Supplement to:
G.D. Cooke and E.B. Welch. 2008. "Eutrophication of Tenkiller Reservoir, Oklahoma and Effects on Water Quality and Fisheries"

January 6, 2009

This supplement was prepared by:

Eugene B. Welch _____

G. Dennis Cooke G. Dennis Cooke

EXHIBIT
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This supplement to the above named report summarizes new data collected in 2008. The inclusion of these 2008 data, with previous data in the report, clearly demonstrates that there has been no improvement in the condition of Tenkiller Reservoir, and illustrates the effect of low (2005, 2006, 2007) and high (1992, 1993, 2008) inflow water volumes on the concentration of phosphorus (TP) in the reservoir, especially in the down-reservoir lacustrine (lake-like) zone. Simply stated, when more water enters the reservoir per unit time, the high-TP inflow is carried farther down the reservoir, with less settling loss of TP to bottom sediments. The condition of the reservoir only appears to be better in low inflow or drought years, because less high-TP inflow water is transported down-reservoir and there is more time for TP to settle to the bottom at the upper end of the reservoir.

This effect is illustrated (upper bars) in Figures 7 and 8 supplements as a metric called water residence time (τ), which is the volume of the reservoir divided by its inflow rate. Lower τ values (1992, 1993, 2008) occur with higher inflows and are associated with more runoff, less settling of TP, and thus higher reservoir TP and chlorophyll (chl). TP concentration is higher in reservoir surface waters when the reservoir is more highly flushed (i.e., shorter residence time; Jones et al. 2008).

Sampling and analytical procedures in 2008 were the same as described in the May, 2008 report. The data used for figures presented are included in the attached appendix.

The TP concentrations at LK-01 to LK-03, shown in Figure 7 supplement, were higher in 2008 than in 2007, 2006 or 2005, the three previous years for which data were collected by CDM for this project. That was largely due to the higher inflow and shorter τ in 2008. In fact, the TP value at LK-01 in June 2008 (58 μg/L) was the highest observed since 1993 (see appendix). As illustrated in Figures 7.1 and 7.2 supplements, TP was directly related to τ at LK-04, but inversely related to τ at LK-01 and 02, the lacustrine stations. The 2008 values for LK-04 and LK-01 are consistent with the previous data from the above report (Figures 7.1 and 7.2 supplements). Therefore, TP concentrations in the reservoir are to a large extent determined by τ, as well as by inflow concentration. That is because loss of TP from the water column decreases with shorter τ and the momentum of higher inflow volumes carries incoming TP farther down the reservoir than lower inflow volumes. Consequently, the deep lacustrine (lake-like) zone (LK-01, 02) retains more TP in the epilimnion. Low inflow volumes (i.e., drought and longer τ), on the other hand, allow for more TP to settle and be retained in sediment in the transition zone (LK-03) or be transported down reservoir at depth, below the epilimnion.

The lower TP concentrations at LK-04, with higher inflows (i.e., shorter τ), may be due to dilution of the TP load from bottom sediment (internal load), which would otherwise have more time to accumulate in the water column at lower inflow volume (i.e., longer τ).

Chlorophyll concentrations were also relatively high in 2008, in response to higher inflows (Figure 8 supplement). While chl was not always related to τ for all the data shown (e.g., chl was as high in 2005 as in 2008, despite a longer τ in 2005), there

was usually a consistent relation between TP and chl using all the data from Tenkiller, compared to a relation developed from 146 Missouri reservoirs (Figure 6, May 2008 report). Therefore, much of the year-to-year variation in chl can be ascribed to variation in TP.

Transparency in 2008 was not substantially different from that in 2007, but was less than in 2005 or 2006 (Figure 9 supplement). Non-algal turbidity also affects transparency, especially in high inflow years, so besides chl, that is some of the cause for low transparency in 2008.

Areal hypolimnetic oxygen deficit rate (AHOD) was higher in 2008, relative to most previous years, and similar to that in 2005 (Figure 29 supplement). High inflow should carry in more organic matter from external sources, as well as produce more algae in-lake from higher TP concentrations, and, therefore, result in higher AHODs. There is some tendency for short τ years to have higher AHODs; e.g., mean AHODs for 2002, 2004 and 2008 were over 1,500 mg/m^2 per day, and they were short τ years. However, the AHOD exceeded that rate in 2005, and that was a long τ year. Long τ also allows more time for uptake of DO by bottom sediment and decomposition in over-lying water, and therefore higher AHODs. Thus, there are competing forces involved, which attribute to the year-to-year variation and lack of obvious trends in AHOD. The AHOD in 2008 remained well above the eutrophic-hypereutrophic boundary.

E.B. Welch and G.D. Cooke
January 6, 2009

Jones, J. R., M. F. Knowlton and D. V. Obrecht. 2008. Role of land cover and hydrology in determining nutrients in mid-continent reservoirs: implications for nutrient criteria and management. Lake and Reservoir Manage. 24:1-9.

Tenkiller Dissolved Oxygen Data for 2008

StationID	Date	Depth	ParamID	Result	UnitsID
LK-01	6/3/2008	0	DO	9.24	mg/L
LK-01	6/3/2008	1	DO	9.39	mg/L
LK-01	6/3/2008	2	DO	9.38	mg/L
LK-01	6/3/2008	3	DO	9.63	mg/L
LK-01	6/3/2008	4	DO	8.42	mg/L
LK-01	6/3/2008	5	DO	6.96	mg/L
LK-01	6/3/2008	6	DO	6.19	mg/L
LK-01	6/3/2008	7	DO	6.11	mg/L
LK-01	6/3/2008	8	DO	6.17	mg/L
LK-01	6/3/2008	9	DO	6.26	mg/L
LK-01	6/3/2008	10	DO	6.33	mg/L
LK-01	6/3/2008	11	DO	6.38	mg/L
LK-01	6/3/2008	12	DO	6.53	mg/L
LK-01	6/3/2008	13	DO	6.43	mg/L
LK-01	6/3/2008	14	DO	6.29	mg/L
LK-01	6/3/2008	15	DO	6.41	mg/L
LK-01	6/3/2008	16	DO	6.48	mg/L
LK-01	6/3/2008	17	DO	6.5	mg/L
LK-01	6/3/2008	18	DO	6.43	mg/L
LK-01	6/3/2008	19	DO	6.38	mg/L
LK-01	6/3/2008	20	DO	6.39	mg/L
LK-01	6/3/2008	21	DO	6.25	mg/L
LK-01	6/3/2008	22	DO	5.99	mg/L
LK-01	6/3/2008	23	DO	5.89	mg/L
LK-01	6/3/2008	24	DO	5.68	mg/L
LK-01	6/3/2008	25	DO	5.45	mg/L
LK-01	6/3/2008	26	DO	5.31	mg/L
LK-01	6/3/2008	27	DO	4.92	mg/L
LK-01	7/9/2008	0	DO	8.18	mg/L
LK-01	7/9/2008	1	DO	7.91	mg/L
LK-01	7/9/2008	2	DO	7.7	mg/L
LK-01	7/9/2008	3	DO	7.56	mg/L
LK-01	7/9/2008	4	DO	7.17	mg/L
LK-01	7/9/2008	5	DO	6.27	mg/L
LK-01	7/9/2008	6	DO	5.29	mg/L
LK-01	7/9/2008	7	DO	3.42	mg/L
LK-01	7/9/2008	8	DO	2.05	mg/L
LK-01	7/9/2008	9	DO	1.38	mg/L
LK-01	7/9/2008	10	DO	1.07	mg/L
LK-01	7/9/2008	11	DO	0.88	mg/L
LK-01	7/9/2008	12	DO	0.8	mg/L
LK-01	7/9/2008	13	DO	0.81	mg/L
LK-01	7/9/2008	14	DO	0.84	mg/L
LK-01	7/9/2008	15	DO	0.89	mg/L
LK-01	7/9/2008	16	DO	0.93	mg/L
LK-01	7/9/2008	17	DO	0.98	mg/L
LK-01	7/9/2008	18	DO	0.96	mg/L
LK-01	7/9/2008	19	DO	1.07	mg/L
LK-01	7/9/2008	20	DO	1.41	mg/L
LK-01	7/9/2008	21	DO	1.65	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-01	7/9/2008	22	DO	2.25	mg/L
LK-01	7/9/2008	23	DO	2.68	mg/L
LK-01	7/9/2008	24	DO	2.62	mg/L
LK-01	7/9/2008	25	DO	2.44	mg/L
LK-01	7/9/2008	26	DO	1.82	mg/L
LK-01	7/9/2008	27	DO	0.58	mg/L
LK-01	7/9/2008	28	DO	0.08	mg/L
LK-01	7/9/2008	29	DO	0.02	mg/L
LK-01	7/9/2008	30	DO	0.01	mg/L
LK-01	8/14/2008	0	DO	7.54	mg/L
LK-01	8/14/2008	1	DO	7.34	mg/L
LK-01	8/14/2008	2	DO	7.34	mg/L
LK-01	8/14/2008	3	DO	7.34	mg/L
LK-01	8/14/2008	4	DO	7.32	mg/L
LK-01	8/14/2008	5	DO	7.31	mg/L
LK-01	8/14/2008	6	DO	7.3	mg/L
LK-01	8/14/2008	7	DO	7.27	mg/L
LK-01	8/14/2008	8	DO	6.92	mg/L
LK-01	8/14/2008	9	DO	6.37	mg/L
LK-01	8/14/2008	10	DO	5.8	mg/L
LK-01	8/14/2008	11	DO	2.98	mg/L
LK-01	8/14/2008	12	DO	1.45	mg/L
LK-01	8/14/2008	13	DO	0.54	mg/L
LK-01	8/14/2008	14	DO	0.7	mg/L
LK-01	8/14/2008	15	DO	0.1	mg/L
LK-01	8/14/2008	16	DO	0.06	mg/L
LK-01	8/14/2008	17	DO	0.05	mg/L
LK-01	8/14/2008	18	DO	0.05	mg/L
LK-01	8/14/2008	19	DO	0.05	mg/L
LK-01	8/14/2008	20	DO	0.05	mg/L
LK-01	8/14/2008	21	DO	0.04	mg/L
LK-01	8/14/2008	22	DO	0.04	mg/L
LK-01	8/14/2008	23	DO	0.04	mg/L
LK-01	8/14/2008	24	DO	0.04	mg/L
LK-01	8/14/2008	25	DO	0.04	mg/L
LK-01	9/22/2008	0	DO	6.74	mg/L
LK-01	9/22/2008	1	DO	6.67	mg/L
LK-01	9/22/2008	2	DO	6.67	mg/L
LK-01	9/22/2008	3	DO	6.65	mg/L
LK-01	9/22/2008	4	DO	6.76	mg/L
LK-01	9/22/2008	5	DO	6.94	mg/L
LK-01	9/22/2008	6	DO	6.67	mg/L
LK-01	9/22/2008	7	DO	6.23	mg/L
LK-01	9/22/2008	8	DO	6.09	mg/L
LK-01	9/22/2008	9	DO	6.16	mg/L
LK-01	9/22/2008	10	DO	6.03	mg/L
LK-01	9/22/2008	11	DO	5.67	mg/L
LK-01	9/22/2008	12	DO	3.48	mg/L
LK-01	9/22/2008	13	DO	0.91	mg/L
LK-01	9/22/2008	14	DO	0.57	mg/L
LK-01	9/22/2008	15	DO	0.70	mg/L

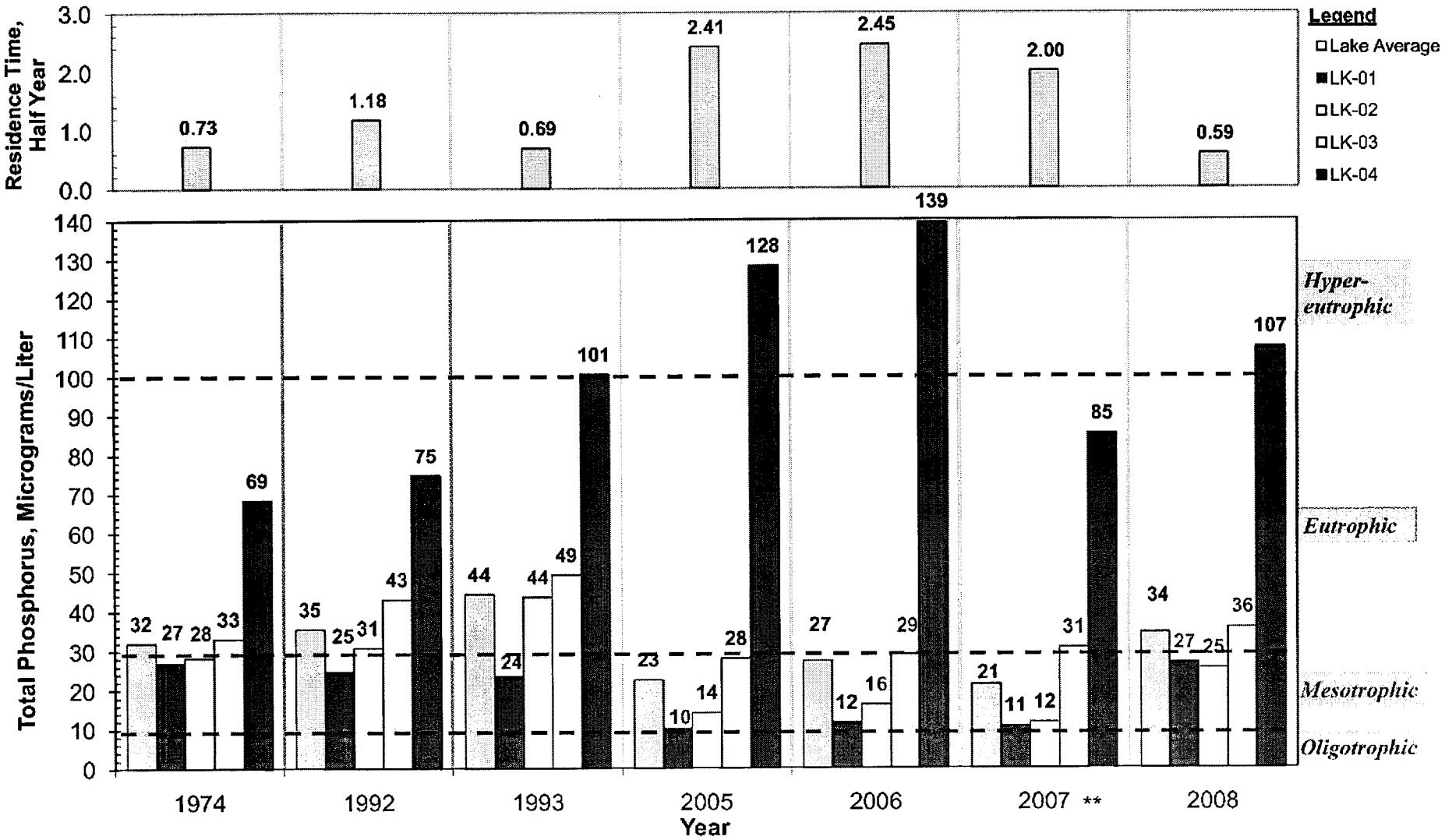
StationID	Date	Depth	ParamID	Result	UnitsID
LK-01	9/22/2008	16	DO	0.31	mg/L
LK-01	9/22/2008	17	DO	0.12	mg/L
LK-01	9/22/2008	18	DO	0.10	mg/L
LK-01	9/22/2008	19	DO	0.08	mg/L
LK-01	9/22/2008	20	DO	0.07	mg/L
LK-01	9/22/2008	21	DO	0.07	mg/L
LK-01	9/22/2008	22	DO	0.07	mg/L
LK-01	9/22/2008	23	DO	0.06	mg/L
LK-01	9/22/2008	24	DO	0.06	mg/L
LK-01	9/22/2008	25	DO	0.18	mg/L
LK-01	9/22/2008	26	DO	0.75	mg/L
LK-02	6/3/2008	0	DO	8.76	mg/L
LK-02	6/3/2008	1	DO	8.84	mg/L
LK-02	6/3/2008	2	DO	8.85	mg/L
LK-02	6/3/2008	3	DO	8.63	mg/L
LK-02	6/3/2008	4	DO	8.56	mg/L
LK-02	6/3/2008	5	DO	8.52	mg/L
LK-02	6/3/2008	6	DO	8.55	mg/L
LK-02	6/3/2008	7	DO	8.37	mg/L
LK-02	6/3/2008	8	DO	8.25	mg/L
LK-02	6/3/2008	9	DO	5.69	mg/L
LK-02	6/3/2008	10	DO	4.94	mg/L
LK-02	6/3/2008	11	DO	4.4	mg/L
LK-02	6/3/2008	12	DO	4.7	mg/L
LK-02	6/3/2008	13	DO	4.85	mg/L
LK-02	6/3/2008	14	DO	5.03	mg/L
LK-02	6/3/2008	15	DO	4.84	mg/L
LK-02	6/3/2008	16	DO	4.91	mg/L
LK-02	6/3/2008	17	DO	4.29	mg/L
LK-02	6/3/2008	18	DO	4.23	mg/L
LK-02	6/3/2008	19	DO	4.28	mg/L
LK-02	6/3/2008	20	DO	4.15	mg/L
LK-02	6/3/2008	21	DO	3.93	mg/L
LK-02	6/3/2008	22	DO	3.59	mg/L
LK-02	6/3/2008	23	DO	2.43	mg/L
LK-02	7/9/2008	0	DO	6.93	mg/L
LK-02	7/9/2008	1	DO	8.02	mg/L
LK-02	7/9/2008	2	DO	8.08	mg/L
LK-02	7/9/2008	3	DO	8.07	mg/L
LK-02	7/9/2008	4	DO	8.03	mg/L
LK-02	7/9/2008	5	DO	8	mg/L
LK-02	7/9/2008	6	DO	7.93	mg/L
LK-02	7/9/2008	7	DO	3.59	mg/L
LK-02	7/9/2008	8	DO	1.89	mg/L
LK-02	7/9/2008	9	DO	0.93	mg/L
LK-02	7/9/2008	10	DO	0.55	mg/L
LK-02	7/9/2008	11	DO	0.47	mg/L
LK-02	7/9/2008	12	DO	0.52	mg/L
LK-02	7/9/2008	13	DO	0.6	mg/L
LK-02	7/9/2008	14	DO	0.63	mg/L
LK-02	7/9/2008	15	DO	0.67	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-02	7/9/2008	16	DO	0.64	mg/L
LK-02	7/9/2008	17	DO	0.51	mg/L
LK-02	7/9/2008	18	DO	0.25	mg/L
LK-02	7/9/2008	19	DO	0.17	mg/L
LK-02	7/9/2008	20	DO	0.16	mg/L
LK-02	7/9/2008	21	DO	0.12	mg/L
LK-02	7/9/2008	22	DO	0.06	mg/L
LK-02	7/9/2008	23	DO	0.03	mg/L
LK-02	7/9/2008	24	DO	0.02	mg/L
LK-02	7/9/2008	25	DO	0.01	mg/L
LK-02	8/14/2008	0	DO	6.6	mg/L
LK-02	8/14/2008	1	DO	6.33	mg/L
LK-02	8/14/2008	2	DO	6.24	mg/L
LK-02	8/14/2008	3	DO	6.12	mg/L
LK-02	8/14/2008	4	DO	6.01	mg/L
LK-02	8/14/2008	5	DO	5.91	mg/L
LK-02	8/14/2008	6	DO	5.8	mg/L
LK-02	8/14/2008	7	DO	5.75	mg/L
LK-02	8/14/2008	8	DO	5.74	mg/L
LK-02	8/14/2008	9	DO	4.8	mg/L
LK-02	8/14/2008	10	DO	2.97	mg/L
LK-02	8/14/2008	11	DO	0.78	mg/L
LK-02	8/14/2008	12	DO	0.2	mg/L
LK-02	8/14/2008	13	DO	0.12	mg/L
LK-02	8/14/2008	14	DO	0.06	mg/L
LK-02	8/14/2008	15	DO	0.05	mg/L
LK-02	8/14/2008	16	DO	0.04	mg/L
LK-02	8/14/2008	17	DO	0.04	mg/L
LK-02	8/14/2008	18	DO	0.04	mg/L
LK-02	8/14/2008	19	DO	0.03	mg/L
LK-02	8/14/2008	20	DO	0.03	mg/L
LK-02	8/14/2008	21	DO	0.03	mg/L
LK-02	8/14/2008	22	DO	0.03	mg/L
LK-02	9/22/2008	0	DO	7.41	mg/L
LK-02	9/22/2008	1	DO	7.36	mg/L
LK-02	9/22/2008	2	DO	7.36	mg/L
LK-02	9/22/2008	3	DO	7.54	mg/L
LK-02	9/22/2008	4	DO	7.72	mg/L
LK-02	9/22/2008	5	DO	7.68	mg/L
LK-02	9/22/2008	6	DO	7.21	mg/L
LK-02	9/22/2008	7	DO	7.08	mg/L
LK-02	9/22/2008	8	DO	7.07	mg/L
LK-02	9/22/2008	9	DO	7.03	mg/L
LK-02	9/22/2008	10	DO	6.95	mg/L
LK-02	9/22/2008	11	DO	6.76	mg/L
LK-02	9/22/2008	12	DO	6.36	mg/L
LK-02	9/22/2008	13	DO	5.99	mg/L
LK-02	9/22/2008	14	DO	5.70	mg/L
LK-02	9/22/2008	15	DO	4.59	mg/L
LK-02	9/22/2008	16	DO	3.75	mg/L
LK-02	9/22/2008	17	DO	3.69	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-02	9/22/2008	18	DO	3.90	mg/L
LK-02	9/22/2008	19	DO	3.72	mg/L
LK-02	9/22/2008	20	DO	2.50	mg/L
LK-02	9/22/2008	21	DO	3.40	mg/L
LK-02	9/22/2008	22	DO	3.80	mg/L
LK-02	9/22/2008	23	DO	3.64	mg/L
LK-02	9/22/2008	24	DO	2.22	mg/L
LK-03	6/3/2008	0	DO	8.47	mg/L
LK-03	6/3/2008	1	DO	8.63	mg/L
LK-03	6/3/2008	2	DO	8.7	mg/L
LK-03	6/3/2008	3	DO	8.4	mg/L
LK-03	6/3/2008	4	DO	7.98	mg/L
LK-03	6/3/2008	5	DO	7.61	mg/L
LK-03	6/3/2008	6	DO	6.99	mg/L
LK-03	6/3/2008	7	DO	6.62	mg/L
LK-03	6/3/2008	8	DO	6.1	mg/L
LK-03	7/9/2008	0	DO	9.67	mg/L
LK-03	7/9/2008	1	DO	9.82	mg/L
LK-03	7/9/2008	2	DO	9.79	mg/L
LK-03	7/9/2008	3	DO	9.67	mg/L
LK-03	7/9/2008	4	DO	9.22	mg/L
LK-03	7/9/2008	5	DO	8.98	mg/L
LK-03	7/9/2008	6	DO	7.92	mg/L
LK-03	7/9/2008	7	DO	5.3	mg/L
LK-03	7/9/2008	8	DO	3.7	mg/L
LK-03	8/14/2008 (8:15 am)	0	DO	6.27	mg/L
LK-03	8/14/2008 (8:15 am)	1	DO	6.28	mg/L
LK-03	8/14/2008 (8:15 am)	2	DO	6.23	mg/L
LK-03	8/14/2008 (8:15 am)	3	DO	6.22	mg/L
LK-03	8/14/2008 (8:15 am)	4	DO	6.07	mg/L
LK-03	8/14/2008 (8:15 am)	5	DO	3.08	mg/L
LK-03	8/14/2008 (8:15 am)	6	DO	1.93	mg/L
LK-03	8/14/2008 (8:15 am)	7	DO	0.53	mg/L
LK-03	8/14/2008 (8:15 am)	8	DO	0.63	mg/L
LK-03	8/14/2008 (10:03 am)	0	DO	6.98	mg/L
LK-03	8/14/2008 (10:03 am)	1	DO	6.89	mg/L
LK-03	8/14/2008 (10:03 am)	2	DO	6.48	mg/L
LK-03	8/14/2008 (10:03 am)	3	DO	6.31	mg/L
LK-03	8/14/2008 (10:03 am)	4	DO	5.8	mg/L
LK-03	8/14/2008 (10:03 am)	5	DO	3.57	mg/L
LK-03	8/14/2008 (10:03 am)	6	DO	1.35	mg/L
LK-03	8/14/2008 (10:03 am)	7	DO	0.53	mg/L
LK-03	9/22/2008	0	DO	10.33	mg/L
LK-03	9/22/2008	1	DO	10.44	mg/L
LK-03	9/22/2008	2	DO	10.30	mg/L
LK-03	9/22/2008	3	DO	9.70	mg/L
LK-03	9/22/2008	4	DO	8.67	mg/L
LK-03	9/22/2008	5	DO	8.49	mg/L
LK-03	9/22/2008	6	DO	7.93	mg/L
LK-03	9/22/2008	7	DO	6.69	mg/L
LK-03	9/22/2008	8	DO	6.26	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-04	6/3/2008	0	DO	8.04	mg/L
LK-04	6/3/2008	1	DO	8.1	mg/L
LK-04	6/3/2008	2	DO	7.09	mg/L
LK-04	6/3/2008	3	DO	6.88	mg/L
LK-04	6/3/2008	4	DO	6.43	mg/L
LK-04	6/3/2008	5	DO	6.23	mg/L
LK-04	6/3/2008	6	DO	6.09	mg/L
LK-04	7/9/2008	0	DO	10.74	mg/L
LK-04	7/9/2008	1	DO	10.67	mg/L
LK-04	7/9/2008	2	DO	10.1	mg/L
LK-04	7/9/2008	3	DO	7.99	mg/L
LK-04	7/9/2008	4	DO	6.87	mg/L
LK-04	7/9/2008	5	DO	6.19	mg/L
LK-04	7/9/2008	6	DO	5.08	mg/L
LK-04	8/14/2008 (6:50 am)	0	DO	6.15	mg/L
LK-04	8/14/2008 (6:50 am)	1	DO	5.97	mg/L
LK-04	8/14/2008 (6:50 am)	2	DO	5.93	mg/L
LK-04	8/14/2008 (6:50 am)	3	DO	5.91	mg/L
LK-04	8/14/2008 (6:50 am)	4	DO	5.43	mg/L
LK-04	8/14/2008 (6:50 am)	5	DO	4.72	mg/L
LK-04	8/14/2008 (6:50 am)	6	DO	3.63	mg/L
LK-04	8/14/2008 (10:30 am)	0	DO	9.98	mg/L
LK-04	8/14/2008 (10:30 am)	1	DO	9.05	mg/L
LK-04	8/14/2008 (10:30 am)	2	DO	7.59	mg/L
LK-04	8/14/2008 (10:30 am)	3	DO	6.65	mg/L
LK-04	8/14/2008 (10:30 am)	4	DO	6.38	mg/L
LK-04	8/14/2008 (10:30 am)	5	DO	6.15	mg/L
LK-04	8/14/2008 (10:30 am)	6	DO	4.42	mg/L
LK-04	9/22/2008	0	DO	14.64	mg/L
LK-04	9/22/2008	1	DO	14.20	mg/L
LK-04	9/22/2008	2	DO	12.11	mg/L
LK-04	9/22/2008	3	DO	8.54	mg/L
LK-04	9/22/2008	4	DO	7.52	mg/L
LK-04	9/22/2008	5	DO	6.71	mg/L
LK-04	9/22/2008	6	DO	6.51	mg/L
LK-04	9/22/2008	7	DO	5.89	mg/L

Average Seasonal* Total Phosphorus and Residence Time for Tenkiller



Note: *Data from: 1974 -- EPA; 1992 and 1993 -- OWRB Clean Lakes Study; 2005, 2006, 2007, 2008 -- CDM;*
Boundaries between Mesotrophic, Eutrophic, and Hypereutrophic conditions of 10, 30, and 100 ug/L, respectively, are according to Numberg;
** Season is June thru September for Total Phosphorus Data and April thru September for Residence Times; ** Only June, July, and August data for 2007*

Figure 7 Supplemental.

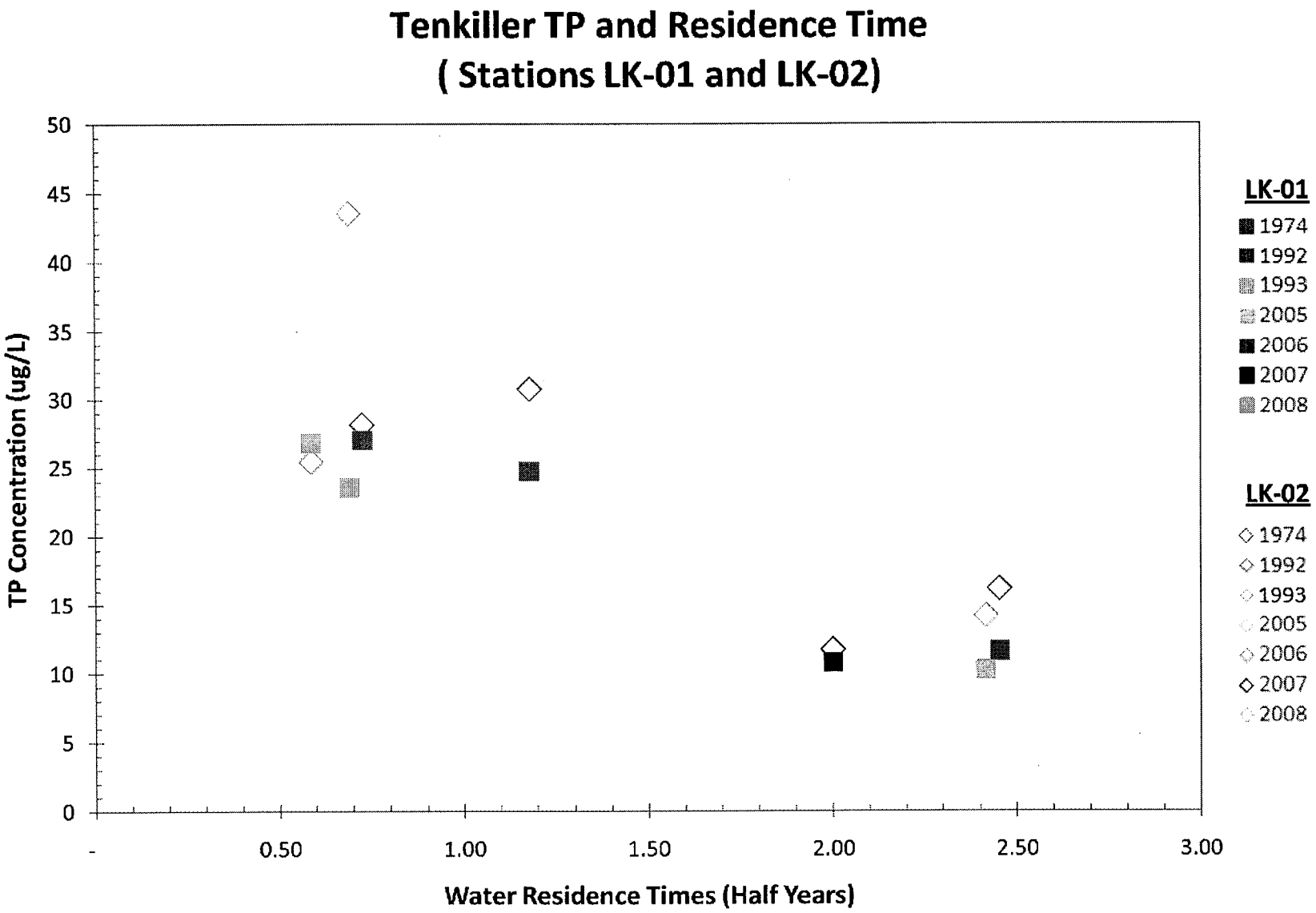


Figure 7.1 Supplemental. Relationship Between Water Residence Time (half years, x axis) and TP Concentration (µg/L, y axis) in Surface Water at Stations LK-01 and LK-02 in Tenkiller

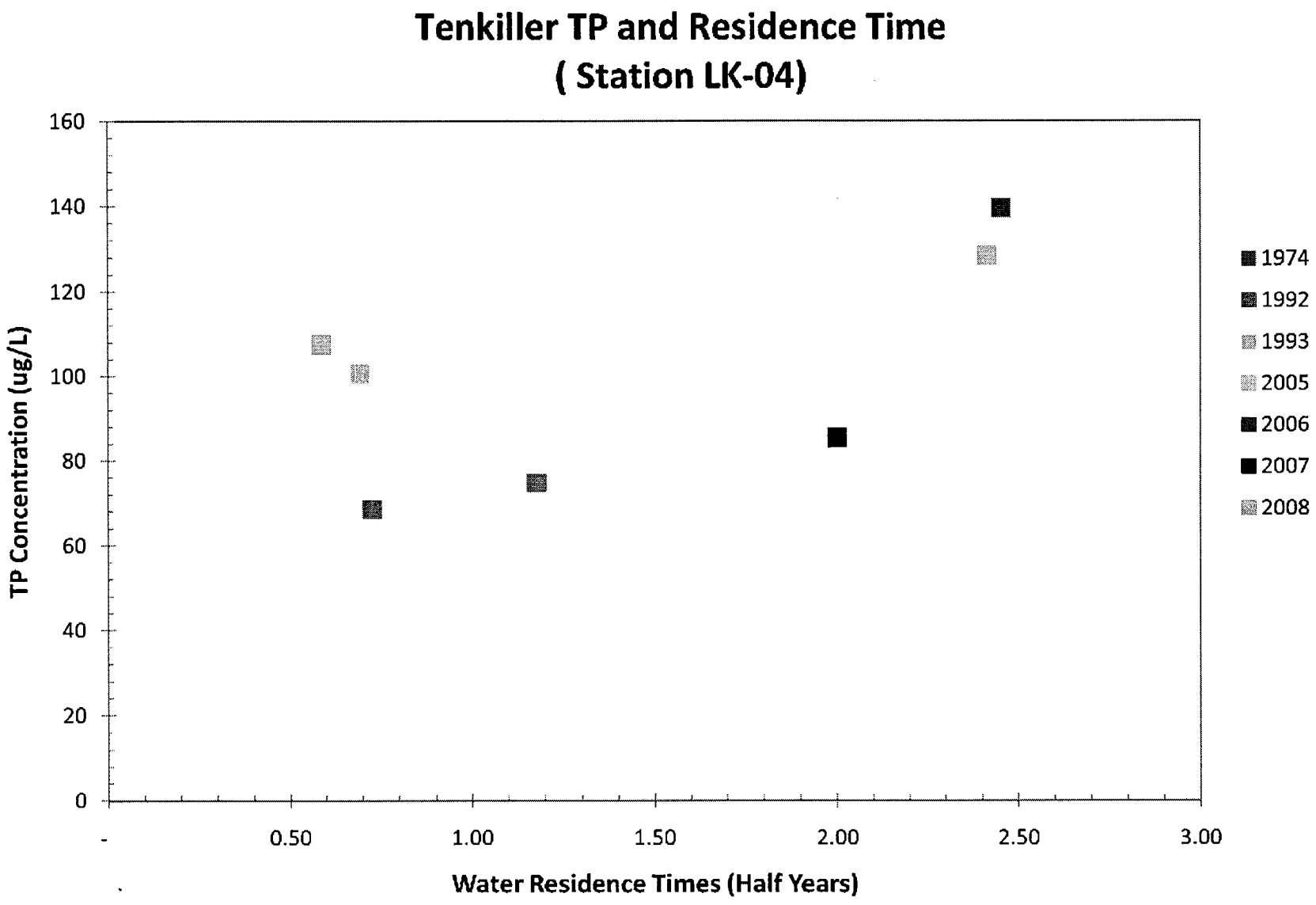
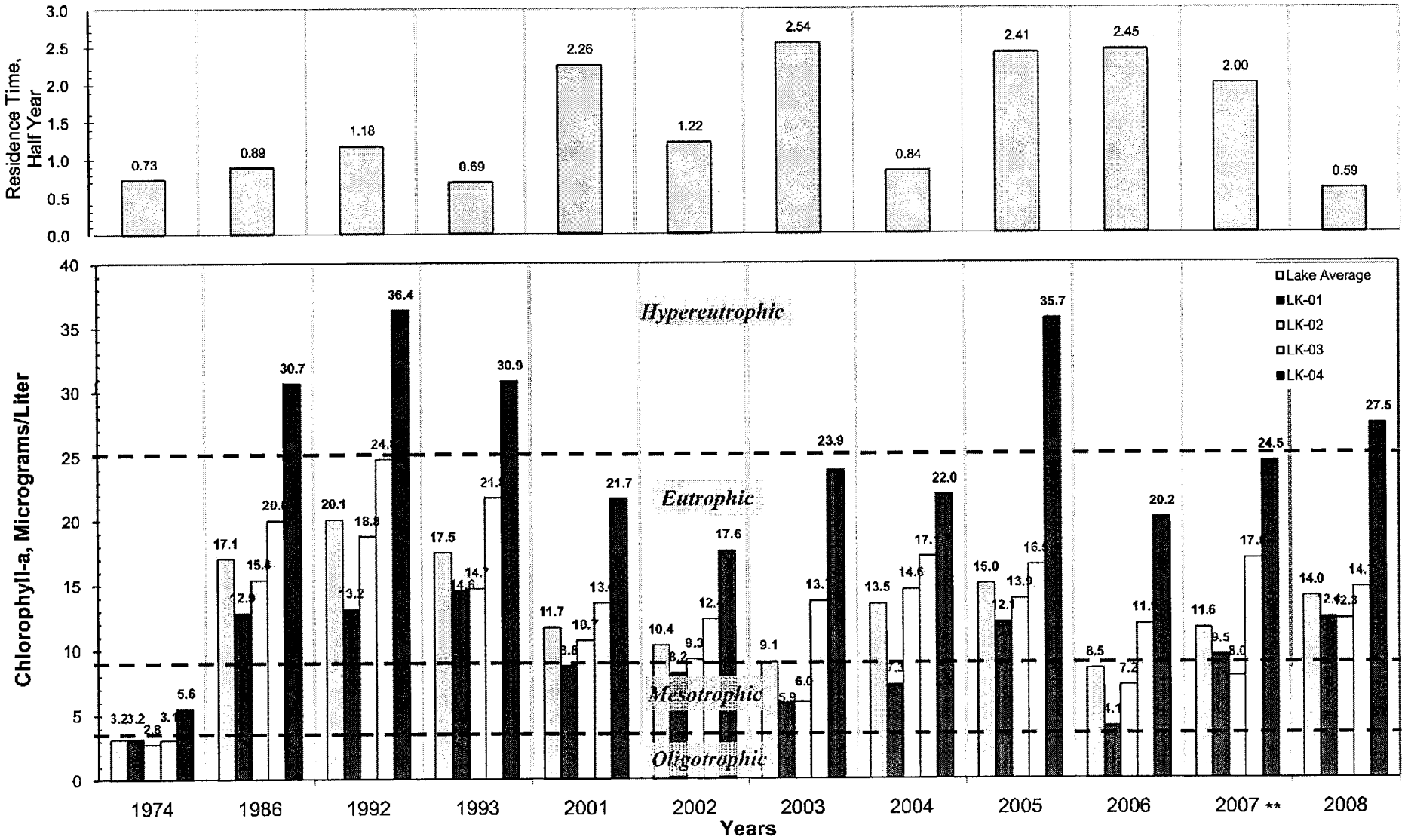


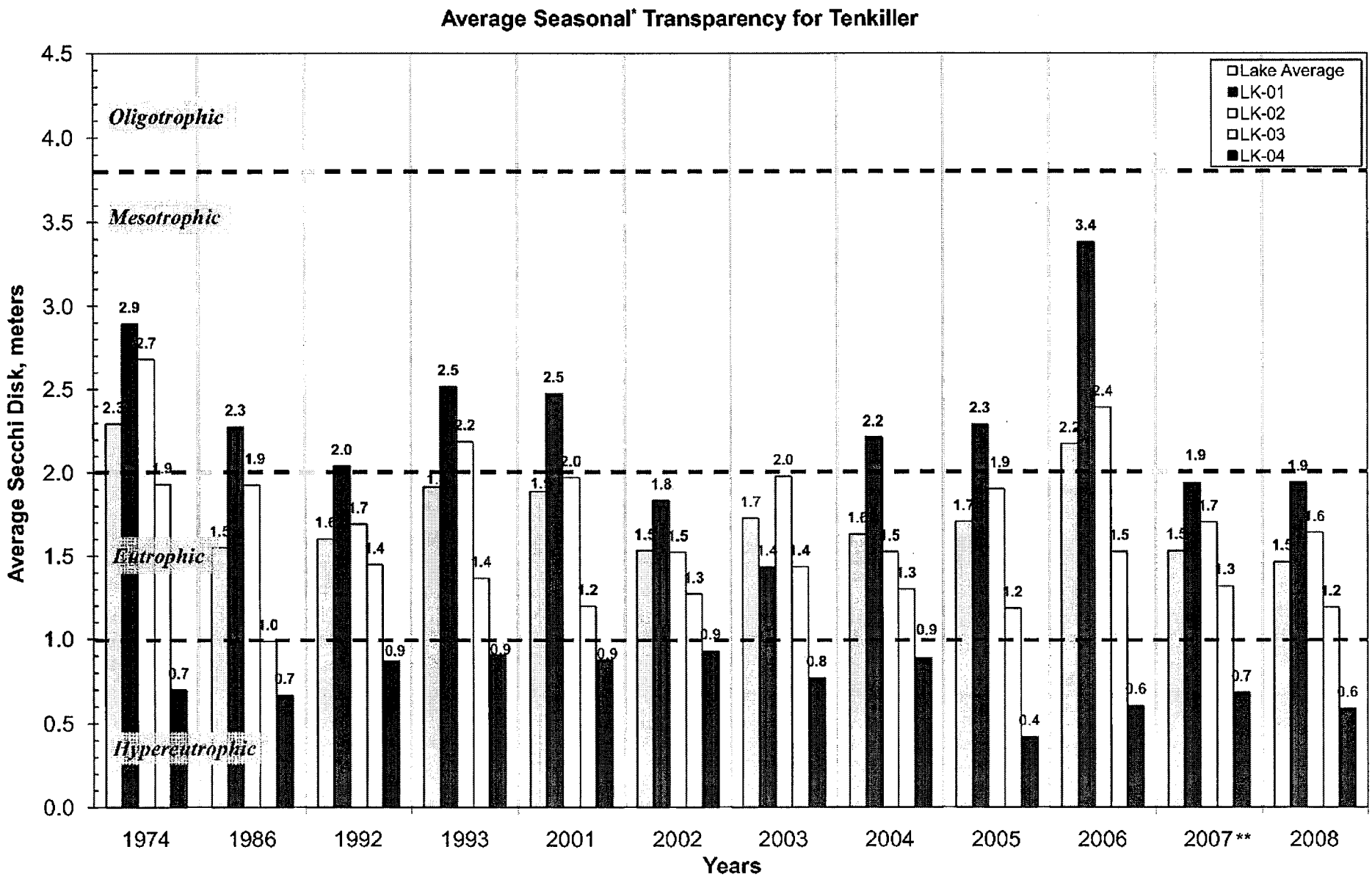
Figure 7.2 Supplemental. Relationship Between Water Residence Time (half years, x axis) and TP Concentration (µg/L, y axis) in Surface Water at Station LK-04 in Tenkiller

Seasonal* Average Chlorophyll Values for Tenkiller



Note: *Data from: 1974 -- EPA; 1986, 2001, 2002, 2003, and 2004 -- Army Corps of Engineers; 1992 and 1993 -- OWRB Clean Lakes Study; 2005, 2006, 2007, 2008 -- CDM;*
Boundaries between Mesotrophic, Eutrophic, and Hypereutrophic conditions of 3.5, 9, and 25 ug/L, respectively, are according to Numberg;
** Season is June thru September for Chlorophyll Data and April thru September for Residence Times; ** Only June, July, and August data for 2007*

Figure 8 Supplemental.



Note: *Data from: 1974 – EPA; 1986, 2001, 2002, 2003, and 2004 -- Army Corps of Engineers; 1992 and 1993 -- OWRB Clean Lakes Study; 2005, 2006, 2007, 2008 -- CDM; Boundaries between Mesotrophic, Eutrophic, and Hypereutrophic conditions of 3.8, 2, and 1 meters, respectively, are according to Nurnberg;*
** Season is June thru September; ** Only June, July, and August data for 2007*

Figure 9 Supplemental.

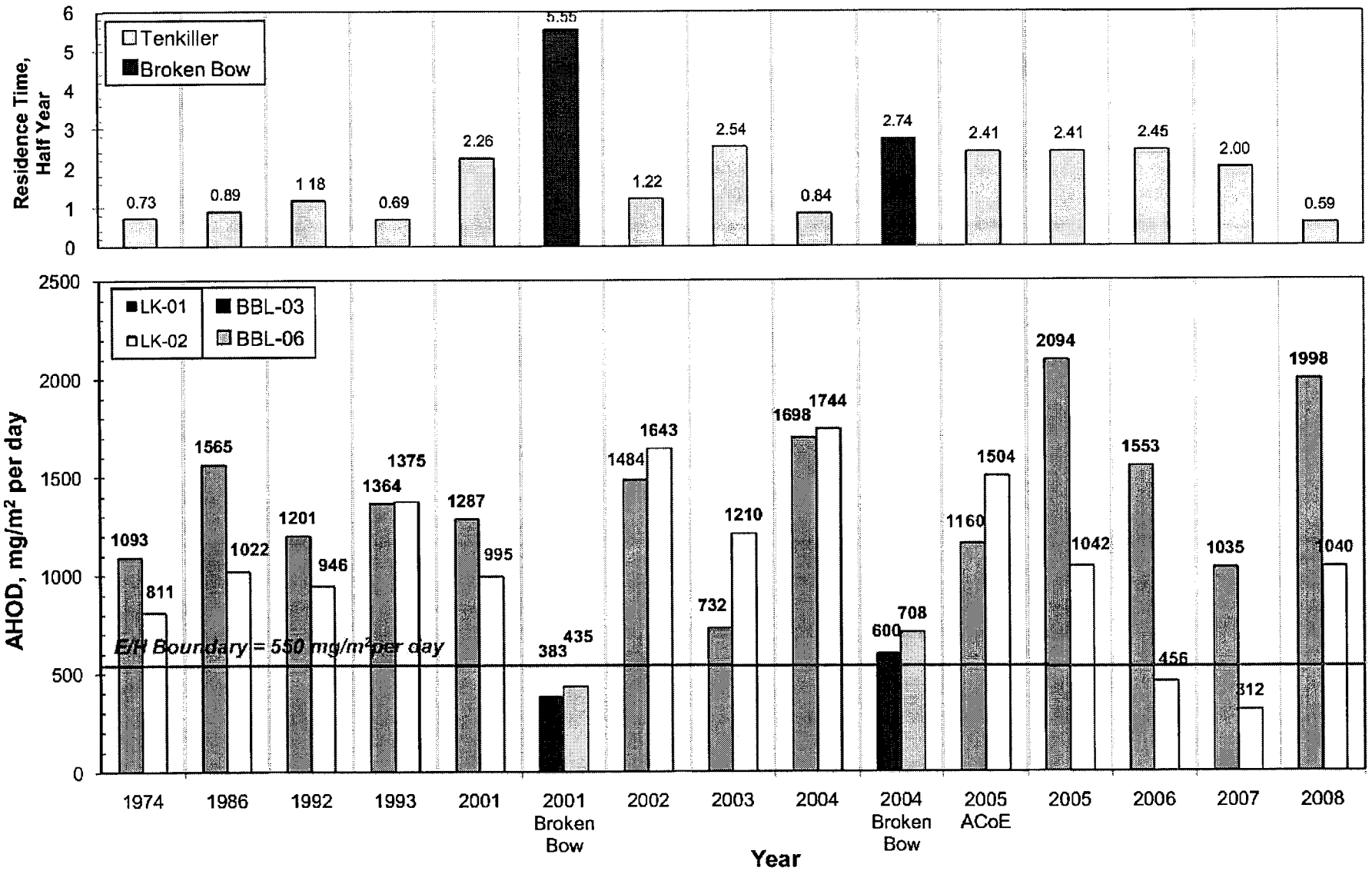


Figure 29 Supplemental. ArealHypolimneticDeficit Rate at LacustrineStations LK-01 and LK-02 in Tenkillerand for Two Years in Broken Bow at Analogous Sites (BBL-03 and BBL-06) as in Tenkiller.

Data are from the various years and sites as available: Residence Times are based on data from the Army Corps of Engineers, April thru September. DO Data are from. 1974 –EPA; 1986, 2001, 2002, 2003, and 2004 –Army Corps of Engineers; 1992 and 1993 – OWRB Clean Lakes Study; 2005, 2006, 2007, 2008 –CDM.

Appendix A: 2008 Supplemental Data

Tenkiller Dissolved Oxygen Data for 2008

StationID	Date	Depth	ParamID	Result	UnitsID
LK-01	6/3/2008	0	DO	9.24	mg/L
LK-01	6/3/2008	1	DO	9.39	mg/L
LK-01	6/3/2008	2	DO	9.38	mg/L
LK-01	6/3/2008	3	DO	9.63	mg/L
LK-01	6/3/2008	4	DO	8.42	mg/L
LK-01	6/3/2008	5	DO	6.96	mg/L
LK-01	6/3/2008	6	DO	6.19	mg/L
LK-01	6/3/2008	7	DO	6.11	mg/L
LK-01	6/3/2008	8	DO	6.17	mg/L
LK-01	6/3/2008	9	DO	6.26	mg/L
LK-01	6/3/2008	10	DO	6.33	mg/L
LK-01	6/3/2008	11	DO	6.38	mg/L
LK-01	6/3/2008	12	DO	6.53	mg/L
LK-01	6/3/2008	13	DO	6.43	mg/L
LK-01	6/3/2008	14	DO	6.29	mg/L
LK-01	6/3/2008	15	DO	6.41	mg/L
LK-01	6/3/2008	16	DO	6.48	mg/L
LK-01	6/3/2008	17	DO	6.5	mg/L
LK-01	6/3/2008	18	DO	6.43	mg/L
LK-01	6/3/2008	19	DO	6.38	mg/L
LK-01	6/3/2008	20	DO	6.39	mg/L
LK-01	6/3/2008	21	DO	6.25	mg/L
LK-01	6/3/2008	22	DO	5.99	mg/L
LK-01	6/3/2008	23	DO	5.89	mg/L
LK-01	6/3/2008	24	DO	5.68	mg/L
LK-01	6/3/2008	25	DO	5.45	mg/L
LK-01	6/3/2008	26	DO	5.31	mg/L
LK-01	6/3/2008	27	DO	4.92	mg/L
LK-01	7/9/2008	0	DO	8.18	mg/L
LK-01	7/9/2008	1	DO	7.91	mg/L
LK-01	7/9/2008	2	DO	7.7	mg/L
LK-01	7/9/2008	3	DO	7.56	mg/L
LK-01	7/9/2008	4	DO	7 17	mg/L
LK-01	7/9/2008	5	DO	6.27	mg/L
LK-01	7/9/2008	6	DO	5.29	mg/L
LK-01	7/9/2008	7	DO	3.42	mg/L
LK-01	7/9/2008	8	DO	2.05	mg/L
LK-01	7/9/2008	9	DO	1.38	mg/L
LK-01	7/9/2008	10	DO	1.07	mg/L
LK-01	7/9/2008	11	DO	0.88	mg/L
LK-01	7/9/2008	12	DO	0.8	mg/L
LK-01	7/9/2008	13	DO	0.81	mg/L
LK-01	7/9/2008	14	DO	0.84	mg/L
LK-01	7/9/2008	15	DO	0.89	mg/L
LK-01	7/9/2008	16	DO	0.93	mg/L
LK-01	7/9/2008	17	DO	0.98	mg/L
LK-01	7/9/2008	18	DO	0.96	mg/L
LK-01	7/9/2008	19	DO	1.07	mg/L
LK-01	7/9/2008	20	DO	1.41	mg/L
LK-01	7/9/2008	21	DO	1.65	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-01	7/9/2008	22	DO	2.25	mg/L
LK-01	7/9/2008	23	DO	2.68	mg/L
LK-01	7/9/2008	24	DO	2.62	mg/L
LK-01	7/9/2008	25	DO	2.44	mg/L
LK-01	7/9/2008	26	DO	1.82	mg/L
LK-01	7/9/2008	27	DO	0.58	mg/L
LK-01	7/9/2008	28	DO	0.08	mg/L
LK-01	7/9/2008	29	DO	0.02	mg/L
LK-01	7/9/2008	30	DO	0.01	mg/L
LK-01	8/14/2008	0	DO	7.54	mg/L
LK-01	8/14/2008	1	DO	7.34	mg/L
LK-01	8/14/2008	2	DO	7.34	mg/L
LK-01	8/14/2008	3	DO	7.34	mg/L
LK-01	8/14/2008	4	DO	7.32	mg/L
LK-01	8/14/2008	5	DO	7.31	mg/L
LK-01	8/14/2008	6	DO	7.3	mg/L
LK-01	8/14/2008	7	DO	7.27	mg/L
LK-01	8/14/2008	8	DO	6.92	mg/L
LK-01	8/14/2008	9	DO	6.37	mg/L
LK-01	8/14/2008	10	DO	5.8	mg/L
LK-01	8/14/2008	11	DO	2.98	mg/L
LK-01	8/14/2008	12	DO	1.45	mg/L
LK-01	8/14/2008	13	DO	0.54	mg/L
LK-01	8/14/2008	14	DO	0.7	mg/L
LK-01	8/14/2008	15	DO	0.1	mg/L
LK-01	8/14/2008	16	DO	0.06	mg/L
LK-01	8/14/2008	17	DO	0.05	mg/L
LK-01	8/14/2008	18	DO	0.05	mg/L
LK-01	8/14/2008	19	DO	0.05	mg/L
LK-01	8/14/2008	20	DO	0.05	mg/L
LK-01	8/14/2008	21	DO	0.04	mg/L
LK-01	8/14/2008	22	DO	0.04	mg/L
LK-01	8/14/2008	23	DO	0.04	mg/L
LK-01	8/14/2008	24	DO	0.04	mg/L
LK-01	8/14/2008	25	DO	0.04	mg/L
LK-01	9/22/2008	0	DO	6.74	mg/L
LK-01	9/22/2008	1	DO	6.67	mg/L
LK-01	9/22/2008	2	DO	6.67	mg/L
LK-01	9/22/2008	3	DO	6.65	mg/L
LK-01	9/22/2008	4	DO	6.76	mg/L
LK-01	9/22/2008	5	DO	6.94	mg/L
LK-01	9/22/2008	6	DO	6.67	mg/L
LK-01	9/22/2008	7	DO	6.23	mg/L
LK-01	9/22/2008	8	DO	6.09	mg/L
LK-01	9/22/2008	9	DO	6.16	mg/L
LK-01	9/22/2008	10	DO	6.03	mg/L
LK-01	9/22/2008	11	DO	5.67	mg/L
LK-01	9/22/2008	12	DO	3.48	mg/L
LK-01	9/22/2008	13	DO	0.91	mg/L
LK-01	9/22/2008	14	DO	0.57	mg/L
LK-01	9/22/2008	15	DO	0.70	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-01	9/22/2008	16	DO	0.31	mg/L
LK-01	9/22/2008	17	DO	0.12	mg/L
LK-01	9/22/2008	18	DO	0.10	mg/L
LK-01	9/22/2008	19	DO	0.08	mg/L
LK-01	9/22/2008	20	DO	0.07	mg/L
LK-01	9/22/2008	21	DO	0.07	mg/L
LK-01	9/22/2008	22	DO	0.07	mg/L
LK-01	9/22/2008	23	DO	0.06	mg/L
LK-01	9/22/2008	24	DO	0.06	mg/L
LK-01	9/22/2008	25	DO	0 18	mg/L
LK-01	9/22/2008	26	DO	0.75	mg/L
LK-02	6/3/2008	0	DO	8.76	mg/L
LK-02	6/3/2008	1	DO	8.84	mg/L
LK-02	6/3/2008	2	DO	8.85	mg/L
LK-02	6/3/2008	3	DO	8.63	mg/L
LK-02	6/3/2008	4	DO	8.56	mg/L
LK-02	6/3/2008	5	DO	8.52	mg/L
LK-02	6/3/2008	6	DO	8.55	mg/L
LK-02	6/3/2008	7	DO	8.37	mg/L
LK-02	6/3/2008	8	DO	8.25	mg/L
LK-02	6/3/2008	9	DO	5.69	mg/L
LK-02	6/3/2008	10	DO	4.94	mg/L
LK-02	6/3/2008	11	DO	4.4	mg/L
LK-02	6/3/2008	12	DO	4.7	mg/L
LK-02	6/3/2008	13	DO	4.85	mg/L
LK-02	6/3/2008	14	DO	5.03	mg/L
LK-02	6/3/2008	15	DO	4.84	mg/L
LK-02	6/3/2008	16	DO	4.91	mg/L
LK-02	6/3/2008	17	DO	4.29	mg/L
LK-02	6/3/2008	18	DO	4.23	mg/L
LK-02	6/3/2008	19	DO	4.28	mg/L
LK-02	6/3/2008	20	DO	4.15	mg/L
LK-02	6/3/2008	21	DO	3.93	mg/L
LK-02	6/3/2008	22	DO	3.59	mg/L
LK-02	6/3/2008	23	DO	2.43	mg/L
LK-02	7/9/2008	0	DO	6.93	mg/L
LK-02	7/9/2008	1	DO	8.02	mg/L
LK-02	7/9/2008	2	DO	8.08	mg/L
LK-02	7/9/2008	3	DO	8.07	mg/L
LK-02	7/9/2008	4	DO	8.03	mg/L
LK-02	7/9/2008	5	DO	8	mg/L
LK-02	7/9/2008	6	DO	7.93	mg/L
LK-02	7/9/2008	7	DO	3.59	mg/L
LK-02	7/9/2008	8	DO	1.89	mg/L
LK-02	7/9/2008	9	DO	0.93	mg/L
LK-02	7/9/2008	10	DO	0.55	mg/L
LK-02	7/9/2008	11	DO	0.47	mg/L
LK-02	7/9/2008	12	DO	0.52	mg/L
LK-02	7/9/2008	13	DO	0.6	mg/L
LK-02	7/9/2008	14	DO	0.63	mg/L
LK-02	7/9/2008	15	DO	0.67	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-02	7/9/2008	16	DO	0.64	mg/L
LK-02	7/9/2008	17	DO	0.51	mg/L
LK-02	7/9/2008	18	DO	0.25	mg/L
LK-02	7/9/2008	19	DO	0.17	mg/L
LK-02	7/9/2008	20	DO	0.16	mg/L
LK-02	7/9/2008	21	DO	0.12	mg/L
LK-02	7/9/2008	22	DO	0.06	mg/L
LK-02	7/9/2008	23	DO	0.03	mg/L
LK-02	7/9/2008	24	DO	0.02	mg/L
LK-02	7/9/2008	25	DO	0.01	mg/L
LK-02	8/14/2008	0	DO	6.6	mg/L
LK-02	8/14/2008	1	DO	6.33	mg/L
LK-02	8/14/2008	2	DO	6.24	mg/L
LK-02	8/14/2008	3	DO	6.12	mg/L
LK-02	8/14/2008	4	DO	6.01	mg/L
LK-02	8/14/2008	5	DO	5.91	mg/L
LK-02	8/14/2008	6	DO	5.8	mg/L
LK-02	8/14/2008	7	DO	5.75	mg/L
LK-02	8/14/2008	8	DO	5.74	mg/L
LK-02	8/14/2008	9	DO	4.8	mg/L
LK-02	8/14/2008	10	DO	2.97	mg/L
LK-02	8/14/2008	11	DO	0.78	mg/L
LK-02	8/14/2008	12	DO	0.2	mg/L
LK-02	8/14/2008	13	DO	0.12	mg/L
LK-02	8/14/2008	14	DO	0.06	mg/L
LK-02	8/14/2008	15	DO	0.05	mg/L
LK-02	8/14/2008	16	DO	0.04	mg/L
LK-02	8/14/2008	17	DO	0.04	mg/L
LK-02	8/14/2008	18	DO	0.04	mg/L
LK-02	8/14/2008	19	DO	0.03	mg/L
LK-02	8/14/2008	20	DO	0.03	mg/L
LK-02	8/14/2008	21	DO	0.03	mg/L
LK-02	8/14/2008	22	DO	0.03	mg/L
LK-02	9/22/2008	0	DO	7.41	mg/L
LK-02	9/22/2008	1	DO	7.36	mg/L
LK-02	9/22/2008	2	DO	7.36	mg/L
LK-02	9/22/2008	3	DO	7.54	mg/L
LK-02	9/22/2008	4	DO	7.72	mg/L
LK-02	9/22/2008	5	DO	7.68	mg/L
LK-02	9/22/2008	6	DO	7.21	mg/L
LK-02	9/22/2008	7	DO	7.08	mg/L
LK-02	9/22/2008	8	DO	7.07	mg/L
LK-02	9/22/2008	9	DO	7.03	mg/L
LK-02	9/22/2008	10	DO	6.95	mg/L
LK-02	9/22/2008	11	DO	6.76	mg/L
LK-02	9/22/2008	12	DO	6.36	mg/L
LK-02	9/22/2008	13	DO	5.99	mg/L
LK-02	9/22/2008	14	DO	5.70	mg/L
LK-02	9/22/2008	15	DO	4.59	mg/L
LK-02	9/22/2008	16	DO	3.75	mg/L
LK-02	9/22/2008	17	DO	3.69	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-02	9/22/2008	18	DO	3.90	mg/L
LK-02	9/22/2008	19	DO	3.72	mg/L
LK-02	9/22/2008	20	DO	2.50	mg/L
LK-02	9/22/2008	21	DO	3.40	mg/L
LK-02	9/22/2008	22	DO	3.80	mg/L
LK-02	9/22/2008	23	DO	3.64	mg/L
LK-02	9/22/2008	24	DO	2.22	mg/L
LK-03	6/3/2008	0	DO	8.47	mg/L
LK-03	6/3/2008	1	DO	8.63	mg/L
LK-03	6/3/2008	2	DO	8.7	mg/L
LK-03	6/3/2008	3	DO	8.4	mg/L
LK-03	6/3/2008	4	DO	7.98	mg/L
LK-03	6/3/2008	5	DO	7.61	mg/L
LK-03	6/3/2008	6	DO	6.99	mg/L
LK-03	6/3/2008	7	DO	6.62	mg/L
LK-03	6/3/2008	8	DO	6.1	mg/L
LK-03	7/9/2008	0	DO	9.67	mg/L
LK-03	7/9/2008	1	DO	9.82	mg/L
LK-03	7/9/2008	2	DO	9.79	mg/L
LK-03	7/9/2008	3	DO	9.67	mg/L
LK-03	7/9/2008	4	DO	9.22	mg/L
LK-03	7/9/2008	5	DO	8.98	mg/L
LK-03	7/9/2008	6	DO	7.92	mg/L
LK-03	7/9/2008	7	DO	5.3	mg/L
LK-03	7/9/2008	8	DO	3.7	mg/L
LK-03	8/14/2008 (8:15 am)	0	DO	6.27	mg/L
LK-03	8/14/2008 (8:15 am)	1	DO	6.28	mg/L
LK-03	8/14/2008 (8:15 am)	2	DO	6.23	mg/L
LK-03	8/14/2008 (8:15 am)	3	DO	6.22	mg/L
LK-03	8/14/2008 (8:15 am)	4	DO	6.07	mg/L
LK-03	8/14/2008 (8:15 am)	5	DO	3.08	mg/L
LK-03	8/14/2008 (8:15 am)	6	DO	1.93	mg/L
LK-03	8/14/2008 (8:15 am)	7	DO	0.53	mg/L
LK-03	8/14/2008 (8:15 am)	8	DO	0.63	mg/L
LK-03	8/14/2008 (10:03 am)	0	DO	6.98	mg/L
LK-03	8/14/2008 (10:03 am)	1	DO	6.89	mg/L
LK-03	8/14/2008 (10:03 am)	2	DO	6.48	mg/L
LK-03	8/14/2008 (10:03 am)	3	DO	6.31	mg/L
LK-03	8/14/2008 (10:03 am)	4	DO	5.8	mg/L
LK-03	8/14/2008 (10:03 am)	5	DO	3.57	mg/L
LK-03	8/14/2008 (10:03 am)	6	DO	1.35	mg/L
LK-03	8/14/2008 (10:03 am)	7	DO	0.53	mg/L
LK-03	9/22/2008	0	DO	10.33	mg/L
LK-03	9/22/2008	1	DO	10.44	mg/L
LK-03	9/22/2008	2	DO	10.30	mg/L
LK-03	9/22/2008	3	DO	9.70	mg/L
LK-03	9/22/2008	4	DO	8.67	mg/L
LK-03	9/22/2008	5	DO	8.49	mg/L
LK-03	9/22/2008	6	DO	7.93	mg/L
LK-03	9/22/2008	7	DO	6.69	mg/L
LK-03	9/22/2008	8	DO	6.26	mg/L

StationID	Date	Depth	ParamID	Result	UnitsID
LK-04	6/3/2008	0	DO	8.04	mg/L
LK-04	6/3/2008	1	DO	8.1	mg/L
LK-04	6/3/2008	2	DO	7.09	mg/L
LK-04	6/3/2008	3	DO	6.88	mg/L
LK-04	6/3/2008	4	DO	6.43	mg/L
LK-04	6/3/2008	5	DO	6.23	mg/L
LK-04	6/3/2008	6	DO	6.09	mg/L
LK-04	7/9/2008	0	DO	10.74	mg/L
LK-04	7/9/2008	1	DO	10.67	mg/L
LK-04	7/9/2008	2	DO	10.1	mg/L
LK-04	7/9/2008	3	DO	7.99	mg/L
LK-04	7/9/2008	4	DO	6.87	mg/L
LK-04	7/9/2008	5	DO	6.19	mg/L
LK-04	7/9/2008	6	DO	5.08	mg/L
LK-04	8/14/2008 (6:50 am)	0	DO	6.15	mg/L
LK-04	8/14/2008 (6:50 am)	1	DO	5.97	mg/L
LK-04	8/14/2008 (6:50 am)	2	DO	5.93	mg/L
LK-04	8/14/2008 (6:50 am)	3	DO	5.91	mg/L
LK-04	8/14/2008 (6:50 am)	4	DO	5.43	mg/L
LK-04	8/14/2008 (6:50 am)	5	DO	4.72	mg/L
LK-04	8/14/2008 (6:50 am)	6	DO	3.63	mg/L
LK-04	8/14/2008 (10:30 am)	0	DO	9.98	mg/L
LK-04	8/14/2008 (10:30 am)	1	DO	9.05	mg/L
LK-04	8/14/2008 (10:30 am)	2	DO	7.59	mg/L
LK-04	8/14/2008 (10:30 am)	3	DO	6.65	mg/L
LK-04	8/14/2008 (10:30 am)	4	DO	6.38	mg/L
LK-04	8/14/2008 (10:30 am)	5	DO	6.15	mg/L
LK-04	8/14/2008 (10:30 am)	6	DO	4.42	mg/L
LK-04	9/22/2008	0	DO	14.64	mg/L
LK-04	9/22/2008	1	DO	14.20	mg/L
LK-04	9/22/2008	2	DO	12.11	mg/L
LK-04	9/22/2008	3	DO	8.54	mg/L
LK-04	9/22/2008	4	DO	7.52	mg/L
LK-04	9/22/2008	5	DO	6.71	mg/L
LK-04	9/22/2008	6	DO	6.51	mg/L
LK-04	9/22/2008	7	DO	5.89	mg/L

Average Seasonal* Total Phosphorus for Tenkiller

Data from:1974 - EPA; 1992-1993 OWRB Clean Lakes Study; 2005-2008 CDM

* Season is June through September

Sample Date	Year	LK01	LK02	LK03	LK04	Lake Average
6/14/1974	1974	0.022	0.026	0.028	0.057	0.028
8/30/1974	1974	0.033	0.030	0.038	0.080	0.036
6/4/1992	1992	0.016	0.023	0.027	0.066	0.026
7/2/1992	1992	0.031	0.051	0.056	0.064	0.048
8/1/1992	1992	0.014**	0.020	0.034	0.081	0.026
8/19/1992	1992	0.038	0.042	0.057	0.081	0.047
9/12/1992	1992	0.025	0.017	0.041	0.081	0.029
6/25/1993	1993	0.033	0.040	0.064	0.097	0.048
7/22/1993	1993	0.020	0.022	0.038	0.051	0.027
8/4/1993	1993	0.016	0.023	0.042	0.076	0.029
8/19/1993	1993	0.021	0.028	0.034	0.061	0.030
9/2/1993	1993	0.015	0.015	0.041	0.093	0.027
9/16/1993	1993	0.009	0.013	0.067	0.103	0.031
9/30/1993	1993	0.051	0.164	0.059	0.223	0.117
6/29/2005	2005	0.011	0.013	0.033		0.017
7/12/2005	2005	0.008	0.011	0.013		0.011
7/26/2005	2005	0.009	0.013	0.032	0.176	0.029
8/9/2005	2005	0.009	0.017	0.022	0.099	0.023
8/23/2005	2005	0.011	0.016	0.043	0.143	0.031
9/7/2005	2005	0.012	0.013	0.020	0.104	0.021
9/20/2005	2005	0.012	0.016	0.033	0.119	0.027
6/1/2006	2006	0.017	0.027	0.037	0.106	0.033
6/14/2006	2006	0.015	0.021	0.034	0.199	0.036
6/27/2006	2006	0.015	0.018	0.033	0.187	0.033
7/13/2006	2006	0.012	0.012	0.019	0.097	0.020
7/25/2006	2006	0.008	0.012	0.022	0.116	0.021
8/9/2006	2006	0.008	0.012	0.021	0.128	0.022
8/22/2006	2006	0.008	0.016	0.026	0.157	0.027
9/14/2006	2006	0.008	0.011	0.032	0.102	0.022
9/26/2006	2006	0.014	0.017	0.037	0.163	0.032
6/12/2007	2007	0.019	0.021	0.050	0.136	0.036
7/17/2007	2007	0.010	0.012	0.039	0.089	0.023
8/29/2007	2007	0.003	0.003	0.003	0.032	0.005
6/3/2008	2008	0.058	0.043	0.039	0.155	0.054
7/9/2008	2008	0.019	0.023	0.037	0.071	0.029
8/14/2008	2008	0.018	0.020	0.041	0.122	0.032
9/22/2008	2008	0.012	0.016	0.026	0.082	0.022

Volumes, m3	**62,264,117**	**116,384,561**	**57,360,939**	**19,596,761**	**255,606,378**

**Changed from 140 to 14 ug/L

Seasonal* Average Chlorophyll Values for Tenkiller

Data from: 1974 - EPA; 1986, 2001, 2002, 2003, and 2004 Army Corps of Engineers; 1992 and 1993 - OWRB Clean Lakes Study; 2005-2008 - CDM

* Season is June through September

Sample Date	Year	LK01	LK02	LK03	LK04	Lake Average
6/14/1974	1974	0.1	0.2	0.3	0.7	0.2
8/30/1974	1974	6.6	5.7	6.6	12.0	6.6
6/3/1986	1986	16.2	15.3	13.5	20.4	15.5
6/17/1986	1986	20.4	35.1	32.2	49.1	32.0
7/1/1986	1986	17.3	19.8	30.9	37.0	23.0
7/15/1986	1986	12.1	16.4	22.5	31.3	17.9
7/29/1986	1986	9.9	13.7	15.2	35.2	14.8
8/12/1986	1986	14.2	11.8	19.9	33.8	15.9
9/9/1986	1986	8.3	7.0	21.4	30.2	12.3
9/23/1986	1986	9.1	12.2	23.5	44.4	16.4
6/4/1992	1992	9.4	16.5	15.7	22.3	15.0
7/2/1992	1992	28.0	39.6	45.6	47.7	38.8
8/1/1992	1992	12.1	13.3	28.0	46.2	18.8
8/19/1992	1992	10.1	13.4	18.8	32.9	15.3
9/12/1992	1992	6.3	11.0	15.8	33.0	12.6
6/25/1993	1993	39.1	32.4	40.3	45.0	36.8
7/22/1993	1993	6.4	3.7	12.6	12.0	7.0
8/4/1993	1993	8.2	13.8	26.5	17.3	15.6
8/19/1993	1993	7.0	10.5	16.9	26.6	12.3
9/2/1993	1993	24.9	22.3	18.9	39.6	23.5
9/16/1993	1993	10.7	11.6	23.5	30.9	15.6
9/30/1993	1993	5.7	8.9	13.7	44.5	11.9
6/21/2001	2001	17.4	22.4	24.0	48.0	23.5
7/26/2001	2001	4.1	4.2	3.7	16.0	5.0
8/17/2001	2001	11.6	11.1	17.4	20.6	13.4
9/5/2001	2001	6.5	9.2	17.2	11.0	10.5
9/20/2001	2001	4.2	6.8	5.7	12.8	6.4
6/12/2002	2002	11.0	15.4	19.2	19.5	15.5
7/10/2002	2002	5.5	4.6	8.6	13.8	6.4
8/8/2002	2002	7.8	6.6	10.4	21.6	8.9
9/13/2002	2002	8.6	10.5	11.3	15.7	10.6
6/3/2003	2003	7.3	8.2	33.2	55.1	17.2
7/8/2003	2003	6.7	5.3	6.1	12.2	6.3
8/4/2003	2003	5.2	4.8	7.2	16.3	6.3
9/8/2003	2003	4.4	5.6	8.5	11.9	6.5
10/10/2003	2003	4.1	5.7	10.9	12.6	7.0
6/16/2004	2004		27.2	26.9	27.5	20.5
7/14/2004	2004	8.5	13.2	18.3	22.4	13.9
8/12/2004	2004	8.8	10.9	13.4	23.0	11.8
9/20/2004	2004	4.6	7.3	10.1	15.1	7.9
6/2/2005	2005	22.0	19.6	12.8		18.6
6/15/2005	2005	14.7	16.1	25.4		18.0
6/29/2005	2005	10.7	13.3	18.6		13.9
7/12/2005	2005	10.7	13.4	17.1		13.6
7/26/2005	2005	7.7	12.0	20.4	31.7	14.3
8/9/2005	2005	13.7	18.4	12.9	15.4	15.8
8/23/2005	2005	10.7	11.3	16.4	37.2	14.3
9/7/2005	2005	10.6	10.3	13.4	18.1	11.7
9/20/2005	2005	7.9	10.7	11.5	76.1	15.2

Seasonal Average Chlorophyll Values for Tenkiller (Continued)

Sample Date	Year	EK01	EK02	EK03	EK04	Lake Average
6/1/2006	2006	7.7	19.1	14.6	18.2	15.3
6/14/2006	2006	4.5	10.2	15.9	19.2	10.8
6/27/2006	2006	5.8	9.0	16.3	26.5	11.2
7/13/2006	2006	5.6	6.0	7.5	18.1	7.2
7/25/2006	2006	3.7	5.2	9.3	13.8	6.4
8/9/2006	2006	2.7	4.0	7.8	27.7	6.4
8/22/2006	2006	2.7	4.7	8.1	30.7	7.0
9/14/2006	2006	2.0	3.2	11.6	25.0	6.5
9/26/2006	2006	2.2	3.6	16.3	2.3	6.0
6/12/2007	2007	14.6	11.7	24.4	26.1	16.4
7/17/2007	2007	6.2	6.8	16.3	22.9	10.0
8/29/2007	2007	7.8	5.4	10.2	24.6	8.5
6/3/2008	2008	18.3	14.9	9.9	27.6	15.6
7/9/2008	2008	16.7	17.9	22.3	24.5	19.1
8/14/2008	2008	9.4	9.5	16.05	20.35	11.8
9/22/2008	2008	5.34	6.942	10.68	37.38	9.7

Volumes, m3	62,264,117	116,384,561	57,360,939	19,596,761	255,606,378

Average Seasonal* Transparency for Tenkiller

Data from: 1975 - EPA; 1986, 2002, 2003, and 2004 - Army Corps of Engineers; 1992 and 1993 - OWRB Clean Lakes Study; 2005-2008 - CDM

* Season is June thru September

Sample Date	Year	LK01	LK02	LK03	LK04	Lake Average
6/14/1974	1974	3.4	2.9	2.0	0.7	2.5
8/30/1974	1974	2.4	2.4	1.8	0.7	2.1
6/3/1986	1986	3.1	2.2	1.5	1.2	2.1
6/17/1986	1986	1.4		1	0.7	1.1
7/1/1986	1986		1.1	0.5	0.5	0.8
7/15/1986	1986	3.3	2.1	0.8	0.4	1.8
7/29/1986	1986	1.4	1.7	1.3	0.6	1.4
8/12/1986	1986	1.6	1.2	0.6	0.5	1.1
8/26/1986	1986	1.8	2.2	1	0.8	1.7
9/9/1986	1986	2.9	2.8	1.1	0.7	2.2
9/23/1986	1986	2.7	2.1	1.1	0.6	1.8
6/4/1992	1992	2.4	1.7	1.6	1	1.7
7/2/1992	1992	1.6	1.6	1.3	0.85	1.4
8/1/1992	1992	1.7	1.65	1.225	0.8	1.5
8/19/1992	1992	2.2	1.7	1.5	0.9	1.7
9/12/1992	1992	2.3	1.8	1.6	0.8	1.7
6/25/1993	1993	1.4	1.55	1.15	1.1	1.4
7/22/1993	1993	2	2.1	1.5	1.1	1.8
8/4/1993	1993	3	2.1	1.2	0.9	1.9
8/19/1993	1993	2.8	2.5	1.95	1.1	2.3
9/2/1993	1993	2	1.85		0.85	1.7
9/16/1993	1993	3.1	2.4	1	0.5	2.0
9/30/1993	1993	3.3	2.8	1.4	0.8	2.3
6/21/2001	2001	2.3	1.7	1.2	0.8	1.7
7/26/2001	2001	2.1	2.5	1.4	1.4	2.1
8/17/2001	2001	1.7	1.3	1.1	0.7	1.3
9/5/2001	2001	3.0	2.0	1.0	0.8	2.0
9/20/2001	2001	3.3	2.3	1.3	0.7	2.3
6/12/2002	2002	1.6	1.5	1.4	1.0	1.5
7/10/2002	2002	1.3	1.2	1.1	0.9	1.2
8/8/2002	2002	1.9	1.6	1.2		1.6
9/13/2002	2002	2.5	1.8	1.4	0.9	1.9
6/3/2003	2003	1.2	1.7	1.2	0.6	1.4
7/8/2003	2003		1.8			1.8
8/4/2003	2003	1.6	2.3	1.6	0.9	1.9
9/8/2003	2003	1.4	2.1	1.4	0.8	1.7
6/16/2004	2004	1.7	1.3	1.3	1.1	1.4
7/14/2004	2004	1.3	1.0	0.9	0.8	1.0
8/12/2004	2004	2.5	1.2	1.3	0.9	1.6
9/20/2004	2004	3.4	2.5	1.7	0.8	2.5
6/2/2005	2005	1.8	1.9	1.4		1.7
6/15/2005	2005	2.2	1.7	1		1.6
6/29/2005	2005	2.25	2.25	1.5		2.1
7/12/2005	2005	2	1.5	1		1.5
7/26/2005	2005	2.5	2	1.25	0.5	1.7
8/9/2005	2005	2.1	1.5	1.25	0.6	1.5
8/23/2005	2005	2.5	2	1	0.25	1.7
9/7/2005	2005	2.5	2	1.5	0.5	1.8
9/20/2005	2005	2.75	2.25	0.75	0.25	1.8

Average Seasonal Transparency for Tenkiller (Continued)

Sample Date	Year	LK01	LK02	LK03	LK04	Lake Average
6/1/2006	2006	2.25	1.75	1.75	0.75	1.7
6/14/2006	2006	2.5	1.75	1	0.5	1.6
6/27/2006	2006	2.4	2	1.2	0.5	1.7
7/12/2006	2006	2.5	2.25	1.5	0.5	1.9
7/25/2006	2006	2.5	2	1.5	0.75	1.8
8/9/2006	2006	3.75	2.75	2	0.6	2.5
8/22/2006	2006	3.5	2.75	1.25	0.35	2.3
9/14/2006	2006	5.25	3	1.75	1.25	3.0
9/26/2006	2006	5.75	3.25	1.75	0.25	3.1
6/12/2007	2007	1.4	1.3	1.15	0.5	1.2
7/17/2007	2007	2.3	1.8	1.3	0.8	1.7
8/29/2007	2007	2.1	2	1.5	0.75	1.7
6/3/2008	2008	1.5	1.25	0.75	0.25	1.1
7/9/2008	2008	1.5	1.25	0.75	0.6	1.1
8/14/2008	2008	1.75	1.8	1.25	0.5	1.5
9/22/2008	2008	3	2.25	2	1	2.2
Surface Area, m^2		10,948,535	21,556,184	11,256,334	6,758,946	50,519,999