5 Harry S Truman Lake

5.1 General Background

Harry S Truman Lake was impounded in October 1979 and reached full pool on 29 November 1979. The primary water quality threats to Truman Lake are sediment, nutrients, bacterial contamination, dissolved oxygen, and herbicides. Currently the lake is listed on the MDNR's 2002 303d list due to elevated concentrations of manganese. As a result a TMDL must be written to deal with the contaminant (MDNR 2002); this is a low priority TMDL for MDNR. Water quality and water quantity issues exist within the upper watershed. Upper watershed issues are beginning to receive some attention as a result of the formation of the Marais des Cygnes, Marmaton, and Little Osage river watershed management plan committee during 2005. There are five Corps lakes (Melvern, Pomona, Hillsdale, Stockton and Pomme de Terre) within the Truman Lake watershed, and when combined, all six lakes comprise 52% of the total surface acres within the district (103,180 A). There are 6 power generation turbines within the Truman Dam, and operation of the turbines historically has been a point of concern in regards to fish mortality (pump-back operation) and water quality standards (i.e., gas supersaturation and dissolved oxygen concentration).

5.1.1 Location

Truman Dam is located on the Osage River 280.2 km (175.1 miles) upstream of the confluence with the Missouri River. The Truman Dam powerhouse is located approximately 2.4 km (1.5 mile) northwest of Warsaw, Missouri. The watershed comprises 15 counties in Missouri and 10 counties in Kansas. Historic water quality sampling sites at Truman Lake include 9 lake, 1 outflow, and 7 inflow sites (Figure 5.1).

5.1.2 Authorized Purposes:

Authorized Purposes: flood control, hydroelectric power production, fish and wildlife conservation, and recreation.

5.1.3 Lake and Watershed Data

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	739.6	4,005.4	209,048	
Multipurpose	706.0	1,181.6	55,406	958
Total		5,187.0		

Total watershed area: 11,500 sq miles (total upstream watershed)
8,914 sq miles (total local drainage below upstream dams; 5,704,960 A)

Watershed ratio: 27.29 FC / 102.97 MP
Average Annual Inflow: 7,315,389 acre-ft/yr (1982 – 2006)
Sediment inflow (measured): 22,321 acre-feet (1979 – 1992)
Flushing rate: 0.16 years
Water management Plan: Approved 12 May 1981; minor revision April 1996
Historic stage hydrograph: 1995 – 2005 (Figure 5.2)

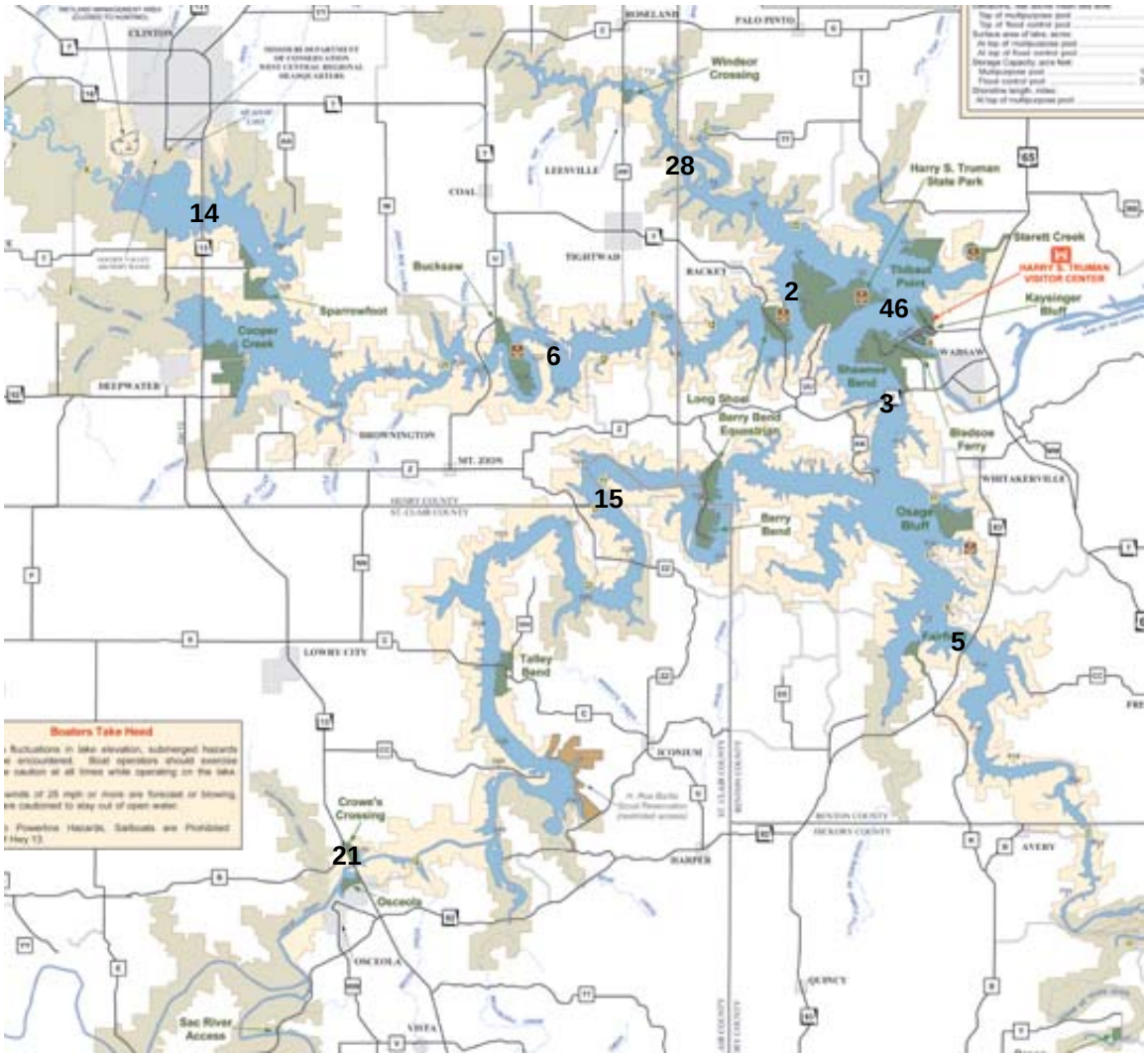

Figure 5.1. Harry S. Truman Lake area map with sample site locations and site numbers.

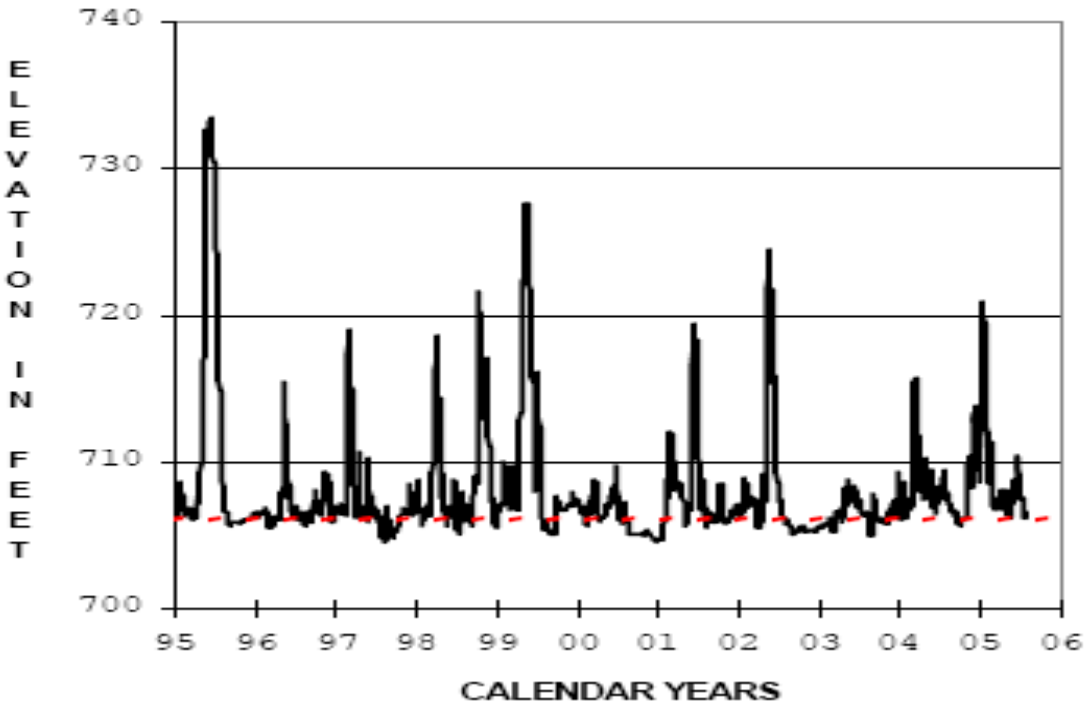

Figure 5.2. Pool elevation hydrograph from 1995 - 2005

5.2 2006 Activities

Harry S. Truman lake was categorized as an 'ambient' lake during 2006, thus only surface water quality samples were collected at the nine lake sites (see Figure 5.1). In addition, surface water samples were collected downstream of the lake approximately 600 m downstream of the powerhouse. Samples were collected and vertical profiles were recorded monthly from May through September. The Marais des Cygnes, Marmaton, and Little Osage river watershed committee completed a watershed management plan during late 2006. The committee is headed by Don Schuster (NRCS) and consists of representatives from MDNR, MDC, EPA, and several counties. This group joined with the Marais Des Cygnes Basin Advisory Committee and submitted a grant proposal to EPA for a Targeted Watershed grant in an effort to coordinate water quality and quantity issues between Kansas and Missouri. The NWK's Water Quality Program has been involved on the periphery to this point, providing input on water quality issues. In addition, the NWK Planning Section proposal -- *Water Resources Analysis Plan for the Upper Osage River Watershed of Kansas and Missouri* – was not selected to receive funding of HQ's "Comprehensive Analyses of Multi-Jurisdictional Use and Management of Water Resources on a Watershed or Regional Scale" grant program. Presentations on Truman Lake water quality were provided at meetings held by the Lake of the Ozarks Watershed Alliance in Camdenton and Warsaw during October 2006.

Truman Lake staff (OF-HST) providing field assistance during 2006 included: Rich Abdoler, Larry Smith, Erin Cordrey, Jason Hurley and Melissa Herheim. Bob Marchi, OF-HST Operations Manager, provided insight and background on the lake resources.

5.3 2006 Data

Comparative historic data includes single samples collected during 1999 (August), 2001 (May), 2002 (July), and monthly (May – September) sampling during 2005. Samples were collected from May through September during 2006.

5.3.1 Inflow

No inflow data was collected from Truman Lake during 2006.

5.3.2 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. Longitudinal differences in median total nitrogen (TN) concentrations (0.5 – 1.4 mg/L) were observed between sample sites from data collected between 1996 and 2006 (Figure 5.3). Highest median concentrations were measured from samples collected at the Highway 65 bridge sites on both the South Grand (#14) and Upper Osage (#21) river arms, while the lowest median concentration is from the Tebo Creek branch site (#28). It should be noted that all median values exceed EPA's proposed ecoregional nutrient criteria for TN (0.46 mg/L). The median TN concentration at Site 14 (South Grand River) is one of the highest within the district.

Phosphorus is another essential nutrient for aquatic life, and it limits algal growth. Similar to TN, longitudinal differences in median total phosphorus (TP) concentrations

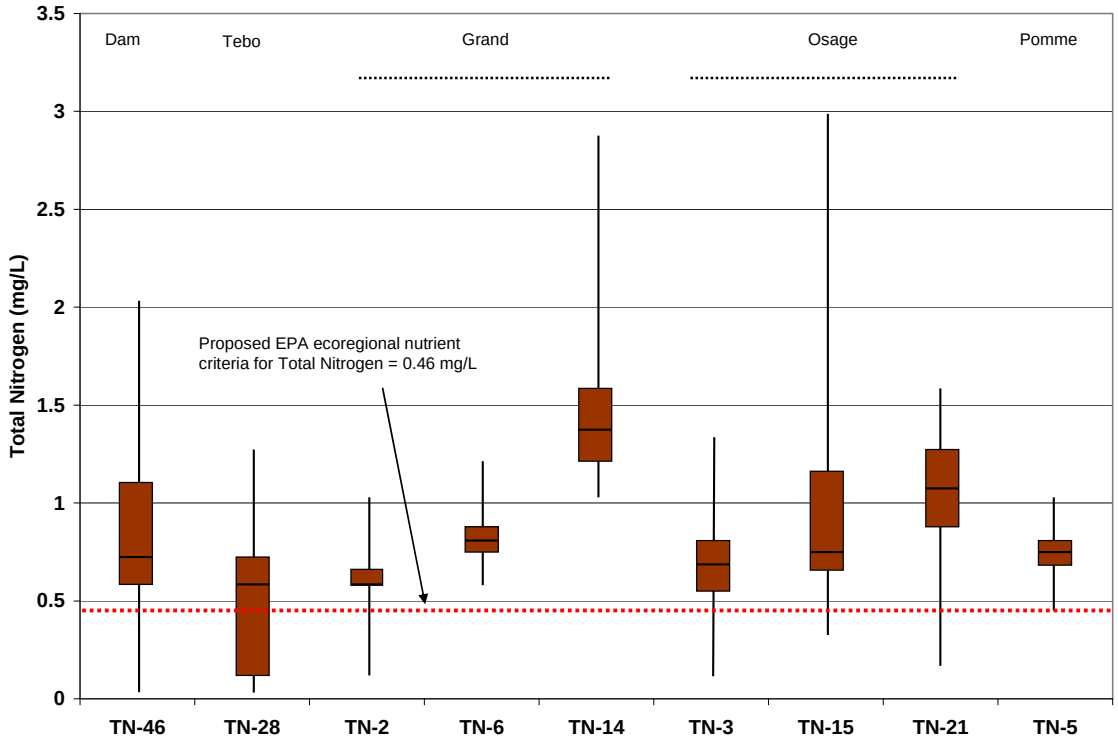

Figure 5.3. Box plots of surface water sample total nitrogen concentrations measured by site during 1999, 2002, and 2005 - 2006 at Harry S. Truman Lake.

(0.04 – 0.19 mg/L) were detected between sample sites at Truman Lake for data collected from 1996 through 2006 (Figure 5.4). The highest concentrations are associated with up-lake sites, with the highest median TP concentration measured at Site 14 (South Grand River). It should be noted that very high concentrations have been measured at Site 2 (lower South Grand River site). The primary source of phosphorus for this site is suspected to be failing septic systems. Median TP concentrations for all nine lake sites currently exceed EPA's proposed ecoregional nutrient criteria.

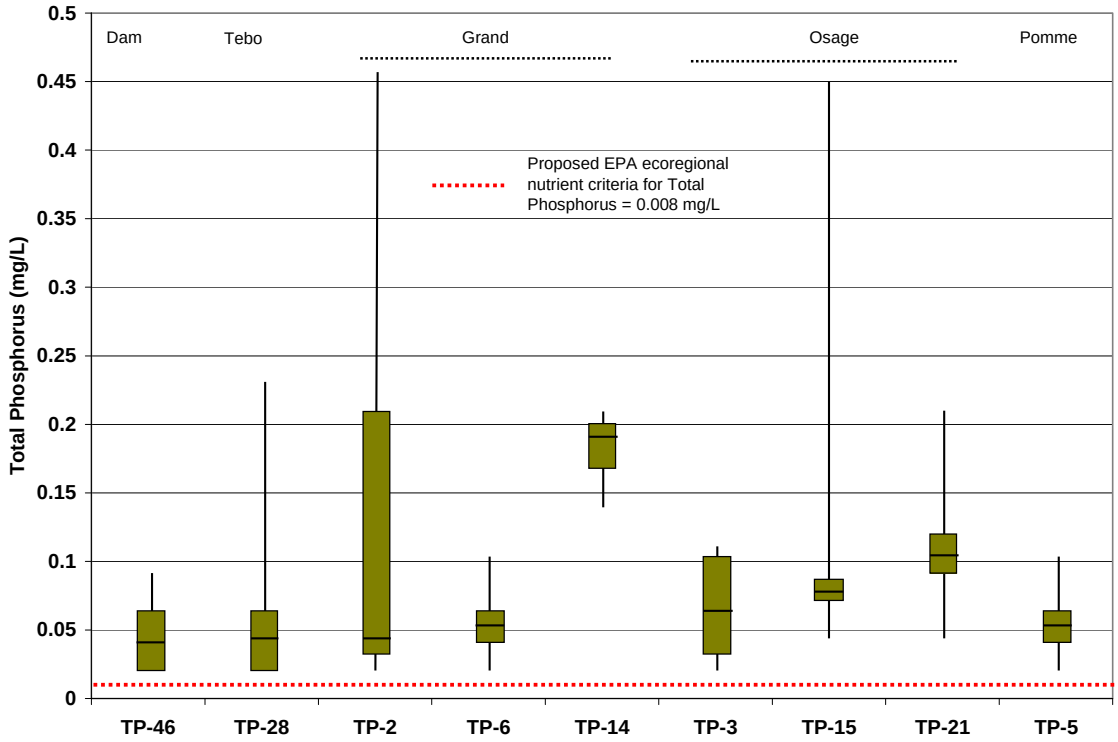

Figure 5.4. Box plots of surface water sample total phosphorus concentrations measured by site during 1999, 2002, and 2005 - 2006 at Harry S. Truman Lake.

The ratio of TN:TP can be used as a surrogate to determine the dominant algal community within a lake. Ratios ≥ 20:1 are indicative of desirable algal communities, whereas ratios ≤ 12:1 are indicative of bloom-forming cyanobacteria (blue green algae). Five of the nine sites exhibited median TN:TP ratios < 12, indicating certain sites within the lake are potentially at risk for cyanobacteria blooms (Figure 5.5). Sites 2, 14, and 21 exhibited the highest TP concentrations and also the lowest TN:TP ratios. It should be noted the microcystin toxin has been collected from Harry Truman Lake during 2000 (Dr. Jennifer Graham, USGS, personal communication).

Mean chlorophyll a concentrations for Truman Lake ranged from 20.0 – 33.4 ug/L during 2006 (Figure 5.6), which is indicative of nutrient-rich waters. Highest values were recorded from samples collected at Sites 14 and 21 (uplake). Mean secchi depth measurements ranged from 0.17 – 1.61 m, indicating the variability of sites and tributaries for the large lake (Figure 5.7). A longitudinal gradient was apparent in terms of water clarity, as the poorest clarity existed at both upper lake sites (Sites 14 and 21).

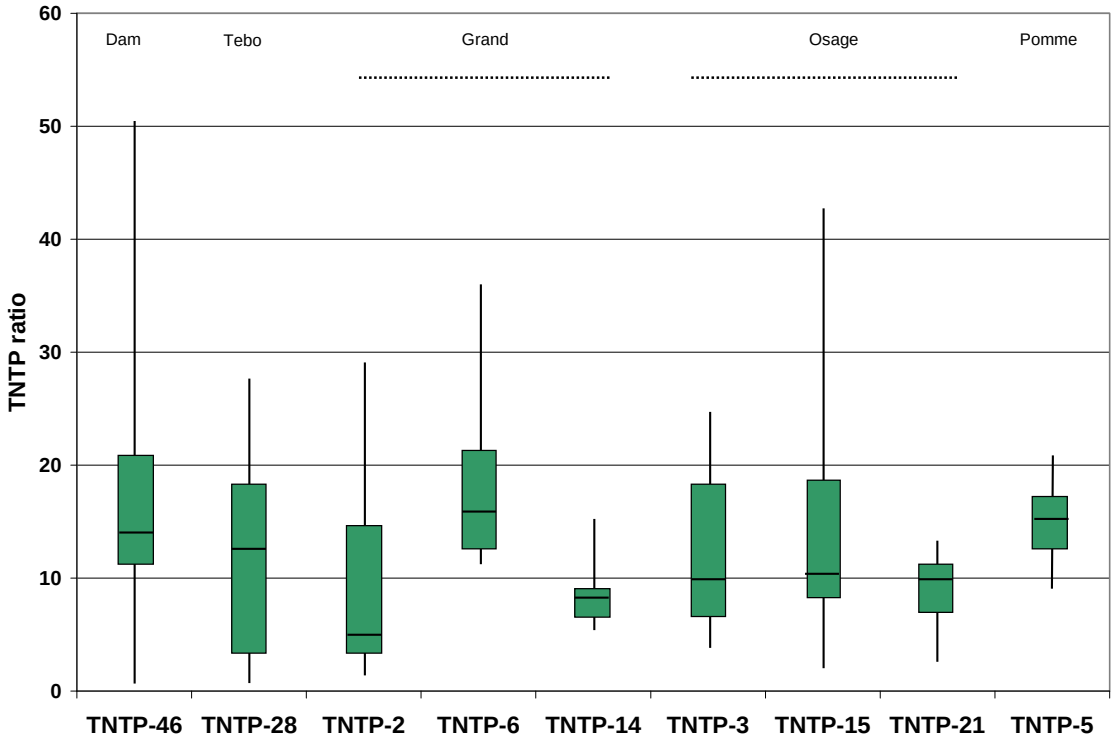

Figure 5.5. Box plots of total nitrogen : total phosphorus ratios from surface water samples measured by site during 2005 - 2006 at Harry S. Truman Lake.

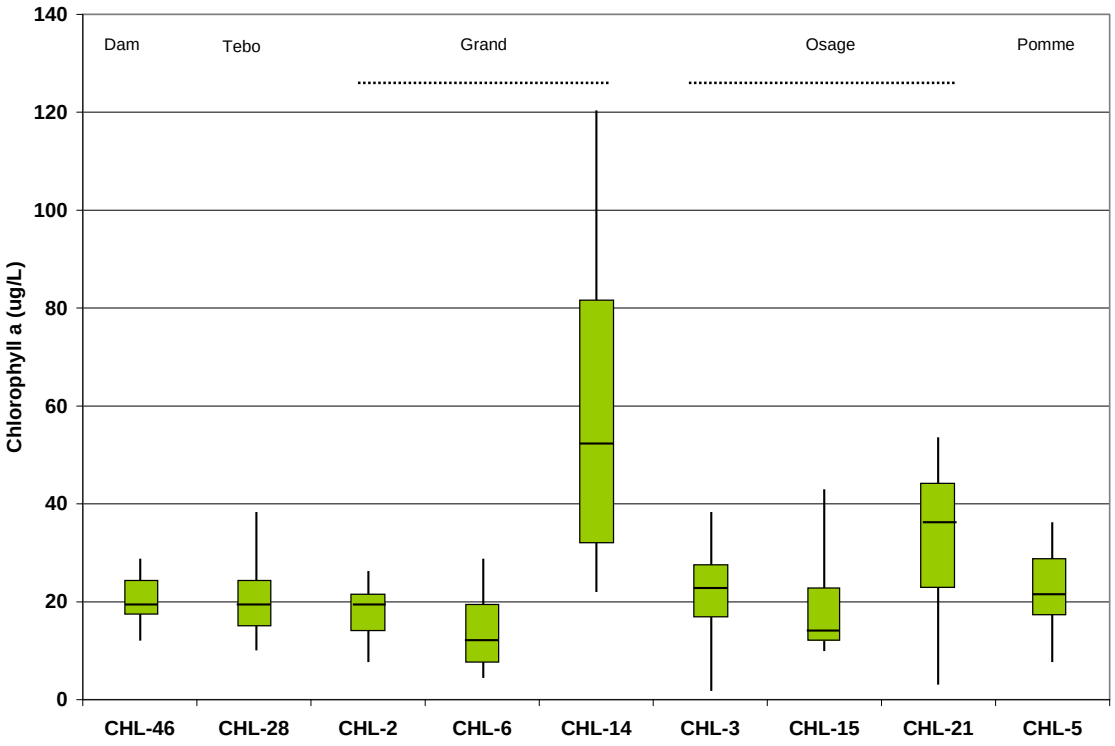

Figure 5.6. Box plots of chlorophyll a concentrations measured by site during 2005 and 2006 at Harry S. Truman Lake.

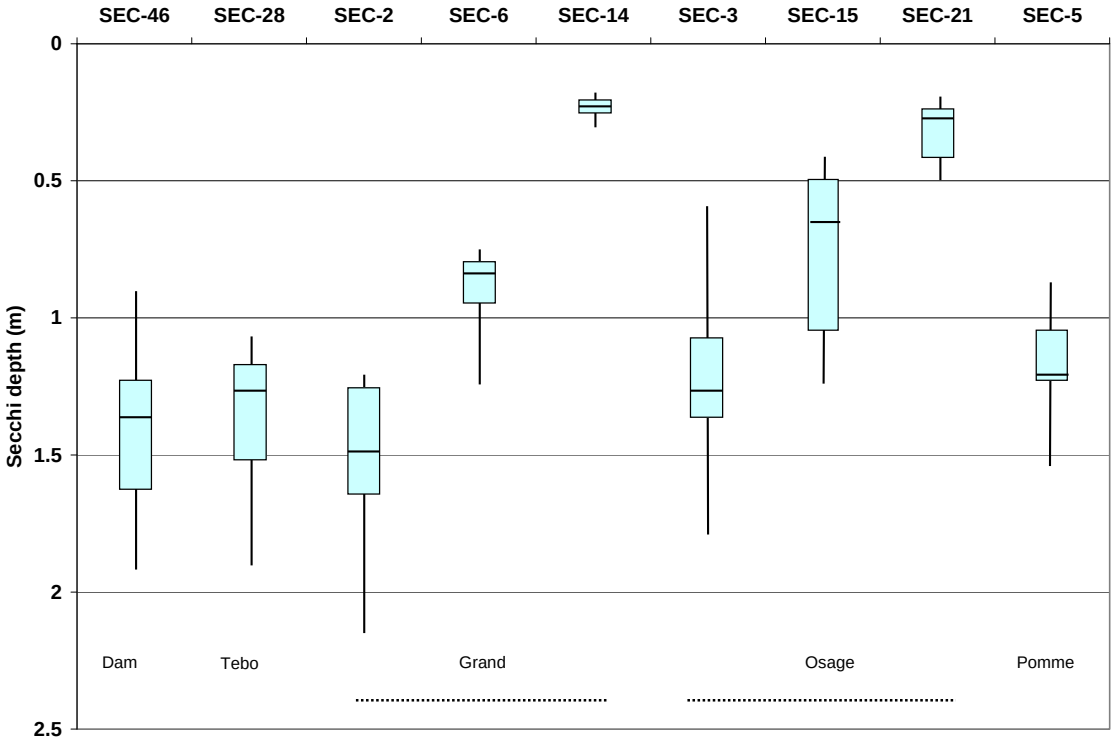

Figure 5.7. Box plots of secchi depth water clarity measured by site during 2005 and 2006 at Harry S. Truman Lake.

This would be expected considering the expansive shallow mud flats in these segments of the lake. Water clarity was higher at all sites during 2006 vs 2005; the lone exception was Site 14 (Figure 5.8). This was most likely a response to drought conditions within the watershed.

Relative concentrations of phycocyanins, or bluegreen algae, were measured vertically throughout the water column during each monthly sample trip at Sites 2, 3, 5, 28 and 46. Such profiles provided information on monthly as well as within lake distribution changes. Figure 5.9 depicts vertical distribution of phycocyanins measured at Site 2 (South Grand arm) from May through July and September. Concentrations increased from May into July, before declining slightly in September. The observed peak concentrations were among the lowest detected within the district.

Vertical profiles were recorded at the lower lake sites from June through September. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Based on this information, the lake was strongly stratified both thermally and chemically between a depth of 5 – 8 m during the summer period at Site 2 (Figure 5.10). Summer stratification occurred at a depth of 4 – 7 m at Site 46 (Figure 5.10).

Fecal bacteria (*E. coli*) samples were collected from three locations at each of six Corp swimming beaches prior to three major holidays (Memorial Day, July 4th, and Labor Day) during 2006. Samples collected from both Thibaut Point and Sparrowfoot prior to Memorial Day exceeded the compliance limits of 126 colonies / 100 ml for a whole-body

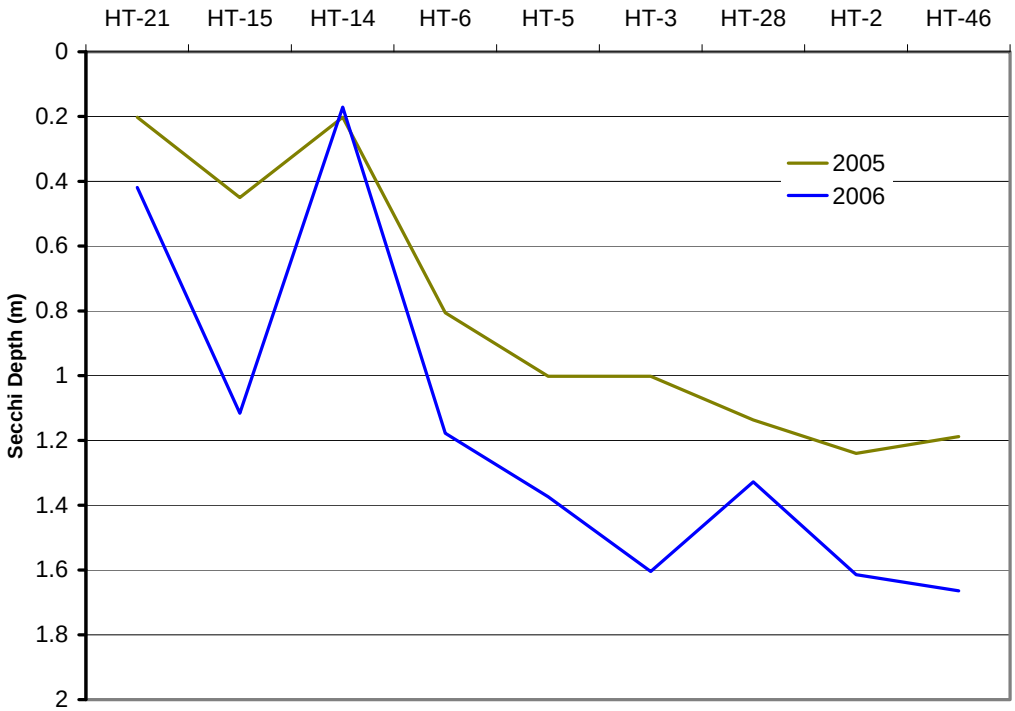

Figure 5.8. Plot of mean summer (June – August) secchi depth water clarity measured by site during 2005 and 2006 at Harry S. Truman Lake.

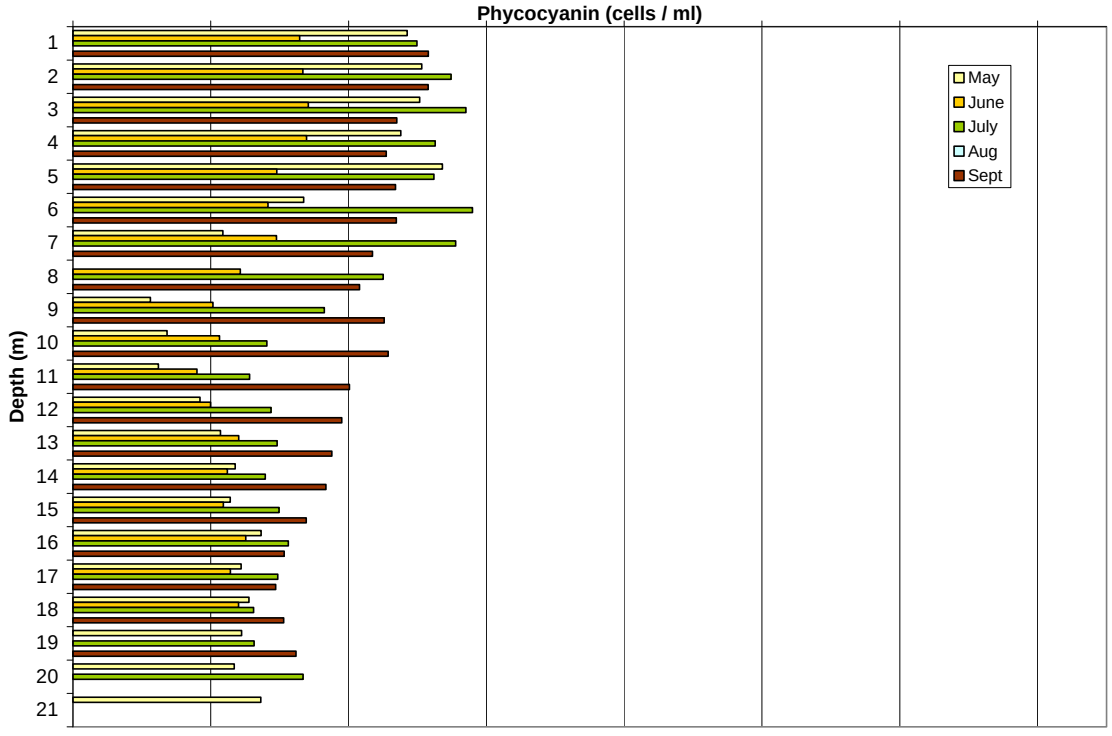

Figure 5.9. Relative concentrations of phycocyanin (bluegreen algae) (cells / ml) measured monthly by depth at Harry S. Truman Lake Site 2 (South Grand River arm) during 2006.

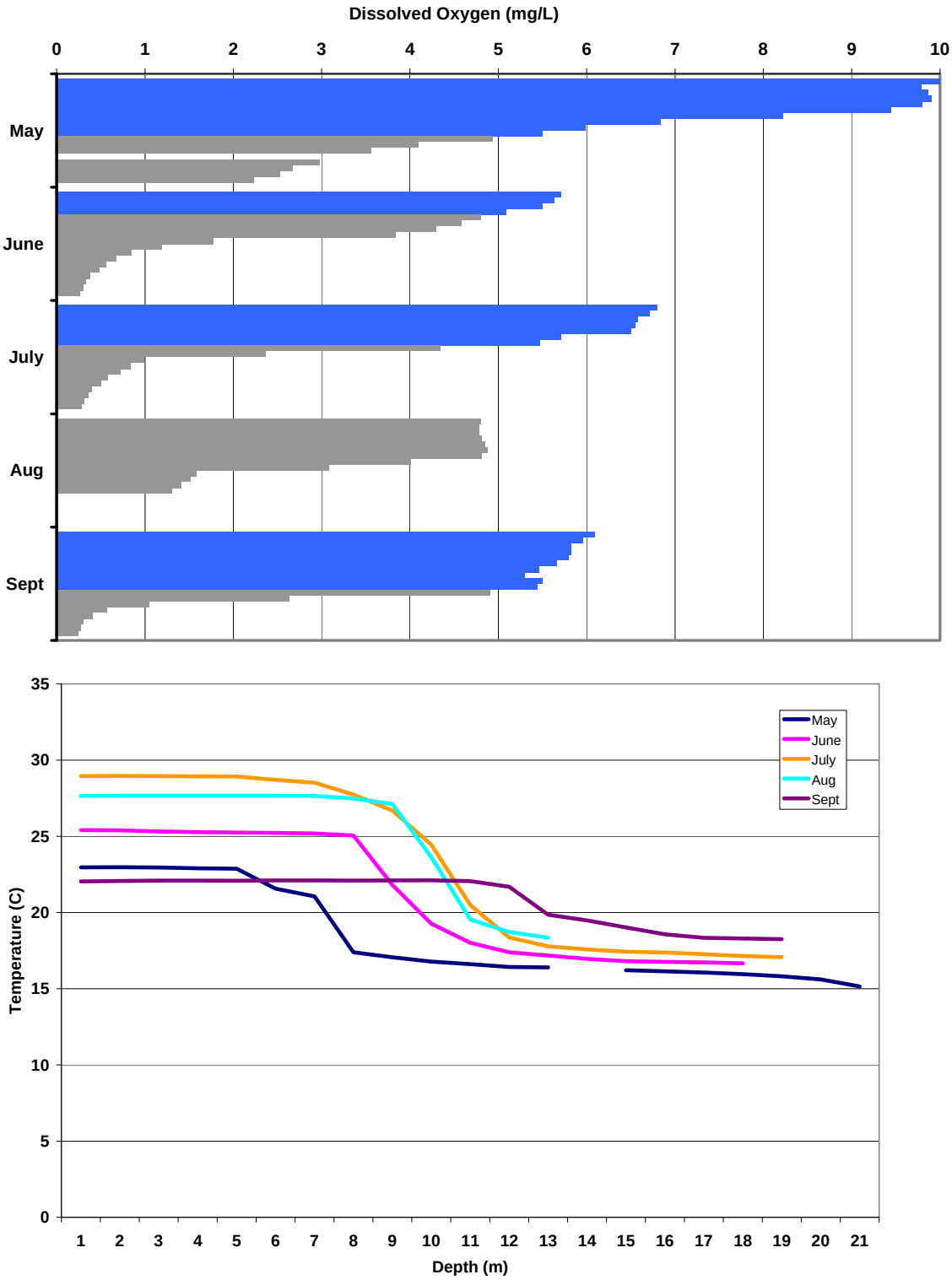

Figure 5.10. Dissolved oxygen concentration (mg/L) histogram and temperature (C) plot from vertical profiles recorded at Site 46 from May – September, 2006 at Harry S. Truman Lake.

contact during the recreational season (Figure 5.11). Thus, both beaches were resampled two days later and were well within compliance limits (means = 6.3 and 48.4 colonies / 100 ml @ Thibaut Point and Sparrowfoot, respectively).

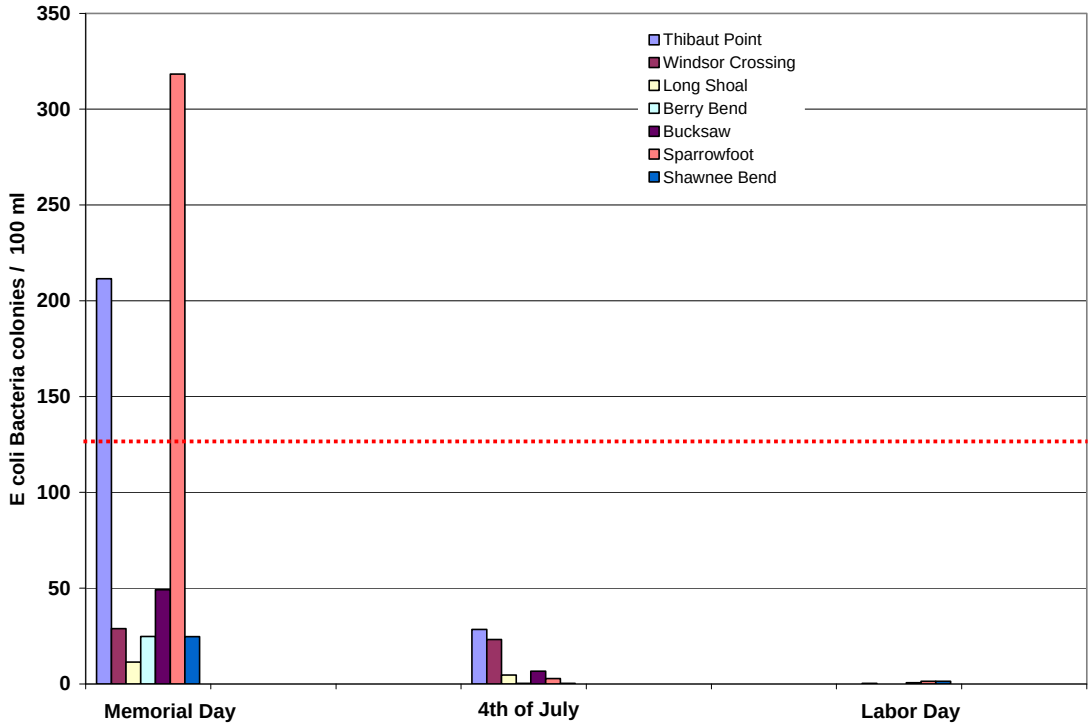

Figure 5.11. Fecal bacteria colonies per 100 ml samples from beach samples collected prior to major holidays at Harry S Truman Lake during 2006.

5.3.3 Outflow

Outflow data was collected from Truman Lake (Site 1) during 2006, but none of it was included in this report.

5.4 Future Activities and Recommendations

Sampling activities for 2007 will include transition from monthly 'ambient' monitoring to 'intensive' monitoring from April through September. This will also include conducting monthly vertical profiles at each of the nine lake sites. Due to concerns of potentially toxic bluegreen algae, phycocyanin concentrations 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. To more completely understand dissolved oxygen dynamics within the tailrace area, 1 – 2 longterm monitoring instruments (Eureka Midges) will be deployed from June 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. The Marais des Cynges, Marmaton, and Little Osage Rivers watershed plan committee completed its' watershed management plan

above the lake. Continued interaction with this group could produce a beneficial relationship in regards to lake water quality. In addition, this group is awaiting word on the status of an EPA Targeted Watershed grant submitted during 2006. In addition, a watershed management plan effort focusing on the Pomme de Terre watershed will begin during 2007. Active involvement and data sharing will be coordinated with this multi-agency and citizen-based effort. It is expected that Truman Lake will be added to a future 303(d) list once the Missouri Clean Water Commission approves nutrient criteria.