BLUE MARSH LAKE

BERKS COUNTY

WATER QUALITY STANDARDS REVIEW

UAA-LAKE REDESIGNATION EVALUATION

Blue Marsh Lake
Stream Code: 01846
Drainage List F

WATER QUALITY MONITORING AND ASSESSMENT SECTION (APF)
DIVISION OF WATER QUALITY ASSESSMENT AND STANDARDS
BUREAU OF WATER SUPPLY AND WASTEWATER MANAGEMENT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANUARY 2005

INTRODUCTION

The Department is initiating a correction to the aquatic life use designation in the water quality standards for Blue Marsh Lake, Berks County. It currently has a Trout Stocking (TSF) designation reflecting the condition of its source water. In most cases within Chapter 93, lakes have been classified according to the aquatic life use of their associated streams. As a result, many lakes in Pennsylvania are misclassified. Most lakes cannot and have not achieved their protected use because of natural conditions.

The water impounded within a lake, when warmed by solar radiation, often becomes too warm to support cold water fish species. Also, most Pennsylvania lakes undergo a period of stratification during summer. In early summer, solar radiation warms the surface waters more rapidly than the bottom waters, causing the upper layer to become less dense. This results in thermal stratification where the density gradient between the top and bottom layers prevents mixing of the waters. The epilimnion (surface layer) is made up of uniformly warm, circulating water and floats upon the cold and relatively undisturbed hypolimnion (bottom layer). During the period of thermal stratification, the waters of the hypolimnion are isolated from the atmosphere and cannot be replenished with oxygen. Algae and other organic debris from the epilimnion settle and decompose in the hypolimnion resulting in an increase in biochemical oxygen demand (BCOD) in the bottom waters. In many water bodies, the rate of dissolved oxygen (DO) depletion in the hypolimnion can cause anoxic conditions (DO = 0 mg/l), incapable of supporting an aquatic community. The thermal stratifications and accompanying DO responses discussed above are naturally occurring phenomena - common to cold water or warm water lakes in temperate climates. Due to stratification and anoxic conditions in the hypolimnion, many lakes cannot support cold water fish species during the summer but can support healthy warm water fish species and therefore should be reclassified.

BACKGROUND

Blue Marsh Lake is owned by the U.S. Army Corps of Engineers (COE) and is located in Penn, Bern, Lower Heidelberg, North Heidelberg and Jefferson Townships and Bernville Borough Berks County. Blue Marsh Lake is located on Tulpehocken Creek (stream code 01846), which is a tributary to the Schuylkill River within the Delaware River basin (drainage list F) (Figure 1). Tulpehocken Creek was impounded in 1974 creating the 1,150 surface acre, 8 mile long lake, which drains a 170 mi^2 watershed consisting primarily of agricultural (68%) and forested (28%) areas. Blue Marsh Lake has a maximum depth of 53 feet with an approximate volume of 3,000 acre-feet of water at normal pool elevation. There are numerous public, non-public, and industrial discharges and withdrawals upstream of Blue Marsh Lake.

WATER QUALITY

Blue Marsh Lake is routinely sampled for water quality parameters by the COE. Figure 2 shows the location of their sampling sites on the main portion of the lake. Blue Marsh Lake typically stratifies during the summer with the thermocline forming between 5 and 15 feet in depth. Once

stratification occurs, the DO in the hypolimnion often drops to levels not supportive of a healthy aquatic community (<2 mg/l). Conditions of stratification and an anoxic hypolimnion were evident in early studies of the lake. Further, lake water temperatures often exceed levels that can support survival of cold water fish species during summer months (Figures 3-14). Water chemistry parameters are consistent with lakes that are in the meso-eutrophic state, which is typical for warm water lakes (Tables 1-6). Physical lake data for temperature and DO reveal conditions that are not supportive of trout stocking.

AQUATIC BIOTA

Blue Marsh Lake has a resident self-supporting warm water fish community. Over the history of the lake, a total of 37 species have been captured during surveys conducted by the Pennsylvania Fish & Boat Commission (PFBC)(Table 7). Examination of catches from trap nets and electrofishing surveys indicated a healthy naturally reproducing population of warmwater species. Natural reproduction is evident upon review of length frequency data (Table 8). Warmwater species such as largemouth and smallmouth bass, pumpkinseed, bluegill, green sunfish, white and black crappie, yellow and brown bullheads, and channel and white catfish have length frequency data showing fish lengths are represented in small and large sizes, which is indicative of natural reproduction consisting of multiple year classes. Cold water salmonids, such as rainbow and brown trout, have been collected in Blue Marsh Lake. These trout likely originated from upstream areas as salmonids are stocked or occur naturally in almost all of the tributaries to Blue Marsh Lake. Salmonids may use Blue Marsh Lake during the late fall, winter, and spring, but it is unlikely that they are present in the lake during the summer as temperatures and DO levels are usually outside normal tolerances for these cold water species. Blue Marsh Lake has always been managed by the PFBC as a warm water fishery by relying on natural reproduction and supplemental stocking of predatory warmwater fish such as walleye, tiger muskellunge, and striped and hybrid striped bass (Table 9). The PFBC has never stocked trout in Blue Marsh Lake.

PUBLIC RESPONSE AND PARTICIPATION SUMMARY

The Department provided public notice of this aquatic life use evaluation and requested any technical data from the general public through publication in the *Pennsylvania Bulletin* on May 31, 2003. A notice was published in Reading Eagle (Reading, PA) on May 30, 2003. In addition, Heidelberg, Jackson, Millcreek, North Lebanon, Bern, Jefferson, Lower Heidelberg, Marion North Heidelberg, Penn, South Heidelberg, Tulpehocken, Upper Bern, and Upper Tulpehocken Townships and the Lebanon and Berks County Planning Commissions as well as Myerstown, Bernville, Robesonia, Strausstown and Womelsdorf Boroughs were notified of the redesignation evaluation in letters dated May 29, 2003. In response, the Berks County Planning Commission submitted a report entitled "Blue Marsh Lake, Water Quality Evaluation, Assessment of Major Chemical/Physical and Biological Parameters" which was prepared by Drs. Phillip Dougherty and John Hall from Albright College. The report was reviewed and results were consistent with those presented in this report.

RECOMMENDATIONS

A review of available data indicates the existing use for Blue Marsh Lake is and has always been Warm Water Fishes (WWF). The predominance of warm water conditions and concurrent warm water fisheries found in Blue Marsh Lake is the consequence of impounding flowing waters. Such conditions are normal and are expected whenever flowing waters are impounded in areas with temperate climates. These warm water conditions are irretrievable since it is not feasible to remove the reservoirs. The historical data indicates that Blue Marsh Lake has supported a warm water fish community since it was constructed and has been managed by the PFBC as such.

It is the Department's conclusion that: 1) the designated use of Blue Marsh Lake is more restrictive than its existing use; 2) the designated use of TSF cannot be attained by implementing effluent limits required under sections 301(b) and 306 of the Federal Clean Water Act (33 U.S.C.A. §§ 1331(b) and 1316); 3) its current use designation cannot be attained by implementing cost-effective and reasonable best management practices (BMPs) for nonpoint source control; and 4) the conditions existing in Blue Marsh Lake are the result of limnological processes that occur naturally in impoundments and it is not feasible to restore Tulpehocken Creek to its original condition by removing Blue Marsh Lake or manage it in a way that would result in the attainment of its designated use.

Based on these findings, the Department recommends that the designated use of Blue Marsh Lake be changed from its current TSF designation to WWF. This recommendation is based on the physical characteristics of the water body, dominance of warm water fish species, and the management and stocking of warm water fish by the PFBC. This recommendation will affect approximately 8.4 miles of the Tulpehocken Creek directly limited to Blue Marsh Lake, which approximates 1,150 surface acres. All tributaries to Blue Marsh Lake will retain their current designations.

REFERENCES

Department of Environmental Protection. File information.

Dougherty, P and J. Hall. 2003. Blue Marsh Lake, Water Quality Evaluation, Assessment of Major Chemical/Physical and Biological Perimeters. Albright College. Reading, PA.

PA Fish and Boat Commission. File information.

U.S. Army Corps of Engineers. File information.

Figure 1. Blue Marsh Reservoir, Berks County

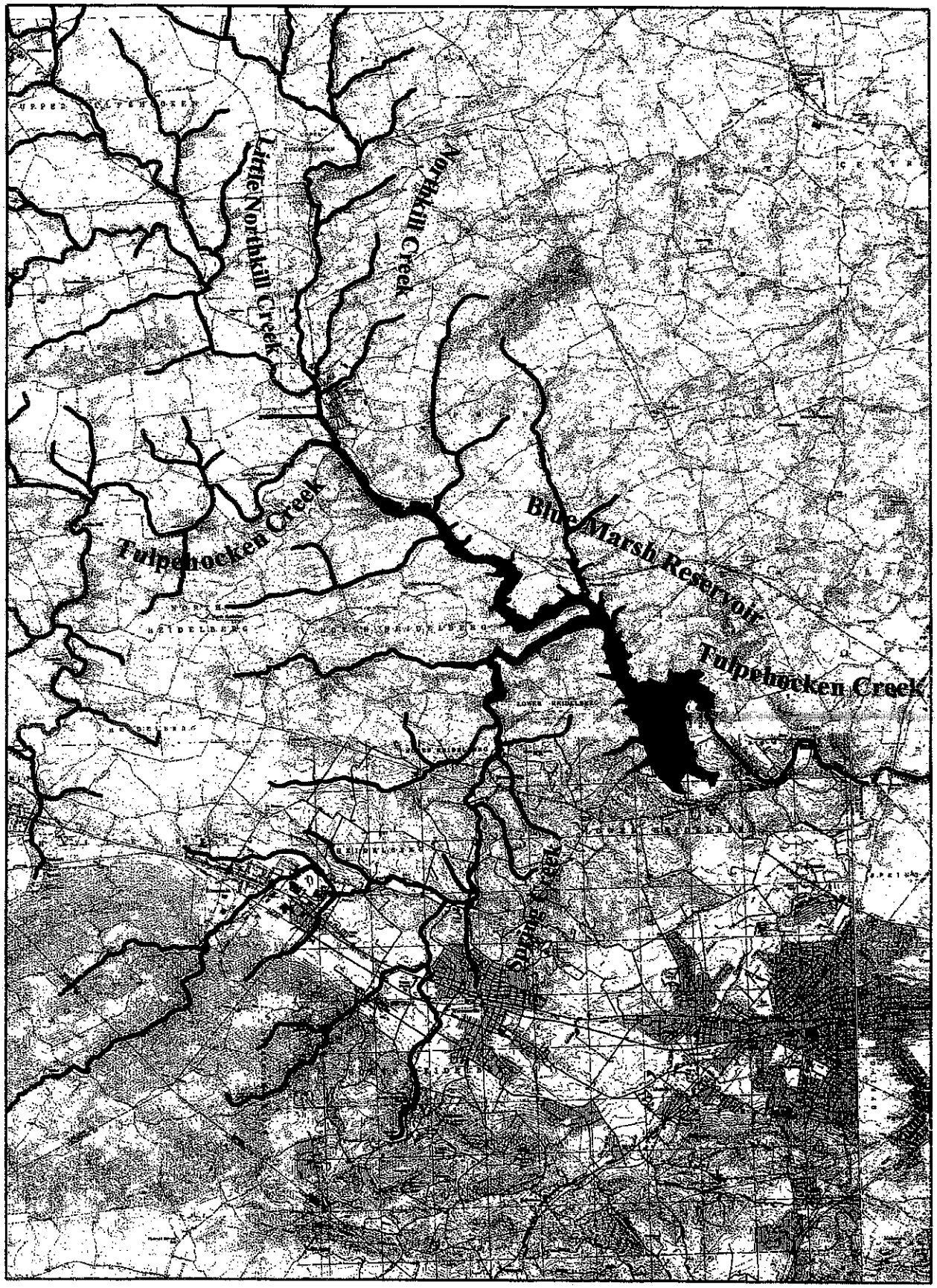


Table 1.

BLUE MARSH LAKE - WATER CHEMISTRY

Station BM-2, Surface

COE

Parameter	Units	Date										
		3/14/1988	4/18/1988	5/11/1988	5/23/1988	6/14/1988	6/28/1988	7/11/1988	7/25/1988	8/8/1988	8/22/1988	9/19/1988
Temp.	°C	6	11.5	16	20	24	24	26	27	29.5	25.5	22
pH	pH units	8	8.7	8.7	8	8.6	8.2	8.5	8.1	8.3	8.3	8.3
Conductance	µmhos/cm	264	290	294	288	285	292	300	300	285	290	313
Diss. O_2	mg/l	15.8	14	11	11	14.8	9	8.5	8.6	9.3	8.1	11.2
Alkalinity	mg/l	-	-	-	-	-	-	-	-	-	-	-
Diss. Solids	mg/l	165	186	174	201	215	235	217	226	207	208	159
Susp. Solids	mg/l	-	-	-	-	-	-	-	-	-	-	-
NH_3-N	mg/l	<0.03	0.082	<0.03	0.046	<0.03	<0.03	<0.03	<0.03	0.233	0.045	0.041
NO_3-N	mg/l	-	-	-	-	-	-	-	-	-	-	-
NO_2-N	mg/l	-	-	-	-	-	-	-	-	-	-	-
N-Kjeldahl	mg/l	-	-	-	-	-	-	-	-	-	-	-
P	mg/l	-	-	-	-	-	-	-	-	-	-	-
P-total	mg/l	0.209	0.06	<0.03	0.2	0.05	0.04	<0.03	0.03	0.05	0.03	0.04
Diss. P	mg/l	0.15	<0.03	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
SO_4	mg/l	-	-	-	-	-	-	-	-	-	-	-
Chlorophyll a	µg/l	-	-	-	3.5	-	2.9	-	<0	-	1	5.1

Parameter	Units	Date										
		5/25/1995	6/21/1995	7/20/1995	8/22/1995	10/3/1995	5/22/2001	5/22/2001	6/12/2001	7/19/2001	8/8/2001	9/26/2001
Temp.	°C	20.6	26.25	28.03	27.24	19.61	-	-	-	-	-	-
pH	pH units	8.47	8.33	8.19	8.65	8.48	-	-	-	-	-	-
Conductance	µmhos/cm	1.77	1.55	1.57	1.67	1.89	-	-	-	-	-	-
Diss. O_2	mg/l	9.78	12.68	9	10.37	9.3	-	-	-	-	-	-
Alkalinity	mg/l	-	-	-	-	-	110	110	95	96	93	108
Diss. Solids	mg/l	160	150	180	150	190	224	224	162	140	198	158
Susp. Solids	mg/l	<5	12	<5	7	<5	<2	<2	13	9	14	<1
NH_3-N	mg/l	<0.1	<0.1	<0.1	<0.1	0.2	0.3	0.3	0.2	<0.1	0.11	0.1
NO_3-N	mg/l	4.1	3.8	2.9	2.7	1.9	5.7	5.7	1.3	1.6	3.6	1.4
NO_2-N	mg/l	0.08	0.06	0.05	0.03	0.04	0.023	0.023	0.051	0.043	<0.1	0.1
N-Kjeldahl	mg/l	0.4	0.8	2.2	0.6	0.6	1.3	1.3	0.6	0.692	0.56	<0.2
P	mg/l	-	-	-	-	-	-	-	0.21	0.06	<0.05	0.05
P-total	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.05	0.07	<0.05	<0.05	<0.05
Diss. P	mg/l	-	-	-	-	-	-	-	-	-	-	-
SO_4	mg/l	<1	<1	<1	<1	<1	-	-	-	-	-	-
Chlorophyll a	µg/l	-	-	-	-	-	1.173	1.173	8.232	8.315	13.111	23.359

Table 2.
BLUE MARSH LAKE - WATER CHEMISTRY
Station BM-2, Bottom
COE

Parameter	Units	Date									
		5/23/1988	6/28/1988	7/25/1988	8/22/1988	9/19/1988	5/25/1995	6/21/1995	7/20/1995	8/22/1995	10/3/1995
Temp.	°C	13	20	19.5	25	19.5	13.9	14.5	18.29	21.95	19.14
pH	pH units	7.2	7.6	7.5	7.2	7.2	8.5	8.9	7.86	7.57	7.98
Conductance	µmhos/cm	215	305	370	340	325	1.97	2.09	2.17	2.13	1.89
Diss. O_2	mg/l	8.2	2.5	1.2	3.5	0.7	4.19	6.86	0.13	0.23	5.12
Alkalinity	mg/l	-	-	-	-	-	-	-	-	-	-
Diss. Solids	mg/l	204	227	262	233	230	180	200	230	230	210
Susp. Solids	mg/l	-	-	-	-	-	5	<5	15	5	6
NH_3-N	mg/l	0.173	0.03	0.96	1.71	0.133	0.5	0.9	0.7	1.8	0.3
NO_3-N	mg/l	3.38	3.78	2.81	1.83	3.48	4.2	2.5	2.7	1.2	1.9
NO_2-N	mg/l	0.065	0.058	0.116	0.03	0.494	0.08	0.15	0.07	0.02	0.04
N-Kjeldahl	mg/l	-	-	-	-	-	0.9	1.3	1.3	2	0.5
P	mg/l	-	-	-	-	-	-	-	-	-	-
P-total	mg/l	0.36	0.04	0.24	0.09	0.11	<0.1	<0.1	<0.1	<0.1	<0.1
Diss. P	mg/l	0.13	<0.03	<0.08	<0.04	<0.03	-	-	-	-	-
SO_4	mg/l	-	-	-	-	-	<1	<1	<1	<1	<1
Chlorophyll a	µg/l	8	8.7	18.9	<0	<0	-	-	-	-	-

Parameter	Units	Date				
		5/22/2001	6/12/2001	7/19/2001	8/8/2001	9/26/2001
Temp.	°C	-	-	-	-	-
pH	pH units	-	-	-	-	-
Conductance	µmhos/cm	-	-	-	-	-
Diss. O_2	mg/l	-	-	-	-	-
Alkalinity	mg/l	155	165	155	160	114
Diss. Solids	mg/l	220	208	180	244	188
Susp. Solids	mg/l	12	9	18	15	1
NH_3-N	mg/l	0.6	1	1.23	3.09	0.1
NO_3-N	mg/l	4.3	3.3	0.115	<0.1	1.6
NO_2-N	mg/l	0.067	0.176	0.013	<0.1	<0.1
N-Kjeldahl	mg/l	0.9	1.1	1.37	3.29	<0.2
P	mg/l	-	0.06	0.16	1.25	0.08
P-total	mg/l	<0.05	<0.05	0.05	0.28	<0.05
Diss. P	mg/l	-	-	-	-	-
SO_4	mg/l	-	-	-	-	-
Chloro 'l a	µg/l	4.41	0.689	2.616	5.[illegible]	10.726

Table 3.

BLUE MARSH LAKE - WATER CHEMISTRY

Station BM-6, Surface

COE

Parameter	Units	Date										
		3/14/1988	4/18/1988	5/11/1988	5/23/1988	6/14/1988	6/28/1988	7/11/1988	7/25/1988	8/8/1988	8/22/1988	9/19/1988
Temp.	°C	6	11.5	16	21.5	25	24	26	26.5	29.5	25.5	22
pH	pH units	8	8.8	8.9	7.8	8.6	8.5	7.9	8.3	8.2	7.9	8
Conductance	µmhos/cm	268	286	292	284	272	288	292	303	290	300	308
Diss. O_2	mg/l	13.6	11.4	10.7	11.8	14.6	8.5	10.2	8	8.1	6.9	9.6
Alkalinity	mg/l	-	-	-	-	-	-	-	-	-	-	-
Diss. Solids	mg/l	155	178	150	201	197	194	218	213	220	223	222
Susp. Solids	mg/l	-	-	-	-	-	-	-	-	-	-	-
NH_3-N	mg/l	<0.03	0.054	<0.03	0.024	<0.03	<0.03	<0.03	<0.03	0.089	0.125	<0.03
NO_3-N	mg/l	-	-	-	-	-	-	-	-	-	-	-
NO_2-N	mg/l	-	-	-	-	-	-	-	-	-	-	-
N-Kjeldahl	mg/l	-	-	-	-	-	-	-	-	-	-	-
P	mg/l	-	-	-	-	-	-	-	-	-	-	-
P-total	mg/l	0.309	0.05	<0.03	0.17	<0.03	0.03	0.04	0.03	0.05	0.03	<0.03
Diss. P	mg/l	0.142	<0.03	<0.03	0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03
SO_4	mg/l	-	-	-	-	-	-	-	-	-	-	-
Chlorophyll a	µg/l	-	-	-	<0	-	7.8	-	3.7	-	5.3	10.1

Parameter	Units	Date									
		5/25/1995	6/21/1995	7/20/1995	8/22/1995	10/3/1995	5/22/2001	6/12/2001	7/19/2001	8/8/2001	9/26/2001
Temp.	°C	20.06	25.33	28.08	27.74	19.99	-	-	-	-	-
pH	pH units	8.63	8.35	8.16	8.7	8.47	-	-	-	-	-
Conductance	µmhos/cm	1.78	1.58	1.61	1.64	1.9	-	-	-	-	-
Diss. O_2	mg/l	9.93	12.61	8.95	11.23	9.82	-	-	-	-	-
Alkalinity	mg/l	-	-	-	-	-	110	95	99	98	108
Diss. Solids	mg/l	190	160	180	140	240	182	146	208	184	182
Susp. Solids	mg/l	<5	13	<5	9	<5	<2	10	4	16	5
NH_3-N	mg/l	<0.1	0.1	<0.1	<0.1	0.2	0.2	0.1	0.133	0.12	0.1
NO_3-N	mg/l	4.2	3.8	3.1	2.7	2	5.6	5.1	1.09	1.1	1.4
NO_2-N	mg/l	0.06	0.06	0.05	0.03	0.04	0.036	0.05	0.043	<0.1	0.1
N-Kjeldahl	mg/l	0.5	0.7	0.3	2.1	0.9	1.2	0.6	0.176	0.75	<0.2
P	mg/l	-	-	-	-	-	-	0.25	0.07	0.05	0.85
P-total	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	0.1	<0.05	<0.05	0.28
Diss. P	mg/l	-	-	-	-	-	-	-	-	-	-
SO_4	mg/l	<1	<1	<1	<1	<1	-	-	-	-	-
Chlorophyll a	µg/l	-	-	-	-	-	1.352	11.207	8.535	9.331	20.081

Table 4.
BLUE MARSH LAKE - WATER CHEMISTRY
Station BM-6, Bottom
COE

Parameter	Units	Date										
		5/23/1988	6/28/1988	7/25/1988	8/22/1988	9/19/1988	5/25/1995	6/21/1995	7/20/1995	8/22/1995	10/3/1995	5/22/2001
Temp.	°C	12.5	16.5	17.5	27	19.5	11.07	13.86	20.43	20.95	18.7	-
pH	pH units	7.1	7.8	7.1	7.4	7.3	9.08	8.98	7.67	7.73	7.73	-
Conductance	µmhos/cm	258	273	348	333	312	1.87	2	2.15	2.13	2.1	-
Diss. O_2	mg/l	8	1.5	0.5	0.2	0.5	5.7	6.61	0.21	0.24	1.4	-
Alkalinity	mg/l	-	-	-	-	-	-	-	-	-	-	175
Diss. Solids	mg/l	192	192	243	233	224	200	200	240	210	220	212
Susp. Solids	mg/l	-	-	-	-	-	<5	<5	<5	<5	8	4
NH_3-N	mg/l	0.243	0.102	2.04	0.741	<0.03	<0.1	0.1	0.3	1	0.7	0.6
NO_3-N	mg/l	3.72	3.39	1.8	2.11	3.15	4.1	4	3.4	1.7	2.6	4.6
NO_2-N	mg/l	0.067	0.386	0.048	0.016	0.365	0.07	0.05	0.03	0.03	0.05	0.062
N-Kjeldahl	mg/l	-	-	-	-	-	0.7	0.4	0.7	1.7	1	1.4
P	mg/l	-	-	-	-	-	-	-	-	-	-	-
P-total	mg/l	0.33	0.03	0.45	0.04	0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05
Diss. P	mg/l	0.1	<0.03	0.18	<0.03	0.05	-	-	-	-	-	-
SO_4	mg/l	-	-	-	-	-	<1	<1	<1	<1	<1	-
Chlorophyll a	µg/l	8	1.4	15.5	<0	<0	-	-	-	-	-	4.617

Parameter	Units	Date			
		6/12/2001	7/19/2001	8/8/2001	9/26/2001
Temp.	°C	-	-	-	-
pH	pH units	-	-	-	-
Conductance	µmhos/cm	-	-	-	-
Diss. O_2	mg/l	-	-	-	-
Alkalinity	mg/l	135	152	150	142
Diss. Solids	mg/l	172	190	232	184
Susp. Solids	mg/l	13	8	24	10
NH_3-N	mg/l	1.3	1.15	1.41	2.7
NO_3-N	mg/l	5	0.167	9	0.7
NO_2-N	mg/l	0.158	0.04	<0.1	<0.1
N-Kjeldahl	mg/l	1.3	1.66	1.62	<0.2
P	mg/l	0.1	0.22	0.9	0.28
P-total	mg/l	<0.05	0.08	0.3	0.1
Diss. P	mg/l	-	-	-	-
SO_4	mg/l	-	-	-	-
Chlorophyll a	µg/l	8.61	25.061	49.323	96.297

Table 5.
BLUE MARSH LAKE - WATER CHEMISTRY
Station BM-7, Surface
COE

Parameter	Units	Date									
		5/25/1995	6/21/1995	7/20/1995	8/22/1995	10/3/1995	5/22/2001	6/12/2001	7/19/2001	8/8/2001	9/26/2001
Temp.	°C	20.83	25.8	27.54	27.21	19.31	-	-	-	-	-
pH	pH units	8.5	8.32	7.75	8.83	8.62	-	-	-	-	-
Conductance	µmhos/cm	1.78	1.59	1.53	1.61	1.86	-	-	-	-	-
Diss. O_2	mg/l	10.35	14.11	9.75	11.59	10.47	-	-	-	-	-
Alkalinity	mg/l	-	-	-	-	-	175	98	98	93	106
Diss. Solids	mg/l	170	160	170	170	180	190	168	166	166	172
Susp. Solids	mg/l	<5	12	<5	11	6	8	12	15	20	<1
NH_3-N	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.376	0.23	0.2
NO_3-N	mg/l	4.2	3.7	2.9	2.5	1.9	5.9	5	1.18	3.7	1.7
NO_2-N	mg/l	0.06	0.06	0.05	0.03	0.04	0.038	0.052	0.032	<0.1	0.1
N-Kjeldahl	mg/l	0.6	0.7	0.4	0.6	0.7	1.2	0.8	0.473	0.32	<0.2
P	mg/l	-	-	-	-	-	-	0.12	0.05	<0.05	0.11
P-total	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
SO_4	mg/l	<1	<1	<1	<1	<1	-	-	-	-	-
Chlorophyll a	µg/l	-	-	-	-	-	1.876	7.557	14.134	21.219	16.288

Table 6.
BLUE MARSH LAKE - WATER CHEMISTRY
Station BM-7, Bottom
COE

Parameter	Units	Date									
		5/25/1995	6/21/1995	7/20/1995	8/22/1995	10/3/1995	5/22/2001	6/12/2001	7/19/2001	8/8/2001	9/26/2001
Temp.	°C	12.5	14.95	20	22.33	17.19	-	-	-	-	-
pH	pH units	8.8	8.55	7.21	7.38	7.97	-	-	-	-	-
Conductance	µmhos/cm	2.01	2.16	2.18	2.38	2.46	-	-	-	-	-
Diss. O_2	mg/l	6.8	7.42	0.21	0.12	7.48	-	-	-	-	-
Alkalinity	mg/l	-	-	-	-	-	185	145	141	145	116
Diss. Solids	mg/l	210	220	230	230	220	196	184	202	252	170
Susp. Solids	mg/l	7	9	6	22	23	4	17	6	27	11
NH_3-N	mg/l	0.2	<0.1	0.8	2.1	0.2	0.2	0.5	1.16	1.07	0.3
NO_3-N	mg/l	3.9	2.5	3	1.6	2.9	6.4	5.3	0.298	2.7	1.7
NO_2-N	mg/l	0.09	0.1	0.04	0.01	0.05	0.044	0.094	0.046	<0.1	0.1
N-Kjeldahl	mg/l	1.1	1.5	0.9	2.1	0.8	0.2	1.2	1.73	1.15	<0.2
P	mg/l	-	-	-	-	-	-	0.15	9.42	0.15	<0.05
P-total	mg/l	<0.1	0.1	<0.1	<0.1	<0.1	<0.05	0.06	3.12	0.06	<0.05
SO_4	mg/l	<1	<1	<1	<1	<1	-	-	-	-	-
Chlorophyll a	µg/l	-	-	-	-	-	1.821	5.918	3.206	3.403	13.591

TABLE 7.
BLUE MARSH LAKE - FISH - Species Occurence
PFBC

Scientific name	Common name	1982-1992	1998	2003
Anguilla rostrata	American eel	X	-	-
Alosa pseudoharengus	Alewife	X	X	X
Esox lucius X E. masquinongy	Tiger muskellunge	X	-	X
Cyprinus carpio	Common carp	X	X	X
Carassius auratus	Goldfish	X	-	-
Notemigonus crysoleucas	Golden shiner	X	-	-
Cyprinella analostana	Satinfin shiner	X	-	-
C. spiloptera	Spotfin shiner	X	-	-
Luxilus cornutus	Common shiner	X	-	-
Notropis hudsonius	Spottail shiner	X	-	-
Pimephales notatus	Bluntnose minnow	X	-	-
Carpiodes cyprinus	Quillback	X	-	-
C. carpio	River carpsucker	X	-	-
Catostomus commersoni	White sucker	X	X	X
Ameiurus natalis	Yellow bullhead	X	X	X
A. nebulosus	Brown bullhead	X	X	X
A. catus	White catfish	X	-	X
Ictalurus punctatus	Channel catfish	X	X	X
Pylodicits olivaris	Flathead catfish	-	-	X
Salvelinus fontinalis	Brook trout	X	-	-
Salmo trutta	Brown trout	X	X	-
S. trutta X S. fontinalis	Tiger trout	X	-	-
Oncorhynchus mykiss	Rainbow trout	X	-	-
O. mykiss	Rainbow-Palomino trout	X	-	-
Morone saxatilis	Striped bass	-	-	X
M. chrysops X M. saxatilis	Striped bass hybrid	X	-	X
Ambloplites rupestris	Rock bass	X	-	-
Pomoxis nigromaculatus	Black crappie	X	X	X
P. annularis	White crappie	X	X	X
Micropterus salmoides	Largemouth bass	X	X	-
M. dolomieu	Smallmouth bass	X	X	X
Lepomis cyanellus	Green sunfish	X	X	X
L. gibbosus	Pumpkinseed	X	X	X
L. macrochirus	Bluegill	X	X	X
Sander vitreus	Walleye	X	X	X
Perca flavescens	Yellow perch	X	X	X
Etheostoma olmstedi	Tessellated darter	X	-	-
	Total Species:	35	16	19

TABLE 8.
BLUE MARSH LAKE - FISH - Catch Length/Frequency Distribution
PFBC

Date	Tiger Musky		Channel Catfish			Brown Bullhead			Yellow Bullhead			White Cafish		Flathead Catfish	Brown Trout	
	1982	2003	1982	1998	2003	1982	1998	2003	1982	1998	2003	1982	2003	2003	1982	1998
Size group (mm)																
>50	-	-	-	-	73	-	-	-	-	-	-	-	-	1	-	-
50 - 74	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-
75 - 99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100 - 124	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
125 - 149	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
150 - 174	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
175 - 199	-	-	-	1	1	3	-	2	1	-	1	-	-	-	-	-
200 - 224	-	-	-	2	2	8	1	2	3	-	-	-	-	-	-	-
225 - 249	-	-	-	10	4	19	2	3	5	1	1	-	-	-	-	1
250 - 274	-	-	-	6	-	23	2	5	1	2	-	1	1	-	1	-
275 - 299	-	-	-	10	6	8	-	5	-	1	1	1	-	-	1	-
300 - 324	-	-	-	16	3	3	-	4	-	-	-	-	-	-	1	-
325 - 349	-	-	-	11	5	1	-	-	-	-	-	-	2	-	-	-
350 - 374	-	-	-	2	4	-	-	-	-	-	-	-	1	-	-	-
375 - 399	-	-	-	4	5	-	-	-	-	-	-	-	-	-	-	-
400 - 424	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-
425 - 449	1	-	-	1	10	-	-	1	-	-	-	-	1	-	-	-
450 - 474	-	-	-	-	8	-	-	-	-	-	-	-	2	-	-	-
475 - 499	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-
500 - 524	-	-	-	1	8	-	-	-	-	-	-	-	-	-	-	-
525 - 549	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
550 - 574	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
575 - 599	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600 - 624	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
625 - 649	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
650 - 674	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
675 - 699	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700 - 724	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
725 - 749	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
750 - 774	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
775 - 799	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800 - 824	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
825 - 849	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
850 - 874	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Size	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-

1982 data comprised of 17 Trap net sets, 13 gill net sets, and 17 electrofishing sites from March and May
1998 data comprised of 6 trap net sets and 5 electrofishing sites from May and June
2003 data comprised of 20 trap net sets from June

TABLE 8. (cont.)

BLUE MARSH LAKE - FISH - Catch Length/Frequency Distribution

PFBC

Date	Rainbow Trout	Striped Bass	Striped Bass Hybrid	Rock Bass	White Crappie			Black Crappie			Largemouth Bass	
	1982	2003	2003	1982	1982	1998	2003	1982	1998	2003	1982	1998
Size group (mm)												
>50	-	-	-	-	-	-	-	-	-	-	-	-
50 - 74	-	-	-	-	1	-	-	1	3	-	-	-
75 - 99	-	-	-	-	5	13	4	2	36	101	1	-
100 - 124	-	-	-	-	20	3	14	1	243	28	2	-
125 - 149	-	-	-	-	17	101	9	13	209	183	15	3
150 - 174	-	1	-	1	1313	44	157	94	208	728	28	11
175 - 199	-	-	1	1	754	53	106	101	96	78	13	3
200 - 224	1	2	-	2	28	70	73	56	8	4	60	3
225 - 249	-	-	-	-	1	56	58	13	3	2	87	9
250 - 274	3	-	-	-	-	31	40	1	1	1	82	23
275 - 299	1	-	2	-	1	8	31	-	-	1	32	5
300 - 324	-	-	3	-	-	7	17	-	-	1	11	7
325 - 349	-	-	1	-	-	-	6	-	-	1	22	3
350 - 374	-	-	2	-	-	1	2	-	-	-	31	2
375 - 399	-	-	-	-	1	-	1	-	-	2	39	3
400 - 424	-	-	-	-	-	-	-	-	-	-	22	1
425 - 449	-	-		-	-	-	-	-	-	-	7	1
450 - 474	-	-	-	-	-	-	-	-	-	-	6	-
475 - 499	-	-	-	-	-	-	-	-	-	-	3	-
500 - 524	-	-	-	-	-	-	-	-	-	-	-	-
525 - 549	-	-	-	-	-	-	-	-	-	-	-	-
550 - 574	-	-	-	-	-	-	-	-	-	-	-	-
575 - 599	-	-	-	-	-	-	-	-	-	-	-	-
600 - 624	-	-	-	-	-	-	-	-	-	-	-	-
625 - 649	-	-	-	-	-	-	-	-	-	-	-	-
650 - 674	-	-	-	-	-	-	-	-	-	-	-	-
675 - 699	-	-	-	-	-	-	-	-	-	-	-	-
700 - 724	-	-	-	-	-	-	-	-	-	-	-	-
725 - 749	-	-	-	-	-	-	-	-	-	-	-	-
750 - 774	-	-	-	-	-	-	-	-	-	-	-	-
775 - 799	-	-	-	-	-	-	-	-	-	-	-	-
800 - 824	-	-	-	-	-	-	-	-	-	-	-	-
825 - 849	-	-	-	-	-	-	-	-	-	-	-	-
850 - 874	-	-	-	-	-	-	-	-	-	-	-	-
No Size	-	8	-	-	-	-	-	-	-	-	-	-

TABLE 8. (cont.)

BLUE MARSH LAKE - FISH - Catch Length/Frequency Distribution

PFBC

Date	Smallmouth Bass			Green Sunfish			Pumpkinseed			Bluegill			Walleye			Yellow Perch	
	1982	1998	2003	1982	1998	2003	1982	1998	2003	1982	1998	2003	1982	1998	2003	1998	2003
Size group (mm)																	
>50	-	-	1	2	-	-	-	-	-	-	-	-	-	2	12	-	-
50 - 74	-	-	-	13	-	-	3	-	-	44	22	-	-	-	-	-	-
75 - 99	-	-	-	19	-	-	-	1	-	29	57	-	-	-	-	-	-
100 - 124	-	7	-	13	-	-	8	3	-	61	71	-	-	-	-	-	-
125 - 149	-	2	-	8	-	-	16	3	-	51	46	-	-	-	-	-	-
150 - 174	-	10	-	-	-	-	1	-	-	45	11	-	2	-	-	-	-
175 - 199	3	20	-	-	-	-	-	-	-	21	5	-	1	-	1	1	-
200 - 224	1	15	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-
225 - 249	2	7	-	-	-	-	-	-	-	-	-	-	-	1	2	-	1
250 - 274	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
275 - 299	4	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	2
300 - 324	-	4	-	-	-	-	-	-	-	-	-	-	13	1	-	-	-
325 - 349	1	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	-
350 - 374	-	-	-	-	-	-	-	-	-	-	-	-	26	2	-	-	-
375 - 399	1	-	-	-	-	-	-	-	-	-	-	-	10	2	1	-	-
400 - 424	-	1	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
425 - 449	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
450 - 474	1	1	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
475 - 499	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
500 - 524	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
525 - 549	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
550 - 574	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
575 - 599	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600 - 624	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
625 - 649	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
650 - 674	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
675 - 699	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700 - 724	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
725 - 749	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
750 - 774	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
775 - 799	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800 - 824	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
825 - 849	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
850 - 874	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Size	-	-	-	-	1	15	-	-	58	-	-	556	-	-	-	-	2

TABLE 9.
BLUE MARSH LAKE - FISH STOCKING HISTORY
WARMWATER/COOLWATER SPECIES
PFBC

Year	Species	Lifestage	Total
2003	Walleye	Phase 1	11,500
2003	White X Striped Bas	Fingerling	10,300
2002	Tiger Muskellunge	Fingerling	5,746
2002	Walleye	Phase 1	11,495
2002	White X Striped Bas	Fingerling	11,498
2001	Striped Bass	Phase 1	11,500
2001	Tiger Muskellunge	Fingerling	5,747
2001	Walleye	Phase 1	11,500
2001	White X Striped Bas	Fingerling	11,500
2000	Striped Bass	Phase 1	11,500
2000	Tiger Muskellunge	Fingerling	5,750
2000	Walleye	Phase 1	23,000
1999	Striped Bass	Fingerling	6,887
1999	Tiger Muskellunge	Fingerling	5,750
1999	Walleye	Fingerling	23,000
1999	White X Striped Bas	Fingerling	13,800
1998	Muskellunge	Fingerling	1,150
1998	Striped Bass	Fingerling	11,500
1998	Tiger Muskellunge	Fingerling	9,250
1998	Walleye	Fingerling	11,500
1997	Muskellunge	Fingerling	1,050
1997	Striped Bass	Phase 1	17,250
1997	Tiger Muskellunge	Fingerling	5,750
1997	Walleye	Phase 1	23,000
1996	Channel Catfish	Adult	80
1996	Channel Catfish	Fingerling	11,500
1996	Tiger Muskellunge	Fingerling	10,750
1996	Walleye	Fingerling	11,500
1995	Channel Catfish	Fingerling	11,500
1995	Muskellunge	Fingerling	2,250
1995	Tiger Muskellunge	Fingerling	4,900
1995	Walleye	Phase 1	34,500
1994	Striped Bass	Fry	1,149,000
1994	Striped Bass	Phase 1	13,800
1994	Tiger Muskellunge	Fingerling	13,550
1994	Walleye	Fry	2,300,000
1994	Walleye	Phase 1	34,500
1994	Yellow Perch	Adult	830
1993	Brown Bullhead	Fingerling	17,632
1993	Muskellunge	Fingerling	3,339
1993	Walleye	Fry	2,300,000

TABLE 9. (cont.)
BLUE MARSH LAKE - FISH STOCKING HISTORY
WARMWATER/COOLWATER SPECIES
PFBC

1993	White X Striped Bas	Phase 1	3,053
1993	Yellow Perch	Adult	4,392
1992	Channel Catfish	Fingerling	11,700
1992	Largemough Bass	Adult	168
1992	Largemough Bass	Fingerling	32,600
1992	Muskellunge	Fingerling	50
1992	Smallmouth Bass	Fingerling	17,473
1992	Tiger Muskellunge	Fingerling	11,850
1992	Walleye	Fry	862,500
1992	Walleye	Phase 1	46,000
1992	White X Striped Bas	Phase 1	13,800
1991	Largemough Bass	Fingerling	28,183
1991	Muskellunge	Fingerling	1,150
1991	Smallmouth Bass	Fingerling	6,900
1991	Walleye	Fry	862,500
1991	Walleye	Phase 1	23,000
1991	White X Striped Bas	Fingerling	13,800
1990	Largemough Bass	Fingerling	7,675
1990	Smallmouth Bass	Fingerling	35,000
1990	Tiger Muskellunge	Fingerling	5,750
1990	Walleye	Fry	862,500
1990	Walleye	Phase 1	23,000
1990	White X Striped Bas	Fingerling	13,380
1989	Largemough Bass	Fingerling	38,575
1989	Smallmouth Bass	Fingerling	23,000
1989	Walleye	Fingerling	8,650
1989	White X Striped Bas	Fingerling	11,500
1988	Channel Catfish	Fingerling	25,850
1988	Largemough Bass	Fingerling	11,775
1988	Tiger Muskellunge	Fingerling	5,750
1988	Walleye	Phase 1	23,000
1988	White X Striped Bas	Fingerling	5,750
1987	Channel Catfish	Fingerling	50,000
1987	Largemough Bass	Fingerling	25,000
1987	Smallmouth Bass	Fingerling	22,000
1987	Walleye	Phase 1	50,000
1987	White Catfish	Fingerling	36,915
1986	Channel Catfish	Fingerling	18,000
1986	Largemough Bass	Fingerling	1,279
1986	Tiger Muskellunge	Fingerling	5,750
1986	Walleye	Phase 1	34,500
1986	White X Striped Bas	Fingerling	9,000

TABLE 9. (cont.)
BLUE MARSH LAKE - FISH STOCKING HISTORY
WARMWATER/COOLWATER SPECIES
PFBC

1985	Tiger Muskellunge	Fingerling	5,750
1985	Walleye	Phase 1	34,500
1985	White X Striped Bas	Fingerling	1,200
1984	Tiger Muskellunge	Fingerling	5,750
1984	White X Striped Bas	Fingerling	9,200
1983	Tiger Muskellunge	Fingerling	5,750
1982	Alewife	Adult	30,000
1982	Channel Catfish	Fingerling	57,500
1982	Tiger Muskellunge	Fingerling	3,450
1981	Channel Catfish	Fingerling	50,000
1980	Channel Catfish	Fingerling	60,000
1980	Largemough Bass	Fingerling	27,000
1980	Largemough Bass	Fry	375,000
1980	Tiger Muskellunge	Fingerling	4,000
1980	Walleye	Fry	500,000
1980	Walleye	Phase 1	35,000
1979	Black Crappie	Fingerling	15,000
1979	Channel Catfish	Fingerling	75,000
1979	Largemough Bass	Fingerling	5,000
1979	Largemough Bass	Fry	400,000
1979	Tiger Muskellunge	Fingerling	13,985
1979	Walleye	Phase 1	25,000

Figure 2.
Blue Marsh Lake Sampling Locations

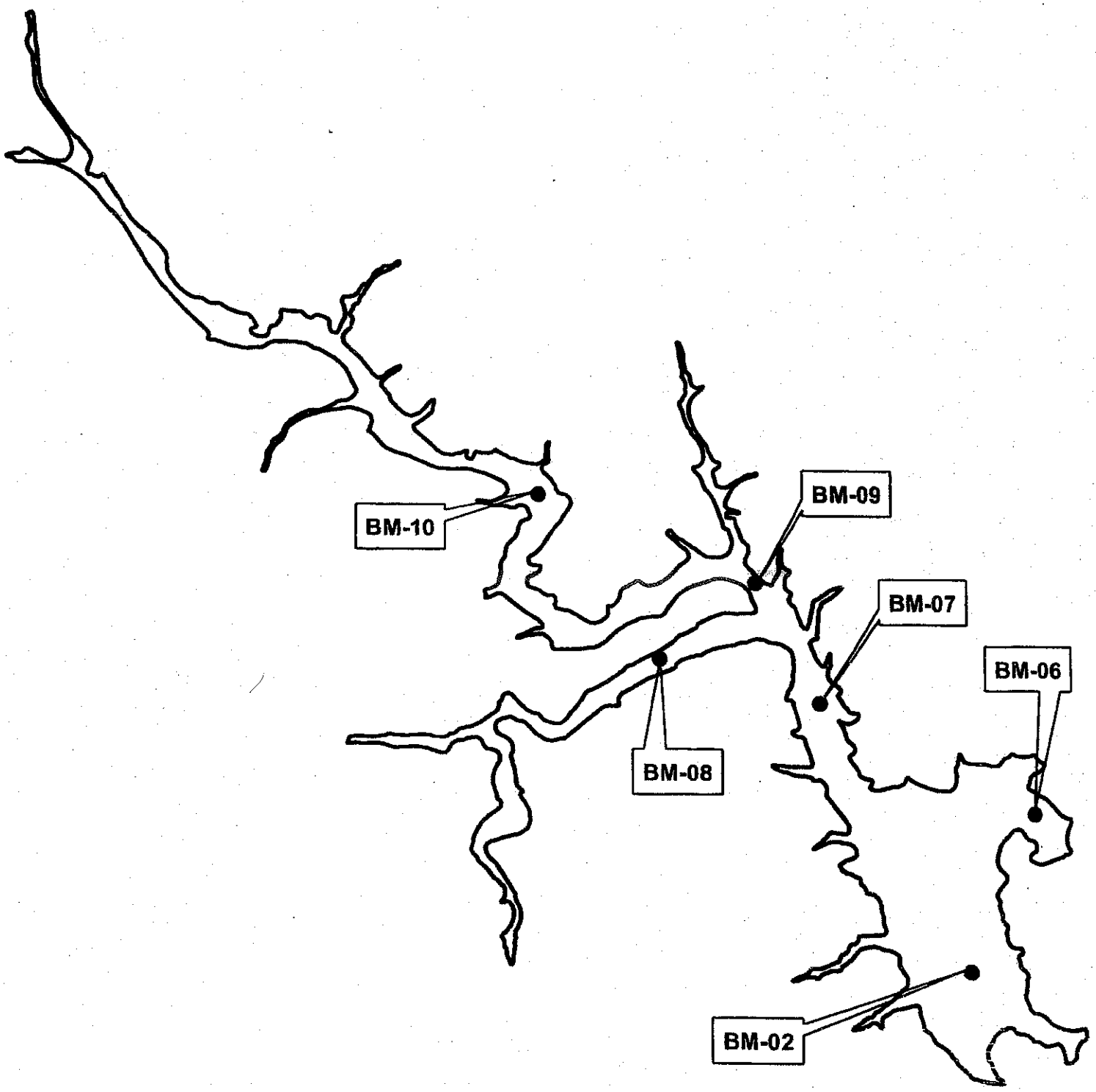
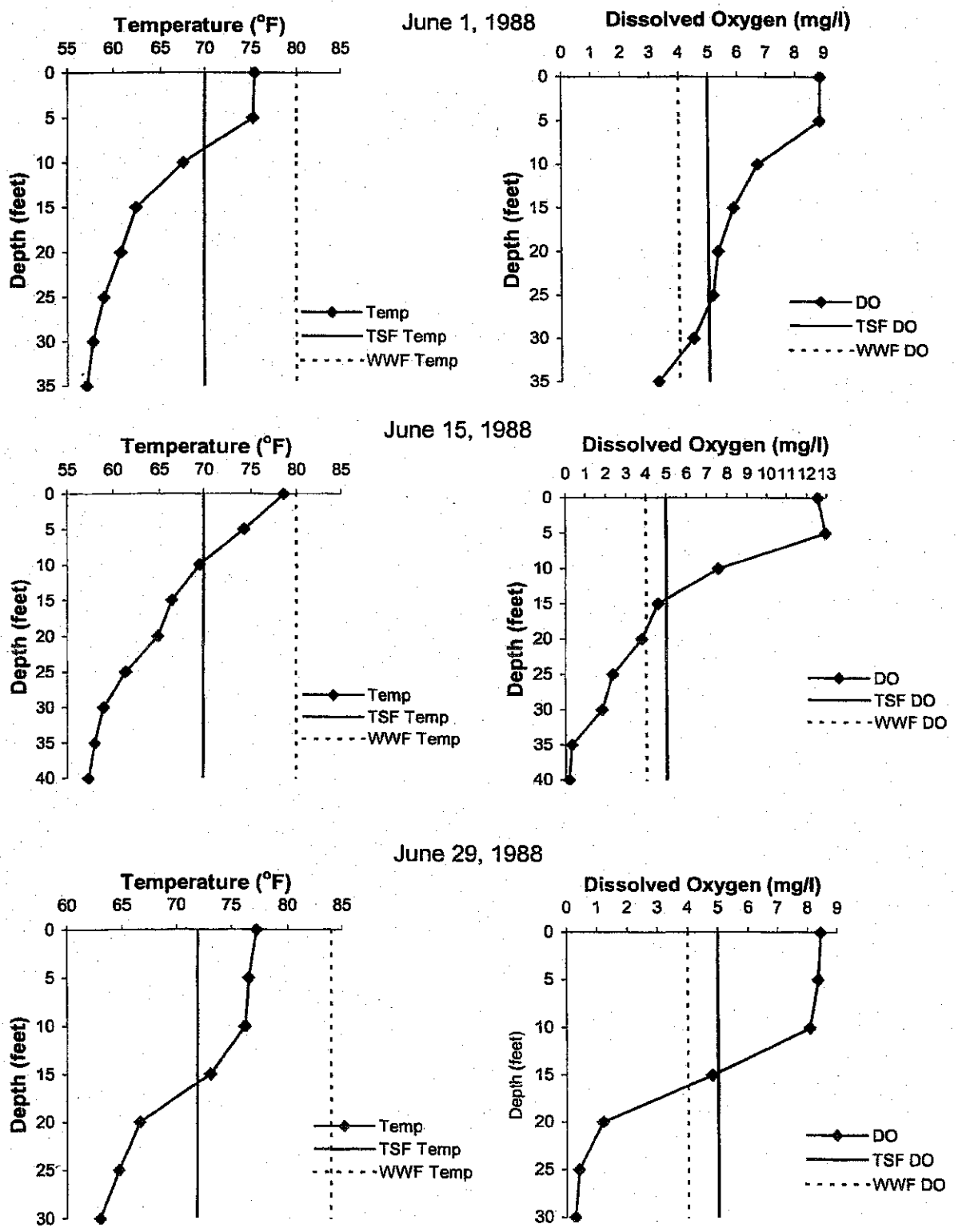


FIGURE 3.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

Temperature and Dissolved Oxygen Profiles - BM02

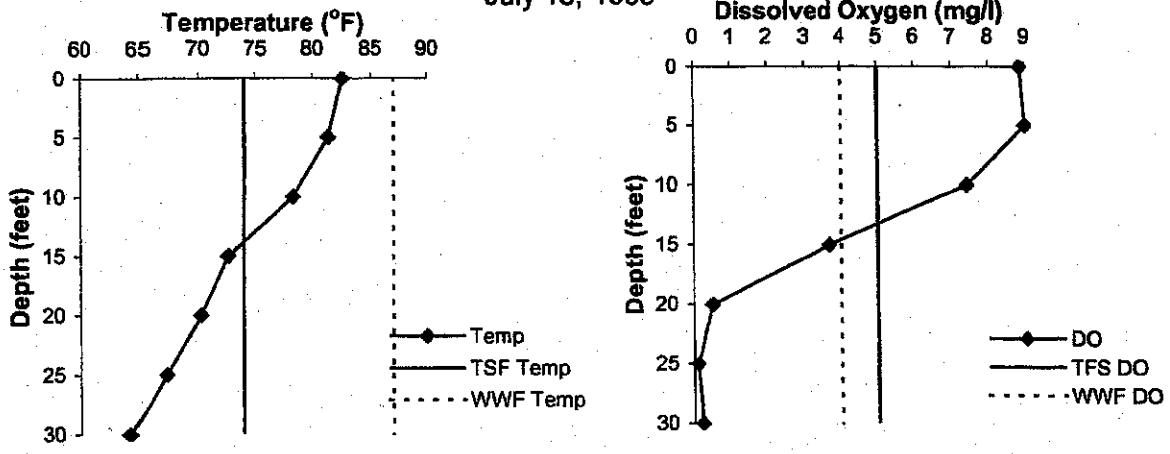
COE



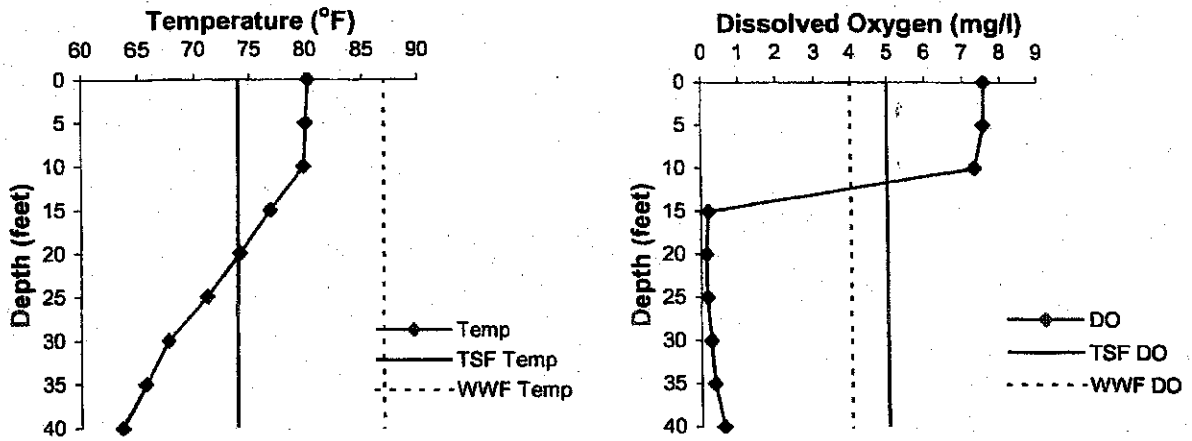
[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

FIGURE 3. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

July 13, 1988



July 27, 1988



August 10, 1988

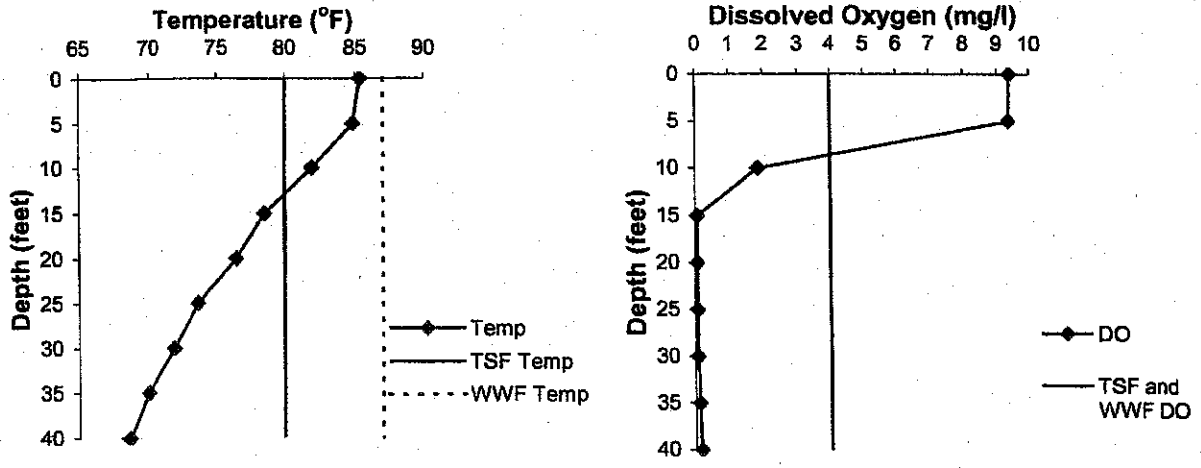
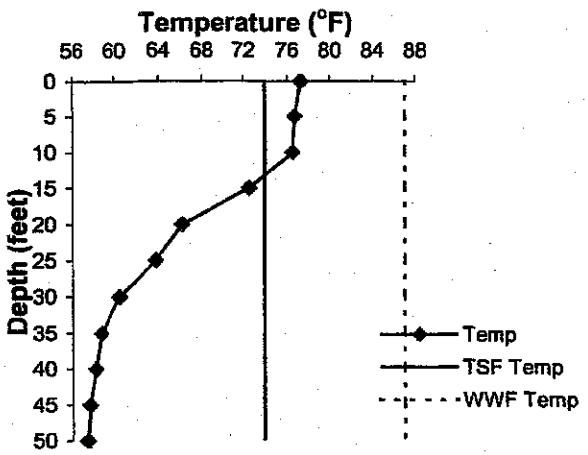
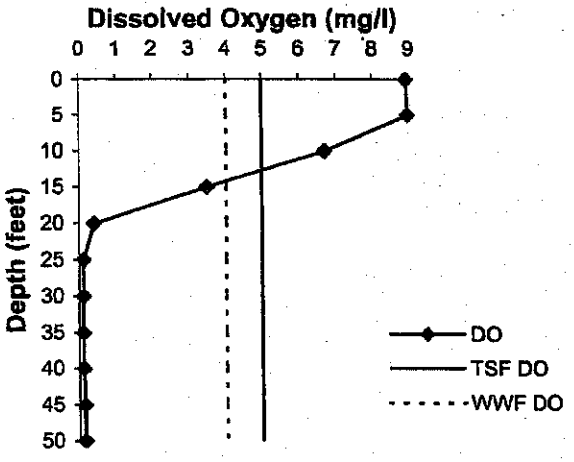


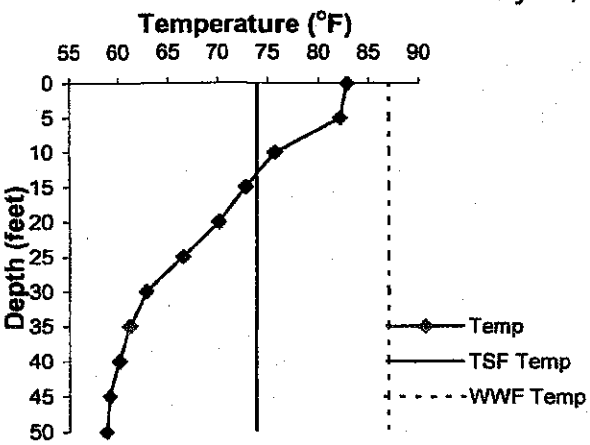
FIGURE 4. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

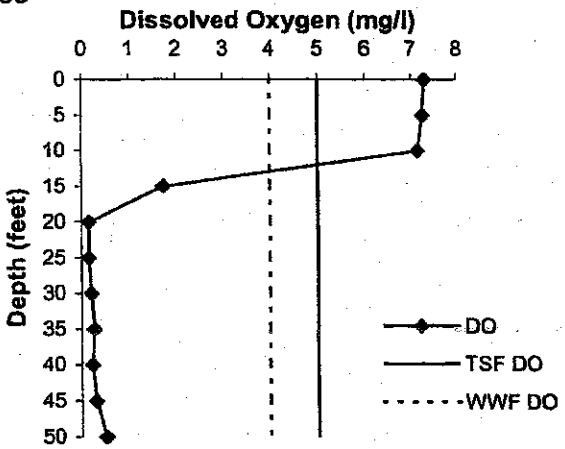
July 13, 1988



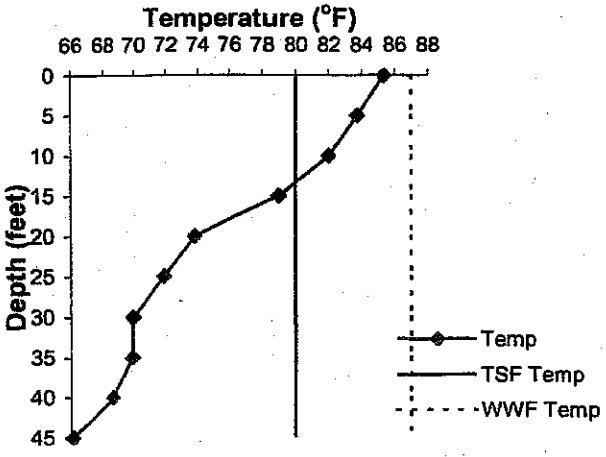


July 27, 1988





August 10, 1988



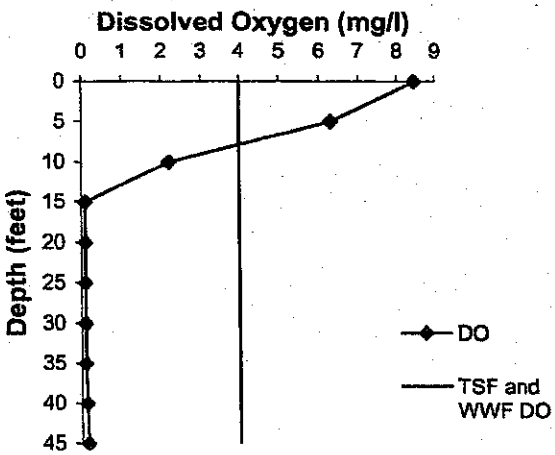
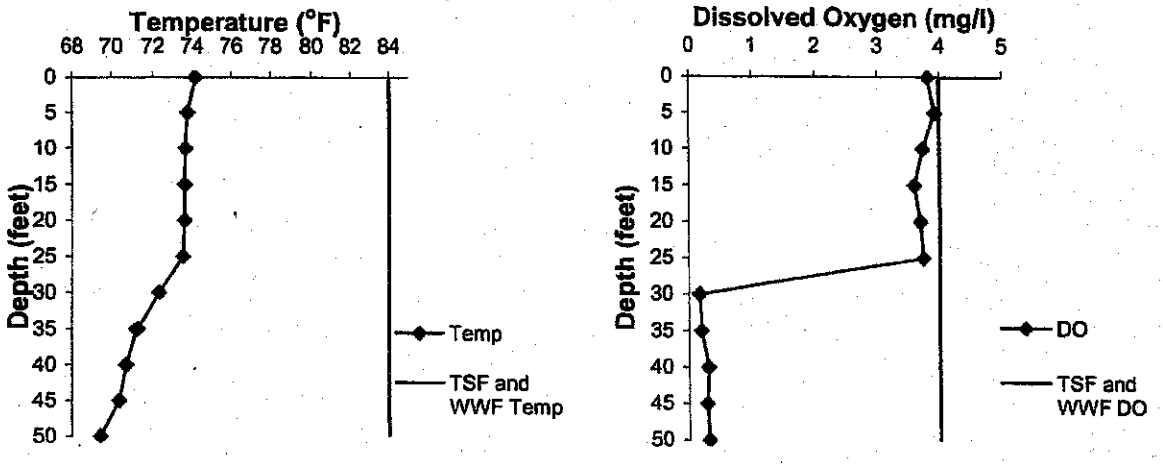
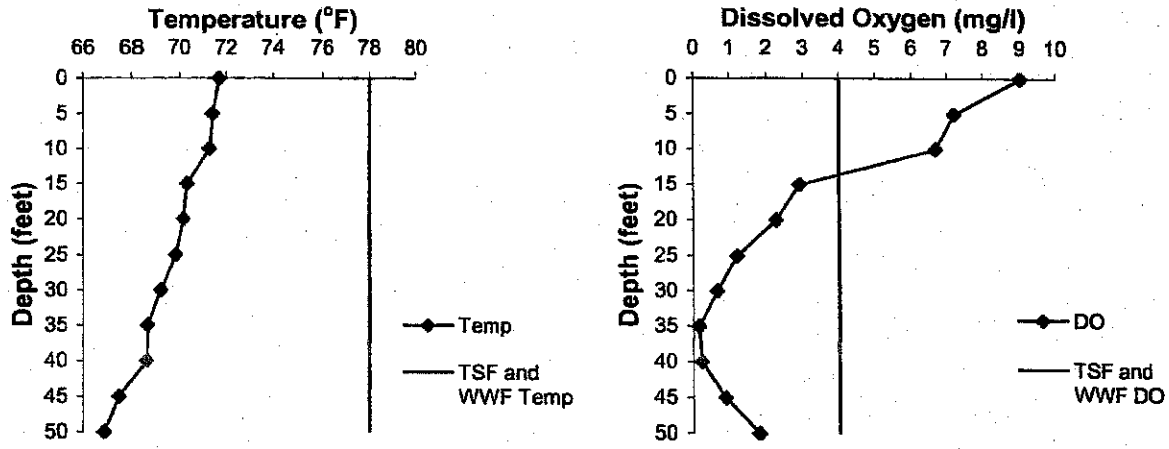


FIGURE 4. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

September 7, 1988



September 21, 1988



October 19, 1988

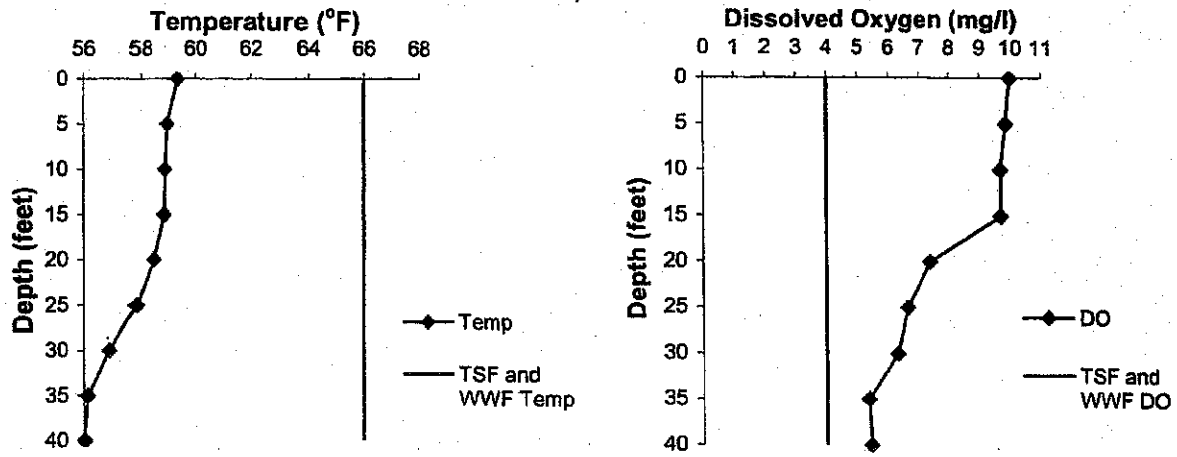


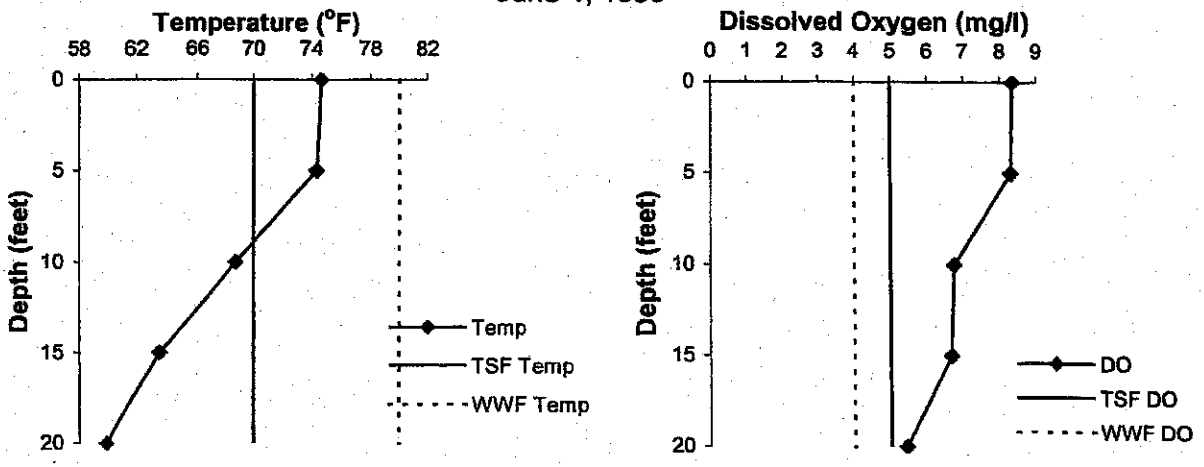
FIGURE 5.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

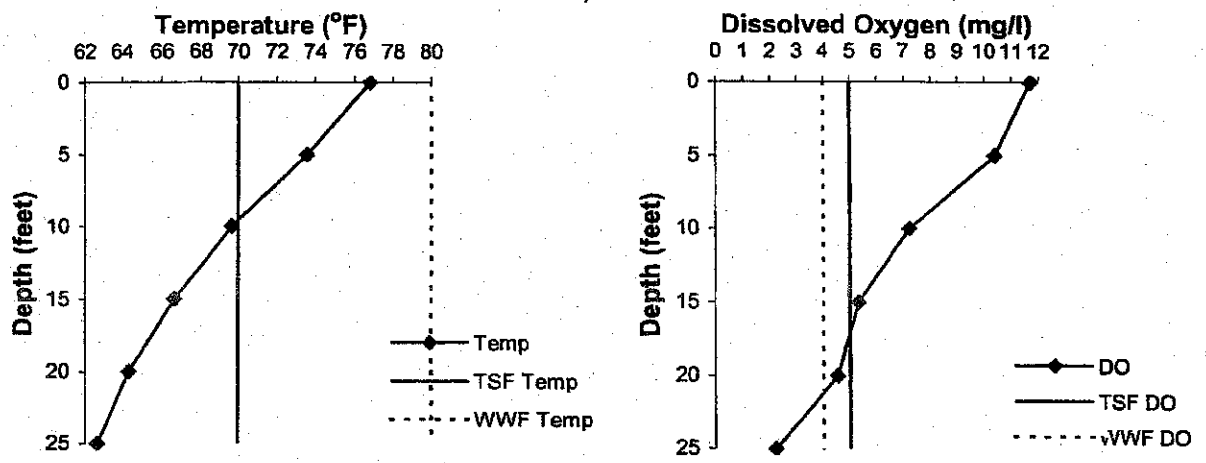
Temperature and Dissolved Oxygen Profiles - BM07

COE

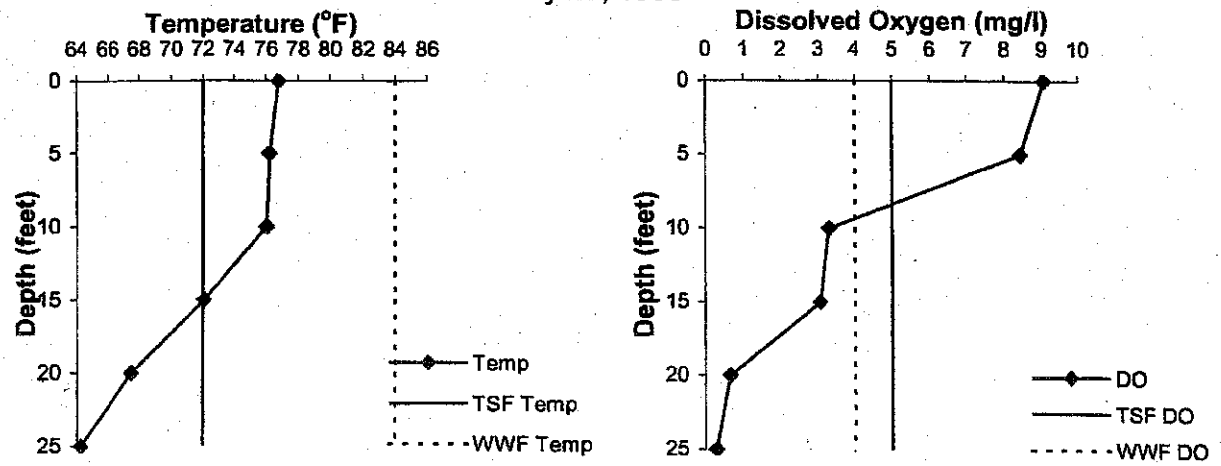
June 1, 1988



June 15, 1988



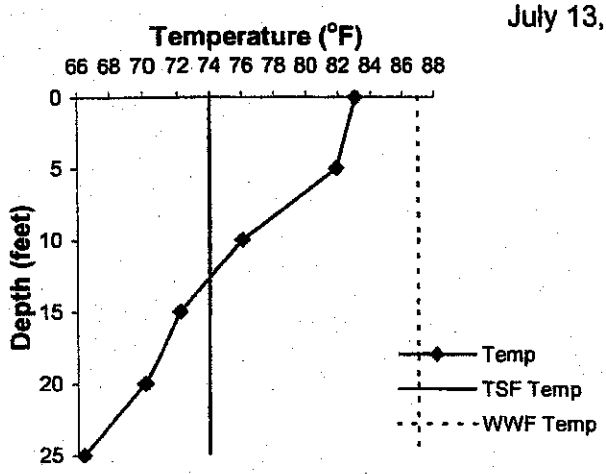
July 29, 1988

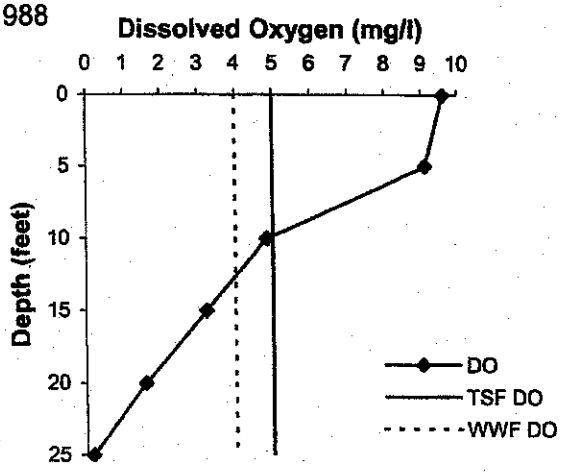


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

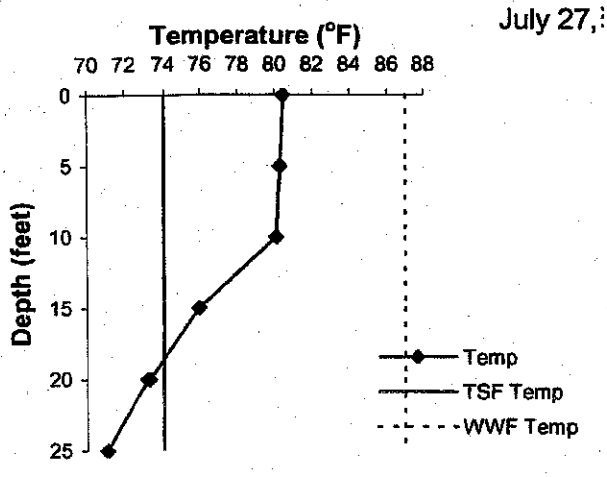
FIGURE 5. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

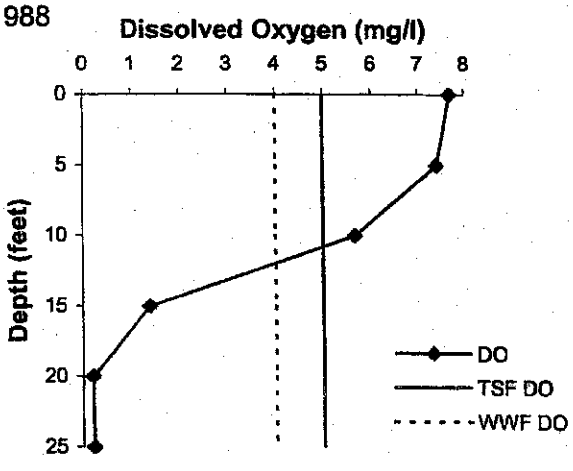
July 13, 1988



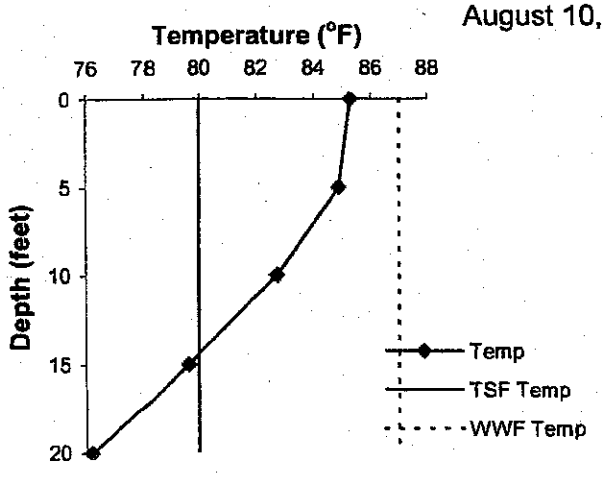


July 27, 1988





August 10, 1988



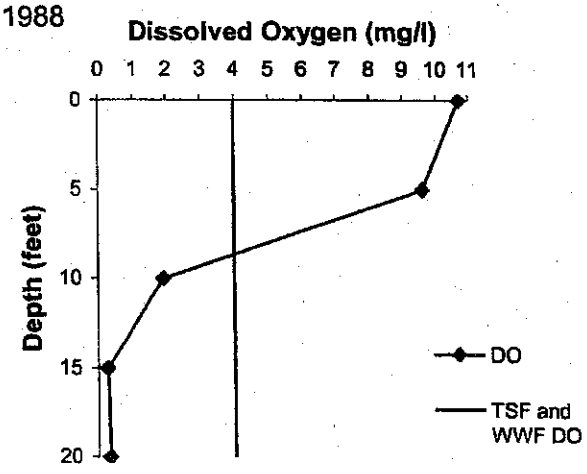
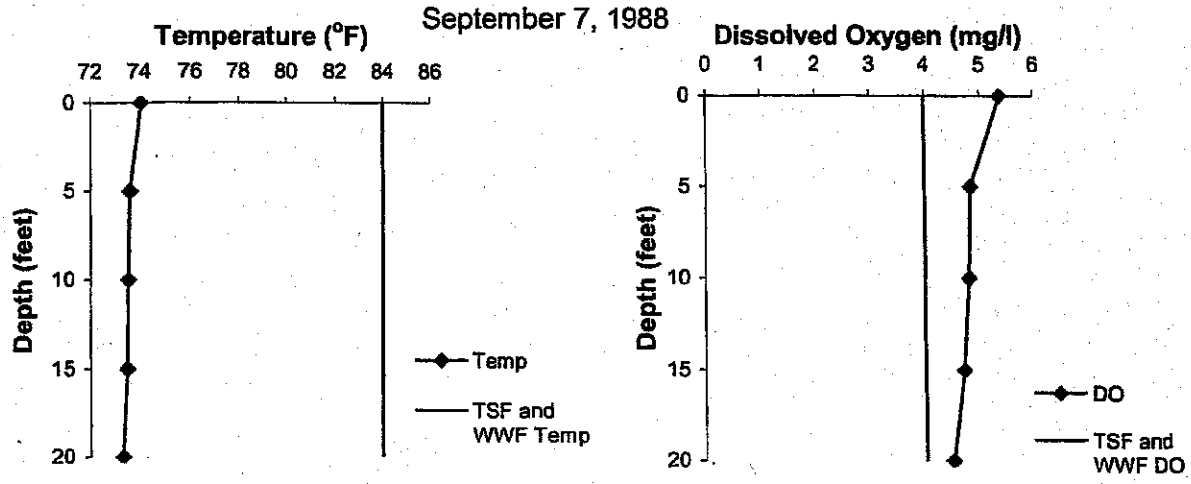
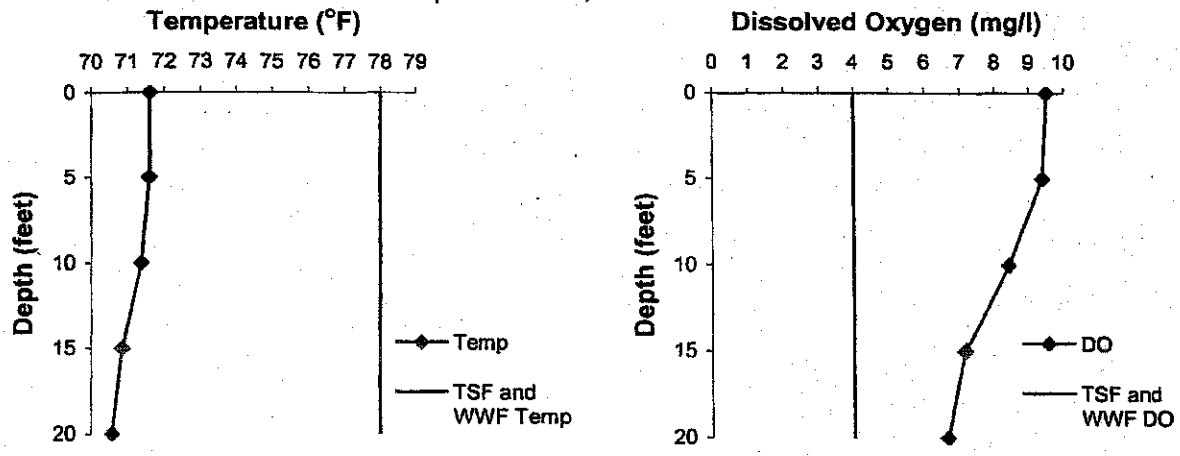


FIGURE 5. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

September 7, 1988



September 21, 1988



October 19, 1988

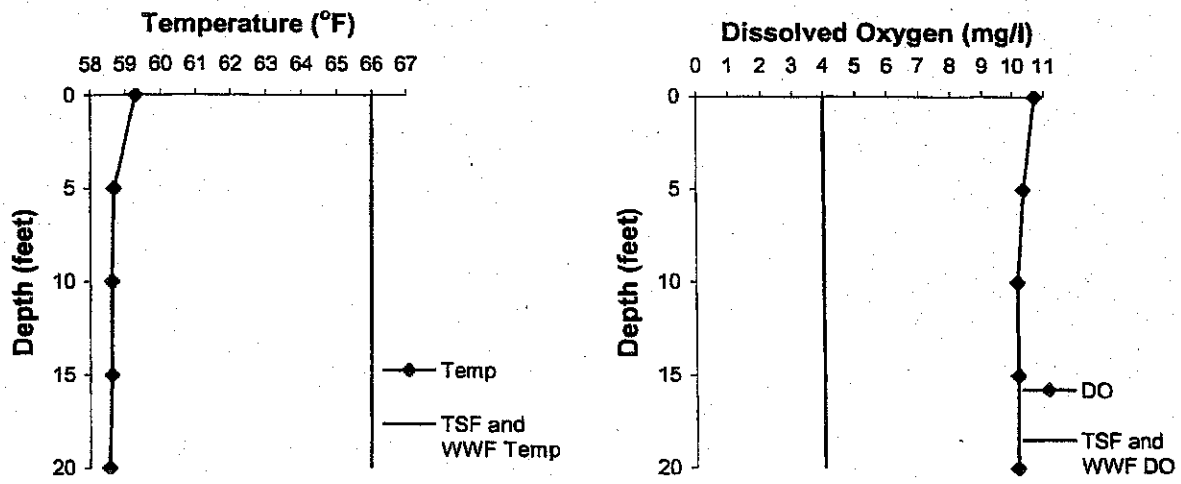


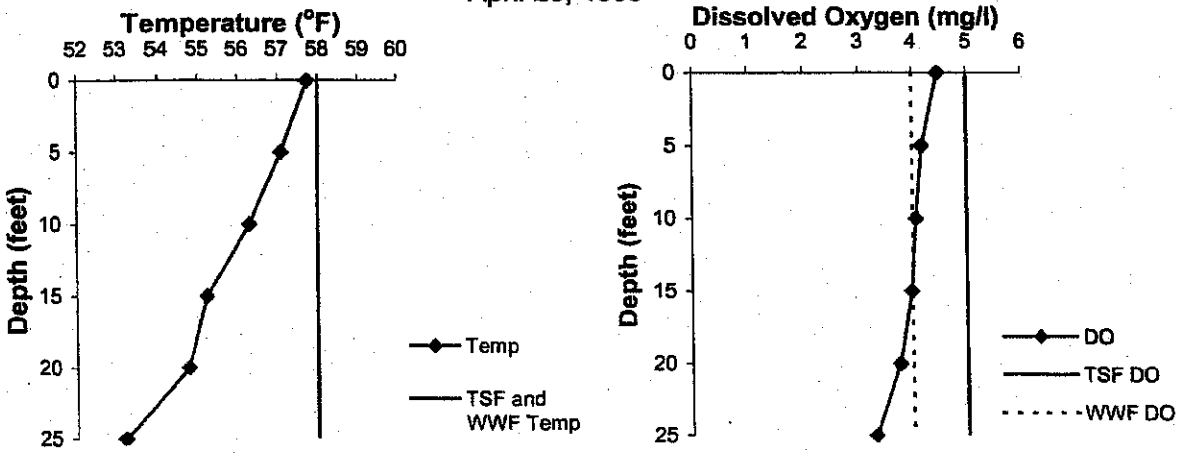
FIGURE 6.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

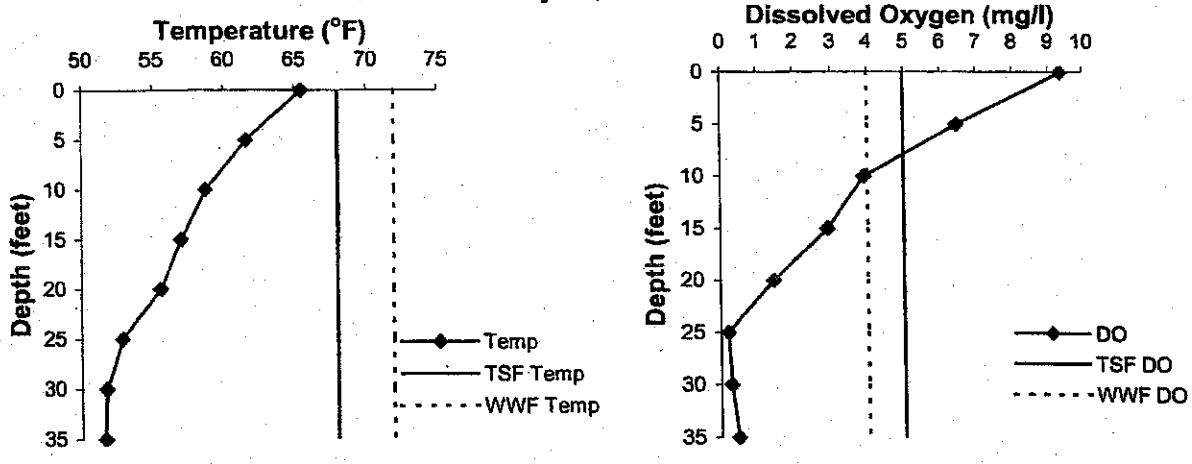
Temperature and Dissolved Oxygen Profiles - BM02

COE

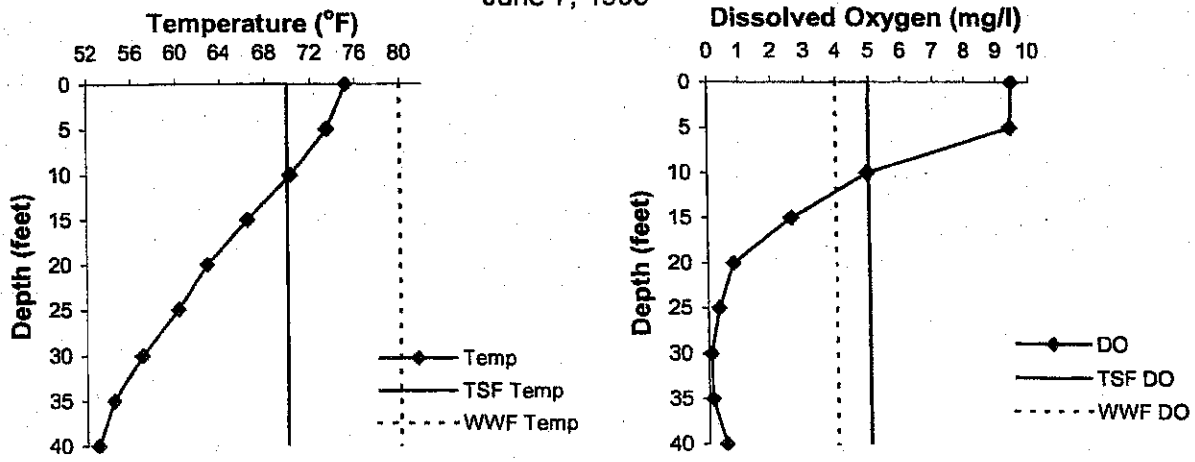
April 26, 1995



May 24, 1995



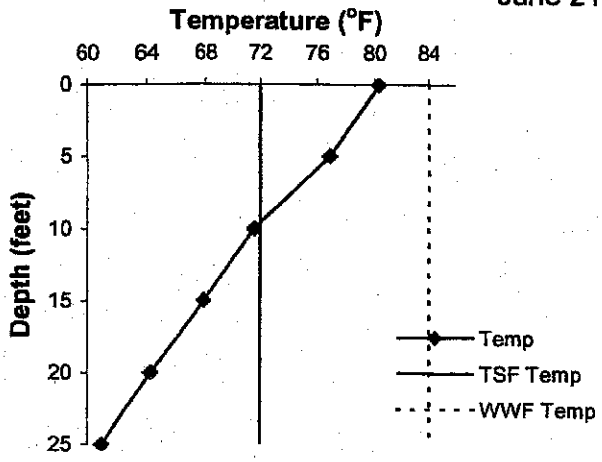
June 7, 1995

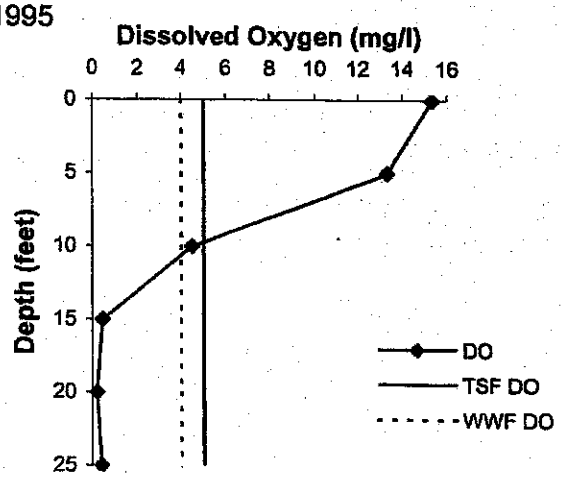


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

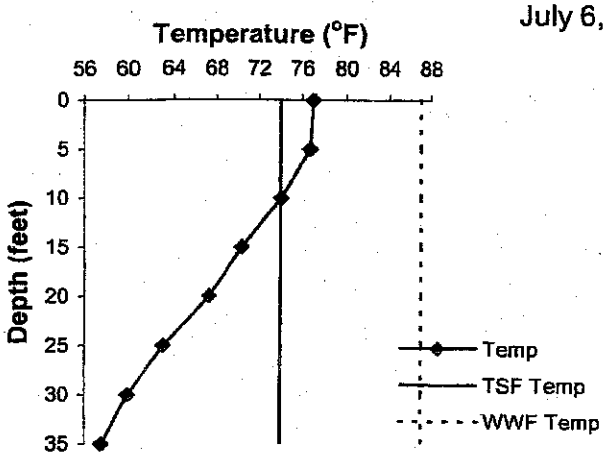
FIGURE 6. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

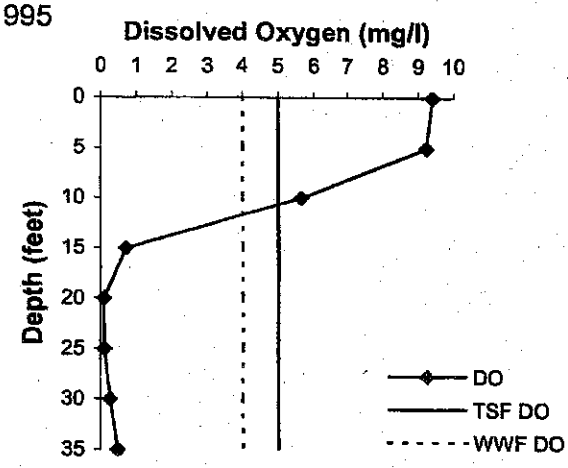
June 21, 1995



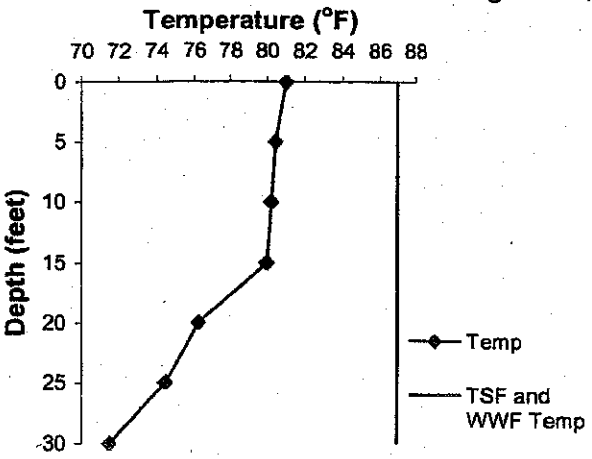


July 6, 1995





August 23, 1995



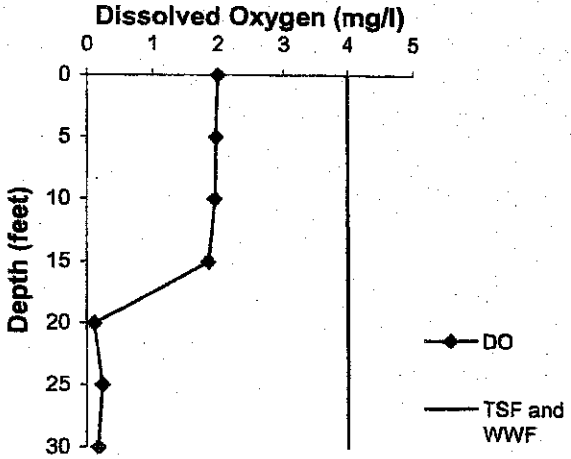


FIGURE 6. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

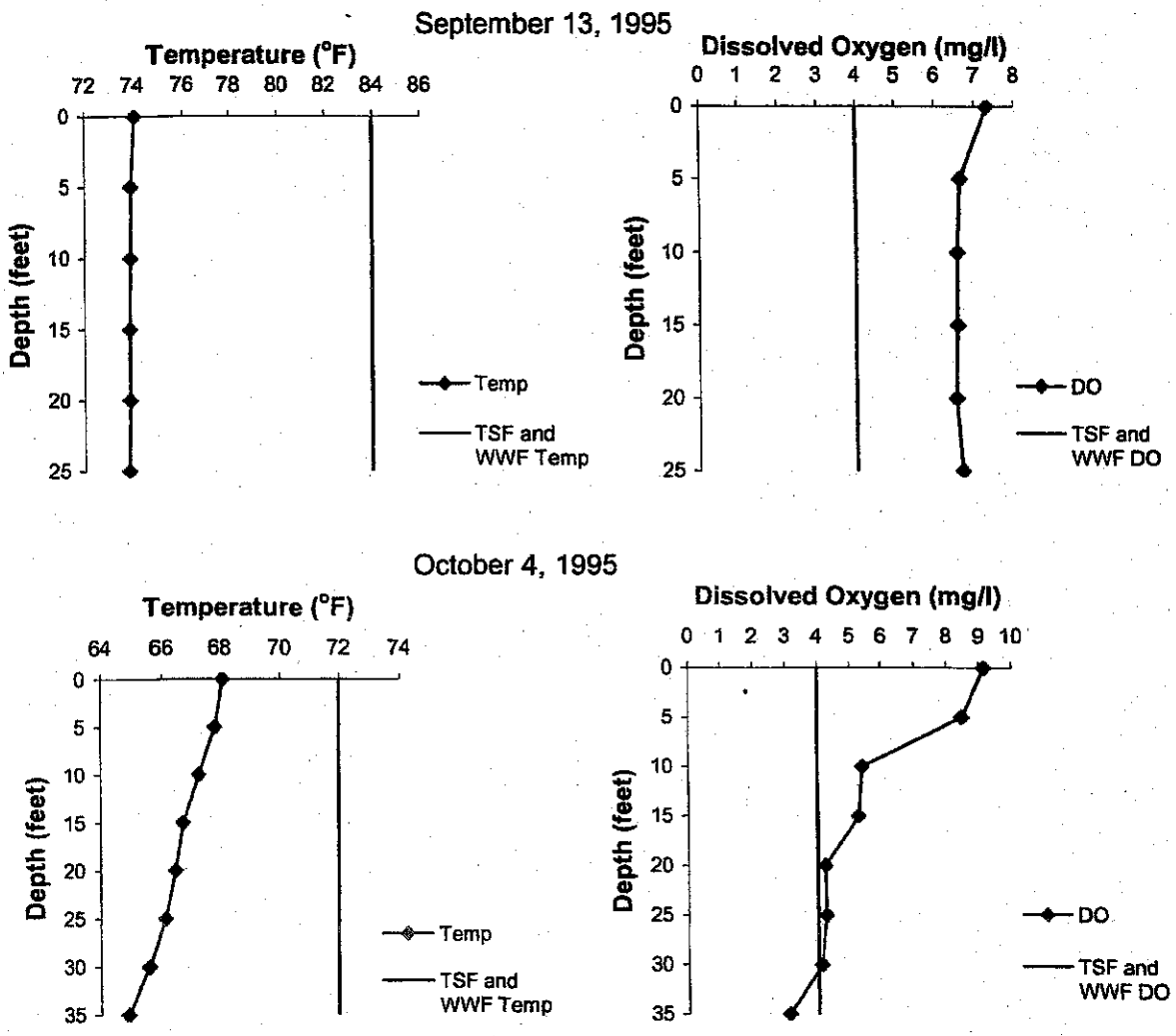


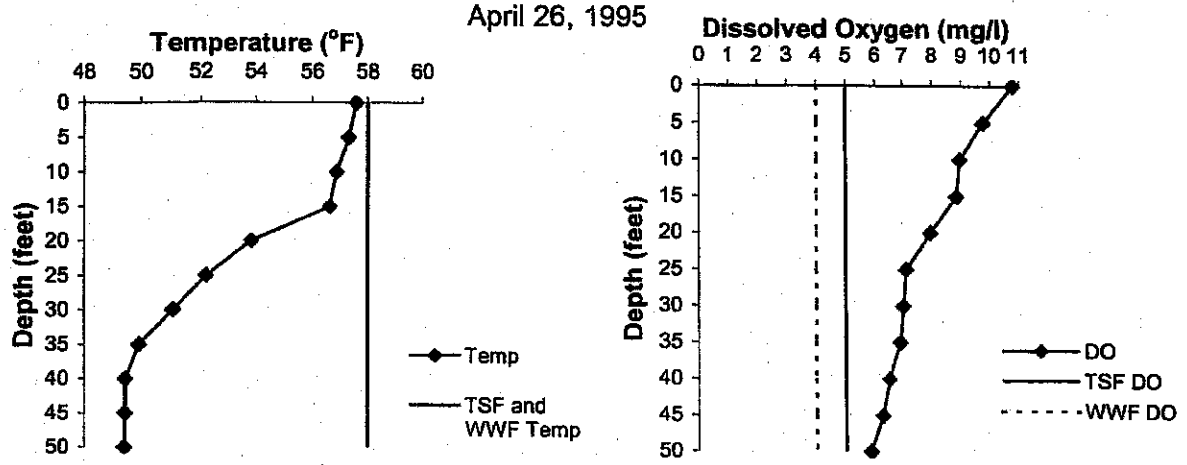
FIGURE 7.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

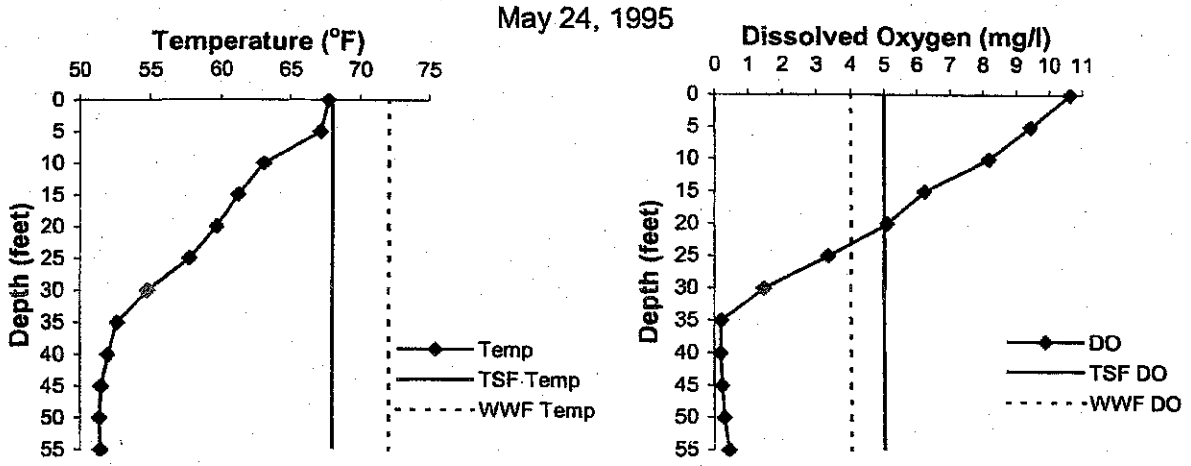
Temperature and Dissolved Oxygen Profiles - BM06

COE

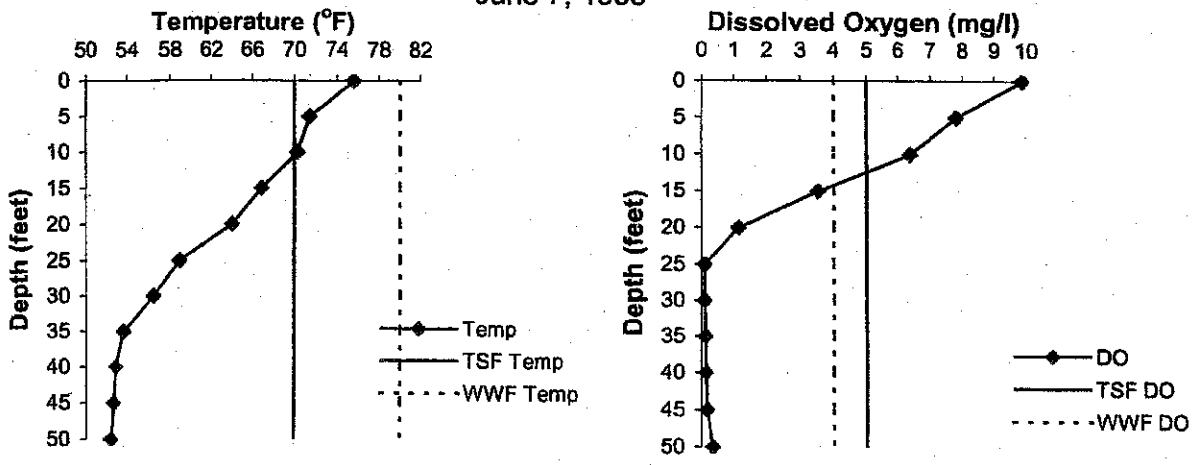
April 26, 1995



May 24, 1995



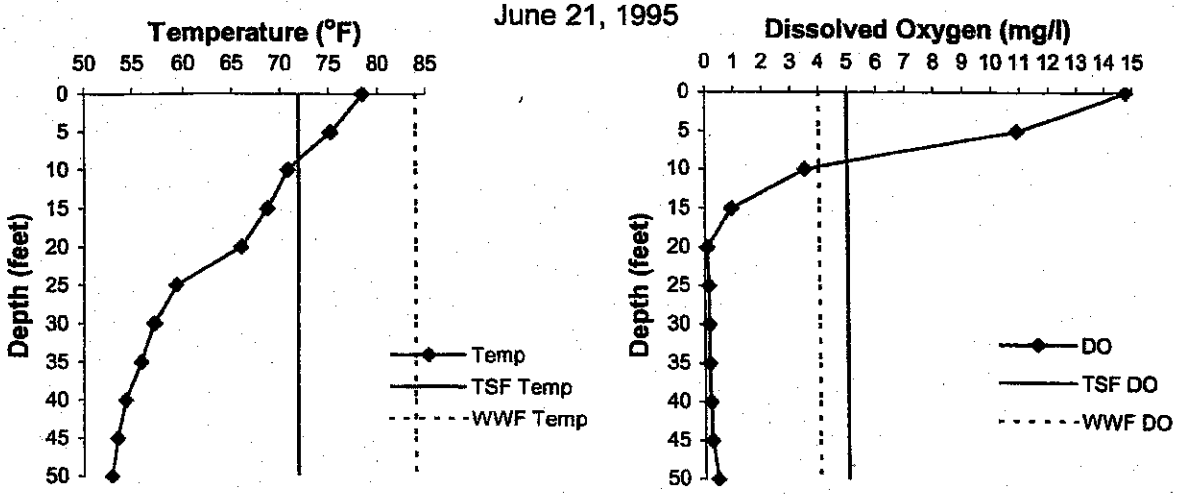
June 7, 1995



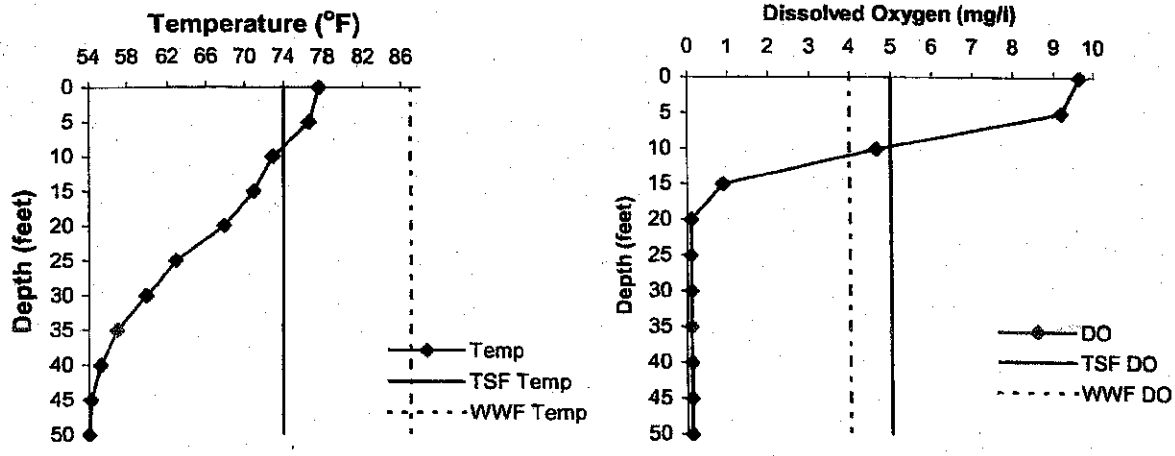
[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

FIGURE 7. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

June 21, 1995



July 6, 1995



August 23, 1995

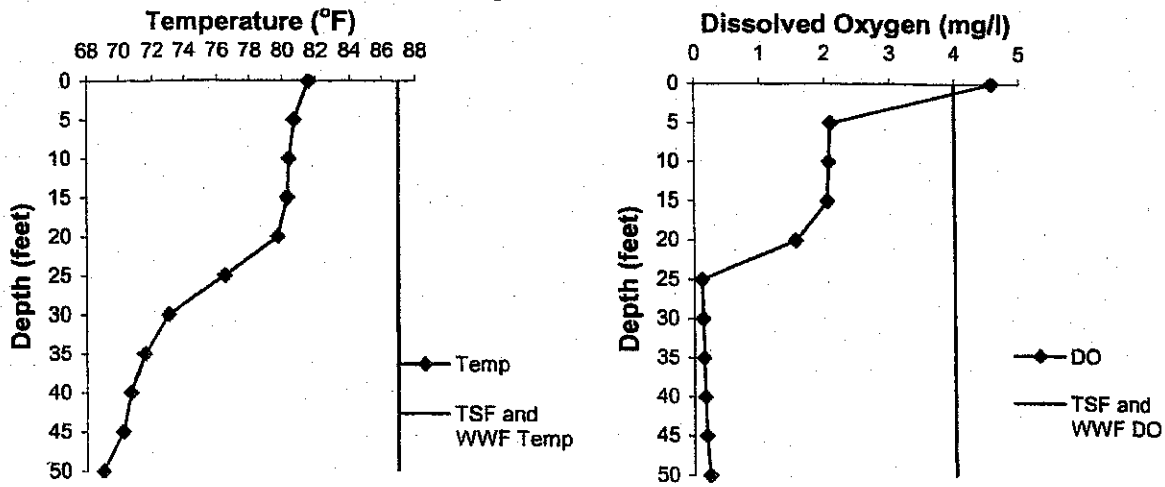
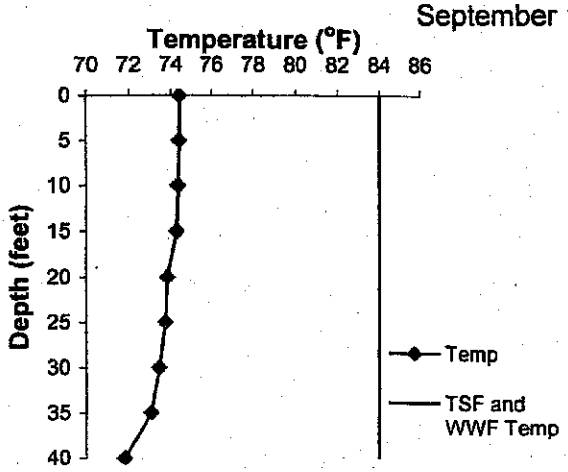
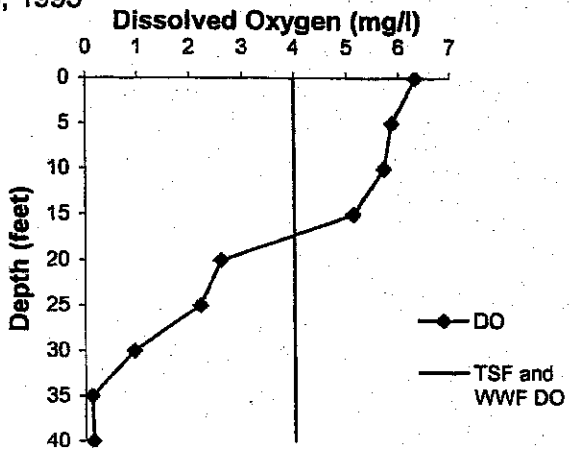


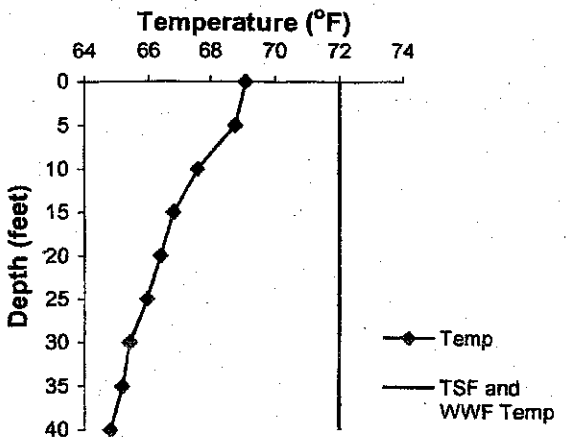
FIGURE 7. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

September 13, 1995





October 4, 1995



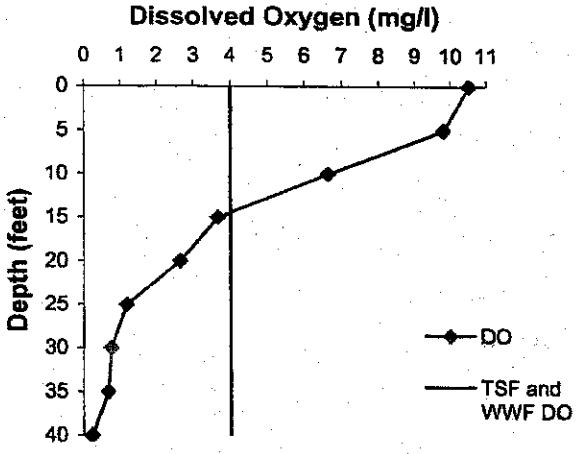


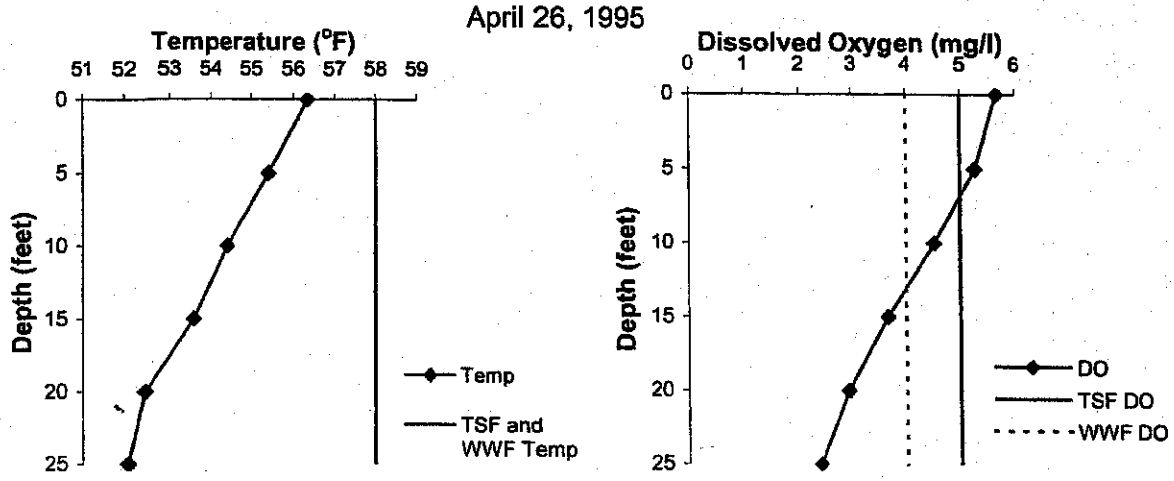
FIGURE 8.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

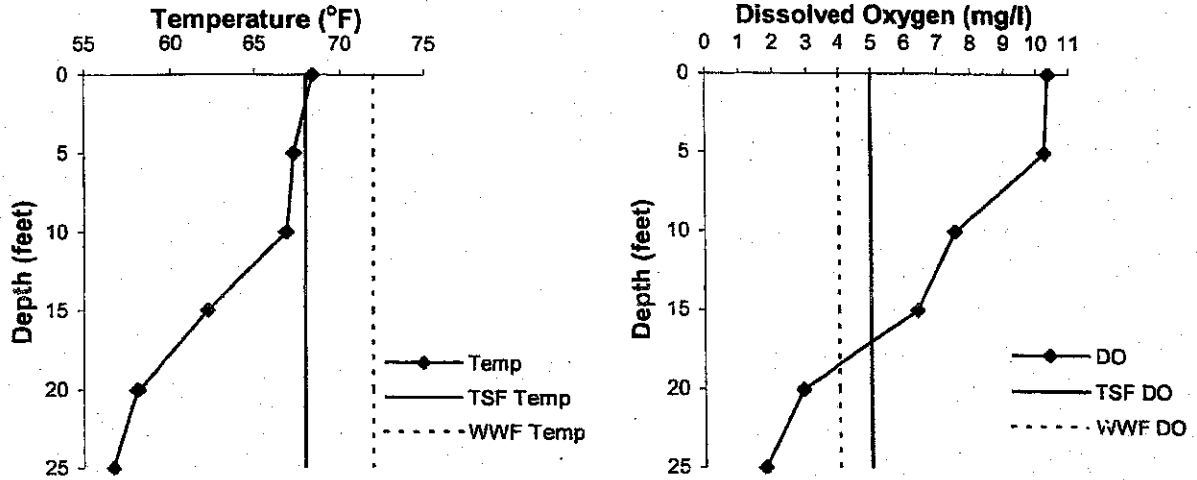
Temperature and Dissolved Oxygen Profiles - BM07

COE

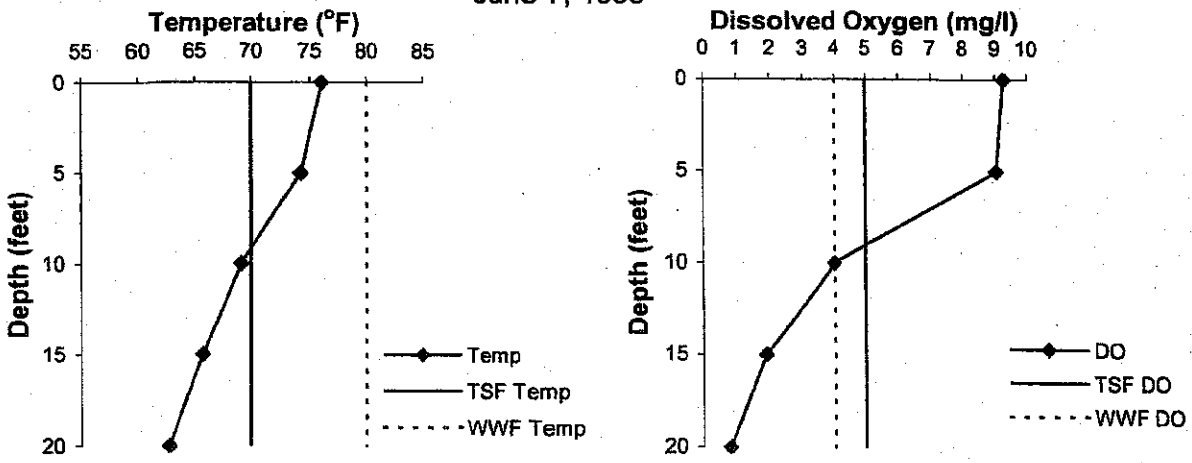
April 26, 1995



May 24, 1995



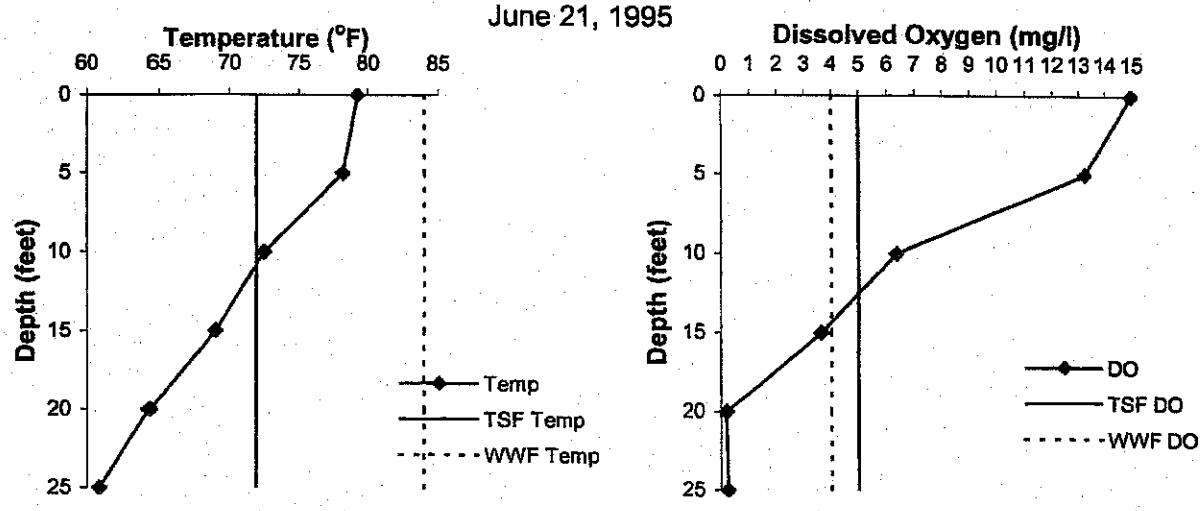
June 7, 1995



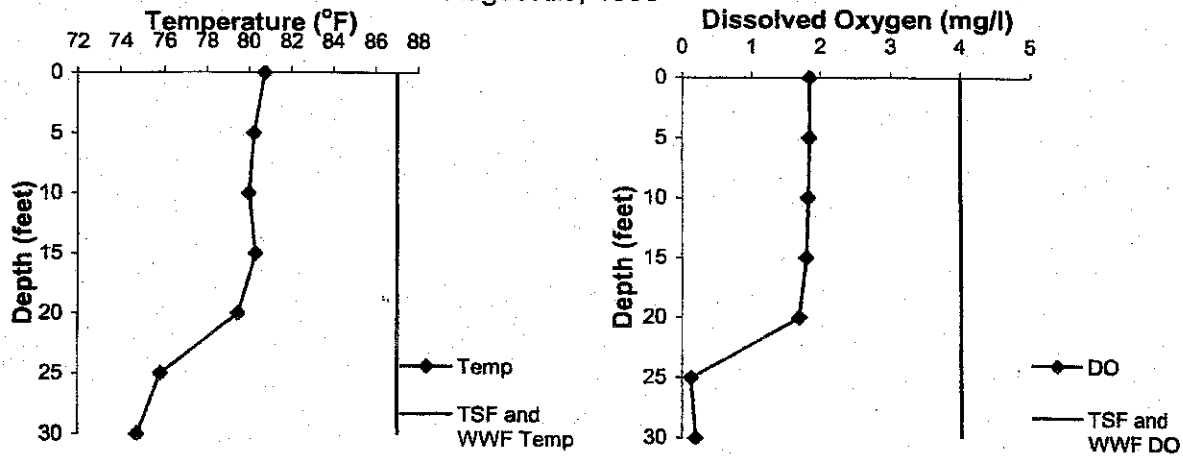
[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

FIGURE 8. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

June 21, 1995



August 23, 1995



September 13, 1995

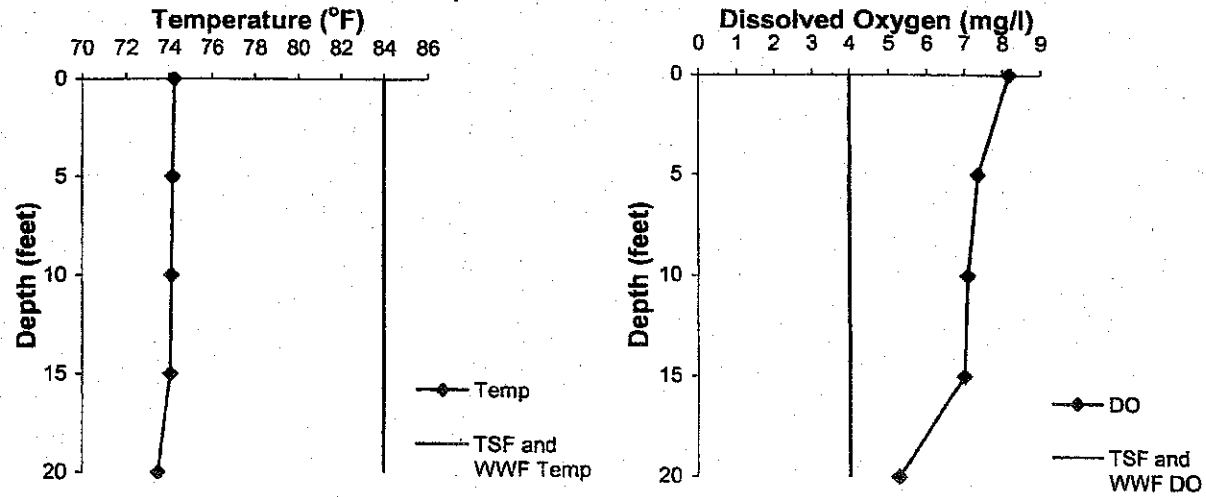


FIGURE 8. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

October 4, 1995

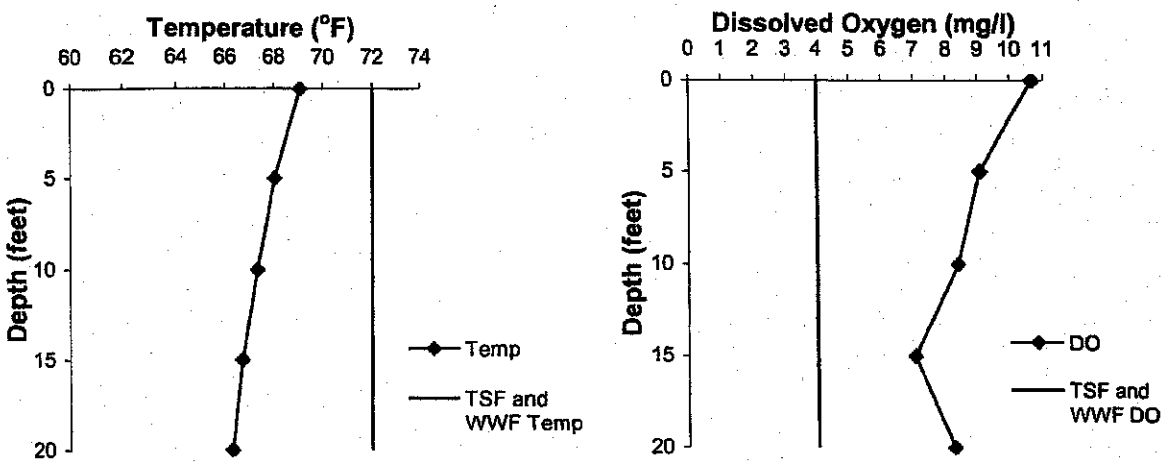


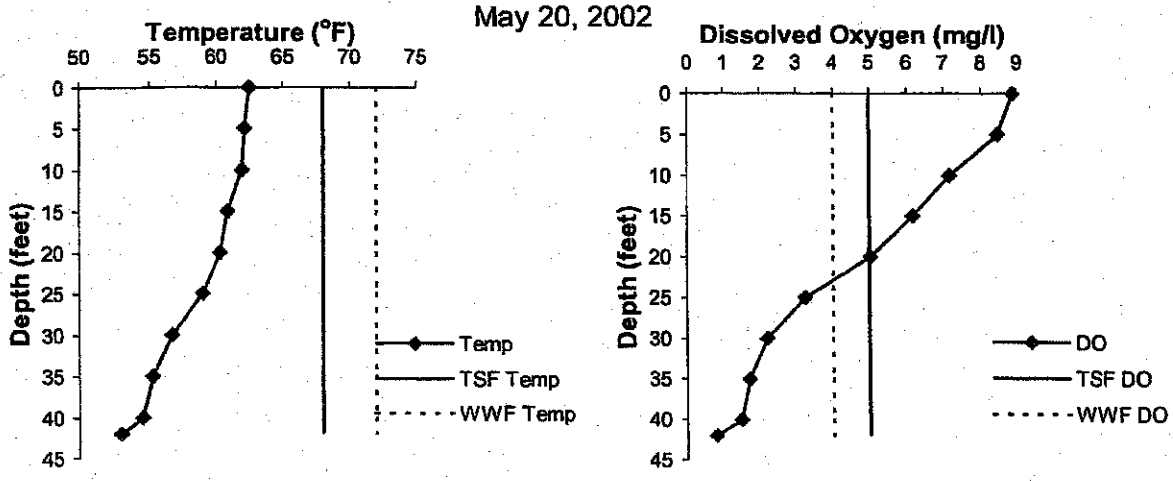
FIGURE 9.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

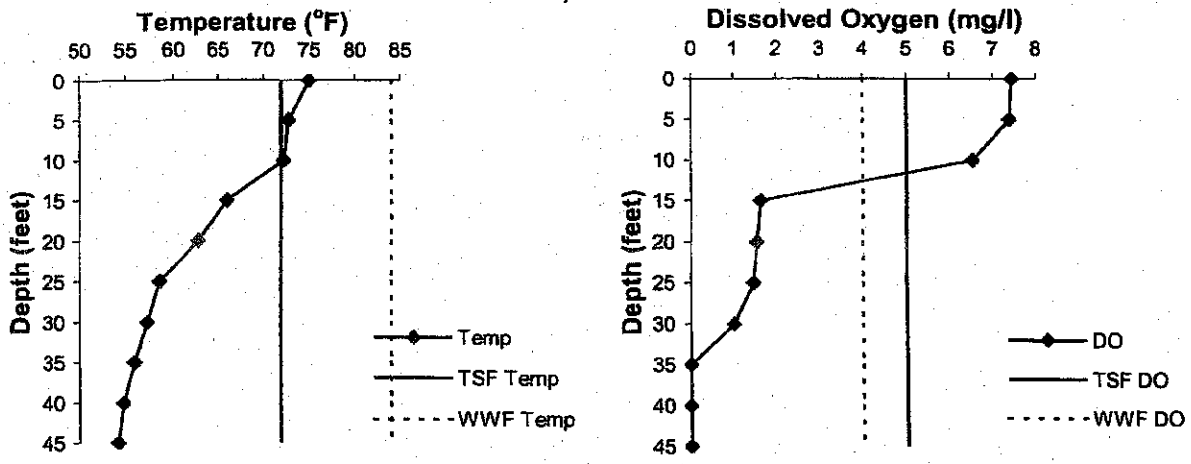
Temperature and Dissolved Oxygen Profiles - BM02

COE

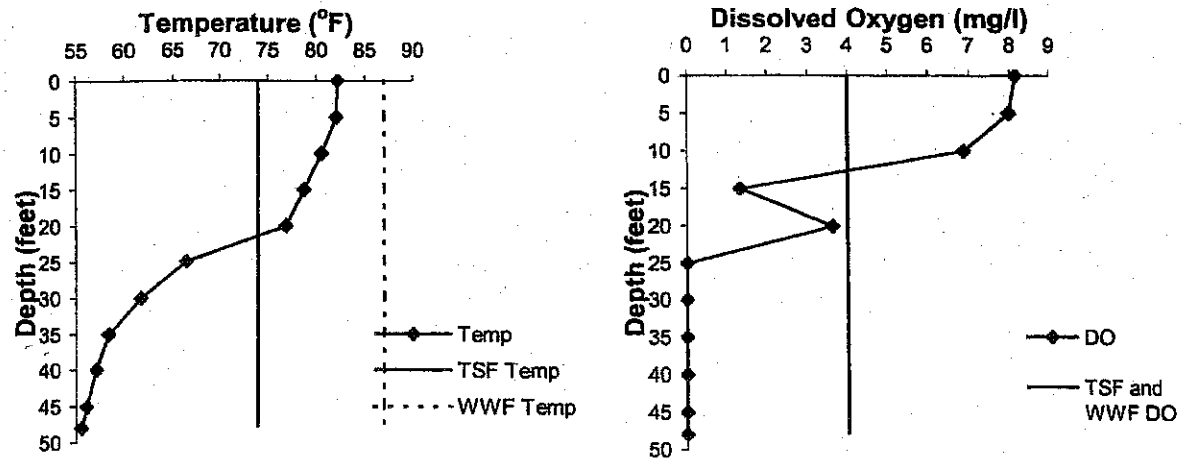
May 20, 2002



June 18, 2002



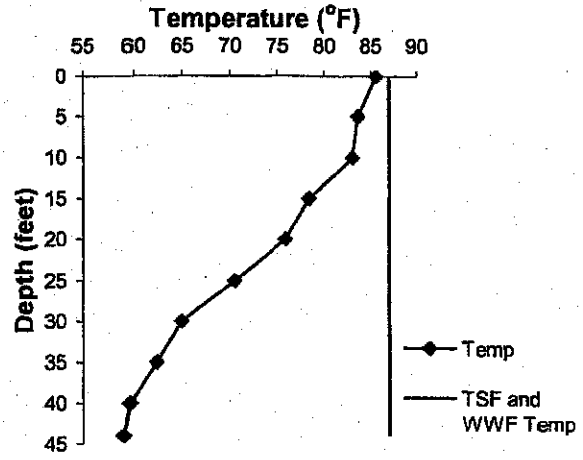
July 22, 2002

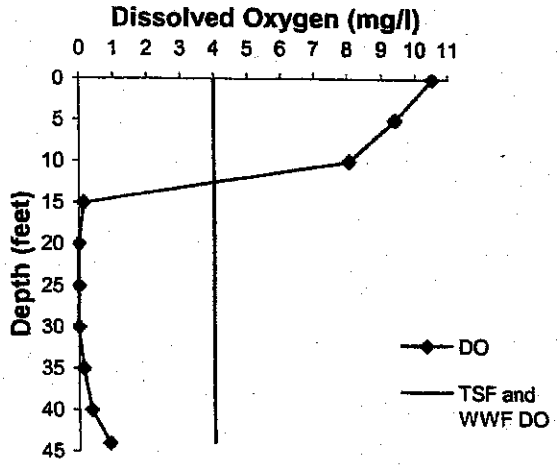


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

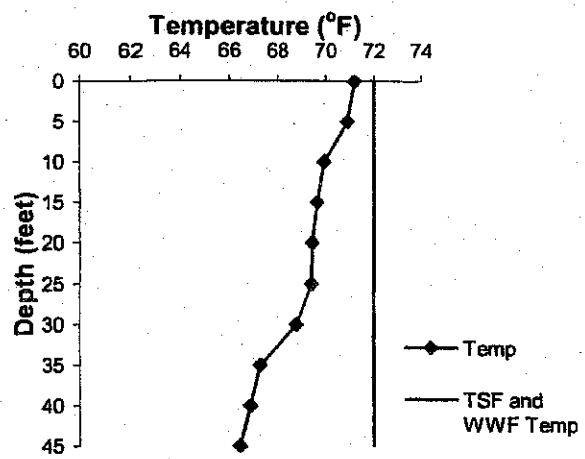
FIGURE 9.-(cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

August 19, 2002





October 1, 2002



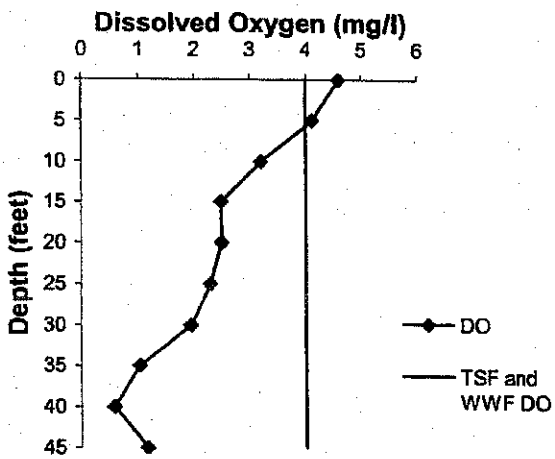


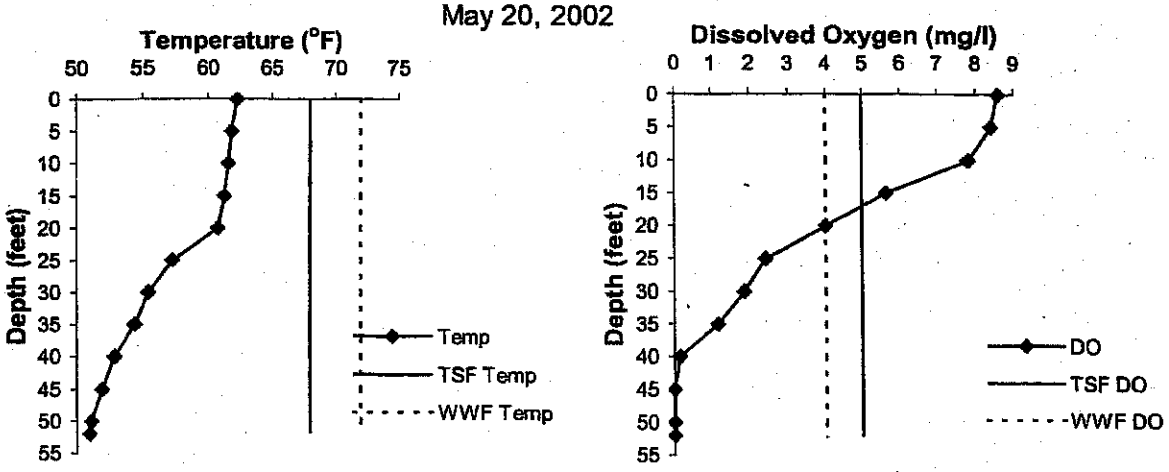
FIGURE 10.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

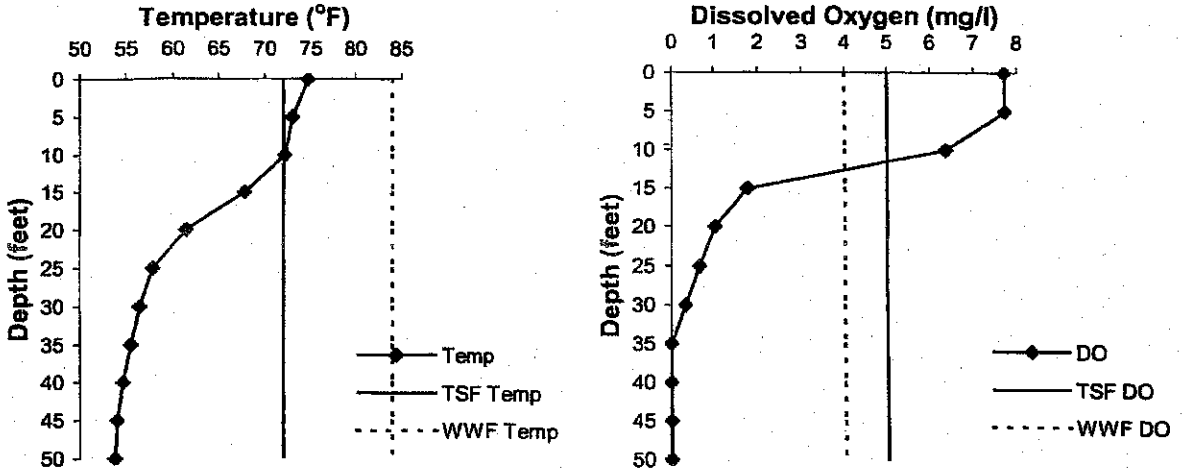
Temperature and Dissolved Oxygen Profiles - BM06

COE

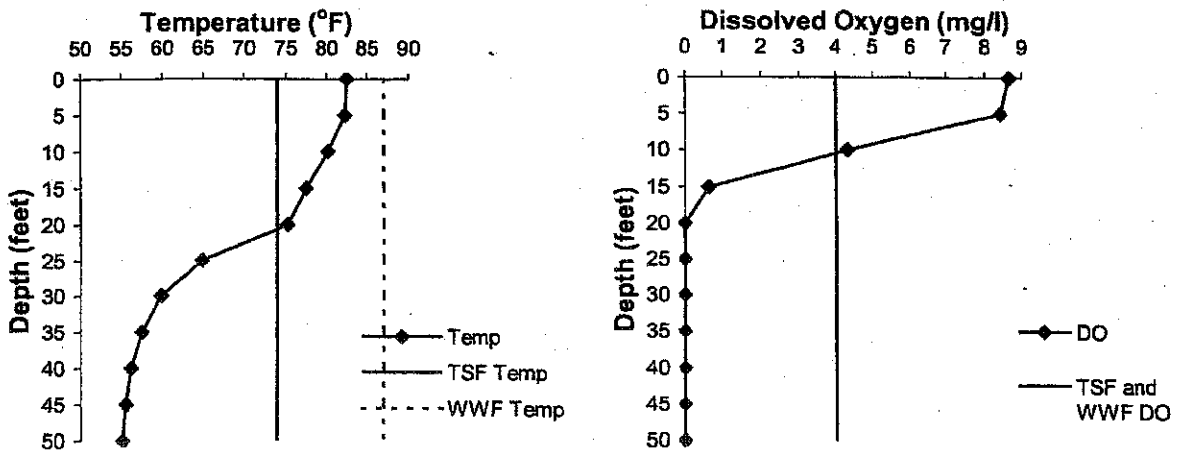
May 20, 2002



June 18, 2002



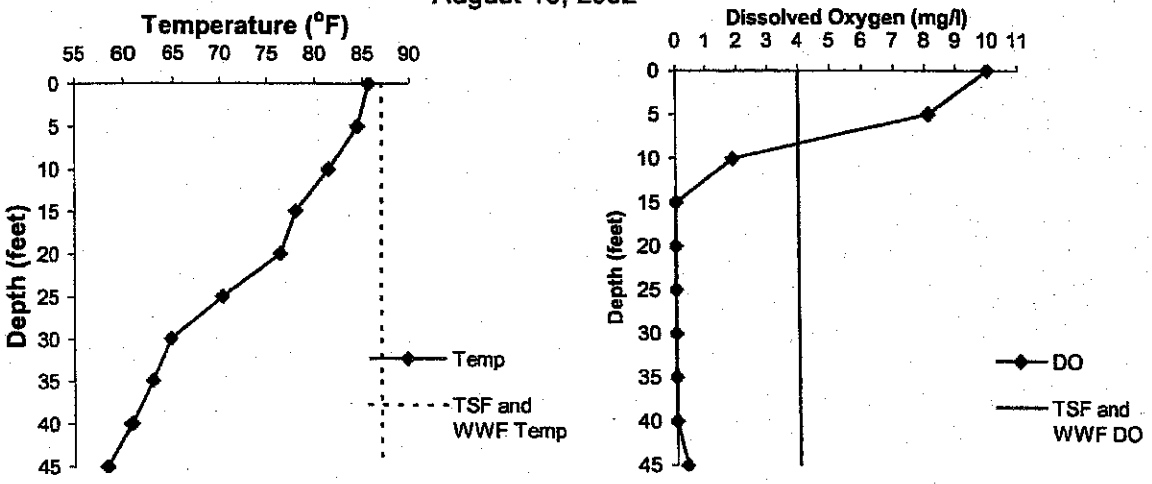
July 22, 2002



[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

FIGURE 10. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

August 19, 2002



October 1, 2002

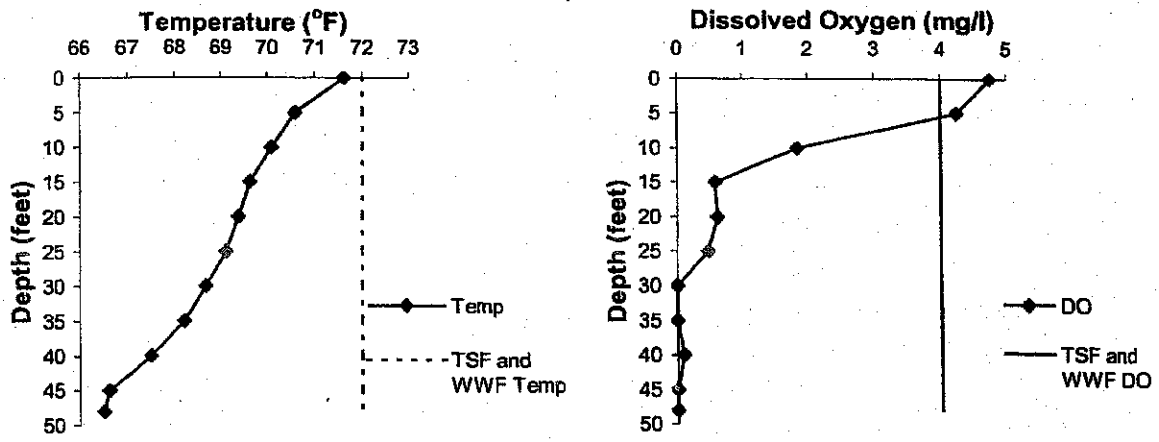


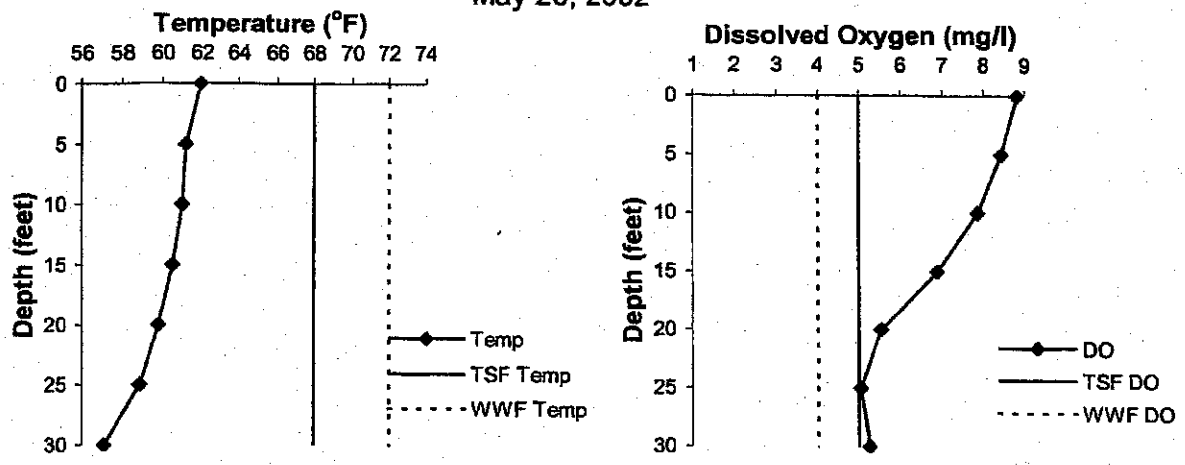
FIGURE 11.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

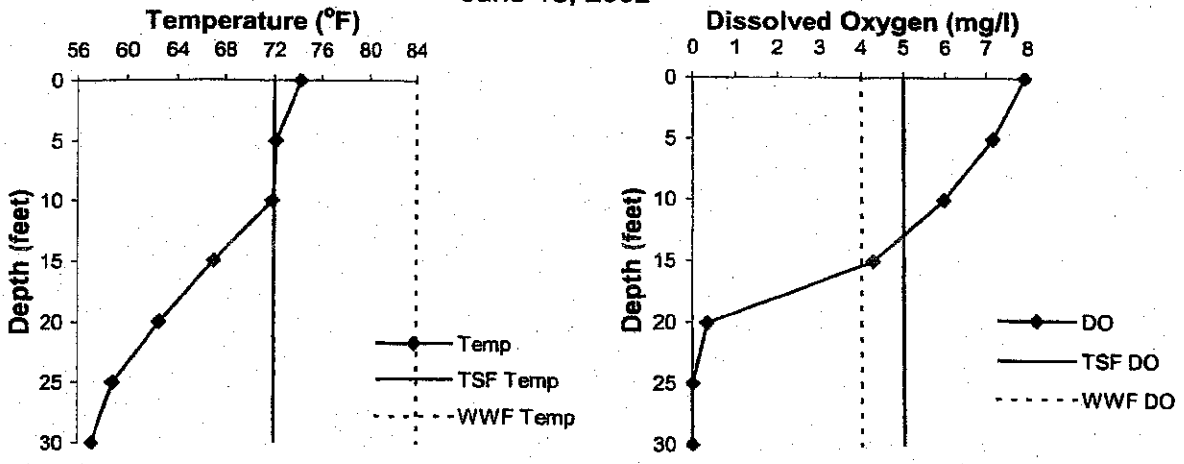
Temperature and Dissolved Oxygen Profiles - BM07

COE

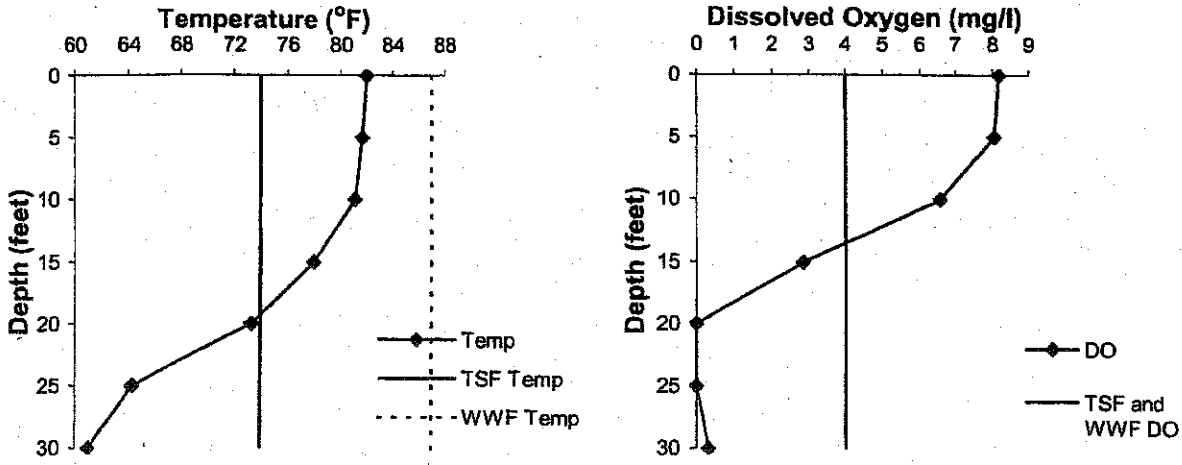
May 20, 2002



June 18, 2002



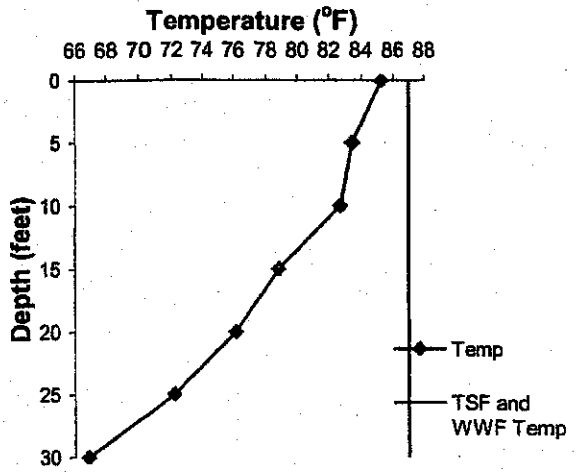
July 22, 2002

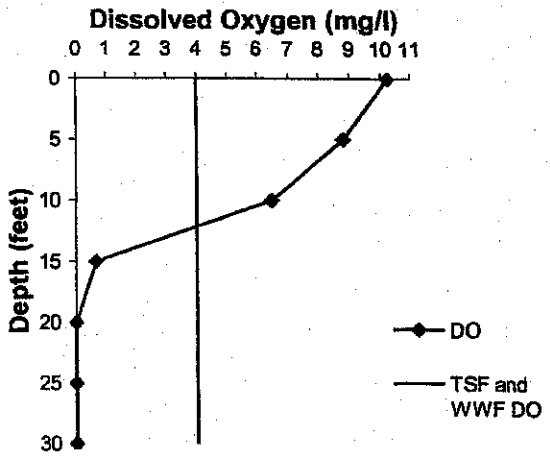


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

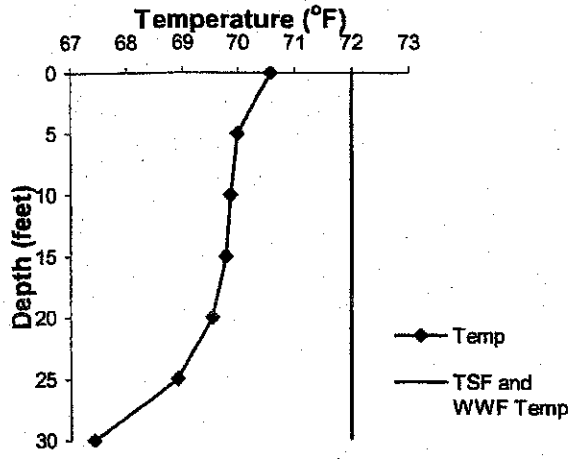
FIGURE 11. (cont.)
WATER CHEMISTRY - Temperature and Dissolved Oxygen Profiles

August 19, 2002





October 1, 2002



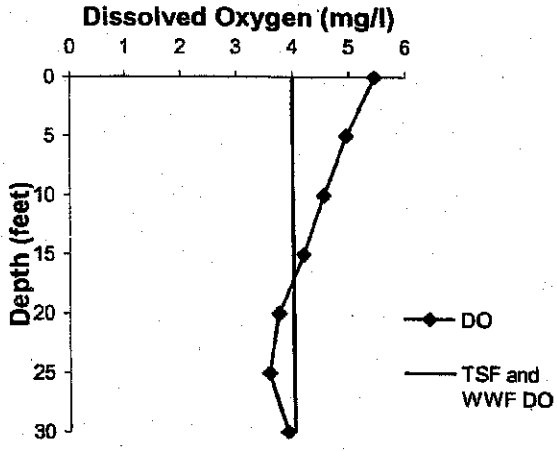


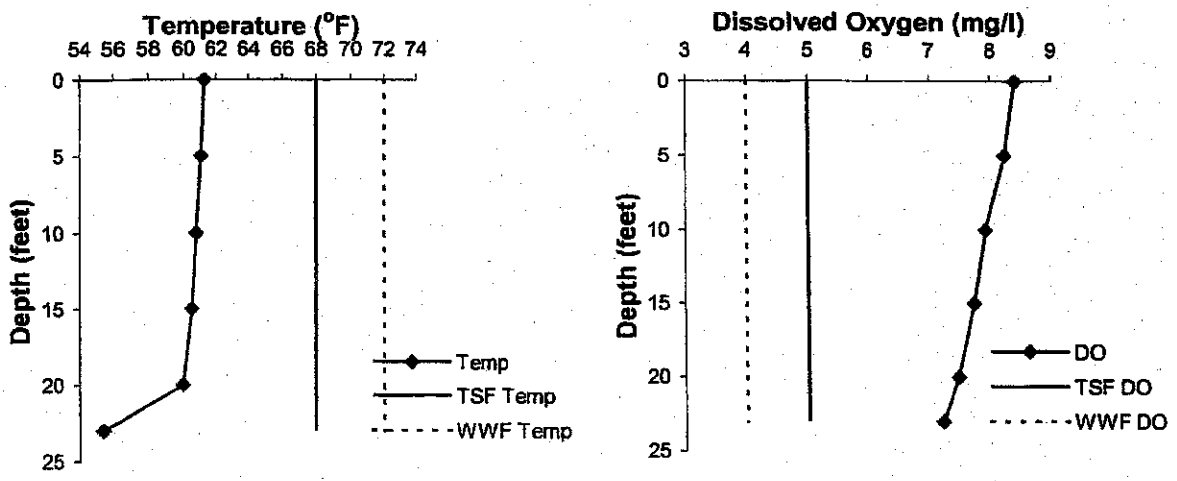
FIGURE 12.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

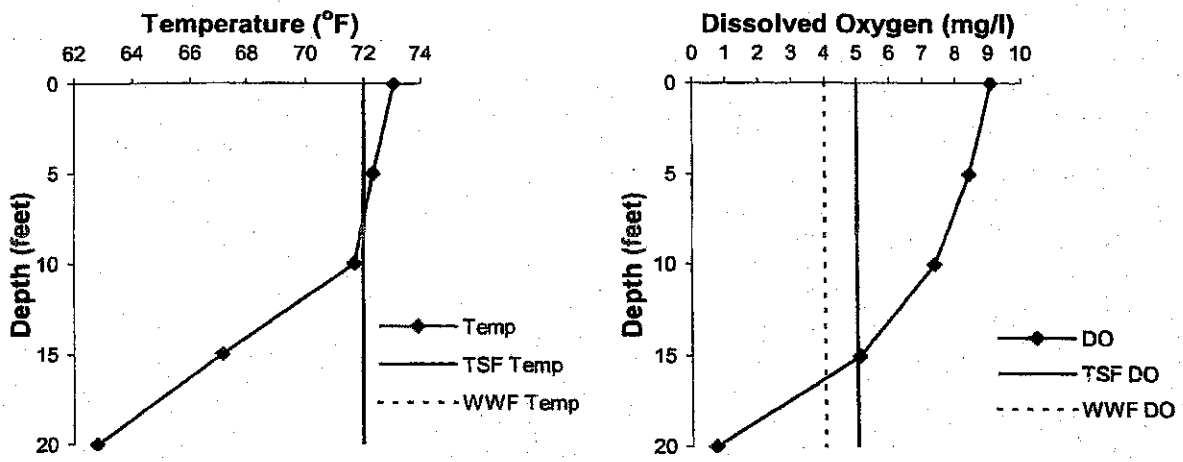
Temperature and Dissolved Oxygen Profiles - BM08

COE

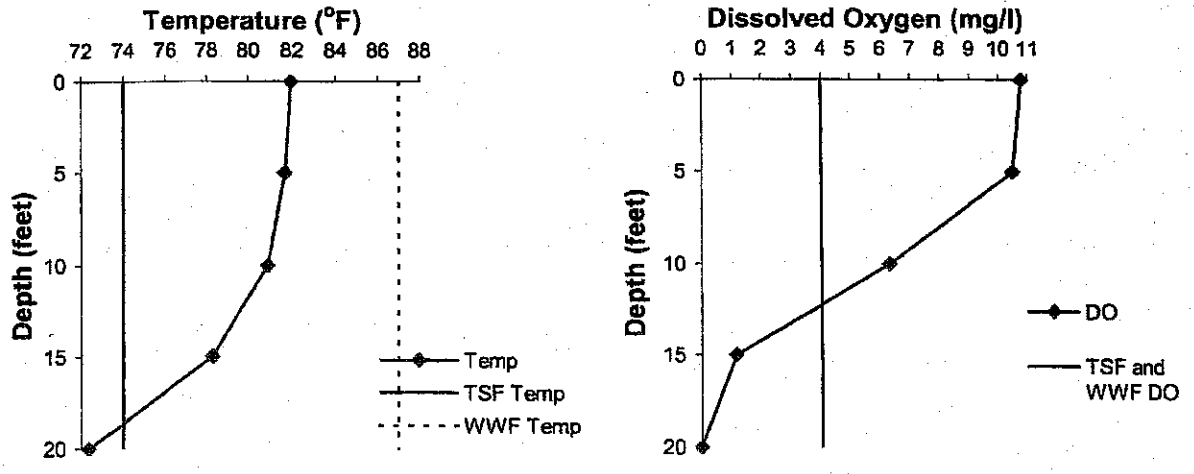
May 20, 2002



June 18, 2002



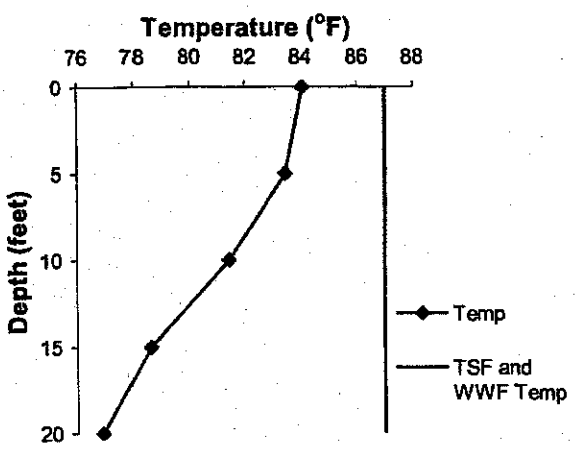
July 22, 2002

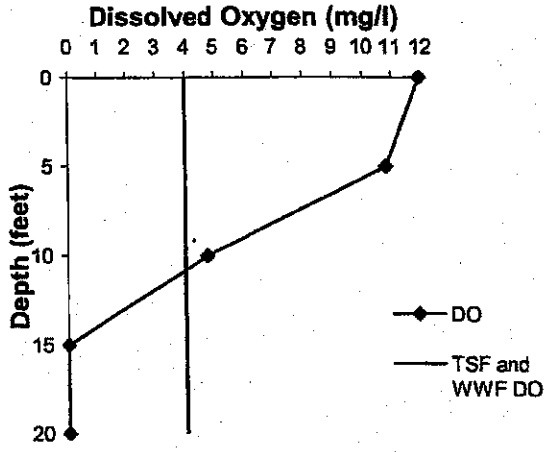


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

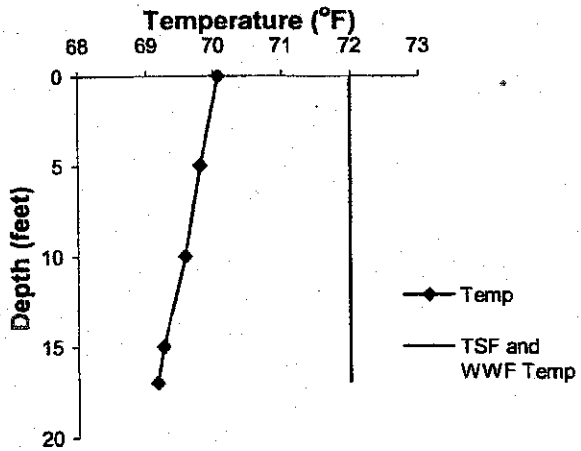
FIGURE 12. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

August 19, 2002





October 1, 2002



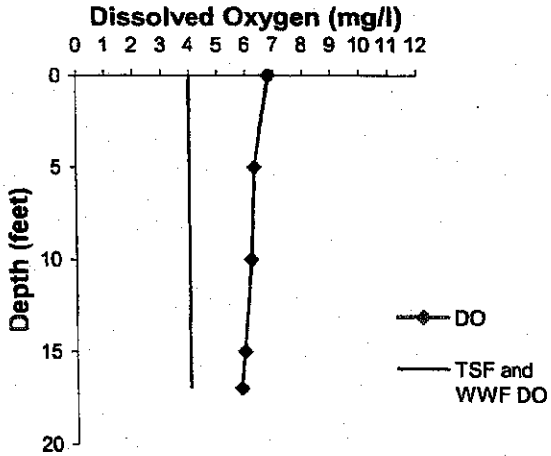
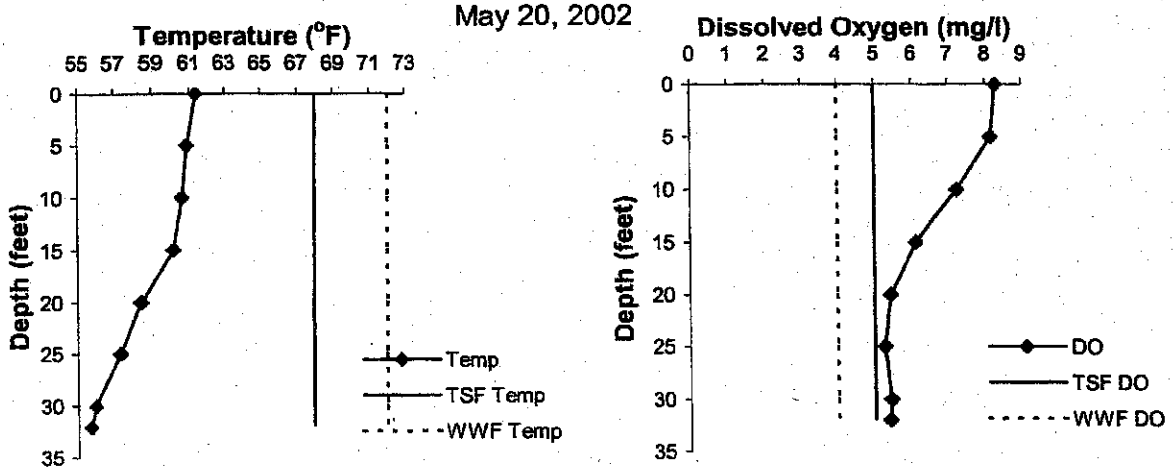
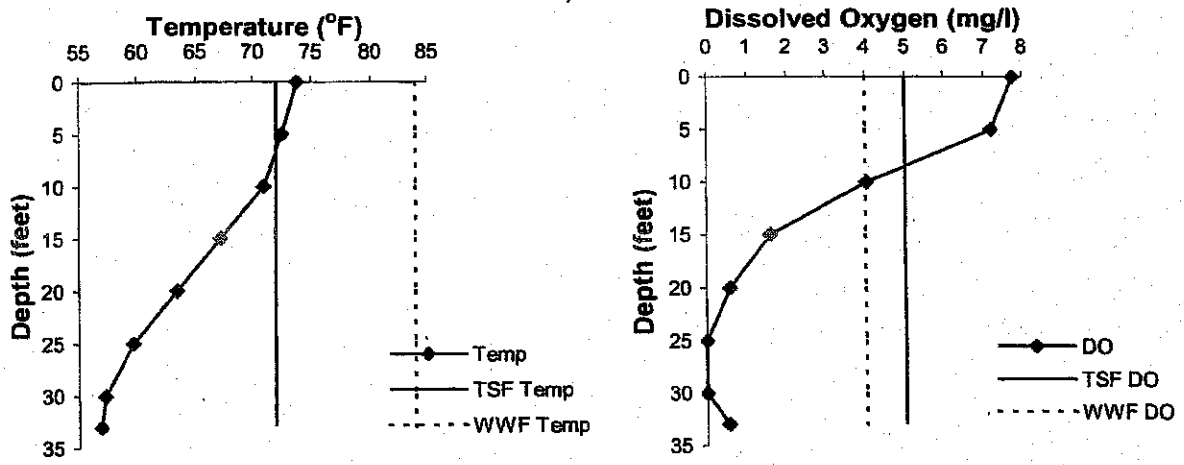


FIGURE 13.
BLUE MARSH LAKE - WATER CHEMISTRY[1]
Temperature and Dissolved Oxygen Profiles - BM09
COE

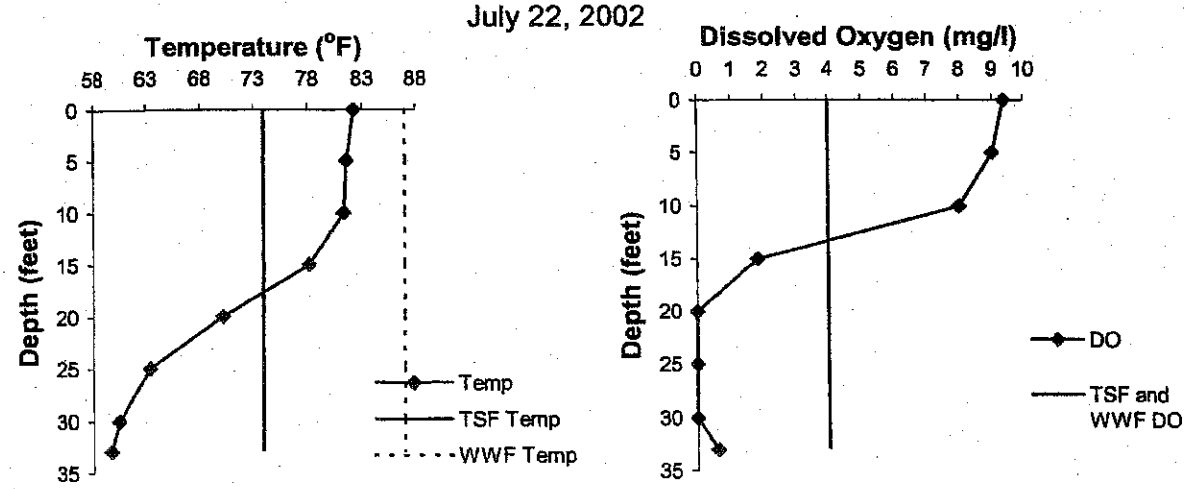
May 20, 2002



June 18, 2002



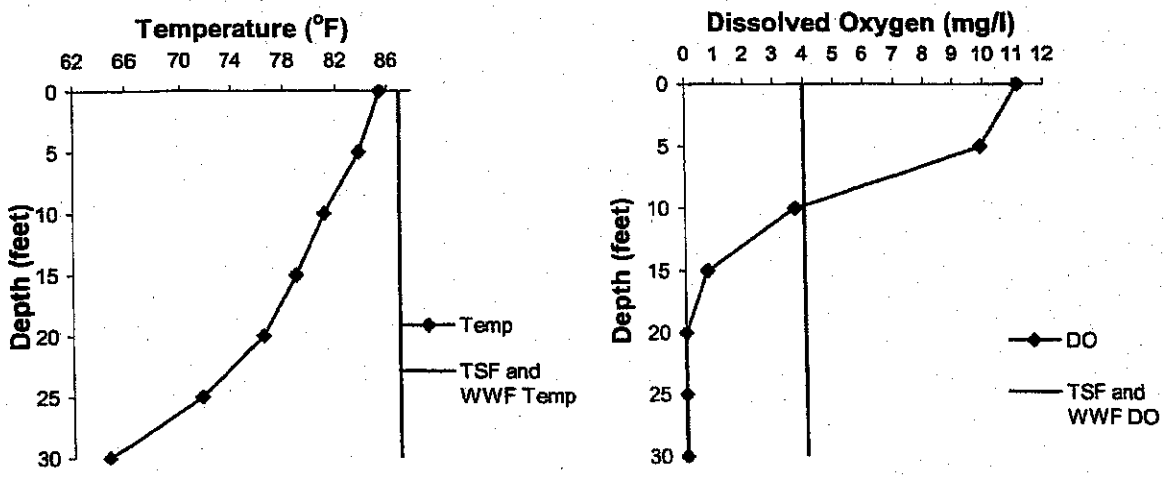
July 22, 2002



[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

FIGURE 13. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

August 19, 2002



October 1, 2002

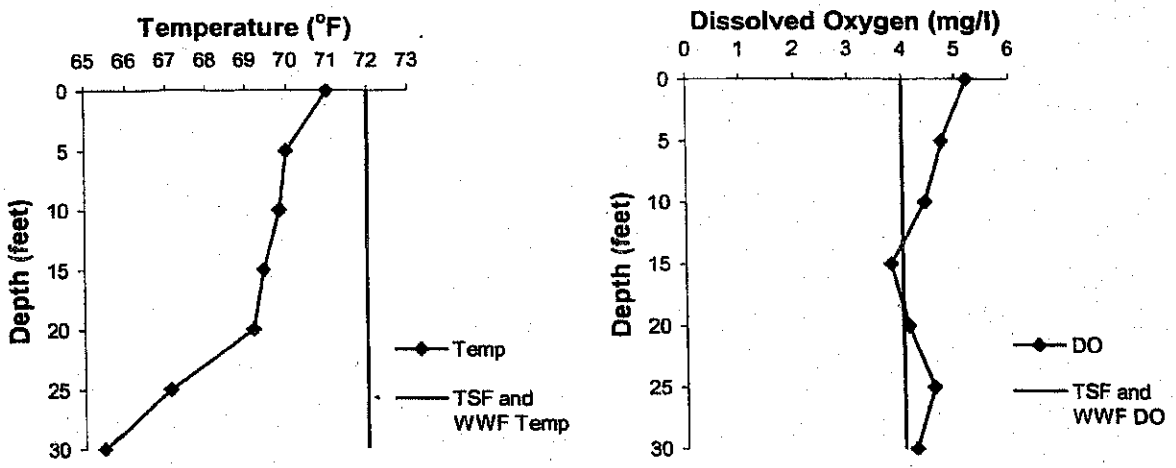


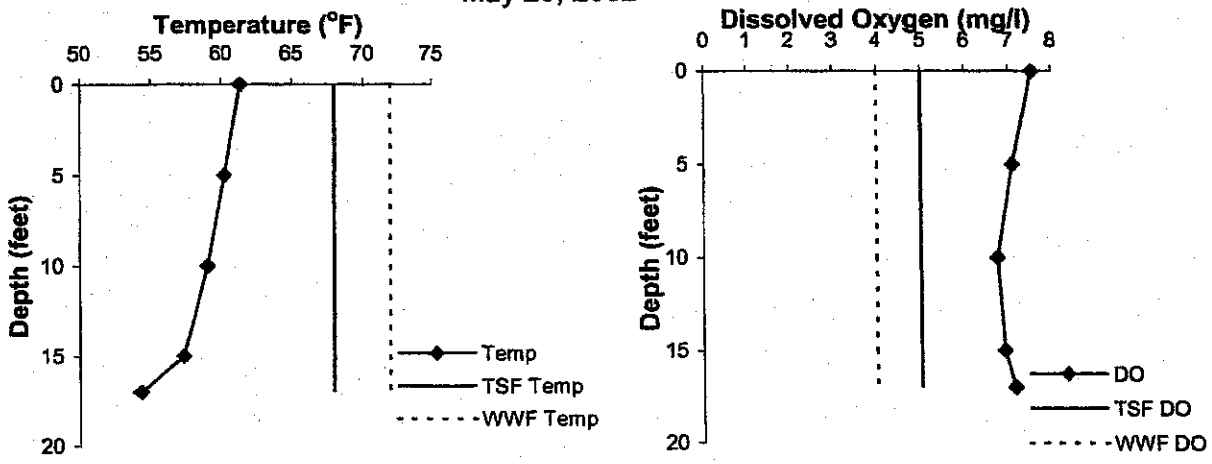
FIGURE 14.

BLUE MARSH LAKE - WATER CHEMISTRY[1]

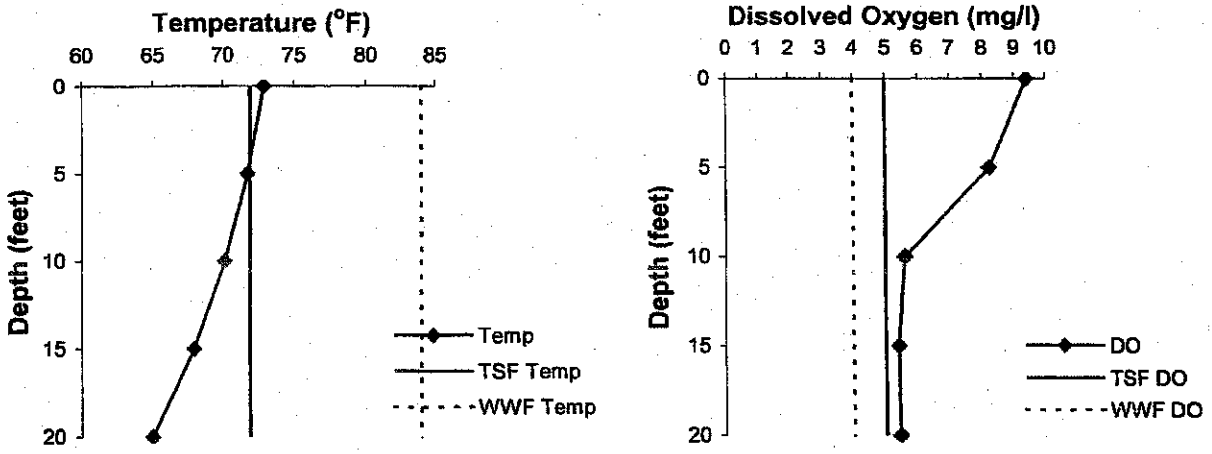
Temperature and Dissolved Oxygen Profiles - BM10

BM10 - COE

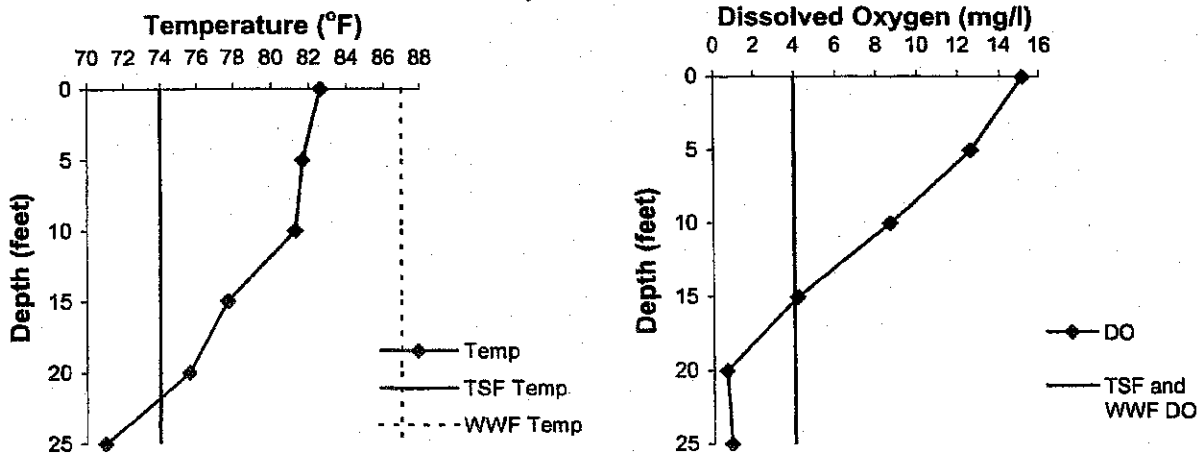
May 20, 2002



June 18, 2002



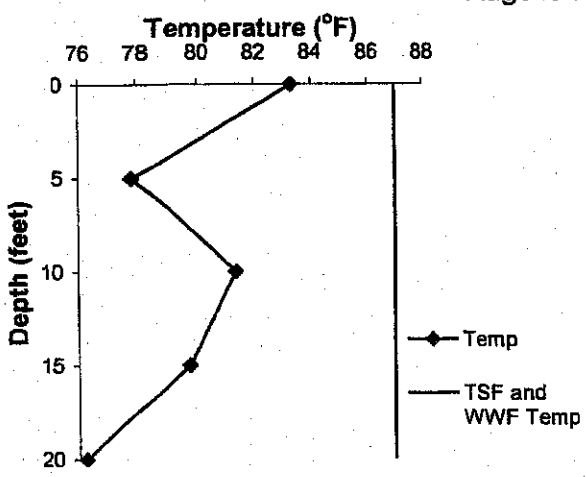
July 22, 2002

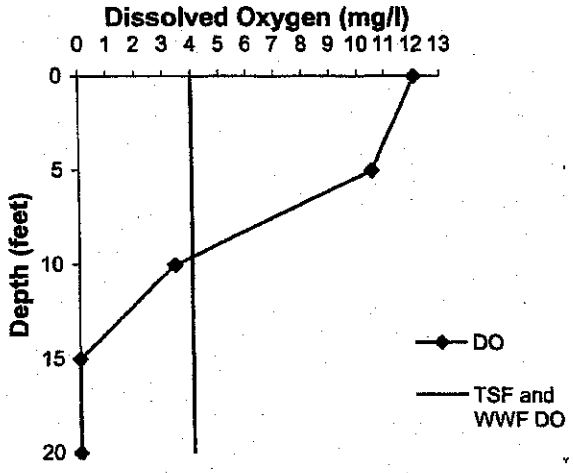


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

FIGURE 14. (cont.)
BLUE MARSH LAKE - WATER CHEMISTRY

August 19, 2002





October 1, 2002