Technical Memorandum

CHICOPEE RIVER WATERSHED 2008 LAKES SAMPLING
DWM WATER QUALITY MONITORING DATA

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Division of Watershed Management
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Introduction

The Chicopee River Watershed water quality survey was conducted in 2008 along with benthic macroinvertebrate sampling and fish population sampling as part of the Division of Watershed Management (DWM) monitoring. This technical memorandum presents final DWM generated 2008 Chicopee River Watershed lakes sampling water quality data for use in watershed assessment reports and for reporting data to outside groups. All other 2008 Chicopee River watershed sampling data are presented in separate technical memoranda.

The Red Bridge Impoundment is an 83 acre impoundment of the Chicopee River located on the Ludlow/Wibraham border (Figure 1). The impoundment is approximately 2 miles downstream from the confluence of the Ware and Quaboag Rivers, which combine to form the Chicopee River. Just upstream from this confluence the Ware River has a confluence with the Swift River. This area of Palmer is known as the three rivers area. Asnacomet Pond is a 127 acre pond located in Hubbardston, MA. The pond is characterized by cold clear waters, good transparency and is a popular trout fishing pond (MassWildlife 2013).

Project Objectives

The results of the 2008 Chicopee River lakes sampling factors into regulatory actions taken by the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (US EPA), are incorporated into DWM's Water Quality Assessment Reports, and are used to update Sections 305(b) and 303(d) reporting elements of the Clean Water Act.

The specific objectives of the 2008 Chicopee River Watershed lakes sampling were to:

1) Collect physico-chemical data to assess the *Aquatic Life Use*.

2) Assess the trophic status of the lake, as appropriate.

Sampling Plan

Information pertaining to station location, rationale and objectives is available in *Sampling Plan for Year 2008 Surface Water Monitoring in the Chicopee River Basin* (Reardon 2008). For a description of the DWM's general approach to watershed monitoring, see the *QUALITY ASSURANCE PROGRAM PLAN, Surface Water Monitoring & Assessment, MA DEP-Division of Watershed Management, 2005-2009* (MassDEP 2005a).

Lake sampling, which included grab samples for water chemistry, chlorophyll *a* (both surface grab and depth-integrated samples), color, turbidity, dissolved oxygen profiles and Secchi disc transparency, was completed at Asnacomet Pond and the Red Bridge Impoundment (Table 1). Lake sampling at Red Bridge Impoundment Station B consisted only of a dissolved oxygen profile. Macrophyte mapping was also conducted at Asnacomet Pond on one occasion. Asnacomet Pond was sampled on July 8th, August 28th and September 25th. The Red Bridge Impoundment was sampled on July 10th, August 25th and September 15th. See Table 1 and figures 1, 2 and 3 for sampling information and locations.

Table 1: Sampling sites, descriptions and parameters for Chicopee River Watershed lakes sampling

Station ID	Unique ID	Waterbody	Description	Latitude	Longitude	True Color, Turbidity	Ammonia-N, Total Nitrogen, Total Phosphorus	Chlorophyll *a* (surface grab and depth integrated)	Dissolved Oxygen Profile
A [W2012]	W2012	Chicopee River	[deep hole approximately 300 feet upstream of Red Bridge Dam, Ludlow/Wilbraham]	42.1782	-72.408085	X	X	X	X
B	W2013	Chicopee River	[upstream of the Red Bridge Impoundment, approximately 450 feet upstream from the Belchertown/Ludlow/Wilbraham border]	42.18553	-72.394058				X
A [W2014]	W2014	Asnacomet Pond	[deep hole, near center of northern half of pond, Hubbardston]	42.45975	-71.984642	X	X	X	X

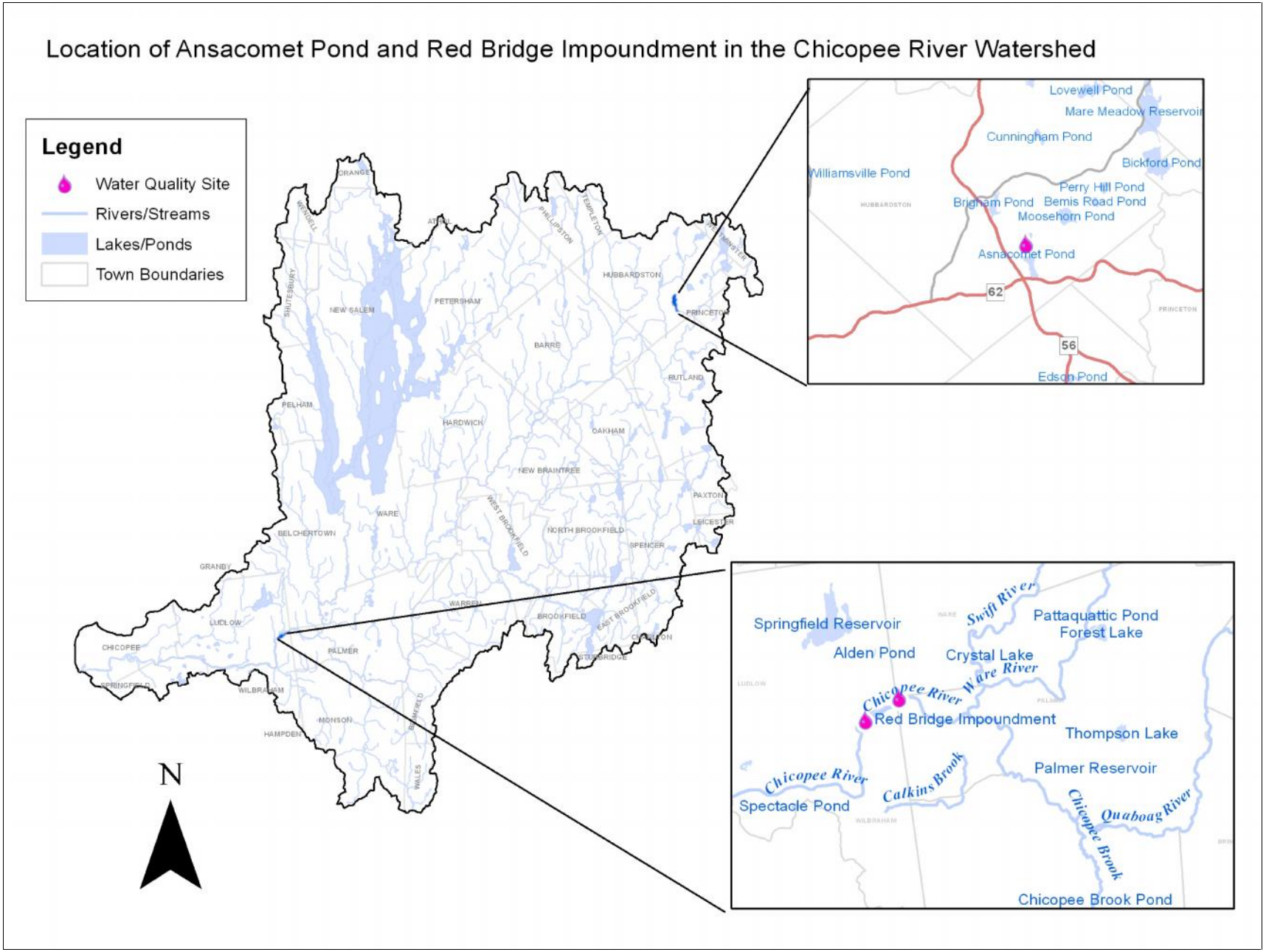

Figure 1. Location of Asnacomet Pond and Red Bridge Impoundment in the Chicopee River Watershed

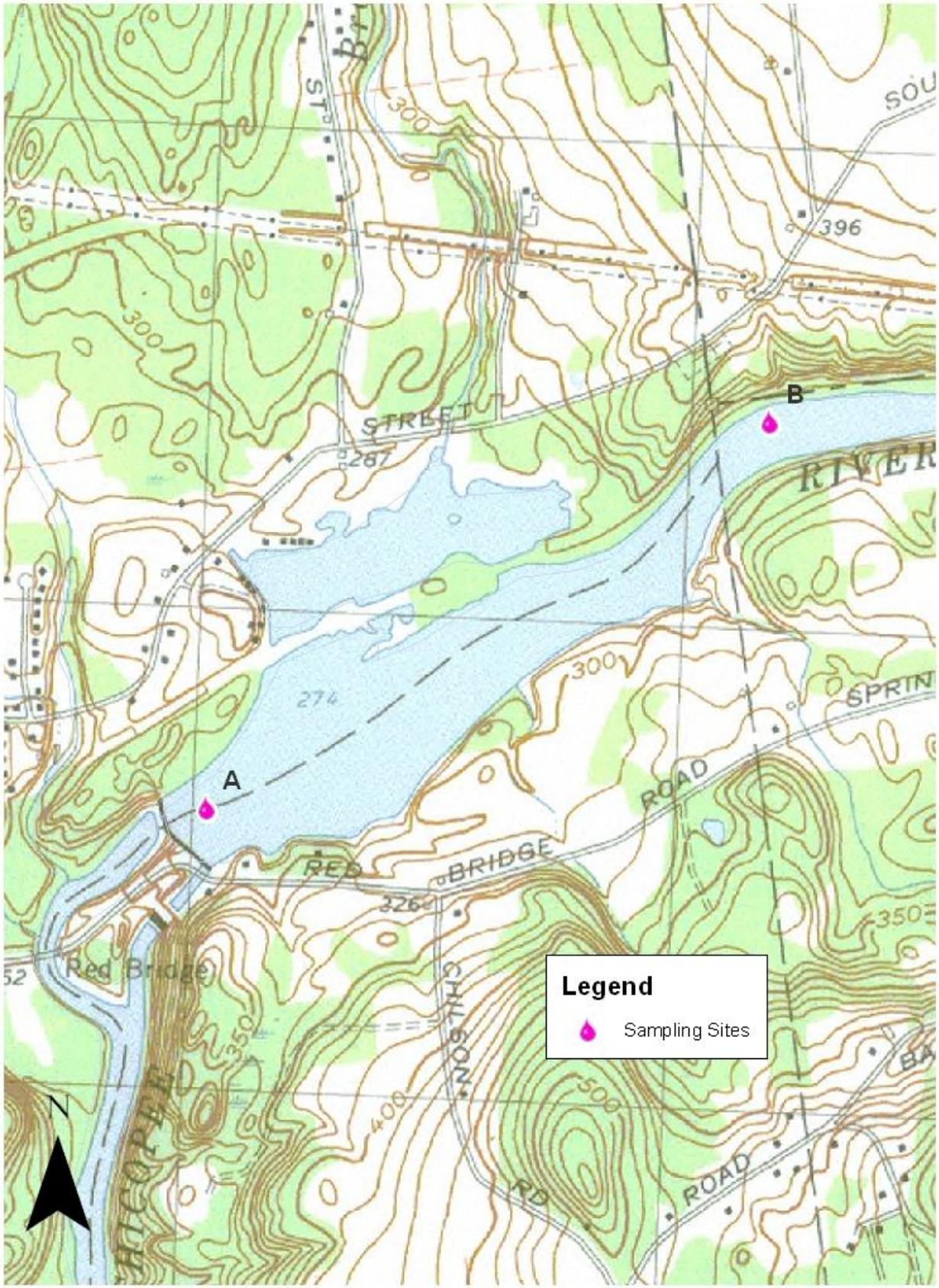

Figure 2. Red Bridge Impoundment Sampling Sites

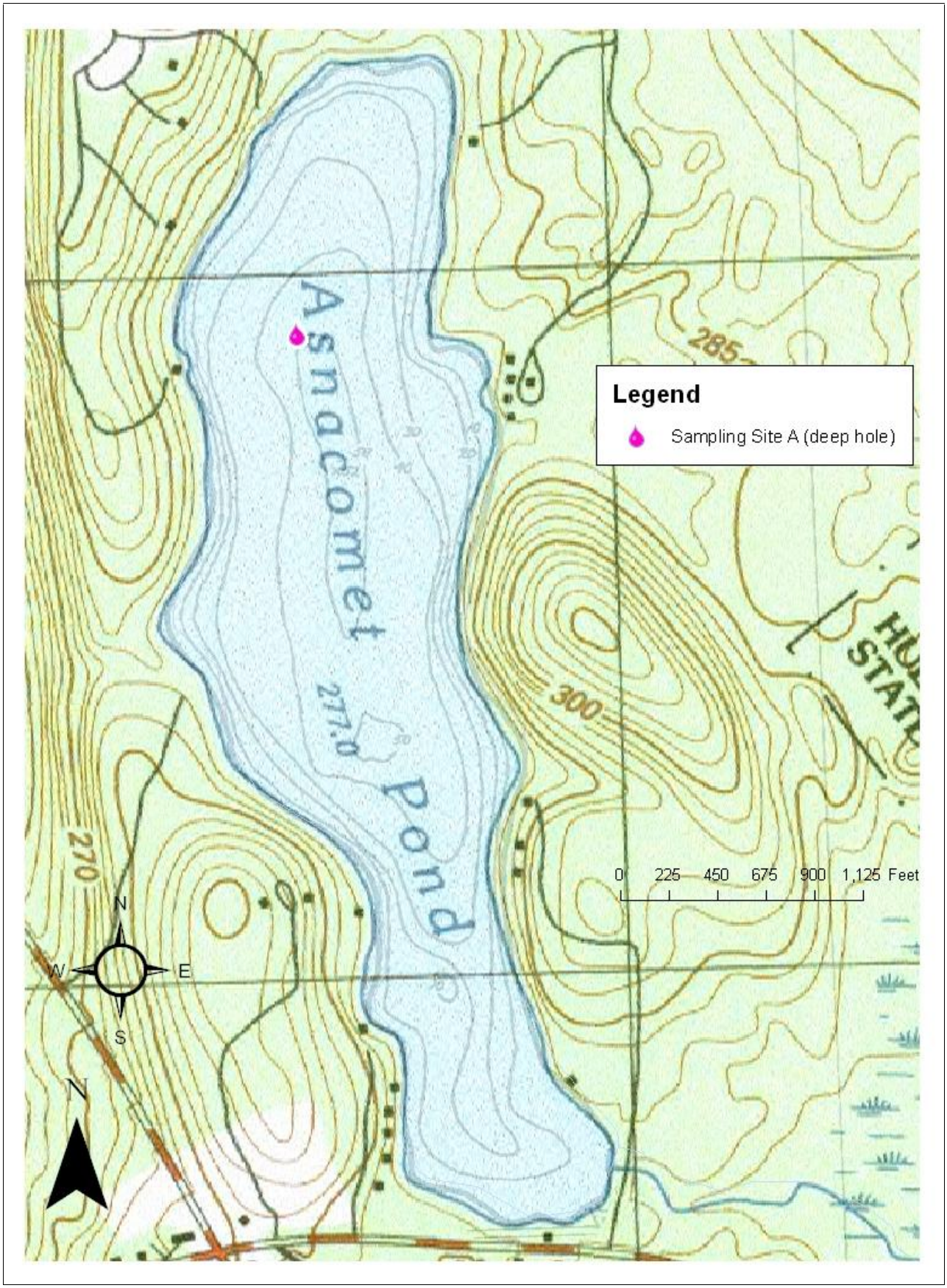

Figure 3: Asnacomet Pond Sampling Site and Approximate Depth Contour Lines (feet) (MassWildlife 2013) (NOTE: NOT FOR NAVIGATIONAL USE)

Field and Analytical Methods

Procedures used for water sampling and sample handling are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring* (MassDEP 2004). The Wall Experiment Station(WES) in Lawrence, MA supplied all field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MassDEP 2001). Procedures for multi-probe calibration and deployment are described in *Water Quality Multiprobe Data Collection* (MassDEP 2005b)

Grab samples for nutrients were collected and sent to the WES in Lawrence, MA where they were analyzed for low-level total phosphorus (TP), total nitrogen (TN) and ammonia as nitrogen (NH_3-N) as appropriate. Chlorophyll *a*, true color and turbidity were analyzed at the DWM laboratory in Worcester, MA. *In-situ* parameters measured using a multi-probe included dissolved oxygen, percent saturation, pH, conductivity, temperature, and total dissolved solids.

Quality Assurance and Quality Control

Monitoring data collected as part of the 2008 Chicopee River Watershed sampling project have generally met the specific programmatic data quality objectives (DQOs) outlined in the applicable quality assurance project plan (MassDEP 2005a) or have met data validation criteria sufficient for publication. Quality assurance for watershed monitoring by the DWM is provided to ensure implementation of an effective and efficient sampling design, and to provide data to meet specific data quality objectives.

The DWM quality assurance and database management staff reviewed lab data reports and all multi-probe data. The data were validated and finalized per appropriate data validation procedures as outlined in *DWM Water Quality Data Validation Process (Summary)* (MassDEP 2012a). Detailed data validation procedures for laboratory data and attended multi-probe data were conducted using appropriate procedures (MassDEP 2012b, MassDEP 2012c). A complete summary of the review process for all 2008 DWM data is provided in the *Water Quality Data Validation Report for Year 2008 Project Data* (MassDEP 2012d). Appendix 1 of this technical memorandum contains definitions for all data qualifiers (MassDEP 2012d).

Station Observations

Station observations were recorded on field sheets for each survey by a DWM investigator. Station observations are described below in Table 2 for each DWM sampling event (MassDEP 2013). Note: If multiple types of plant density were observed, the highest observed density is used in this table.
S=sparse (0-25%, M=moderate (25-50%), D=dense (50-75%), VD=very dense (75-100%), N=none, U=unobservable, NR=not recorded

Table 2. 2008 Field observations from MassDEP DWM surveys

Unique ID	Date	Time	Flow Status	Odor	Water Clarity	Color	Scum	Floating Scum Comments	Objectionable Deposits	Aquatic Plant Density at Sampling Station	Aquatic Plant Cover Density (Whole Lake)	Aquatic Plant Cover Species (Whole Lake)	Comments
W2012	7/10/08	13:30	NR	N	Slightly Turbid	Light Yellow/Tan Rusty (orangish)	No		No	N	S	*Myriophyllum sp.*	
W2012	8/25/08	12:00	NR	N	Clear	Blackish	No		No	N	NR		Same site as previous sampling
W2012	9/15/08	12:00	NR	Musty (Basement)	Slightly Turbid	Dark Tan	Yes	other - near edge, foam, algae and debris mat from wind.	No	N	S	*Myriophyllum sp.*	Power plant does not seem to be dropping level of water, cannot see bricks of the impoundment during beginning of sampling.
W2013	7/10/08	12:39	NR	N	Moderately Turbid	Light Yellow/Tan	No		No	N			
W2013	8/25/08	11:10	NR	N	Clear	Brownish	No		No	N			- lots of bubbles, lake vigorously bubbled either (H2S or CH4) Mark thinks lowered impoundment may reduce water pressure thus gas release - note water level looks down 6" (rocks still wet)
W2014	7/8/08	10:00	NR	N	Clear	Other (Blue)	No		No	N	S	*Eriocaulon sp.*	very clear water, no color

Unique ID	Date	Time	Flow Status	Odor	Water Clarity	Color	Scum	Floating Scum Comments	Objectionable Deposits	Aquatic Plant Density at Sampling Station	Aquatic Plant Cover Density (Whole Lake)	Aquatic Plant Cover Species (Whole Lake)	Comments
W2014	9/25/08	11:20	Normal	N	Clear	Clear	No		No	N	S	*Nitella sp.*	Mattson found *Nittella* @ 30-35 feet depth possibly contributing to metalimnion bulge in DO
W2014	8/28/08	10:00	Normal	N	Clear	Clear	No		No	N	S	*Juncus sp., Nymphaea odorata*	Forgot VanDorn. 36-1414 and 36-1415 not taken, 36-1413 also not taken

Sampling Issues and Coordinator Notes

Field crews sampling Asnacomet Pond on 8/28/08 forgot the Van Dorn water sampler and, therefore, there is no near-bottom nutrient data for this sampling date.

Survey Conditions

Precipitation data collected during the survey period in 2008 were downloaded from the National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC) for the Worcester Airport and Springfield/Chicopee airport weather stations (NOAA 2013a). The precipitation totals on the water quality survey dates and the five days prior to the survey dates were extracted from the retrieved records. In addition, the Worcester Airport weather station's monthly precipitation totals for 2008 and the monthly average of total precipitation for the period 1981 to 2010 was downloaded to determine if precipitation amounts in 2008 were above or below normal (Table 3, NOAA 2013b).

In order to categorize conditions at the Red Bridge Impoundment stations, stream discharge data from the Chicopee River at Indian Orchard (01177000) were downloaded from the United States Geological Survey (Table 4, USGS 2013). The entire period of record for this USGS gage station was downloaded and the average daily discharge values on the water quality survey dates and the five days prior to the survey dates were extracted from these records. The percent of time that the average daily discharge on the extracted dates were equaled or exceeded during the entire period of record for the gage was calculated to put the discharge value into historical perspective. The precipitation and discharge data are summarized and presented in Table 4.

Table 3. Total monthly precipitation in 2008 and monthly average precipitation for 1981 to 2010 at the Worcester Airport weather station (NOAA 2013a, NOAA 2013b).

Month	Worcester Airport 2008 Total Monthly Precipitation (in)	Worcester Airport Monthly Average Precipitation (1981-2010) (in.)	Worcester Airport 2008 Precipitation as Percent of Monthly Average Precipitation (1981-2010)
January	2.45	3.49	70
February	9.69	3.23	300
March	5.62	4.21	133
April	4.24	4.11	103
May	2.45	4.19	58
June	5.56	4.19	133
July	7.96	4.23	188
August	3.53	3.71	95
September	9.22	3.93	235
October	2.62	4.68	56
November	4.25	4.28	99
December	5.64	3.82	148

Table 4. Precipitation and discharge-The precipitation totals (inches) and daily average discharge (cubic feet per second) with percent exceeded on the water quality survey dates and the five days prior to the survey dates. Percent exceeded is the percent of time that the discharge was equaled or exceeded during the period of record for the stream gage(USGS 2013) (NOAA 2013b).

	Precipitation(in)	**Precipitation (in)**	**Discharge (cfs) (% exceeded)**
Date	Worcester Airport	Springfield/ Chicopee Airport	USGS 01177000 Chicopee River At Indian Orchard
7/3/08	0.33	0.3	671 (52%)
7/4/08	0.23	0.03	633 (54%)
7/5/08	0.03	0.61	614 (55%)
7/6/08	0	0	669 (52%)
7/7/08	0	0	562 (59%)
7/8/08	0	0	517 (62%)
7/9/08	0.72	T	523 (62%)
7/10/08	0	0	537 (61%)
8/20/08	0	0	813 (44%)
8/21/08	0	0.01	863 (42%)
8/22/08	0	0	725 (49%)
8/23/08	0	0.01	740 (48%)
8/24/08	0	0	557 (59%)
8/25/08	T	T	552 (60%)
8/26/08	0	0	593 (57%)
8/27/08	0	0	480 (65%)
8/28/08	0	0	469 (66%)
9/10/08	0	0	2760 (7%)
9/11/08	0	0	2230 (10%)
9/12/08	0.28	0.29	1840 (14%)
9/13/08	T	0	1800 (14%)
9/14/08	0.78	0.38	1860 (14%)
9/15/08	0	0	2080 (11%)
9/20/08	0	0	1030 (34%)
9/21/08	0	0	965 (37%)
9/22/08	0	0	888 (40%)
9/23/08	0	0.01	887 (41%)
9/24/08	0	0	752 (47%)
9/25/08	0	0	760 (47%)

Results

Red Bridge Impoundment

Both surface and depth-integrated chlorophyll *a* (mg/m3) values at the Red Bridge Impoundment Station A (deep hole) on all sampling dates were low (<4 mg/m^3) (Table 5). The Red Bridge Impoundment was thermally stratified on the 7/10/08 sampling date (Figure 4) and not thermally stratified on the 8/25/08 and 9/15/08 sampling dates (Figures 5, 6). Total phosphorus concentrations were less than 0.070 mg/L for samples collected both near the surface and near the bottom on all sampling dates (Table 5). The ammonia-N and total phosphorus concentrations in the near bottom sample on 8/25/08 were greater than in the surface water sample which indicates that some nutrients were being released from the sediments on this date. There was no strong pattern of greater ammonia-N or total phosphorus concentrations in near bottom samples when compared to near surface samples on the other sampling dates.

The water at station A in the Red Bridge Impoundment was highly colored (>50 PCU) and was described as having either a light yellow tan/orangish, blackish or dark tan color on the three respective sampling dates (Tables 2,5). Turbidity on each sampling date was low (< 3 NTU) (Table 5). The Secchi disk depth was generally around 2m on each sampling date (Table 5). Given the low chlorophyll *a* concentrations and lack of turbidity, the highly colored water is the likely determinant of Secchi disk depth.

Dissolved oxygen (DO) in the hypolimnion at Station A in the Red Bridge Impoundment on 7/10/08 was <6 mg/L at a depth of 6.5 m and approached 0 mg/L with increasing depth in the hypolimnion (Table 6, Figure 4). At 11.5 m depth the dissolved oxygen was <0.2 mg/L and the dissolved oxygen percent saturation was <2% (Table 6, Figure 4). On 8/25/08 the DO near the surface was 8.8 mg/L and less than 6 mg/L at a depth of 9.1 m (Table 6). On 8/25/08 the dissolved oxygen 0.5 m off the bottom (depth 11.7m) was 0.9 mg/L (Table 6). Greater dissolved oxygen concentrations were seen at depth on the 9/15/08 sampling date. The DO on this date near the surface was 9.0 mg/L and less than 6 mg/L at a depth of 12.0 m (Table 6). The near bottom dissolved oxygen was 4.8 mg/L (Table 6). The water temperature gradient was also the smallest on the 9/15/08 sampling date (Figure 6).

Water temperature at Station B just upstream from the Red Bridge Impoundment was greater than 20 degrees Celsius on both the 7/10/08 and the 8/25/08 sampling date (Table 7). Dissolved oxygen was greater than 6 mg/L at all depths and on both sampling dates (Table 7). Conductivity at Station B on both sampling dates ranged from 120 to 133 uS/cm (Table 7) similar to the values seen at Station A.

Asnacomet Pond

Both surface and depth-integrated chlorophyll *a* (mg/m3) values at the Asnacomet Pond Station A (deep hole) on all sampling dates were low (<4). Total nitrogen concentrations were less than 0.4 mg/L on all occasions. Ammonia-N surface concentrations were below the detection limit (0.02 mg/L) on all occasions. A near bottom sample for ammonia-N was only sampled on one occasion (9/28/08) with a result of 0.2 mg/L. Total phosphorus concentrations in near surface water quality samples were <0.005 mg/L on all occasions. The total phosphorus concentrations in near bottom water quality samples were 0.005 mg/L on 7/8/08 and 0.020 mg/L on 9/25/08 (Table 8).

Asnacomet Pond was thermally stratified on all three sampling dates (Table 9, Figures 7, 8, 9). A metalimnetic bulge in dissolved oxygen concentration was seen on 7/8/08 and 8/28/08 (Figure 7, 8). The Secchi disc depth for the three sampling days ranged from 6.6 m to 7.6 m (Table 8). Dissolved oxygen concentrations ranged from 4.4 mg/L at a depth of 13.6 m to 12.2 mg/L in the metalimnion (7.5m) on 7/8/08. Near-surface dissolved oxygen was to 8.1 mg/L on 7/8/08. On 8/28/08 the dissolved oxygen concentration ranged from less than 0.2 mg/L at a depth of 14.3 m to 11.0 mg/L in the metalimnion (7.0m) (Table 9). On 9/25/08 the dissolved oxygen concentration ranged from 0.2 mg/L at a depth of 14.6 m to 8.8 mg/L near the surface (Table 9). The dissolved oxygen concentration on 9/25/08 generally stayed constant down to the Secchi disc depth and then decreased with depth (Figure 9).

Water temperatures in the metalimnion and hypolimnion were less than 20 degrees Celsius on 7/8/08 and 8/28/08 and less 20 degrees Celsius at all depths on 9/25/08 (Table 9, Figures 7, 8 and 9). Conductivity at Station A on all sampling dates ranged from 34 to 55 uS/cm (Table 9) with the two values greater than 50 uS/cm occurring in near-bottom samples.

During the 7/8/08 sampling date, aquatic plants were mapped. *Eriocaulon sp*., the only aquatic plant noted, was generally found in the littoral zone of the pond with a generally low percent cover density and low biovolume (MassDEP 2013).

Discussion

The retention time for the Red Bridge Impoundment is approximately one day (Ryder 2013). The short retention time likely explains, in part, the low chlorophyll *a* concentrations found. It is also important to note that rainfall totals for July and September of 2008 were above normal. The increased rainfall influenced the hydrology and holding time of the Red Bridge Impoundment. The Red Bridge Impoundment is also the site of a hydroelectric generation station that operates on a limited hold and release basis that often lowers the impoundment by as much as one foot per day (Slater 2012). The next downstream hydroelectric dam project has documented very rapid flow changes (at times a difference of 1000 cfs) over short periods of time (Collins Hydroelectric Project LLP 2012). The total phosphorus concentration of the water samples was generally below the EPA Gold Book value of 0.050 mg/L for rivers. Although the water quality sampling conducted was limited, water quality is markedly improved from the last MassDEP sampling of the impoundment in 1977.

Asnacomet Pond was found to be a clear, oligotrophic lake. On the 8/28/08 sampling date *Nitella sp.* was found at depths of 30 -35 feet and may have been one of the factors in the observed metalimnetic dissolved oxygen bulge. Given the excellent, documented water quality, efforts to preserve good water quality should be pursued and encouraged.

Water Quality Data

All MassDEP DWM water quality data are managed and maintained in the Water Quality Data Access Database. Tables 5,6,7,8 and 9 below are for the 2008 lakes sampling in the Chicopee River Watershed. The procedures used to accept, accept with qualification or censor data are based on the DWM SOP for data validation and usability (MassDEP 2012a), and are in addition to separate quality assurance activities and laboratory validation steps undertaken by WES. Data symbols and qualifiers are listed in Appendix 1.

Table 5: Chicopee River/Red Bridge Impoundment Laboratory water quality data
Unique ID: W2012 Station ID: A
Description: [deep hole approximately 300 feet upstream of Red Bridge Dam, Ludlow/Wilbraham]

Sample OWMID	QC OWMID	QC Type	Sample Date	Sample Time	Lake Level	Max Depth (meters)	Sample Depth (meters)	Relative Sample Depth (meters)	Secchi Depth (meters)	Secchi Depth Qualifiers*	Analyte	Units	Result	Result Qualifiers*
36-1066		Routine Sample	7/10/08	15:05	**	12.2	**	Surface	2		Chlorophyll *a*	mg/m^3	2.1	
36-1064	36-1065	Duplicate	7/10/08	15:13	**	12.2	0.0-6.0	--	2		Chlorophyll *a*	mg/m^3	2	
36-1061	36-1062	Duplicate	7/10/08	14:27	**	12.2	**	Surface	2		Total Phosphorus	mg/L	0.036	
36-1068		Routine Sample	7/10/08	15:34	**	12.2	**	Near bottom	2		Total Phosphorus	mg/L	0.047	
36-1061	36-1062	Duplicate	7/10/08	14:27	**	12.2	**	Surface	2		True Color	PCU	80	d
36-1061	36-1062	Duplicate	7/10/08	14:27	**	12.2	**	Surface	2		Turbidity	NTU	2.2	
36-1422	36-1423	Duplicate	8/25/08	13:10	**	12.2	**	Surface	2.2		Ammonia-N	mg/L	<0.02	
36-1426		Routine Sample	8/25/08	13:16	**	12.2	**	Near bottom	2.2		Ammonia-N	mg/L	0.41	
36-1427		Routine Sample	8/25/08	12:03	**	12.2	**	Surface	2.2		Chlorophyll a	mg/m^3	3.3	
36-1428	36-1429	Duplicate	8/25/08	12:20	**	12.2	0.0-6.5	--	2.2		Chlorophyll *a*	mg/m^3	1.4	
36-1422	36-1423	Duplicate	8/25/08	13:10	**	12.2	**	Surface	2.2		Total Nitrogen	mg/L	0.53	
36-1426		Routine Sample	8/25/08	13:16	**	12.2	**	Near bottom	2.2		Total Nitrogen	mg/L	1	
36-1422	36-1423	Duplicate	8/25/08	13:10	**	12.2	**	Surface	2.2		Total Phosphorus	mg/L	0.026	
36-1426		Routine Sample	8/25/08	13:16	**	12.2	**	Near bottom	2.2		Total Phosphorus	mg/L	0.061	
36-1422	36-1423	Duplicate	8/25/08	13:10	**	12.2	**	Surface	2.2		True Color	PCU	40	
36-1422	36-1423	Duplicate	8/25/08	13:10	**	12.2	**	Surface	2.2		Turbidity	NTU	1.6	

Table 5 (continued). Chicopee River/Red Bridge Impoundment Laboratory water quality data
Unique ID: W2012 Station ID: A
Description: [deep hole approximately 300 feet upstream of Red Bridge Dam, Ludlow/Wilbraham]

Sample OWMID	QC OWMID	QC Type	Sample Date	Sample Time	Lake Level	Max Depth (meters)	Sample Depth (meters)	Relative Sample Depth (meters)	Secchi Depth (meters)	Secchi Depth Qualifiers	Analyte	Units	Result	Result Qualifiers
36-1408	36-1409	Duplicate	9/15/08	13:18	**	12.7	**	Surface	1.8		Ammonia-N	mg/L	0.03	d
36-0807		Routine Sample	9/15/08	13:45	**	12.7	12.0	Near bottom	1.8		Ammonia-N	mg/L	0.17	
36-0804		Routine Sample	9/15/08	13:50	**	12.7	**	Surface	1.8		Chlorophyll *a*	mg/m^3	1.9	
36-0808	36-0809	Duplicate	9/15/08	13:55	**	12.7	0.0-6.0	--	1.8		Chlorophyll *a*	mg/m^3	1.6	
36-1408	36-1409	Duplicate	9/15/08	13:18	**	12.7	**	Surface	1.8		Total Nitrogen	mg/L	0.55	
36-0807		Routine Sample	9/15/08	13:45	**	12.7	12.0	Near bottom	1.8		Total Nitrogen	mg/L	0.65	
36-1408	36-1409	Duplicate	9/15/08	13:18	**	12.7	**	Surface	1.8		Total Phosphorus	mg/L	0.033	
36-0807		Routine Sample	9/15/08	13:45	**	12.7	12.0	Near bottom	1.8		Total Phosphorus	mg/L	0.04	
36-1408	36-1409	Duplicate	9/15/08	13:18	**	12.7	**	Surface	1.8		True Color	PCU	58	
36-1408	36-1409	Duplicate	9/15/08	13:18	**	12.7	**	Surface	1.8		Turbidity	NTU	2.2	

***See Appendix 1 for a complete list of data symbols and qualifiers**

Table 6: Chicopee River/Red Bridge Impoundment Attended Probe Data
Unique ID: W2012 Station ID: A
Description: [deep hole approximately 300 feet upstream of Red Bridge Dam, Ludlow/Wilbraham]

OWMID	Date	Time	Flow Condition	Sample Depth (meters)	Depth Qualifiers	Temperature (deg. C)	Temperature Qualifiers*	pH (SU)	pH Qualifiers*	Specifiic Conductivity (uS/cm)	Specific Conductivity Qualifiers*	Total Dissolved Solids (mg/l)	Total Dissolved Solids Qualifiers*	Dissolved Oxygen (mg/l)	Dissolved Oxygen Qualifiers*	Saturation (%)	Saturation Qualifiers*
36-1070	7/10/08	13:59	**	0.5		25.9		6.9		122		78		7.5		94	
36-1070	7/10/08	14:05	**	1.5		25.0		6.8		123		79		7.0		87	
36-1070	7/10/08	14:12	**	3.0		23.9		6.6		122		78		6.5		79	
36-1070	7/10/08	14:16	**	4.9		22.2		6.4		116		75		6.5		76	
36-1070	7/10/08	14:22	**	6.5		19.8		6.3		113		73		5.7		64	
36-1070	7/10/08	14:31	**	7.0		19.4		6.2		113		72		4.7		52	
36-1070	7/10/08	14:46	**	8.1		15.5	u	6.2		116		74		0.2	u	2	u
36-1070	7/10/08	14:53	**	9.5		13.9		6.4		126		80		<0.2		<2	
36-1070	7/10/08	14:59	**	11.5		12.5		6.6		147		94		<0.2		<2	
36-1430	8/25/08	12:02	**	0.5		22.1	u	7.2		127		82		8.8		101	
36-1430	8/25/08	12:13	**	2.0		21.0		6.9		127		83		8.1		91	
36-1430	8/25/08	12:23	**	3.6		20.1		6.9		124		81		7.9		87	
36-1430	8/25/08	12:32	**	5.1		19.4		6.8		123		80		7.5		81	
36-1430	8/25/08	12:42	**	8.0		18.5		6.7		120		78		6.1		65	
36-1430	8/25/08	12:49	**	9.1		18.4		6.6		119		77		5.9		63	
36-1430	8/25/08	12:56	**	9.9		18.3		6.6		120		78		5.1		54	
36-1430	8/25/08	13:03	**	11.0		18.0		6.5		123		80		2.4		25	
36-1430	8/25/08	13:18	**	11.7		17.9		6.5		126		82		0.9		9	
36-1590	9/15/08	12:03	**	0.6		19.1		6.7		96		62		9.0		97	

Table 6 (continued). Chicopee River/Red Bridge Impoundment Attended Probe Data
Unique ID: W2012 Station ID: A
Description: [deep hole approximately 300 feet upstream of Red Bridge Dam, Ludlow/Wilbraham]

OWMID	Date	Time	Flow Condition	Sample Depth (meters)	Depth Qualifiers	Temperature (deg. C)	Temperature Qualifiers*	pH (SU)	pH Qualifiers*	Specifiic Conductivity (uS/cm)	Specific Conductivity Qualifiers*	Total Dissolved Solids (mg/l)	Total Dissolved Solids Qualifiers*	Dissolved Oxygen (mg/l)	Dissolved Oxygen Qualifiers*	Saturation (%)	Saturation Qualifiers*
36-1590	9/15/08	12:13	**	2.1		18.9		6.7		96		62		8.9		96	
36-1590	9/15/08	12:19	**	4.0		18.8		6.7		96		62		8.9		95	
36-1590	9/15/08	12:25	**	6.0		18.4		6.6		96		63		8.9		95	
36-1590	9/15/08	12:31	**	8.0		18.0		6.6		97		63		8.9		94	
36-1590	9/15/08	12:37	**	8.9		17.3		6.5		94		61		8.7		91	
36-1590	9/15/08	12:44	**	10.1		17.0		6.4		95		62		7.9		81	
36-1590	9/15/08	12:48	**	11.0		17.0		6.4		96		63		7.2		74	
36-1590	9/15/08	12:54	**	12.0		16.9		6.4		100		65		5.6		57	
36-1590	9/15/08	12:59	**	12.6		16.9		6.4		101		66		4.8		50	

***See Appendix 1 for a complete list of data symbols and qualifiers**

Table 7: Chicopee River/Red Bridge Impoundment Attended Probe Data
Unique ID: W2012 Station ID: B
Description: [upstream of the Red Bridge Impoundment, approximately 450 feet upstream from the Belchertown/Ludlow/Wilbraham border]

OWMID	Date	Time	Flow Condition	Sample Depth (meters)	Depth Qualifiers	Temperature (deg. C)	Temperature Qualifiers*	pH (SU)	pH Qualifiers*	Specifiic Conductivity (uS/cm)	Specific Conductivity Qualifiers*	Total Dissolved Solids (mg/l)	Total Dissolved Solids Qualifiers*	Dissolved Oxygen (mg/l)	Dissolved Oxygen Qualifiers*	Saturation (%)	Saturation Qualifiers*
36-1500	7/10/08	12:47	**	0.6		26.3	m	6.9	m	125	m	80	m	7.5	m	95	m
36-1500	7/10/08	12:53	**	1.5		26.1		6.9		125		80		7.4		94	
36-1500	7/10/08	12:59	**	2.5		25.2	m	6.8	m	124	m	80	m	7.2	m	89	m
36-1500	7/10/08	13:04	**	3.4		24.4		6.7		123		79		7.3		89	
36-1500	7/10/08	13:09	**	4.5		23.6		6.6		120		77		7.5		90	
36-1500	7/10/08	13:20	**	5.2		23.1	u	6.5		121		78		6.8	u	81	u
36-1500	7/10/08	13:12	**	5.5		##	u	6.2	i	120	i	77	i	##	u, i	##	u, i
36-1660	8/25/08	11:20	**	0.5		21.7		7.1		134		87		8.5		97	
36-1660	8/25/08	11:33	**	4.6		20.1		7.0		133		86		8.6		95	

***See Appendix 1 for a complete list of data symbols and qualifiers**

Table 8: Asnacomet Pond water quality data
Unique ID: W2014 Station ID: A
Description: [deep hole, near center of northern half of pond, Hubbardston]

Sample OWMID	QC OWMID	QC Type	Sample Date	Sample Time	Lake Level	Max Depth (meters)	Sample Depth (meters)	Relative Sample Depth (meters)	Secchi Depth (meters)	Secchi Depth Qualifiers*	Analyte	Units	Result	Result Qualifiers*
36-1050	36-1051	Duplicate	07/08/08	12:23	**	14.1	**	Surface	7.6		Total Phosphorus	mg/L	<0.005	
36-1050	36-1051	Duplicate	07/08/08	12:23	**	14.1	**	Surface	7.6		True Color	PCU	<15	
36-1050	36-1051	Duplicate	07/08/08	12:23	**	14.1	**	Surface	7.6		Turbidity	NTU	0.5	
36-1058		Routine Sample	07/08/08	12:49	**	14.1	**	Near bottom	7.6		Total Phosphorus	mg/L	0.005	
36-1054		Routine Sample	07/08/08	13:02	**	14.1	**	Surface	7.6		Chlorophyll *a*	mg/m^3	<1.0	
36-1055	36-1056	Duplicate	07/08/08	13:07	**	14.1	0.0-13.5	--	7.6		Chlorophyll *a*	mg/m^3	2.1	
36-1411	36-1412	Duplicate	08/28/08	10:35	Normal	15.5	**	Surface	7.3		Ammonia-N	mg/L	<0.02	
36-1411	36-1412	Duplicate	08/28/08	10:35	Normal	15.5	**	Surface	7.3		Total Nitrogen	mg/L	0.14	
36-1411	36-1412	Duplicate	08/28/08	10:35	Normal	15.5	**	Surface	7.3		Total Phosphorus	mg/L	<0.005	
36-1411	36-1412	Duplicate	08/28/08	10:35	Normal	15.5	**	Surface	7.3		True Color	PCU	<15	
36-1411	36-1412	Duplicate	08/28/08	10:35	Normal	15.5	**	Surface	7.3		Turbidity	NTU	0.6	
36-1417	36-1418	Duplicate	08/28/08	11:30	Normal	15.5	**	--	7.3		Chlorophyll *a*	mg/m^3	2.9	d
36-1416		Routine Sample	08/28/08	11:31	Normal	15.5	**	Surface	7.3		Chlorophyll a	mg/m^3	1.9	
36-1567		Routine Sample	09/25/08	11:50	Normal	15.5	**	Surface	6.6		Chlorophyll *a*	mg/m^3	2.4	
36-1558	36-1559	Duplicate	09/25/08	11:50	Normal	15.5	**	Surface	6.6		Ammonia-N	mg/L	<0.02	
36-1558	36-1559	Duplicate	09/25/08	11:50	Normal	15.5	**	Surface	6.6		Total Nitrogen	mg/L	0.13	
36-1558	36-1559	Duplicate	09/25/08	11:50	Normal	15.5	**	Surface	6.6		Total Phosphorus	mg/L	<0.005	
36-1558	36-1559	Duplicate	09/25/08	11:50	Normal	15.5	**	Surface	6.6		True Color	PCU	<15	
36-1558	36-1559	Duplicate	09/25/08	11:50	Normal	15.5	**	Surface	6.6		Turbidity	NTU	<0.5	b
36-1569	36-1570	Duplicate	09/25/08	12:05	Normal	15.5	0.0-14.0	--	6.6		Chlorophyll *a*	mg/m^3	3.6	d
36-1568		Routine Sample	09/25/08	12:20	Normal	15.5	14.0	Near bottom	6.6		Ammonia-N	mg/L	0.2	

Table 8 (continued). Asnacomet Pond water quality data
Unique ID: W2014 Station ID: A
Description: [deep hole, near center of northern half of pond, Hubbardston]

Sample OWMID	QC OWMID	QC Type	Sample Date	Sample Time	Lake Level	Max Depth (meters)	Sample Depth (meters)	Relative Sample Depth (meters)	Secchi Depth (meters)	Secchi Depth Qualifiers*	Analyte	Units	Result	Result Qualifiers*
36-1568		Routine Sample	09/25/08	12:20	Normal	15.5	14.0	Near bottom	6.6		Total Nitrogen	mg/L	0.43	
36-1568		Routine Sample	09/25/08	12:20	Normal	15.5	14.0	Near bottom	6.6		Total Phosphorus	mg/L	0.02	

***See Appendix 1 for a complete list of data symbols and qualifiers**

Table 9: Asnacomet Pond Attended Probe Data
Unique ID: W2014 Station ID: A
Description: [deep hole, near center of northern half of pond, Hubbardston]

OWMID	Date	Time	Flow Condition	Sample Depth (meters)	Depth Qualifiers	Temperature (deg. C)	Temperature Qualifiers*	pH (SU)	pH Qualifiers*	Specifiic Conductivity (uS/cm)	Specific Conductivity Qualifiers*	Total Dissolved Solids (mg/l)	Total Dissolved Solids Qualifiers*	Dissolved Oxygen (mg/l)	Dissolved Oxygen Qualifiers*	Saturation (%)	Saturation Qualifiers*
36-1060	7/8/08	11:37	**	0.6		25.8		6.4		35		23		8.1		101	
36-1060	7/8/08	11:41	**	1.5		25.5		6.4		35		23		8.0		100	
36-1060	7/8/08	11:48	**	4.1		22.8		6.2		35		23		8.8		104	
36-1060	7/8/08	11:55	**	6.1		15.4	m	6.1	m	34	m	22	m	12.1	m	123	m
36-1060	7/8/08	11:59	**	7.5		11.3	m	5.7	m	34	m	22	m	12.2	m	113	m
36-1060	7/8/08	12:02	**	9.0		8.5	m	5.3	m	34	m	22	m	10.8	m	93	m
36-1060	7/8/08	12:05	**	10.1		7.5	m	5.2	m	34	m	22	m	9.5	m	81	m
36-1060	7/8/08	12:09	**	11.3		6.8	m	5.1	m	34	m	22	m	8.4	m	70	m
36-1060	7/8/08	12:12	**	12.1		6.5	m	5.0	m	34	m	22	m	6.8	m	57	m
36-1060	7/8/08	12:18	**	13.6		6.2	m	5.0	m	35	m	22	m	4.4	u, m	36	u, m
36-1420	8/28/08	10:13	Normal	0.5		22.6		6.6		37		24		8.6		99	

Table 9 (continued). Asnacomet Pond Attended Probe Data
Unique ID: W2014 Station ID: A
Description: [deep hole, near center of northern half of pond, Hubbardston]

OWMID	Date	Time	Flow Condition	Sample Depth (meters)	Depth Qualifiers	Temperature (deg. C)	Temperature Qualifiers*	pH (SU)	pH Qualifiers*	Specifiic Conductivity (uS/cm)	Specific Conductivity Qualifiers*	Total Dissolved Solids (mg/l)	Total Dissolved Solids Qualifiers*	Dissolved Oxygen (mg/l)	Dissolved Oxygen Qualifiers*	Saturation (%)	Saturation Qualifiers*
36-1420	8/28/08	10:22	Normal	2.5		22.6		6.6		37		24		8.6		99	
36-1420	8/28/08	10:29	Normal	5.1		22.4		6.5		37		24		8.4		97	
36-1420	8/28/08	10:37	Normal	6.1		19.8		6.1		37		24		9.6		105	
36-1420	8/28/08	10:46	Normal	7.0		15.3		6.0		37		24		11.0		110	
36-1420	8/28/08	10:53	Normal	8.1		11.7		5.9		37		24		10.8		100	
36-1420	8/28/08	11:07	Normal	10.0		8.9		5.8		37		24		9.0		78	
36-1420	8/28/08	11:14	Normal	12.2		7.0		5.6		39		25		3.7		30	
36-1420	8/28/08	11:23	Normal	14.3		6.3		6.1		52		34		<0.2		<2	
36-1571	9/25/08	11:25	Normal	0.5		19.1		6.5		35		23		8.8		94	
36-1571	9/25/08	11:39	Normal	3.5		19.1		6.5		35		23		8.7		94	
36-1571	9/25/08	11:46	Normal	6.5		18.9		6.5		35		22		8.5		92	
36-1571	9/25/08	11:53	Normal	7.5		17.1		5.8		36		23		8.0		82	
36-1571	9/25/08	12:03	Normal	8.4		12.8	u	5.7		36		23		8.1		76	
36-1571	9/25/08	12:13	Normal	9.5		9.9		5.7		36		23		6.6		58	
36-1571	9/25/08	12:21	Normal	10.5		8.7		5.5		37		23		4.8		41	
36-1571	9/25/08	12:29	Normal	12.5		7.4		5.5		38		24		0.3		2	
36-1571	9/25/08	12:34	Normal	14.6		6.7		6.1		55		35		0.2		<2	

***See Appendix 1 for a complete list of data symbols and qualifiers**

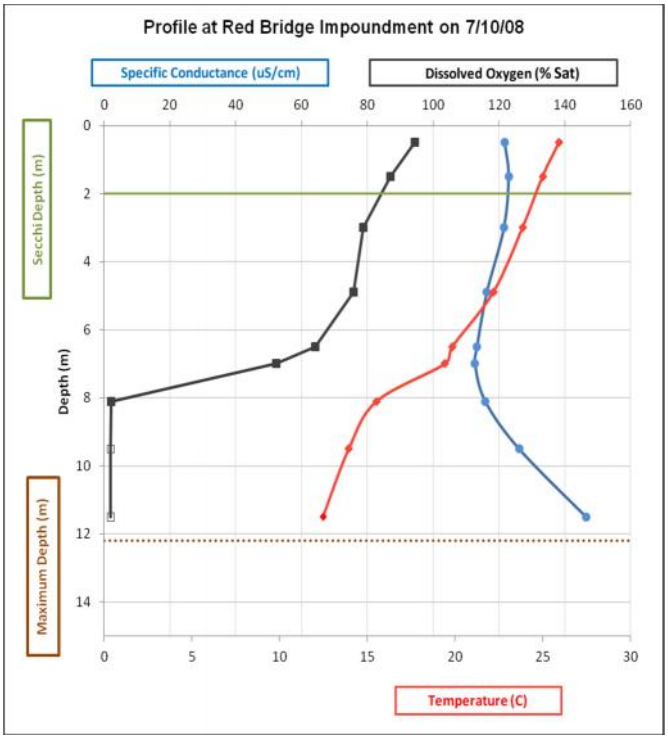

Figure 4: Profile at Red Bridge Impoundment Station A on 7/10/08*

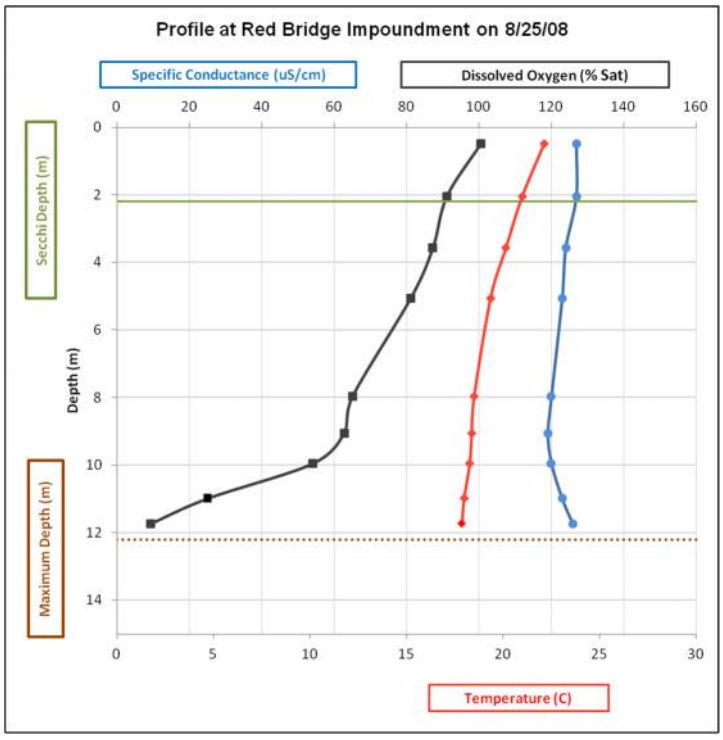

Figure 5: Profile at Red Bridge Impoundment Station A on 8/25/08

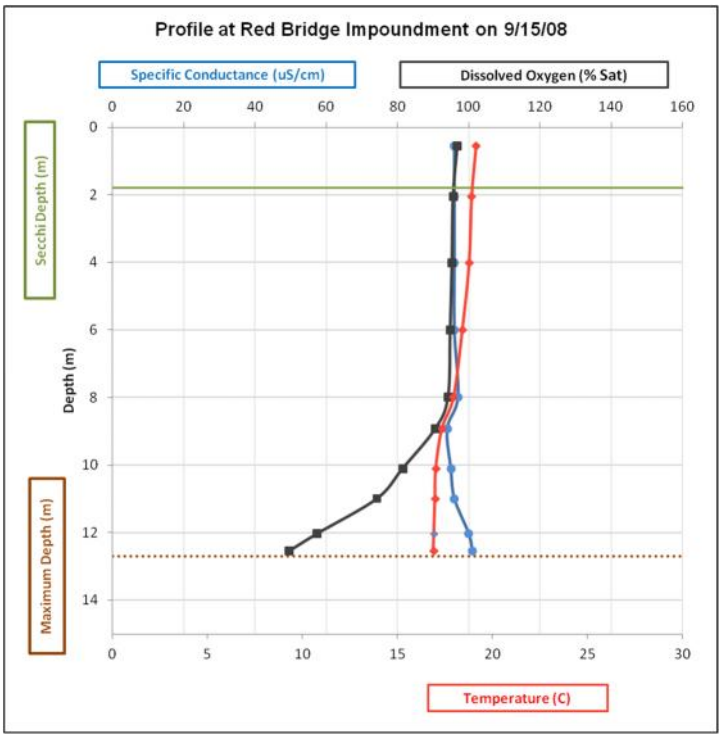

Figure 6: Profile at Red Bridge Impoundment Station A on 9/15/08

*(Hollow markers denote values below the minimum detection limit)

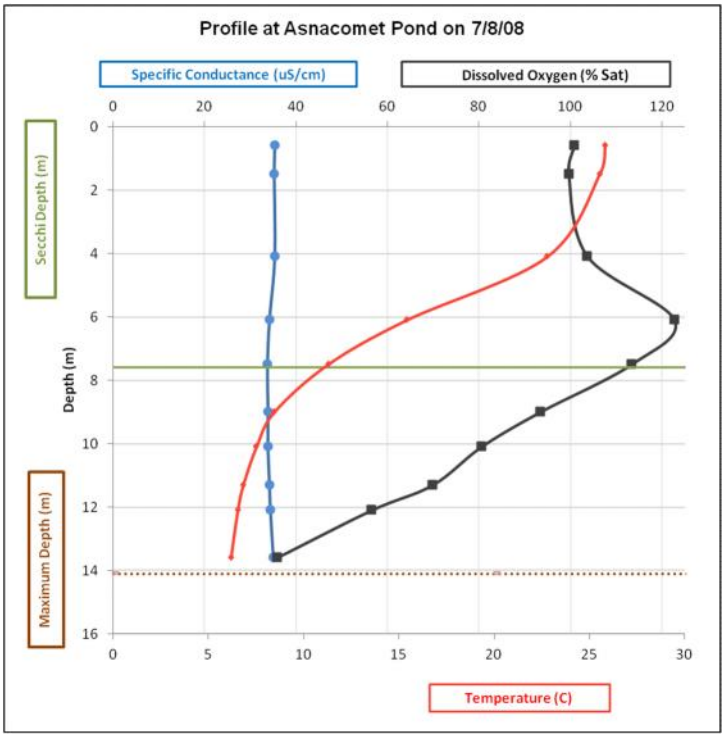

Figure 7. Profile at Asnacomet Pond Station A on 7/8/08

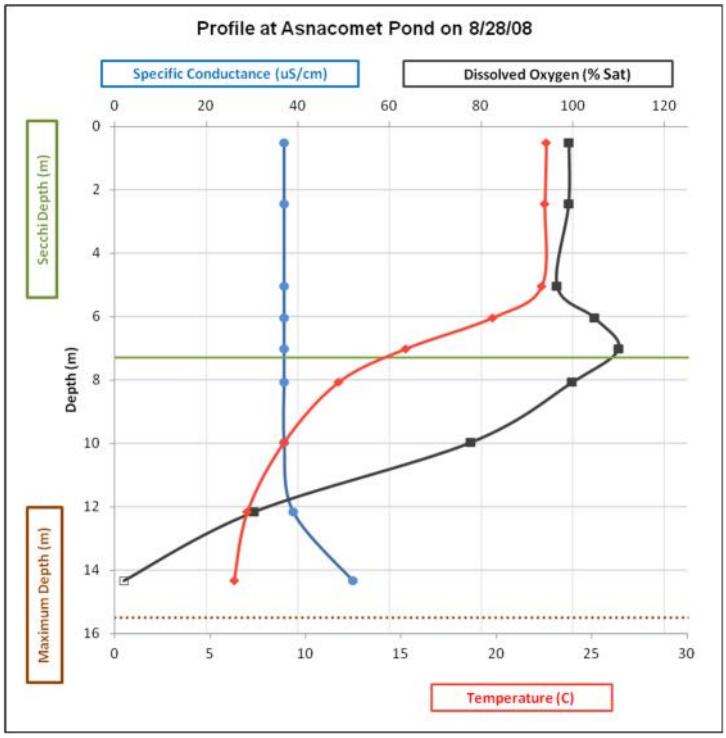

Figure 8. Profile at Asnacomet Pond Station A on 8/28/08*

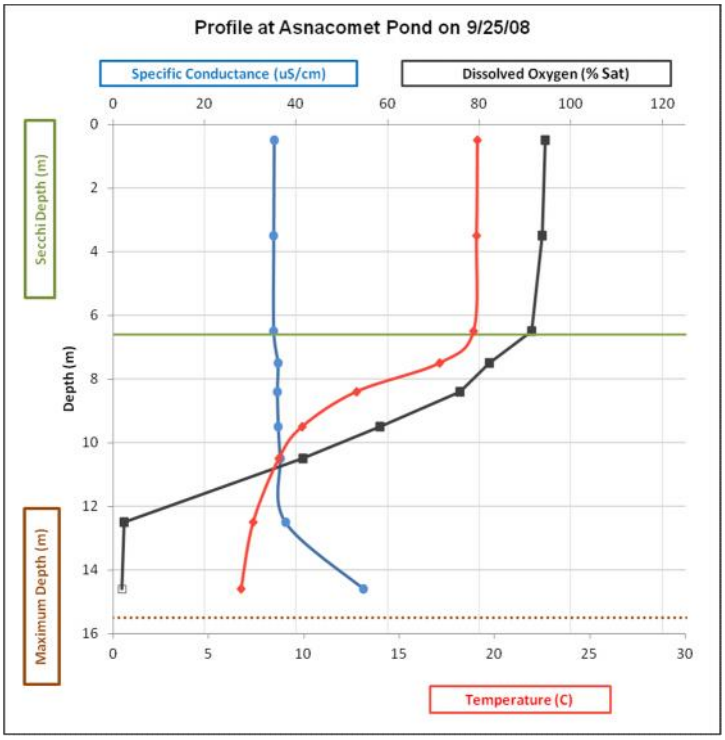

Figure 9. Profile at Asnacomet Pond Station A on 9/25/08*

*(Hollow markers denote values below the minimum detection limit)

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Appendix 1: 2008 Data Symbols and Qualifiers

Excerpted from: Water Quality Data Validation Report for Year 2008 Project Data (CN 361.0)

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and multi-probe data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data. Data qualifiers reported by laboratories are typically either directly-transferable to DWM data (e.g., "H" for holding time violation) or indirectly-transferable, where the qualifier symbol is transformed to conform to DWM's qualifier list (e.g., "R" qualifier used by a lab to reject data due to poor QC results is transformed to "a").

General Symbols (applicable to all types):

" ## " = Censored data (i.e., data that has been discarded for some reason).

" ** " = Missing data (i.e., data that should have been reported).

" -- " = No data (i.e., data not taken/not required)

" ^^ " = No data due to no water

Multi-probe-specific Qualifiers:

" i " = inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey checks outside typical acceptance ranges for the low ionic and deionized water checks, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses. Where documentation on unit pre-calibration is lacking, but SOPs at the time of sampling dictated pre-calibration prior to use, then data are considered potentially inaccurate.

" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" s " = field sheet recorded data were used to accept data, not data electronically recorded in the Multi-probe surveyor unit, due to operator error or equipment failure.

" u " = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" c " = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

" r " = data not representative of actual field conditions.

" t " = tidal conditions

Sample-Specific Qualifiers:

" a " = accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

" b " = blank Contamination in lab reagant blanks and/or field blank samples (indicating possible bias high and false positives).

" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

" e " = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" f " = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

" h " = holding time violation (usually indicating possible bias low)

" j " = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl). Also used to note where values have been reported at levels less than the mdl.

" m " = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

" p " = samples not preserved per SOP or analytical method requirements.

" r " = samples collected may not be representative of actual field conditions, including the possibility of "outlier" data and flow-limited conditions (e.g., pooled).

" t " = tidal conditions