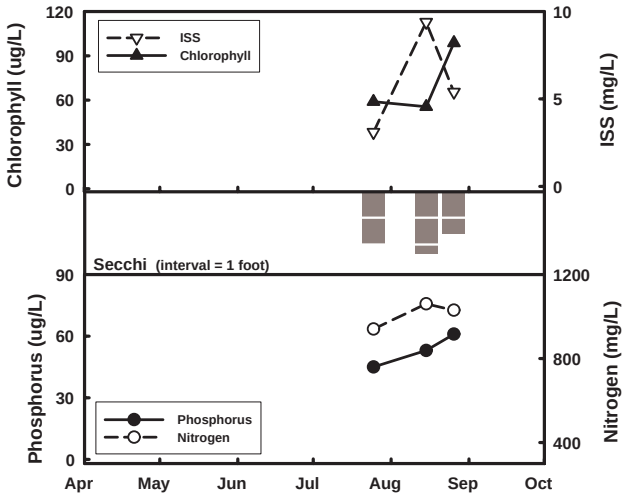
Lake Wappapello

Butler County and Wayne County

Site 1

Date	Secchi (inches)	TP (µg/L)	TN (µg/L)	CHL (µg/L)	ISS (mg/L)
7/25	24	45	940	59	3.1
8/15	28	53	1060	55.6	9.4
8/26	19	61	1030	98.8	5.4
Mean	**23**	**53**	**1009**	**68.7**	**5.4**



Lake Wappapello was sampled three times during a month long period late July to late August in 2008. At the dam site, Secchi transparency was low and fairly stable during this period. High levels of chlorophyll indicate a large amount of algal biomass within the lake, which when coupled with moderately high levels of inorganic suspended solids explains the low water clarity. The chlorophyll to phosphorus ratio for these three samples were all >1 with an average of 1.3, indicating that the algal population was in bloom condition during this month long period. Simply put, the algae were being extremely efficient using the available phosphorus.

Because Lake Wappapello was only sampled during a one month period in 2008, it is hard to identify any seasonal patterns. Past LMVP data, along with University of Missouri data collected during the summer, suggest an annual pattern of water quality at the dam site in Lake Wappapello. Phosphorus and nitrogen values tend to be low early in the summer then increase as summer progresses. This pattern differs from that observed in many Missouri reservoirs where maximum nutrient values tend to occur late spring and are associated with inputs from the watershed following spring rains.

Lake Wappapello is shallow, with an average depth at recreational pool of about 7.5 feet. The average Missouri reservoir has a mean depth that is twice that deep (18 feet). It is quite possible that Lake Wappapello is polymictic, meaning that it mixes multiple times during the year. This is a condition that is mostly associated with shallow water bodies where there is not enough depth to overcome mixing associated with wind energy. During stratified periods in the summer the deep water layer of Lake Wappapello can become anoxic. This loss of dissolved oxygen will allow nutrients to migrate out of the sediment and into the water. Once the lake mixes, these nutrients are distributed throughout the water column. The lake may then re-stratify, setting the whole process up to occur again. Multiple cycles of stratification/mixing during the summer would translate to an increase in nutrients caused by internal loading and not external inputs. Polymictic behavior would explain why maximum nutrient values are measured late in the summer as opposed to late-spring.

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Summertime changes in water quality at Lake Wappapello dam site. Values are averages of both volunteer and university collected data.

	MAY	JUNE	JULY	AUGUST
Average Phosphorus (µg/L)	29	30	49	58
Average Nitrogen (µg/L)	379	419	831	1042
Average Chlorophyll (µg/L)	15.5	19.0	54.6	70.5

LMVP data were combined with University of Missouri monitoring data to demonstrate the difference in water quality from May to August in Lake Wappapello. On average, phosphorus concentrations double from May to August, while nitrogen increases by a factor of 2 ½ . The increase in algal chlorophyll is even more dramatic, with August values averaging more than four times the values measured in May.

Site 2

Date	Secchi (inches)	TP (µg/L)	TN (µg/L)	CHL (µg/L)	ISS (mg/L)
7/25	16	69	810	57.5	9.2
8/15	18	76	950	74.1	10.7
8/26	15	79	870	80.9	15
Mean	**16**	**75**	**875**	**70.1**	**11.4**

Site 2 had higher phosphorus and inorganic suspended solids values than Site 1. Because phosphorus often enters lakes bound to soil particles, it is not a surprise that these two parameters would show similar patterns relative to the dam site. Nitrogen on the other hand was slightly lower at Site 2 and chlorophyll levels were similar to those measured at Site 1. Secchi depth measurements at this site were low and stable at about 16 inches. High levels of both algal chlorophyll and inorganic suspended solids keep clarity from fluctuating. Similar to Site 1, the chlorophyll:phosphorus ratios suggest efficient use of nutrients by the algal population. The ratio values at this site were ≈1, a little lower than those observed at the dam. It is possible that the slightly higher inorganic suspended solids values may account for the slightly lower chlorophyll to phosphorus ratios.

Site 3

Date	Secchi (inches)	TP (µg/L)	TN (µg/L)	CHL (µg/L)	ISS (mg/L)
7/25		17	140	5.8	3.2
8/15		13	150	4.2	2.4
8/26		12	180	2.9	1.6
Mean		**14**	**156**	**4.1**	**2.3**

All parameters monitored at Site 3 were stable across the three sample collection dates. Phosphorus, nitrogen and chlorophyll values at Site 3 were substantially lower than those measured at the other two sites on Lake Wappapello. This would seem to indicate that nutrients measured at the other sites are not originating from the St. Francois River. It should be noted that nutrient loads in rivers are not consistent when nonpoint sources are involved. Instead, most nutrients and inorganic suspended solids move through the river after storm events. The majority of the annual load of these pollutants flow down the river during a relatively short period of time. Lower nutrient and suspended sediment values may reflect the timing of sample collection (during low flow periods, when pollutant levels are normally low) and not provide us with a realistic view of nutrient inputs from the St. Francois River.

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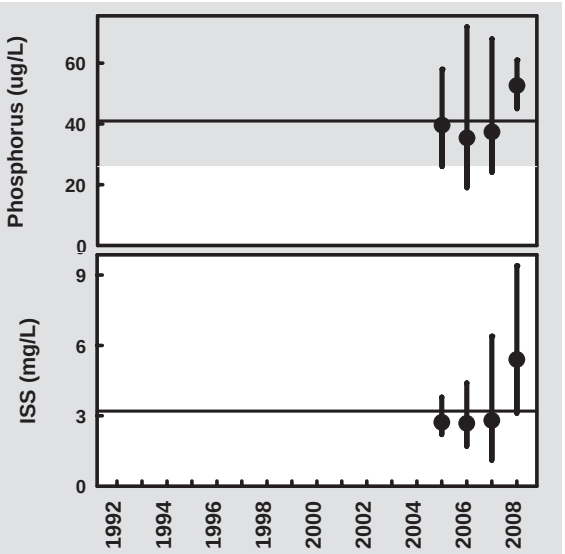
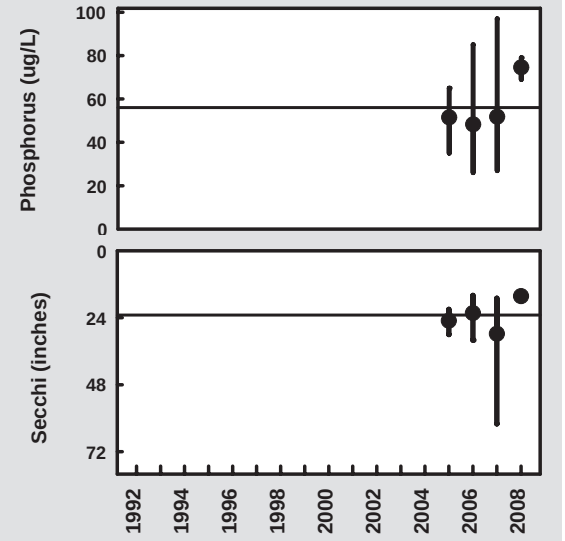
Site 1

Given the predictable increases in nutrient concentrations that occur over the course of the sample season, it is not surprising that summertime geometric mean phosphorus was higher in 2008 compared to previous summers. With sampling being limited to a month long period over late summer in 2008, no samples were collected earlier in the sample season when lower phosphorus levels would be expected. Inorganic suspended solids levels were also higher in 2008 relative to previous summers. There is no indication that inorganic suspended solids accumulate over the course of the sample season from internal loading as the nutrients do. Higher inorganic suspended solids in 2008 may reflect increased inflows into the lake associated with more rain during the sample season (over 25 inches of rain fell in the upper watershed during March-May 2008).



Site 2

The long-term trend for phosphorus at Site 2 is similar to that observed at Site 1; higher values in 2008 relative to the past three summers. Higher values in 2008 were also measured for nitrogen, inorganic suspended solids and chlorophyll. It is quite likely the higher values related to limited sample collection during the 2008 season. Long-term Secchi values differ from those seen at the dam in that only one of four years had a Secchi measurement that exceeded 30 inches in depth.



Site 3

Geometric mean phosphorus has been stable from one year to the next, differing by only 2 µg/L. Nitrogen and chlorophyll have also been comparable from one year to the next. Inorganic suspended solids display a little more variation, with the 2007 geometric mean being twice that of 2008. No trends in water quality are obvious at this point in time.