Study for the Ongoing Assessment of Water Quality in Jordan Lake
2009 Results

Purpose:

The objective of this study is to evaluate progress in reducing nutrient and nutrient related pollution in Jordan Lake, as required under section 3.(c) of S.L. 2009 – 216. This report summarizes results of samples collected in 2009.

Methods:

The detailed study plan can be found at http://www.esb.enr.state.nc.us/documents/JordanLake_forweb.pdf. Nine monitoring stations were sampled in 2009 as shown in Figure 1. All stations were sampled twice per month in August and September, and once per month October – December. In addition, all stations were sampled once in April and July 2009 except for CPF055D. Station CPF055D was created when study plan was implemented in July 2009 and sampled for the first time in August 2009. Duplicate samples were collected at one station per sampling event on a rotating schedule and analyzed for nutrients, turbidity, and chlorophyll *a*. Results for each duplicate station were averaged and used as a single result when data was analyzed for 2009. Results are presented by station and by the three lake management areas, Upper New Hope, Lower New Hope, and Haw River.

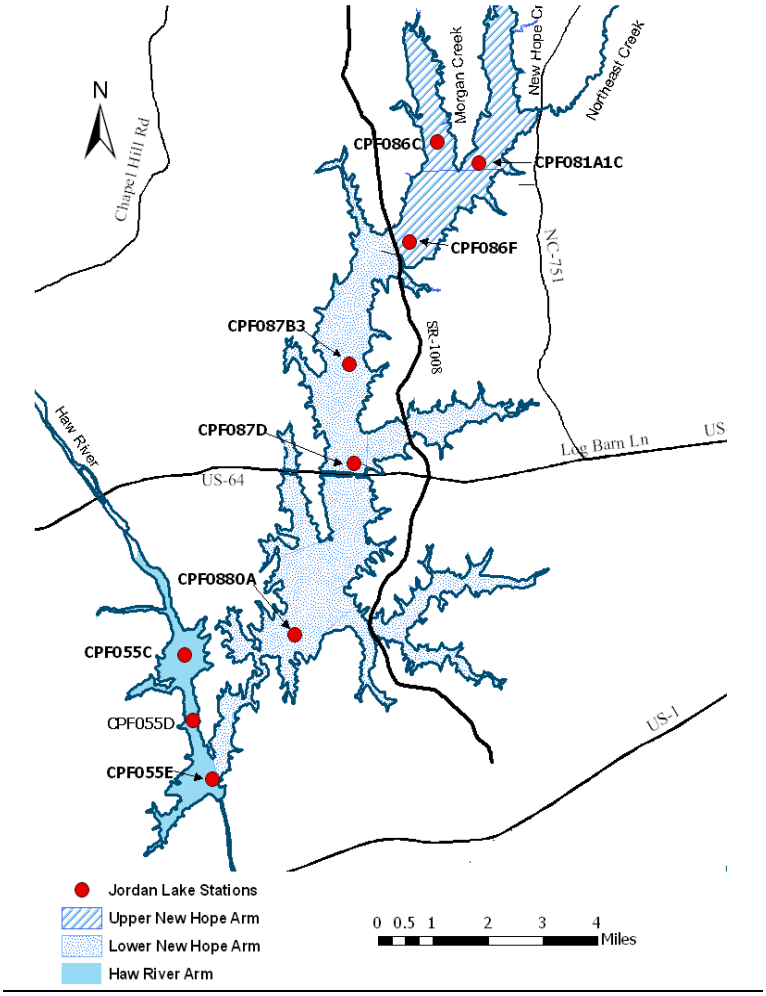

Figure 1. Jordan Lake Monitoring Stations

Results:

Results for chlorophyll *a*, pH and turbidity are shown in Table 1, by station, and in Table 2, by management area. These are the parameters for which the lake is impaired. Results are presented as counts greater than applicable water quality standards. When 10 or more samples were collected, percentages are also presented. Table 3 summarizes selected chemical and physical parameters by station. Results of duplicate sampling are shown in Table 4.

Table 1. The number and percent of samples that exceeded state standards during 2009 at a station.

	Station	n	Turbidity		Chlorophyll *a*		pH	
			n > 25 NTU	*% > 25 NTU*	*n > 40 µg/L*	*% > 40 µg/L*	*n > 9.0*	*% > 9.0*
Upper New Hope	CPF086C	9	7	n/a	8	n/a	3	n/a
	CPF081A1C	9	7	n/a	8	n/a	2	n/a
	CPF086F	9	0	n/a	8	n/a	0	n/a
Lower New Hope	CPF087B3	9	0	n/a	6	n/a	0	n/a
	CPF087D	9	0	n/a	2	n/a	0	n/a
	CPF0880A	9	0	n/a	1	n/a	0	n/a
Haw River	CPF055C	9	1	n/a	5	n/a	0	n/a
	CPF055D	7	1	n/a	1	n/a	0	n/a
	CPF055E	9	1	n/a	1	n/a	0	n/a

n/a- *Percent over standard level is only calculated when there are 10 or more samples ($n \geq 10$).*

Table 2. The number and percent of samples within a lake management area that exceeded state standards during 2009.

Management Area	n	Turbidity		Chlorophyll *a*		pH	
		n > 25 NTU	*% > 25 NTU*	*n > 40 µg/L*	*% > 40 µg/L*	*n > 9.0*	*% > 9.0*
Upper New Hope	27	14	51.9%	24	88.9%	5	18.5%
Lower New Hope	27	0	0.0%	9	33.3%	0	0.0%
Haw River	25	3	12.0%	7	28.0%	0	0.0%

Table 3. Summary statistics for selected chemical and physical parameters by station during 2009.

				Photic Zone Composite Samples (2x Secchi depth)									*Surface Parameters*		
			Secchi	TP	TKN	NH_3	NO_x	TN	TON	TIN	Chla	Turb	Temp	DO	pH
	Station	Stats	(m)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(µg/L)	(NTU)	(°C)	(mg/L)	(S.U.)
Upper New Hope Arm	**CPF086C**	Mean	0.3	0.14	1.27	0.02	0.10	1.37	1.25	0.12	89	33.3	22.7	8.5	8.0
	n = 9	Min	0.3	0.09	0.81	0.01	0.01	1.05	0.76	0.02	20	16.0	8.9	4.1	7.2
		Max	0.4	0.18	1.80	0.05	0.28	1.98	1.79	0.33	126	45.0	30.9	10.9	9.0
		Median	0.3	0.15	1.30	0.01	0.05	1.41	1.29	0.06	95	35.0	24.4	9.1	7.6
		Std Dev	0.0	0.03	0.29	0.02	0.10	0.28	0.30	0.12	31	9.5	7.5	1.9	0.7
	CPF081A1C	Mean	0.3	0.15	1.31	0.02	0.06	1.38	1.30	0.08	85	38.1	22.5	7.4	7.7
	n = 9	Min	0.3	0.10	0.78	0.01	0.01	1.00	0.72	0.02	12	17.0	8.7	4.6	7.1
		Max	0.4	0.19	1.50	0.06	0.22	1.59	1.49	0.28	112	60.0	29.7	11.0	8.9
		Median	0.3	0.16	1.45	0.01	0.01	1.51	1.44	0.02	95	38.0	24.4	6.9	7.5
		Std Dev	0.0	0.03	0.26	0.02	0.09	0.23	0.27	0.10	29	14.1	7.6	2.2	0.6
	CPF086F	Mean	0.4	0.10	1.06	0.04	0.07	1.13	1.02	0.11	66	18.2	22.5	7.3	7.6
	n = 9	Min	0.3	0.07	0.82	0.01	0.01	1.01	0.77	0.02	27	12.0	9.5	5.3	7.1
		Max	0.6	0.14	1.20	0.10	0.23	1.28	1.12	0.28	85	25.0	30.6	9.9	8.8
		Median	0.4	0.10	1.10	0.04	0.01	1.11	1.04	0.09	69	17.0	24.4	7.1	7.5
		Std Dev	0.1	0.02	0.12	0.03	0.09	0.10	0.11	0.09	17	4.5	7.1	1.6	0.5
Lower New Hope Arm	**CPF087B3**	Mean	0.7	0.06	0.87	0.05	0.06	0.92	0.81	0.11	43	9.4	22.2	8.4	8.2
	n = 9	Min	0.4	0.05	0.79	0.01	0.01	0.80	0.73	0.02	29	6.1	10.3	5.0	7.2
		Max	0.9	0.09	0.96	0.18	0.29	1.08	0.94	0.33	54	17.0	30.1	12.7	9.4
		Median	0.7	0.06	0.85	0.04	0.01	0.92	0.82	0.10	46	8.6	23.6	8.6	7.9
		Std Dev	0.1	0.01	0.06	0.06	0.09	0.08	0.07	0.11	9	3.1	7.0	2.4	0.8
	CPF087D	Mean	0.8	0.05	0.80	0.07	0.10	0.89	0.72	0.17	32	7.4	21.9	8.6	8.2
	n = 9	Min	0.6	0.03	0.62	0.01	0.01	0.76	0.60	0.02	20	4.2	10.3	5.5	7.4
		Max	1.1	0.08	0.94	0.26	0.46	1.08	0.85	0.47	46	13.0	29.6	12.1	9.3
		Median	0.8	0.04	0.78	0.04	0.01	0.87	0.72	0.12	31	7.0	23.2	9.2	7.8
		Std Dev	0.1	0.01	0.09	0.08	0.16	0.11	0.09	0.15	9	2.7	7.0	2.1	0.8
	CPF0880A	Mean	0.9	0.05	0.76	0.08	0.13	0.89	0.68	0.21	28	6.5	22.1	7.9	7.8
	n = 9	Min	0.7	0.03	0.61	0.01	0.01	0.62	0.60	0.02	16	4.0	10.6	5.7	7.3
		Max	1.1	0.08	0.91	0.25	0.53	1.18	0.85	0.55	49	11.0	29.5	11.1	8.9
		Median	0.9	0.04	0.76	0.02	0.01	0.91	0.65	0.16	28	5.5	23.9	7.4	7.5
		Std Dev	0.1	0.02	0.12	0.10	0.22	0.19	0.08	0.21	9	2.6	6.7	2.0	0.6
Haw River Arm	**CPF055C**	Mean	0.6	0.09	0.89	0.04	0.32	1.21	0.85	0.36	42	16.8	22.2	7.3	7.6
	n = 9	Min	0.3	0.07	0.61	0.01	0.01	0.84	0.59	0.02	4	5.7	11.0	5.5	7.3
		Max	1.0	0.18	1.20	0.19	1.00	1.84	1.19	1.01	82	75.0	28.8	9.7	8.4
		Median	0.7	0.07	0.84	0.01	0.30	1.15	0.82	0.33	42	9.1	23.8	7.1	7.5
		Std Dev	0.2	0.04	0.17	0.06	0.32	0.28	0.18	0.32	22	22.1	6.6	1.5	0.3
	CPF055D	Mean	0.8	0.08	0.78	0.04	0.33	1.11	0.74	0.37	33	15.5	22.4	7.4	7.7
	n = 7	Min	0.3	0.05	0.68	0.01	0.01	0.73	0.66	0.02	4	4.0	11.2	5.7	7.1
		Max	1.3	0.18	1.00	0.09	1.00	1.68	0.99	1.01	74	75.0	29.4	9.8	8.5
		Median	0.8	0.06	0.76	0.02	0.27	1.01	0.71	0.29	34	6.0	24.1	7.3	7.5
		Std Dev	0.3	0.05	0.11	0.04	0.36	0.33	0.12	0.37	21	26.3	6.7	1.5	0.5
	CPF055E	Mean	0.9	0.06	0.70	0.03	0.30	1.00	0.68	0.33	31	8.5	22.3	6.9	7.7
	n = 9	Min	0.5	0.04	0.59	0.01	0.01	0.70	0.56	0.02	5	4.0	11.3	4.2	6.9
		Max	1.2	0.10	0.83	0.09	0.99	1.58	0.79	1.00	46	28.5	29.9	9.6	8.7
		Median	0.9	0.05	0.69	0.01	0.16	0.82	0.68	0.18	33	5.4	24.1	6.6	7.5
		Std Dev	0.2	0.02	0.09	0.03	0.35	0.31	0.09	0.36	13	8.0	6.6	1.8	0.5

Note: All NO_x and NH_4 minimum data equal to 0.01 mg/L are samples that were below laboratory detection limit of 0.02 mg/L. Any data below detection limit were entered as half the detection limit in order to calculate TKN, TN or TON values.

Table 4. Results of Jordan Lake station duplicates during 2009.

Station	Date	TP	TKN	NH_3	NO_x	TN	TON	TIN	Chla	Turbidity
CPF055E	12/10/2009	0.10	0.61	0.07	0.52	1.13	0.54	0.59	5.0	29
CPF055E	12/10/2009	0.10	0.65	0.08	0.52	1.17	0.57	0.60	5.1	28
CPF081A1C	8/27/2009	0.15	1.50	0.01	0.01	1.51	1.49	0.02	104	21
CPF081A1C	8/27/2009	0.14	1.40	0.01	0.01	1.41	1.39	0.02	120	22
CPF086C	8/6/2009	0.15	1.40	0.01	0.01	1.41	1.39	0.02	93	40
CPF086C	8/6/2009	0.15	1.40	0.01	0.01	1.41	1.39	0.02	100	39
CPF086F	9/2/2009	0.14	1.00	0.01	0.19	1.19	0.99	0.20	79	23
CPF086F	9/2/2009	0.14	1.10	0.01	0.20	1.30	1.09	0.21	78	23
CPF087B3	9/28/2009	0.05	0.93	0.18	0.02	0.95	0.75	0.20	30	7.7
CPF087B3	9/28/2009	0.05	0.88	0.18	0.01	0.89	0.70	0.19	32	7.8
CPF087D	10/8/2009	0.05	0.84	0.13	0.06	0.90	0.71	0.19	35	7.1
CPF087D	10/8/2009	0.05	0.84	0.12	0.06	0.90	0.72	0.18	36	7.3
CPF0880A	11/9/2009	0.04	0.64	0.01	0.50	1.14	0.63	0.51	21	6.6
CPF0880A	11/9/2009	0.04	0.68	0.01	0.49	1.17	0.67	0.50	21	6.7