

Appendix E: Excerpt from Baseline Lake Survey 2004 Technical Memo

Two basic types of lake surveys were conducted in 2004: 1) Nutrient Criteria Surveys and 2) Baseline Lake Surveys. The Nutrient Criteria Surveys were conducted in 2004 consisted of diurnal monitoring for dissolved oxygen and temperature at 21 lakes. Each lake was monitored once in late summer for a period ranging between 24 -72 hours using a deployed data logger. The Baseline Lake Surveys combined both water quality sampling and multiprobe profiles with some biological monitoring. Typically three monthly samples were collected during the summer to provide information on the chemical, biological and physical conditions of a lake system. Data were collected to evaluate the trophic state of the lake, and in some cases, to identify major Non Point Source (NPS) pollution. The Baseline Lakes Surveys and to a lesser extent the Nutrient Criteria Surveys are used to support the development of Total Maximum Daily Load (TMDL) reports, and particularly, the verification of total phosphorus concentrations in the lakes. The Nutrient Criteria Surveys were designed to collect the data needed to develop nutrient criteria and water quality standards for the state of Massachusetts. Data generated from these lakes surveys will be used to assess the capacity of each waterbody to support designated uses as defined in the states surface water quality standards, and ultimately inclusion in the Summary of Water Quality (305b Report) Assessment.

Sampling was conducted in a similar manner to the 2003 survey (see MassDEP 2007). Water quality multiprobe profiles were collected only once in late summer (except for Alum Pond which was measured twice). Total phosphorus was collected from surface and near bottom and apparent color was collected from surface samples. Sampling also integrated chlorophyll-a and included field observations for each lake and aquatic plant mapping for selected lakes. Five lakes including Dutton Pond, Alum Pond, Pistol Pond , Sibley Pond and Wielock Pond were sampled in 2004 in the French and Quinebaug River Watersheds as part of DWM 2004 lake sampling.

Procedures used for water sampling and sample handling are described in both the *Quality Assurance Project Plan for TMDL Baseline Lakes Survey 2004* and .the *2003 Nutrient Criteria Lakes Survey Quality Assurance Plan* which also applies for the 2004 Nutrient Criteria Survey (MassDEP 2004, MassDEP 2003, Chase, 2007). All methods and complete Standard Operating Procedures are include in the above QAPP's and are available from MassDEP. Methods used to determine data quality are detailed in *Data Validation Report for Year2004 Project Data* (MassDEP 2006). Data were excerpted from the *Baseline Lake Survey 2004 Technical Memo* are presented in tables C1, C2 and C3 (Haque and Mattson, 2008). Quality assurance and quality control data from French and Quinebaug River Waterhed Lakes are presented in table C4. For complete details on 2004 DWM lake sampling see the *Baseline Lake Survey 2004 Technical Memo* (Haque and Mattson, 2008).

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Table C1: 2004 MassDEP DWM French and Quinebaug River Watershed Lakes physico-chemical data

Alum Pond (PALIS: 41001)

Unique_ID: W1221 Station: A, Mile Point: -9

Description: [deep hole, Sturbridge]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	Rel Depth	Depth	Chl-a	TP	App Color
	M	24hr	M			24hr			m	mg/m3	mg/L	PCU
06/17/04	7.0	10:15	11.9									
				LB-2712	LB-2713	10:15	MNGR	s	<0.5	--	0.008	<15*
				LB-2713	LB-2712	10:15	MNGR	s	<0.5	--	0.008	<15*
				LB-2714	--	10:30	VDOR	nb	11.0	--	0.078	--
				LB-2715	LB-2716	10:35	DINT	--	0 - 7.0	2.2*	--	--
				LB-2716	LB-2715	10:36	DINT	--	0 - 7.0	2.4*	--	--
07/13/04	5.4	11:30	11.6									
				LZ-2781	--	11:30	MNGR	s	<0.5	--	0.007	<15*
				LZ-2782	--	11:36	VDOR	nb	10.5	--	0.065	--
				LZ-2783	--	11:38	DINT	--	0 - 10.5	2.6*	--	--
08/17/04	5.9	13:15	12.9									
				LB-3071	--	12:52	MNGR	s	<0.5	--	0.006	<15*
				LB-3072	--	12:55	VDOR	nb	11.4	--	0.12 b	--
				LB-3073	--	13:22	DINT	--	0 - 8.0	<1.0*	--	--

HOBBS BROOK/Pistol Pond (Saris: 4129250) (PALIS: 41057)

Unique_ID: W1224 Station: A, Mile Point: 1.851

Description: [mid lake, Sturbridge]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	Rel Depth	Depth	Chl-a	TP	App Color
	M	24hr	m			24hr			m	mg/m3	mg/L	PCU
06/16/04	>1.6	10:15	1.6									
				LB-2741	LB-2742	10:08	MNGR	s	<0.5	--	0.034 b	85*
				LB-2742	LB-2741	10:08	MNGR	s	<0.5	--	0.038 b	90*
				LB-2746	--	10:28	VDOR	nb	1.1	--	0.041 b	--
				LB-2743	LB-2744	10:20	DINT	--	0 - 1.1	3.1*	--	--
				LB-2744	LB-2743	10:21	DINT	--	0 - 1.1	3.1*	--	--
07/14/04	0.7	11:01	1.4									
				LZ-2821	LZ-2822	11:00	MNGR	--	<0.5	--	0.027	190*
				LZ-2825	LZ-2826	11:00	DINT	--	0 - 0.9	7.2*	--	--
				LZ-2822	LZ-2821	11:01	MNGR	--	<0.5	--	0.028	180*
				LZ-2826	LZ-2825	11:01	DINT	--	0 - 0.9	7.8*	--	--
08/18/04	1.1	14:00	1.8									
				LB-3101	LB-3102	14:00	MNGR	s	<0.5	--	0.038	100*
				LB-3102	LB-3101	14:00	MNGR	s	<0.5	--	0.036	80*
				LB-3105	LB-3106	14:05	DINT	--	0 - 1.3	20.7* d	--	--
				LB-3106	LB-3105	14:06	DINT	--	0 - 1.3	14.9* d	--	--

Table C1 (continued): 2004 MassDEP DWM French and Quinebaug River Watershed Lakes physico-chemical data

Wielock Pond (PALIS: 41056)

Unique_ID: W1223 Station: A, Mile Point: -9

Description: [deep hole 30 feet north/northwest of outlet I-beam, Dudley]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	Rel Depth	Depth	Chl-a	TP	App Color
	M	24hr	m			24hr			m	mg/m3	mg/L	PCU
06/16/04	2.1	13:00	3.0									
				LB-2730	--	13:00	MNGR	s	<0.5	--	0.024 b	40*
				LB-2736	--	13:15	MNGR	s	<0.5	--	--	44*
				LB-2731	--	13:05	VDOR	nb	2.5	--	0.064 b	--
				LB-2732	--	13:08	DINT	--	0 - 2.5	62*	--	--
07/14/04	1.9	12:15	2.7									
				LZ-2811	--	12:05	MNGR	s	<0.5	--	0.043	55*
				LZ-2812	--	12:10	VDOR	nb	2.3	--	0.047 b	--
				LZ-2813	--	12:15	DINT	--	0 - 2.3	14.0*	--	--
08/18/04	1.7	11:00	3.0									
				LB-3091	--	10:40	MNGR	s	<0.5	--	0.029	60*
				LB-3092	--	10:50	VDOR	nb	2.5	--	0.041	--
				LB-3093	--	11:00	DINT	--	0 - 2.5	16.6*	--	--

Table C2: 2004 MassDEP DWM French and Quinebaug River Watershed Lake *in-situ* data

Alum Pond (PALIS: 41001)

Unique_ID: W1221 Station: A

Description: [deep hole, Sturbridge]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
08/17/04									
	LB-3074	12:58	0.4	23.6	7.4	91.0	59.0	8.3	98
08/19/04									
	LB-3076	10:25	0.5	23.8	7.6 c	88.3	56.7	8.1	97
	LB-3076	10:32	4.0	23.3	7.8 c	88.0	56.3	8.1	96
	LB-3076	10:37	6.0	23.0	7.6 c	88.1	56.4	7.4	88
	LB-3076	11:02	7.0	20.1	7.0 c	87.0	55.7	7.5	84
	LB-3076	10:44	7.5	17.7	7.1 c	86.1	55.1	6.9	73
	LB-3076	10:50	8.5	14.2	6.8	86.4	55.3	3.3	33
	LB-3076	10:56	11.0	9.9	7.2 c	137	87.9	<0.2 u	<2 u

HOBBS BROOK/Pistol Pond (Saris: 4129250) (PALIS: 41057)

Unique_ID: W1224 Station: A, Mile Point: 1.851

Description: [mid lake, Sturbridge]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
08/18/04									
	LB-3107	14:15	0.6	21.0	6.2	727 cu	465 cu	2.2 u	25 u
	LB-3107	14:24	1.3	20.7	6.2	1,027 cu	657 cu	<0.2 u	<2 u

Wielock Pond (PALIS: 41056)

Unique_ID: W1223 Station: A

Description: [deep hole 30 feet north/northwest of outlet I-beam, Dudley]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
08/18/04									
	LB-3094	10:43 s	0.7 s	21.9 s	7.4 cs	139 s	88.5 s	6.9 s	80 s
	LB-3094	10:50 s	2.5 s	20.8 s	7.0 cs	140 s	89.4 s	2.1 isu	27 isu

Table C3: 2004 MassDEP DWM French and Quinebaug River Watershed Lake summary tables of *in-situ* data

MA42015 Dutton Pond

Summary DO and Temp data for each deployed day

Segment: MA42015

Project: Nutrient Criteria, Lakes (2004)

Waterbody: Dutton Pond

Site Unique ID (Station ID): W1263(B)

Site Description: mid lake, Leicester

Censored Data? None

All 2 Day(s)	◀ All Days / Individual Days ▶	7/28/04	7/29/04	
22.75	Hours of DO Measurements	11.50	11.25	
22.75	Hours of High (>=6 mg/l) DO Values	11.50	11.25	
0	Hours of Moderate (5-6 mg/l) DO Values			
0	Hours of Low (<5 mg/l) DO Values			
0.0%	Percent of hours with low DO Values			
14.90	Maximum DO	14.9	12.9	
10.30	Minimum DO	11.5	10.3	
12.55	Average DO	13.8	11.3	
20.8	Maximum Temp (c)	20.8	20.3	
19.8	Minimum Temp (c)	20.0	19.8	
20.2	Average Temp (c)	20.4	20.0	
13.8	Hours >20 (c)	10.0	3.8	
9.0	Hours >28.3 (c)	1.5	7.5	

Table C3 (continued): 2004 MassDEP DWM French and Quinebaug River Watershed Lake summary tables of *in-situ* data

MA41001 Alum Pond

Summary DO and Temp data for each deployed day

Segment: MA41001

Project: TMDL Baseline Lakes (2004)

Waterbody: Alum Pond

Site Unique ID (Station ID): W1221(A)

Site Description: deep hole, Sturbridge

Censored Data? None

All 0 Day(s)	◀ All Days / Individual Days ▶			
0.00	Hours of DO Measurements			
0	Hours of High (>=6 mg/l) DO Values			
0	Hours of Moderate (5-6 mg/l) DO Values			
0	Hours of Low (<5 mg/l) DO Values			
0.0%	Percent of hours with low DO Values			
0.00	Maximum DO			
0.00	Minimum DO			
0.00	Average DO			
23.4	Maximum Temp (c)	23.4	23.0	
22.7	Minimum Temp (c)	23.1	22.7	
23.1	Average Temp (c)	23.2	22.8	
22.0	Hours >20 (c)	11.8	10.3	
0.0	Hours >28.3 (c)			

MA41057 Pistol Pond

Summary DO and Temp data for each deployed day

Segment: MA41057

Project: TMDL Baseline Lakes (2004)

Waterbody: Hobbs Brook/Pistol Pond

Site Unique ID (Station ID): W1224(A)

Site Description: mid lake, Sturbridge

Censored Data? None

All 2 Day(s)	◀ All Days / Individual Days ▶	8/17/04	8/18/04	
26.00	Hours of DO Measurements	12.75	13.25	
0	Hours of High (>=6 mg/l) DO Values			
0	Hours of Moderate (5-6 mg/l) DO Values			
26	Hours of Low (<5 mg/l) DO Values	12.75	13.25	
100.0%	Percent of hours with low DO Values	100.0%	100.0%	
3.20	Maximum DO	1.6	3.2	
0.60	Minimum DO	0.8	0.6	
1.70	Average DO	1.3	2.1	
21.2	Maximum Temp (c)	21.2	21.2	
20.5	Minimum Temp (c)	20.7	20.5	
21.0	Average Temp (c)	21.0	20.9	
26.0	Hours >20 (c)	12.8	13.3	
0.0	Hours >28.3 (c)			

Table C3 (continued): 2004 MassDEP DWM French and Quinebaug River Watershed Lake summary tables of *in-situ* data

MA41047 Sibley Pond

Summary DO and Temp data for each deployed day

Segment: MA41047

Project: Nutrient Criteria, Lakes (2004)

Waterbody: Sibley Pond

Site Unique ID (Station ID): W0731(A)

Site Description: North Basin, deep hole at southern end, Charlton.

Censored Data? None

All 2 Day(s)	◀ All Days / Individual Days ▶	7/28/04	7/29/04	
24.00	Hours of DO Measurements	10.00	14.00	
24	Hours of High (>=6 mg/l) DO Values	10.00	14.00	
0	Hours of Moderate (5-6 mg/l) DO Values			
0	Hours of Low (<5 mg/l) DO Values			
0.0%	Percent of hours with low DO Values			
9.10	Maximum DO	9.0	9.1	
7.50	Minimum DO	8.2	7.5	
8.25	Average DO	8.6	8.0	
23.6	Maximum Temp (c)	23.0	23.6	
22.3	Minimum Temp (c)	22.6	22.3	
22.7	Average Temp (c)	22.8	22.6	
24.0	Hours >20 (c)	10.0	14.0	
0.0	Hours >28.3 (c)			

MA41056 Wielock Pond

Segment: MA41056

Project: TMDL Baseline Lakes (2004)

Waterbody: Wielock Pond

Site Unique ID (Station ID): W1223(A)

Site Description: deep hole 30 feet north/northwest of outlet I-beam, Dudley

Censored Data? None

All 2 Day(s)	◀ All Days / Individual Days ▶	8/17/04	8/18/04	
25.25	Hours of DO Measurements	14.00	11.25	
19.25	Hours of High (>=6 mg/l) DO Values	8.75	10.50	
6.00	Hours of Moderate (5-6 mg/l) DO Values	5.25	0.75	
0.00	Hours of Low (<5 mg/l) DO Values			
0.0%	Percent of hours with low DO Values			
7.00	Maximum DO	7.0	6.9	
5.10	Minimum DO	5.1	5.8	
6.29	Average DO	6.2	6.4	
22.1	Maximum Temp (c)	22.1	22.0	
21.5	Minimum Temp (c)	21.5	21.8	
21.8	Average Temp (c)	21.8	21.9	
25.3	Hours >20 (c)	14.0	11.3	
0.0	Hours >28.3 (c)			

Table C4: 2004 MassDEP DWM French and Quinebaug River Watershed Lakes Sampling Quality Assurance/Quality Control Data

Alum Pond (PALIS: 41001)

Unique_ID: W1221 Station: A, Mile Point: -9

Description: [deep hole, Sturbridge]

Date	OWMID	QAQC	Time (24hr)	Depth (m)	Chl-a mg/m3	TP mg/L	App Color PCU
6/17/2004	LB-2712	LB-2713	10:15	--	--	0.008	<15*
6/17/2004	LB-2713	LB-2712	10:15	--	--	0.008	<15*
6/17/2004	LB-2715	LB-2716	10:35	0 - 7.0	2.2*	--	--
6/17/2004	LB-2716	LB-2715	10:36	0 - 7.0	2.4*	--	--
<i>Relative</i>	<i>Percent</i>	<i>Difference</i>			8.7%	0.0%	0.0%

HOBBS BROOK/Pistol Pond (Saris: 4129250) (PALIS: 41057)

Unique_ID: W1224 Station: A, Mile Point: 1.851

Description: [mid lake, Sturbridge]

Date	OWMID	QAQC	Time (24hr)	Depth (m)	Chl-a mg/m3	TP mg/L	App Color PCU
6/16/2004	LB-2741	LB-2742	10:08	--	--	0.034 b	85*
6/16/2004	LB-2742	LB-2741	10:08	--	--	0.038 b	90*
6/16/2004	LB-2743	LB-2744	10:20	0 - 1.1	3.1*	--	--
6/16/2004	LB-2744	LB-2743	10:21	0 - 1.1	3.1*	--	--
<i>Relative</i>	<i>Percent</i>	<i>Difference</i>			0.0%	11.1%	5.7%
7/14/2004	LZ-2821	LZ-2822	11:00	--	--	0.027	190*
7/14/2004	LZ-2822	LZ-2821	11:01	--	--	0.028	180*
7/14/2004	LZ-2825	LZ-2826	11:00	0 - 0.9	7.2*	--	--
7/14/2004	LZ-2826	LZ-2825	11:01	0 - 0.9	7.8*	--	--
<i>Relative</i>	<i>Percent</i>	<i>Difference</i>			8.0%	3.6%	5.4%
8/18/2004	LB-3101	LB-3102	14:00	--	--	0.038	100*
8/18/2004	LB-3102	LB-3101	14:00	--	--	0.036	80*
8/18/2004	LB-3105	LB-3106	14:05	0 - 1.3	20.7* d	--	--
8/18/2004	LB-3106	LB-3105	14:06	0 - 1.3	14.9* d	--	--
<i>Relative</i>	<i>Percent</i>	<i>Difference</i>			32.6%	5.4%	22.2%

Data Qualifiers

The following data qualifiers or symbols are used in the MassDEP/DWM Water Quality Database (WQD) 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.

General Symbols (applicable to all types):

“##” = Censored data (i.e., data that has been discarded for some reason). NOTE: Prior to 2001 data,

“***” denoted either censored or missing data.

“**” = Missing data (i.e., data that should have been reported). See NOTE above.

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

* = Analysis performed by Laboratory OTHER than DEP’s Wall Experiment Station (WES)

[] = A result reported inside brackets has been “censored”, but is shown for informational purposes (e.g., high blank results).

Multi-probe-specific Qualifiers:

“i” = inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses.

- “i” = General Depth Criteria: Apply to each OWMID#
- Clearly erroneous readings due to faulty depth sensor: Censor (i)
 - **Negative and zero depth readings: Censor (i); (likely in error)**
 - **0.1 m depth readings: Qualify (i); (potentially in error)**
 - **0.2 and greater depth readings: Accept without qualification; (likely accurate)**

Specific Depth Criteria: Apply to entirety of depth data for survey date

- **If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, ie. that all positive readings may be in error.)**

“ 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.

“ ? ” = Light interference on Turbidity sensor (Multiprobe error message). Data is typically censored.

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 reagent 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).

Sample codes for sampling:

OWMID: Office of Watershed Management Identification Code for the bottle.

QAQC: the OWMID codes (e.g. LB-1903) refer to the field duplicate sample (usually immediately above or below in the table) to be compared with the current sample.

Time: Local time.

SymTyp: Sample Type- VDOR= Van Dorn; DINT= Depth integrated by vertical hose; MNGR= Manual Grab; NR= not recorded.

RelDepth: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

References

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