2 Blue Springs Lake

2.1 General Background

Blue Springs Lake was impounded in 1988, and reached full pool on 18 March 1990. The main threats to the water quality of Blue Springs Lake are nutrients, bacterial contamination, herbicides / pesticides, and other contaminants related to an urban environment. An exotic aquatic plant, Eurasian Milfoil (*Myriophyllum spicatum*), is present in the lake and is a serious concern of Jackson County Parks and Recreation Department (JCPRD). An unsuccessful drawdown was attempted in 2002 to control the plant. As a follow-up, JCPRD and the Missouri Department of Conservation (MDC) conducted a test treatment in one cove during 2005. Although test results were mixed, it was concluded that Sonar would not be a cost effective treatment for milfoil in Blue Springs Lake. Aquatic vegetation control efforts are important to overall lake water quality, as this undesirable plant does serve as a nutrient sink.

2.1.1 Location

A dam located 7.4 river km (4.6 river miles) upstream on the East Fork of the Little Blue River impounds Blue Springs Lake; the dam is 46 river km (28.8 river miles) upstream of the Missouri River. The lake is located approximately 26.8 km (17 miles) east-southeast of downtown Kansas City, in Jackson County, Missouri. Historic water quality sample sites at Blue Springs Lake include 3 lake, 1 outflow, and 0 inflow sites (Figure 2.1).

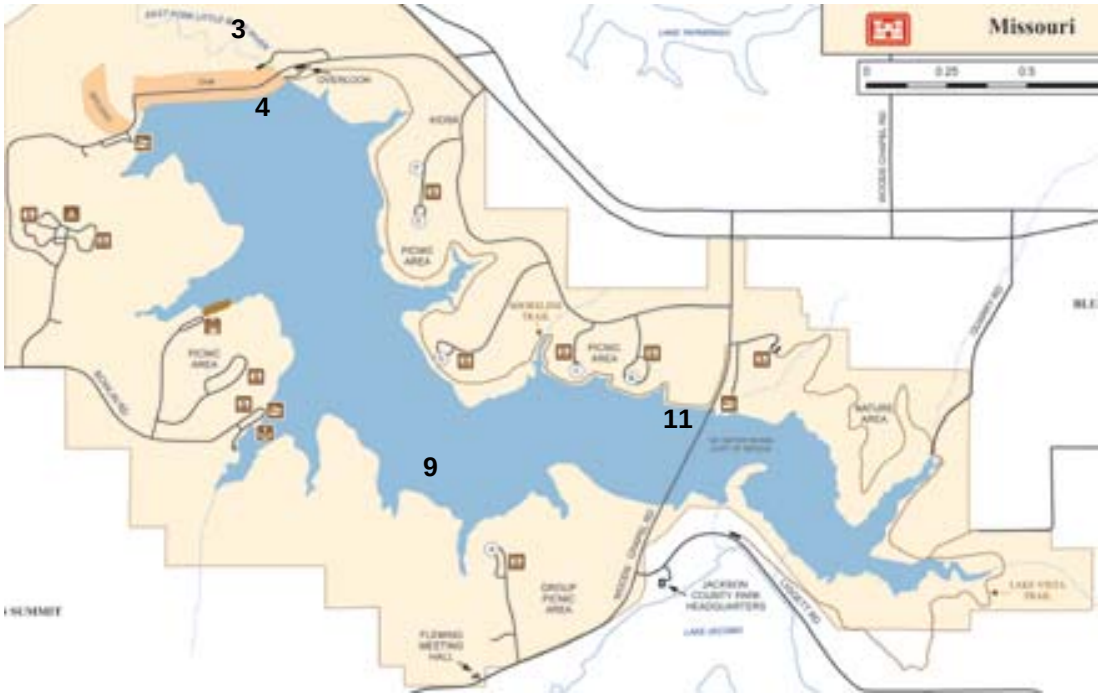

Figure 2.1. Blue Springs Lake area map with sample site locations and numbers.

2.1.2 Authorized Purposes: flood control, recreation, and fish and wildlife conservation, and water quality improvement.

2.1.3 State Use Designations: Aquatic life, human health / fish consumption, whole-body contact, boating and canoeing, and livestock & wildlife watering.

2.1.4 Lake and Watershed Data

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	820.3	15.8	982	
Multipurpose	802.0	10.8	722	12
Total		26.6		

Total watershed area: 32.8 sq. miles (20,992 A)
Watershed ratio: 21.38 flood control (FC) / 29.07 multipurpose (MP)
Average Annual Inflow: 26,135 acre-ft/yr (1990 – 2006)
Average Annual outflow: 000 acre-ft
Sediment inflow (estimated): 3 acre-ft/yr
Flushing rate: 0.41 years
Water management Plan: Approved 27 January 1994
Historic stage hydrograph: 1996 – 2006 (Figure 2.2)

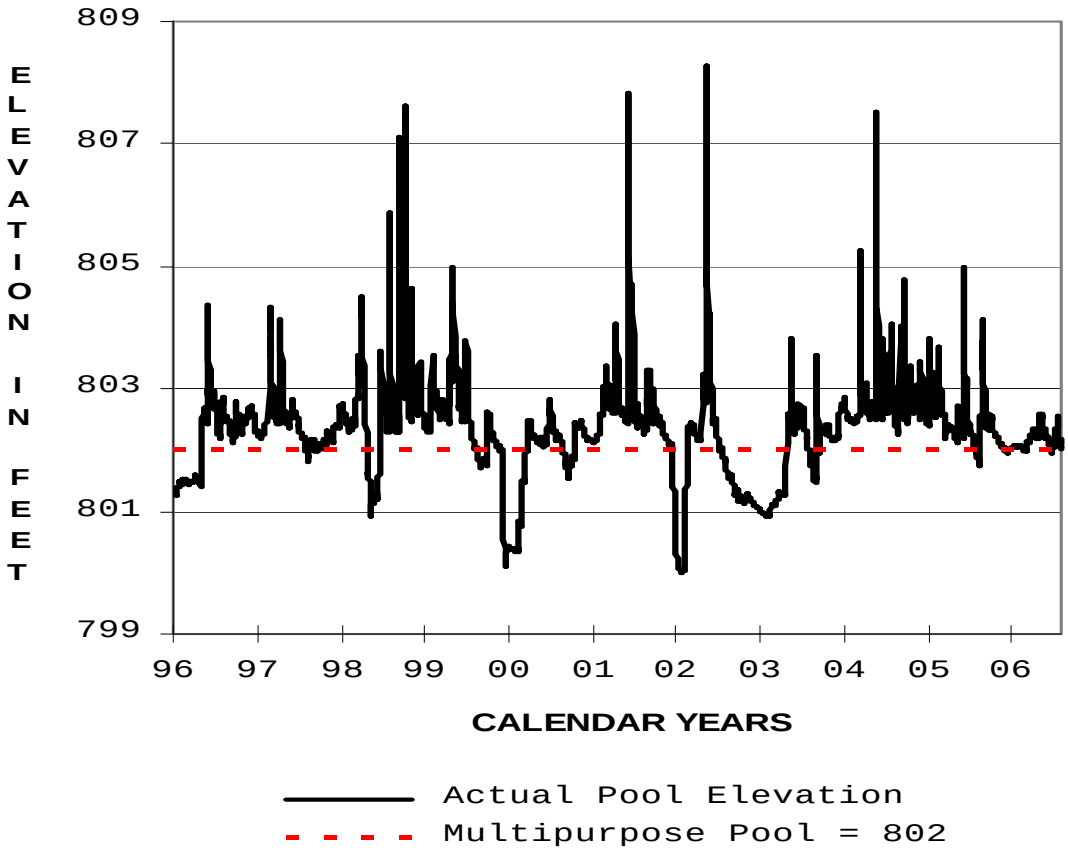

Figure 2.2. Pool elevation hydrograph from 1996 – 2006 (red dashed line is multipurpose pool elevation).

2.2 2006 Activities

Blue Springs Lake was categorized as an 'ambient' lake during 2006, thus only surface samples were collected at the three lake sites. Samples were collected from May through September. The mid-lake site (Site 9) was dropped from sampling after July because data was similar to the down-lake site (Site 4) and would be a programmatic cost savings. Todd Gemeinhardt (MO Dept. of Conservation) provided field assistance and a boat at Blue Springs Lake during 2006. Fecal bacteria (*Escherichia coli*) samples were collected weekly at the swimming beach from April through September by JCPRD.

2.3 2006 Data

Comparative historic data is limited to single samples from 1999 (June) and 2002 (July), four monthly samples during 2004 (April - July), and four months of data during 2005 (May through July and September). Samples were collected from May through September during 2006.

2.3.1 Inflow

There is no inflow sample site at Blue Springs Lake because Lake Jacomo dam is immediately above the lake.

2.3.2 Lake

Nitrogen is an essential nutrient to aquatic life. However, excessive concentrations can result in algal blooms, low DO levels, taste and odor issues in drinking water, and even fish kills. In regards to nutrients, total nitrogen (TN) concentrations from surface samples are relatively consistent between all three lake sites, with median values of samples collected between 1999 and 2005 ranging from 0.72 – 0.78 mg/L (Figure 2.3). Although all samples exceed the proposed EPA nutrient criteria value of 0.36 mg/L TN, these are some of the lowest median values within the district.

Phosphorus is another essential nutrient for aquatic life, and it limits algal growth. Total phosphorus (TP) concentrations are low compared to the other district lakes, with median values ranging from 0.04 – 0.06 mg/L (Figure 2.4). All values exceed EPA's proposed nutrient criteria value of 0.02 mg/L. However, the exotic milfoil most likely serves as a nutrient sink for phosphorus within the lake. A high flushing rate and presence of aquatic vegetation likely result in lower TP concentrations – even in an urban watershed.

The ratio of TN:TP can be used as a surrogate to determine the dominant algal community within a waterbody. Ratios $\geq$ 20:1 are indicative of desirable algal communities, whereas ratios $\leq$ 12:1 are indicative of bloom-forming cyanobacteria (blue green algae). As would be expected, there is high monthly and annual variability in the TN:TP ratio at all sites; see Figure 2.5 as an example from Site 4. Median TN:TP ratios

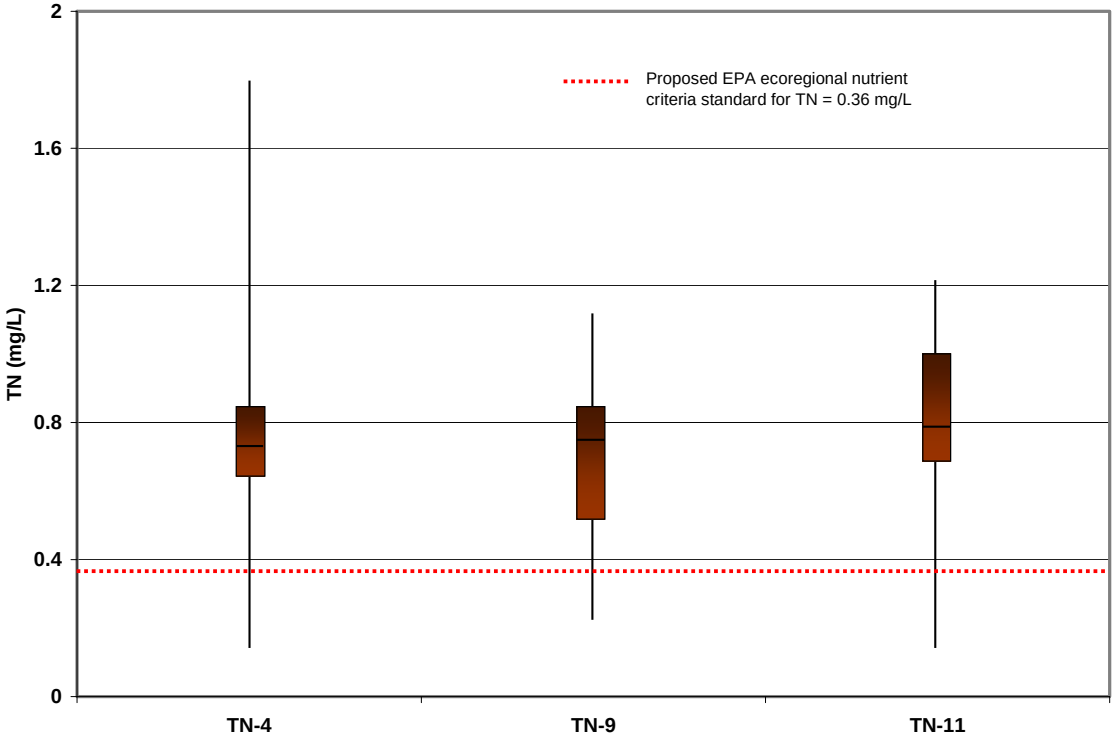

Figure 2.3. Box plots of surface water sample total nitrogen concentrations measured at lake sites from 1999 through 2006 at Blue Springs Lake.

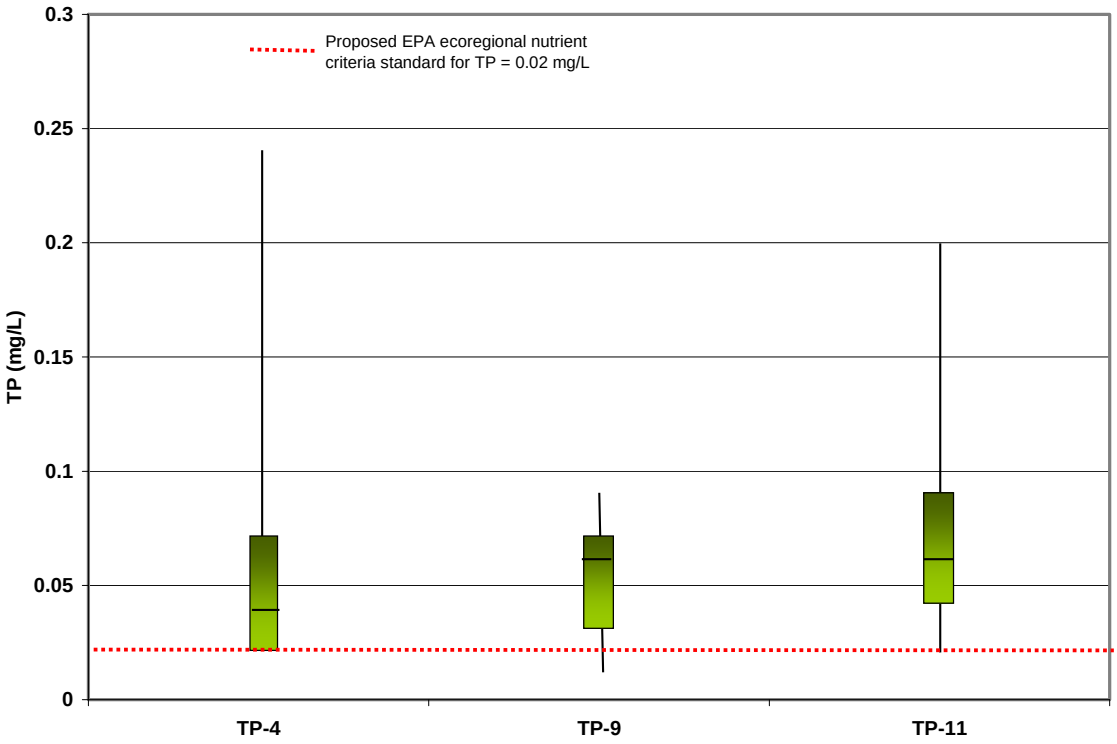

Figure 2.4. Box plots of surface water sample total phosphorus concentrations measured at lake sites from 1999 through 2006 at Blue Springs Lake.

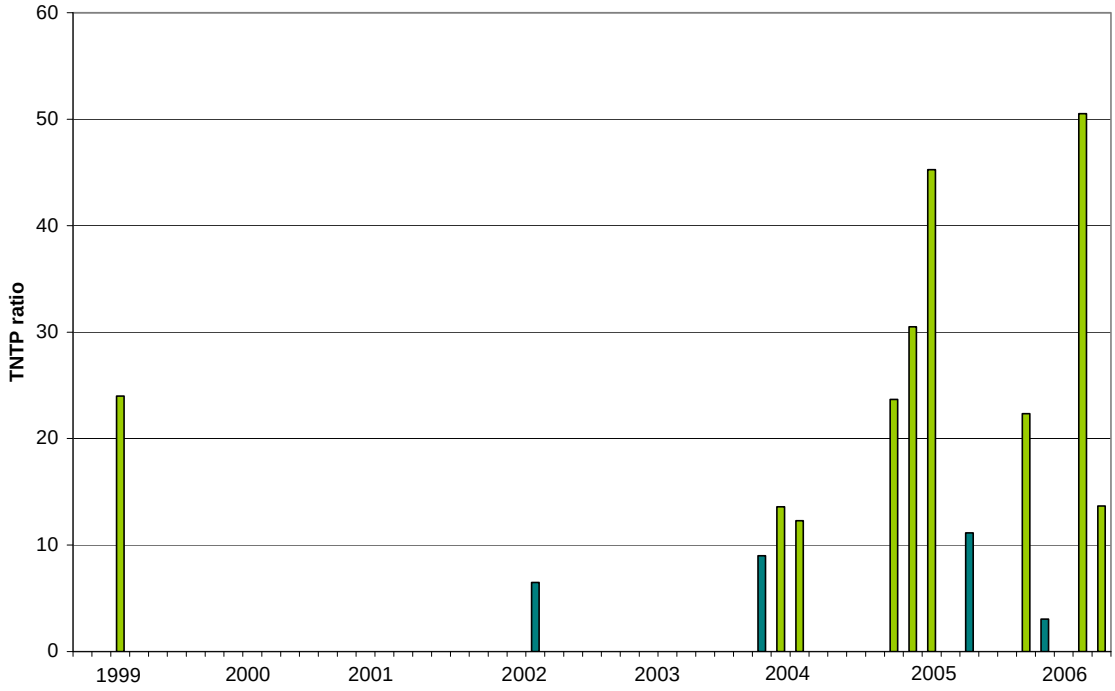

Figure 2.5. Graph of total nitrogen : total phosphorous (TN : TP) ratio by sample date at Site 4 from 1999 through 2006 at Blue Springs Lake.

from the upper lake sites were slightly greater than 12, indicating the lake could potentially be at risk for cyanobacteria blooms.

Relative concentrations of phycocyanins, or bluegreen algae, were measured vertically throughout the water column during each monthly sample trip. Such profiles provided information on monthly as well as within lake distribution changes. Figure 2.6 depicts vertical distribution of phycocyanins measured at Site 4 (Tower) from May through September. Concentrations increased gradually from May into June, but expanded greatly during July and September.

Chlorophyll *a* samples were collected at Sites 4 and 11 during July and August 2006. Mean chlorophyll a values by sample date ranged from 34.18 – 47.5 ug/L, which is indicative of eutrophic waters. Box plots of chlorophyll *a* indicate similar median values between sites (Figure 2.7), although values are variable between months. Mean TSI values averaged 62.4 for both Sites 4 and 11, which further classifies Blue Springs Lake as eutrophic.

Secchi depths indicated relatively good water clarity during May and June at Site 4, but measurements were less than historic summer means during both July and August (Figure 2.8). This was most likely the result of increased algal production, as was measured by both chlorophyll and relative bluegreen algal concentrations (Figure 2.6). As expected, secchi depths were consistently lower at the shallow upper site in comparison to the dam site (Figure 2.8).

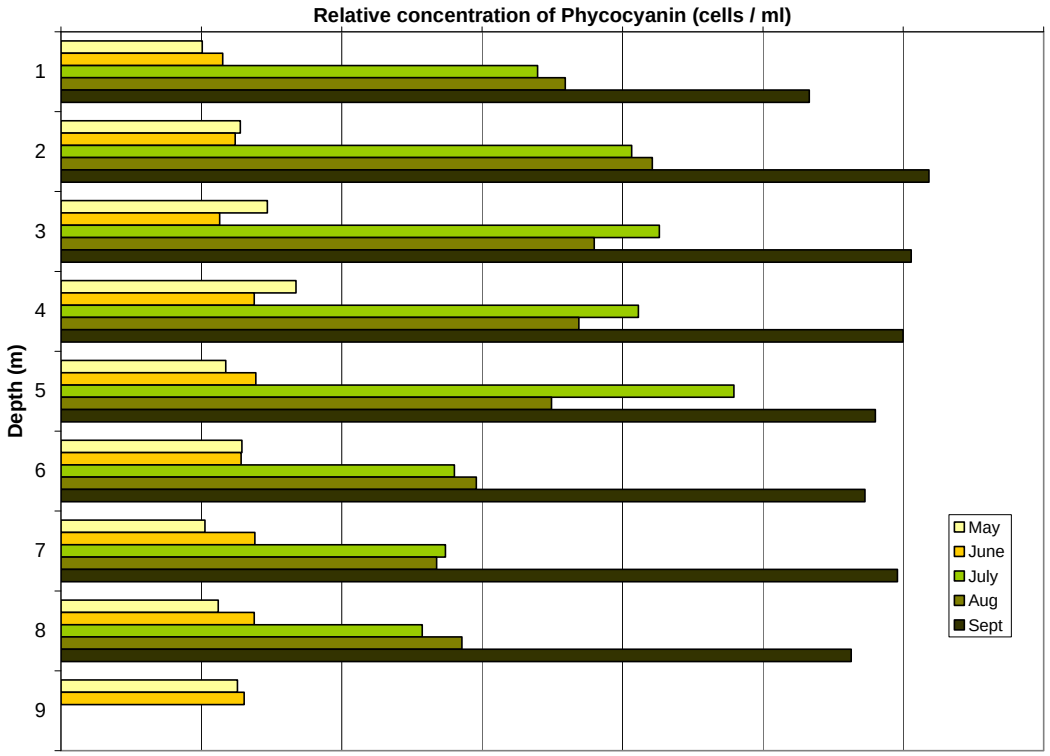

Figure 2.6. Plot of relative phycocyanin (bluegreen algae) concentrations (cells / ml) measured by depth and month at Blue Springs Lake Site 4 during 2006.

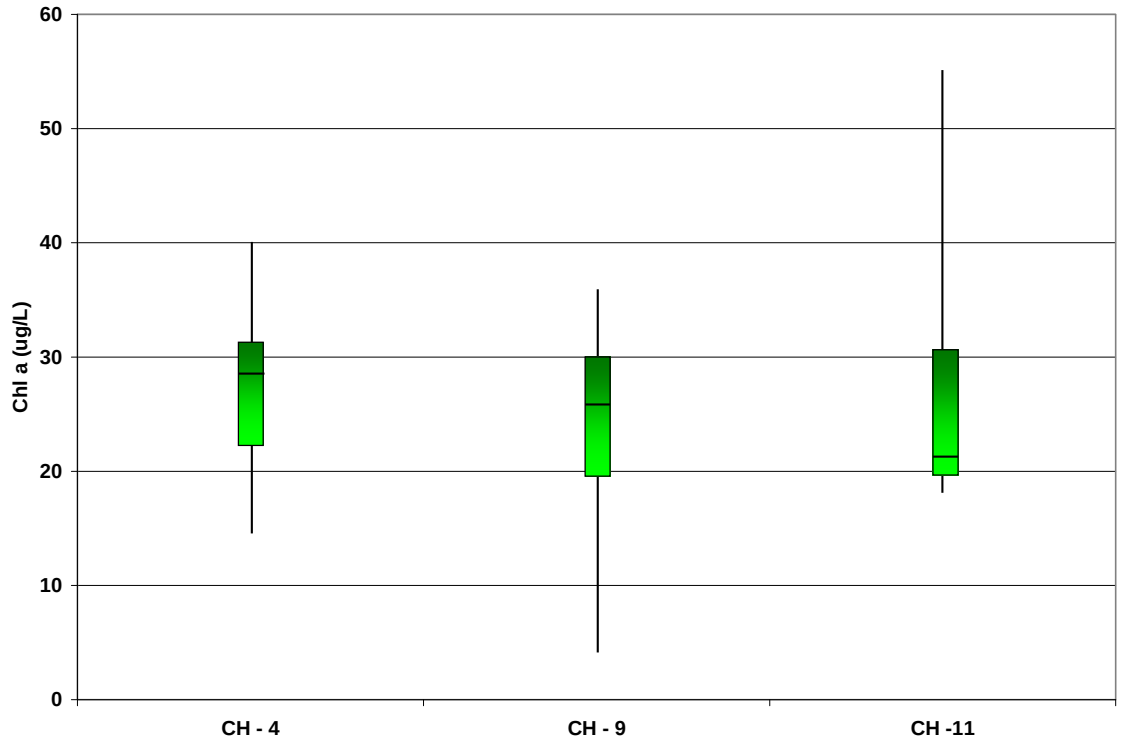

Figure 2.7. Box plots of chlorophyll a concentrations measured at lake sites from 1999 through 2006 at Blue Springs Lake.

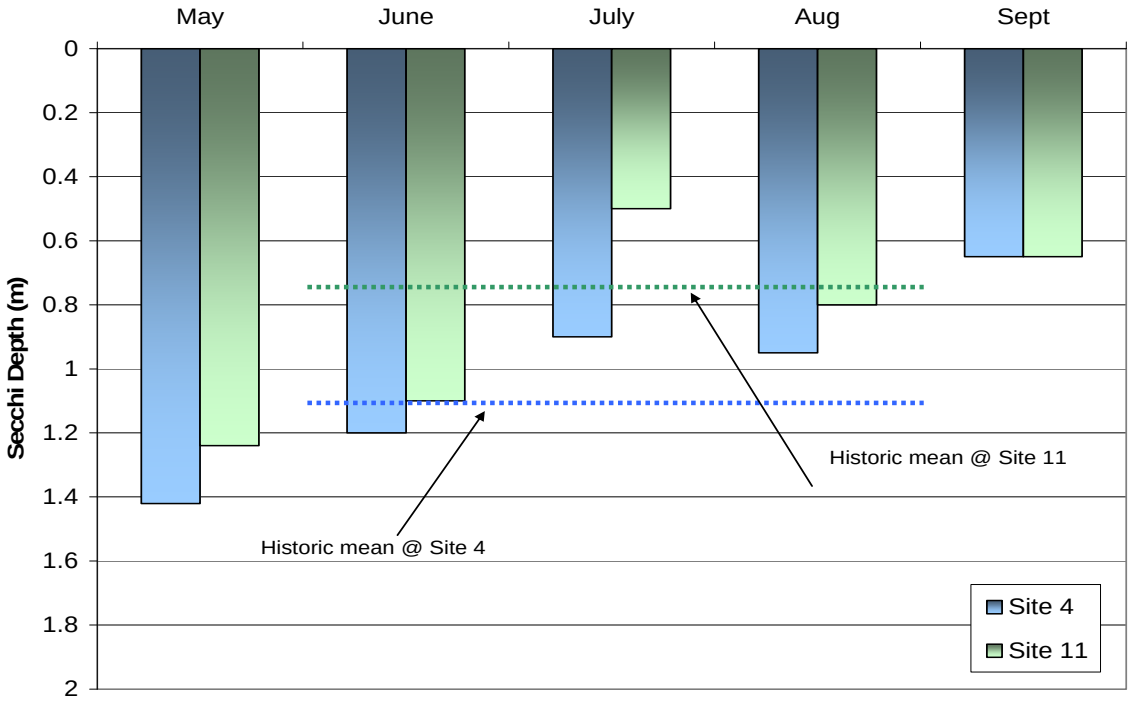

Figure 2.8. Plots of secchi depth measurements by site and sample date during 2006. Dotted lines represent historic mean values by site.

Vertical profiles were recorded during the monthly (May through September) sampling trips. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Typical of smaller, eutrophic reservoirs in Missouri, the lake was stratified both thermally as well as chemically between 4 – 5 m during July (Figure 2.9). The depth of stratification was 1 – 2 m deeper in 2006 than 2005, while the strength of stratification was not as significant or as prolonged as during 2005.

Only August fecal bacteria data was available from beach monitoring during 2006. This composite sample indicated an E coli concentration < 10 colonies / 100 ml sample.

2.3.3 Outflow

No outflow samples were collected from Blue Springs Lake during 2006.

2.4 Future Activities and Recommendations

Sampling activities for 2007 will include transition to monthly 'intensive' monitoring from April through September, as well as conducting monthly vertical profiles at both lake sites. Bacteria sampling at the beach will continue on a weekly basis during the summer by JCPRD. Due to elevated phycocyanin concentrations measured during 2006, this lake will be monitored for the cyanotoxin microcystin during August and September. Geosmin, associated with taste and odor issues in drinking water, will be examined from samples collected near the tower from July through September. Caffeine will be measured at several sites around the lake as a surrogate for human impacts resulting from failing septic systems, WWTP's, illicit dumping from boats, etc. A contaminant group of interest is polyaromatic hydrocarbons (PAHs). These compounds are

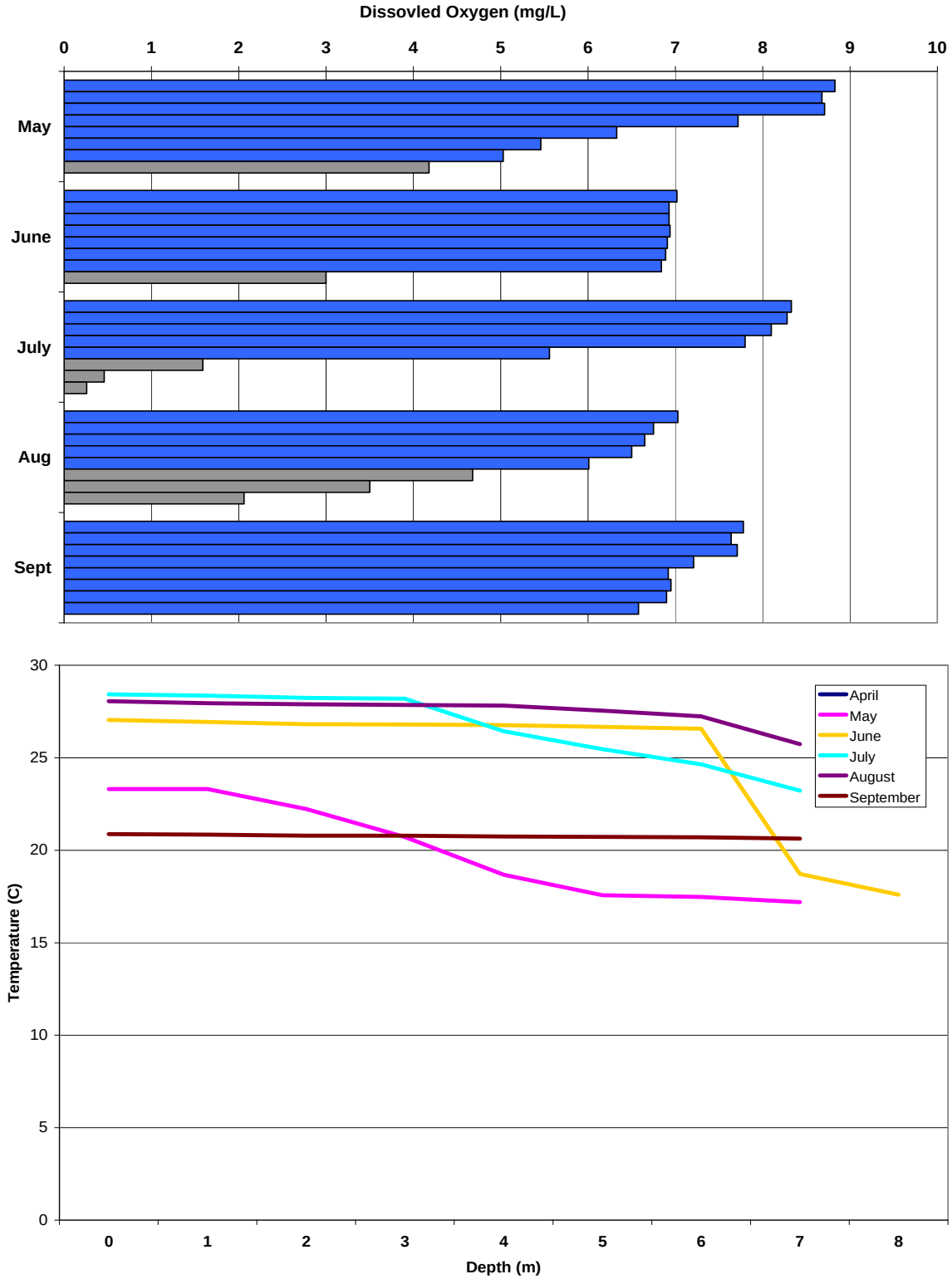

Figure 2.9. Dissolved oxygen concentration (mg/L) histogram and temperature (C) plots from vertical profiles recorded at Site 4 during May through September, 2006 at Blue Springs Lake.

components of asphalt, fuels, oils, and greases. They enter receiving waters from stormwater runoff, industrial and wastewater treatment discharges, and through atmospheric deposition. They do not dissolve, but attach to particulate material and eventually settle out to the substrate. These compounds are highly toxic to aquatic biota, and thus baseline data is desired to track within district lakes. This is a high priority item when future funding becomes available.