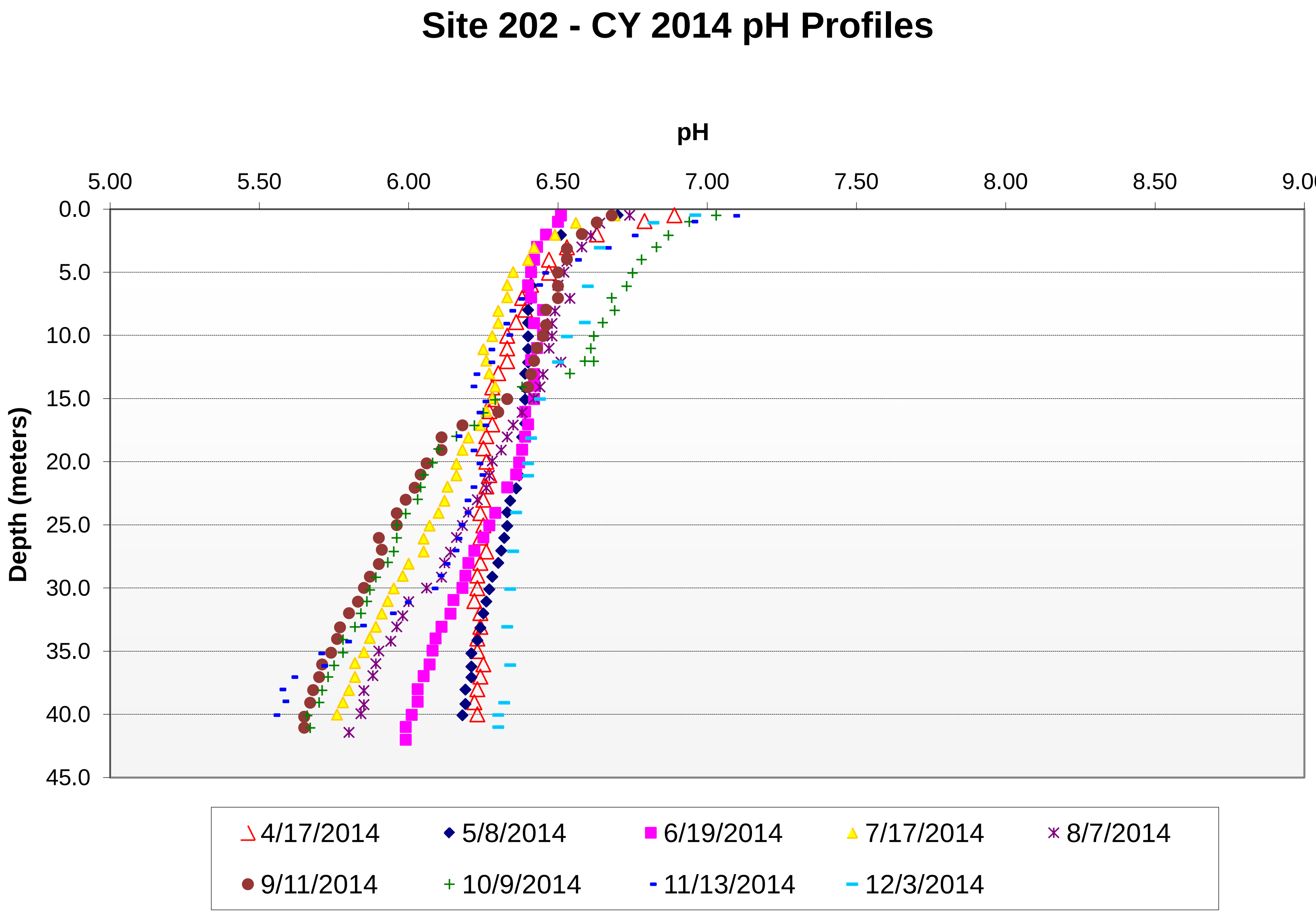
Stream Hydrographs

Site 202 - CY 2014 Temperature Profiles

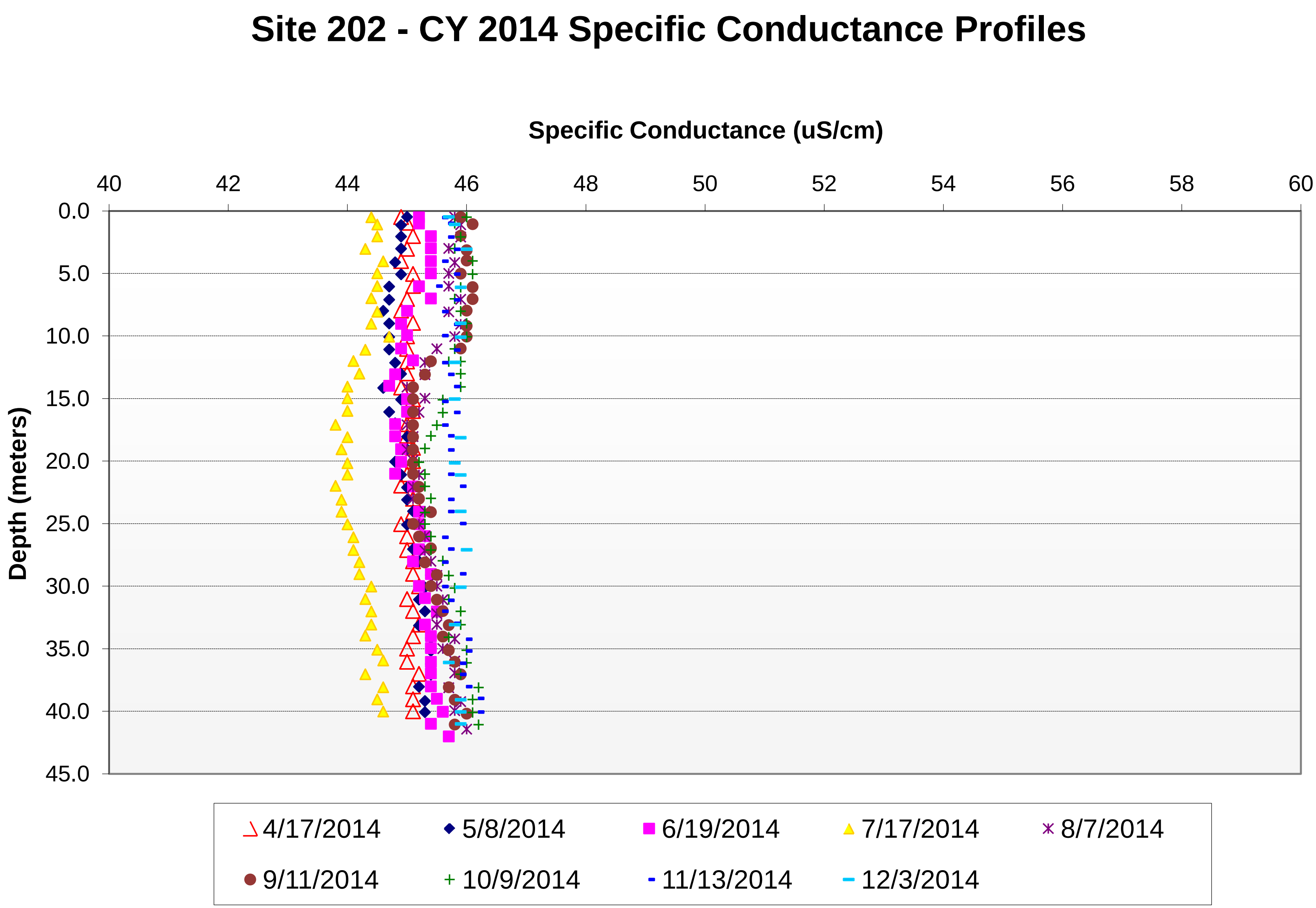


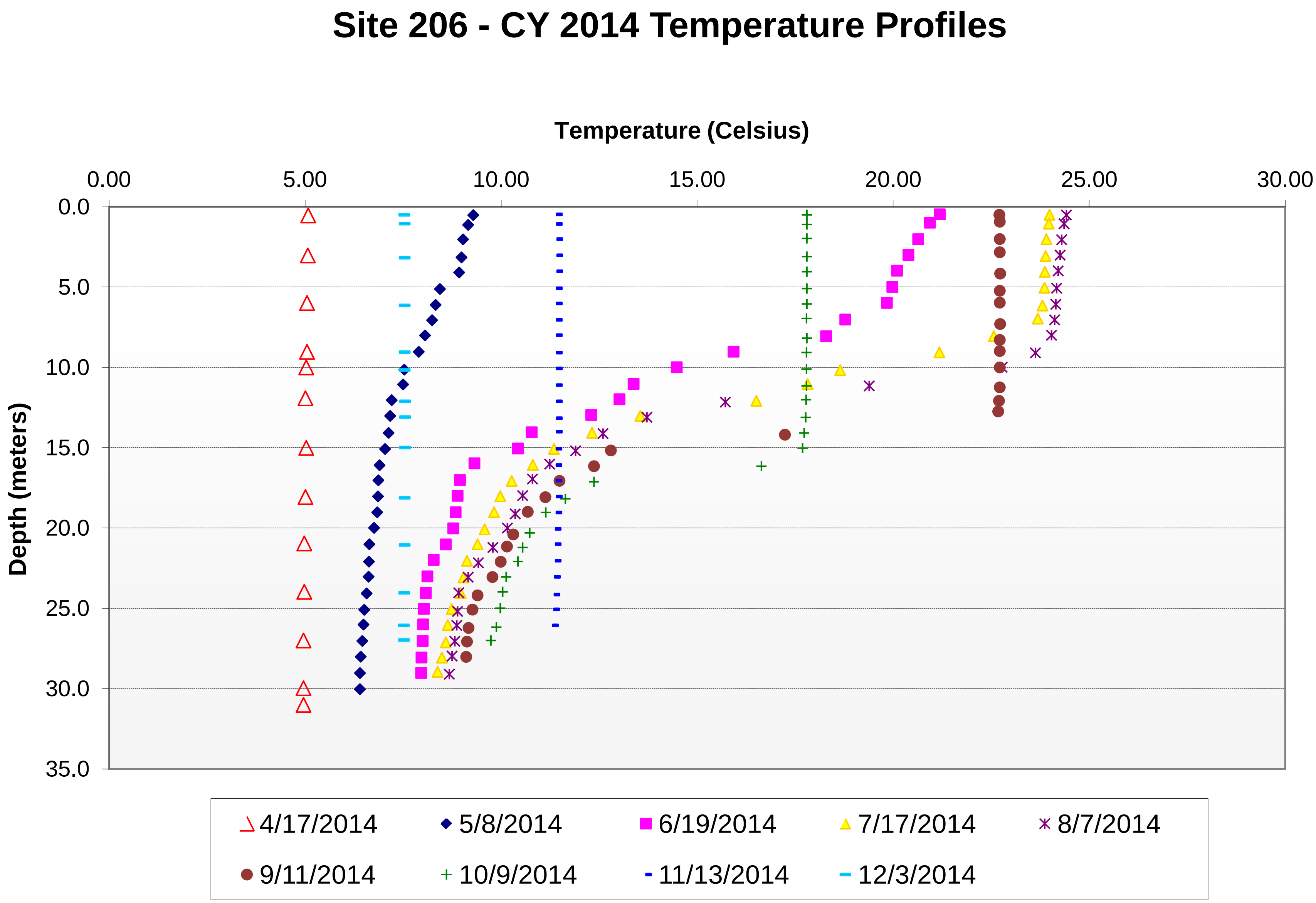
Site 202 - CY 2014 Dissolved Oxygen Profiles

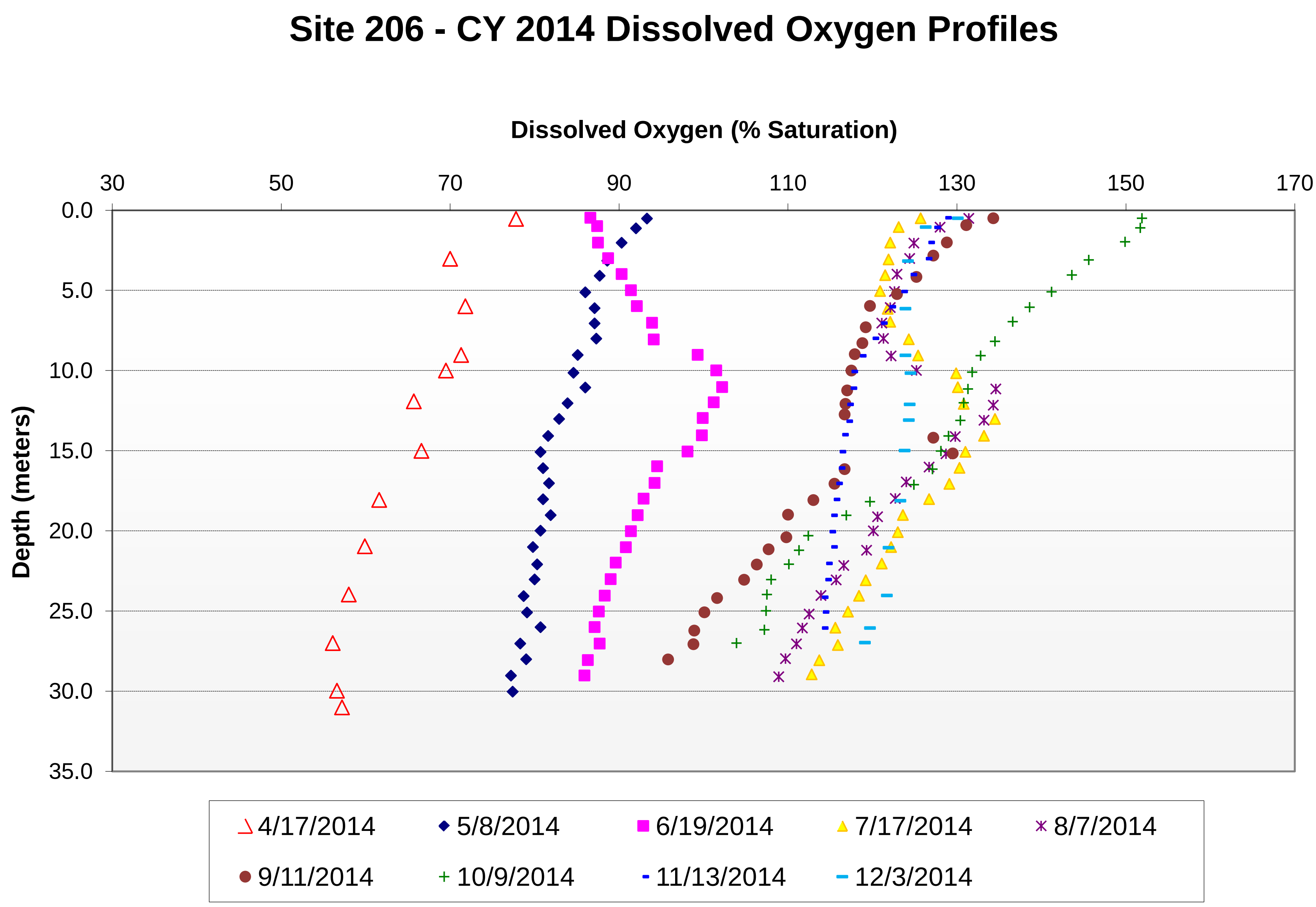




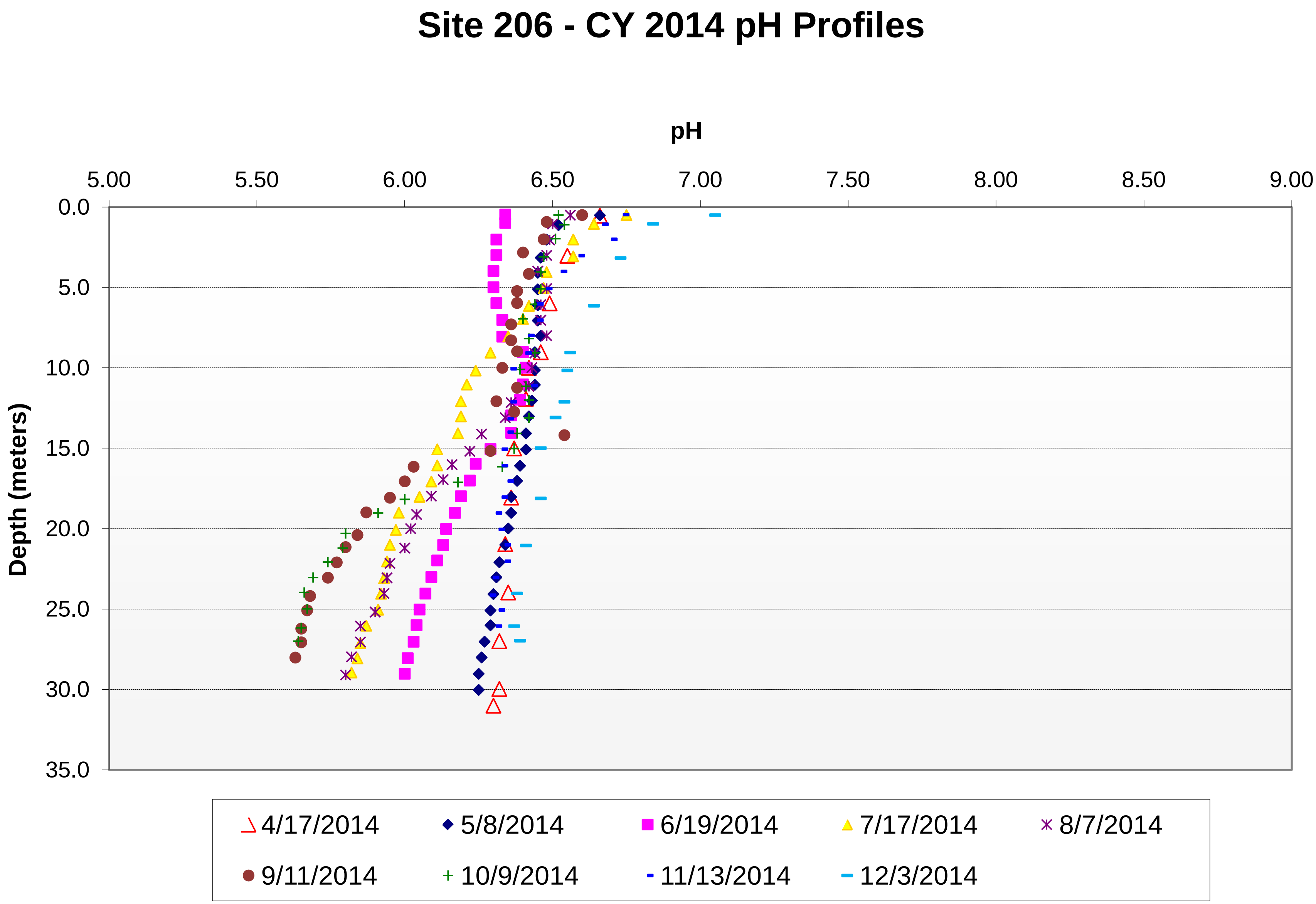
Site 202 - CY 2014 pH Profiles
pH
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/2014
10/9/2014
11/13/2014
12/3/2014


Site 202 - CY 2014 Specific Conductance Profiles
Specific Conductance (uS/cm)
40
42
44
46
48
50
52
54
56
58
60
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/2014
10/9/2014
11/13/2014
12/3/2014

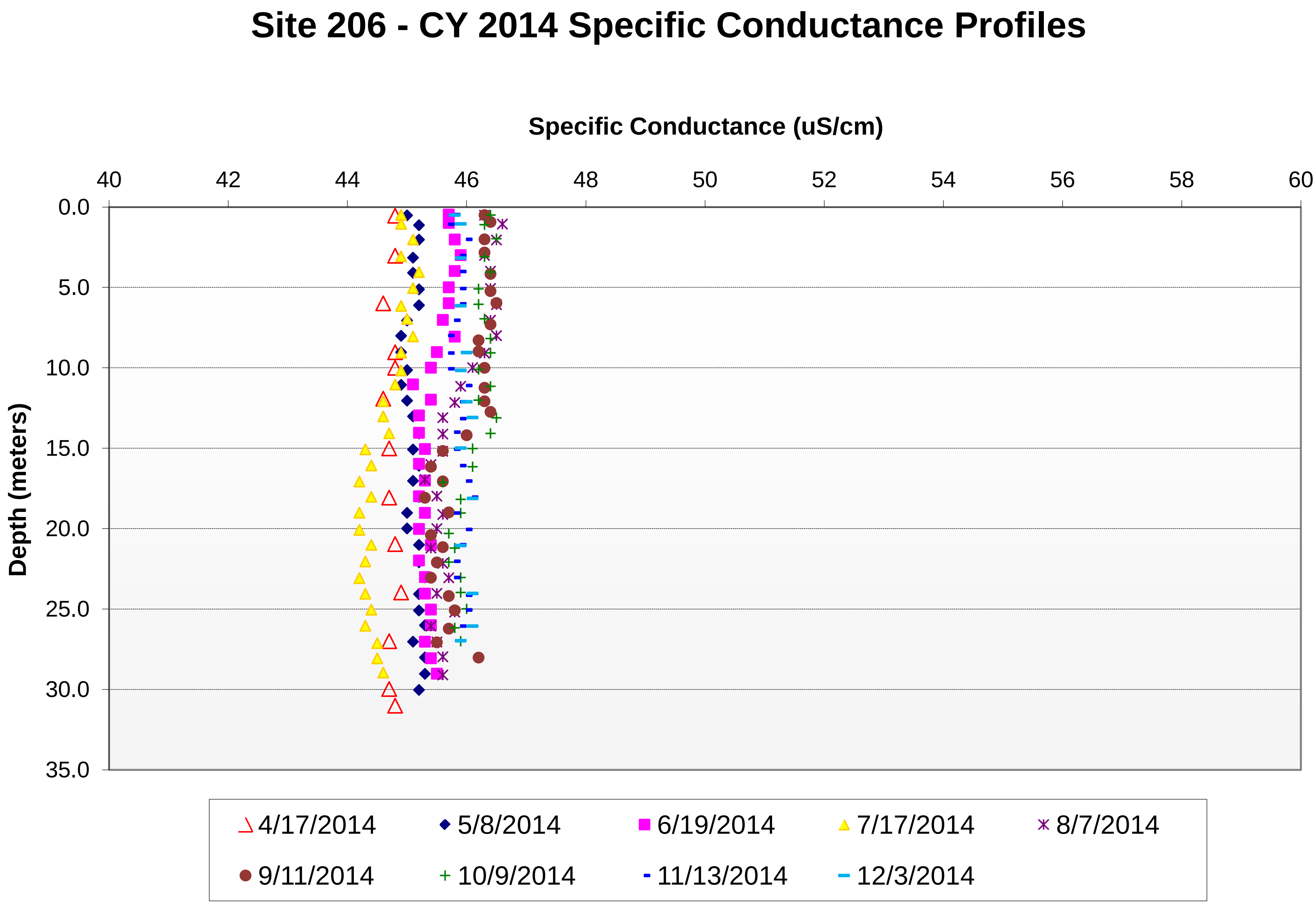

Site 206 - CY 2014 Temperature Profiles
Temperature (Celsius)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/2014
10/9/2014
11/13/2014
12/3/2014



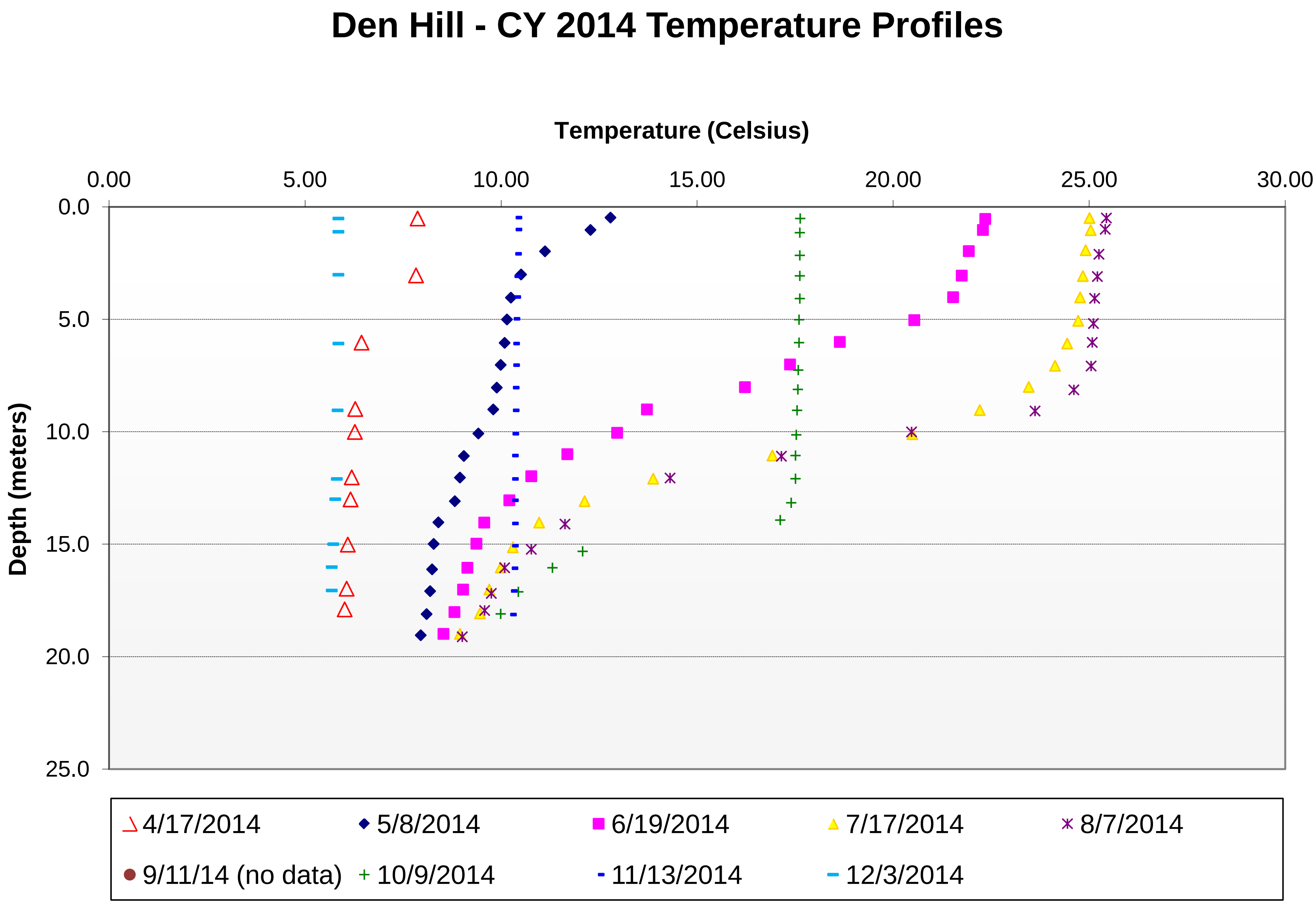
Site 206 - CY 2014 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
30
50
70
90
110
130
150
170
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/2014
10/9/2014
11/13/2014
12/3/2014

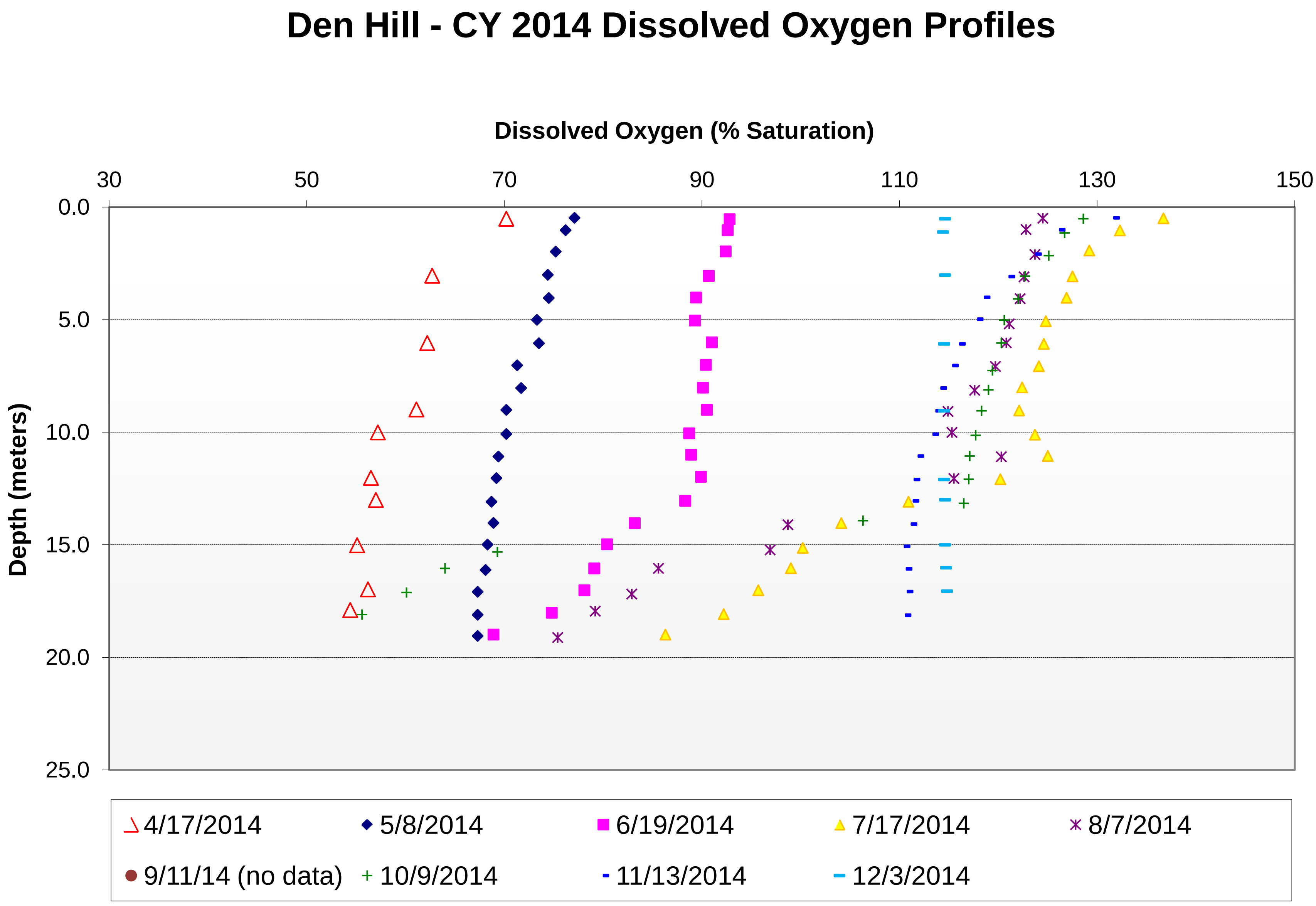


Site 206 - CY 2014 pH Profiles
pH
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/2014
10/9/2014
11/13/2014
12/3/2014



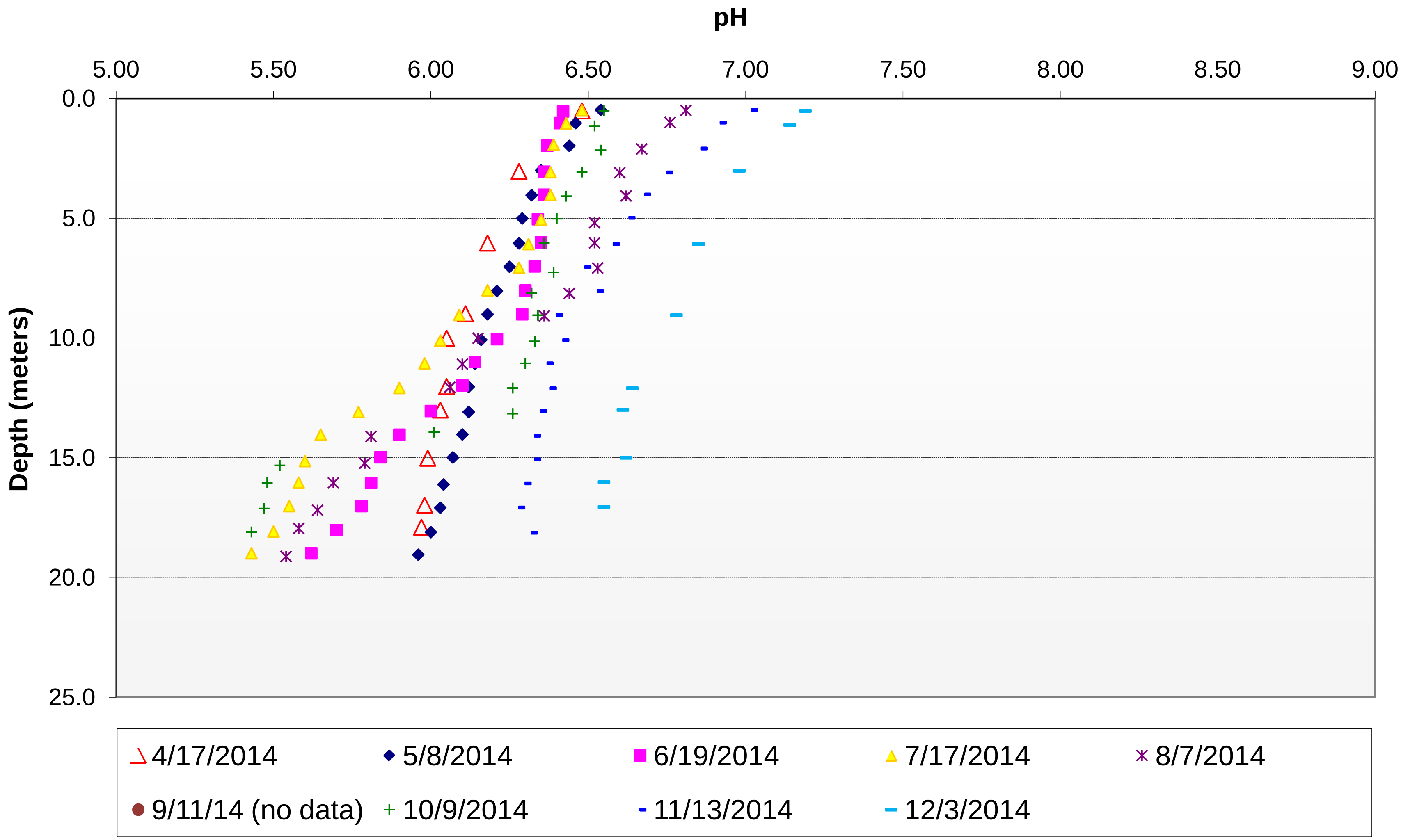
Site 206 - CY 2014 Specific Conductance Profiles
Specific Conductance (uS/cm)
40
42
44
46
48
50
52
54
56
58
60
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/2014
10/9/2014
11/13/2014
12/3/2014


Den Hill - CY 2014 Temperature Profiles
Temperature (Celsius)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/14 (no data)
10/9/2014
11/13/2014
12/3/2014

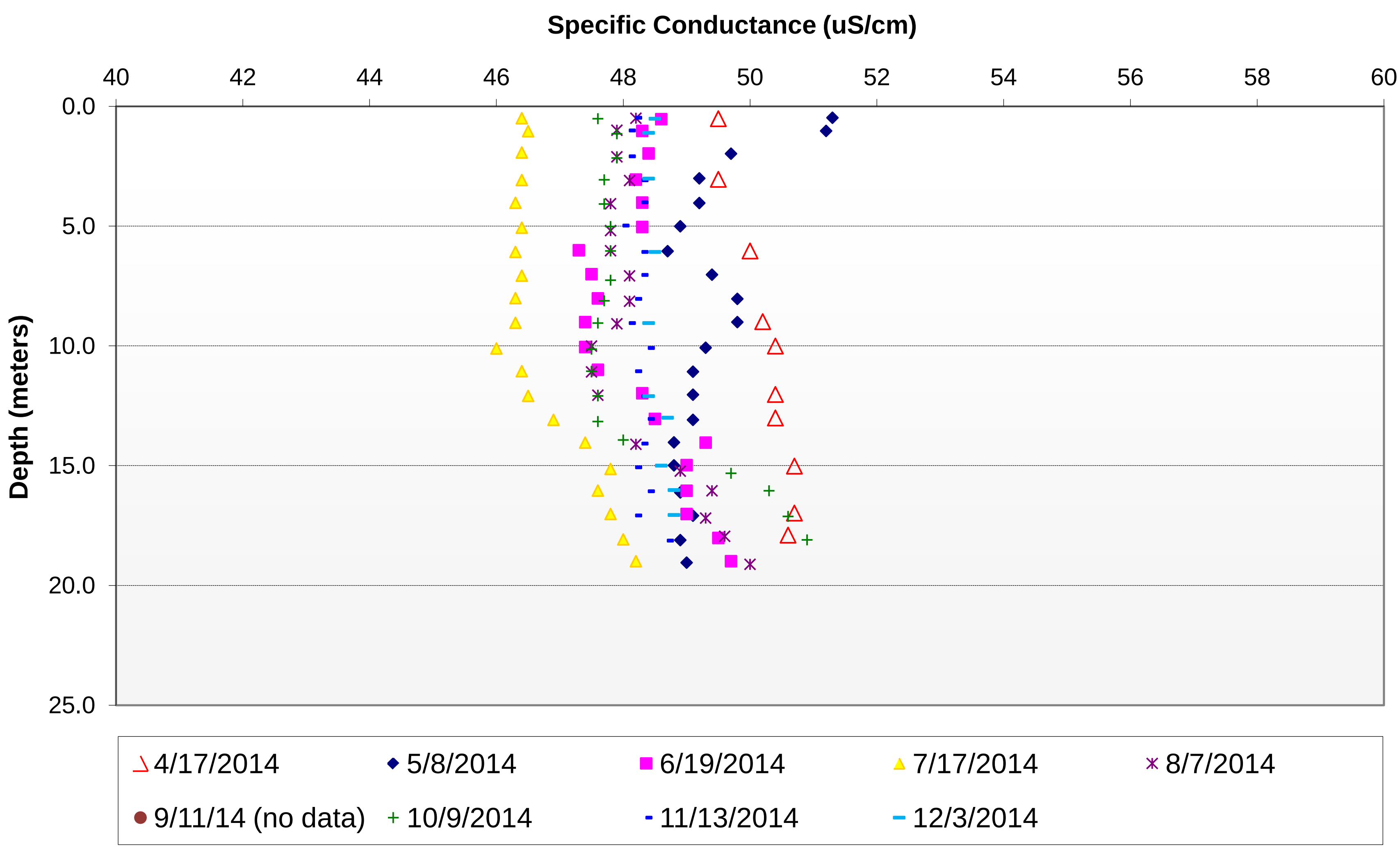


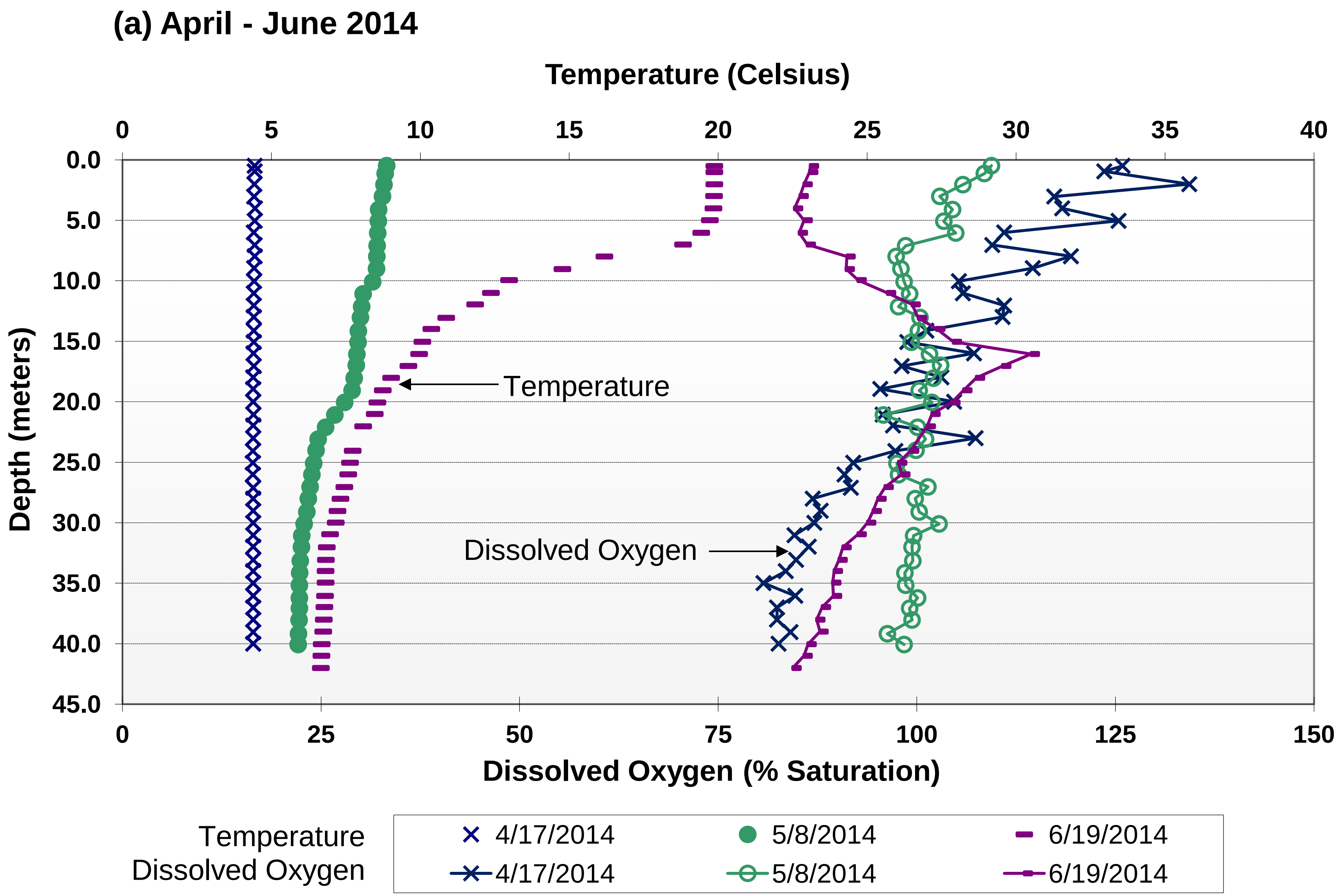
Den Hill - CY 2014 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
30
50
70
90
110
130
150
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
4/17/2014
5/8/2014
6/19/2014
7/17/2014
8/7/2014
9/11/14 (no data)
10/9/2014
11/13/2014
12/3/2014

Den Hill - CY 2014 pH Profiles

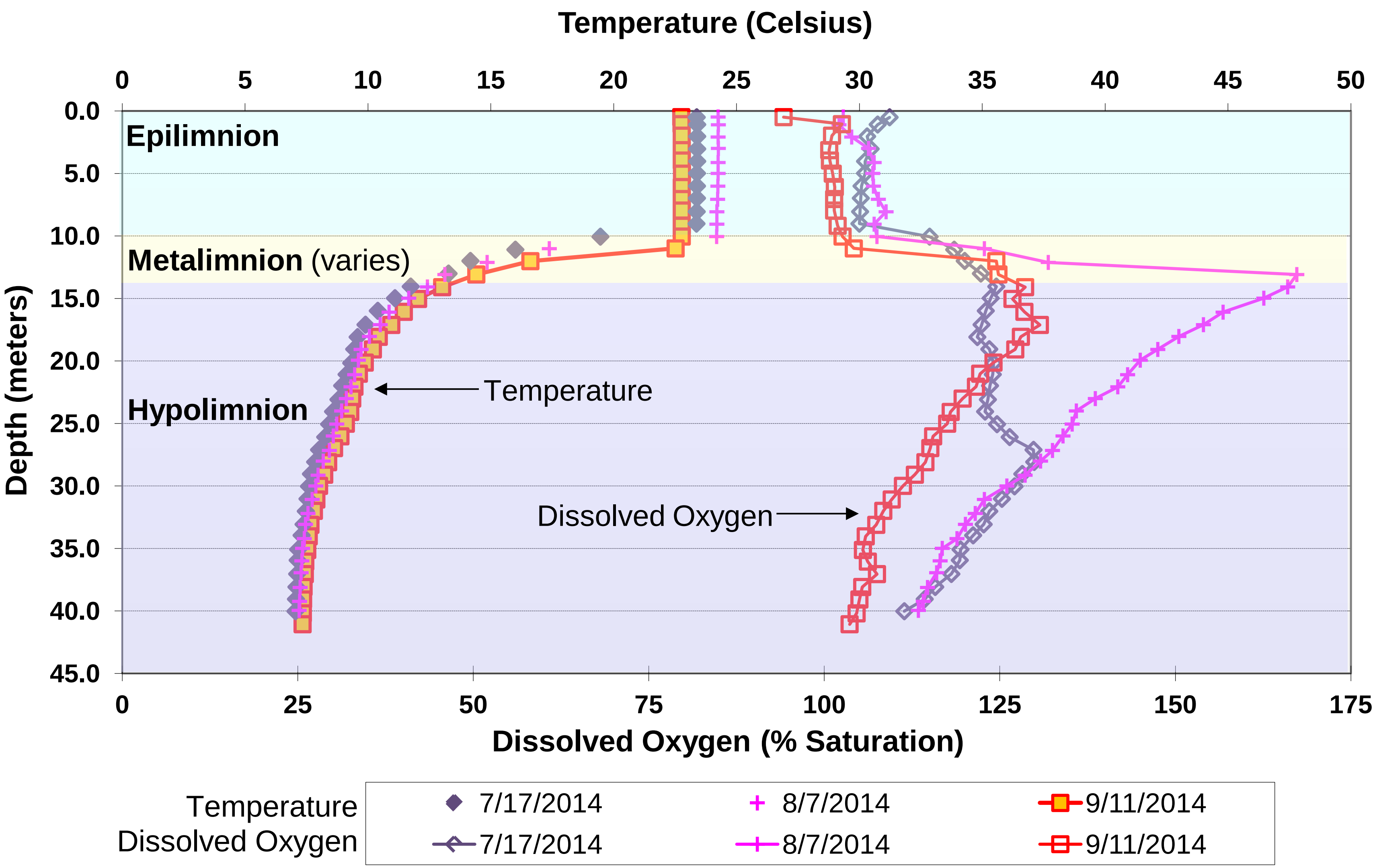


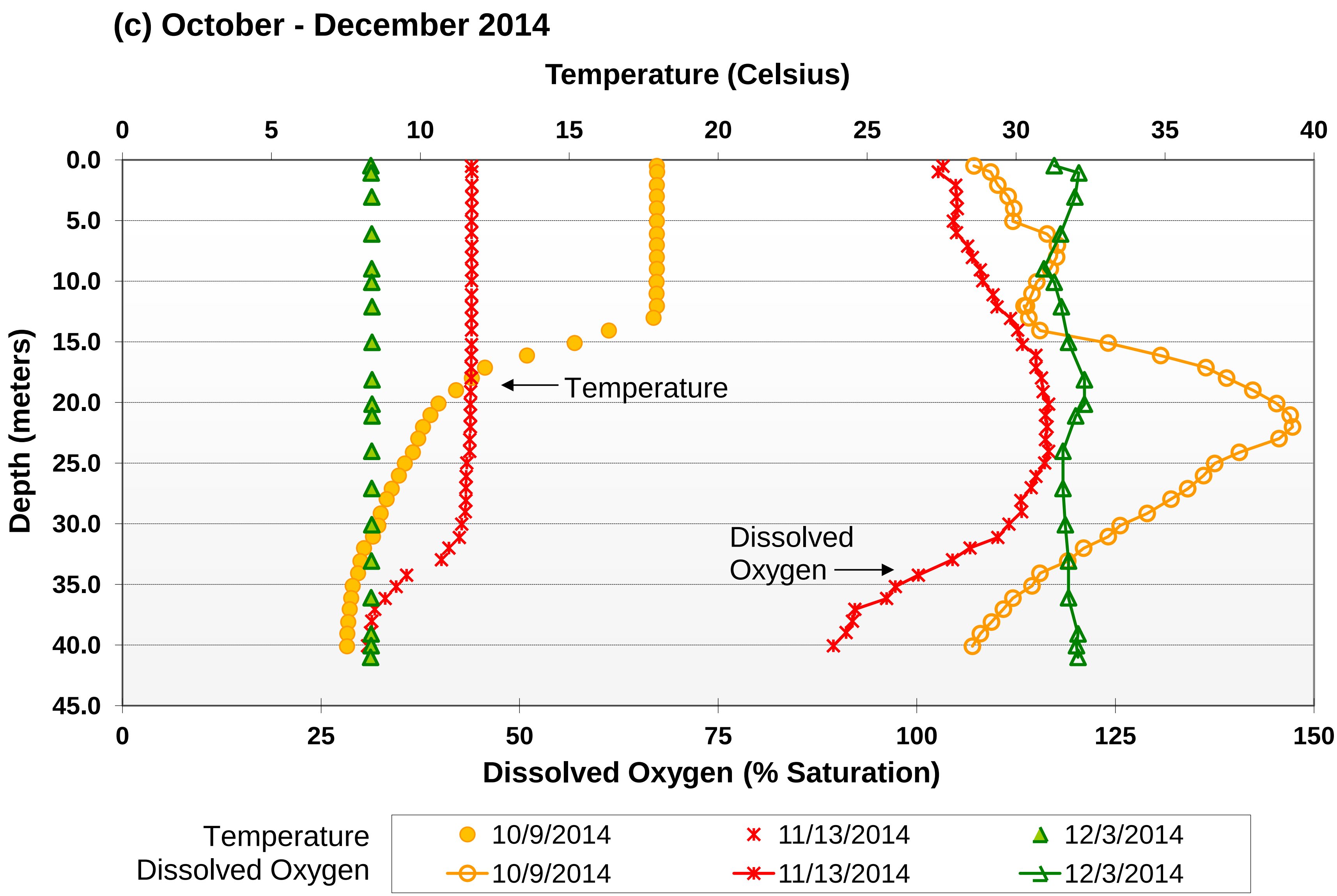
Den Hill - CY 2014 Specific Conductance Profiles

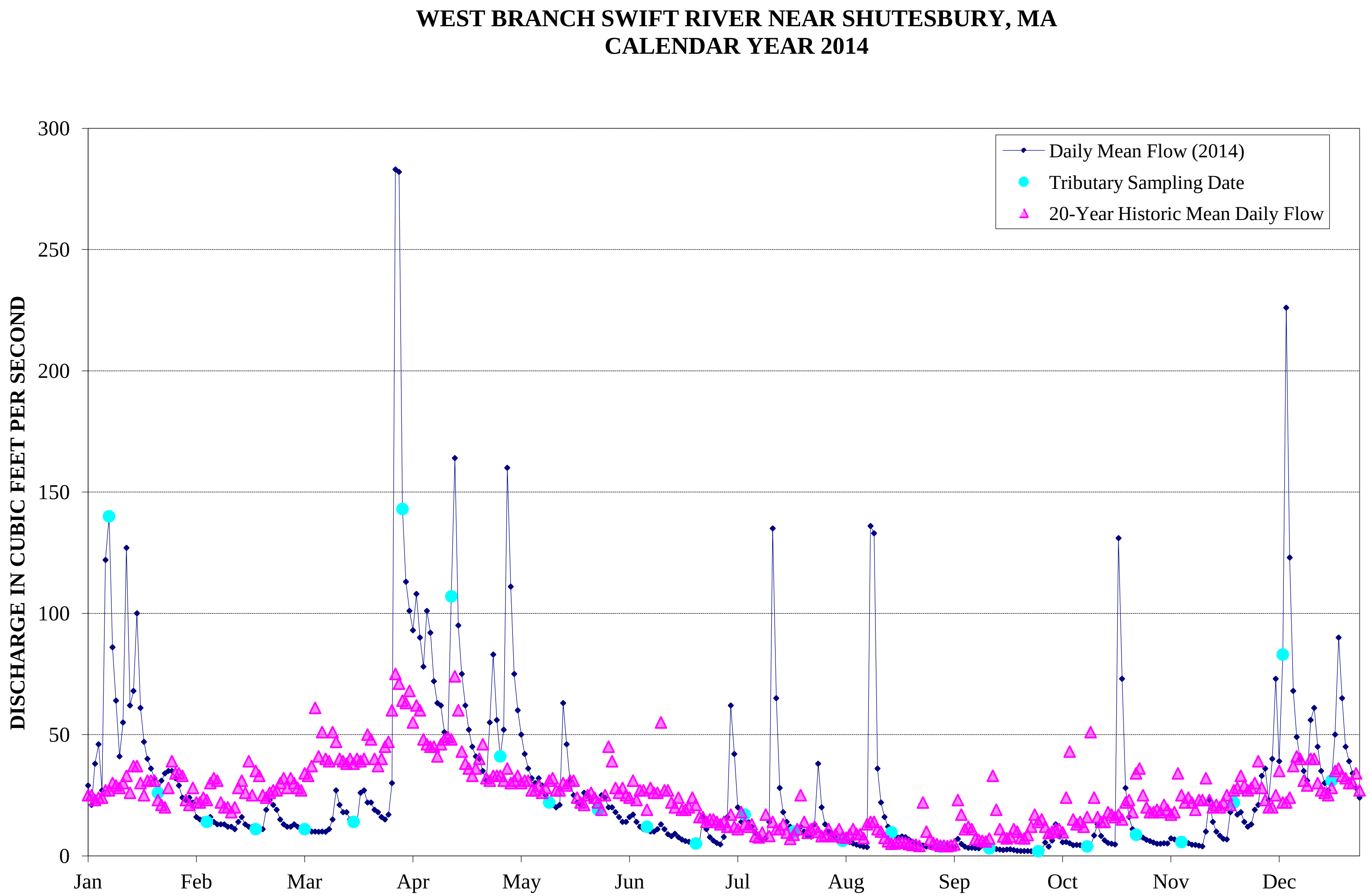



(a) April - June 2014
Temperature (Celsius)
0
5
10
15
20
25
30
35
40
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Temperature
Dissolved Oxygen
0
25
50
75
100
125
150
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
4/17/2014
5/8/2014
6/19/2014
4/17/2014
5/8/2014
6/19/2014

(b) July - September 2014




(c) October - December 2014
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 25 50 75 100 125 150
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
10/9/2014
11/13/2014
12/3/2014
10/9/2014
11/13/2014
12/3/2014



Source: U.S. Geological Survey website (provisional data accessed May 22, 2015).

USGS 01174565: WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA JANUARY 1, 2014 - DECEMBER 31, 2014 Daily Mean Discharge, cubic feet per second												
DATE	**Jan 2014**	**Feb 2014**	**Mar 2014**	**Apr 2014**	**May 2014**	**Jun 2014**	**Jul 2014**	**Aug 2014**	**Sep 2014**	**Oct 2014**	**Nov 2014**	**Dec 2014**
1	29 A	16 A	13 A:e	143 A	160 A	18 A	4.7 A	10 A	3.8 A	2.4 A	6.1 P	19 P
2	21 A	15 A	12 A	113 A	111 A	16 A	7.8 A	8.6 A	3.8 A	5.5 A	5.5 P	21 P
3	38 A	15 A	11 A	101 A	75 A	14 A	16 A	7.5 A	4.7 A	3.8 A	5.0 P	33 P
4	46 A	14 A	11 A:e	93 A	60 A	14 A	62 A	6.9 A	4.1 A	6.3 A	5.0 P	36 P
5	27 A:e	16 A	11 A	108 A	50 A	16 A	42 A	6.2 A	3.5 A	13 A	5.2 P	23 P
6	122 A	14 A	10 A:e	90 A	42 A	17 A	20 A	7.4 A	3.5 A	8.0 A	5.1 P	40 P
7	140 A:e	13 A:e	10 A:e	78 A	36 A	14 A	14 A	5.7 A	7.0 A	5.6 A	7.2 P	73 P
8	86 A:e	13 A:e	9.9 A	101 A	32 A	12 A	17 A	5.1 A	4.9 A	5.7 A	6.8 P	39 P
9	64 A	13 A	10 A	92 A	30 A	11 A	14 A	4.6 A	3.8 A	5.2 A	6.3 P	83 P
10	41 A	12 A	9.9 A	72 A	32 A	12 A	12 A	4.2 A	3.3 A	4.4 A	5.7 P	226 P
11	55 A	12 A:e	11 A	63 A	29 A	10 A	9.5 A	3.8 A	3.3 A	4.5 A	5.3 P	123 P
12	127 A	11 A:e	15 A	62 A	25 A	10 A	7.7 A	3.6 A	3.2 A	4.4 A	5.2 P	68 P
13	62 A	14 A	27 A	51 A	22 A	11 A	6.6 A	136 A	3.1 A	4.0 A	4.6 P	49 P
14	68 A	16 A	21 A:e	47 A	21 A	13 A	7.4 A	133 A	4.3 A	3.9 A	4.5 P	40 P
15	100 A	13 A	18 A	107 A	20 A	11 A	14 A	36 A	3.5 A	3.9 A	4.2 P	35 P
16	61 A	12 A	18 A	164 A	21 A	8.9 A	135 A	22 A	3.1 A	8.4 A	3.9 P	31 P
17	47 A	12 A	15 A:e	95 A	63 A	8.1 A	65 A	16 A	3.1 A	13 A	10 P	56 P
18	40 A	11 A:e	14 A:e	75 A	46 A	9.1 A	28 A	12 A	2.8 A	8.2 A	23 P	61 P
19	36 A	11 A	14 A	62 A	31 A	7.7 A	18 A	9.7 A	2.6 A	6.4 A	14 P	45 P
20	32 A	11 A	26 A	52 A	25 A	6.7 A	14 A	8.3 A	2.4 A	5.3 P	10 P	35 P
21	26 A:e	19 A	27 A	45 A	22 A	6.1 A	12 A	7.5 A	2.6 A	5.0 P	8.3 P	30 P
22	31 A:e	23 A	22 A	41 A	21 A	5.8 A	10 A	8.0 A	2.7 A	4.7 P	7.0 P	27 P
23	34 A:e	21 A	22 A	40 A	26 A	5.5 A	8.8 A	7.7 A	2.4 A	131 P	6.8 P	31 P
24	35 A:e	19 A	19 A:e	35 A	25 A	5.1 A	12 A	6.7 A	2.1 A	73 P	18 P	50 P
25	35 A:e	15 A:e	18 A:e	31 A	23 A	4.9 A	10 A	5.9 A	2.0 A	28 P	22 P	90 P
26	32 A	13 A:e	16 A	55 A	20 A	16 A	8.1 A	5.3 A	2.0 A	16.0 P	17.0 P	65 P
27	29 A	12 A:e	15 A:e	83 A	19 A	11 A	7.9 A	4.9 A	2.0 A	11 P	18 P	45 P
28	24 A	12 A:e	17 A	56 A	25 A	7.7 A	13 A	4.3 A	1.9 A	8.7 P	14 P	39 P
29	23 A		30 A	41 A	24 A	6.3 A	38 A	3.8 A	1.9 A	7.7 P	12 P	34 P
30	24 A		283 A	52 A	20 A	5.3 A	20 A	3.7 A	1.9 A	7.5 P	13 P	28 P
31	22 A		282 A		20 A		13 A	3.6 A		6.6 P		24 P
MAX	**140**	**23**	**283**	**164**	**160**	**18**	**135.0**	**136**	**7**	**131**	**23**	**226**
MIN	**21**	**11**	**9.9**	**31**	**19**	**4.9**	**4.7**	**3.6**	**1.9**	**2.4**	**3.9**	**19**
MEAN	**50.2**	**14.2**	**33.5**	**74.9**	**37.9**	**10.4**	**21.5**	**16.39**	**3.18**	**13.6**	**9**	**52**
DEPARTURE FROM NORM	23	-13	-11	30	10	-14	10	8	-7	-6	-13	23
1984-2013	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1984 - 2013**											
MEAN	27.2	27.5	44.0	44.9	28.2	24.2	11.4	8.1	10.5	19.5	22.7	28.9
MIN	2.6	7.2	14	13	11	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	63.1	32.0	29.3	52.9	115.3	54.5	75.3

Notes:

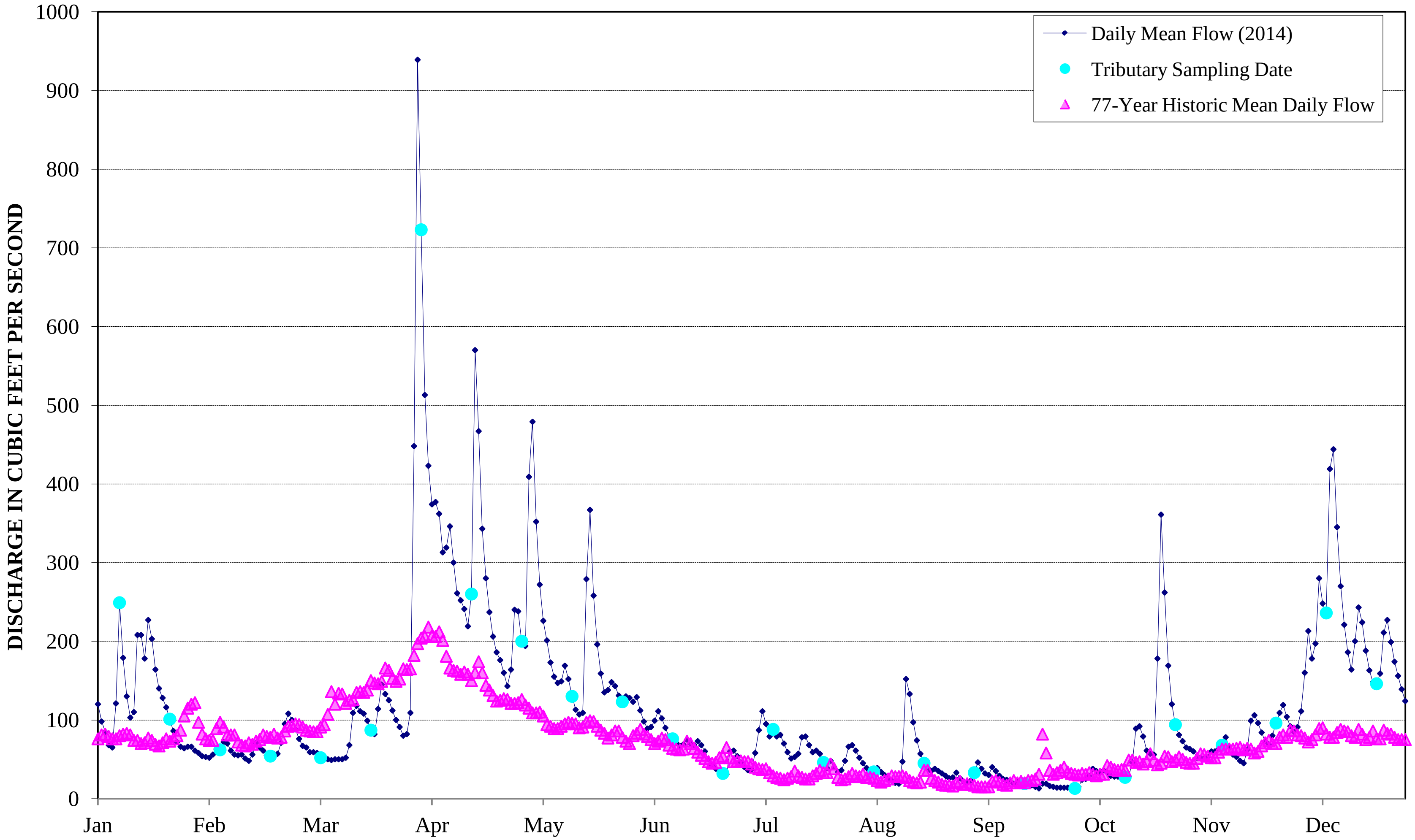
Source: U.S. Geological Survey website (accessed May 22, 2015)

A = Approved data.

e = Estimated value.

P = Provisional data, subject to revision.

EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
CALENDAR YEAR 2014



Source: U.S. Geological Survey website (provisional data accessed May 21, 2015).

USGS 01174500: EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
JANUARY 1, 2014 - DECEMBER 31, 2014
Daily Mean Discharge, cubic feet per second

DATE	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sep 2014	Oct 2014	Nov 2014	Dec 2014
1	120 A	52 A	59 A	723 A	409 A	112 A	36 P	52 P	23 P	15 P	63 P	91 P
2	98 A	56 A	59 A	513 A	479 A	98 A	37 P	45 P	33 P	24 P	60 P	111 P
3	85 A	63 A	58 A	423 A	352 A	89 A	58 P	39 P	46 P	25 P	52 P	160 P
4	68 A	62 A	52 A	374 A	272 A	91 A	87 P	35 P	38 P	29 P	52 P	213 P
5	65 A	72 A	52 A	377 A	226 A	99 A	111 P	34 P	32 P	38 P	51 P	178 P
6	121 A	70 A	50 A	362 A	201 A	111 A	95 P	39 P	30 P	35 P	53 P	197 P
7	249 A	61 A	49 A	313 A	173 A	102 A	79 P	34 P	40 P	33 P	60 P	280 P
8	179 A	56 A	50 A	319 A	155 A	90 A	88 P	30 P	35 P	36 P	60 P	248 P
9	130 A	55 A	50 A	346 A	147 A	79 P	79 P	26 P	29 P	33 P	63 P	236 P
10	103 A	56 A	50 A	300 A	149 A	76 P	81 P	23 P	25 P	29 P	68 P	419 P
11	110 A	51 A	52 A	261 A	169 A	71 P	70 P	20 P	24 P	28 P	78 P	444 P
12	208 A	48 A	68 A	252 A	152 A	67 P	59 P	19 P	22 P	28 P	66 P	345 P
13	208 A	56 A	109 A	241 A	130 A	69 P	51 P	47 P	19 P	26 P	56 P	270 P
14	178 A	71 A	118 A	219 A	113 A	75 P	53 P	152 P	21 P	27 P	53 P	221 P
15	227 A	65 A	111 A	260 A	107 A	70 P	57 P	133 P	19 P	28 P	48 P	186 P
16	203 A	61 A	108 A	570 A	109 A	68 P	78 P	97 P	19 P	46 P	45 P	164 P
17	164 A	55 A	99 A	467 A	279 A	73 P	79 P	74 P	18 P	89 P	62 P	200 P
18	140 A	54 A	87 A	343 A	367 A	68 P	68 P	57 P	17 P	92 P	99 P	243 P
19	128 A	57 A	82 A	280 A	258 A	60 P	59 P	45 P	15 P	79 P	106 P	224 P
20	116 A	57 A	114 A	237 A	196 A	50 P	61 P	39 P	13 P	61 P	96 P	188 P
21	101 A	71 A	145 A	206 A	159 A	42 P	57 P	35 P	19 P	57 P	84 P	163 P
22	86 A	95 A	133 A	186 A	135 A	38 P	46 P	38 P	19 P	56 P	73 P	148 P
23	72 A	108 A	125 A	176 A	138 A	35 P	39 P	35 P	16 P	178 P	69 P	146 P
24	66 A	100 A	112 A	160 A	148 A	32 P	48 P	32 P	15 P	361 P	80 P	159 P
25	64 A	88 A	100 A	143 A	143 A	31 P	40 P	29 P	14 P	262 P	96 P	211 P
26	66 A	76 A	91 A	164 A	131 A	60 P	34 P	26 P	14 P	169 P	109 P	227 P
27	66 A	67 A	80 A	240 A	123 A	61 P	36 P	27 P	14 P	120 P	119 P	199 P
28	61 A	65 A	82 A	238 A	130 A	54 P	48 P	33 P	14 P	94 P	104 P	174 P
29	58 A		109 A	200 A	128 A	46 P	66 P	26 P	14 P	81 P	92 P	156 P
30	54 A		448 A	194 A	123 A	40 P	68 P	22 P	13 P	73 P	85 P	139 P
31	53 A		939 A		129 A		61 P	20 P		65 P		124 P
MAX	**249**	**108**	**939**	**723**	**479**	**112**	**111**	**152**	**46**	**361**	**119**	**444**
MIN	**53**	**48**	**49**	**143**	**107**	**31**	**34**	**19.0**	**13**	**15**	**45**	**91**
MEAN	**117.6**	**66.0**	**124**	**303**	**191.3**	**69**	**62.2**	**44.0**	**22.3**	**75**	**73**	**209**
DEPARTURE FROM NORM	36	-16	-13	146	101	7	30	20	-5	33	9	128
1937-2013	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1937 - 2013**											
MEAN	81.9	81.5	137	157	90.3	62.0	32.0	24.2	27.2	42.1	64.0	80.8
MIN	5.3	19	46	35	31	6.9	3.2	0	0	0.7	4.2	16
MAX	240	258	292	421	189	181	179	127	390	244	177	264

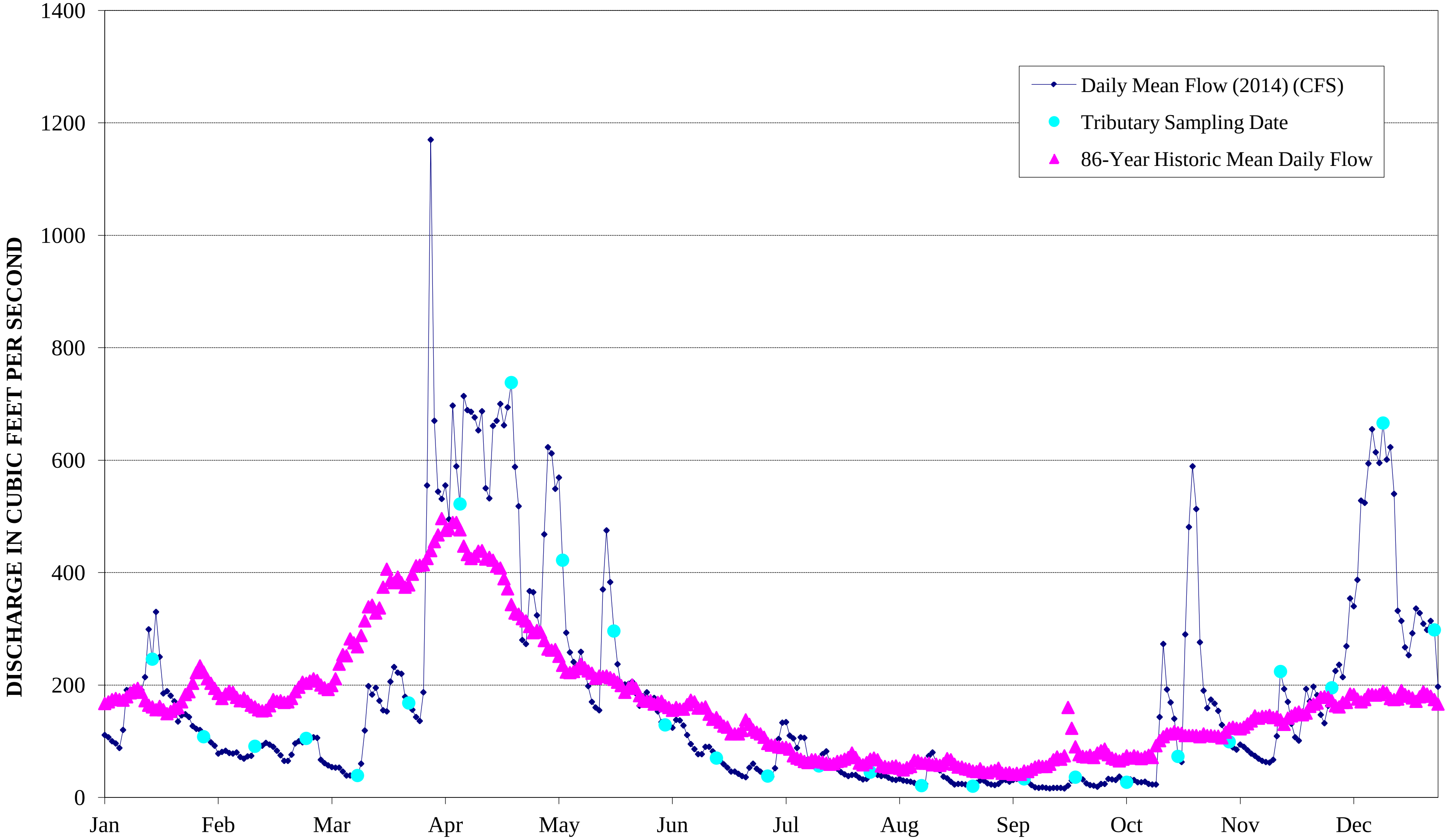
Notes:

A = Approved data.

P = Provisional data, subject to revision.

Source: U.S. Geological Survey website (accessed May 21, 2015)

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
CALENDAR YEAR 2014



Source: U.S. Geological Survey website (provisional data for new location, accessed May 22, 2015).

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
JANUARY 1, 2014 - DECEMBER 31, 2014
Daily Mean Discharge, cubic feet per second

DATE	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sep 2014	Oct 2014	Nov 2014	Dec 2014
1	111 A	78 A	67 A:e	670 A	468 A	153 A	38 A	38 A:e	22 A	24 P	154 P	163 P
2	107 A	81 A	61 A:e	544 A	623 A	134 A	37 A	39 A:e	24 A	33 P	129 P	195 P
3	100 A:e	83 A	57 A	531 A	612 A	129 A	52 A	35 A:e	30 A	32 P	109 P	225 P
4	96 A:e	79 A	54 A:e	555 A	549 A	125 A	104 A	32 A	31 A	31 P	99 P	236 P
5	88 A	78 A	53 A	495 A	569 A	124 A	133 A	31 A	28 A	37 P	89 P	214 P
6	120 A	80 A	53 A:e	697 A	422 A	138 A	134 A	33 A	31 A	31 P	85 P	269 P
7	191 A	72 A:e	46 A:e	589 A	293 A	137 A	110 A	30 A	33 A	27 P	94 P	354 P
8	192 A	69 A:e	39 A:e	522 A	258 A	128 A	105 A	29 A	35 A	32 P	90 P	340 P
9	187 A	73 A	39 A:e	714 A	241 A	111 A	88 A	28 A	33 A	31 P	84 P	387 P
10	184 A	74 A	38 A:e	689 A	234 A	95 A	107 A	26 A	28 A	27 P	78 P	528 P
11	191 A	91 A:e	39 A	686 A	259 A	86 A	106 A	24 A	22 A	27 P	74 P	524 P
12	214 A	90 A:e	60 A	676 A	229 A	77 A	68 A	21 A	18 A	28 P	69 P	594 P
13	299 A	92 A:e	119 A	653 A	198 A	77 A	56 A	24 A	17 A	24 P	65 P	655 P
14	246 A	97 A:e	198 A:e	687 A	170 A	90 A	56 A	74 A	18 A	23 P	63 P	614 P
15	330 A	94 A	183 A	550 A	160 A	90 A:e	56 A	80 A	17 A	23 P	62 P	595 P
16	250 A	90 A	195 A	532 A	155 A	82 A:e	77 A	62 A	16 A	143 P	67 P	666 P
17	185 A	83 A	172 A	661 A	370 A	70 A:e	82 A	48 A	17 A	273 P	109 P	601 P
18	189 A	75 A	155 A:e	670 A	475 A	65 A:e	63 A	37 A	17 A	192 P	224 P	623 P
19	181 A	65 A	153 A:e	700 A	383 A	59 A:e	58 A	34 A	17 A	169 P	193 P	540 P
20	171 A	65 A	206 A	662 A	296 A	53 A	51 A	28 A	16 A	140 P	170 P	332 P
21	135 A:e	76 A	232 A	694 A	237 A	46 A	45 A	23 A:e	21 A	73 P	131 P	314 P
22	146 A:e	96 A	222 A	738 A	198 A	46 A	41 A	24 A:e	30 A	63 P	107 P	267 P
23	148 A	100 A	220 A	588 A	201 A	42 A	38 A	24 A	36 A	290 P	101 P	253 P
24	143 A	98 A	179 A:e	518 A	202 A	38 A	40 A	23 A	34 A	481 P	145 P	292 P
25	127 A	105 A	168 A:e	280 A	206 A	36 A	40 A	22 A	32 A	589 P	193 P	336 P
26	122 A	107 A	156 A:e	273 A	185 A	53 A	35 A	20 A	25 A	513 P	171 P	328 P
27	120 A	107 A	143 A:e	367 A	163 A	60 A	32 A	26 A	22 A	276 P	197 P	309 P
28	108 A	106 A	136 A:e	365 A	180 A	51 A	33 A:e	30 A	21 A	190 P	182 P	298 P
29	105 A		187 A	324 A	187 A	46 A	45 A:e	30 A	19 A	159 P	147 P	314 P
30	98 A		555 A	296 A	172 A	41 A	44 A	25 A	24 A	174 P	132 P	298 P
31	92 A		1170 A		177 A		40 A	23 A		167 P		197 P
MAX	**330**	**107**	**1170**	**738**	**623**	**153**	**134**	**80**	**36**	**589**	**224**	**666**
MIN	**88**	**65**	**38**	**273**	**155**	**36**	**32**	**20**	**16**	**23**	**62**	**163**
MEAN	**161**	**86**	**173**	**564**	**293**	**83**	**65**	**33**	**24**	**139**	**120**	**383**
DEPARTURE FROM NORM	-20	-95	-155	163	78	-61	-7	-23	-41.3	46.8	-20	205
1928-2013	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1928 - 2013**											
MEAN	181	180	327	402	215	143	71.6	55.8	65.8	92.6	141	178
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:
A = Approved data.
e = Estimated value.

Source: U.S. Geological Survey website (accessed May 22, 2015)

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 $CaCO_3$)
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 2014
(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
1/7	0.04	16.59	118	5.23	30.9	0.477			30	41	1530						1340	
1/21	0.13	18.57	130	5.86	40.1	0.253			*0*	*0*	428						1960	
2/4	0.07	17.42	121	6.21	44.8	0.219			*0*	*0*	305						2150	
2/18	-0.04	16.06	115	6.11	40.6	0.259			*0*	*0*	301						1980	
3/4	0.04	15.59	108	5.99	48.4	0.230			3	*0*	216						2230	
3/18	0.05	16.04	111	5.89	46.6	0.234			83	156	373		0.0149	0.0602	*0*	0.070510	1960	*0*
4/1	0.61	16.08	114	5.49	32.7	0.549			*0*	20	723						1260	
4/15	10.53	12.79	117	5.51	38.4	0.269			12	31	624						1630	
4/29	7.73	17.60	150	5.63	43.6	0.236			48	74	908						1710	
5/13	12.26	17.64	167	5.70	52.7	0.318			*0*	*0*	1150						1960	
5/27	13.44	10.13	99	5.76	49.7	0.277			4	10	1560						1920	
6/10	15.01	9.71	98	5.89	53.4	0.402			12	41	1990						2180	
6/24	16.19	10.33	106	5.95	68.4	0.328			*0*	10	1260		0.0160	0.0703	0.155	0.10822	2820	0.00577
7/8	18.78	8.97	98	5.70	37.9	0.399			48	41	4160						1960	
7/22	17.25	10.03	105	5.75	41.9	0.335			*0*	10	1720						1870	
8/5	17.43	9.47	100	5.84	49.3	0.342			20	*0*	3280						2160	
8/19	13.54	10.19	100	5.88	41.4	0.296			10	31	4880						1890	
9/2	18.57	7.02	76	6.12	60.0	0.352			33.3	31	4110						2700	
9/16	11.54	10.01	93	6.13	56.4	0.362			*0*	20	801		0.0168	0.0570	0.200	0.11152	2360	0.00517
9/30	14.27	9.06	90	6.29	67.7	0.348			10	31	2610						2660	
10/14	9.82	10.91	98	6.13	51.8	0.646			*0*	*0*	1160						2080	
10/28	7.46	12.40	106	5.69	38.8	0.295			4	10	1400						1740	
11/10	4.27	19.57	155	5.81	41.2	0.236			*0*	*0*	880						1720	
11/25	5.29	14.27	116	5.95	33.6	0.312			32	31	1420						1560	
12/9	1.17	14.40	101	6.00	38.5	0.197			*0*	10	670		0.0146	0.0156	0.157	0.12222	1650	*0*
12/23	3.08	15.35	115	6.00	38.6	0.214			*0*	*0*	512						1700	
AVG.	8.41	13.32	112	5.87	45.7	0.323			13	23	1500		0.0156	0.0508	0.128	0.10312	1970	*<0.005*
MAX.	18.78	19.57	167	6.29	68.4	0.646			83	156	4880		0.0168	0.0703	0.200	0.12222	2820	0.00577
MIN.	-0.04	7.02	76	5.23	30.9	0.197			*<10*	*<10*	216		0.0146	0.0156	*<0.100*	0.070510	1260	*<0.005*
MEDIAN	8.78	13.53	107	5.89	42.8	0.304			3.5	10	1155		0.0155	0.0586	0.156	0.10987	1960	*<0.005*

NOTES

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 2014
(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
1/7	0.04	13.03	92	5.95	100.9	0.898			18	52	2600						3010	
1/21	0.04	17.87	125	6.22	96.6	0.448			2	*0*	336						3430	
2/4	-0.01	16.50	114	6.27	93.6	0.282			12	*0*	185						3590	
2/18	-0.05	15.39	110	6.53	98.4	0.584			1	*0*	173						3860	
3/4	0.04	15.57	108	6.35	115.2	0.477			17	20	173						4450	
3/18	0.04	15.16	105	6.41	124.4	0.415			4	10	120		0.0161	0.109	0.112	0.057860	4070	0.0114
4/1	0.74	15.37	110	6.12	94.0	1.57			12	31	495						2500	
4/15	11.42	13.82	129	6.17	96.0	0.703			72	145	1020						3050	
4/29	7.77	19.78	169	6.36	94.1	0.547			*0*	*0*	435						3000	
5/13	13.16	18.53	179	6.30	95.5	0.623			8	20	1120						3440	
5/27	14.15	10.32	102	6.23	94.0	0.579			*0*	10	1110						3280	
6/10	15.67	9.52	98	6.30	102.0	0.652			8	20	1520						3940	
6/24	16.33	10.18	105	6.31	113.5	0.697			36	41	5790		0.0213	0.0867	0.266	0.12473	4790	0.0156
7/8	19.03	9.54	105	6.21	98.4	1.32			51.4	122	15500						4660	
7/22	17.71	10.46	111	6.30	103.4	1.05			20	41	6490						4260	
8/5	17.62	9.22	98	6.31	106.7	0.940			*0*	10	7270						4630	
8/19	13.84	10.47	103	6.39	97.5	0.850			30	31	2910						3910	
9/2	18.84	6.71	73	6.37	109.8	0.736			40	63	6870						4970	
9/16	11.97	9.83	92	6.48	114.1	0.925			*0*	20	2720		0.0199	0.0548	0.113	0.087070	4800	0.00682
9/30	14.54	9.28	93	6.59	120.5	1.37			30	41	3260						4990	
10/14	10.44	10.60	96	6.51	119.5	0.799			70	41	1670						4990	
10/28	7.71	12.18	104	6.50	98.1	0.627			*0*	10	1610						3830	
11/10	4.62	19.11	153	6.33	100.4	0.584			4	*0*	565						4150	
11/25	7.20	12.61	107	6.36	83.6	0.638			52	75	2760						3290	
12/9	1.21	14.35	101	6.49	97.6	0.426			4	*0*	459		0.0158	0.0697	0.111	0.081940	3430	*0*
12/23	3.24	15.30	115	6.46	85.4	0.416			20	20	521						3120	
AVG.	8.74	13.10	111	6.34	102.0	0.737			20	32	2600		0.0183	0.0801	0.151	0.087900	3900	0.00846
MAX.	19.03	19.78	179	6.59	124.4	1.57			72	145	15500		0.0213	0.109	0.266	0.12473	4990	0.0156
MIN.	-0.05	6.71	73	5.95	83.6	0.282			*<10*	*<10*	120		0.0158	0.0548	0.111	0.057860	2500	*<0.005*
MEDIAN	9.11	12.82	105	6.34	98.4	0.645			12	20	1320		0.0180	0.0782	0.113	0.084505	3890	0.00911

NOTES

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 2014
(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
1/7	0.05	14.14	100	5.72	71.4	1.04			36	110	4110						2460	
1/21	0.09	15.62	109	6.22	87.1	0.451			10	10	247						3290	
2/4	0.01	13.83	96	6.12	98.5	0.509			4	20	160						3990	
2/18	-0.01	12.83	92	6.16	104.8	0.528			5	*0*	121						4190	
3/4	0.13	13.45	94	6.29	106.0	0.533			23	86	161						4530	
3/18	0.11	13.15	91	6.19	104.8	0.487			10	31	148		0.0169	0.160	0.176	0.092960	3880	0.0230
4/1	0.16	15.42	108	6.08	68.1	0.762			24	63	487						2200	
4/15	12.48	12.29	117	5.96	102.7	0.490			10	20	379						3370	
4/29	9.49	15.65	139	5.82	101.6	0.432			8	31	565						3370	
5/13	16.57	14.11	147	5.92	111.5	0.838			84	122	1940						4050	
5/27	16.61	7.12	74	5.90	103.7	0.776			60	41	2040						4020	
6/10	18.32	6.39	69	5.92	117.0	1.02			76	120	2720						4840	
6/24	19.52	7.77	86	5.95	121.5	1.66			36	175	3450		0.0238	0.0292	0.314	0.18230	5490	0.00876
7/8	22.02	5.62	66	5.86	104.4	1.27			104	148	7270						4880	
7/22	20.57	6.55	74	5.86	106.9	1.20			90	52	8160						4460	
8/5	20.40	6.56	74	5.91	115.9	1.12			60	121	7700						5130	
8/19	16.97	7.29	77	5.89	102.7	1.07			90	63	3450						4070	
9/2	21.22	4.78	54	5.92	118.8	1.31			80	52	6490						5570	
9/16	13.92	7.26	71	5.93	115.4	1.32			73.3	52	1860		0.0214	0.0128	0.212	0.17838	4980	0.00839
9/30	15.88	7.40	76	6.25	123.0	1.04			20	52	1520						5030	
10/14	10.41	7.97	72	6.09	108.7	1.26			20	10	650						4430	
10/28	8.57	9.86	86	5.91	83.4	1.00			40	31	860						3280	
11/10	4.95	15.92	128	6.06	98.7	0.88			8	*0*	565						3610	
11/25	3.99	12.54	98	6.16	71.1	0.875			92	288	4350						2810	
12/9	0.26	13.68	94	6.21	85.1	0.553			4	20	480		0.0153	0.0616	0.208	0.15022	3180	0
12/23	2.48	14.21	105	6.28	94.0	0.481			12	*0*	199						3310	
AVG.	9.81	10.82	92	6.02	101.0	0.881			42	66	2310		0.0194	0.0659	0.228	0.15097	4020	0.0100
MAX.	22.02	15.92	147	6.29	123.0	1.66			104	288	8160		0.0238	0.160	0.314	0.18230	5570	0.0230
MIN.	-0.01	4.78	54	5.72	68.1	0.432			4	*<10*	121		0.0153	0.0128	0.176	0.092960	2200	*<0.005*
MEDIAN	9.95	12.42	92	5.96	104.1	0.878			30	52	1190		0.0192	0.0454	0.210	0.16430	4040	0.0086

NOTES

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").
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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 2014
(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
1/7	0.13	13.06	93	5.52	98.7	0.635			4	20	862						2110	
1/21	0.73	15.85	113	5.73	73.4	0.323			2	*0*	323						1830	
2/4	0.09	15.55	108	5.78	122.6	0.507			*0*	*0*	301						2720	
2/18	-0.04	12.44	89	5.66	120.4	0.641			*0*	*0*	295						2480	
3/4	0.11	13.12	91	5.63	117.5	0.709			*0*	*0*	311						2670	
3/18	0.54	13.48	95	5.85	103.6	0.392			2	*0*	187		0.0138	0.0473	0.176	0.20165	2160	0.0138
4/1	0.89	14.77	106	5.34	55.1	0.680			4	10	504						1210	
4/15	14.00	9.66	95	5.31	76.8	0.509			6	*0*	1790						1550	
4/29	10.39	14.73	134	5.56	85.8	0.408			*0*	*0*	2480						1650	
5/13	17.94	11.98	128	5.46	92.6	0.561			4	63	4610						1820	
5/27	18.99	7.17	79	5.30	86.8	0.698			4	*0*	3080						1770	
6/10	20.05	6.06	68	5.35	95.3	0.715			24	10	2360						1960	
6/24	19.18	7.81	86	5.35	109.1	1.41			20	31	1920		0.0301	0.0354	0.521	0.31920	2140	0.0294
7/8	22.15	6.21	73	5.19	87.6	0.685			64	41	5480						2060	
7/22	20.65	6.54	74	5.31	93.7	0.639			10	30	3870						2100	
8/5	20.14	5.95	67	5.38	90.1	0.620			60	20	5170						2150	
8/19	17.20	6.59	70	5.36	104.0	0.584			10	52	5480						2110	
9/2	20.90	4.53	51	5.64	113.7	0.851			66.7	41	6130						2730	
9/16	12.97	7.51	72	5.66	111.9	1.45			110	169	9800		0.0302	0.0293	0.440	0.25240	2500	0.0233
9/30	15.04	5.84	59	5.82	110.1	1.08			13.3	63	5170						2530	
10/14	11.18	6.16	57	5.64	123.0	0.981			20	97	4350						2560	
10/28	8.74	10.07	88	5.38	92.1	0.562			20	52	2720						1930	
11/10	5.28	15.12	123	5.60	92.2	0.532			*0*	10	1310						1970	
11/25	5.66	11.52	94	5.53	76.0	0.503			28	84	1380						1730	
12/9	1.11	13.76	97	5.31	60.2	0.508			*0*	*0*	988		0.0194	*0*	0.240	0.28730	1170	*0*
12/23	3.23	15.52	117	5.13	55.1	0.278			*0*	*0*	521						1380	
AVG.	10.28	10.42	89	5.49	94.1	0.672			18	31	2750		0.0234	0.02800	0.344	0.26514	2040	0.0166
MAX.	22.15	15.85	134	5.85	123.0	1.45			110	169	9800		0.0302	0.0473	0.521	0.31920	2730	0.0294
MIN.	-0.04	4.53	51	5.13	55.1	0.278			*<10*	*<10*	187		0.0138	*<0.005*	0.176	0.20165	1170	*<0.005*
MEDIAN	10.79	10.80	90	5.49	93.2	0.628			5	15	2140		0.0248	0.03235	0.340	0.26985	2080	0.0186

NOTES

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 2014

(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
1/7	0.36	12.83	92	6.68	93.3	0.946	10.7	8.79	*0*	*0*	1150		0.0190	0.0919	0.223	0.14181	5390	0.0269
1/21	0.94	15.79	113	6.27	89.4	0.432	8.84	6.57	2	*0*	383		0.0162	0.0638	0.277	0.13156	4510	0.0119
2/4	0.82	15.73	111	6.49	107.0	0.523	11.5	9.56	*0*	*0*	441		0.0149	0.131	0.157	0.087905	5950	0.0203
2/18	-0.09	15.66	112	6.68	107.8	0.626	12.0	9.92	3	*0*	305		0.0157	0.137	0.241	0.086680	5850	0.0639
3/4	0.06	15.37	107	6.46	112.1	0.630	11.3	9.25	*0*	*0*	318		0.0202	0.146	0.106	0.088085	6220	0.0259
3/18	1.63	14.26	103	6.59	99.7	0.540	9.12	7.21	*0*	*0*	464		0.0178	0.118	0.136	0.10587	4540	0.0219
4/1	1.46	14.83	108	6.14	57.7	1.31	4.58	2.60	20	31	1140		0.0257	0.0597	0.189	0.19280	2120	0.0119
4/15	14.54	12.33	123	6.17	79.4	3.02	6.16	4.12	108	63	4610		0.0303	0.00879	0.222	0.14266	3150	*0*
4/29	10.47	15.07	137	6.03	87.5	0.867	7.41	5.45	*0*	20	836		0.0203	0.0133	0.261	0.13936	3700	*0*
5/13	18.20	10.79	116	6.33	86.2	1.20	7.59	5.60	*0*	*0*	1780		0.0203	*0*	0.333	0.15665	3810	*0*
5/27	18.81	8.95	98	6.36	84.2	1.03	9.22	7.14	*0*	*0*	743		0.0205	0.0176	0.361	0.22210	4020	0.00537
6/10	20.42	7.79	88	6.41	87.1	0.723	10.5	8.43	*0*	*0*	1840		0.0196	0.0503	0.260	0.19025	4510	0.00601
6/24	18.92	8.81	96	6.45	86.5	0.470	10.8	8.77	8	10	3440		0.0205	0.0577	0.236	0.16470	4700	*0*
7/8	24.42	7.83	96	6.49	91.9	1.86	11.9	9.82	8	63	7270		0.0379	0.0150	0.468	0.20575	5290	0.00589
7/22	21.88	8.36	96	6.44	88.3	0.560	12.4	10.2	10	*0*	1840		0.0123	0.0360	0.280	0.18910	4730	0.00627
8/5	21.45	8.28	95	6.43	90.5	0.564	11.9	9.79	10	20	10500		0.0181	0.0522	0.341	0.17735	4900	*0*
8/19	17.00	9.04	96	6.42	85.4	0.525	11.1	8.93	*0*	*0*	6130		0.0103	0.0515	0.286	0.15790	4400	0.00584
9/2	21.91	6.42	74	6.46	90.4	0.442	11.2	9.12	20	*0*	5500		0.0145	0.0500	0.250	0.15346	4570	0.00644
9/16	14.41	9.55	94	6.54	88.4	0.422	11.6	9.59	60	*0*	2100		0.0127	0.0287	0.226	0.13785	4440	*0*
9/30	14.93	9.72	98	6.67	87.2	0.593	11.9	9.94	6.67	10	2780		0.0171	0.0512	0.284	0.10091	4290	*0*
10/14	12.97	10.39	100	6.62	92.4	0.279	12.1	9.99	*0*	*0*	1530		0.0104	*0*	0.260	0.12131	4660	*0*
10/28	8.48	11.55	101	6.33	80.7	0.243	11.2	9.18	4	*0*	985		0.0136	0.0110	0.160	0.15519	4200	0.00656
11/10	5.88	15.51	128	6.47	91.8	0.848	10.6	8.39	4	*0*	987		0.0198	*0*	0.359	0.30220	4560	0.0068
11/25	7.85	12.49	108	6.60	96.9	0.653	10.2	8.42	*0*	31	1470		0.0199	0.0149	0.320	0.19050	4460	*0*
12/9	2.75	13.41	98	6.49	85.1	0.706	8.04	6.04	*0*	*0*	504		0.0191	0.0245	0.192	0.27315	3990	*0*
12/23	3.51	16.71	127	6.47	81.8	0.592	7.86	5.92	*0*	*0*	364		0.0103	0.0292	0.228	0.16691	3860	0.00787
AVG.	10.92	11.83	104	6.44	89.6	0.792	10.1	8.03	10	10	2290		0.0183	0.0484	0.256	0.16085	4490	0.00922
MAX.	24.42	16.71	137	6.68	112.1	3.02	12.4	10.2	108	63	10500		0.0379	0.146	0.468	0.30220	6220	0.0639
MIN.	-0.09	6.42	74	6.03	57.7	0.243	4.58	2.60	*<10*	*<10*	305		0.0103	*<0.005*	0.106	0.086680	2120	*<0.005*
MEDIAN	11.72	11.94	101	6.46	88.4	0.610	10.8	8.78	1	*<10*	1310		0.0186	0.0430	0.255	0.15592	4510	0.00595

NOTES

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 2014

(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
1/7	0.10	13.02	93	6.15	61.5	0.985	5.00	3.22	26	110	8160		0.0215	0.0808	0.263	0.23255	2510	0.0265
1/21	0.44	16.12	114	6.23	56.4	0.405	5.17	2.94	6	31	301		0.0170	0.0753	0.161	0.19295	2440	0.0102
2/4	0.17	16.81	117	6.28	69.7	0.646	6.52	4.58	20	31	288		0.0168	0.114	0.232	0.16819	2930	0.0352
2/18	0.10	15.24	110	6.26	68.1	0.698	6.93	5.02	1	*0*	189		0.0189	0.109	0.281	0.19725	2940	0.0759
3/4	0.33	15.25	107	6.32	72.8	0.659	6.77	4.79	3	10	160		0.0242	0.119	0.203	0.16160	3210	0.0489
3/18	0.38	14.68	103	6.32	74.9	0.669	6.24	4.19	*0*	*0*	145		0.0247	0.123	0.178	0.16452	2800	0.0411
4/1	0.22	15.61	110	5.94	48.1	0.902	4.22	2.16	6	52	650		0.0259	0.0720	0.161	0.16835	1710	0.0128
4/15	12.25	12.52	119	5.85	53.5	2.93	5.04	3.06		754	1720		0.126	0.0462	0.354	0.17659	2010	0.0173
4/29	9.11	13.81	122	5.90	55.0	0.643	4.74	2.74	8	41	670		0.0253	0.0197	0.225	0.19965	1910	*0*
5/13	17.35	10.05	106	6.05	64.7	1.04	5.72	3.83	16	98	1420		0.0250	0.00749	0.339	0.20510	2280	*0*
5/27	16.37	9.28	97	5.89	57.2	0.885	6.05	4.00	20	121	1220		0.0256	0.0231	0.272	0.26050	2180	*0*
6/10	18.86	8.06	88	5.99	64.7	1.18	6.69	4.69	16	41	1040		0.0325	0.0385	0.320	0.28305	2470	*0*
6/24	19.85	8.20	91	6.06	65.8	0.90	7.86	5.80	4	*0*	5010		0.0324	0.0191	0.334	0.27460	2760	0.0162
7/8	22.47	8.11	96	6.06	59.3	1.42	7.71	5.69	28	41	2330		0.0417	0.0293	0.434	0.38345	2780	0.0077
7/22	22.02	7.61	88	6.09	62.2	1.23	8.68	6.69	*0*	*0*	2500		0.0299	0.0107	0.412	0.36350	2780	0.0137
8/5	22.79	7.66	90	6.09	59.5	1.02	8.43	6.33	30	10	3610		0.0393	0.0131	0.336	0.30915	2940	0.00596
8/19	18.68	8.34	91	6.01	54.4	1.13	7.04	4.91	*0*	*0*	1420		0.0310	0.00677	0.469	0.36935	2500	0.00744
9/2	23.91	6.48	78	6.33	62.6	1.25	8.23	6.08	10	*0*	4350		0.0364	*0*	0.414	0.31360	2790	0.00801
9/16	16.10	8.78	90	6.27	61.7	2.13	8.87	6.80	40	30	2190		0.0356	*0*	0.376	0.25675	2730	0.00718
9/30	17.80	9.82	105	6.58	63.6	1.00	8.90	6.89	*0*	10	1250		0.0236	*0*	0.317	0.19895	2560	*0*
10/14	11.92	9.92	93	6.29	61.4	1.24	8.83	6.80	10	10	663		0.0211	*0*	0.376	0.19800	2630	*0*
10/28	9.54	11.21	100	5.78	57.4	0.793	5.47	3.35	16	*0*	2480		0.0309	0.00841	0.408	0.44980	2440	0.00963
11/10	5.45	15.26	125	6.14	69.6	0.732	6.46	4.46	4	10	882		0.0219	0.0154	0.281	0.31605	2790	0.0102
11/25	3.59	13.97	108	6.59	68.2	0.606	6.01	4.29	24	*0*	1050		0.0256	0.0380	0.394	0.29185	2840	*0*
12/9	0.55	14.85	103	6.09	61.5	0.511	4.85	2.95	12	20	1500		0.0262	0.0426	0.207	0.44870	2550	*0*
12/23	2.27	17.12	125	6.08	56.7	0.477	5.03	3.43	4	31	512		0.0169	0.0405	0.225	0.21655	2300	0.00792
AVG.	10.49	11.84	103	6.14	61.9	1.00	6.59	4.60	12	56	1760		0.0306	0.0405	0.307	0.26156	2570	0.0139
MAX.	23.91	17.12	125	6.59	74.9	2.93	8.90	6.89	40	754	8160		0.126	0.123	0.469	0.44980	3210	0.0759
MIN.	0.10	6.48	78	5.78	48.1	0.405	4.22	2.16	*<10*	*<10*	145		0.0168	*<0.005*	0.161	0.16160	1710	*<0.005*
MEDIAN	10.73	11.87	103	6.09	61.6	0.902	6.49	4.52	10	15	1240		0.0256	0.0262	0.319	0.24465	2600	0.00797

NOTES

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 2014
(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
1/7	0.37	12.70	91	6.35	190.5	2.26	10.9	8.86	26	51	1730		0.0324	1.12	0.383	0.096100	7610	0.0164
1/21	0.55	16.02	113	6.32	188.6	1.18	11.8	9.64	2	*0*	282		0.0216	1.12	0.196	0.067630	8000	0.01490
2/4	1.04	15.61	111	6.35	190.4	2.00	12.2	10.2	8	*0*	292		0.0274	1.16	0.239	0.050675	8270	0.0329
2/18	0.67	14.74	108	6.53	197.9	2.22	13.0	11.1	4	*0*	185		0.0268	1.07	0.267	0.051935	8320	0.0377
3/4	0.38	14.67	103	6.54	237.6	1.43	12.6	10.6	*0*	*0*	160		0.0276	1.16	0.225	0.050220	10000	0.0254
3/18	0.63	14.75	104	6.53	265.8	1.98	11.9	9.93	*0*	10	185		0.0314	1.14	0.283	0.059420	9020	0.0222
4/1	1.34	14.78	107	5.98	182.7	1.16	8.19	6.23	5	30	393		0.0266	0.82	0.225	0.11345	5780	0.00575
4/15	10.53	14.63	133	6.34	182.3	9.30	12.2	9.89	84	109	8660		0.134	0.511	0.733	0.16228	7050	*0*
4/29	6.69	17.66	147	6.08	198.4	0.454	12.0	10.0	12	*0*	393		0.0127	0.595	0.208	0.092840	6900	*0*
5/13	11.57	19.91	185	6.34	196.3	0.506	13.4	11.3	8	*0*	1960		0.0200	0.601	0.366	0.10434	7450	*0*
5/27	12.38	10.16	97	6.28	202.0	0.596	14.6	12.6	16	10	1040		0.0227	0.609	0.259	0.11863	7800	*0*
6/10	13.01	9.62	93	6.52	216.7	0.769	15.7	13.6	8	10	2610		0.0275	0.672	0.215	0.13188	8740	0.00683
6/24	13.08	11.03	106	6.44	269.5	0.769	17.4	15.3	28	20	2910		0.0375	0.936	0.202	0.10593	12200	0.0102
7/8	16.61	9.13	96	6.40	223.0	1.09	17.5	15.4	180	228	12000		0.0509	0.503	0.272	0.23260	8520	0.0144
7/22	14.95	9.71	97	6.37	321.8	0.700	20.0	17.9	40	63	5790		0.0304	1.04	0.240	0.11912	13300	0.0153
8/5	15.59	9.39	96	6.31	327.7	0.749	20.8	20.8	20	134	13000		0.0327	1.16	0.264	0.13066	14900	0.0125
8/19	13.14	9.81	95	6.47	334.5	0.807	19.2	17.2	*0*	31	5790		0.0261	0.787	0.211	0.099700	12400	0.0103
9/2	17.24	6.98	73	6.63	401.6	0.958	23.5	23.5	10	*0*	6870		0.0215	1.04	0.203	0.065370	17300	0.00846
9/16	11.41	10.06	93	6.60	405.4	0.873	23.6	23.6	190	121	2990		0.0267	0.967	0.180	0.054370	17700	0.00821
9/30	13.48	8.83	86	6.70	447.0	0.899	26.8	26.8	6.67	10	3780		0.0284	0.613	0.174	0.055265	20800	0.00562
10/14	11.83	8.87	83	6.60	446.4	0.668	23.8	23.8	10	52	3440		0.0187	0.659	0.228	0.091390	16800	*0*
10/28	9.24	11.12	99	6.34	302.5	0.405	15.6	13.6	8	*0*	1470		0.0169	1.22	0.229	0.10545	11000	0.00971
11/10	6.77	14.81	125	6.51	297.5	0.281	15.7	13.8	*0*	*0*	878		0.0138	1.20	0.240	0.075775	11300	0.00840
11/25	7.77	11.54	100	6.28	242.0	0.507	14.6	12.9	12	10	1240		0.0241	0.859	0.406	0.12055	9130	0.00660
12/9	2.75	13.48	99	6.36	221.0	1.41	11.7	9.74	88	201	1990		0.0284	1.23	0.259	0.089140	8550	*0*
12/23	4.12	16.09	124	6.35	179.4	0.558	11.4	9.52	40	63	529		0.0129	0.832	0.279	0.096950	7250	0.00527
AVG.	8.35	12.54	106	6.40	264.2	1.33	15.8	14.1	31	44	3100		0.0300	0.909	0.269	0.097757	10620	0.0107
MAX.	17.24	19.91	185	6.70	447.0	9.30	26.8	26.8	190	228	13000		0.134	1.23	0.733	0.23260	20800	0.0377
MIN.	0.37	6.98	73	5.98	179.4	0.281	8.19	6.23	*<10*	*<10*	160		0.0127	0.503	0.174	0.050220	5780	*<0.005*
MEDIAN	9.89	12.12	99	6.37	230.3	0.840	14.6	12.8	10	10	1845		0.0268	0.952	0.240	0.096525	8880	0.00843

NOTES

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 2014
(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
1/7	0.04	13.08	93	6.28	171.4	1.63	6.16	4.24	76	156	13000		0.0216	0.179	0.285	0.21080	4210	0.0206
1/21	0.40	15.98	113	6.62	212.7	0.451	7.49	5.43	*0*	*0*	285		0.0127	0.257	0.156	0.12428	4930	0.0205
2/4	0.30	16.39	114	6.54	247.1	0.665	9.17	7.19	6	20	185		0.0147	0.254	0.275	0.10724	6100	0.0485
2/18	-0.03	15.08	108	6.49	240.5	0.717	9.69	7.86	7	31	134		0.0146	0.249	0.289	0.10604	5970	0.124
3/4	0.09	14.90	104	6.46	275.3	0.572	8.45	6.56	4	473	708		0.0171	0.251	0.202	0.090360	6660	0.0595
3/18	0.74	14.94	106	6.63	283.7	0.441	7.69	5.65	7	63	201		0.0169	0.234	0.231	0.098760	5670	0.0323
4/1	0.91	16.01	115	6.38	195.9	0.618	5.24	3.25	1	20	627		0.0186	0.206	0.192	0.15459	3570	0.00546
4/15	13.71	12.88	126	6.44	199.0	0.623	7.03	5.00	4	*0*	2480		0.0202	0.0838	0.192	0.14094	4090	0.00818
4/29	9.64	13.83	123	6.33	208.8	0.522	7.41	5.50	*0*	*0*	613		0.0126	0.0633	0.248	0.14576	4230	*0*
5/13	17.10	16.63	175	6.59	212.3	0.881	9.40	7.26	*0*	*0*	1400		0.0205	0.0306	0.342	0.17424	4620	*0*
5/27	17.30	8.89	94	6.47	195.4	0.874	9.39	7.16	8	10	1150		0.0244	0.0468	0.326	0.21745	4370	0.0168
6/10	19.05	8.23	91	6.54	207.5	1.27	11.2	9.14	4	31	1230		0.0304	0.0841	0.396	0.26795	5120	0.0525
6/24	17.65	9.27	99	6.64	227.5	1.01	11.9	9.80	8	*0*	404		0.0293	0.259	0.358	0.27400	5720	0.0303
7/8	20.77	8.44	96	6.61	207.3	1.43	11.4	9.27	28	75	5790		0.0356	0.0787	0.448	0.32485	5020	0.0296
7/22	19.56	8.57	94	6.61	231.6	1.20	12.0	9.99	10	10	1110		0.0282	0.150	0.423	0.30765	5140	0.0198
8/5	19.63	8.28	92	6.67	234.5	1.42	12.4	10.4	*0*	*0*	1260		0.0334	0.242	0.368	0.29025	5810	0.00883
8/19	15.55	9.46	97	6.58	207.0	1.06	10.3	8.22	*0*	31	3260		0.0240	0.0713	0.405	0.29260	5000	0.0163
9/2	19.75	6.62	73	6.81	239.9	0.499	12.8	10.7	30	10	1920		0.0202	0.419	0.278	0.17422	6090	0.00638
9/16	11.19	10.62	98	6.89	235.4	1.43	13.6	11.5	10	*0*	2040		0.0319	0.273	0.374	0.15309	6590	0.00589
10/14	11.18	10.11	94	6.78	248.2	0.486	14.1	12.1	*0*	*0*	1230		0.0113	*0*	0.261	0.18675	6010	*0*
10/28	9.18	11.35	101	6.41	201.1	0.628	8.05	5.89	12	*0*	985		0.0205	0.0237	0.293	0.33105	4850	0.00827
11/10	5.24	15.86	129	6.68	263.1	0.467	8.66	6.70	8	10	417		0.0154	0.0320	0.274	0.19325	6050	0.0132
11/25	6.09	13.10	108	6.70	243.7	0.500	8.21	6.42	64	98	839		0.0205	0.0278	0.296	0.17172	5610	*0*
12/9	2.54	13.44	98	6.49	242.8	0.533	7.18	5.25	12	31	1210		0.0173	0.115	0.182	0.19705	5250	*0*
12/23	3.23	16.14	121	6.50	217.7	0.431	7.67	5.87	8	*0*	315		0.00873	0.163	0.219	0.14762	4890	0.00842
AVG.	9.63	12.32	106	6.57	226.0	0.814	9.46	7.45	12	43	1710		0.0208	0.152	0.293	0.19530	5260	0.0214
MAX.	20.77	16.63	175	6.89	283.7	1.63	14.1	12.1	76	473	13000		0.0356	0.419	0.448	0.33105	6660	0.124
MIN.	-0.03	6.62	73	6.28	171.4	0.431	5.24	3.25	*<10*	*<10*	134		0.00873	*<0.005*	0.156	0.090360	3570	*<0.005*
MEDIAN	9.64	13.08	101	6.58	227.5	0.628	9.17	7.16	7	10	1110		0.0202	0.150	0.285	0.17424	5140	0.0132

NOTES

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 2014
(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
1/7	0.04	12.19	86	5.74	30.6	0.973	4.58	2.71	52	213	7700		0.0250	0.0617	0.315	0.33050	1800	0.0171
1/21	0.04	16.53	115	6.19	34.3	0.572	4.73	2.46	*0*	*0*	294		0.0189	0.0724	0.242	0.31525	2030	0.00938
2/4	-0.05	16.15	111	6.30	42.8	0.838	6.22	4.15	8	52	311		0.0216	0.138	0.321	0.30225	2690	0.0280
2/18	-0.06	15.98	114	6.32	42.7	0.930	6.92	4.86	1	*0*	282		0.0214	0.127	0.365	0.34540	2500	0.0755
3/4	0.04	15.54	108	6.29	42.5	1.04	6.49	4.47	4	*0*	110		0.0282	0.130	0.333	0.30420	2610	0.0576
3/18	0.04	15.41	107	6.42	40.8	1.02	6.03	4.01	13	31	327		0.0302	0.117	0.295	0.27710	2210	0.0368
4/1	0.66	15.15	108	5.71	25.3	1.00	3.68	1.67	1	20	598		0.0304	0.0407	0.230	0.24370	1150	0.0139
4/15	12.48	10.59	101	5.72	28.9	0.939	4.41	2.45	20	41	1050		0.0303	0.0342	0.243	0.25105	1570	*0*
4/29	8.78	14.25	125	5.94	31.8	0.509	4.67	2.61	*0*	20	712		0.0142	0.0255	0.282	0.31900	1520	*0*
5/13	15.17	9.11	92	5.99	34.3	0.851	5.99	3.90	8	10	2190		0.0238	0.0211	0.424	0.37215	1970	*0*
5/27	16.36	9.24	96	5.87	33.0	0.738	6.10	3.88	4	63	1270		0.0251	0.0370	0.364	0.44075	1910	*0*
6/10	17.68	8.33	89	6.05	36.2	0.959	7.17	4.93	68	63	1210		0.0369	0.0834	0.382	0.51740	2290	*0*
6/24	16.95	9.70	102	6.18	38.8	1.36	8.69	6.44	24	241	4110		0.0471	0.103	0.470	0.50280	2780	0.00791
7/8	21.35	8.10	94	6.17	39.8	1.26	8.40	6.28	52	109	6870		0.0463	0.0672	0.493	0.53445	2560	0.00879
7/22	19.23	8.49	93	6.23	39.0	1.58	9.55	7.29	20	52	6130		0.0426	0.0603	0.476	0.54220	2760	0.00672
8/5	20.03	8.53	95	6.23	36.2	1.39	8.89	6.59	60	146	14100		0.0426	0.0588	0.472	0.46560	2720	*0*
8/19	15.54	9.15	94	5.97	34.2	0.857	7.16	5.12	10	31	3450		0.0294	0.0315	0.459	0.52540	2400	0.00637
9/2	20.47	6.50	73	6.35	40.9	0.967	10.1	7.94	33.3	41	1620		0.0297	0.0566	0.383	0.41560	2940	0.00586
9/16	12.41	10.05	95	6.53	41.5	1.09	9.60	7.42	10	*0*	1330		0.0334	0.0446	0.359	0.33115	2820	0.00638
9/30	14.33	9.80	98	6.72	42.7	0.719	9.94	7.89	*0*	*0*	480		0.0267	0.0382	0.314	0.28090	2630	*0*
10/14	10.75	10.70	98	6.45	45.3	0.779	9.58	7.60	*0*	10	842		0.0254	0.0103	0.296	0.29510	2680	*0*
10/28	8.24	12.04	105	5.79	38.3	0.523	5.03	2.78	24	*0*	2250		0.0240	0.0242	0.438	0.57980	1980	0.00771
11/10	4.36	16.41	130	6.00	42.0	0.572	5.83	3.78	*0*	*0*	1140		0.0210	0.0230	0.394	0.50290	2350	0.00900
11/25	4.93	13.38	107	6.52	39.1	0.545	5.19	3.25	16	63	1940		0.0239	0.0334	0.487	0.44090	2080	*0*
12/9	0.75	14.89	103	6.08	36.3	0.447	4.38	2.36	*0*	30	1150		0.0202	0.0400	0.314	0.23055	2010	*0*
12/23	2.57	16.89	125	6.05	36.2	0.432	4.65	2.72	4	*0*	496		0.0117	0.0482	0.272	0.35525	2060	*0*
AVG.	9.35	12.04	102	6.15	37.4	0.880	6.69	4.60	17	48	2380		0.0281	0.0587	0.362	0.38544	2270	0.0114
MAX.	21.35	16.89	130	6.72	45.3	1.58	10.1	7.94	68	241	14100		0.0471	0.138	0.493	0.57980	2940	0.0755
MIN.	-0.06	6.50	73	5.71	25.3	0.432	3.68	1.67	*<10*	*<10*	110		0.0117	0.0103	0.230	0.23055	1150	*<0.005*
MEDIAN	9.77	11.37	101	6.18	38.6	0.894	6.16	4.08	9	31	1180		0.0261	0.0464	0.362	0.35033	2320	0.00638

NOTES

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 2014
(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
1/7	0.04	12.53	89	6.20	72.8	0.920			22	52	3580						2690	
1/21	0.04	16.42	114	6.75	64.7	0.411			2	*0*	355						2650	
2/4	-0.08	16.66	115	6.47	85.7	0.550			12	51	318						3370	
2/18	-0.08	15.77	113	6.48	86.7	0.605			5	10	169						3400	
3/4	0.05	15.69	109	6.57	93.2	0.519			*0*	20	160						3670	
3/18	0.06	15.41	107	6.42	91.1	0.619			*0*	*0*	226		0.0205	0.127	0.187	0.14478	3130	0.0292
4/1	0.89	15.37	110	5.82	55.9	1.18			5	10	583						1720	
4/15	12.80	13.64	131	6.02	68.0	0.895			6	*0*	771						2120	
4/29	9.20	14.60	129	6.12	72.0	0.531			*0*	10	536						2280	
5/13	16.33	10.82	112	6.27	78.3	0.801			*0*	10	1130						2590	
5/27	16.57	9.42	99	6.22	72.8	0.840			12	20	1420						2590	
6/10	19.05	8.32	92	6.35	78.1	0.887			*0*	31	1840						2880	
6/24	19.05	9.19	100	6.50	85.3	0.541			220	206	2610		0.0246	0.0593	0.309	0.20865	3330	0.00506
7/8	22.41	9.03	106	6.47	75.7	1.40			25.7	85	7700						3350	
7/22	21.43	8.57	98	6.51	79.2	0.686			*0*	*0*	1850						3300	
8/5	21.37	8.94	103	6.52	74.6	0.650			*0*	10	2500						3110	
8/19	17.39	9.12	97	6.38	69.3	0.586			30	41	1350						2770	
9/2	21.58	6.56	75	6.61	84.1	0.439			80	30	1540						3730	
9/16	12.67	10.19	97	6.63	81.9	0.457			*0*	20	676		0.0167	0.0119	0.219	0.16233	3590	0.00517
9/30	14.79	10.08	101	6.73	83.8	0.408			*0*	20	399						3370	
10/14	11.79	10.99	103	6.62	82.5	0.345			*0*	*0*	420						3410	
10/28	9.16	11.68	104	6.48	67.4	0.569			4	20	1240						2570	
11/10	5.41	16.06	131	6.53	84.5	0.637			*0*	*0*	644						3590	
11/25	4.63	14.13	113	6.51	82.2	0.549			12	*0*	908						2960	
12/9	1.15	14.40	101	6.24	73.8	0.493			4	20	613		0.0188	0.0304	0.263	0.27020	2790	*0*
12/23	2.77	17.50	130	6.33	70.2	0.360			4	*0*	285						2580	
AVG.	10.02	12.35	107	6.41	77.5	0.649			17	26	1300		0.0202	0.0572	0.245	0.19649	2980	0.00986
MAX.	22.41	17.50	131	6.75	93.2	1.40			220	206	7700		0.0246	0.127	0.309	0.27020	3730	0.0292
MIN.	-0.08	6.56	75	5.82	55.9	0.345			*<10*	*<10*	160		0.0167	0.0119	0.187	0.14478	1720	*<0.005*
MEDIAN	10.50	12.11	105	6.48	78.2	0.578			4	15	724		0.0197	0.0449	0.241	0.18549	3040	0.00512

NOTES

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 2014

GATES BROOK, AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/7	0.11	18.52	132	4.95	20.9	0.311			14	52	691						1020	
1/21	0.61	22.54	160	4.96	21.7	0.150			*0*	*0*	369						1080	
2/4	0.15	19.39	135	6.41	23.6	0.133			*0*	*0*	327						1140	
2/18	0.13	16.80	121	6.04	23.9	0.121			*0*	*0*	158						1220	
3/4	0.06	18.84	131	6.32	24.7	0.142			*0*	*0*	272						1250	
3/18	0.06	18.09	126	4.37	23.1	0.134			*0*	*0*	199		0.0124	0.00542	*0*	0.050130	1170	*0*
4/1	1.84	17.43	128	4.69	19.2	0.439			13	41	383						776	
4/15	10.08	11.29	102	5.18	20.7	0.162			2	*0*	738						991	
4/29	7.03	16.13	135	4.95	20.4	0.143			*0*	*0*	554						917	
5/13	10.28	16.80	152	5.04	20.3	0.187			*0*	*0*	1050						1010	
5/27	12.09	11.29	107	5.28	20.4	0.178			*0*	*0*	1150						1050	
6/10	13.06	10.15	98	5.62	22.2	0.135			*0*	*0*	1780						1180	
6/24	14.34	12.07	119	5.73	23.9	0.117			8	*0*	3260		0.0153	*0*	0.145	0.054950	1270	*0*
7/8	17.24	9.55	102	5.99	23.2	0.358			16	75	5790						1370	
7/22	16.99	11.18	117	5.95	25.1	0.178			*0*	31	4110						1360	
8/5	17.87	9.49	102	5.95	26.3	0.156			*0*	10	2600						1410	
8/19	13.97	10.59	105	6.17	25.4	0.173			20	41	3870						1300	
9/2	19.18	6.89	75	6.42	27.3	0.152			20	10	5790						1450	
9/16	12.15	10.76	101	6.36	27.1	0.163			10	10	2760		0.0224	0.0157	0.109	0.069145	1350	*0*
9/30	14.98	10.30	104	6.57	28.5	0.170			20	*0*	3650						1270	
10/14	11.67	10.24	96	6.33	29.6	0.148			40	20	2190						1290	
10/28	8.62	15.67	137	5.79	21.9	0.558			324	663	4350						1200	
11/10	5.17	21.11	171	5.97	26.4	0.136			*0*	*0*	798						1350	
11/25	8.26	12.03	105	6.63	25.8	0.193			*0*	10	839						1430	
12/9	3.04	12.94	96	5.80	22.6	0.174			*0*	*0*	355		0.0150	*0*	0.113	0.088990	1210	*0*
12/23	4.85	20.34	160	5.61	21.8	0.140			4	*0*	309						1100	
AVG.	8.61	14.25	120	5.73	23.7	0.194			19	37	1860		0.0163	0.00528	*<0.100*	0.065804	1200	*<0.005*
MAX.	19.18	22.54	171	6.63	29.6	0.558			324	663	5790		0.0224	0.0157	0.145	0.088990	1450	*<0.005*
MIN.	0.06	6.89	75	4.37	19.2	0.117			*<10*	*<10*	158		0.0124	*<0.005*	*<0.100*	0.050130	776	*<0.005*
MEDIAN	9.35	12.51	118	5.88	23.4	0.159			*<10*	*<10*	945		0.0152	*<0.005*	0.111	0.062048	1220	*<0.005*

NOTES

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 2014
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
1/7	0.04	14.05	100	6.35	47.3	3.37			30	41	1080						4570	
1/21	0.12	16.97	119	6.41	53.0	1.22			2	*0*	216						4730	
2/4	0.36	16.95	118	6.64	64.3	1.09			2	*0*	299						5610	
2/18	0.00	15.00	108	6.76	69.1	0.786			39	86	364						5820	
3/4	0.19	16.11	112	6.51	69.6	0.652			0.667	*0*	158						6350	
3/18	0.34	15.03	105	6.65	59.9	1.16			*0*	*0*	146		0.0192	0.0426	*0*	0.099990	5010	*0*
4/1	4.77	14.29	114	6.23	33.8	2.28			*0*	*0*	158						2850	
4/15	12.19	13.55	128	6.36	47.0	4.57			266	315	7270						4050	
4/29	8.41	13.42	116	6.29	54.2	0.830			28	30	520						4650	
5/13	16.03	8.67	89	6.56	57.0	0.805			4	10	1330						5130	
5/27	14.94	10.62	107	6.71	60.6	0.797			*0*	*0*	1110						5700	
6/10	16.98	9.19	97	6.76	74.6	1.16			4	31	2480						7150	
6/24	17.44	9.57	101	6.93	89.3	0.606			*0*	10	2380		0.0263	0.0703	0.374	0.092490	8850	*0*
7/8	19.91	9.04	102	6.88	95.4	0.824			132	265	6490						10600	
7/22	19.66	9.10	100	6.84	103.6	0.666			50	187	5790						10800	
8/5	20.07	9.31	104	6.85	108.2	0.845			220	228	3650						11500	
8/19	16.61	9.55	100	6.90	107.0	0.743			10	110	3130						11100	
9/2	20.88	6.85	78	7.06	114.7	0.517				471	12000						12000	
9/4									62.5	63	3870							
9/16	13.80	10.32	101	6.99	111.0	0.289			*0*	75	3650		0.0251	0.0222	*0*	0.086810	10600	*0*
9/30	15.08	9.10	92	6.93	117.9	0.303			10	*0*	3260						11100	
10/14	13.84	10.43	102	7.00	113.6	0.366			*0*	10	1940						11200	
10/28	10.38	11.84	108	6.80	95.4	0.483			*0*	10	1020						9270	
11/10	7.30	14.39	123	6.72	99.0	0.278			*0*	*0*	785						9370	
11/25	8.37	12.23	107	6.68	79.5	1.06			8	10	1310						7110	
12/9	1.83	14.33	102	6.79	56.8	2.24			64	146	6870		0.0308	0.0444	0.259	0.28330	5320	*0*
12/23	4.69	16.15	126	6.54	54.1	1.13			4	*0*	410						4900	
AVG.	10.16	12.16	106	6.70	78.3	1.12			36	78	2660		0.0254	0.0449	0.158	0.14065	7510	*<0.005*
MAX.	20.88	16.97	128	7.06	117.9	4.57			266	471	12000		0.0308	0.0703	0.374	0.28330	12000	*<0.005*
MIN.	0.00	6.85	78	6.23	33.8	0.278			*<10*	*<10*	146		0.0192	0.0222	*<0.100*	0.086810	2850	*<0.005*
MEDIAN	11.29	12.04	105	6.74	72.1	0.815			4	10	1330		0.0257	0.0435	0.130	0.096240	6730	*<0.005*

NOTES

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 2014
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
1/14	0.30	16.24	114	6.14	90.5	0.810			4	10	823					0.21605	3040	
1/28	-0.04	16.87	119	6.31	99.0	0.680			4	*0*	282					0.18075	3710	
2/11	-0.06	17.12	121	6.39	104.9	0.818			6	*0*	199					0.16364	3850	
2/25	0.19	14.87	105	6.60	108.7	0.842			8	41	285					0.16135	3560	
3/11	0.58	16.56	118	6.73	106.4	0.828			4	*0*	121					0.15956	4020	
3/25	0.30	14.56	102	6.26	104.1	0.648			*0*	31	134		0.0188	0.0776	0.153	0.15763	3370	0.00829
4/8	4.38	13.00	101	5.64	66.4	0.647			*0*	*0*	233					0.16577	1970	
4/22	10.48	12.03	108	5.90	81.4	0.717			4	*0*	417					0.23355	2660	
5/6	11.37	10.83	101	5.83	87.1	0.827			4	*0*	1070					0.25295	2810	
5/20	15.44	8.86	90	5.99	86.3	1.23			14	20	1530					0.28195	2920	
6/3	19.70	9.02	100	5.91	91.8	1.64			12	20	1440					0.25155	3110	
6/17	20.96	7.95	90	6.15	109.6	2.43			8	41	3450		0.0286	0.0306	0.384	0.26275	4070	0.00782
7/1	23.92	8.53	103	6.28	107.0	2.56			20	10	3650					0.28185	4180	
7/15	24.52	8.22	101	6.15	105.2	4.12			40	31	5480					0.36485	3950	
7/29	21.54	8.87	104	6.15	94.7	3.08			140	189	12000					0.29100	3650	
8/12	22.31	8.37	98	6.45	103.8	2.00			20	52	5790					0.23285	3990	
8/26	20.62	8.31	94	6.12	93.8	1.59			30	52	2280					0.25600	3760	
9/9	20.59	7.72	87	6.36	107.1	2.66			40	41	2760		0.0258	0.00809	0.315	0.26660	4330	0.00814
9/23	15.43	9.20	94	6.37	91.5	2.12			210	295	7270					0.20055	3540	
10/7	13.89	10.92	107	6.39	100.6	1.80			10	10	627					0.26205	3750	
10/21	10.55	11.69	107	6.04	86.0	1.54			80	10	4110					0.58270	3220	
11/4	4.93	15.21	121	6.32	108.0	1.04			*0*	31	1860					0.31980	3470	
11/18	3.02	21.08	160	6.83	89.4	1.43			104	132	7270					0.27170	2940	
12/2	2.64	17.95	134	6.78	87.5	0.794			8	10	1400					0.23925	3060	
12/16	1.24	18.63	134	6.06	83.4	0.742			6	*0*	1260		0.0169	0.0231	0.227	0.24150	2940	*0*
12/30	1.24	19.94	143	6.20	82.8	0.600			*0*	*0*	749					0.21145	2930	
AVG.	10.39	12.79	110	6.24	95.3	1.47			30	39	2560		0.0225	0.0348	0.270	0.25037	3420	0.00606
MAX.	24.52	21.08	160	6.83	109.6	4.12			210	295	12000		0.0286	0.0776	0.384	0.58270	4330	0.00829
MIN.	-0.06	7.72	87	5.64	66.4	0.600			*<10*	*<10*	121		0.0169	0.00809	0.153	0.15763	1970	*<0.005*
MEDIAN	10.52	11.86	104	6.23	94.3	1.14			8	15	1420		0.0223	0.0269	0.271	0.24653	3510	0.00798

NOTES

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 2014
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
1/14	0.09	22.23	155	6.22	75.0	0.528			16	31	616					0.17785	2330	
1/28	-0.01	16.08	113	6.41	78.4	0.405			2	*0*	183					0.14414	2740	
3/11	0.13	18.40	129	6.51	86.7	0.646			2	31	161					0.13639	2960	
3/25	0.13	18.05	125	6.37	87.8	0.447			*0*	*0*	135		0.0172	0.0895	0.116	0.12165	2700	0.00641
4/8	4.19	13.92	108	5.86	60.9	0.543			4	*0*	266					0.15096	1760	
4/22	8.98	9.55	82	5.95	69.9	0.344			*0*	*0*	676					0.17374	2070	
5/1	17.49	7.59	80	5.95	73.4	2.280			28	52	2600					0.26395	2700	
5/6	9.63	14.97	135	5.68	69.7	0.503			4	10	1560					0.18425	2120	
5/20	13.73	9.90	97	5.79	69.3	0.756			14	41	1850					0.24025	2200	
6/3	15.76	9.49	97	5.71	70.3	1.17			16	63	1920					0.23745	2330	
6/17	17.49	7.59	80	5.95	73.4	2.28			28	52	2600		0.0309	0.0467	0.525	0.26395	2700	0.0108
7/1	20.29	8.08	91	5.89	71.9	2.09			28	145	4880					0.29725	2820	
7/15	21.99	7.21	84	5.79	69.5	2.32			70	121	9210					0.34850	2630	
7/29	19.35	8.25	93	5.71	57.6	2.78			490	364	19900					0.36030	2220	
8/12	19.28	7.69	84	6.25	67.3	2.32			40	160	5480					0.24645	2560	
8/26	18.47	6.89	74	5.93	65.9	1.67			200	708	8660					0.23835	2600	
9/9	16.80	8.77	92	6.19	96.5	2.28			80	52	3440		0.0253	0.00898	0.327	0.29260	4090	0.00647
9/23	11.71	9.92	94	6.08	71.0	1.28			70	134	6490					0.22945	2490	
10/7	11.26	13.17	122	6.73	94.1	1.54			50	31	1420					0.30485	3490	
10/21	8.94	13.79	121	5.99	72.8	1.08			40	41	1920					0.37480	2370	
11/4	3.91	19.56	151	6.23	70.5	0.609			4	10	1270					0.30890	2360	
11/18	2.83	17.01	128	6.64	67.3	0.873			224	256	3450					0.30495	2130	
12/2	2.09	22.61	166	6.59	71.6	0.470			4	10	1190					0.21775	2320	
12/16	0.98	24.08	172	5.81	65.8	0.330			4	*0*	663		0.0146	0.0374	0.144	0.20620	2110	*0*
12/30	1.00	24.50	175	6.07	78.2	0.455			6	10	631					0.20735	2560	
AVG.	9.86	13.57	114	6.09	73.4	1.20			57	93	3250		0.0220	0.0456	0.278	0.24129	2530	0.00592
MAX.	21.99	24.50	175	6.73	96.5	2.78			490	708	19900		0.0309	0.0895	0.525	0.37480	4090	0.0108
MIN.	-0.01	6.89	74	5.68	57.6	0.330			*<10*	*<10*	135		0.0146	0.00898	0.116	0.12165	1760	*<0.005*
MEDIAN	9.63	13.17	108	5.99	71.0	0.873			16	41	1850		0.0213	0.0421	0.236	0.23835	2490	0.00644

NOTES

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 2014
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
1/14	0.17	15.83	110	5.73	91.1	0.782			4	*0*	865					0.29535	2990	
1/28	0.06	14.05	99	5.79	97.7	0.468			*0*	*0*	279					0.24065	3300	
2/11	-0.01	14.77	104	6.37	92.6	0.610			2	10	521					0.23985	3180	
2/25	0.09	17.70	124	6.39	117.0	0.659			*0*	10	238					0.22160	3350	
3/11	0.14	15.56	109	6.14	107.6	0.673			*0*	10	213					0.21930	3420	
3/25	0.10	15.37	107	5.92	109.6	0.517			1	*0*	201		0.0205	0.117	0.277	0.21380	3070	0.0122
4/8	4.41	11.71	91	5.14	63.8	0.388			*0*	*0*	266					0.23400	1810	
4/22	8.64	10.01	86	5.62	76.3	0.478			*0*	*0*	554					0.28235	2340	
5/6	9.95	14.44	131	5.68	77.6	0.441			16	134	1230					0.29765	2380	
5/20	14.33	9.43	94	5.62	78.9	0.715			10	*0*	1870					0.40345	2570	
6/3	17.69	8.91	95	5.79	79.9	1.03			20	20	1370					0.32970	2760	
6/17	19.96	7.26	81	6.04	84.0	1.22			16	20	2100		0.0229	0.0229	0.486	0.34995	3030	0.00521
7/1	22.29	8.45	99	6.08	87.5	1.34			8	*0*	3870					0.38250	3540	
7/15	23.60	7.80	94	6.07	88.3	1.41			*0*	20	1860					0.48450	3340	
7/29	19.90	8.35	95	6.17	84.2	1.31			60	86	4610					0.35015	3280	
8/12	19.52	8.93	98	6.24	93.7	1.08			*0*	73	1630					0.27040	3530	
8/26	18.45	8.15	88	6.07	90.8	0.935			10	52	1330					0.29905	3330	
9/9	16.30	8.82	91	6.26	116.3	1.63			30	20	4110		0.0225	0.0122	0.338	0.38090	3640	*0*
9/23	12.36	9.62	92	5.98	99.0	1.04			150	156	6490					0.34410	3090	
10/7	11.75	11.65	109	6.46	111.0	0.746			*0*	*0*	627					0.40540	3130	
10/21	9.75	11.73	105	5.72	85.6	0.749			50	30	1370					0.58825	2730	
11/4	4.32	16.62	130	5.92	86.6	0.591			12	10	1550					0.46790	2910	
11/18	2.81	21.32	160	6.17	97.2	0.847			312	744	5480					0.43960	2900	
12/2	1.81	19.00	139	6.32	96.0	0.497			8	31	1050					0.34405	2930	
12/16	0.63	17.38	123	5.60	73.5	0.487			4	10	1220		0.0145	0.0362	0.219	0.31575	2380	*0*
12/30	0.24	23.44	163	5.78	74.0	0.469			2	10	738					0.27570	2340	
AVG.	9.20	12.93	108	5.96	90.8	0.812			28	56	1760		0.0201	0.0471	0.330	0.33369	2970	0.00435
MAX.	23.60	23.44	163	6.46	117.0	1.63			312	744	6490		0.0229	0.117	0.486	0.58825	3640	0.0122
MIN.	-0.01	7.26	81	5.14	63.8	0.388			*<10*	*<10*	201		0.0145	0.0122	0.219	0.21380	1810	*<0.005*
MEDIAN	9.20	11.72	102	6.01	89.6	0.731			6	10	1280		0.0215	0.0296	0.308	0.32273	3050	0.00261

NOTES

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 2014
WARE RIVER AND TRIBUTARIES
(115) BRIGHAM POND OUTLET AT DAM, NEAR OLD PRINCETON ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/14	0.78	14.97	106	5.66	60.6	0.873	5.10	2.93	4	*0*	1370		0.0167	0.0832	0.299	0.28250	2470	0.0408
1/28	0.28	15.64	111	5.83	64.7	0.566	5.47	3.47	2	*0*	384		0.0164	0.0916	0.332	0.25590	2730	0.0513
2/11	0.24	15.18	108	5.88	61.6	0.693	6.22	4.23	3	10	345		0.0174	0.0937	0.329	0.25190	2710	0.0799
2/25	0.48	14.14	100	5.96	69.9	0.759	6.16	4.18	*0*	*0*	332		0.0158	0.117	0.286	0.23220	2830	0.0865
3/11	0.93	14.47	104	6.16	72.2	0.690	6.44	4.36	*0*	*0*	265		0.0224	0.122	0.291	0.23045	3160	0.0725
3/25	1.72	13.61	99	5.81	72.7	0.562	5.14	3.05	*0*	*0*	288		0.0184	0.120	0.239	0.18415	2530	0.0273
4/8	4.07	12.26	95	5.41	51.7	0.562	3.46	1.58	*0*	*0*	359		0.0173	0.0477	0.144	0.19685	1880	*0*
4/22	10.65	9.39	84	5.64	58.6	0.587	4.27	2.21	*0*	*0*	563		0.0128	0.0196	0.240	0.23195	2100	*0*
5/6	12.40	9.73	93	5.67	59.8	0.656	4.52	2.50	*0*	*0*	677		0.0105	0.00609	0.295	0.24810	2110	*0*
5/20	17.14	8.49	89	5.71	61.5	1.14	5.27	3.27	8	31	1260		0.0227	*0*	0.338	0.29575	2400	*0*
6/3	21.36	8.55	98	5.91	63.7	0.700	5.96	3.89	*0*	*0*	203		0.0153	*0*	0.294	0.27910	2470	*0*
6/17	21.85	6.88	79	5.96	64.8	0.835	6.63	4.50	*0*	*0*	3870		0.0201	0.00722	0.422	0.30860	2720	*0*
7/1	25.18	7.21	89	5.84	66.8	0.733	7.50	5.35	*0*	*0*	3450		0.0247	0.00569	0.346	0.29155	2960	0.00677
7/15	25.11	6.69	83	5.75	63.7	1.26	8.36	6.24	*0*	*0*	1420		0.0267	0.00924	0.406	0.36510	2770	0.0103
7/29	24.46	6.89	85	5.93	62.2	1.83	8.40	6.27	*0*	10	4350		0.0222	*0*	0.403	0.35510	2740	*0*
8/12	24.15	6.97	84	6.09	63.6	1.23	8.63	6.69	*0*	*0*	4880		0.0226	*0*	0.397	0.33285	2870	0.00653
8/26	23.50	7.66	91	5.93	59.7	1.06	7.63	5.51	10	20	6130		0.0230	0.00680	0.406	0.32930	2640	0.00731
9/9	22.40	7.19	84	5.99	59.9	1.33	7.79	5.82	*0*	*0*	9800		0.0226	*0*	0.449	0.30895	2560	0.00508
9/23	16.46	7.78	82	5.80	55.6	1.60	7.00	4.80	40	20	3450		0.0288	0.00578	0.406	0.27015	2240	0.00797
10/7	14.56	9.37	93	5.85		1.49	7.04	5.00	20	*0*	3650		0.0237	0.00928	0.424	0.26190	2270	0.0108
10/21	12.67	8.99	86	5.66	58.9	1.18	6.24	4.00	40	52	1110		0.0251	0.00825	0.434	0.42590	2460	0.0117
11/4	6.65	12.71	105	5.59	59.6	1.03	4.95	2.82	4	*0*	487		0.0193	0.0190	0.420	0.45215	2550	0.0146
11/18	4.08	18.59	145	6.24	58.5	0.917	4.71	2.65	6	10	860		0.0172	0.0244	0.377	0.33320	2300	0.00574
12/2	2.49	17.79	132	6.27	57.3	0.580	4.17	2.31	8	*0*	529		0.0174	0.0333	0.334	0.30240	2280	*0*
12/16	1.90	17.23	127	5.46	56.4	0.487	3.62	1.54	2	10	1560		0.0147	0.0480	0.311	0.29435	2120	0.00597
12/30	2.33	18.69	138	5.64	55.8	0.462	3.78	2.06	2	*0*	670		0.00769	0.0428	0.195	0.25360	2030	*0*
AVG.	11.46	11.43	100	5.83	61.6	0.916	5.94	3.89	6	6	2010		0.0193	0.0354	0.339	0.29131	2500	0.0173
MAX.	25.18	18.69	145	6.27	72.7	1.83	8.63	6.69	40	52	9800		0.0288	0.122	0.449	0.45215	3160	0.0865
MIN.	0.24	6.69	79	5.41	51.7	0.462	3.46	1.54	*<10*	*<10*	203		0.0077	*<0.005*	0.144	0.18415	1880	*<0.005*
MEDIAN	11.53	9.56	94	5.84	60.6	0.797	6.06	3.95	1	*<10*	985		0.0189	0.0141	0.336	0.28703	2500	0.00665

NOTES

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 2014
WARE RIVER AND TRIBUTARIES
(126A) MOOSEHORN POND BELOW OUTLET, AT HEALDVILLE ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/14	0.86	15.86	113	5.69	47.2	0.900	5.35	3.32	4	*0*	738		0.0170	0.0545	0.320	0.27020	2060	0.0639
1/28	-0.05	15.49	109	5.73	54.4	0.700	6.20	4.20	*0*	10	420		0.0176	0.0550	0.373	0.28205	2540	0.0819
2/11	-0.06	15.38	108	5.75	52.3	0.845	6.70	4.57	*0*	*0*	209		0.0182	0.0530	0.410	0.28110	2540	0.0906
2/25	0.09	14.51	102	5.85	56.0	1.09	6.59	4.61	*0*	*0*	369		0.0185	0.0660	0.387	0.27515	2380	0.112
3/11	0.27	14.90	105	6.09	57.7	0.888	6.95	4.94	*0*	*0*	246		0.0232	0.0667	0.360	0.26055	2530	0.0919
3/25	1.13	13.60	97	5.85	49.5	0.833	5.94	4.12	*0*	*0*	327		0.0205	0.0568	0.285	0.19690	1990	0.0374
4/8	5.12	12.13	96	5.37	41.2	0.709	3.60	1.71	2	*0*	341		0.0186	0.0192	0.180	0.21100	1650	*0*
4/22	11.16	8.78	80	5.56	44.9	0.570	4.35	2.37	*0*	*0*	1180		0.0143	0.0127	0.254	0.22745	1790	*0*
5/6	11.39	10.19	95	5.58	47.0	0.546	4.27	2.28	*0*	*0*	934		0.0101	*0*	0.311	0.24310	1820	*0*
5/20	15.55	8.99	91	5.55	51.5	0.840	4.64	2.56	6	41	1560		0.0218	0.00531	0.319	0.29760	2000	*0*
6/3	19.28	8.36	92	5.51	51.6	0.958	5.35	3.31	8	52	1470		0.0442	0.0191	0.341	0.29860	2040	*0*
6/17	20.65	6.94	78	5.70	52.4	1.31	6.07	4.05	16	31	3170		0.0268	0.0500	0.450	0.34485	2290	0.0110
7/1	23.29	7.59	90	5.75	50.2	1.49	7.14	5.07	4	41	1850		0.0366	0.0324	0.426	0.43205	2550	0.00929
7/15	23.60	7.59	91	5.67	52.2	1.26	7.03	4.89	*0*	31	3450		0.0365	0.0299	0.486	0.42695	2410	0.00926
7/29	20.83	8.06	93	5.77	47.1	1.12	7.09	5.04	20	41	5170		0.0270	0.00982	0.446	0.36760	2230	0.00648
8/12	21.02	7.60	86	5.99	47.4	0.945	7.13	5.20	*0*	*0*	2720		0.0275	0.0357	0.422	0.32720	2230	0.00690
8/26	19.62	7.97	88	5.73	47.7	0.704	6.31	4.19	20	20	1400		0.0208	0.0322	0.320	0.29705	2300	0.00746
9/9	17.78	7.94	85	5.78	50.8	0.874	7.58	5.60	10	30	3260		0.0251	0.0172	0.470	0.33350	2300	0.0064
9/23	12.94	9.61	93	5.72	43.0	0.626	5.90	3.87	20	63	2600		0.0230	0.00912	0.342	0.24645	1740	*0*
10/7	12.89	10.23	98	5.95	45.7	0.639	6.47	4.55	10	*0*	798		0.0198	*0*	0.375	0.29255	1970	*0*
10/21	10.01	11.41	103	5.51	51.2	0.562	5.11	3.19	10	10	1350		0.0184	*0*	0.348	0.34645	1970	*0*
11/4	4.78	15.37	121	5.78	48.5	0.507	4.26	2.31	*0*	*0*	909		0.0137	0.0136	0.319	0.35235	1870	0.00650
11/18	2.41	20.88	155	6.38	47.9	0.519	4.12	2.20	46	96	2990		0.0170	0.0242	0.357	0.36135	1800	*0*
12/2	1.76	18.46	134	5.98	47.8	0.541	4.28	2.43	12	*0*	836		0.0166	0.0314	0.308	0.30355	1940	*0*
12/16	1.32	17.27	125	5.59	47.8	0.448	3.86	1.96	*0*	*0*	670		0.0135	0.0293	0.232	0.28965	1880	0.0106
12/30	0.79	21.73	154	5.69	46.6	0.428	4.05	2.37	2	10	537		0.00935	0.0308	0.195	0.25995	1860	0.00621
AVG.	9.94	12.19	103	5.75	49.2	0.802	5.63	3.65	7	18	1520		0.0214	0.0290	0.348	0.30097	2100	0.0215
MAX.	23.60	21.73	155	6.38	57.7	1.49	7.58	5.60	46	96	5170		0.0442	0.0667	0.486	0.43205	2550	0.112
MIN.	-0.06	6.94	78	5.37	41.2	0.428	3.60	1.71	*<10*	*<10*	209		0.00935	*<0.005*	0.180	0.19690	1650	*<0.005*
MEDIAN	10.59	10.82	97	5.73	48.2	0.771	5.92	3.96	3	5	1060		0.0192	0.0296	0.345	0.29480	2020	0.00649

NOTES

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 2014
WARE RIVER AND TRIBUTARIES
(127) WAITE POND OUTLET AT DAM, AT HIGH BRIDGE ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/14	3.15	12.79	97	5.66	34.5	0.554	6.49	4.44	*0*	*0*	583		0.0137	0.0608	0.272	0.25020	2320	0.0328
1/28	1.38	16.97	124	5.91	32.2	0.408	6.01	4.12	*0*	*0*	495		0.0124	0.0744	0.217	0.19725	2110	0.0311
2/11	0.77	12.86	93	5.89	34.3	0.463	6.58	4.57	*0*	*0*	246		0.0118	0.103	0.192	0.15404	2470	0.0447
2/25	1.05	12.48	90	5.74	36.9	0.508	7.54	5.51	*0*	*0*	285		0.0116	0.0890	0.246	0.15379	2420	0.0757
3/11	1.52	10.29	75	5.66	40.5	0.516	8.54	6.51	*0*	*0*	216		0.0172	0.0909	0.235	0.15721	2760	0.0679
3/25	2.86	11.20	84	5.52	38.7	0.440	7.73	5.75	*0*	*0*	246		0.0139	0.0602	0.200	0.12633	2330	0.0242
4/8	4.73	12.70	100	5.17	26.3	0.477	4.51	2.65	*0*	10	464		0.0122	0.0266	0.169	0.14256	1590	*0*
4/22	11.08	8.11	74	5.50	32.1	0.515	4.93	2.99	4	10	1210		0.0104	0.0208	0.307	0.16626	1710	0.011
5/6	11.29	11.14	104	5.39	33.7	0.603	5.09	3.16	*0*	*0*	987		0.0142	0.0120	0.236	0.17215	1780	*0*
5/20	16.00	7.93	82	5.42	32.3	0.728	5.55	3.48	10	10	1610		0.0150	0.00836	0.246	0.19220	1900	0.00826
6/3	18.73	5.90	64	5.24	35.6	0.927	6.38	4.39	4	63	8660		0.0162	0.0178	0.328	0.21130	2030	0.0212
6/17	20.04	3.63	40	5.43	42.1	1.09	7.20	5.16	4	20	3450		0.0225	0.0256	0.446	0.23555	2250	0.0412
7/1	23.27	4.54	54	5.53	40.9	1.19	7.51	5.44	4	*0*	6130		0.0231	0.0135	0.406	0.23405	2370	0.0327
7/15	24.58	4.78	59	5.33	39.6	1.17	7.39	5.39	10	31	6870		0.0267	0.0138	0.495	0.20235	2130	0.0313
7/29	21.29	3.76	44	5.73	38.8	1.22	7.61	5.44	80	110	10500		0.0198	0.00704	0.470	0.28750	2200	0.0197
8/12	20.69	2.80	32	5.68	51.1	1.40	8.99	6.86	60	52	3280		0.0224	*0*	0.514	0.34395	2440	0.0220
8/26	19.11	2.88	32	5.47	54.1	1.34	8.56	6.38	20	10	3610		0.0234	0.00606	0.433	0.28790	2400	0.0184
9/9	17.48	2.61	28	5.48	51.5	1.47	8.51	6.35	60	63	3870		0.0244	0.00698	0.613	0.34810	2260	0.0285
9/23	13.57	5.44	54	5.25	35.0	1.72	6.62	4.58	50	85	8160		0.0249	0.00959	0.442	0.23220	1800	0.0249
10/7	12.31	5.91	56	5.54	44.6	1.13	8.07	5.93	10	10	2060		0.0212	*0*	0.514	0.28350	2060	0.0187
10/21	10.56	8.04	73	5.31	32.5	1.16	6.26	4.37	30	20	2490		0.0186	0.00573	0.403	0.25020	1750	0.0157
11/4	5.03	12.46	99	5.76	39.4	1.63	6.01	3.99	4	*0*	1130		0.0211	0.0201	0.479	0.29140	1940	0.0321
11/18	3.50	20.84	160	6.38	34.1	0.958	6.09	4.12	*0*	10	1920		0.0163	0.0408	0.464	0.26770	1990	0.0314
12/2	2.57	16.52	123	6.12	33.8	0.615	5.69	3.78	*0*	*0*	573		0.0150	0.0387	0.357	0.24020	2120	0.0142
12/16	1.98	17.36	128	5.59	31.5	0.550	4.97	2.96	*0*	*0*	860		0.0134	0.0554	0.378	0.26275	2040	0.0145
12/30	2.10	19.69	145	5.65	32.0	0.492	4.94	3.13	*0*	*0*	404		0.00787	0.0519	0.184	0.20795	1930	0.00954
AVG.	10.41	9.76	81	5.59	37.6	0.895	6.68	4.67	13	19	2700		0.0173	0.0330	0.356	0.22687	2120	0.0258
MAX.	24.58	20.84	160	6.38	54.1	1.72	8.99	6.86	80	110	10500		0.0267	0.103	0.613	0.34810	2760	0.0757
MIN.	0.77	2.61	28	5.17	26.3	0.408	4.51	2.65	*<10*	*<10*	216		0.00787	*<0.005*	0.169	0.12633	1590	*<0.005*
MEDIAN	10.82	9.20	78	5.54	35.3	0.828	6.54	4.51	4	10	1410		0.0163	0.0205	0.368	0.23313	2115	0.0231

NOTES
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 2014
WARE RIVER AND TRIBUTARIES
(128) LOVEWELL POND OUTLET BELOW DAM, AT GRIMES ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/14	3.81	12.93	99	5.65	60.9	0.960	5.99	3.90	*0*	10	1110		0.0228	0.0612	0.448	0.40640	2820	0.0491
1/28	3.26	13.03	100	5.66	60.9	0.873	6.61	4.44	*0*	*0*	723		0.0211	0.0649	0.426	0.36030	2900	0.0540
2/11	3.06	12.14	93	5.75	61.3	1.01	7.83	5.74	*0*	*0*	836		0.0227	0.0452	0.484	0.35095	2840	0.0873
2/25	2.57	11.79	89	5.73	65.0	1.23	7.95	5.72	*0*	*0*	166		0.0235	0.0386	0.457	0.36500	2940	0.110
3/11	3.27	11.00	84	5.59	70.6	1.94	8.60	6.43	*0*	*0*	836		0.0342	0.0455	0.496	0.35715	3230	0.123
3/25	0.26	11.44	80	5.84	100.4	0.880	7.92	5.80	3	20	5170		0.0226	0.144	*0*	0.22225	4460	0.0823
4/8	4.49	11.74	92	5.49	46.4	0.800	4.68	2.78	*0*	*0*	313		0.0218	0.0377	0.231	0.23385	1860	*0*
4/22	11.70	9.80	90	5.65	51.8	0.780	4.19	2.06	*0*	*0*	565		0.0165	0.00763	0.254	0.24475	1860	*0*
5/6	12.22	8.94	85	5.67	58.0	0.722	3.97	1.91	*0*	*0*	1080		0.0194	*0*	0.312	0.25325	2070	*0*
5/20	17.40	8.71	92	5.57	62.5	0.710	3.87	1.83	*0*	*0*	9210		0.0185	0.00531	0.270	0.26920	2110	*0*
6/3	21.00	7.37	84	5.45	66.2	0.444	3.78	1.80	4	10	8660		0.0173	0.0176	0.292	0.28515	2070	0.0140
6/17	21.38	6.05	69	5.43	68.9	0.494	4.24	2.25	*0*	10	7700		0.0212	0.0637	0.375	0.31000	2300	0.0344
7/1	23.13	6.50	77	5.42	71.7	0.714	5.00	3.13	4	20	4350		0.0328	0.106	0.392	0.32390	2750	0.0330
7/15	24.58	6.77	83	5.48	68.5	1.55	4.89	2.90	20	20	6130		0.0424	0.0559	0.506	0.33365	2330	0.0275
7/29	22.61	7.37	88	5.61	66.4	0.748	4.98	2.92	10	20	2990		0.0203	0.0248	0.363	0.33175	2230	0.0160
8/12	22.23	6.30	73	6.24	69.7	0.509	4.45	2.52	*0*	10	1970		0.0191	0.0519	0.360	0.28570	2300	0.00880
8/26	20.54	6.82	77	5.59	69.0	0.492	4.80	2.75	*0*	*0*	2060		0.0170	0.0719	0.259	0.25600	2410	0.0110
9/9	19.95	7.31	82	5.73	68.4	0.563	4.62	2.72	40	20	4610		0.0168	0.0470	0.406	0.24365	2250	0.00954
9/23	14.91	8.87	90	5.73	66.6	0.623	4.60	2.64	10	20	4610		0.0168	0.0160	0.287	0.22090	2110	0.00773
10/7	14.35	10.32	103	5.84	65.6	0.840	4.63	2.72	10	10	1190		0.0157	0.0171	0.349	0.21865	2110	0.0193
10/21	12.26	10.05	95	5.54	62.3	0.841	4.49	2.47	10	20	1560		0.0176	0.0245	0.364	0.28020	2040	0.0315
11/4	5.76	14.04	114	5.72	57.6	0.956	4.42	2.38	4	*0*	1090		0.0158	0.0344	0.508	0.36620	2010	0.0946
11/18	3.90	19.42	150	6.16	57.4	0.888	4.44	2.40	4	10	1300		0.0177	0.0491	0.509	0.35090	2100	0.129
12/2	2.22	17.61	130	6.18	57.9	0.749	4.31	2.35	*0*	*0*	650		0.0178	0.0593	0.509	0.32865	2090	0.102
12/16	2.31	16.38	122	5.55	55.0	0.643	4.10	2.11	2	*0*	557		0.0150	0.0523	0.386	0.35865	2140	0.0975
12/30	1.57	20.23	146	5.72	56.4	0.601	4.15	2.35	*0*	*0*	389		0.0116	0.0591	0.313	0.32400	2070	0.0844
AVG.	11.34	10.88	96	5.69	64.1	0.829	5.14	3.12	5	8	2690		0.0207	0.0462	0.368	0.30312	2400	0.0472
MAX.	24.58	20.23	150	6.24	100.4	1.94	8.60	6.43	40	20	9210		0.0424	0.144	0.509	0.40640	4460	0.129
MIN.	0.26	6.05	69	5.42	46.4	0.444	3.78	1.80	*<10*	*<10*	166		0.0116	*<0.005*	*<0.100*	0.21865	1860	*<0.005*
MEDIAN	11.96	10.19	90	5.66	63.8	0.765	4.61	2.68	*<10*	5	1245		0.0188	0.0463	0.370	0.31695	2185	0.0323

NOTES
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 2014
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
1/14	0.25	16.75	117	6.10	87.9	0.769			4	10	759					0.19650	3300	
1/28	-0.02	15.36	108	5.96	105.4	0.693			*0*	*0*	185					0.16719	4510	
2/11	-0.08	15.40	108	6.10	102.1	0.789			*0*	*0*	185					0.15618	4380	
2/25	0.10	14.49	102	6.27	110.7	0.780			*0*	10	275					0.15452	4390	
3/11	0.15	14.12	99	6.28	123.1	0.753			*0*	10	146					0.14447	5250	
3/25	0.13	13.92	97	6.02	100.7	0.832			2	*0*	228		0.0204	0.0867	0.239	0.13958	3560	0.0169
4/8	5.54	11.88	95	5.71	71.7	0.533			4	*0*	269					0.14969	2380	
4/22	11.06	9.99	91	5.82	81.6	0.558			*0*	20	857					0.16974	2930	
5/6	11.38	10.81	101	5.86	79.0	0.556			4	*0*	860					0.18335	2680	
5/20	15.41	9.04	92	5.81	79.1	0.989			4	41	1780					0.24880	2880	
6/3	18.26	8.38	90	5.81	86.4	1.53			28	52	2380					0.20400	3320	
6/17	20.91	6.75	77	6.04	89.6	2.19			52	216	2380		0.0240	0.0419	0.452	0.24305	3820	0.0181
7/1	23.80	6.98	84	5.95	104.9	2.61			12	98	2720					0.27935	5010	
7/15	24.26	7.12	87	5.98	105.5	2.43			140	175	6130					0.39810	4820	
7/29	21.09	7.55	88	6.03	107.0	3.27			20	84	9800					0.30820	5030	
8/12	21.46	7.18	82	6.09	99.0	2.83			70	63	3280					0.25185	4560	
8/26	19.57	6.82	75	5.97	109.5	2.34			*0*	41	2910					0.24170	5050	
9/9	17.86	6.79	73	6.02	110.8	2.46			20	20	4110		0.0260	0.0116	0.444	0.32155	4910	0.0125
9/23	13.73	8.44	83	6.00	104.7	1.98			60	132	5480					0.25435	4160	
10/7	12.40	10.33	98	6.06	110.1	1.61			*0*	20	1660					0.25565	4610	
10/21	10.07	10.23	92	5.87	90.1	1.31			20	10	1280					0.42410	3460	
11/4	4.40	14.57	114	6.01	85.3	0.87			12	20	1070						3270	
11/18	3.41	19.96	153	6.27	92.2	1.11			80	97	4350					0.25860	3500	
12/2	1.67	18.45	134	6.57	84.6	0.561			16	10	1050					0.22285	3380	
12/16	1.37	17.02	123	5.93	76.0	0.469			*0*	10	697		0.0123	0.0492	0.208	0.21525	2960	*0*
12/30	0.52	20.97	147	5.92	72.6	0.466			*0*	*0*	301					0.18035	2820	
AVG.	9.95	11.90	100	6.02	95.0	1.36			21	44	2120		0.0207	0.0474	0.336	0.23076	3880	0.0119
MAX.	24.26	20.97	153	6.57	123.1	3.27			140	216	9800		0.0260	0.0867	0.452	0.42410	5250	0.0181
MIN.	-0.08	6.75	73	5.71	71.7	0.466			*<10*	*<10*	146		0.0123	0.0116	0.208	0.13958	2380	*<0.005*
MEDIAN	10.57	10.57	96	6.01	95.6	0.928			4	20	1180		0.0222	0.0456	0.342	0.22285	3690	0.0147

NOTES

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 2014
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
1/14	2.74	12.88	96	6.18	252.0	0.624			*0*	10	279					0.16333	10400	
1/28	0.11	12.37	88	6.26	286.9	0.590			*0*	*0*	30					0.15506	11100	
2/11	0.11	12.03	85	6.35	325.9	0.548			*0*	*0*	75					0.14453	11900	
2/25	0.13	10.63	75	6.51	353.5	0.592			*0*	*0*	134					0.12405	12300	
3/11	0.65	10.51	75	6.60	358.8	0.705			4	20	108					0.11955	13800	
3/25	1.49	10.26	74	6.23	304.8	0.724			*0*	*0*	52		0.0166	0.0734	0.236	0.14595	8950	0.0198
4/8	6.09	10.28	84	6.10	176.1	0.525			*0*	*0*	85					0.15687	5910	
4/22	11.95	8.36	77	6.08	228.2	0.605			*0*	10	520					0.12583	8590	
5/6	12.03	9.51	90	6.09	207.5	0.512			4	10	265					0.14384	8200	
5/20	16.84	5.75	60	6.02	211.4	0.849			10	41	1080					0.17521	9000	
6/3	18.39	5.39	58	5.97	217.6	1.09			40	148	3870					0.21475	9650	
6/17	19.77	3.52	39	6.02	230.3	1.47			60	171	17300		0.0166	0.0173	0.459	0.23800	11800	0.0131
7/1	22.47	2.30	27	6.01	254.3	3.88			116	201	8660					0.26000	13600	
7/15	24.11	2.30	28	5.83	209.8	3.85			70	318	13000					0.23960	10200	
7/29	20.98	3.04	35	5.83	204.6	2.77			60	169	14100					0.23310	10500	
8/12	20.39	4.01	45	5.98	223.0	1.90			80	110	14100					0.24250	11400	
8/26	18.24	1.84	20	6.07	236.3	1.98			10	10	8660					0.29840	12900	
9/9	17.62	1.38	15	5.93	219.9	4.79			*0*	*0*	3650		0.0350	*0*	0.526	0.39750	11400	*0*
9/23	13.00	3.16	31	5.79	210.5	1.64			10	20	4110					0.18430	10100	
10/7	11.74	3.24	30	6.06	227.4	1.40			10	10	1920					0.25665	10700	
10/21	9.68	2.87	26	5.69	204.1	1.70			*0*	31	1780					0.24720	8260	
11/4	4.38	9.97	78	6.15	192.8	0.571			*0*	*0*	867					0.18000	8130	
11/18	3.57	17.35	133	6.75	202.0	0.747			74	121	5790					0.19455	8800	
12/2	2.37	14.54	108	6.83	208.3	0.471			*0*	*0*	591					0.19925	8410	
12/16	1.08	15.46	111	6.34	205.2	0.443			*0*	*0*	146		0.0129	0.0806	0.307	0.18715	8770	0.00796
12/30	1.38	16.62	120	6.33	233.2	0.332			*0*	*0*	201					0.14846	10200	
AVG.	10.05	8.06	66	6.15	237.9	1.36			21	54	3900		0.0203	0.0428	0.382	0.19906	10190	0.0102
MAX.	24.11	17.35	133	6.83	358.8	4.79			116	318	17300		0.0350	0.0806	0.526	0.39750	13800	0.0198
MIN.	0.11	1.38	15	5.69	176.1	0.332			*<10*	*<10*	30		0.0129	*<0.005*	0.236	0.11955	5910	*<0.005*
MEDIAN	10.71	8.94	74	6.09	221.5	0.736			2	10	974		0.0166	0.0454	0.383	0.185725	10200	0.0105

NOTES

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Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
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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 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	1/1	5.1	6.51	*0*	30	1	
WABWTF	1/2	5.3	6.64	*0*	22	*0*	
WABWTF	1/3	3.7	6.54	10	42	10.8	
WABWTF	1/4	4.2	6.58	11	32	12.1	
WABWTF	1/5	4.2	6.51	9	29	6.3	
WABWTF	1/6	4.4	6.50	8	28	8.6	
WABWTF	1/7	3.7	6.78	1	37	2	
WABWTF	1/8	3.8	6.59	*0*	30	6.3	
WABWTF	1/9	3.8	6.51	1	25	2	
WABWTF	1/10	3.7	6.52	*0*	14	*0*	
WABWTF	1/11	3.3	6.58	*0*	12	*0*	
WABWTF	1/12	3.8	6.53	*0*	50	1	
WABWTF	1/13	3.6	6.55	1	17	1	
WABWTF	1/14	3.5	6.82	*0*	7	1	
WABWTF	1/15	3.8	6.55	*0*	14	*0*	
WABWTF	1/16	3.8	6.79	*0*	16	*0*	
WABWTF	1/17	3.5	6.73	3	13	4.1	
WABWTF	1/18	3.9	6.70	1	6	2	
WABWTF	1/19	3.0	6.71	1	5	*0*	
WABWTF	1/20	3.5	6.72	*0*	5	*0*	
WABWTF	1/21	2.9	6.70	*0*	4	2	
WABWTF	1/22	2.0	6.56	2	12	4.1	
WABWTF	1/23	2.0	6.69	*0*	6	4.1	
WABWTF	1/24	1.7	6.46	*0*	5	1	
WABWTF	1/25	2.3	6.64	*0*	8	3.1	
WABWTF	1/26	2.4	6.70	1	8	*0*	
WABWTF	1/27	1.7	6.52	*0*	2	*0*	
WABWTF	1/28	2.0	6.87	*0*	2	*0*	
WABWTF	1/29	1.7	6.63	*0*	2	*0*	
WABWTF	1/30	2.0	6.53	1	3	*0*	
WABWTF	1/31	2.1	6.56	*0*	1	*0*	
WABWTF	2/1	2.1	6.65	*0*	4	1	
WABWTF	2/2	1.9	6.63	*0*	2	*0*	
WABWTF	2/3	2.1	6.61	1	2	*0*	
WABWTF	2/4	2.1	6.86	*0*	1	*0*	
WABWTF	2/5	2.1	6.58	*0*	1	*0*	
WABWTF	2/6	1.8	6.57	*0*	4	*0*	
WABWTF	2/7	1.9	6.62	*0*	2	1	
WABWTF	2/8	2.0	6.62	*0*	2	*0*	
WABWTF	2/9	1.9	6.58	*0*	2	*0*	
WABWTF	2/10	1.9	6.52	*0*	1	*0*	
WABWTF	2/11	2.2	6.69	*0*	1	*0*	
WABWTF	2/12	1.9	6.53	*0*	1	1	
WABWTF	2/13	2.0	6.49	*0*	*0*	*0*	
WABWTF	2/14	2.0	6.48	*0*	*0*	*0*	
WABWTF	2/15	2.0	6.57	*0*	1	*0*	
WABWTF	2/16	1.9	6.50	*0*	2	*0*	
WABWTF	2/17	2.0	6.50	*0*	1	*0*	
WABWTF	2/18	2.5	6.83	*0*	3	1	
WABWTF	2/19	1.9	6.46	*0*	2	*0*	
WABWTF	2/20	2.0	6.55	*0*	*0*	*0*	

QUABBIN LABORATORY RECORDS 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	2/21	2.1	6.52	*0*	1	*0*	
WABWTF	2/22	2.1	6.45	*0*	2	*0*	
WABWTF	2/23	2.5	6.48	*0*	1	*0*	
WABWTF	2/24	2.1	6.44	*0*	3	*0*	
WABWTF	2/25	2.6	6.74	*0*	*0*	*0*	
WABWTF	2/26	2.1	6.54	*0*	1	*0*	
WABWTF	2/27	2.4	6.58	*0*	1	*0*	
WABWTF	2/28	2.6	6.84	*0*	1	*0*	
WABWTF	3/1	2.4	6.38	*0*	1	*0*	
WABWTF	3/2	2.1	6.41	*0*	*0*	*0*	
WABWTF	3/3	2.4	6.78	*0*	2	*0*	
WABWTF	3/4	2.8	6.86	*0*	2	*0*	
WABWTF	3/5	2.2	6.59	*0*	*0*	*0*	
WABWTF	3/6	2.4	6.59	*0*	2	*0*	
WABWTF	3/7	2.9	6.79	*0*	2	*0*	
WABWTF	3/8	2.5	6.65	*0*	*0*	*0*	
WABWTF	3/9	2.3	6.63	*0*	1	*0*	
WABWTF	3/10	2.5	6.82	*0*	1	*0*	
WABWTF	3/11	2.9	6.99	*0*	1	*0*	
WABWTF	3/12	2.6	6.51	*0*	*0*	*0*	
WABWTF	3/13	2.6	6.61	*0*	3	*0*	
WABWTF	3/14	2.6	6.75	*0*	1	*0*	
WABWTF	3/15	2.5	6.58	*0*	3	1	
WABWTF	3/16	2.9	6.65	*0*	2	*0*	
WABWTF	3/17	2.6	6.55	*0*	4	*0*	
WABWTF	3/18	3.4	6.77	*0*	3	*0*	
WABWTF	3/19	2.7	6.56	*0*	*0*	*0*	
WABWTF	3/20	2.9	6.56	*0*	3	1	
WABWTF	3/21	2.9	6.63	*0*	2	*0*	
WABWTF	3/22	3.0	6.53	*0*	2	*0*	
WABWTF	3/23	2.8	6.56	*0*	1	*0*	
WABWTF	3/24	2.8	6.57	*0*	4	4.1	
WABWTF	3/25	3.2	6.68	*0*	1	*0*	
WABWTF	3/26	3.1	6.51	*0*	1	1	
WABWTF	3/27	3.2	6.53	*0*	1	*0*	
WABWTF	3/28	3.3	6.60	*0*	2	*0*	
WABWTF	3/29	3.5	6.54	*0*	1	*0*	
WABWTF	3/30	3.3	6.53	*0*	1	*0*	
WABWTF	3/31	3.4	6.80	*0*	2	*0*	
WABWTF	4/1	3.2	6.73	*0*	3	*0*	
WABWTF	4/2	3.3	6.75	*0*	3	1	
WABWTF	4/3	3.5	6.49	*0*	3	*0*	
WABWTF	4/4	3.5	6.70	*0*	6	*0*	
WABWTF	4/5	3.8	6.52	*0*	2	*0*	
WABWTF	4/6	3.8	6.54	*0*	3	*0*	
WABWTF	4/7	3.7	6.76	*0*	2	*0*	
WABWTF	4/8	4.1	6.75	*0*	*0*	*0*	
WABWTF	4/9	3.9	6.44	*0*	2	*0*	
WABWTF	4/10	4.0	6.49	*0*	5	*0*	
WABWTF	4/11	4.0	6.45	*0*	2	*0*	
WABWTF	4/12	4.3	6.56	*0*	1	*0*	

QUABBIN LABORATORY RECORDS 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	4/13	4.9	6.50	*0*	1	*0*	
WABWTF	4/14	4.7	6.51	*0*	2	*0*	
WABWTF	4/15	4.6	6.79	*0*	1	*0*	
WABWTF	4/16	4.9	6.48	*0*	14	2	
WABWTF	4/17	5.6	6.48	*0*	4	*0*	
WABWTF	4/18	5.3	6.43	*0*	3	*0*	
WABWTF	4/19	5.7	6.50	*0*	3	*0*	
WABWTF	4/20	6.1	6.51	*0*	4	*0*	
WABWTF	4/21	5.9	6.56	*0*	2	*0*	
WABWTF	4/22	5.3	6.80	*0*	5	*0*	
WABWTF	4/23	5.8	6.52	*0*	1	1	
WABWTF	4/24	6.1	6.54	*0*	14	2	
WABWTF	4/25	6.3	6.52	*0*	5	*0*	
WABWTF	4/26	6.3	6.59	*0*	4	*0*	
WABWTF	4/27	6.1	6.60	*0*	3	*0*	
WABWTF	4/28	6.8	6.64	*0*	10	*0*	
WABWTF	4/29	6.8	6.65	*0*	5	*0*	
WABWTF	4/30	7.0	6.59	*0*	6	*0*	
WABWTF	5/1	7.0	6.68	*0*	2	*0*	
WABWTF	5/2	7.2	6.63	*0*	4	*0*	
WABWTF	5/3	7.3	6.59	*0*	5	*0*	
WABWTF	5/4	6.9	6.62	*0*	10	*0*	
WABWTF	5/5	7.4	6.65	*0*	4	*0*	
WABWTF	5/6	7.7	6.79	*0*	10	*0*	
WABWTF	5/7	8.1	6.67	*0*	4	*0*	
WABWTF	5/8	8.2	6.62	*0*	11	*0*	
WABWTF	5/9	7.9	6.60	*0*	3	*0*	
WABWTF	5/10	7.9	6.64	*0*	6	*0*	
WABWTF	5/11	7.5	6.61	1	5	*0*	
WABWTF	5/12	7.4	6.84	*0*	4	*0*	
WABWTF	5/13	8.1	6.77	*0*	7	*0*	
WABWTF	5/14	8.1	6.64	*0*	10	*0*	
WABWTF	5/15	7.7	6.57	*0*	1	*0*	
WABWTF	5/16	7.9	6.60	*0*	3	*0*	
WABWTF	5/17	7.9	6.54	*0*	11	1	
WABWTF	5/18	8.8	6.70	2	140	5.2	
WABWTF	5/19	8.3	6.65	1	61	4.1	
WABWTF	5/20	8.9	6.82	*0*	50	*0*	
WABWTF	5/21	8.8	6.62	*0*	34	*0*	
WABWTF	5/22	8.4	6.65	*0*	30	1	
WABWTF	5/23	8.4	6.63	*0*	13	1	
WABWTF	5/24	10.5	6.61	*0*	16	*0*	
WABWTF	5/25	9.2	6.64	*0*	19	1	
WABWTF	5/26	8.5	6.64	*0*	18	1	
WABWTF	5/27	9.3	6.82	*0*	13	2	
WABWTF	5/28	10.3	6.58	*0*	13	*0*	
WABWTF	5/29	9.2	6.61	*0*	12	*0*	
WABWTF	5/30	8.4	6.61	*0*	12	1	
201	5/31	9.1	6.73	*0*	3	*0*	
201	6/1	8.9	6.75	*0*	6	*0*	
201	6/2	8.4	6.65	*0*	2	*0*	

QUABBIN LABORATORY RECORDS 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
201	6/3	8.8	6.74	0	9	0	
201	6/4	9.8	6.60	0	5	0	
201	6/5	8.7	6.70	0	6	0	
201	6/6	8.6	6.65	0	6	0	
WABWTF	6/7	8.9	6.64	0	12	0	
WABWTF	6/8	8.9	6.53	0	11	0	
WABWTF	6/9	9.2	6.61	0	17	0	
WABWTF	6/10	9.5	6.87	0	25	0	
WABWTF	6/11	9.3	6.60	0	28	0	
WABWTF	6/12	9.1	6.58	0	24	0	
WABWTF	6/13	9.6	6.61	2	42	0	
WABWTF	6/14	9.6	6.55	0	26	0	
WABWTF	6/15	9.1	6.60	0	36	0	
WABWTF	6/16	9.0	6.66	0	28	0	
WABWTF	6/17	9.9	6.88	0	30	0	
WABWTF	6/18	9.6	6.55	0	23	0	
WABWTF	6/19	9.9	6.58	0	23	0	
WABWTF	6/20	9.4	6.50	0	27	0	
WABWTF	6/21	9.6	6.55	0	36	0	
WABWTF	6/22	9.5	6.51	0	40	0	
WABWTF	6/23	10.7	6.58	0	39	0	
WABWTF	6/24	9.7	6.80	0	64	0	
WABWTF	6/25	9.3	6.56	1	79	1	
WABWTF	6/26	10.2	6.63	0	73	0	
WABWTF	6/27	9.8	6.85	0	56	0	
WABWTF	6/28	10.1	6.63	0	73	0	
WABWTF	6/29	10.0	6.56	0	58	0	
WABWTF	6/30	9.9	6.58	0	32	0	
WABWTF	7/1	10.1	6.77	0	30	0	
WABWTF	7/2	10.1	6.55	0	45	0	
WABWTF	7/3	9.9	6.56	0	29	0	
WABWTF	7/4	10.3	6.58	0	31	0	
WABWTF	7/5	10.3	6.61	0	33	1	
WABWTF	7/6	9.5	6.56	0	50	0	
WABWTF	7/7	10.3	6.61	0	32	0	
WABWTF	7/8	10.3	6.73	0	28	0	
WABWTF	7/9	10.4	6.56	0	61	0	
WABWTF	7/10	10.7	6.58	0	59	0	
WABWTF	7/11	10.3	6.56	0	86	0	
WABWTF	7/12	10.5	6.55	0	96	0	
WABWTF	7/13	10.7	6.67	0	102	0	
WABWTF	7/14	10.7	6.52	0	285	0	
WABWTF	7/15	10.7	6.74	0	238	0	
WABWTF	7/16	10.6	6.63	0	261	0	
WABWTF	7/17	10.6	6.65	0	326	0	
WABWTF	7/18	11.2	6.76	0	276	0	
WABWTF	7/19	13.4	6.73	0	261	0	
WABWTF	7/20	11.0	6.60	0	285	0	
WABWTF	7/21	10.4	6.58	0	411	0	
WABWTF	7/22	10.9	6.74	0	249	0	
WABWTF	7/23	10.6	6.62	0	236	0	

QUABBIN LABORATORY RECORDS 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	7/24	11.0	6.59	*0*	196	*0*	
WABWTF	7/25	10.7	6.57	*0*	194	*0*	
WABWTF	7/26	11.1	6.59	*0*	219	*0*	
WABWTF	7/27	11.3	6.52	*0*	345	*0*	
WABWTF	7/28	11.7	6.56	*0*	411	*0*	
WABWTF	7/29	11.7	6.71	*0*	308	*0*	
WABWTF	7/30	10.9	6.48	*0*	365	*0*	
WABWTF	7/31	11.2	6.61	*0*	387	*0*	
WABWTF	8/1	11.5	6.57	*0*	240	*0*	
WABWTF	8/2	11.4	6.51	*0*	272	*0*	
WABWTF	8/3	10.9	6.57	*0*	210	*0*	
WABWTF	8/4	11.2	6.67	*0*	185	*0*	
WABWTF	8/5	11.6	6.67	*0*	184	*0*	
WABWTF	8/6	11.6	6.53	*0*	276	*0*	
WABWTF	8/7	11.3	6.56	*0*	261	*0*	
WABWTF	8/8	11.4	6.49	*0*	194	*0*	
WABWTF	8/9	11.3	6.42	*0*	186	*0*	
WABWTF	8/10	11.5	6.49	*0*	179	*0*	
WABWTF	8/11	11.8	6.49	*0*	249	*0*	
WABWTF	8/12	11.9	6.64	1	166	*0*	
WABWTF	8/13	12.3	6.52	*0*	1120	*0*	
WABWTF	8/14	11.3	6.66	*0*	365	*0*	
WABWTF	8/15	11.9	6.57	*0*		*0*	>2420
WABWTF	8/16	11.5	6.45	1	229	*0*	
WABWTF	8/17	12.3	6.49	*0*	357	*0*	
WABWTF	8/18	11.8	6.65	*0*	374	*0*	
WABWTF	8/19	11.7	6.65	*0*	217	*0*	
WABWTF	8/20	11.9	6.48	*0*	332	*0*	
WABWTF	8/21	12.3	6.51	*0*	394	*0*	
WABWTF	8/22	12.0	6.49	*0*	3970	*0*	
WABWTF	8/23	12.2	6.49	*0*	352	*0*	
WABWTF	8/24	11.6	6.30	*0*	384	*0*	
WABWTF	8/25	11.7	6.64	*0*	373	*0*	
WABWTF	8/26	12.0	6.66	*0*	839	*0*	
WABWTF	8/27	11.9	6.23	*0*	354	*0*	
WABWTF	8/28	12.7	6.49	*0*	4180	*0*	
WABWTF	8/29	12.1	6.40	*0*	279	*0*	
WABWTF	8/30	12.3	6.38	*0*	3680	*0*	
WABWTF	8/31	12.3	6.34	*0*	634	*0*	
WABWTF	9/1	12.9	6.41	*0*	689	*0*	
WABWTF	9/2	12.9	6.68	*0*	740	*0*	
WABWTF	9/3	12.7	6.43	*0*	899	*0*	
WABWTF	9/4	12.5	6.46	*0*	744	*0*	
WABWTF	9/5	13.3	6.52	*0*	857	*0*	
WABWTF	9/6	12.5	6.49	*0*	542	*0*	
WABWTF	9/7	13.3	6.45	*0*	1100	*0*	
WABWTF	9/8	12.7	6.43	*0*	1100	*0*	
WABWTF	9/9	13.3	6.80	*0*	2910	*0*	
WABWTF	9/10	13.2	6.50	*0*	1740	*0*	
WABWTF	9/11	12.3	6.35	*0*	1640	*0*	
WABWTF	9/12	14.5	6.44	*0*	2910	*0*	

QUABBIN LABORATORY RECORDS 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	9/13	13.7	6.33	0	3080	0	
WABWTF	9/14	13.9	6.46	0	1640	0	
WABWTF	9/15	12.8	6.40	0	1230	0	
WABWTF	9/16	12.8	6.57	0	1640	0	
WABWTF	9/17	13.5	6.44	0	2320	0	
WABWTF	9/18	13.4	6.42	0	1640	0	
WABWTF	9/19	17.3	6.74	0	9680	0	
WABWTF	9/20	12.9	6.34	0	1230	0	
WABWTF	9/21	14.2	6.43	0	1950	0	
WABWTF	9/22	13.9	6.48	0	1740	0	
WABWTF	9/23	13.0	6.54	0	1300	0	
WABWTF	9/24	14.4	6.45	0	2070	0	
WABWTF	9/25	14.5	6.45	0	1840	0	
WABWTF	9/26	17.3	6.44	0	2070	4	
WABWTF	9/27	15.4	6.43	1	2450	0	
WABWTF	9/28	13.7	6.33	0	1100	0	
WABWTF	9/29	14.1	6.41	0	1300	0	
WABWTF	9/30	15.7	6.60	0	1380	0	
WABWTF	10/1	16.8	6.46	0	1640	0	
WABWTF	10/2	18.9	6.53	0	2600	4	
WABWTF	10/3	17.4	6.42	1	2450	0	
WABWTF	10/4	14.1	6.31	0	1950	0	
WABWTF	10/5	15.3	6.37	0	3080	0	
WABWTF	10/6	14.0	6.34	0	2190	0	
WABWTF	10/7	12.6	6.44	0	6210	0	
WABWTF	10/8	12.9	6.49	0	5650	0	
WABWTF	10/9	15.4	6.24	0	5200	4	
WABWTF	10/10	13.7	6.29	0	6930	0	
WABWTF	10/11	15.5	6.37	0	5650	0	
WABWTF	10/12	15.5	6.25	0	4810	0	
WABWTF	10/13	15.4	6.35	0	4480	0	
WABWTF	10/14	13.3	6.41	0	5650	0	
WABWTF	10/15	14.4	6.28	0		0	>9680
WABWTF	10/16	15.7	6.33	0	9800	0	
WABWTF	10/17	15.3	6.65	2	9800	0	
WABWTF	10/18	15.7	6.33	0	6490	0	
WABWTF	10/19	17.4	6.54	1	7700	0	
WABWTF	10/20	16.9	6.52	1	5170	0	
WABWTF	10/21	15.1	6.62	1	4610	0	
WABWTF	10/22	16.9	6.57	0	1790	0	
WABWTF	10/23	16.2	6.40	0	1990	0	
WABWTF	10/24	15.9	6.52	1	1270	0	
WABWTF	10/25	15.7	6.50	0	1720	0	
WABWTF	10/26	15.4	6.55	1	1190	0	
WABWTF	10/27	15.3	6.46	0	1040	0	
WABWTF	10/28	14.4	6.84	1	744	0	
WABWTF	10/29	14.7	6.39	0	593	8	
WABWTF	10/30	14.6	6.32	0	714	0	
WABWTF	10/31	14.7	6.48	0	500	0	
WABWTF	11/1	14.7	6.54	0	325	0	
WABWTF	11/2	13.7	6.47	1	744	4	

QUABBIN LABORATORY RECORDS 2014
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	11/3	13.2	6.47	1	442	*0*	
WABWTF	11/4	12.9	6.58	*0*	432	*0*	
WABWTF	11/5	12.9	6.48	2	282	4	
WABWTF	11/6	12.8	6.34	*0*	245	*0*	
WABWTF	11/7	12.8	6.36	*0*	182	*0*	
WABWTF	11/8	12.6	6.45	2	233	*0*	
WABWTF	11/9	12.5	6.40	1	189	*0*	
WABWTF	11/10	12.2	6.48	*0*	113	*0*	
WABWTF	11/11	12.2	6.50	*0*	150	*0*	
WABWTF	11/12	12.0	6.70	1	131	*0*	
WABWTF	11/13	12.2	6.49	*0*	108	1	
WABWTF	11/14	12.0	6.45	*0*	101	*0*	
WABWTF	11/15	11.6	6.48	1	101	*0*	
WABWTF	11/16	11.5	6.50	*0*	102	*0*	
WABWTF	11/17	11.0	6.74	*0*	93	*0*	
WABWTF	11/18	10.7	6.76	*0*	75	*0*	
WABWTF	11/19	10.7	6.50	*0*	76	*0*	
WABWTF	11/20	10.7	6.57	*0*	62	*0*	
WABWTF	11/21	10.0	6.79	*0*	66	*0*	
WABWTF	11/22	10.2	6.51	*0*	59	*0*	
WABWTF	11/23	10.0	6.55	*0*	96	*0*	
WABWTF	11/24	10.2	6.54	*0*	75	*0*	
WABWTF	11/25	10.1	6.51	*0*	76	*0*	
WABWTF	11/26	9.9	6.57	*0*	58	*0*	
WABWTF	11/27	9.5	6.56	2	69	3.1	
WABWTF	11/28	8.9	6.80	2	79	2	
WABWTF	11/29	9.2	6.54	*0*	48	2	
WABWTF	11/30	9.1	6.61	*0*	63	*0*	
WABWTF	12/1	9.1	6.61	*0*	64	1	
WABWTF	12/2	8.8	6.72	*0*	48	1	
WABWTF	12/3	9.0	6.53	*0*	45	2	
WABWTF	12/4	8.9	6.48	*0*	58	2	
WABWTF	12/5	8.8	6.47	*0*	40	*0*	
WABWTF	12/6	8.7	6.48	*0*	51	*0*	
WABWTF	12/7	8.3	6.62	*0*	54	1	
WABWTF	12/8	8.1	6.58	2	42	*0*	
WABWTF	12/9	7.3	6.88	*0*	23	1	
WABWTF	12/10	7.8	6.62	2	57	2	
WABWTF	12/11	7.7	6.60	2	57	5.2	
WABWTF	12/12	7.7	6.66	1	39	1	
WABWTF	12/13	7.7	6.55	1	26	2	
WABWTF	12/14	7.5	6.67	1	35	1	
WABWTF	12/15	7.7	6.67	*0*	34	*0*	
WABWTF	12/16	6.6	6.84	1	25	1	
WABWTF	12/17	7.5	6.47	*0*	29	*0*	
WABWTF	12/18	7.4	6.61	*0*	28	*0*	
WABWTF	12/19	7.3	6.69	*0*	20	*0*	
WABWTF	12/20	7.1	6.65	1	23	1	
WABWTF	12/21	7.1	6.69	*0*	29	*0*	
WABWTF	12/22	6.9	6.64	*0*	16	*0*	
WABWTF	12/23	6.6	6.83	*0*	17	*0*	

QUABBIN LABORATORY RECORDS 2014

MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WABWTF	12/24	7.0	6.60	3	26	4.1	
WABWTF	12/25	7.0	6.66	3	21	2	
WABWTF	12/26	7.0	6.61	*0*	19	3.1	
WABWTF	12/27	7.0	6.67	*0*	16	*0*	
WABWTF	12/28	6.9	6.66	*0*	12	1	
WABWTF	12/29	6.9	6.62	1	17	*0*	
WABWTF	12/30	5.8	6.74	*0*	10	*0*	
WABWTF	12/31	6.5	6.70	*0*	9	*0*	
	AVG.	8.5	6.58	*<1*	560	*<1 - <4*	
	MAX.	18.9	6.99	11	9800	12.1	
	MIN.	1.7	6.23	*<1*	*<1*	*<1 - <4*	
	MEDIAN	9.0	6.57	*<1*	30	*<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.

Samples collected at Site 201 (Winsor Power Station) during installation of ultraviolet disinfection.

QUABBIN LABORATORY RECORDS 2014
OTHER SAMPLING RESULTS

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

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
4/7/14	Administration Building Kitchen	Iron	123	ug/L	Samples analyzed at MWRA Deer Island Laboratory.
		Manganese	2.35	ug/L	
		Nitrate	0.389	mg/L	
		Nitrite	<0.00500	mg/L	
		Sodium	30800	ug/L	
7/15/14	Administration Building Kitchen	Volatile Organic Contaminants	<0.5	ug/L	Sample analyzed at MWRA Deer Island Laboratory. All results were less than method detection limits.

DRINKING WATER WELL SAMPLES - NOT FOR PWS COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
April 2014	Stockroom	Multiple	-	-	See memo dated May 13, 2014, 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
10/15/14	New Salem, Bathroom Sink	First Draw	5	661	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	3.74	189	
10/16/14	Oakham Kitchen Sink	First Draw	9.60	5.14	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.58	<3.00	
10/15/14	Residence #1 (Forestry Office), Kitchen Sink	First Draw	5.51	414	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	3.56	115	
10/15/14	Residence #2 (Conference Center), Kitchen Sink	First Draw	3.43	84.5	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	2.39	53.2	
10/15/14	Residence #3 (Ranger Station), Kitchen Sink	First Draw	5.17	1390	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.46	813	
		POU Filter	<0.0500	<3.00	
10/15/14	Administration Building, Kitchen Sink	First Draw	5.68	97.5	Sample analyzed at MWRA Deer Island Laboratory.
		Admin. Cooler with POU filter	1.92	76.5	

QUABBIN LABORATORY RECORDS 2014
ADMINISTRATION BUILDING BACTERIOLOGICAL ANALYSIS RESULTS

DATE	***E. coli* RESULT**	**TOTAL COLIFORM RESULT**
	Visitor Center Fountain	Visitor Center Fountain
1/6/2014	A	A
2/3/2014	A	A
3/3/2014	A	A
4/7/2014	A	A
5/5/2014	A	A
6/2/2014	A	A
7/7/2014	A	A
8/4/2014	A	A
9/9/2014	A	A
10/6/2014	A	A
11/3/2014	A	A
12/1/2014	A	A

NOTE: A = ABSENT
P = PRESENT

QUABBIN LABORATORY RECORDS 2014
(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
4/17	0.5	8.9	4.44	16.06	125.9	6.89	44.9	202S	4/17/14	0.198	5.74	3.74	0	0	0									527.68
4/17	1.0		4.44	15.75	123.6	6.79	45.0																	
4/17	2.0		4.43	17.13	134.3	6.63	45.1																	
4/17	3.0		4.42	14.97	117.3	6.53	45.0																	
4/17	4.0		4.45	15.08	118.3	6.47	44.9																	
4/17	5.0		4.44	15.99	125.4	6.47	45.1																	
4/17	6.0		4.41	14.16	111.0	6.41	45.1	202M	4/17/14				1	0	0									
4/17	7.0		4.44	13.96	109.5	6.38	45.0																	
4/17	8.0		4.44	15.23	119.4	6.39	44.9																	
4/17	9.0		4.42	14.62	114.6	6.36	45.1																	
4/17	10.0		4.42	13.43	105.3	6.33	45.0																	
4/17	11.0		4.41	13.51	105.8	6.33	45.0																	
4/17	12.0		4.41	14.16	111.0	6.33	45.0																	
4/17	13.0		4.41	14.14	110.8	6.30	45.0																	
4/17	14.1		4.41	12.91	101.2	6.28	44.9																	
4/17	15.1		4.41	12.60	98.8	6.28	45.1																	
4/17	16.0		4.40	13.69	107.2	6.27	45.1																	
4/17	17.1		4.41	12.52	98.1	6.28	45.0																	
4/17	18.0		4.39	13.16	103.1	6.26	45.0	202D	4/17/14				0	0	20									
4/17	18.9		4.39	12.18	95.4	6.25	45.1																	
4/17	20.0		4.39	13.37	104.7	6.26	45.1	202M	4/17/14	0.201	5.75	3.87												
4/17	21.1		4.40	12.22	95.7	6.27	45.0																	
4/17	22.0		4.39	12.39	97.0	6.26	44.9																	
4/17	23.0		4.39	13.72	107.4	6.25	45.1																	
4/17	24.1		4.38	12.43	97.3	6.24	45.1																	
4/17	25.0		4.38	11.75	92.0	6.25	44.9																	
4/17	26.0		4.38	11.62	90.9	6.24	45.0																	
4/17	27.1		4.39	11.71	91.7	6.26	45.0																	
4/17	28.0		4.39	11.10	86.9	6.24	45.1																	
4/17	29.0		4.39	11.22	87.9	6.23	45.1																	
4/17	30.0		4.39	11.12	87.1	6.23	45.2																	
4/17	31.0		4.39	10.80	84.6	6.22	45.0																	
4/17	32.0		4.39	11.03	86.4	6.24	45.1																	
4/17	33.1		4.39	10.82	84.8	6.24	45.2																	
4/17	34.0		4.39	10.66	83.5	6.23	45.1																	
4/17	35.0		4.39	10.30	80.7	6.23	45.0																	
4/17	36.0		4.39	10.81	84.7	6.25	45.0																	
4/17	37.0		4.39	10.52	82.4	6.24	45.2																	
4/17	38.0		4.39	10.53	82.4	6.23	45.1	202D	4/17/14	0.216	5.73	3.82												
4/17	39.0		4.39	10.73	84.1	6.22	45.1																	
4/17	40.0		4.39	10.55	82.6	6.23	45.1																	
5/8	0.5	10.5	8.87	12.40	109.4	6.70	45.0	202S	5/8/14	0.213	5.49	3.54	0	0	0		0	0	0.247	0.0051	2000	0.02317		528.83
5/8	1.1		8.82	12.31	108.5	6.63	44.9																	
5/8	2.1		8.78	12.02	105.8	6.51	44.9																	
5/8	3.0		8.73	11.70	102.9	6.43	44.9																	
5/8	4.1		8.60	11.92	104.5	6.42	44.8																	
5/8	5.1		8.59	11.80	103.4	6.41	44.9																	
5/8	6.1		8.57	11.97	104.9	6.41	44.7	202M	5/8/14				0	0	10									
5/8	7.1		8.55	11.26	98.6	6.41	44.7																	
5/8	8.0		8.54	11.12	97.4	6.40	44.6																	
5/8	9.0		8.53	11.20	98.0	6.40	44.7																	
5/8	10.1		8.40	11.28	98.4	6.40	44.7																	
5/8	11.1		8.08	11.44	99.1	6.40	44.7																	
5/8	12.1		8.03	11.30	97.7	6.40	44.8																	
5/8	13.0		7.99	11.62	100.4	6.39	44.9																	
5/8	14.2		7.92	11.62	100.2	6.39	44.6																	
5/8	15.1		7.91	11.51	99.3	6.39	44.9																	
5/8	16.1		7.87	11.80	101.6	6.39	44.7																	
5/8	17.0		7.85	11.97	103.0	6.39	44.8																	
5/8	18.1		7.78	11.89	102.1	6.38	45.0	202D	5/8/14				0	0	0									
5/8	19.1		7.71	11.69	100.3	6.38	45.0																	
5/8	20.1		7.46	11.95	101.9	6.37	44.8	202M	5/8/14	0.243	5.60	3.81					0	0	0.182	0.00648	1980	0.023255	1910	
5/8	21.1		7.13	11.33	95.8	6.37	44.9																	

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
5/8	22.1		6.82	11.94	100.1	6.36	45.0																	
5/8	23.1		6.57	12.12	101.1	6.34	45.0																	
5/8	24.0		6.50	12.00	99.9	6.33	45.1																	
5/8	25.1		6.42	11.73	97.5	6.33	45.0																	
5/8	26.0		6.36	11.78	97.7	6.32	45.3																	
5/8	27.0		6.30	12.25	101.4	6.31	45.1																	
5/8	28.0		6.24	12.07	99.8	6.30	45.2																	
5/8	29.1		6.19	12.15	100.3	6.28	45.4																	
5/8	30.1		6.10	12.48	102.8	6.27	45.3																	
5/8	31.1		6.02	12.11	99.6	6.26	45.2																	
5/8	32.0		6.01	12.09	99.4	6.25	45.3																	
5/8	33.2		5.97	12.12	99.5	6.24	45.2																	
5/8	34.1		5.95	11.99	98.5	6.23	45.4																	
5/8	35.2		5.94	12.01	98.6	6.21	45.4																	
5/8	36.2		5.94	12.19	100.1	6.21	45.4																	
5/8	37.1		5.94	12.08	99.1	6.21	45.4																	
5/8	38.0		5.93	12.12	99.4	6.19	45.2																	
5/8	39.2		5.91	11.74	96.3	6.19	45.3	202D	5/8/14	0.211	5.66	3.79					*0*	*0*	0.211	*0*	1860	0.021795		
5/8	40.1		5.90	12.00	98.4	6.18	45.3																	
6/19	0.5	12.8	19.87	7.81	86.6	6.51	45.2	202S	6/19/14	0.224	5.44	3.55	*0*	*0*	20									528.74
6/19	1.0		19.87	7.80	86.5	6.50	45.2																	
6/19	2.0		19.87	7.73	85.8	6.46	45.4																	
6/19	3.0		19.86	7.69	85.3	6.43	45.4																	
6/19	4.0		19.84	7.63	84.6	6.42	45.4																	
6/19	5.0		19.72	7.76	85.8	6.41	45.4																	
6/19	6.0		19.43	7.75	85.2	6.40	45.2	202M	6/19/14				*0*	*0*	31									
6/19	7.0		18.82	7.93	86.2	6.41	45.4																	
6/19	8.0		16.18	8.87	91.2	6.45	45.0																	
6/19	9.0		14.77	9.13	91.1	6.42	44.9	202M	6/19/14	0.265	5.79	4.02												
6/19	9.9		12.98	9.66	92.6	6.45	45.0																	
6/19	11.0		12.37	10.18	96.3	6.43	44.9																	
6/19	12.0		11.84	10.63	99.4	6.41	45.1																	
6/19	13.1		10.87	10.96	100.2	6.42	44.8																	
6/19	14.0		10.37	11.34	102.5	6.42	44.7																	
6/19	15.0		10.07	11.67	104.6	6.42	45.0																	
6/19	16.1		9.96	12.79	114.4	6.39	45.0																	
6/19	17.0		9.60	12.49	110.8	6.40	44.8																	
6/19	18.0		9.02	12.29	107.5	6.39	44.8	202D	6/19/14				*0*	*0*	30									
6/19	19.1		8.74	12.18	105.9	6.38	44.9																	
6/19	20.1		8.56	12.07	104.4	6.37	44.9																	
6/19	21.0		8.47	11.81	101.9	6.36	44.8																	
6/19	22.0		8.08	11.85	101.3	6.33	45.1																	
6/19	24.1		7.73	11.70	99.2	6.29	45.2																	
6/19	25.0		7.64	11.55	97.7	6.27	45.2																	
6/19	26.0		7.58	11.61	98.1	6.25	45.3																	
6/19	27.1		7.45	11.40	96.0	6.22	45.2																	
6/19	28.0		7.32	11.33	95.1	6.20	45.1																	
6/19	29.0		7.22	11.29	94.5	6.19	45.4																	
6/19	30.0		7.16	11.22	93.8	6.18	45.2																	
6/19	31.0		6.97	11.13	92.6	6.15	45.3																	
6/19	32.0		6.86	10.93	90.7	6.14	45.5																	
6/19	33.1		6.83	10.88	90.2	6.11	45.3																	
6/19	34.0		6.82	10.81	89.6	6.09	45.4																	
6/19	35.0		6.82	10.79	89.4	6.08	45.4																	
6/19	36.1		6.80	10.81	89.5	6.07	45.4																	
6/19	37.0		6.78	10.64	88.1	6.05	45.4																	
6/19	38.0		6.76	10.56	87.4	6.03	45.4																	
6/19	39.0		6.74	10.62	87.8	6.03	45.5																	
6/19	40.0		6.69	10.45	86.3	6.01	45.6																	
6/19	41.0		6.68	10.39	85.8	5.99	45.4	202D	6/19/14	0.185	5.69	3.78												
6/19	42.0		6.66	10.22	84.4	5.99	45.7																	
7/17	0.5	10.1	23.38	9.13	109.3	6.69	44.4	202S	7/17/14	0.208	5.48	3.70	1	*0*	776		*0*	*0*	0.144	0.00744	1690	0.022555		528.07
7/17	1.1		23.40	8.98	107.6	6.56	44.5																	

QUABBIN LABORATORY RECORDS 2014
(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
7/17	2.0		23.40	8.86	106.1	6.49	44.5																	
7/17	3.0		23.40	8.90	106.6	6.42	44.3																	
7/17	4.0		23.40	8.83	105.8	6.40	44.6																	
7/17	5.0		23.39	8.83	105.8	6.35	44.5																	
7/17	6.0		23.39	8.79	105.3	6.33	44.5	202M	7/17/14				0	0	1270									
7/17	7.0		23.39	8.78	105.2	6.33	44.4																	
7/17	8.1		23.38	8.78	105.1	6.30	44.5																	
7/17	9.0		23.37	8.77	105.0	6.30	44.4																	
7/17	10.1		19.46	10.37	115.0	6.28	44.7																	
7/17	11.1		16.00	11.48	118.5	6.25	44.3																	
7/17	12.0		14.17	12.09	120.0	6.26	44.1	202M	7/17/14	0.238	5.58	3.73					0	0	0.13	0.00716	1710	0.02363	1850	
7/17	13.0		13.28	12.56	122.3	6.27	44.2																	
7/17	14.1		11.74	13.25	124.5	6.29	44.0																	
7/17	15.0		11.10	13.35	123.7	6.28	44.0																	
7/17	16.0		10.40	13.50	123.0	6.26	44.0																	
7/17	17.1		9.90	13.58	122.4	6.24	43.8																	
7/17	18.1		9.58	13.63	121.8	6.20	44.0	202D	7/17/14				0	0	173									
7/17	19.1		9.44	13.86	123.5	6.18	43.9																	
7/17	20.2		9.32	13.97	124.1	6.16	44.0																	
7/17	21.1		9.13	14.03	124.0	6.16	44.0																	
7/17	22.0		8.95	14.03	123.6	6.13	43.8																	
7/17	23.1		8.80	14.06	123.3	6.12	43.9																	
7/17	24.1		8.58	14.08	122.9	6.10	43.9																	
7/17	25.1		8.42	14.33	124.6	6.07	44.0																	
7/17	26.1		8.26	14.59	126.4	6.05	44.1																	
7/17	27.1		8.01	15.08	129.8	6.05	44.1																	
7/17	28.1		7.85	15.15	129.9	6.00	44.2																	
7/17	29.0		7.68	15.02	128.2	5.98	44.2																	
7/17	30.0		7.60	14.91	127.1	5.95	44.4																	
7/17	31.0		7.54	14.73	125.3	5.93	44.3																	
7/17	32.0		7.47	14.54	123.5	5.91	44.4																	
7/17	33.1		7.38	14.48	122.7	5.89	44.4																	
7/17	34.0		7.30	14.34	121.2	5.87	44.3																	
7/17	35.1		7.16	14.17	119.4	5.85	44.5																	
7/17	35.9		7.14	14.16	119.3	5.82	44.6																	
7/17	37.0		7.12	14.02	118.1	5.82	44.3																	
7/17	38.1		7.09	13.76	115.8	5.80	44.6																	
7/17	39.1		7.07	13.60	114.3	5.78	44.5	202D	7/17/14	0.188	5.64	3.95					0.0074	0	0.154	0.00605	1950	0.022345		
7/17	40.0		7.05	13.25	111.4	5.76	44.6																	
8/7	0.5	12.6	24.25	8.47	102.7	6.74	45.8	202S	8/7/14	0.234	5.56	3.74	0	0	487									527.33
8/7	1.1		24.26	8.43	102.1	6.64	45.9																	
8/7	2.1		24.25	8.57	103.9	6.61	45.9																	
8/7	3.0		24.26	8.77	106.3	6.58	45.7																	
8/7	4.1		24.25	8.84	107.1	6.53	45.8																	
8/7	5.0		24.25	8.82	106.9	6.52	45.7																	
8/7	6.0		24.24	8.83	107.0	6.50	45.7	202M	8/7/14				0	0	395									
8/7	7.1		24.23	8.89	107.7	6.54	45.9																	
8/7	8.1		24.20	8.99	108.8	6.49	45.7																	
8/7	9.1		24.20	8.85	107.1	6.48	45.9																	
8/7	10.1		24.19	8.88	107.5	6.48	45.8																	
8/7	11.0		17.38	11.60	122.8	6.47	45.5																	
8/7	12.1		14.85	13.15	131.9	6.51	45.3	202M	8/7/14	0.273	5.82	4.03												
8/7	13.1		13.13	17.31	167.3	6.45	45.3																	
8/7	14.1		12.42	17.46	166.0	6.44	45.0																	
8/7	15.0		11.66	17.39	162.6	6.42	45.3																	
8/7	16.1		10.86	17.09	156.8	6.38	45.2																	
8/7	17.1		10.50	16.93	154.0	6.35	45.0																	
8/7	18.0		10.06	16.71	150.5	6.33	45.1	202D	8/7/14				0	0	1050									
8/7	19.1		9.72	16.51	147.5	6.31	45.0																	
8/7	19.9		9.61	16.28	145.0	6.28	45.1																	
8/7	21.1		9.46	16.13	143.2	6.27	45.2																	
8/7	22.1		9.31	16.03	141.8	6.26	45.1																	
8/7	23.0		9.12	15.74	138.6	6.23	45.1																	

QUABBIN LABORATORY RECORDS 2014
(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
8/7	24.0		8.93	15.51	135.9	6.20	45.3																	
8/7	25.1		8.73	15.51	135.3	6.18	45.2																	
8/7	26.0		8.59	15.41	134.0	6.16	45.3																	
8/7	27.2		8.43	15.30	132.5	6.14	45.3																	
8/7	28.0		8.18	15.20	130.8	6.12	45.4																	
8/7	29.1		7.97	15.02	128.6	6.11	45.5																	
8/7	30.0		7.88	14.75	126.0	6.06	45.5																	
8/7	31.1		7.73	14.43	122.8	6.00	45.6																	
8/7	32.2		7.56	14.34	121.5	5.98	45.5																	
8/7	33.1		7.46	14.21	120.1	5.96	45.5																	
8/7	34.2		7.41	14.08	118.9	5.94	45.8																	
8/7	35.0		7.34	13.85	116.8	5.90	45.6																	
8/7	36.0		7.31	13.82	116.5	5.89	45.8																	
8/7	36.9		7.28	13.78	116.0	5.88	45.8																	
8/7	38.1		7.24	13.64	114.7	5.85	45.7																	
8/7	39.2		7.22	13.58	114.1	5.85	45.9																	
8/7	40.0		7.20	13.50	113.4	5.84	45.8	202D	8/7/14	0.234	5.70	4.01												
8/7	41.4		7.18	13.05	109.6	5.80	46.0																	
9/11	0.5	8.4	22.75	7.99	94.2	6.68	45.9	202S	9/11/14	0.263	5.67	3.87	0	0	5170									526.26
9/11	1.1		22.76	8.69	102.5	6.63	46.1																	
9/11	2.0		22.77	8.57	101.1	6.58	45.9																	
9/11	3.1		22.77	8.54	100.7	6.53	46.0																	
9/11	4.0		22.77	8.54	100.8	6.53	46.0																	
9/11	5.0		22.78	8.57	101.2	6.50	45.9																	
9/11	6.1		22.77	8.60	101.5	6.50	46.1	202M	9/11/14				0	0	6870									
9/11	7.1		22.77	8.59	101.4	6.50	46.1																	
9/11	8.0		22.77	8.59	101.4	6.46	46.0																	
9/11	9.2		22.77	8.63	101.9	6.46	46.0																	
9/11	10.1		22.77	8.70	102.6	6.45	46.0																	
9/11	11.0		22.52	8.87	104.2	6.43	45.9																	
9/11	12.0		16.61	11.93	124.5	6.42	45.4																	
9/11	13.1		14.41	12.54	124.8	6.41	45.3	202M	9/11/14	0.282	5.88	4.33												
9/11	14.1		13.02	13.33	128.6	6.40	45.1																	
9/11	15.0		12.04	13.43	126.8	6.33	45.1																	
9/11	16.1		11.46	13.79	128.5	6.30	45.1																	
9/11	17.1		10.95	14.20	130.7	6.18	45.1																	
9/11	18.1		10.44	14.07	128.0	6.11	45.1	202D	9/11/14				0	0	1070									
9/11	19.1		10.20	14.06	127.2	6.11	45.1																	
9/11	20.1		9.87	13.82	124.1	6.06	45.1																	
9/11	21.0		9.63	13.70	122.2	6.04	45.1																	
9/11	22.1		9.45	13.68	121.6	6.02	45.2																	
9/11	23.0		9.36	13.50	119.7	5.99	45.2																	
9/11	24.1		9.28	13.33	118.0	5.96	45.4																	
9/11	25.0		9.10	13.34	117.5	5.96	45.1																	
9/11	26.0		8.88	13.18	115.5	5.90	45.2																	
9/11	27.0		8.62	13.21	115.1	5.91	45.4																	
9/11	28.1		8.38	13.21	114.4	5.90	45.3																	
9/11	29.1		8.22	13.09	112.9	5.87	45.5																	
9/11	30.0		8.01	12.95	111.2	5.85	45.4																	
9/11	31.1		7.90	12.81	109.6	5.83	45.5																	
9/11	32.0		7.80	12.70	108.4	5.80	45.6																	
9/11	33.1		7.66	12.62	107.4	5.77	45.7																	
9/11	34.0		7.59	12.47	105.9	5.76	45.6																	
9/11	35.1		7.53	12.44	105.5	5.74	45.7																	
9/11	36.1		7.45	12.54	106.2	5.71	45.8																	
9/11	37.1		7.43	12.70	107.5	5.70	45.9																	
9/11	38.1		7.38	12.47	105.4	5.68	45.7																	
9/11	39.1		7.36	12.43	105.0	5.67	45.8	202D	9/11/14	0.184	5.68	3.92												
9/11	40.2		7.35	12.39	104.6	5.65	46.0																	
9/11	41.1		7.34	12.27	103.6	5.65	45.8																	
10/9	0.5	8.7	17.94	10.01	107.2	7.03	46.0	202S	10/9/14	0.288	5.65	3.71	0	0	1960		0	0	0.13	0	1880	0.020695		525.16
10/9	1.0		17.95	10.21	109.3	6.94	45.8																	
10/9	2.1		17.94	10.29	110.2	6.87	45.9																	

QUABBIN LABORATORY RECORDS 2014
(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
10/9	3.0		17.94	10.41	111.5	6.83	45.8																	
10/9	4.0		17.94	10.48	112.2	6.78	46.1																	
10/9	5.1		17.94	10.47	112.1	6.75	46.1																	
10/9	6.1		17.94	10.87	116.4	6.73	45.9	202M	10/9/14				*0*	*0*	1400									
10/9	7.0		17.94	10.99	117.7	6.68	45.8																	
10/9	8.0		17.94	10.98	117.6	6.69	45.9																	
10/9	9.0		17.94	10.91	116.8	6.65	46.0																	
10/9	10.1		17.93	10.75	115.1	6.62	46.0																	
10/9	11.0		17.93	10.69	114.5	6.61	45.8																	
10/9	12.1		17.94	10.63	113.8	6.62	45.7																	
10/9	12.0		17.94	10.60	113.5	6.59	45.9																	
10/9	13.0		17.83	10.67	114.1	6.54	45.9																	
10/9	14.1		16.33	11.15	115.5	6.38	45.9																	
10/9	15.1		15.18	12.28	124.1	6.29	45.6	202M	10/9/14	0.350	5.74	3.87					*0*	*0*	0.143	*0*	1870	0.02132	1960	
10/9	16.1		13.58	13.39	130.7	6.25	45.6																	
10/9	17.1		12.17	14.43	136.4	6.22	45.5																	
10/9	18.0		11.73	14.85	139.0	6.16	45.4	202D	10/9/14				*0*	*0*	2010									
10/9	19.0		11.20	15.39	142.3	6.10	45.3																	
10/9	20.1		10.61	15.93	145.3	6.08	45.2																	
10/9	21.0		10.34	16.22	147.0	6.05	45.3																	
10/9	22.0		10.09	16.35	147.3	6.04	45.3																	
10/9	23.0		9.93	16.22	145.6	6.03	45.4																	
10/9	24.1		9.75	15.72	140.6	5.99	45.3																	
10/9	25.0		9.48	15.48	137.5	5.96	45.3																	
10/9	26.0		9.28	15.39	136.1	5.96	45.4																	
10/9	27.1		9.04	15.26	134.1	5.95	45.4																	
10/9	28.0		8.87	15.08	132.0	5.93	45.6																	
10/9	29.2		8.67	14.81	129.0	5.89	45.7																	
10/9	30.2		8.59	14.44	125.6	5.87	45.8																	
10/9	31.1		8.41	14.34	124.1	5.86	45.7																	
10/9	32.0		8.11	14.08	121.0	5.84	45.9																	
10/9	33.1		7.99	13.89	119.0	5.82	45.9																	
10/9	34.1		7.91	13.50	115.5	5.78	45.7																	
10/9	35.1		7.73	13.45	114.5	5.78	46.0																	
10/9	36.1		7.68	13.19	112.1	5.75	46.0																	
10/9	37.0		7.63	13.06	110.9	5.73	45.9																	
10/9	38.1		7.58	12.90	109.4	5.71	46.2																	
10/9	39.1		7.55	12.75	108.0	5.70	46.1																	
10/9	40.1		7.54	12.62	107.0	5.66	46.1	202D	10/9/14	0.157	5.75	3.93					0.0133	0.0278	0.127	*0*	2620	0.02159		
10/9	41.1		7.52	12.57	106.5	5.67	46.2																	
11/13	0.5	9.7	11.72	10.86	103.3	7.09	45.6	202S	11/13/14	0.274	5.60	3.70	*0*	*0*	85									524.91
11/13	1.0		11.73	10.79	102.7	6.95	45.7																	
11/13	2.1		11.73	11.03	104.9	6.75	45.7																	
11/13	3.1		11.73	11.03	105.0	6.66	45.8																	
11/13	4.0		11.73	11.05	105.1	6.56	45.6																	
11/13	5.1		11.72	11.00	104.6	6.45	45.8																	
11/13	6.0		11.72	11.04	105.0	6.43	45.5	202M	11/13/14				*0*	*0*	160									
11/13	7.1		11.73	11.18	106.4	6.37	45.8																	
11/13	8.1		11.72	11.25	107.0	6.34	45.6																	
11/13	9.1		11.73	11.35	108.0	6.32	45.8																	
11/13	10.0		11.72	11.39	108.3	6.33	45.6																	
11/13	11.1		11.72	11.52	109.6	6.27	45.8																	
11/13	12.1		11.72	11.57	110.1	6.27	45.6																	
11/13	13.1		11.72	11.75	111.8	6.22	45.7																	
11/13	14.0		11.72	11.84	112.7	6.21	45.8																	
11/13	15.2		11.72	11.91	113.3	6.25	45.6																	
11/13	16.1		11.71	12.09	115.0	6.23	45.8																	
11/13	17.1		11.71	12.09	115.0	6.25	45.6																	
11/13	18.0		11.71	12.16	115.7	6.16	45.7	202D	11/13/14				*0*	*0*	109									
11/13	19.1		11.69	12.19	115.9	6.21	45.7																	
11/13	20.1		11.68	12.27	116.6	6.23	45.8	202M	11/13/14	0.291	5.99	4.07												
11/13	21.1		11.68	12.23	116.2	6.24	45.7																	
11/13	22.0		11.68	12.25	116.4	6.21	45.9																	

QUABBIN LABORATORY RECORDS 2014
(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
11/13	23.1		11.66	12.24	116.2	6.19	45.7																	
11/13	24.0		11.66	12.27	116.6	6.19	45.7																	
11/13	25.0		11.56	12.24	116.1	6.17	45.9																	
11/13	26.1		11.54	12.14	115.0	6.16	45.6																	
11/13	27.0		11.53	12.07	114.4	6.15	45.7																	
11/13	28.1		11.53	11.95	113.1	6.12	45.6																	
11/13	29.0		11.51	11.95	113.2	6.10	45.9																	
11/13	30.0		11.39	11.82	111.6	6.08	45.6																	
11/13	31.1		11.31	11.69	110.2	5.99	45.7																	
11/13	32.0		10.96	11.41	106.7	5.94	45.6																	
11/13	33.0		10.71	11.24	104.5	5.84	45.8																	
11/13	34.2		9.54	11.09	100.2	5.79	46.0																	
11/13	35.2		9.19	10.86	97.3	5.70	46.0																	
11/13	36.2		8.82	10.83	96.2	5.71	45.9																	
11/13	37.1		8.47	10.46	92.2	5.61	45.9																	
11/13	38.0		8.37	10.46	91.9	5.57	46.0	202D	11/13/14	0.272	5.76	4.03												
11/13	39.0		8.33	10.37	91.1	5.58	46.2																	
11/13	40.1		8.23	10.22	89.5	5.55	46.2																	
12/3	0.5	9.0	8.34	13.59	117.3	6.96	45.7	202S	12/3/14	0.281	5.81	3.94	*0*	*0*	41		*0*	0.00759	0.273	0.0071	1910	0.02086		525.06
12/3	1.1		8.35	13.95	120.4	6.82	45.8																	
12/3	3.1		8.37	13.89	119.9	6.64	46.0																	
12/3	6.1		8.37	13.67	118.1	6.60	45.9	202M	12/3/14				1	*0*	30									
12/3	9.0		8.37	13.43	116.0	6.59	45.9																	
12/3	10.1		8.37	13.58	117.3	6.53	45.9																	
12/3	12.1		8.38	13.69	118.2	6.50	45.8																	
12/3	15.0		8.38	13.79	119.1	6.44	45.8																	
12/3	18.1		8.38	14.02	121.1	6.41	45.9	202D	12/3/14				*0*	10	41									
12/3	20.1		8.38	14.02	121.1	6.40	45.8	202M	12/3/14	0.267	5.58	3.82					*0*	0.00746	0.191	0.0061	1920	0.020095	2020	
12/3	21.1		8.38	13.89	120.0	6.40	45.9																	
12/3	24.0		8.37	13.71	118.4	6.36	45.9																	
12/3	27.1		8.37	13.71	118.4	6.35	46.0																	
12/3	30.1		8.37	13.74	118.7	6.34	45.9																	
12/3	33.1		8.36	13.79	119.1	6.33	45.8																	
12/3	36.1		8.35	13.80	119.1	6.34	45.7																	
12/3	39.1		8.35	13.94	120.3	6.32	45.9																	
12/3	40.1		8.35	13.91	120.1	6.30	45.9	202D	12/3/14	0.287	5.67	3.92					*0*	0.00716	0.189	0.00638	1930	0.019955		
12/3	41.0		8.33	13.94	120.3	6.30	45.9																	
	AVG.	10.1	10.56	12.26	110.7	6.25	45.3			0.242	5.68	3.86	<1	0	860	N/A	<0.005	0.00417	0.177	<0.005	1940	0.021772	1940	
	MAX.	12.8	24.26	17.46	167.3	7.09	46.2			0.350	5.99	4.33	1	10	6870	N/A	0.0133	0.0278	0.273	0.00744	2620	0.023630	2020	
	MIN.	8.4	4.38	7.63	80.7	5.55	43.8			0.157	5.44	3.54	<1	<10	<10	N/A	<0.005	<0.005	0.127	<0.005	1690	0.019955	1850	
	MEDIAN	9.7	8.57	12.15	109.3	6.27	45.3			0.238	5.68	3.87	<1	<10	109	N/A	<0.005	0.00000	0.168	0.00608	1915	0.021693	1935	

NOTES
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 2014
(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
4/17	0.5	8.1	5.08	9.76	77.8	6.66	44.8	206S	4/17/14	0.244	5.73	3.67	0	0	0									527.68
4/17	3.0		5.07	8.78	70.0	6.55	44.8																	
4/17	6.0		5.05	9.01	71.8	6.49	44.6	206M	4/17/14				0	0	0									
4/17	9.0		5.05	8.95	71.3	6.46	44.8																	
4/17	10.0		5.03	8.73	69.5	6.42	44.8																	
4/17	11.9		5.01	8.25	65.7	6.41	44.6																	
4/17	15.0		5.03	8.36	66.6	6.37	44.7	206M	4/17/14	0.27	5.72	3.83												
4/17	18.1		5.01	7.74	61.6	6.36	44.7																	
4/17	21.0		4.98	7.53	59.9	6.34	44.8																	
4/17	24.0		4.98	7.29	58.0	6.35	44.9	206D	4/17/14				0	0	0									
4/17	27.0		4.96	7.06	56.1	6.32	44.7																	
4/17	29.0		*No data collected at this depth.*					206D	4/17/14	0.229	5.73	3.94												
4/17	30.0		4.96	7.13	56.6	6.32	44.7																	
4/17	31.0		4.96	7.19	57.2	6.30	44.8																	
5/8	0.5	9.8	9.29	10.47	93.3	6.66	45.0	206S	5/8/14	0.245	5.70	3.77	0	0	0		0	0	0.342	0	1690	0.02287		528.83
5/8	1.1		9.16	10.36	92.0	6.52	45.2																	
5/8	2.0		9.03	10.19	90.3	6.48	45.2																	
5/8	3.2		8.99	10.02	88.6	6.46	45.1																	
5/8	4.1		8.93	9.93	87.7	6.45	45.1																	
5/8	5.1		8.44	9.85	86.0	6.45	45.2																	
5/8	6.1		8.33	10.00	87.1	6.45	45.2	206M	5/8/14				0	0	20									
5/8	7.1		8.24	10.02	87.1	6.45	45.0																	
5/8	8.0		8.06	10.09	87.3	6.46	44.9																	
5/8	9.0		7.90	9.88	85.1	6.44	44.9																	
5/8	10.1		7.53	9.90	84.6	6.44	45.0																	
5/8	11.1		7.50	10.08	86.0	6.44	44.9																	
5/8	12.0		7.21	9.91	83.9	6.43	45.0																	
5/8	13.0		7.17	9.79	82.9	6.42	45.1																	
5/8	14.1		7.13	9.65	81.6	6.41	45.2																	
5/8	15.1		7.04	9.56	80.7	6.41	45.1	206M	5/8/14	0.27	5.76	3.84					0	0	0.212	0	1690	0.02285	1920	
5/8	16.1		6.90	9.64	81.0	6.39	45.2																	
5/8	17.0		6.87	9.72	81.7	6.38	45.1																	
5/8	18.0		6.86	9.65	81.0	6.36	45.2																	
5/8	19.0		6.84	9.76	81.9	6.36	45.0																	
5/8	20.0		6.76	9.63	80.7	6.35	45.0																	
5/8	21.0		6.64	9.55	79.8	6.34	45.2																	
5/8	22.1		6.63	9.62	80.3	6.32	45.2																	
5/8	23.0		6.62	9.58	80.0	6.31	45.3																	
5/8	24.1		6.57	9.44	78.7	6.30	45.2	206D	5/8/14				0	0	10									
5/8	25.1		6.51	9.50	79.1	6.29	45.2																	
5/8	26.0		6.49	9.69	80.7	6.29	45.3																	
5/8	27.0		6.46	9.41	78.3	6.27	45.1																	
5/8	28.0		6.42	9.51	79.0	6.26	45.3	206D	5/8/14	0.257	5.6	3.65					0	0	0.196	0.00542	1700	0.02184		
5/8	29.0		6.40	9.30	77.2	6.25	45.3																	
5/8	30.0		6.40	9.32	77.4	6.25	45.2																	
6/19	0.5	12.0	21.19	7.60	86.6	6.34	45.7	206S	6/19/14	0.217	5.76	3.88	0	0	10									528.74
6/19	1.0		20.94	7.72	87.4	6.34	45.7																	
6/19	2.0		20.64	7.77	87.5	6.31	45.8																	
6/19	3.0		20.39	7.91	88.7	6.31	45.9																	
6/19	4.0		20.10	8.10	90.3	6.30	45.8																	
6/19	5.0		19.98	8.22	91.4	6.30	45.7																	
6/19	6.0		19.84	8.31	92.1	6.31	45.7	206M	6/19/14				0	0	10									
6/19	7.0		18.78	8.65	93.9	6.33	45.6																	
6/19	8.1		18.29	8.76	94.1	6.33	45.8																	
6/19	9.0		15.93	9.71	99.3	6.40	45.5	206M	6/19/14	0.317	5.63	3.61												
6/19	10.0		14.48	10.24	101.5	6.41	45.4																	
6/19	11.0		13.38	10.56	102.2	6.40	45.1																	
6/19	12.0		13.02	10.54	101.2	6.39	45.4																	
6/19	13.0		12.30	10.57	99.9	6.36	45.2																	
6/19	14.0		10.78	10.95	99.8	6.36	45.2																	
6/19	15.1		10.43	10.84	98.1	6.29	45.3																	
6/19	16.0		9.32	10.72	94.5	6.24	45.2																	
6/19	17.0		8.95	10.78	94.2	6.22	45.3																	
6/19	18.0		8.89	10.65	92.9	6.19	45.2																	

QUABBIN LABORATORY RECORDS 2014
(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
6/19	19.0		8.84	10.58	92.2	6.17	45.3																	
6/19	20.0		8.78	10.50	91.4	6.14	45.2																	
6/19	21.0		8.59	10.48	90.8	6.13	45.4																	
6/19	22.0		8.28	10.43	89.6	6.11	45.2																	
6/19	23.0		8.12	10.39	89.0	6.09	45.3																	
6/19	24.0		8.08	10.33	88.3	6.07	45.3	206D	6/19/14				0	0	10									
6/19	25.0		8.03	10.26	87.6	6.05	45.4																	
6/19	26.0		8.01	10.21	87.1	6.04	45.4																	
6/19	27.0		8.00	10.28	87.7	6.03	45.3																	
6/19	28.1		7.97	10.12	86.3	6.01	45.4	206D	6/19/14	0.216	5.69	3.74												
6/19	29.0		7.96	10.07	85.9	6.00	45.5																	
7/17	0.5	10.9	23.99	10.38	125.7	6.75	44.9	206S	7/17/14	0.212	5.64	3.91	0	0	31		0	0	0.121	0.00669	1550	0.0223		528.07
7/17	1.1		23.97	10.17	123.1	6.64	44.9																	
7/17	2.0		23.91	10.10	122.1	6.57	45.1																	
7/17	3.1		23.89	10.09	121.9	6.57	44.9																	
7/17	4.1		23.87	10.06	121.5	6.48	45.2																	
7/17	5.0		23.86	10.01	120.9	6.47	45.1																	
7/17	6.2		23.81	10.09	121.8	6.42	44.9	206M	7/17/14				0	0	275									
7/17	7.0		23.69	10.14	122.1	6.40	45.0																	
7/17	8.1		22.57	10.54	124.3	6.35	45.1																	
7/17	9.1		21.18	10.93	125.4	6.29	44.9																	
7/17	10.2		18.65	11.91	129.9	6.24	44.9																	
7/17	11.0		17.82	12.13	130.1	6.21	44.8																	
7/17	12.1		16.51	12.53	130.8	6.19	44.6	206M	7/17/14	0.276	5.52	3.75					0	0	0.149	0.0116	1540	0.02595	1890	
7/17	13.0		13.55	13.74	134.5	6.19	44.6																	
7/17	14.1		12.32	13.98	133.2	6.18	44.7																	
7/17	15.1		11.35	14.06	131.0	6.11	44.3																	
7/17	16.1		10.81	14.16	130.3	6.11	44.4																	
7/17	17.1		10.27	14.21	129.1	6.09	44.2																	
7/17	18.0		9.98	14.04	126.7	6.05	44.4																	
7/17	19.0		9.82	13.75	123.6	5.98	44.2																	
7/17	20.1		9.58	13.76	123.0	5.97	44.2																	
7/17	21.0		9.40	13.73	122.2	5.95	44.4																	
7/17	22.0		9.13	13.70	121.1	5.94	44.3																	
7/17	23.1		9.04	13.51	119.2	5.93	44.2																	
7/17	24.1		8.97	13.45	118.4	5.92	44.3	206D	7/17/14				0	0	0									
7/17	25.0		8.74	13.36	117.1	5.91	44.4																	
7/17	26.0		8.64	13.22	115.6	5.87	44.3																	
7/17	27.1		8.59	13.28	115.9	5.85	44.5																	
7/17	28.1		8.49	13.06	113.7	5.84	44.5	206D	7/17/14	0.260	5.58	3.75					0	0	0.135	0.00832	1740	0.02355		
7/17	29.0		8.38	12.99	112.8	5.82	44.6																	
8/7	0.5	12.7	24.42	10.81	131.4	6.56	46.3	206S	8/7/14	0.215	5.67	3.84	0	0	145									527.33
8/7	1.1		24.36	10.54	128.0	6.50	46.6																	
8/7	2.1		24.30	10.30	124.9	6.49	46.5																	
8/7	3.0		24.26	10.26	124.4	6.48	46.3																	
8/7	4.0		24.21	10.15	122.9	6.45	46.4																	
8/7	5.1		24.17	10.13	122.6	6.48	46.4																	
8/7	6.1		24.15	10.09	122.1	6.46	46.5	206M	8/7/14				0	0	384									
8/7	7.0		24.12	10.02	121.1	6.46	46.4																	
8/7	8.0		24.04	10.05	121.3	6.48	46.5																	
8/7	9.1		23.63	10.20	122.2	6.44	46.3																	
8/7	10.0		22.78	10.62	125.2	6.43	46.1																	
8/7	11.2		19.39	12.21	134.6	6.42	45.9																	
8/7	12.2		15.72	13.13	134.3	6.36	45.8	206M	8/7/14	0.296	5.77	4.09												
8/7	13.1		13.72	13.61	133.2	6.34	45.6																	
8/7	14.1		12.60	13.60	129.8	6.26	45.6																	
8/7	15.2		11.90	13.69	128.7	6.22	45.6																	
8/7	16.0		11.24	13.69	126.7	6.16	45.4																	
8/7	17.0		10.80	13.54	124.0	6.13	45.3																	
8/7	18.0		10.55	13.47	122.7	6.09	45.5																	
8/7	19.1		10.36	13.30	120.6	6.04	45.6																	
8/7	20.0		10.16	13.30	120.1	6.02	45.5																	
8/7	21.2		9.79	13.34	119.3	6.00	45.4																	
8/7	22.2		9.42	13.14	116.6	5.95	45.6																	

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
8/7	23.1		9.16	13.12	115.7	5.94	45.7																	
8/7	24.0		8.92	12.99	113.9	5.93	45.5	206D	8/7/14				*0*	*0*	97									
8/7	25.2		8.89	12.85	112.5	5.90	45.8																	
8/7	26.1		8.87	12.76	111.7	5.85	45.4																	
8/7	27.1		8.82	12.69	111.0	5.85	45.5																	
8/7	28.0		8.75	12.58	109.7	5.82	45.6	206D	8/7/14	0.261	5.52	3.78												
8/7	29.1		8.68	12.50	108.9	5.80	45.6																	
9/11	0.5	*Not*	22.71	11.39	134.3	6.60	46.3	206S	9/11/14	0.294	5.78	4.12	*0*	*0*	4350									526.26
9/11	0.9	*measured.*	22.72	11.12	131.1	6.48	46.4																	
9/11	2.0	*Rough*	22.72	10.93	128.8	6.47	46.3																	
9/11	2.8	*waves.*	22.72	10.79	127.2	6.40	46.3																	
9/11	4.2		22.73	10.62	125.2	6.42	46.40																	
9/11	5.2		22.72	10.42	122.9	6.38	46.4																	
9/11	6.0		22.72	10.15	119.7	6.38	46.5	206M	9/11/14				*0*	*0*	2600									
9/11	7.3		22.73	10.11	119.2	6.36	46.4																	
9/11	8.3		22.72	10.07	118.8	6.36	46.2																	
9/11	9.0		22.72	10.00	117.9	6.38	46.2																	
9/11	10.0		22.72	9.97	117.5	6.33	46.3																	
9/11	11.2		22.72	9.92	117.0	6.38	46.3																	
9/11	12.1		22.70	9.91	116.8	6.31	46.3																	
9/11	12.7		22.68	9.90	116.7	6.37	46.4																	
9/11	14.2		17.24	12.03	127.2	6.54	46.0																	
9/11	15.2		12.80	13.48	129.5	6.29	45.6	206M	9/11/14	0.384	5.71	3.88												
9/11	16.2		12.37	12.26	116.7	6.03	45.4																	
9/11	17.1		11.49	12.39	115.5	6.00	45.6																	
9/11	18.1		11.13	12.22	113.0	5.95	45.3																	
9/11	19.0		10.68	12.02	110.0	5.87	45.7																	
9/11	20.4		10.31	12.11	109.8	5.84	45.4																	
9/11	21.2		10.15	11.92	107.7	5.80	45.6																	
9/11	22.1		9.99	11.81	106.3	5.77	45.5																	
9/11	23.1		9.78	11.70	104.8	5.74	45.4																	
9/11	24.2		9.40	11.44	101.6	5.68	45.7	206D	9/11/14				*0*	*0*	233									
9/11	25.1		9.27	11.31	100.1	5.67	45.8																	
9/11	26.2		9.17	11.21	98.9	5.65	45.7	206D	9/11/14	0.231	5.59	3.73												
9/11	27.1		9.13	11.21	98.8	5.65	45.5																	
9/11	28.0		9.11	10.87	95.8	5.63	46.2																	
10/9	0.5	8.4	17.80	14.23	151.9	6.52	46.4	206S	10/9/14	0.352	5.77	3.92	*0*	*0*	185		*0*	*0*	*0*	*0*	1800	0.019735		525.16
10/9	1.1		17.80	14.20	151.7	6.54	46.3																	
10/9	2.0		17.80	14.04	149.9	6.51	46.5																	
10/9	3.1		17.80	13.64	145.6	6.47	46.3																	
10/9	4.0		17.80	13.44	143.6	6.46	46.4																	
10/9	5.1		17.80	13.22	141.2	6.46	46.2																	
10/9	6.1		17.80	12.98	138.6	6.44	46.2	206M	10/9/14				*0*	*0*	109									
10/9	7.0		17.79	12.79	136.6	6.40	46.3																	
10/9	8.2		17.80	12.60	134.5	6.42	46.4																	
10/9	9.1		17.79	12.44	132.8	6.44	46.4																	
10/9	10.1		17.79	12.35	131.8	6.39	46.2																	
10/9	11.2		17.79	12.30	131.3	6.41	46.4																	
10/9	12.0		17.78	12.26	130.8	6.42	46.2																	
10/9	13.1		17.77	12.22	130.4	6.42	46.5																	
10/9	14.1		17.73	12.09	129.0	6.38	46.4																	
10/9	15.0		17.69	12.02	128.1	6.37	46.1																	
10/9	16.2		16.64	12.20	127.1	6.33	46.1	206M	10/9/14	0.343	5.78	4					*0*	*0*	0.136	*0*	1950	0.02018	1980	
10/9	17.1		12.37	13.15	124.9	6.18	45.6																	
10/9	18.2		11.64	12.81	119.7	6.00	45.9																	
10/9	19.0		11.14	12.66	116.9	5.91	45.9																	
10/9	20.3		10.73	12.29	112.4	5.80	45.7																	
10/9	21.2		10.55	12.22	111.3	5.79	45.8																	
10/9	22.1		10.43	12.12	110.1	5.74	45.7																	
10/9	23.0		10.13	11.97	108.0	5.69	45.9																	
10/9	24.0		10.04	11.95	107.5	5.66	45.9	206D	10/9/14				*0*	*0*	183									
10/9	25.0		9.98	11.95	107.4	5.67	46.0	206D	10/9/14	0.326	5.66	3.81					0.00539	0.00981	0.172	*0*	1970	0.022855		
10/9	26.2		9.88	11.95	107.2	5.65	45.8																	
10/9	27.0		9.74	11.62	103.9	5.64	45.9																	

QUABBIN LABORATORY RECORDS 2014
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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
11/13	0.5	8.3	11.42	13.62	128.7	6.74	45.8	206S	11/13/14	0.32	5.75	3.84	*0*	*0*	*0*									524.91
11/13	1.1		11.42	13.48	127.4	6.67	45.7																	
11/13	2.0		11.43	13.41	126.7	6.70	46.0																	
11/13	3.0		11.43	13.38	126.4	6.59	45.9																	
11/13	4.0		11.43	13.19	124.6	6.53	45.9																	
11/13	5.1		11.42	13.07	123.5	6.48	45.9																	
11/13	6.0		11.42	12.93	122.1	6.45	45.9	206M	11/13/14				1	*0*	20									
11/13	7.0		11.42	12.82	121.1	6.45	45.8																	
11/13	8.0		11.42	12.71	120.1	6.42	45.7																	
11/13	9.1		11.42	12.55	118.6	6.41	45.7																	
11/13	10.1		11.42	12.45	117.6	6.36	45.7																	
11/13	11.1		11.42	12.44	117.5	6.43	46.0																	
11/13	12.1		11.42	12.39	117.1	6.36	45.9																	
11/13	13.2		11.42	12.38	117.0	6.35	45.9	206M	11/13/14	0.31	5.85	4.10												
11/13	14.0		11.42	12.33	116.5	6.35	45.8																	
11/13	15.1		11.41	12.30	116.2	6.33	45.8																	
11/13	16.1		11.41	12.29	116.1	6.33	45.9																	
11/13	17.0		11.41	12.26	115.8	6.35	46.0																	
11/13	18.0		11.42	12.23	115.5	6.33	46.1																	
11/13	19.0		11.41	12.19	115.2	6.31	45.8																	
11/13	20.1		11.39	12.18	115.0	6.32	46.0																	
11/13	21.0		11.39	12.20	115.2	6.34	45.9																	
11/13	22.0		11.39	12.14	114.6	6.34	45.8																	
11/13	23.0		11.37	12.13	114.5	6.30	45.8																	
11/13	24.1		11.36	12.09	114.1	6.29	46.0	206D	11/13/14				*0*	*0*	10									
11/13	25.1		11.35	12.11	114.2	6.32	46.0	206D	11/13/14	0.31	5.87	4.12												
11/13	26.1		11.32	12.10	114.1	6.31	45.9																	
12/3	0.5	7.8	7.53	15.38	130.1	7.05	45.8	206S	12/3/14	0.315	5.71	3.97	*0*	*0*	10		*0*	*0*	0.189	0.00599	1780	0.020525		525.06
12/3	1.1		7.54	14.92	126.3	6.84	45.9																	
12/3	3.2		7.54	14.68	124.2	6.73	45.9																	
12/3	6.1		7.54	14.64	123.9	6.64	45.9	206M	12/3/14				*0*	*0*	*0*									
12/3	9.1		7.54	14.64	123.9	6.56	46.0																	
12/3	10.2		7.54	14.71	124.5	6.55	45.9																	
12/3	12.1		7.55	14.70	124.4	6.54	46.0																	
12/3	13.1		7.55	14.69	124.3	6.51	46.1	206M	12/3/14	0.342	5.79	4.05					*0*	0.00531	0.216	0.00632	1770	0.02057	2030	
12/3	15.0		7.55	14.63	123.8	6.46	45.9																	
12/3	18.1		7.54	14.58	123.3	6.46	46.1																	
12/3	21.1		7.54	14.41	121.9	6.41	45.9																	
12/3	24.0		7.53	14.38	121.7	6.38	46.1	206D	12/3/14				*0*	*0*	*0*									
12/3	26.1		7.52	14.15	119.7	6.37	46.1	206D	12/3/14	0.307	5.77	3.96					*0*	*0*	0.224	0.00572	1790	0.02026		
12/3	27.0		7.52	14.08	119.1	6.39	45.9																	
	AVG.	9.8	12.59	11.45	109.5	6.28	45.5			0.282	5.71	3.87	<1	<10	322	N/A	<0.005	<0.005	0.174	<0.005	1750	0.021957	1960	
	MAX.	12.7	24.42	15.38	151.9	7.05	46.6			0.384	5.87	4.12	1	<10	4350	N/A	0.00539	0.0098	0.342	0.01160	1970	0.025950	2030	
	MIN.	7.8	4.96	7.06	56.1	5.63	44.2			0.212	5.52	3.61	<1	<10	<10	N/A	<0.005	<0.005	0.000	<0.005	1540	0.019735	1890	
	MEDIAN	9.1	10.76	11.76	116.2	6.35	45.6			0.276	5.72	3.84	<1	<10	10	N/A	<0.005	<0.005	0.181	0.00557	1755	0.02207	1950	

NOTES
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.

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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
4/17	0.5	4.0	7.87	8.21	70.2	6.48	49.5	DENS	4/17/14	0.561	5.40	3.52	1	0	52									527.68
4/17	3.1		7.83	7.33	62.7	6.28	49.5																	
4/17	6.0		6.44	7.53	62.2	6.18	50.0	DENM	4/17/14				2	0	20									
4/17	9.0		6.28	7.43	61.1	6.11	50.2																	
4/17	10.0		6.27	6.96	57.2	6.05	50.4	DENM	4/17/14	0.46	5.78	3.91												
4/17	12.0		6.19	6.88	56.5	6.05	50.4																	
4/17	13.0		6.16	6.96	57.0	6.03	50.4	DEND	4/17/14				0	0	0									
4/17	15.0		6.09	6.73	55.1	5.99	50.7																	
4/17	17.0		6.06	6.88	56.2	5.98	50.7	DEND	4/17/14	0.47	5.80	3.92												
4/17	17.9		6.01	6.67	54.4	5.97	50.6																	
5/8	0.5	5.3	12.79	7.97	77.1	6.54	51.3	DENS	5/8/14	0.36	5.58	3.63	0	0	0		0	0.00678	0.228	0.00953	3290	0.07807		528.83
5/8	1.0		12.28	7.98	76.2	6.46	51.2																	
5/8	2.0		11.12	8.08	75.2	6.44	49.7																	
5/8	3.0		10.51	8.11	74.4	6.35	49.2																	
5/8	4.0		10.25	8.17	74.5	6.32	49.2																	
5/8	5.0		10.15	8.06	73.3	6.29	48.9																	
5/8	6.1		10.09	8.09	73.5	6.28	48.7	DENM	5/8/14				0	0	0									
5/8	7.0		9.99	7.87	71.3	6.25	49.4																	
5/8	8.0		9.89	7.93	71.7	6.21	49.8																	
5/8	9.0		9.80	7.79	70.2	6.18	49.8																	
5/8	10.1		9.42	7.86	70.2	6.16	49.3	DENM	5/8/14	0.36	5.56	3.58					0	0.0133	0.229	0.01	3070	0.062345	2030	
5/8	11.1		9.05	7.83	69.4	6.14	49.1																	
5/8	12.0		8.95	7.83	69.2	6.12	49.1																	
5/8	13.1		8.82	7.80	68.7	6.12	49.1	DEND	5/8/14				0	0	0									
5/8	14.0		8.40	7.90	68.9	6.10	48.8																	
5/8	15.0		8.28	7.85	68.3	6.07	48.8																	
5/8	16.1		8.24	7.84	68.1	6.04	48.9																	
5/8	17.1		8.19	7.76	67.3	6.03	49.1																	
5/8	18.1		8.10	7.78	67.3	6.00	48.9	DEND	5/8/14	0.354	5.85	3.73					0	0.0199	0.227	0.00923	2850	0.052485		
5/8	19.1		7.95	7.80	67.3	5.96	49.0																	
6/19	0.5	6.1	22.35	7.97	92.8	6.42	48.6	DENS	6/19/14	0.31	5.79	3.81	0	0	63									528.74
6/19	1.0		22.29	7.96	92.6	6.41	48.3																	
6/19	2.0		21.93	8.00	92.4	6.37	48.4																	
6/19	3.1		21.75	7.88	90.7	6.36	48.2																	
6/19	4.0		21.53	7.80	89.4	6.36	48.3																	
6/19	5.0		20.54	7.95	89.3	6.34	48.3																	
6/19	6.0		18.64	8.41	91.0	6.35	47.3	DENM	6/19/14				0	0	62									
6/19	7.0		17.37	8.58	90.4	6.33	47.5																	
6/19	8.0		16.22	8.76	90.1	6.30	47.6																	
6/19	9.0		13.72	9.28	90.5	6.29	47.4	DENM	6/19/14	0.37	5.87	3.94												
6/19	10.1		12.96	9.25	88.7	6.21	47.4																	
6/19	11.0		11.69	9.54	88.9	6.14	47.6																	
6/19	12.0		10.77	9.86	89.9	6.10	48.3																	
6/19	13.1		10.21	9.82	88.3	6.00	48.5	DEND	6/19/14				0	0	0									
6/19	14.0		9.57	9.38	83.2	5.90	49.3																	
6/19	15.0		9.37	9.11	80.4	5.84	49.0																	
6/19	16.1		9.14	9.02	79.1	5.81	49.0																	
6/19	17.0		9.03	8.93	78.1	5.78	49.0																	
6/19	18.0		8.81	8.59	74.8	5.70	49.5																	
6/19	19.0		8.53	7.97	68.9	5.62	49.7	DEND	6/19/14	0.311	5.78	3.72												
7/17	0.5	9.9	25.01	11.07	136.7	6.48	46.4	DENS	7/17/14	0.28	5.68	3.93	0	0	187		0	0	0.177	0.00659	1360	0.03378		528.07
7/17	1.0		25.04	10.71	132.3	6.43	46.5																	
7/17	1.9		24.91	10.49	129.2	6.39	46.4																	
7/17	3.1		24.84	10.36	127.5	6.38	46.4																	
7/17	4.0		24.77	10.33	126.9	6.38	46.3																	
7/17	5.1		24.72	10.16	124.8	6.35	46.4																	
7/17	6.1		24.44	10.21	124.6	6.31	46.3	DENM	7/17/14				0	0	305									
7/17	7.1		24.13	10.22	124.1	6.28	46.4																	
7/17	8.0		23.46	10.21	122.4	6.18	46.3																	
7/17	9.0		22.21	10.43	122.1	6.09	46.3																	
7/17	10.1		20.49	10.92	123.7	6.03	46.0																	
7/17	11.1		16.92	11.87	125.0	5.98	46.4	DENM	7/17/14	0.38	5.74	3.87					0	0	0.227	0.00935	1380	0.03493	1910	
7/17	12.1		13.88	12.19	120.2	5.90	46.5																	

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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
7/17	13.1		12.13	11.69	110.9	5.77	46.9	DEND	7/17/14				0	0	52									
7/17	14.0		10.97	11.28	104.1	5.65	47.4																	
7/17	15.1		10.30	11.02	100.2	5.60	47.8																	
7/17	16.0		9.99	10.97	99.0	5.58	47.6																	
7/17	17.0		9.70	10.67	95.7	5.55	47.8																	
7/17	18.1		9.46	10.34	92.2	5.50	48.0	DEND	7/17/14	0.297	5.62	3.85					0.0108	0.00955	0	0.0104	2500	0.043155		
7/17	19.0		8.95	9.80	86.3	5.43	48.2																	
8/7	0.5	8.1	25.44	10.05	124.5	6.81	48.2	DENS	8/7/14	0.34	6.14	4.21	0	0	420									527.33
8/7	1.0		25.41	9.91	122.8	6.76	47.9																	
8/7	2.1		25.25	10.02	123.7	6.67	47.9																	
8/7	3.1		25.21	9.94	122.6	6.60	48.1																	
8/7	4.1		25.14	9.92	122.2	6.62	47.8																	
8/7	5.2		25.11	9.83	121.1	6.52	47.8																	
8/7	6.0		25.08	9.81	120.8	6.52	47.8	DENM	8/7/14				0	0	1050									
8/7	7.1		25.05	9.73	119.7	6.53	48.1																	
8/7	8.1		24.61	9.64	117.6	6.44	48.1																	
8/7	9.1		23.62	9.60	114.9	6.36	47.9																	
8/7	10.0		20.47	10.23	115.3	6.15	47.5																	
8/7	11.1		17.15	11.42	120.3	6.10	47.5																	
8/7	12.1		14.31	11.64	115.5	6.06	47.6	DENM	8/7/14	0.392	5.80	3.97												
8/7	13.0		*No data collected at this depth.*					DEND	8/7/14				0	0	1860									
8/7	14.1		11.63	10.56	98.7	5.81	48.2																	
8/7	15.2		10.77	10.58	96.9	5.79	48.9																	
8/7	16.1		10.09	9.50	85.6	5.69	49.4																	
8/7	17.2		9.75	9.28	82.9	5.64	49.3																	
8/7	18.0		9.58	8.90	79.2	5.58	49.6	DEND	8/7/14	0.354	5.73	3.85												
8/7	19.1		9.01	8.59	75.4	5.54	50.0																	
9/11	*No data, no samples - Rough reservoir conditions.*																							526.26
10/9	0.5	5.9	17.63	12.08	128.6	6.55	47.6	DENS	10/9/14	0.443	5.91	4.05	0	0	1420		0	0	0.191	0	1580	0.02821		525.16
10/9	1.2		17.62	11.91	126.7	6.52	47.9																	
10/9	2.2		17.62	11.76	125.1	6.54	47.9																	
10/9	3.1		17.62	11.53	122.7	6.48	47.7																	
10/9	4.1		17.62	11.46	122.0	6.43	47.7																	
10/9	5.0		17.60	11.34	120.6	6.40	47.8																	
10/9	6.0		17.60	11.31	120.3	6.36	47.8	DENM	10/9/14				1	0	1780									
10/9	7.3		17.58	11.24	119.4	6.39	47.8																	
10/9	8.1		17.57	11.19	119.0	6.32	47.7																	
10/9	9.1		17.55	11.13	118.3	6.34	47.6																	
10/9	10.1		17.53	11.09	117.7	6.33	47.5																	
10/9	11.1		17.51	11.03	117.1	6.30	47.5																	
10/9	12.1		17.51	11.03	117.0	6.26	47.6																	
10/9	13.2		17.40	11.00	116.5	6.26	47.6	DEND	10/9/14				0	0	2380									
10/9	13.9		17.12	10.09	106.3	6.01	48.0																	
10/9	15.3		12.08	7.35	69.3	5.52	49.7	DENM	10/9/14	0.457	5.90	3.95					0	0	0.149	0	1680	0.028465	2000	
10/9	16.1		11.31	6.90	64.0	5.48	50.3																	
10/9	17.1		10.44	6.61	60.1	5.47	50.6	DEND	10/9/14	0.528	5.97	4.06					0.00631	0.00606	0.157	0.00595	2170	0.028815		
10/9	18.1		9.99	6.18	55.6	5.43	50.9																	
11/13	0.5	7.5	10.39	14.28	131.7	7.02	48.2	DENS	11/13/14	0.501	6.21	4.38	0	0	591									524.91
11/13	1.0		10.39	13.69	126.2	6.92	48.1																	
11/13	2.1		10.38	13.43	123.8	6.86	48.1																	
11/13	3.1		10.36	13.14	121.1	6.75	48.3																	
11/13	4.0		10.36	12.86	118.6	6.68	48.3																	
11/13	5.0		10.34	12.80	117.9	6.63	48.0																	
11/13	6.1		10.33	12.61	116.1	6.58	48.3	DENM	11/13/14				0	0	563									
11/13	7.0		10.33	12.53	115.4	6.49	48.3																	
11/13	8.0		10.32	12.40	114.2	6.53	48.2																	
11/13	9.1		10.32	12.34	113.7	6.40	48.1	DENM	11/13/14	0.497	6.09	4.24												
11/13	10.1		10.31	12.32	113.4	6.42	48.4																	
11/13	11.1		10.30	12.15	111.9	6.37	48.2																	
11/13	12.1		10.30	12.12	111.5	6.38	48.3																	
11/13	13.1		10.30	12.10	111.4	6.35	48.4	DEND	11/13/14				0	0	576									
11/13	14.1		10.30	12.09	111.2	6.33	48.3																	
11/13	15.1		10.30	12.00	110.5	6.33	48.2																	

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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
11/13	16.1		10.29	12.03	110.7	6.30	48.4	DEND	11/13/14	0.537	6.25	4.40												
11/13	17.1		10.27	12.05	110.8	6.28	48.2																	
11/13	18.1		10.25	12.03	110.6	6.32	48.7																	
12/3	0.5	6.9	5.85	14.13	114.6	7.19	48.5	DENS	12/3/14	0.408	6.02	4.15	*0*	*0*	72		*0*	0.0131	0.228	0.00716	1720	0.037845		525.06
12/3	1.1		5.85	14.10	114.4	7.14	48.4																	
12/3	3.0		5.85	14.13	114.6	6.98	48.4																	
12/3	6.1		5.85	14.12	114.5	6.85	48.5	DENM	12/3/14				*0*	*0*	74									
12/3	9.1		5.83	14.13	114.5	6.78	48.4	DENM	12/3/14	0.416	6.01	4.16					*0*	0.0128	0.241	0.00739	1790	0.03883	2070	
12/3	12.1		5.81	14.14	114.5	6.64	48.4																	
12/3	13.0		5.77	14.16	114.6	6.61	48.7	DEND	12/3/14				1	*0*	75									
12/3	15.0		5.72	14.17	114.6	6.62	48.6																	
12/3	16.0		5.68	14.21	114.7	6.55	48.8	DEND	12/3/14	0.412	6.10	4.18					*0*	0.0129	0.203	0.00847	1820	0.040130		
12/3	17.1		5.68	14.21	114.8	6.55	48.8																	
	AVG.	6.7	13.46	10.11	98.9	6.24	48.4			0.408	5.86	3.96	<1	<10	483	N/A	<0.005	0.00787	0.188	0.00701	2100	0.042255	2000	
	MAX.	9.9	25.44	14.28	136.7	7.19	51.3			0.561	6.25	4.40	2	<10	2380	N/A	0.0108	0.0199	0.241	0.0104	3290	0.078070	2070	
	MIN.	4.0	5.68	6.18	54.4	5.43	46.0			0.281	5.40	3.52	<1	<10	<10	N/A	<0.005	<0.005	0.000	<0.005	1360	0.028210	1910	
	MEDIAN	6.5	10.36	10.05	110.6	6.31	48.3			0.400	5.83	3.94	<1	<10	74.5	N/A	<0.005	0.00817	0.215	0.00793	1805	0.038338	2015	

NOTES

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.