APPENDIX A

EFDC WATER QUALITY MODEL PARAMETERS AND KINETIC COEFFICIENTS

Lake Thunderbird, Oklahoma

Table 1. Kinetic Coefficients for Cyanobacteria

		Zones									
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Maximum growth rate for Cyanobacteria (/day)		1.20	1.20	1.20	1.20	1.20	1.00	1.20	1.20	1.20	1.20
Basal metabolism rate for Cyanobacteria (/day)		0.06	0.07	0.055	0.055	0.07	0.06	0.055	0.055	0.055	0.07
Settling velocity for Cyanobacteria (m/day)		0.01	0.01	0.01	0.01	0.01	0.001	0.01	0.01	0.01	0.01
Predation rate onCyanobacteria (/day)		0.01	0.01	0.01	0.01	0.01	0	0.01	0.01	0.01	0.01
Carbon-to-Chl ratio for Cyanobacteria (mg C/µg Chl)	0.01										
Nitrogen-to-Carbon ratio for Cyanobacteria (g N/g C)	0.167										
Constant 1 used in determining algae C:P ratio (gC / G P)	42										
Constant 2 used in determining algae C:P ratio (gC / G P)	85										
Constant 3 used in determining algae C:P ratio (gC / G P)	200										
Oxygen-to-Carbon ratio (g O2/g C)	2.67										
Oxygen-to-Nitrogen (NO3) ratio (g O2/g N)	4.33										
N half-saturation constant for Cyanobacteria (mg N/L)	0.025										
P half-saturation constant for Cyanobacteria (mg P/L)	0.018										
Suboptimal temperature coefficient for growth	0.0060										
Superoptimal temperature coefficient for growth	0.0060										
Lower optimal temperature for growth (deg-C)	30										
Upper optimal temperature for growth(deg-C)	30										
Reference temperature for basal metabolism (Deg-C)	20										
Temperature coefficient for basal metabolism	0.0690										
Optimal depth for growth (meters)	1.0										

Table 2. Kinetic Coefficients for Diatoms

		Zones									
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Maximum growth rate for diatoms (/day)		2.20	2.20	2.20	2.20	2.20	1.00	2.20	2.20	2.20	2.20
Basal metabolism rate for diatoms (/day)		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Settling velocity for diatoms (m/day)		0.04	0.10	0.10	0.10	0.10	0.001	0.10	0.10	0.10	0.10
Predation rate on diatoms (/day)		0.025	0.025	0.025	0.025	0.025	0	0.025	0.025	0.025	0.025
Carbon-to-Chl ratio for algae:diatoms (mg C/µg Chl)	0.05										
Nitrogen-to-Carbon ratio for diatoms (g N/g C)	0.167										
Constant 1 used in determining algae C:P ratio (gC / G P)	42										
Constant 2 used in determining algae C:P ratio (gC / G P)	85										
Constant 3 used in determining algae C:P ratio (gC / G P)	200										
Oxygen-to-Carbon ratio (g O2/g C)	2.67										
Oxygen-to-Nitrogen (NO3) ratio (g O2/g N)	4.33										
N half-saturation constant for diatoms (mg N/L)	0.065										
P half-saturation constant for diatoms (mg P/L)	0.006										
Suboptimal temperature coefficient for growth	0.0025										
Superoptimal temperature coefficient for growth	0.0120										
Lower optimal temperature for growth (deg-C)	18										
Upper optimal temperature for growth(deg-C)	20										
Reference temperature for basal metabolism (Deg-C)	20										
Temperature coefficient for basal metabolism	0.0690										
Optimal depth for growth (meters)	1.0										

Table 3. Kinetic Coefficients for Green Algae

		Zones									
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Maximum growth rate for greens (/day)		1.80	1.80	1.80	1.80	1.80	1.00	1.80	1.80	1.80	1.80
Basal metabolism rate for greens (/day)		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Settling velocity for greens (m/day)		0.04	0.1	0.2	0.2	0.2	0.001	0.1	0.1	0.1	0.2
Predation rate on greens (/day)		0.05	0.05	0.05	0.05	0.05	0	0.05	0.05	0.05	0.05
Carbon-to-Chl ratio for algae:greens (mg C/µg Chl)	0.065										
Nitrogen-to-Carbon ratio for greens (g N/g C)	0.167										
Constant 1 used in determining algae C:P ratio (gC / G P)	42										
Constant 2 used in determining algae C:P ratio (gC / G P)	85										
Constant 3 used in determining algae C:P ratio (gC / G P)	200										
Oxygen-to-Carbon ratio (g O2/g C)	2.67										
Oxygen-to-Nitrogen (NO3) ratio (g O2/g N)	4.33										
N half-saturation constant for greens (mg N/L)	0.045										
P half-saturation constant for greens (mg P/L)	0.010										
Suboptimal temperature coefficient for growth	0.0100										
Superoptimal temperature coefficient for growth	0.0100										
Lower optimal temperature for growth (deg-C)	25										
Upper optimal temperature for growth(deg-C)	25										
Reference temperature for basal metabolism (Deg-C)	20										
Temperature coefficient for basal metabolism	0.0690										
Optimal depth for growth (meters)	1.0										

Table 4. Light Attenuation Coefficients

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Background light extinction coefficient (1/m)		1.0	5.0	2.2	1.8	2.3	0.5	1.8	1.8	2.0	3.0
Light extinction due to TSS (1/m per mg/L)	0.052										
Light extinction due to chlorophyll a (1/m per mg/L)	0.031										
Light extinction due to POC (1/m per mg/L)	0.078										
Photosynthetic Fraction of Incident Light (PAR)	0.43										

Table 5. Kinetic Coefficients for Organic Carbon

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Algae predation, carbon fraction to RPOC	0.28										
Algae predation, carbon fraction to LPOC	0.12										
Algae predation, carbon fraction to DOC	0.60										
Fraction of basal metablolism excreted as DOC, cyanobacteria	0.25										
Fraction of basal metablolism excreted as DOC, diatoms	0.25										
Fraction of basal metablolism excreted as DOC, greens	0.25										
Oxygen half-sat constant for algae DOC excretion, cyabobacteria (g O2/m^3)	0.50										
Oxygen half-sat constant for algae DOC excretion, diatoms (g O2/m^3)	0.50										
Oxygen half-sat constant for algae DOC excretion, greens (g O2/m^3)	0.50										
Minimum dissulution rate of RPOC (/day)	0.005										
Minimum dissulution rate of LPOC (/day)	0.075										
Minimum heterotrophic respiration rate of DOC (/day)	0.01										
Constant relating RPOC Diss. rate to total Chl-a	0.00										
Constant relating LPOC Diss. rate to total Chl-a	0.00										
Constant relating DOC Resp. rate to total Chl-a	0.00										
Reference temprature for dissolution (degC)	20.00										
Reference temperature for mineralization (degC)	20.00										
Temperature effect coefficient for dissolution	0.069										
Temperature effect coefficient for mineralization	0.069										
Half-Saturation constant for denitrification (g N/m^3)	0.10										
Ratio of denitrification rate to oxic DOC respiration rate	0.50										
Settling velocity for RPOC (m/day)		0.04	0.2	0.2	0.2	0.2	0.001	0.2	0.2	0.2	0.2
Settling velocity for LPOC (m/day)		0.04	0.2	0.2	0.2	0.2	0.001	0.2	0.2	0.2	0.2

Table 6. Kinetic Coefficients for Organic Phosphorus

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Algae predation, phosphorus fraction to RPOP	0.21										
Algae predation, phosphorus fraction to LPOP	0.09										
Algae predation, phosphorus fraction to DOP	0.20										
Fraction of metabolized P producted as RPOP, cyanobacteria	0.20										
Fraction of metabolized P producted as RPOP, diatoms	0.20										
Fraction of metabolized P producted as RPOP, greens	0.20										
Fraction of metabolized P producted as LPOP, cyanobacteria	0.20										
Fraction of metabolized P producted as LPOP, diatoms	0.20										
Fraction of metabolized P producted as LPOP, greens	0.20										
Fraction of metabolized P producted as DOP, cyanobacteria	0.20										
Fraction of metabolized P producted as DOP, diatoms	0.20										
Fraction of metabolized P producted as DOP, greens	0.20										
Minimum hydrolosis rate of RPOP (/day)	0.005										
Minimum hydrolosis rate of LPOP (/day)	0.075										
Minimum mineralization rate of DOP (/day)	0.10										
Constant relating hydrolosis rate of RPOP to algae	0.00										
Constant relating hydrolosis rate of LPOP to algae	0.00										
Constant relating mineralization rate of DOP to algae	0.20										
Settling velocity for RPOP (m/day)		0.04	0.2	0.2	0.2	0.2	0.001	0.2	0.2	0.2	0.2
Settling velocity for LPOP (m/day)		0.04	0.2	0.2	0.2	0.2	0.001	0.2	0.2	0.2	0.2

Table 7. Kinetic Coefficients for Total Phosphate

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Algae predation, phosphorus fraction to Inorganic-P	0.50										
Fraction of metabolized P produced as P4T, cyanobacteria	0.40										
Fraction of metabolized P produced as P4T, diatoms	0.40										
Fraction of metabolized P produced as P4T, greens	0.40										
Partition coefficient for sorbed/dissolved PO4 (to TSS or TAM)	0.04										

Table 8. Kinetic Coefficients for Organic Nitrogen

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Algae predation, nitrogen fraction to RPON	0.28										
Algae predation, nitrogen fraction to LPON	0.12										
Algae predation, nitrogen fraction to DON	0.35										
Fraction of metabolized N producted as RPON, cyanobacteria	0.075										
Fraction of metabolized N producted as RPON, diatoms	0.075										
Fraction of metabolized N producted as RPON, greens	0.075										
Fraction of metabolized N producted as LPON, cyanobacteria	0.075										
Fraction of metabolized N producted as LPON, diatoms	0.075										
Fraction of metabolized N producted as LPON, greens	0.075										
Fraction of metabolized N producted as DON, cyanobacteria	0.25										
Fraction of metabolized N producted as DON, diatoms	0.25										
Fraction of metabolized N producted as DON, greens	0.25										
Minimum hydrolosis rate of RPON (/day)	0.005										
Minimum hydrolosis rate of LPON (/day)	0.100										
Minimum mineralization rate of DON (/day)	0.030										
Constant relating hydrolosis rate of RPON to algae	0.000										
Constant relating hydrolosis rate of LPON to algae	0.000										
Constant relating mineralization rate of DON to algae	0.000										
Settling velocity for RPON (m/day)		0.04	0.2	0.2	0.2	0.2	0.001	0.2	0.2	0.2	0.2
Settling velocity for LPON (m/day)		0.04	0.2	0.2	0.2	0.2	0.001	0.2	0.2	0.2	0.2

Table 9. Kinetic Coefficients for Organic Ammonia and Nitrate/Nitrite

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Algae predation, nitrogen fraction to DIN	0.25										
Fraction of metabolized N producted as DIN, cyanobacteria	0.60										
Fraction of metabolized N producted as DIN, diatoms	0.60										
Fraction of metabolized N producted as DIN, greens	0.60										
Mass NO3 reduces per DOC oxidized (gN / g C)	0.933										
Maximum nitrification rate (gN /m3 /day)	0.08										
Oxygen half-Sat constant for nitrification (gO2 / m3)	1.00										
NH4 half-saturation constant for nitrification (gN / m3)	1.00										
Reference temperature for nitrification (degC)	21.00										
Suboptimal temperature coefficient for nitrification	0.0450										
Superoptimal temperature coefficient for nitrification	0.0045										

Table 10. Kinetic Coefficients for Chemical Oxygen Demand

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Oxygen Half-Sat constant for COD decay (mg/L O_2)	1.50										
COD decay rate (/day)	0.10										
Reference temperature for COD decay (degC)	20.00										
Temperature rate constant for COD decay	0.041										

Table 11. Kinetic Coefficients for Dissolved Oxygen

	Zones										
Kinetic Coefficient	**Global**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Reaeration Option Switch		2	2	1	1	2	1	1	1	1	1
Reaeration Rate Constant		3.933	3.933	1	1	3.933	1	1	1	1	1
Reaeration constant (3.933 for O'Connor-Dobbins; 5.32 for Owen-Gibbs	1.00										
Temperature rate constant for reaeration	1.024										