

13 Pomme de Terre Lake

13.1 General Background

Pomme de Terre Lake was impounded in 1961 and reached full pool in 1963. The main water quality threats to Pomme de Terre Lake are nutrients and bacterial contamination.

13.1.1 Location

Pomme de Terre Lake is located approximately 96 km (60 miles) north of Springfield, Missouri. The dam is located at river km 73 (river mile 45.6) on the Pomme de Terre River. The watershed includes portions of Hickory, Polk, Green and Webster counties. Historic water quality sample sites at Pomme de Terre Lake include 3 lake, 1 outflow, and 2 inflow (Figure 13.1).

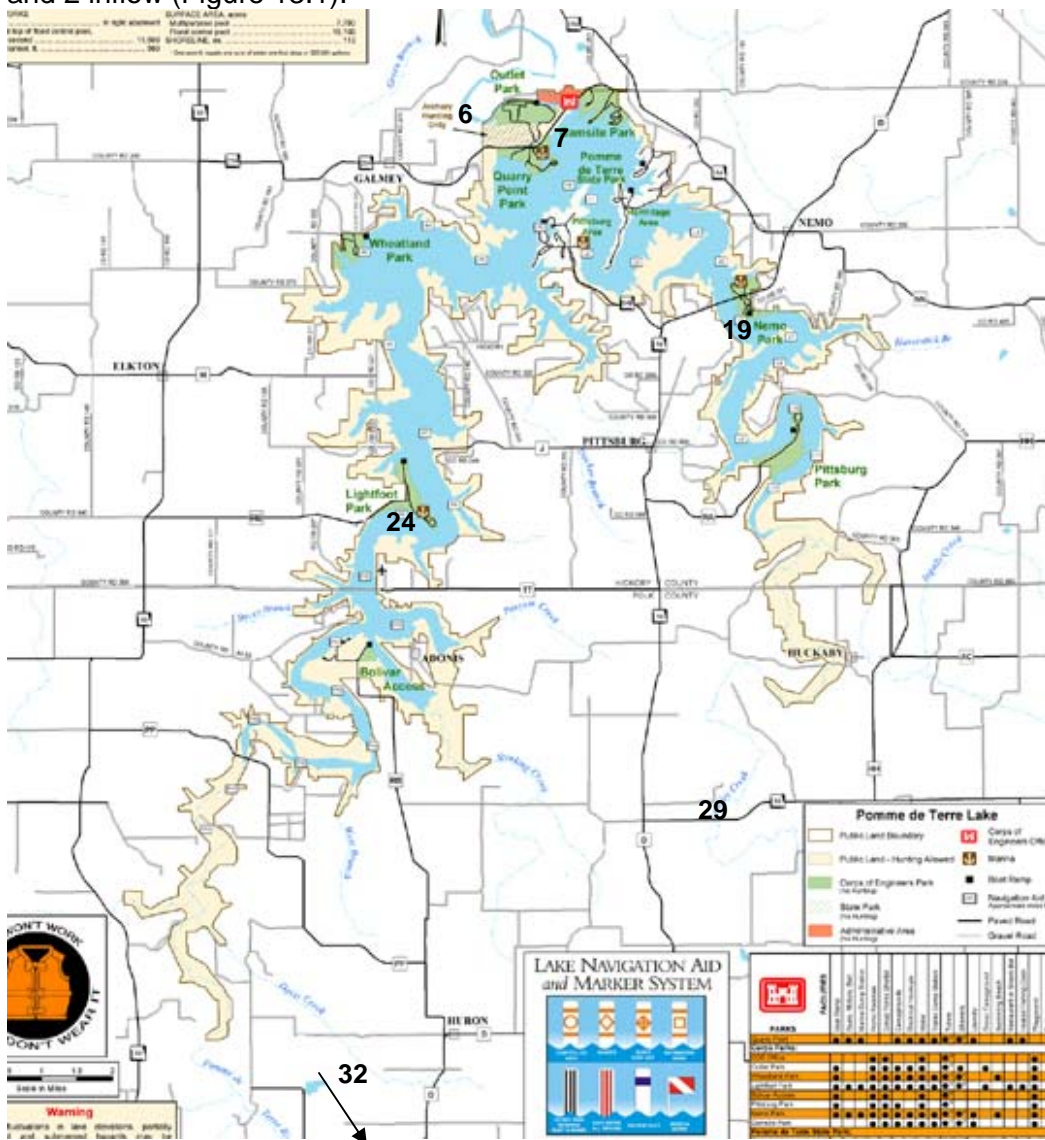


Figure 13.1. Pomme de Terre Lake area map with sample site locations.

13.1.2 Authorized Purposes: Flood control, water quality improvement, supplemental navigation on the lower Missouri and Mississippi Rivers, recreation, and fish and wildlife management.

13.1.3 State Use Designations: Livestock and wildlife watering, protection of warmwater aquatic life and human health / fish consumption, and whole-body contact recreation.

13.1.4 Lake and Watershed Data

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	874.0	406.9	16,100	
Multipurpose	839.0	237.5	7,820	113
Total		644.4		

Total watershed area: 611 sq miles (391,040 A)
 Watershed ratio: 24.3 FC / 50.0 MP
 Average Annual Inflow: 367,038 acre-feet
 Average flushing rate:
 Sediment inflow (measured): 4,358 acre-feet (1961 – 1974)
 Water management Plan: Submitted for approval on 20 May 2005
 Historic stage hydrograph: 1996 – 2006 (Figure 13.2)

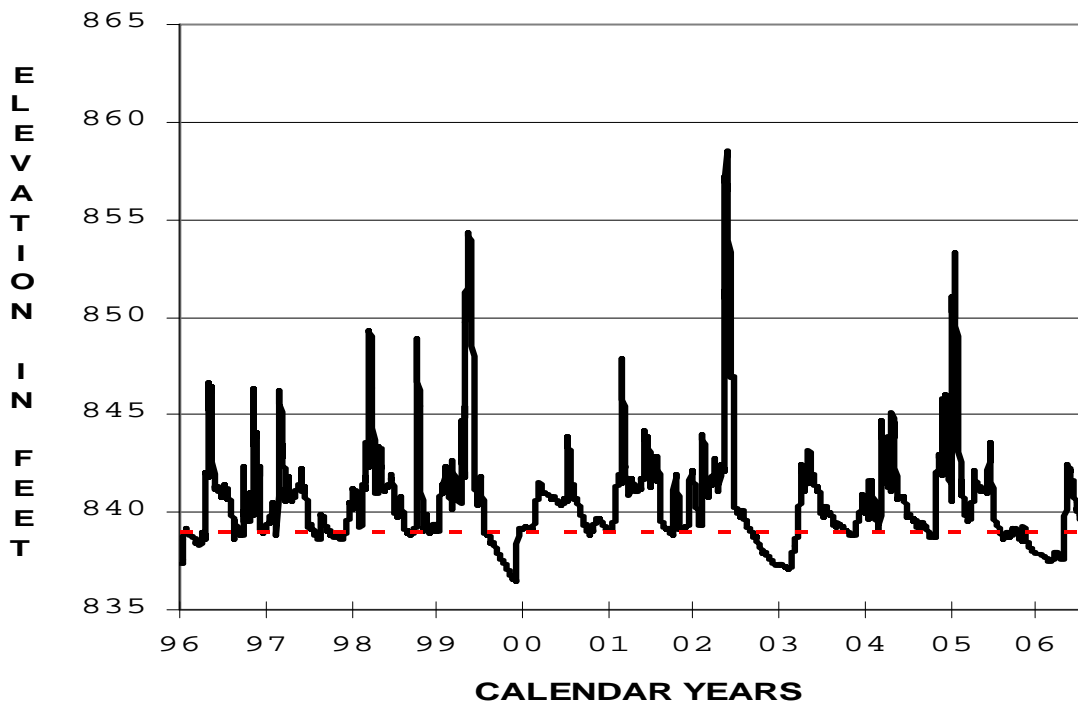


Figure 13.2. Pool elevation hydrograph from 1996 – 2006 (red-dashed line is the multipurpose pool elevation – 839.0 msl).

13.2 2006 Activities

Pomme de Terre Lake was categorized as an ‘ambient’ lake during 2006, thus surface water samples were to be collected at the three lake sites from May through September 2006. Vertical profiles (temperature, DO) were to be recorded at the three lake sites from June through September. Pomme de Terre Lake staff (OF-PT) providing field assistance with the WQP during 2006 included Glenn Locke and Jon Carlisle. Brad Myers, OF-PT Operations Manager, provided technical insight and background knowledge on Pomme de Terre Lake and surrounding watershed.

13.3 2006 Data

Comparative historic data consists of a single sample collected in 2002, three samples (April – July) during 2004 and five monthly (May - September) samples during 2005. Due to miscommunication, samples were only collected during September 2006.

13.3.1 Inflow

No inflow samples were collected at the two tributary streams during 2006 (Pomme de Terre River [Site 32] downstream of Bolivar, and Site 29 located on Lindley Creek at State Road 64 bridge).

13.3.2 Lake

Based on nutrient concentrations and chlorophyll a values, Pomme de Terre is considered mesotrophic – eutrophic. 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. Median total nitrogen concentrations from surface water samples of lake sites range from 0.64 – 0.78 mg/L (Figure 13.3). Although typical of district lakes, these concentrations exceed EPA’s proposed ecoregional nutrient criteria value of 0.46 mg/L TN. Historically, the highest TN concentrations are measured at Site 29 (Lindley Creek), which may be indicative of some landuse activities occurring upstream of the site.

Phosphorus is another essential nutrient for aquatic life, and it limits algal growth. Median total phosphorus concentrations from surface water samples at lake sites ranged from 0.06 – 0.07 mg/L. These concentrations are typical for district lakes, and are indicative of eutrophic waters (Figure 13.4). These concentrations exceed EPA’s proposed ecoregional nutrient criteria value of 0.008 mg/L TP. Inflow TP concentrations were significantly higher than lake sites – nearly 2x the concentration -- indicating opportunities for improvement in landuse practices and nonpoint source nutrient control.

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. Median TN:TP ratios at all three lake sites are ~ 12 , indicating the lake is at risk for cyanobacteria blooms (Figure 13.5). Microcystin toxins have been detected at Pomme de Terre Lake during 2000 (Dr Jennifer Graham, USGS, personal communication).

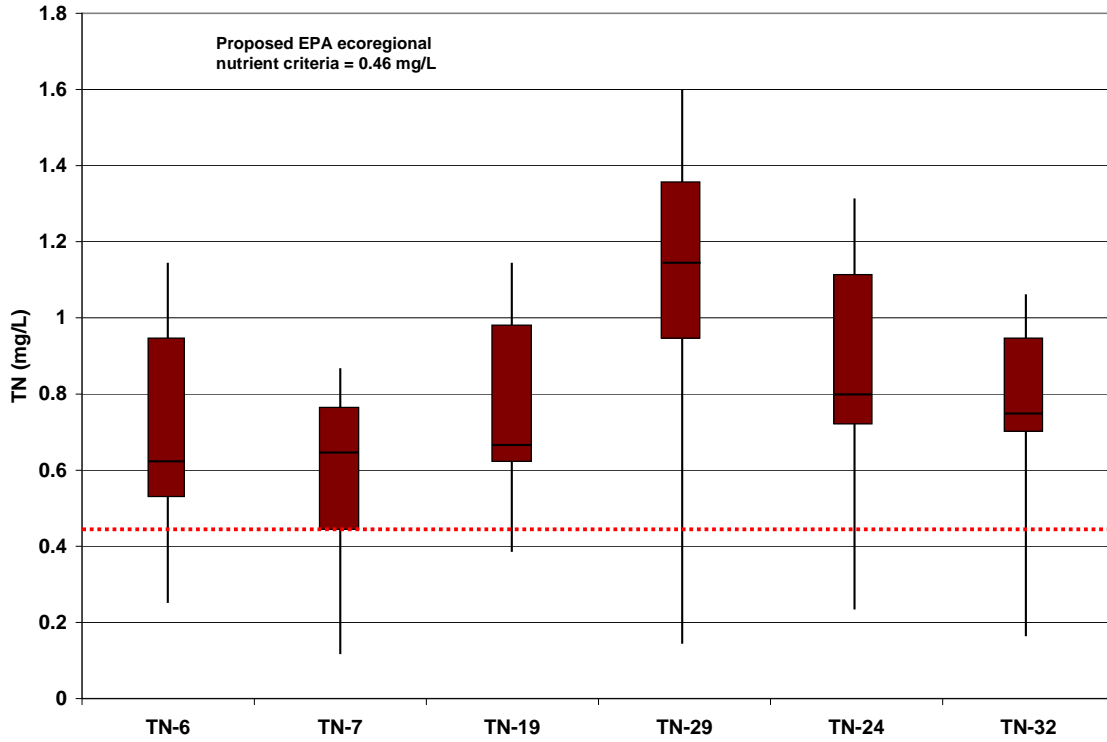


Figure 13.3. Box plots of surface water sample total nitrogen concentrations measured at outflow (TN-6), lake, and inflow (TN-29 & TN-32) sites from 2004 – 2006 at Pomme de Terre Lake.

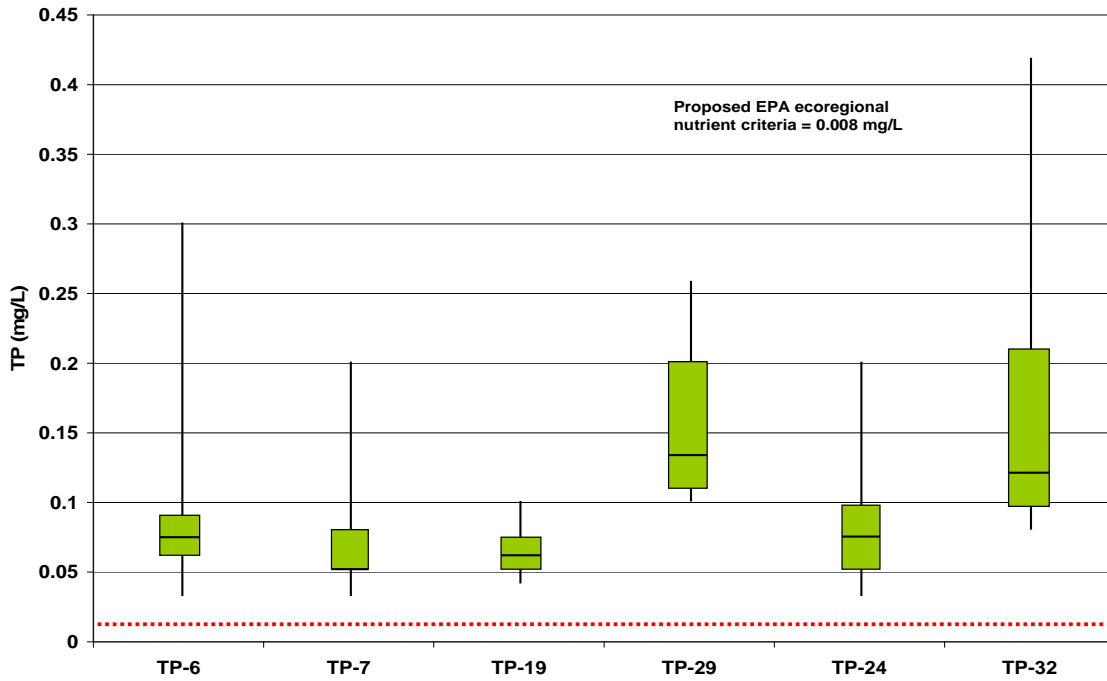


Figure 13.4. Box plots of surface water sample total phosphorus concentrations measured at outflow (TP-6), lake, and inflow (TP-29 & TP-32) sites from 2004 – 2006 at Pomme de Terre Lake.

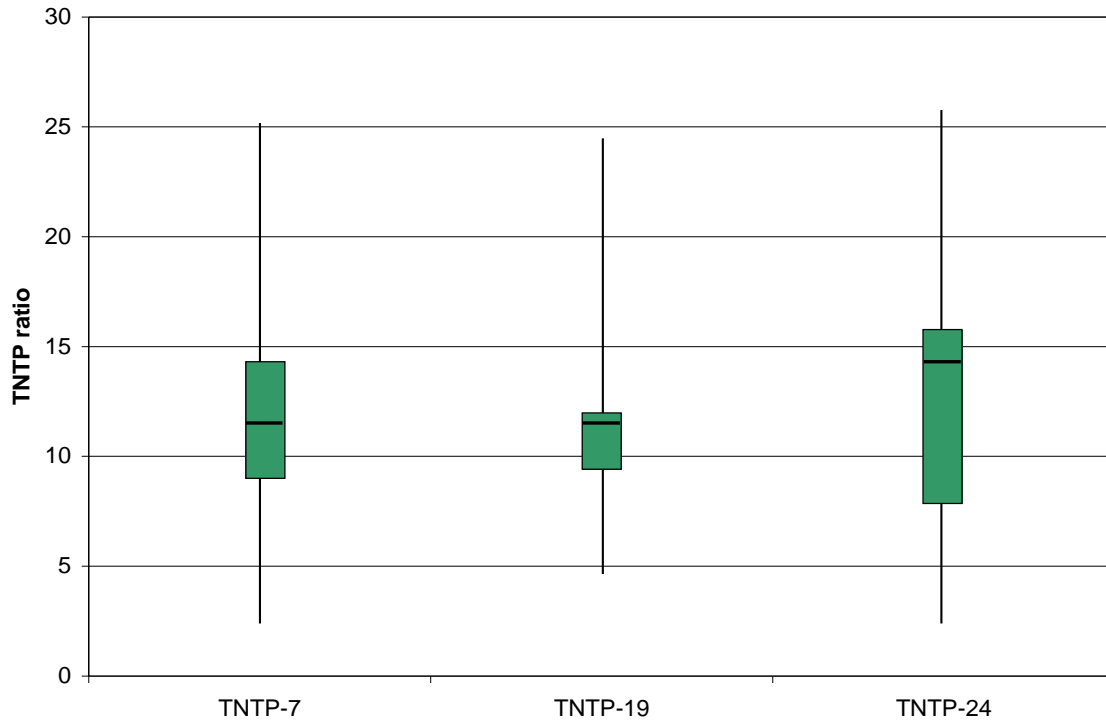


Figure 13.5. Boxplots of total nitrogen : total phosphorus (TN : TP) ratio by site from 2004 – 2006 at Pomme de Terre Lake.

No chlorophyll *a* samples were collected during 2006. However, historic mean chlorophyll *a* concentrations range from 19 – 28 ug/L between July and September at the three lake sites. These values are indicative of eutrophic waters. Secchi depth measured from July through September indicated water clarity was variable between sites and months (Figure 13.6). The clearest water (1.3 – 2 m) was measured at Site 7 (tower), while moderately clear water was measured near Lightfoot Park (0.7 – 0.8 m) in the Pomme de Terre River arm.

No herbicide samples were collected from either inflow, lake or outflow sites during 2006. However, historic atrazine surface water sample concentrations are consistently less than 0.2 ug/L, which is well below EPA's drinking water maximum contaminant level of 3 ug/L. In addition, all other contaminants (ie., alachlor, metolachlor, cyanazine) monitored during 2004 and 2005 were below detection limits from all three lake sites.

Vertical profiles were not recorded during 2006. However, profiles were recorded during June through September 2005. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Based on these profiles, the lake stratified both chemically and thermally between 4-5 m depth during July - August (Figure 13.7). The thermocline had extended to nearly 10 m by late September, as the lake water temperatures began to cool and fall turnover was beginning.

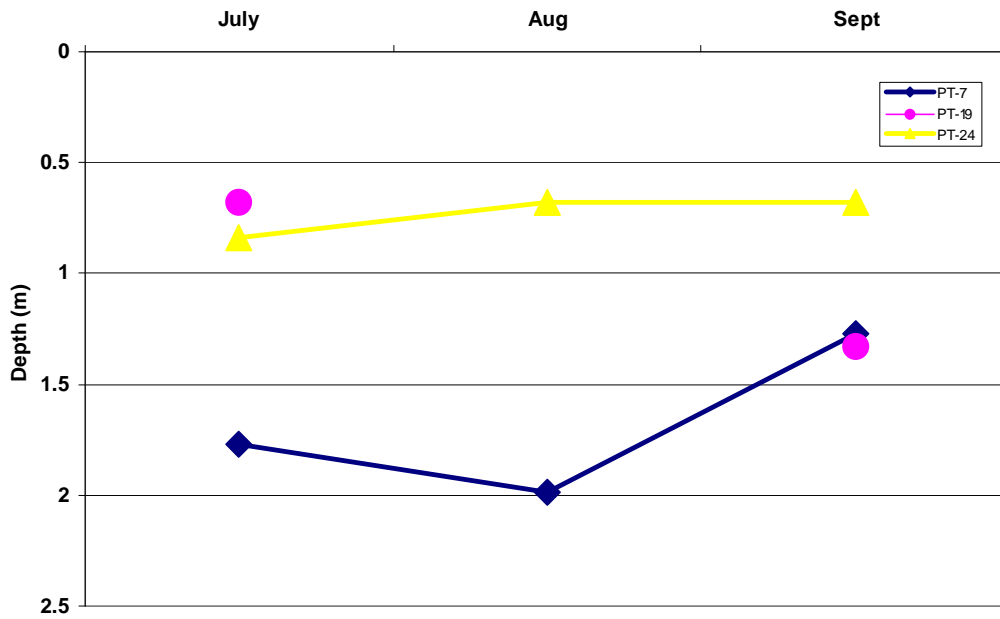
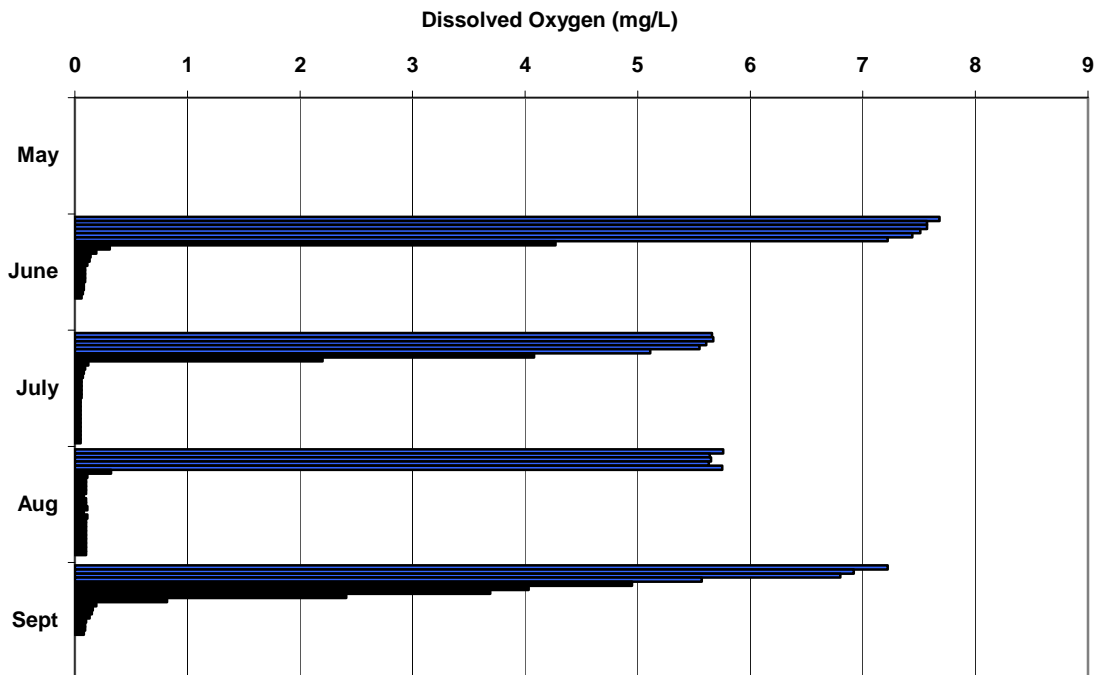


Figure 13.6. Secchi depths measured by site at Pomme de Terre Lake during July, August and September 2005.



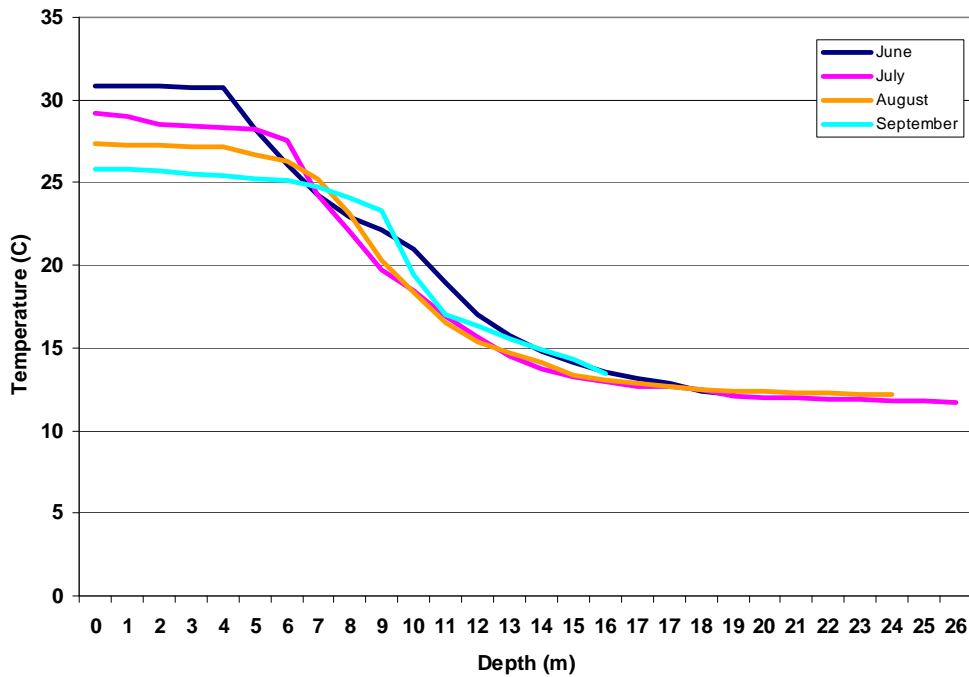


Figure 13.7. Dissolved oxygen concentration (mg/L) histogram and temperature (°C) plot from a vertical profile recorded at Site 7 from June through September 2005.

No metal samples were collected during 2006. However, total iron exceeded EPA’s Drinking Water Standard of Secondary Maximum Contaminant Levels (SMCL) of 300 ug/L from surface samples collected at both inflow sites during August 2006. Concentrations ranged from 398 – 646 ug/L, with the highest concentration recorded at Site 29 (Lindley Creek). Implications are directed at drinking water facilities related to taste and staining issues. In addition, all surface samples (lake and inflows) collected during August exceeded EPA’s SMCL for manganese (50 ug/L). Sample concentrations ranged from 63 – 228 ug/L, with lowest concentrations measured at lake sites. Implications are directed at drinking water facilities due to taste and stain issues.

Fecal bacteria (*E. coli*) samples are typically collected from three locations at both Wheatland and Nemo Park beaches prior to three major holidays (Memorial Day, July 4th, and Labor Day). None of the composite samples exceeded the state standard of 126 colonies / 100 ml sample for whole-body contact during the recreational season (Figure 13.8).

13.3.3 Outflow

No outfall samples were collected from Pomme de Terre Lake during 2006.

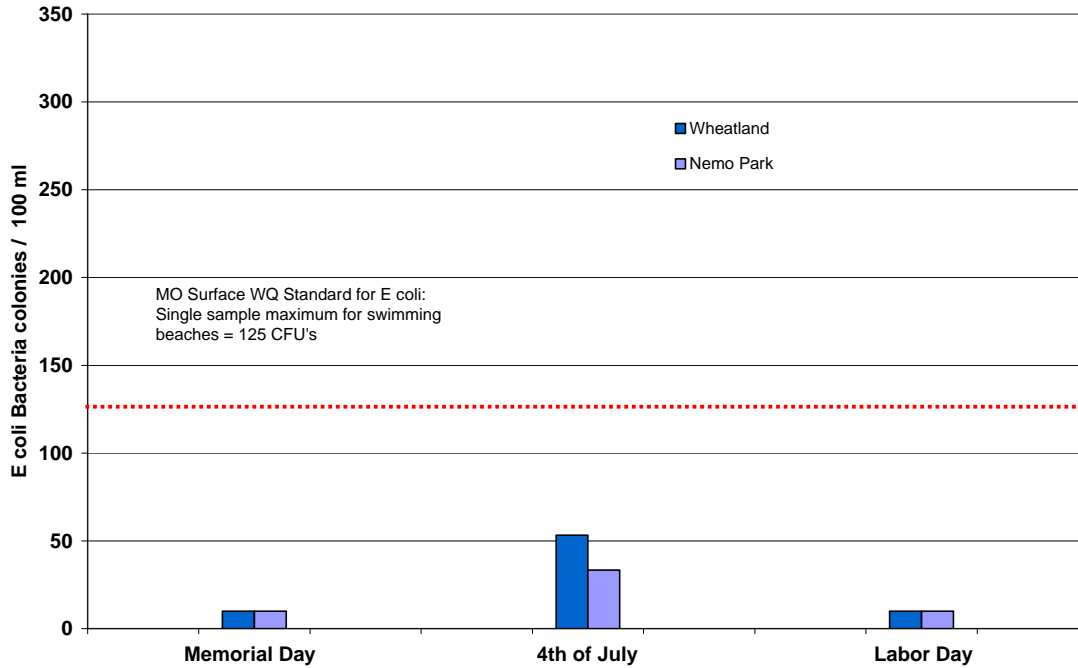


Figure 13.8. Geometric means of fecal bacteria (*E coli*) colonies per 100 ml samples from beach samples collected weekly at Long Branch Lake State Park during 2006.

13.4 Future Activities and Recommendations

Sampling activities for 2007 will include 'ambient' monitoring from May through September, as well as conducting at least one summer vertical profile at each of the three lake sites. In addition, a Hach HQ-10 portable temperature – dissolved oxygen meter with 15 m cable was provided for use at the lake to provide more frequent profile data. 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 watershed management group, directed by the local NRCS and involving federal, state, and local input, will be implemented during 2007. Our water quality dataset will be shared with this group, and input provided during meetings.
