APPENDIX I

MODELING METHODOLOGIES AND ASSUMPTIONS

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Methodology For Determining Watershed Loading

To quantify the effects of additional loads on the water quality conditions in Lake Lanier, an existing CEQUAL-W2 Lake Lanier model developed by Limno-Tech, Inc.(LTI) for the Upper Chattahoochee Basin Group was used.

The existing model consists of two coupled models, a watershed model and a water quality model. The water quality model is a CEQUAL–W2 model, which is a two dimensional, laterally averaged model. This water quality model uses the watershed inputs simulated from the watershed model. The model predicts the daily lake concentration of Total Nitrogen (TN) and Total Phosphorus (TN) at specified depths. An annual average in-lake concentration of the constituents of concern was calculated for each of the three lake levels—high, medium, and low—for the surface and bottom layers of the lake. Additional details of the assumptions and application of the lake model can be found in the model report prepared for the Upper Chattahoochee Basin Group (LTI, 1998).

Generalized Watershed Loading Function model (GWLF) is the watershed model used. Input necessary for calculating the loads from the watershed required identification of land use alterations, which were used in calculating the difference in loadings from baseline (year 1997) conditions, and from the no action alternative or from the proposed alternative. The land use alterations were distributed proportionally among the numerous direct drainage areas draining into the lake. Loads were calculated for sediment, total phosphorus (TP) and total nitrogen (TN) for each section of the lake and the upper watersheds. These parameters are primarily affected by altered land use conditions. Using the year 1997 as the baseline or reference year, the percent increase in loads was calculated for each constituent of concern (sediment, TP and TN) for both the no action alternative and the preferred alternative. These loads were quantified as an annual average loading condition and represent the long-term effects. More detailed information on the original GWLF model may be found in *Development of Linked Watershed and Water Quality Models for Lake Lanier* (LTI, 1998).

Land use categories were derived from February 1997 satellite imagery (LTI, 1998). Various land use classes were combined for modeling purposes and are presented in Table I-1. Table I-2 presents the 1996–1997 land use distribution in the Lake Lanier watershed broken down by land use and aerial distribution for the three discrete zones of influence that drain to the lake.

Table I-1
Land Cover Classification for Each Land Cover in the Lake Lanier Watershed

Observed Land Use	Grouped Land Use
Open Water	Open Water
Clearcut/Young Pine/Timber Harvest	Construction
Pasture	Pasture
Cultivated/Exposed Earth	Cropland
Low-Density Urban	Low-Density Urban
High-Density Urban	High-Density Urban
Emergent Wetland	Wetland
Scrub/Shrub Wetland	Wetland
Forested Wetland	Wetland
Coniferous Forest	Forest
Mixed Forest	Forest
Hardwood Forest	Forest

Source: LTI, 1998.

Table I-2
Lake Lanier Watershed Land Use Distribution by Zone

Land Use	Zone 1 Government Areas (mi^2) [1]	Zone 2 Non-Government Areas (mi^2)	Zone 3 Regional Areas upstream (mi^2)	Total Land Use Area (mi^2)	Percent of Total
Open Water	60.76	0.00	0.00	60.76	5.90
Low-Density Urban	1.35	17.66	27.74	46.74	4.54
High-Density Urban	0.39	30.74	34.17	65.30	6.34
Forest	23.29	210.22	568.37	801.87	77.86
Pasture	0.39	19.22	27.26	46.87	4.55
Construction	0.00	2.64	3.26	5.90	0.57
Cropland	0.16	0.97	1.34	2.47	0.24
Wetlands	0.00	0.00	0.00	0.00	0.00
Totals	**86.35**	**281.45**	**662.13**	**1029.92**	**100.00**

[1] mi^2 = square miles.

For EIS modeling purposes, the areas classified as high-density were assumed to have the characteristics of commercial land with an associated imperviousness of 85 percent, and the areas classified as low-density urban lands were assumed to be residential in nature and were assigned an imperviousness of 12 percent (1 to 2 houses per acre) based on commonly used modeling standards.

To determine annual average loadings to Lake Lanier, the watershed was broken down into three discrete zones of influence surrounding the project: Zone 1, the principal study area, which includes all government-owned lands and waters constituting the Lake Lanier Project (direct influence); Zone 2, the nongovernmental lands bordering government lands surrounding the lake (direct influence); and Zone 3, the watershed upstream of Lake Lanier (to address indirect regional issues influencing the lake).

A quantitative determination of the relative impact of various shoreline management actions on water quality in Lake Lanier required developing an existing or baseline loading condition for the lake that can be evaluated relative to various development options. To develop this baseline loading condition, the three zones described above that provide loadings to the lake above the dam were input into the Generalized Watershed Loading Function (GWLF) model (Haith, 1996). The GWLF model was developed for the Upper Chattahoochee Basin Group, which is part of the linked watershed and water quality model for Lake Lanier (LTI, 1998).

For EIS modeling purposes, the GWLF model was updated to include land use distributions from Table I-2 and was executed to determine the average annual loadings for each of the three discrete zones of influence around Lake Lanier.

To quantify the potential water quality impacts, the analysis included the following general assumptions:

- All the new docks are single, one-owner docks and are associated with the addition of one new home each in the immediate watershed.
- Under present zoning conditions at Lake Lanier, lot sizes are a mix of 0.5 to 1 acre; therefore, to come up with a representative acreage, the density of the existing docks within the LDA was used to extrapolate the amount of land use change. A value of 0.72 acre for each dock was used for land use area determinations.
- All the homes are assumed to be within the immediate vicinity of the lake, behind the LDA, and total lot area is assumed to replace an equivalent amount of forested area based on the existing computed density of homes area per dock.
- The increase in land development in the upper watersheds predicted by LTI for tempered land development in their 1998 modeling effort was repeated in this EIS.
- !0% of the residential land that is being converted from forest or agriculture is represented as disturbed.
- The water quality model utilizes actual stream flow and lake levels. Because of the data needs of the model, the three lake levels for the study were chosen from the 5-year critical design period selected

for prior modeling applications (LTI, 1998). This subset of years, from the entire period of record of the water surface elevations dated from 1956 to 2002, contains dry, wet, and medium years

- A septic system failure rate of 15 percent is applied. Repeating the assumption applied by LTI in 1998.

- Flow from the various waste water treatment plants discharging to Lake Lanier was increased as projected in the Clean Lakes study.

- Level of treatment for the treatment plants remained unchanged except for Gwinnett County which is to double their level of treatment.

The assumptions made in determining all potential land use alterations are highly conservative. First, a significant portion of the development might occur independent of whether a dock is installed. Therefore, assuming that a permit for a boat dock will induce the construction of a house not otherwise being built if the permit was denied would significantly overstate the impact of the Corps's permitting action. Furthermore, some of the additional docks would not result in direct development. It is expected that people commuting from surrounding areas would use some of the new docks, and some might be used by existing houses on the lake. In addition, not all community docks would be built out to their full capacity because of design and space restrictions. Finally, some development associated with additional boat slips will occur outside the immediate watershed area of Lake Lanier.

Six locations, Middle Lake, Lower Lake, Buford Dam, Chattahoochee Upper Arm, Chestatee, and Little River, were selected for analysis of the Lake to analyze the spatial and temporal variability of the constituents. These locations corresponded to the existing water quality sampling locations in the lake. The constituents identified for analysis were algae, dissolved oxygen, total nitrogen and phosphorus. Daily concentrations of each constituent were modeled along the lake and at specified depths for the critical period 1984 to 1988.

The years 1984 to 1988 contain dry, wet, and medium years with a wide range of lake levels. Different lake levels were analyzed to address the effects of the proposed action as well as cumulative effects of other management programs. A water surface elevation graph is provided with statistics (percentile) to illustrate the rationale behind selecting the low-, medium-, and high-flow periods (Figure I-1). As shown in the graph the 5-year period from 1984 to 1988 covers the range of water surface levels that would be expected to occur in the lake. For the analysis the lake was divided into a surface layer and a bottom layer.

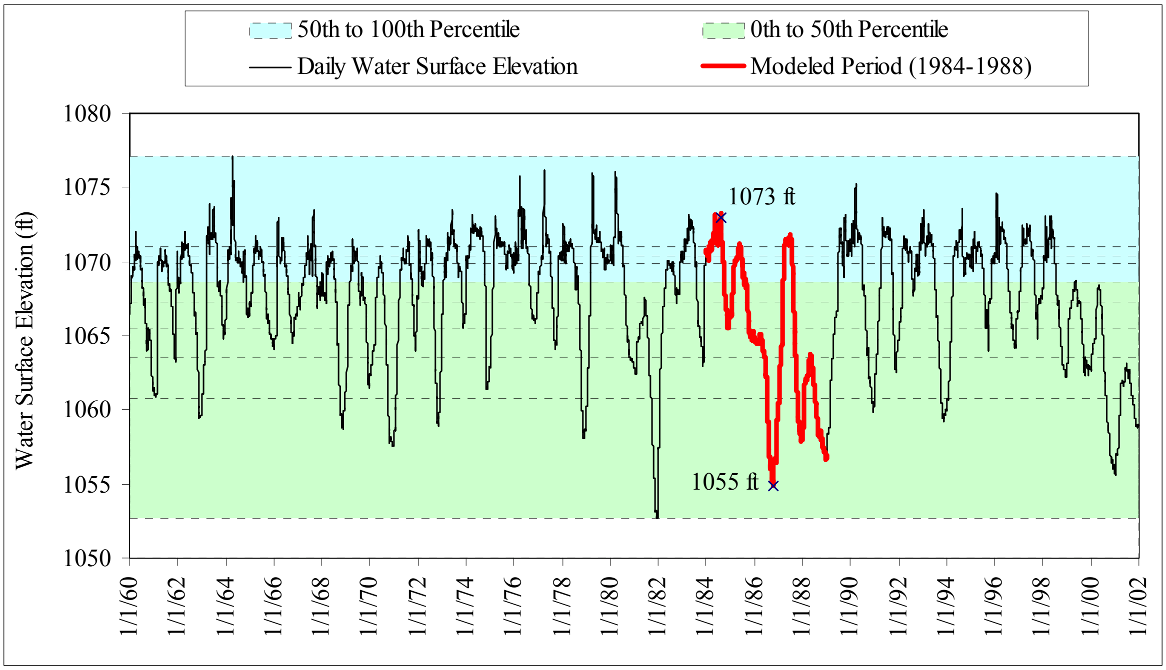

Figure I-1: Flow periods utilized for analysis purposes

Model Results Under The No Action Alternative

The mean annual concentrations and ranges for the low-, medium-, and high-lake level years at the surface and bottom for each of the selected locations, for the baseline and the No Action Alternative condition is shown in Table I-3 and Figure I-2. The average DO in the surface layer is around 6 mg/L and around 4 mg/L in the bottom layer; the concentrations drop as low as 3 mg/L in the surface layer and zero mg/L in the bottom layer for the No Action Alternative. Average phosphorus concentrations in the lake range from approximately 0.01 mg/L in the surface layer to 0.015 mg/L in the bottom layer, with the highest concentrations coming from the headwater of the Chattahoochee, Chestatee, and Little River. Nutrient fluxes from the sediment layer to the water column can be seen at all locations in the lake. The Little River region has the highest nutrient releases and wide fluctuations in the maximum and minimum values. Additional loadings for total phosphorus, total nitrogen, and sediment are broken down by land use in Table I-4.

Table I-3: Mean Annual Concentrations

NO ACTION ALTERNATIVE

Surface (above 14 m)

Low Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	9.00%	13.97%	9.95%	8.89%	8.20%	6.59%
Dissolved Oxygen	-3.09%	-5.07%	-4.12%	-4.09%	-3.18%	-3.44%
Nitrogen	40.02%	25.65%	45.92%	37.42%	39.88%	40.32%
Phosphorous	34.36%	61.54%	45.63%	29.62%	33.97%	33.52%

Medium Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	6.51%	14.54%	10.77%	13.25%	5.10%	3.81%
Dissolved Oxygen	-1.89%	-3.00%	-3.26%	-3.26%	-2.16%	-2.46%
Nitrogen	42.62%	15.13%	43.79%	29.23%	41.35%	40.85%
Phosphorous	15.85%	37.45%	24.67%	8.95%	17.40%	19.24%

High Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	8.37%	9.07%	11.39%	11.00%	7.84%	6.85%
Dissolved Oxygen	-2.13%	-2.42%	-3.36%	-3.39%	-2.37%	-2.81%
Nitrogen	18.28%	10.40%	21.46%	15.49%	18.15%	18.45%
Phosphorous	11.23%	32.49%	20.47%	10.82%	13.22%	15.90%

Bottom (below 14 m)

Low Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	-3.08%	0.00%	-4.83%	-1.73%	-3.78%	-5.65%
Dissolved Oxygen	-4.06%	0.00%	-3.12%	-2.93%	-3.99%	-3.69%
Nitrogen	37.07%	0.00%	36.06%	29.98%	37.42%	35.90%
Phosphorous	20.20%	0.00%	21.02%	11.78%	21.57%	23.14%

Medium Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	0.49%	0.00%	4.76%	4.95%	-0.83%	-2.83%
Dissolved Oxygen	-4.41%	0.00%	-3.57%	-3.99%	-4.49%	-4.50%
Nitrogen	40.30%	0.00%	37.38%	27.90%	39.94%	37.00%
Phosphorous	10.74%	0.00%	9.89%	4.74%	11.79%	11.38%

High Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	4.81%	0.00%	9.60%	9.64%	4.66%	4.36%
Dissolved Oxygen	-3.22%	0.00%	-3.66%	-4.03%	-3.13%	-3.29%
Nitrogen	15.01%	0.00%	18.41%	14.90%	15.07%	14.96%
Phosphorous	4.47%	0.00%	9.09%	4.22%	5.15%	5.54%

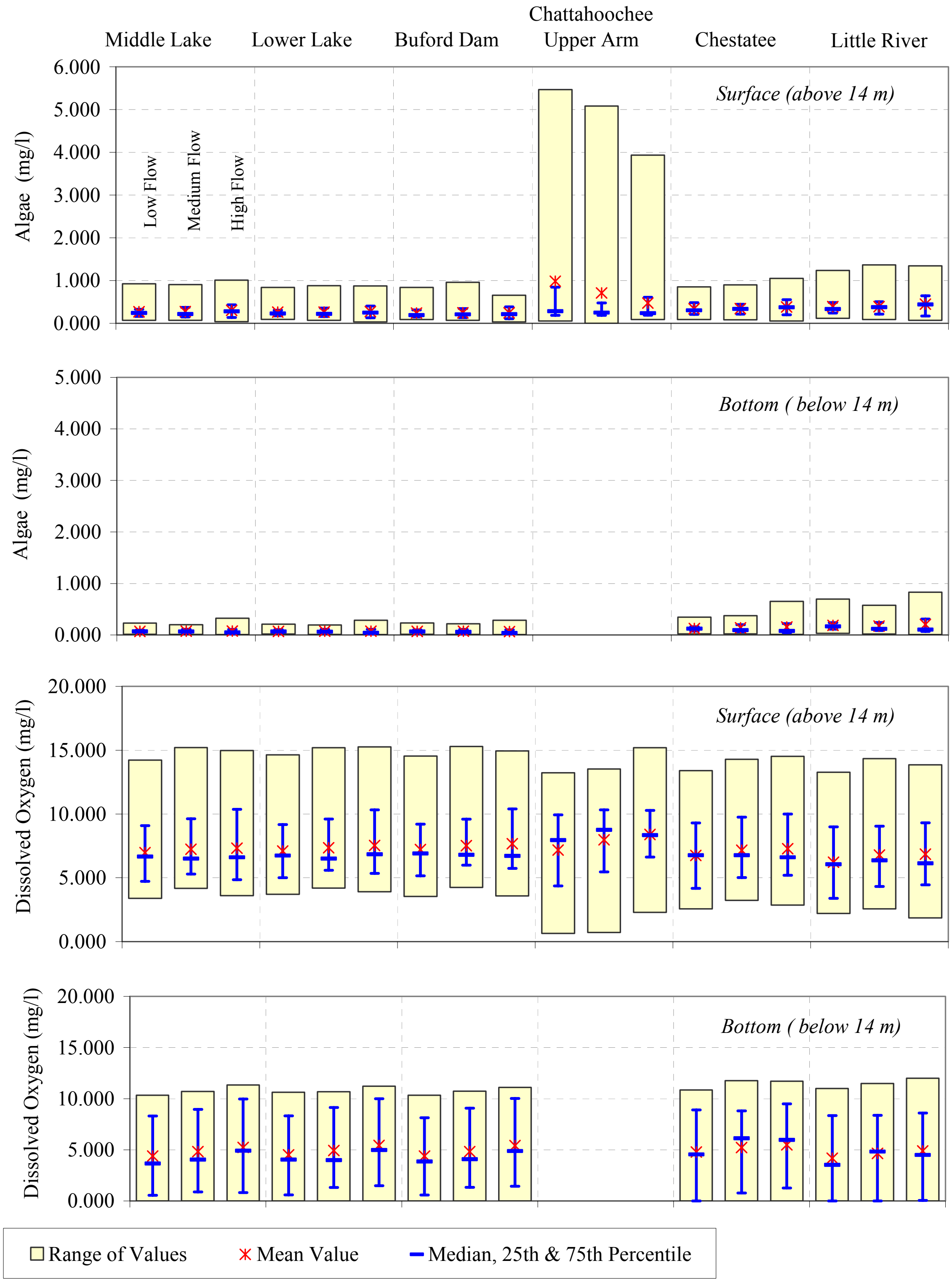

Figure I-2: No Action Alternative

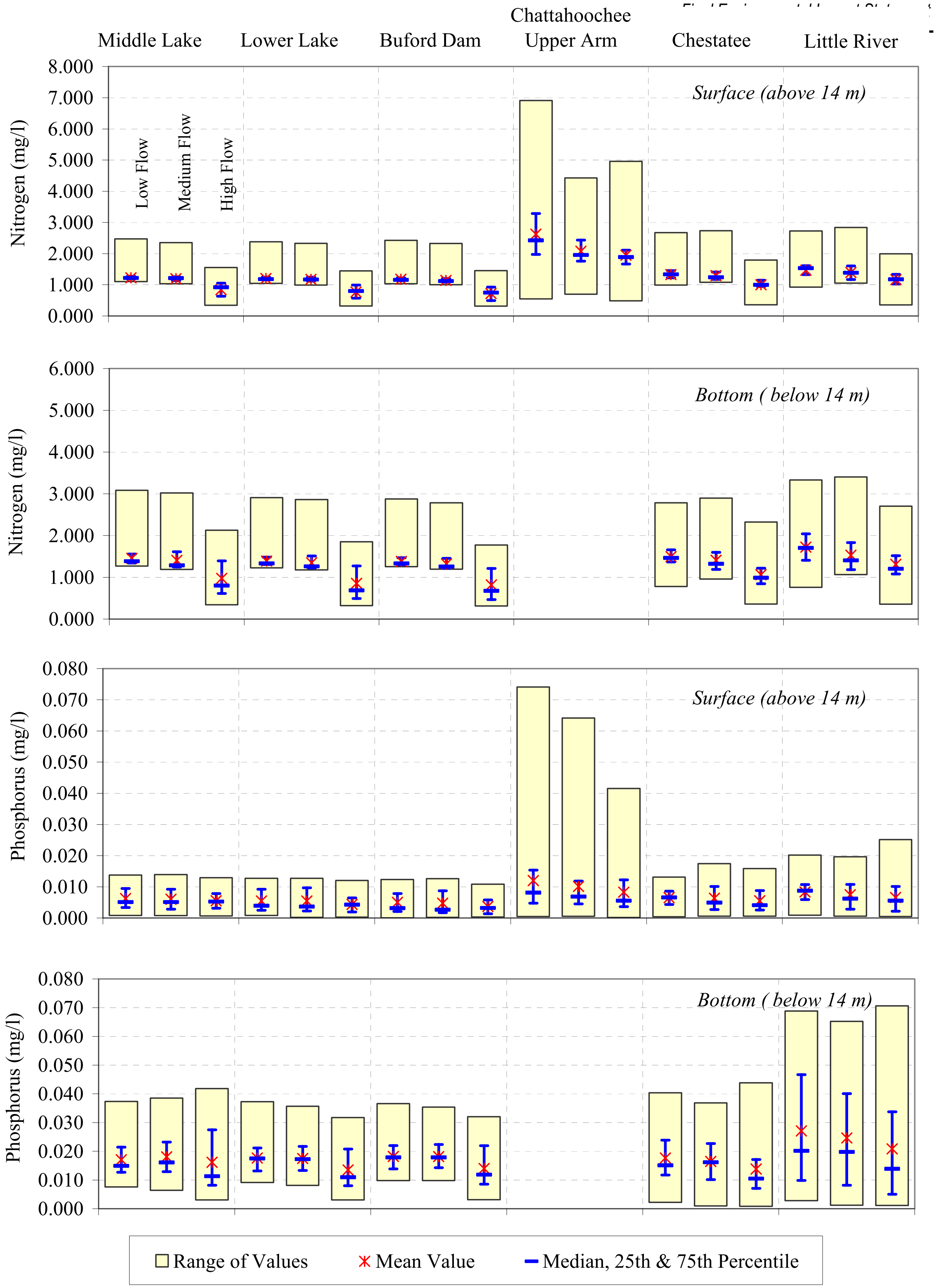

Figure I-2: No Action Alternative (continued)

Table I-4: Additional Loadings by Land Use

Additional Loadings for TP, TN and Sediment Under the No Action Alternative and Preferred Alternative

Zone 1

LANDUSE	**TP (tons/yr)**					**TN (tons/yr)**					**Sediment (tons/yr)**			
	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt
Urban (Low)	106.83	108.38	1.45	107.16	0.30	960.98	973.84	1.34	963.68	0.28	0.00	0.00		0.00
Urban (High)	200.68	200.68	0.00	200.68	0.00	1,801.21	1,801.21	0.00	1,801.21	0.00	0.00	0.00		0.00
Forest	358.35	353.98	-1.22	357.86	-0.14	2,712.89	2,703.24	-0.36	2,711.81	-0.04	1,612.70	1,753.28	8.72	1,628.4
Pasture	274.06	274.06	0.00	274.06	0.00	808.03	808.03	0.00	808.03	0.00	11.19	11.19	0.00	11.19
Construction	129.41	132.72	2.55	129.94	0.41	320.82	329.02	2.55	322.12	0.41	92.61	67.33	-27.30	88.50
Crops	375.02	375.02	0.00	375.02	0.00	745.03	745.03	0.00	745.03	0.00	669.14	669.14	0.00	669.14
Wetlands	0.00					0.00					0.00	0.00		0.00
Septic System	341.10	647.93	89.95	378.18	10.87	11,103.59	21,091.42	89.95	12,310.23	10.87	0.00	0.00		0.00
Groundwate	531.99	524.07	-1.49	531.03	-0.18	53,198.60	52,407.48	-1.49	53,103.45	-0.18	0.00	0.00		0.00
Watershed	2,317.44	2,616.84	12.92	2,353.93	1.57	71,651.14	80,859.26	12.85	72,765.56	1.56	2,385.65	2,500.94	4.83	2,397.3

Zone 2 — **Additional Loadings for TP, TN and Sediment Under the No Action Alternative and Preferred Alternative**

LANDUSE	**TP (tons/yr)**					**TN (tons/yr)**					**Sediment (tons/yr)**			
	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.
Urban (Low)	1,397.69	2,845.54	103.59	1,572.59	12.51	12,572.60	25,569.24	103.37	14,142.68	12.49	0.00	0.00		0.00
Urban (High)	15,634.43	15,634.43	0.00	15,634.43	0.00	140,325.22	140,325.22	0.00	140,325.22	0.00	0.00	0.00		0.00
Forest	3,234.41	2,910.41	-10.02	3,195.22	-1.21	24,486.21	22,226.02	-9.23	24,213.02	-1.12	131,380.86	118,523.70	-9.79	129,826.07
Pasture	13,884.08	13,884.08	0.00	13,884.08	0.00	40,934.69	40,934.69	0.00	40,934.69	0.00	28,152.82	28,152.82	0.00	28,152.82
Construction	9,664.76	13,472.67	39.40	10,125.35	4.77	23,959.35	33,399.31	39.40	25,101.17	4.77	516,544.22	693,808.28	34.32	537,387.18
Crops	2,279.29	2,279.29	0.00	2,279.29	0.00	4,528.18	4,528.18	0.00	4,528.18	0.00	24,718.25	24,718.25	0.00	24,718.25
Wetlands	0.00	0.00		0.00		0.00	0.00		0.00		0.00	0.00		0.00
Point sources	3,400.00	9,950.00	192.65	9,950.00	192.65	1,543.00	19,896.00	1,189.44	19,869.00	1,187.69	0.00	0.00		0.00
Septic System	3,505.32	6,658.28	89.95	3,886.33	10.87	114,105.69	216,739.12	89.95	126,505.77	10.87	0.00	0.00		0.00
Groundwater	5,466.94	5,385.49	-1.49	5,457.16	-0.18	546,693.78	538,548.52	-1.49	545,716.00	-0.18	0.00	0.00		0.00
Watershed	58,466.92	73,020.18	24.89	65,984.45	12.86	909,148.71	1,042,166.30	14.63	941,335.72	3.54	700,796.14	865,203.05	23.46	720,084.32

Table I-4 (continued): Additional Loadings by Land Use

Zone 3	Additional Loadings for TP, TN and Sediment Under the No Action Alternative and Preferred Alternative													
LANDUSE	TP (tons/yr)					TN (tons/yr)					Sediment (tons/yr)			
	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.
Urban (Low)	2,486.47	8,834.66	255.31	8,834.66	255.31	22,003.62	78,156.48	255.20	78,156.48	255.20	0.00	0.00		0.00
Urban (High)	17,784.15	24,431.67	37.38	24,431.67	37.38	159,416.88	219,005.07	37.38	219,005.07	37.38	0.00	0.00		0.00
Forest	5,577.30	4,864.75	-12.78	4,864.75	-12.78	85,165.14	73,179.69	-14.07	73,179.69	-14.07	24,078.80	21,286.03	-11.60	21,286.03
Pasture	28,085.02	22,246.40	-20.79	22,246.40	-20.79	84,368.65	66,709.94	-20.93	66,709.94	-20.93	2,138.08	1,687.00	-21.10	1,687.00
Construction	4,428.76	11,609.32	162.13	11,609.32	162.13	10,979.07	28,779.98	162.13	28,779.98	162.13	35,151.31	91,610.42	160.62	91,610.42
Crops	3,688.49	2,694.03	-26.96	2,694.03	-26.96	7,190.25	5,250.11	-26.98	5,250.11	-26.98	3,393.21	2,478.36	-26.96	2,478.36
Wetlands	0.00	0.00		0.00		0.00	0.00		0.00		0.00	0.00		0.00
Point sources	5,157.00	10,680.00	107.10	10,680.00	107.10	103,434.00	128,194.00	23.94	128,194.00	23.94	0.00	0.00		0.00
Septic System	5,730.72	20,418.50	256.30	20,418.50	256.30	186,540.55	664,635.10	256.30	664,635.10	256.30	0.00	0.00		0.00
Groundwater	9,553.44	9,074.12	-5.02	9,074.12	-5.02	955,344.20	907,412.20	-5.02	907,412.20	-5.02	0.00	0.00		0.00
Watershed	82,491.36	114,853.45	39.23	114,853.45	39.23	1,614,442.36	2,171,322.56	34.49	2,171,322.56	34.49	64,761.39	117,061.81	80.76	117,061.81

TOTAL LOADS	Additional Loadings for TP, TN and Sediment Under the No Action Alternative and Preferred Alternative													
LANDUSE	TP (tons/yr)					TN (tons/yr)					Sediment (tons/yr)			
	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.	% change	1997	No Action	% change	Preferred Alt.
Urban (Low)	3,990.98	11,788.57	195.38	10,514.40	163.45	35,537.20	104,699.55	194.62	93,262.84	162.44	0.00	0.00		0.00
Urban (High)	33,619.26	40,266.78	19.77	40,266.78	19.77	301,543.30	361,131.49	19.76	361,131.49	19.76	0.00	0.00		0.00
Forest	9,170.06	8,129.14	-11.35	8,417.83	-8.20	112,364.24	98,108.95	-12.69	100,104.52	-10.91	157,072.35	141,563.01	-9.87	152,740.58
Pasture	42,243.17	36,404.54	-13.82	36,404.54	-13.82	126,111.36	108,452.65	-14.00	108,452.65	-14.00	30,302.08	29,851.01	-1.49	29,851.01
Construction	14,222.93	25,214.71	77.28	21,864.61	53.73	35,259.25	62,508.30	77.28	54,203.27	53.73	551,788.14	785,486.02	42.35	629,086.09
Crops	6,342.80	5,348.34	-15.68	5,348.34	-15.68	12,463.46	10,523.32	-15.57	10,523.32	-15.57	28,780.60	27,865.75	-3.18	27,865.75
Wetlands	0.00	0.00		0.00		0.00	0.00		0.00		0.00	0.00		0.00
Point sources	8,557.00	20,630.00	141.09	20,630.00	141.09	104,977.00	148,090.00	41.07	148,090.00	41.07	0.00	0.00		0.00
Septic System	9,577.15	27,724.72	189.49	24,683.01	157.73	311,749.83	902,465.64	189.48	803,451.10	157.72	0.00	0.00		0.00
Groundwater	15,552.37	14,983.68	-3.66	15,062.32	-3.15	1,555,236.57	1,498,368.20	-3.66	1,506,231.64	-3.15	0.00	0.00		0.00
To Lake	143,275.72	190,490.48	32.95	183,191.83	27.86	2,595,242.21	3,294,348.12	26.94	3,185,450.84	22.74	767,943.18	984,765.79	28.23	839,543.43

Model Results Under The Preferred Action Alternative

The mean annual concentrations and ranges for the low-, medium-, and high lake level years at the surface and bottom for each of the selected locations, for the baseline and the Preferred Alternative condition is shown in Table I-5 and Figure I-3. The average dissolved oxygen concentration is around 7 mg/L in the surface layer and around 5 mg/L in the bottom layer; the concentrations goes as low as 3 mg/L in the surface layer and zero mg/L in the bottom layer for the Preferred Alternative condition. Average phosphorus concentrations in the lake range from approximately 0.01 mg/L in the surface layer to 0.015 mg/L in the bottom layer, with the highest concentrations coming from the headwater at Chattahoochee, Chestatee, and Little River. Nutrient fluxes from the sediment layer to the water column can be seen at all locations in the lake, with the Little River region having the highest nutrient releases and wide fluctuations in the maximum and minimum values. Additional loadings for total phosphorus, total nitrogen, and sediment are broken down by land use in Table I-4.

Table I-5: Mean Annual Concentrations

PREFERRED ALTERNATIVE

Surface (above 14 m)

Low Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	6.76%	13.84%	8.53%	8.16%	6.34%	5.40%
Dissolved Oxygen	-2.36%	-4.46%	-3.33%	-3.31%	-2.44%	-2.69%
Nitrogen	32.61%	23.61%	39.12%	32.10%	32.65%	33.28%
Phosphorous	24.11%	56.01%	35.94%	22.78%	24.30%	24.63%

Medium Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	4.63%	13.68%	8.92%	11.87%	3.99%	3.22%
Dissolved Oxygen	-1.30%	-2.58%	-2.65%	-2.65%	-1.57%	-1.90%
Nitrogen	35.03%	13.53%	37.89%	25.37%	34.19%	34.13%
Phosphorous	9.95%	33.05%	19.47%	6.02%	11.55%	13.56%

High Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	5.60%	8.86%	8.39%	8.97%	5.63%	5.47%
Dissolved Oxygen	-1.48%	-2.03%	-2.51%	-2.62%	-1.68%	-2.08%
Nitrogen	14.66%	9.47%	18.44%	13.32%	14.73%	15.34%
Phosphorous	6.29%	29.06%	14.74%	6.88%	8.06%	10.78%

Bottom (below 14 m)

Low Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	-0.21%		-2.37%	0.09%	-0.62%	-2.16%
Dissolved Oxygen	-3.16%		-2.44%	-2.16%	-3.16%	-2.91%
Nitrogen	30.24%		30.28%	25.37%	30.54%	29.52%
Phosphorous	14.68%		15.84%	8.78%	15.72%	16.95%

Medium Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	1.09%		4.84%	4.82%	0.22%	-1.05%
Dissolved Oxygen	-3.45%		-2.77%	-3.17%	-3.54%	-3.60%
Nitrogen	33.38%		31.93%	24.02%	33.17%	30.91%
Phosphorous	7.52%		6.93%	3.06%	8.32%	8.03%

High Lake Level

Constituent	Buford Dam	Chattahoochee Upper Arm	Chestatee	Little River	Lower Lake	Middle Lake
Algae	4.25%		7.88%	8.27%	4.30%	4.22%
Dissolved Oxygen	-2.43%		-2.88%	-3.12%	-2.39%	-2.57%
Nitrogen	12.59%		16.27%	13.05%	12.73%	12.86%
Phosphorous	2.91%		7.39%	2.93%	3.46%	3.99%

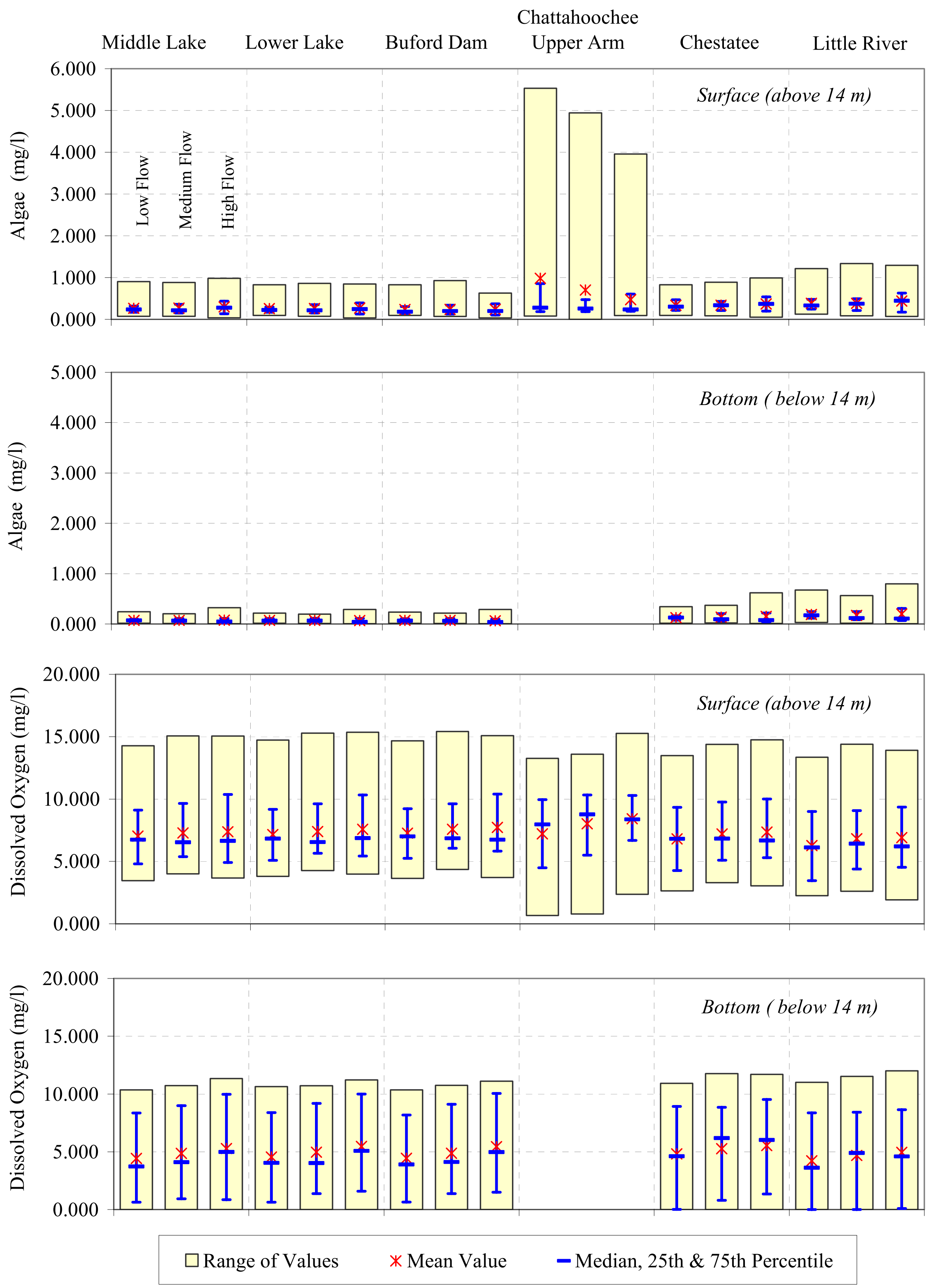

Figure I-3: Preferred Alternative

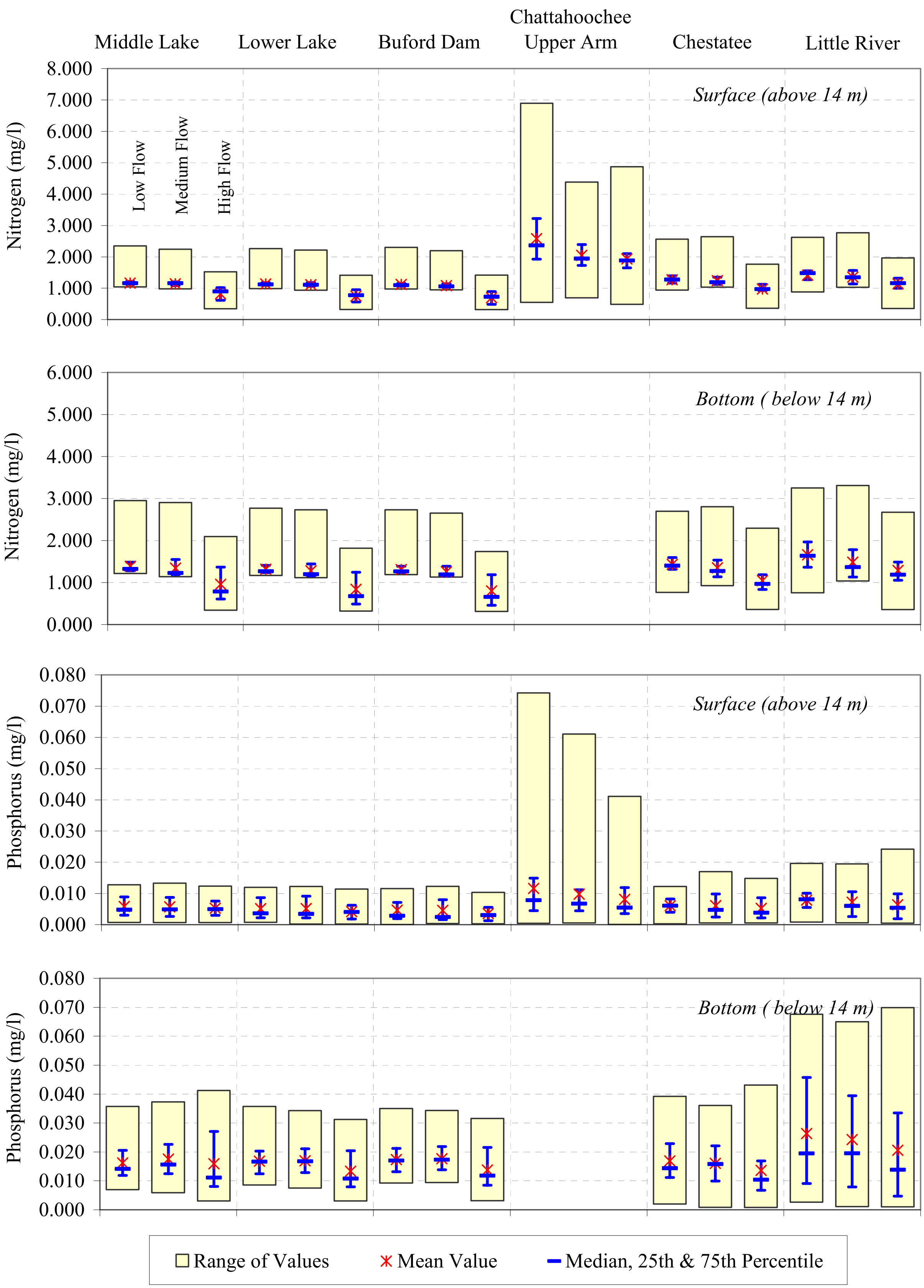

Figure I-3: Preferred Alternative (continued)

Visual and Aesthetic Resources

Visual and aesthetic impact assessments, particularly at the landscape level, can be difficult because of their inherently subjective and somewhat intangible nature. Visual impacts are a function of not only changes to the physical components of natural and man-made landscapes but also the preferences and perceptions of people who see the changes. People with different backgrounds and experiences can be expected to react differently to what they see.

In general, the visual effects of a change in shoreline management practices are more acceptable where there is an existing disturbance to the natural landscape than in places where no change in natural scenery has occurred. Alteration of undisturbed landscapes might be considered negative even if visual quality objectives have been met because the existing visual conditions will be changed. Building additional boat docks on the shoreline of Lake Lanier would change the landscape of the lake's shoreline and the landscape and visual character of the shoreline where boat docks are introduced. Scenic integrity would be lowered, and scenic attractiveness would be reduced. The degree or significance of visual impacts reflects the degree to which these changes are deemed acceptable to residents, lake users, and visitors to the lake and its recreational facilities.

The difficulty lies in the different preferences and perceptions of the landscape viewers, as noted above. People's experiences, values, lifestyles, cultures, and subcultures influence their responses to the visual environment and to changes in that visual environment. Among the myriad factors in the perception of landscapes and landscape change are an individual's previous experience of landscapes, gender, age, education, degree of environmental awareness, and cross-cultural awareness.

The task is potentially even more complicated given the size of Lake Lanier, its different morphology, and the fact that although the shoreline is generally heavily vegetated, there are differences in topography, slope, aspect, vegetative type, and cover. There are also differences in the design, materials, color, and level of maintenance of both the existing docks and the houses and structures on the private land behind and above the shoreline. All these factors affect the visual absorption capacity of the lake's shoreline.

Given this degree of complexity, the approach taken in this document is to avoid the debate about landscape preferences and perception and landscape sensitivity and simply measure the change in the acreage of the lake and surrounding land from which one or more boat docks would be visible for each alternative under consideration. These viewsheds are then used as a surrogate for assessing visual impacts. Using this approach, an increase in the number of docks along the shoreline and an increase in the acreage of the lake and surrounding land from which the docks would be clearly visible would constitute a visual impact. The larger the number of docks and the greater the acreage of viewsheds, the more substantial the adverse impacts. For the purpose of characterizing the landscape visibility impacts of the alternatives as minor or major, a percentage change in lake acreage or land acreage from which docks would be visible of 50 percent has been chosen as a dividing line. That is, only where an alternative would result in a change of 50 percent or more from the existing condition in the acreage of the lake or surrounding land from which docks would be clearly visible are the visual and aesthetic impacts considered major.

Although the mass, scale, and height of most boat docks would be relatively small when viewed individually, their visibility from the surrounding area, particularly from the water, is quite marked. Assuming an effective visibility range of 1.0 mile and a hypothetical straight shoreline, an individual boat dock can be clearly visible from an area totaling 1.6 square miles (approximately 2,010 acres) on the water and up to 1.6 square miles on land, depending on the topography and vegetation surrounding the site. Collectively, new boat docks can thus have a visual impact on the landscape despite their relatively small individual size.