A

APPENDIX A

Public Participation Materials

Presentation Outline

- Onterra, LLC
- Why Create a Management Plan?
- Elements of a Lake Management Planning Project
  - Data & Information
  - Planning Process

Onterra, LLC

- Founded in 2005
- Staff
  - Five full-time ecologists
  - One part-time ecologist
  - One intern
- Services
  - Science and planning
- Philosophy
  - Promote realistic planning
  - Assist, not direct

Why create a lake management plan?

- To create a better understanding of lake's positive and negative attributes.
- To discover ways to minimize the negative attributes and maximize the positive attributes.
- To foster realistic expectations and dispel myths.
- To create a snapshot of the lake for future reference and planning.

Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

Brings it all together

Data and information gathering

- Study Components
  - Water Quality Analysis
  - Watershed Assessment
  - Aquatic Plant Surveys
  - Fisheries Data Integration
  - Stakeholder Survey

Water Quality Analysis

- General water chemistry (current & historic)
  - Citizens Lake Monitoring Network
  - WDNR Long-term Trend Monitoring Program
- Nutrient analysis
  - Lake trophic state (Eutrophication)
  - Limiting plant nutrient
- Supporting data for watershed modeling

Watershed Assessment

- Delineation of drainage basin
- Modeling
  - Land cover
  - Phosphorus loading
  - Scenario development

Aquatic Plant Surveys

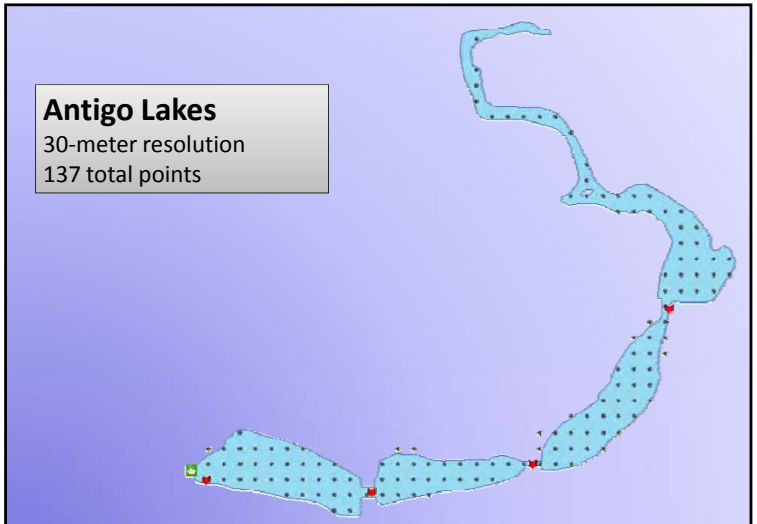
- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Curly-leaf pondweed survey
  - Point-intercept survey
  - Plant community mapping

Non-native Aquatic Plants

Curly-leaf Pondweed

Non-native Aquatic Plants

Eurasian Water Milfoil

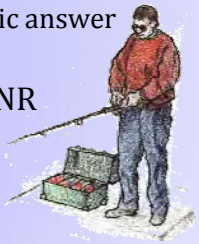


Fisheries Data Integration

- No fish sampling completed
- Assemble data from WDNR, USGS, USFWS, & GLIFWC
- Fish survey results summaries (if available)
- Use information in planning as applicable

Stakeholder Survey

- Standard survey used as base
  - Planning committee potentially develops additional questions and options
  - Must not lead respondent to specific answer through a "loaded" question
- Survey must be approved by WDNR

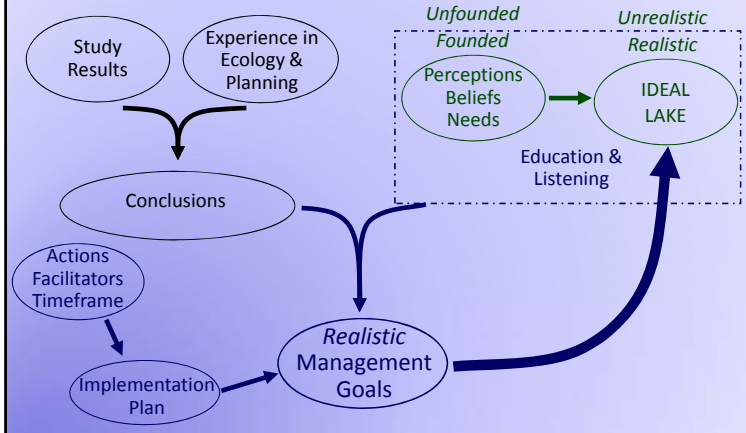


Planning Process

Planning Committee Meetings

Rely on Park and Recreation Board (plus staff)
Study Results (including a stakeholder survey)
Conclusions & Initial Recommendations
Management Goals
Management Actions
  Timeframe
  Facilitator(s)

Implementation Plan



B

APPENDIX B

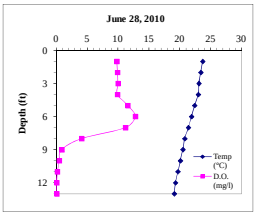
Water Quality Data

Antigo Lakes Basin 1

Date: 06-28-10
Time: 9:00
Weather: sunny, breezy, 65-70°F
Ent: TWH **Verf:**

Max Depth (ft): 13.1
ALB1S Depth (ft): 6.0
ALB1B Depth (ft): 0.0
Secchi Depth (ft): 7.0

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	23.7	9.8		
2.0	23.4	9.9		
3.0	23.1	10.0		
4.0	23.0	9.9		
5.0	22.4	11.6		
6.0	21.9	12.8		
7.0	21.4	11.2		
8.0	20.8	4.1		
9.0	20.5	0.9		
10.0	20.1	0.5		
11.0	19.7	0.2		
12.0	19.3	0.1		
13.0	19.1	0.1		



Parameter	PLS	PLB
Total P (µg/L)	42.000	
Dissolved P (µg/L)		
Chl a (µg/L)	26.20	
TKN (µg/L	570.00	
NO3+NO2-N (µg/L)	ND	
NH3-N (µg/L)	ND	
Total N (µg/L)	570.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)		

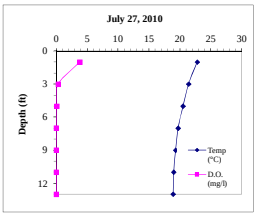
Data collected by BTB and TWH (Onterra)

Antigo Lakes Basin 1

Date: 07-27-10
Time: 13:30
Weather: little breeze, cloudy, 80°F, rained between sites
Ent: TWH **Verf:**

Max Depth (ft): 13.6
ALB1S Depth (ft): 6.0
ALB1B Depth (ft): 0.0
Secchi Depth (ft): 4.0

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	22.8	3.8		
3.0	21.4	0.3		
5.0	20.5	0.1		
7.0	19.7	0.0		
9.0	19.3	0.0		
11.0	19.0	0.0		
13.0	18.9	0.0		



Parameter	PLS	PLB
Total P (µg/L)	109.000	
Dissolved P (µg/L)		
Chl a (µg/L)	15.50	
TKN (µg/L	1170.00	
NO3+NO2-N (µg/L)	ND	
NH3-N (µg/L)	70.000	
Total N (µg/L)	1170.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)	29.0	

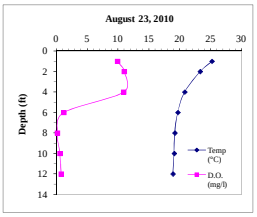
Data collected by TAH (Onterra)
Note: Much FA in all basins, tea colored water, did not see any CLP during sampling or short lake cruise.

Antigo Lakes Basin 1

Date: 08-23-10
Time: 13:45
Weather: clear, very little wind 82°F
Ent: TWH **Verf:**

Max Depth (ft): 13.7
ALB1S Depth (ft): 6.0
ALB1B Depth (ft): 0.0
Secchi Depth (ft): 5.0

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	25.2	9.9		
2.0	23.3	11.0		
4.0	20.8	10.9		
6.0	19.7	1.2		
8.0	19.2	0.2		
10.0	19.1	0.6		
12.0	18.9	0.8		



Parameter	PLS	PLB
Total P (µg/L)	94.000	
Dissolved P (µg/L)		
Chl a (µg/L)	71.00	
TKN (µg/L	1310.00	
NO3+NO2-N (µg/L)	ND	
NH3-N (µg/L)	21.000	
Total N (µg/L)	1310.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)		

Data collected by TAH and MKH (Onterra)
Note: Very much FA & Wolffia

Water Quality Data

2010	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	3	5.3	NA	NA
Total P (µg/L)	3	81.7	NA	NA
Dissolved P (µg/L)	0		NA	NA
Chl a (µg/L)	3	37.6	NA	NA
TKN (µg/L	3	1016.7	NA	NA
NO3+NO2-N (µg/L)	0		NA	NA
NH3-N (µg/L)	2	45.5	NA	NA
Total N (µg/L)	3	1016.7	NA	NA
Lab Cond. (µS/cm)	0		NA	NA
Lab pH	0		NA	NA
Alkal (mg/l CaCO3)	0		NA	NA
Total Susp Sol (mg/l)	0		NA	NA
Calcium (µg/L)	1	29.0	NA	NA

Wisconsin Trophic State Index (WTSI)

Year	TP	Chla	SD
2010	62.41	61.96	53.08
All Years (weighted)	62.41	61.96	53.08
WI Natural Lakes	53.19	54.23	47.33
Northeast Region	51.05	51.49	45.61

Morphological / Geographical Data

Parameter	Value
Acreage	
Volume (acre-feet)	
Perimeter (miles)	
Shoreland Development	
Maximum Depth (feet)	
County	Forest County
WBIC	
Lillie Mason Region(1983)	Northeast Region
Nichols Ecoregion(1999)	NLFF

Watershed Data

WiLMS Class	Acreage	kg/yr	lbs/yr
Forest			
Open Water			
Pasture/Grass			
Row Crops			
Urban - Rural Residential			
Wetland			

Watershed to Lake Area

	Secchi (feet)				Chlorophyll a (µg/L)				Phosphorus (µg/L)				Phosphorus (µg/L)				Nitrogen (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season		Summer		Spring Turnover		Fall Turnover		Spring Turnover		Fall Turnover	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
2010	3	5.3	3	5.3	3	37.6	3	37.6	3	81.7	3	81.7								
All Years (weighted)		5.3		5.3		37.6		37.6		81.7		81.7								
WI Natural Lakes				7.9				13.4				25								
Northeast Region				8.9				9.3				19								

Summer 2009 N: 1017
Summer 2009 P: 82

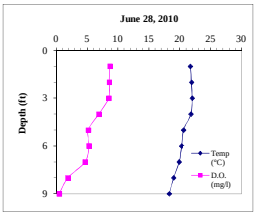
Summer 2009 N:P 12 :1

Antigo Lakes Basin 2

Date: 06-28-10
Time: 9:00
Weather: sunny, breezy, 65-70°F
Ent: TWH **Verf:**

Max Depth (ft): 9.5
ALB2S Depth (ft): 6.0
ALB2B Depth (ft): 0.0
Secchi Depth (ft): 6.2

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	21.7	8.7		
2.0	21.9	8.6		
3.0	22.0	8.5		
4.0	21.8	6.9		
5.0	20.6	5.2		
6.0	20.3	5.3		
7.0	19.9	4.7		
8.0	19.0	1.9		
9.0	18.3	0.5		



Parameter	PLS	PLB
Total P (µg/L)	43.000	
Dissolved P (µg/L)		
Chl a (µg/L)	18.60	
TKN (µg/L	710.00	
NO3+NO2-N (µg/L)	209.000	
NH3-N (µg/L)	15.000	
Total N (µg/L)	710.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)		

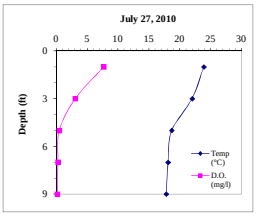
Data collected by BTB and TWH (Onterra)

Antigo Lakes Basin 2

Date: 07-27-10
Time: 13:30
Weather: cloudy, little breeze, rained between sites, 80°F
Ent: TWH **Verf:**

Max Depth (ft): 10.5
ALB2S Depth (ft): 6.0
ALB2B Depth (ft): 0.0
Secchi Depth (ft): 4.4

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	23.9	7.7		
3.0	22.0	3.1		
5.0	18.7	0.5		
7.0	18.1	0.3		
9.0	17.8	0.2		



Parameter	PLS	PLB
Total P (µg/L)	90.000	
Dissolved P (µg/L)		
Chl a (µg/L)	22.50	
TKN (µg/L	1200.00	
NO3+NO2-N (µg/L)	363.000	
NH3-N (µg/L)	39.000	
Total N (µg/L)	1200.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)	25.6	

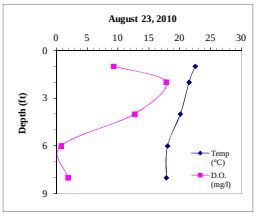
Data collected by TAH (Onterra)
Note: Much FA in all basins, tea colored water, did not see any CLP during sampling or short lake cruise.

Antigo Lakes Basin 2

Date: 08-23-10
Time: 14:15
Weather: clear, very little wind 82°F
Ent: TWH **Verf:**

Max Depth (ft): 9.1
ALB2S Depth (ft): 6.0
ALB2B Depth (ft): 0.0
Secchi Depth (ft): 3.2

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	22.5	9.3		
2.0	21.5	17.8		
4.0	20.1	12.7		
6.0	18.0	0.8		
8.0	17.8	1.9		



Parameter	PLS	PLB
Total P (µg/L)	153.000	
Dissolved P (µg/L)		
Chl a (µg/L)	410.00	
TKN (µg/L	2270.00	
NO3+NO2-N (µg/L)	132.000	
NH3-N (µg/L)	18.000	
Total N (µg/L)	2270.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)		

Data collected by TAH and MKH (Onterra)
Note: Very much FA & Wolffia

Water Quality Data

2010	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	3	4.6	NA	NA
Total P (µg/L)	3	95.3	NA	NA
Dissolved P (µg/L)	0		NA	NA
Chl a (µg/L)	3	150.4	NA	NA
TKN (µg/L	3	1393.3	NA	NA
NO3+NO2-N (µg/L)	3	234.7	NA	NA
NH3-N (µg/L)	3	24.0	NA	NA
Total N (µg/L)	3	1393.3	NA	NA
Lab Cond. (µS/cm)	0		NA	NA
Lab pH	0		NA	NA
Alkal (mg/l CaCO3)	0		NA	NA
Total Susp Sol (mg/l)	0		NA	NA
Calcium (µg/L)	1	25.6	NA	NA

Wisconsin Trophic State Index (WTSI)			
Year	TP	Chla	SD
2010	63.61	72.36	55.13
All Years (weighted)	63.61	72.36	55.13
WI Natural Lakes	53.19	54.23	47.33
Northeast Region	51.05	51.49	45.61

Morphological / Geographical Data

Parameter	Value
Acreage	
Volume (acre-feet)	
Perimeter (miles)	
Shoreland Development	
Maximum Depth (feet)	
County	Forest County
WBIC	
Lillie Mason Region(1983)	Northeast Region
Nichols Ecoregion(1999)	NLFF

Watershed Data

WiLMS Class	Acreage	kg/yr	lbs/yr
Forest			
Open Water			
Pasture/Grass			
Row Crops			
Urban - Rural Residential			
Wetland			

Watershed to Lake Area

	Secchi (feet)				Chlorophyll a (µg/L)				Phosphorus (µg/L)				Phosphorus (µg/L)				Nitrogen (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season				Spring Turnover		Fall Turnover		Spring Turnover		Fall Turnover	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
2010	3	4.6	3	4.6	3	150.4	3	150.4	3	95.3	3	95.3								
All Years (weighted)		4.6		4.6		150.4		150.4		95.3		95.3								
WI Natural Lakes				7.9				13.4				25								
Northeast Region				8.9				9.3				19								

Summer 2009 N: 1393
Summer 2009 P: 95

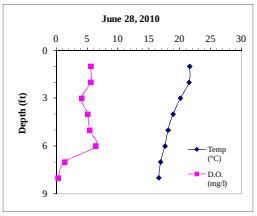
Summer 2009 N:P 15 :1

Antigo Lakes Basin 3

Date: 06-28-10
Time: 9:00
Weather: sunny, breezy, 65-70°F
Ent: TWH **Verf:**

Max Depth (ft): 8.6
ALB3S Depth (ft): 6.0
ALB3B Depth (ft): 0.0
Secchi Depth (ft): 4.9

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	21.6	5.6		
2.0	21.5	5.6		
3.0	20.1	4.1		
4.0	18.9	5.1		
5.0	18.1	5.4		
6.0	17.6	6.4		
7.0	16.9	1.4		
8.0	16.6	0.3		



Parameter	ALB3S	ALB3B
Total P (µg/L)	60.000	
Dissolved P (µg/L)		
Chl a (µg/L)	26.20	
TKN (µg/L	810.00	
NO3+NO2-N (µg/L)	511.000	
NH3-N (µg/L)	35.000	
Total N (µg/L)	810.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)		

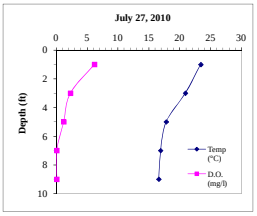
Data collected by BTB and TWH (Onterra)

Antigo Lakes Basin 3

Date: 07-27-10
Time: 13:30
Weather: cloudy, little breeze, rained between sites, 80°F
Ent: TWH **Verf:**

Max Depth (ft): 9.0
ALB3S Depth (ft): 6.0
ALB3B Depth (ft): 0.0
Secchi Depth (ft): 4.5

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	23.4	6.2		
3.0	20.9	2.3		
5.0	17.8	1.2		
7.0	16.9	0.1		
9.0	16.6	0.1		



Parameter	ALB3S	ALB3B
Total P (µg/L)	68.000	
Dissolved P (µg/L)		
Chl a (µg/L)	15.50	
TKN (µg/L	820.00	
NO3+NO2-N (µg/L)	637.000	
NH3-N (µg/L)	34.000	
Total N (µg/L)	820.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)	26.5	

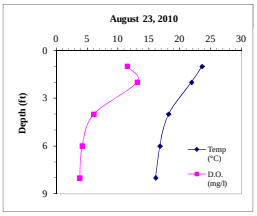
Data collected by TAH (Onterra)
Note: Much FA in all basins, tea colored water, did not see any CLP during sampling or short lake cruise.

Antigo Lakes Basin 3

Date: 08-23-10
Time: 13:15
Weather: clear, very little wind, 82°F
Ent: TWH **Verf:**

Max Depth (ft): 8.7
ALB3S Depth (ft): 6.0
ALB3B Depth (ft): 0.0
Secchi Depth (ft): 3.6

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	23.6	11.5		
2.0	21.9	13.1		
4.0	18.2	6.1		
6.0	16.8	4.2		
8.0	16.1	3.8		



Parameter	ALB3S	ALB3B
Total P (µg/L)	59.000	
Dissolved P (µg/L)		
Chl a (µg/L)	71.00	
TKN (µg/L	1040.00	
NO3+NO2-N (µg/L)	570.000	
NH3-N (µg/L)		
Total N (µg/L)	1040.00	
Lab Cond. (µS/cm)		
Lab pH		
Alkal (mg/l CaCO3)		
Total Susp Sol (mg/l)		
Calcium (mg/l)		

Data collected by TAH and MKH (Onterra)
Note: Very much FA and Wolffia.

Water Quality Data

2009/2010	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	3	4.3	NA	NA
Total P (µg/L)	3	62.3	NA	NA
Dissolved P (µg/L)	0		NA	NA
Chl a (µg/L)	3	37.6	NA	NA
TKN (µg/L	3	890.0	NA	NA
NO3+NO2-N (µg/L)	3	572.7	NA	NA
NH3-N (µg/L)	2	34.5	NA	NA
Total N (µg/L)	3	890.0	NA	NA
Lab Cond. (µS/cm)	0		NA	NA
Lab pH	0		NA	NA
Alkal (mg/l CaCO3)	0		NA	NA
Total Susp Sol (mg/l)	0		NA	NA
Calcium (µg/L)	1	26.5	NA	NA

Wisconsin Trophic State Index (WTSI)			
Year	TP	Chla	SD
1985	51.45		
2010	60.30	66.04	56.10
All Years (weighted)	58.85	66.04	56.10
WI Natural Lakes	53.19	54.23	47.33
Northeast Region	51.05	51.49	45.61

Morphological / Geographical Data

Parameter	Value
Acreage	
Volume (acre-feet)	
Perimeter (miles)	
Shoreland Development	
Maximum Depth (feet)	
County	Forest County
WBIC	
Lillie Mason Region(1983)	Northeast Region
Nichols Ecoregion(1999)	NLFF

Watershed Data

WiLMS Class	Acreage	kg/yr	lbs/yr
Forest			
Open Water			
Pasture/Grass			
Row Crops			
Urban - Rural Residential			
Wetland			

Watershed to Lake Area

	Secchi (feet)				Chlorophyll a (µg/L)				Phosphorus (µg/L)				Phosphorus (µg/L)				Nitrogen (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season				Spring Turnover		Fall Turnover		Spring Turnover		Fall Turnover	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1985									1	20	1	20								
2010	3	4.3	3	4.3	3	64.8	3	64.8	3	62.3	3	62.3								
All Years (weighted)		4.3	3.0	4.3	3.0	64.8	3.0	64.8	3.0	51.7	2.5	51.7								
WI Natural Lakes				7.9				13.4				25								
Northeast Region				8.9				9.3				19								

Summer 2009 N: 890
Summer 2009 P: 62

Summer 2009 N:P 14 :1

C

APPENDIX C

Watershed Analysis WILMS Results

Date: 7/27/2011 Antigo Lakes Current

Lake Id: Antigo Lakes
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 22711.0 acre
Total Unit Runoff: 12 in.
Annual Runoff Volume: 22711.0 acre-ft
Lake Surface Area <As>: 20.0 acre
Lake Volume <V>: 140 acre-ft
Lake Mean Depth <z>: 7.0 ft
Precipitation - Evaporation: 5.3 in.
Hydraulic Loading: 22719.8 acre-ft/year
Areal Water Load <qs>: 1136.0 ft/year
Lake Flushing Rate <p>: 162.28 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 42.0 mg/m^3
Observed growing season mean phosphorus (GSM): 81.7 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre	Low	Most Likely	High	Loading %	Low	Most Likely	High
	(ac)	Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	8375	0.50	1.00	3.00	67.5	1695	3389	10168
Mixed AG	1838	0.30	0.80	1.40	11.9	223	595	1041
Pasture/Grass	5155	0.10	0.30	0.50	12.5	209	626	1043
HD Urban (1/8 Ac)	237	1.00	1.50	2.00	2.9	96	144	192
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	256	0.05	0.10	0.25	0.2	5	10	26
Wetlands	393	0.10	0.10	0.10	0.3	16	16	16
Forest	6457	0.05	0.09	0.18	4.7	131	235	470
Lake Surface	20.0	0.10	0.30	1.00	0.0	1	2	8

OINT SOURCE DATA

Point Sources	Water Load (m^3/year)	Low (kg/year)	Most Likely (kg/year)	High (kg/year)	Loading %

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.3	0.5	0.8	
# capita-years	0.0				
% Phosphorus Retained by Soil		98	90	80	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	5235.8	11062.8	28581.9	100.0
Total Loading (kg)	2374.9	5018.0	12964.7	100.0
Areal Loading (lb/ac-year)	261.79	553.14	1429.10	0.0
Areal Loading (mg/m^2-year)	29342.79	61999.35	160181.98	0.0
Total PS Loading (lb)	0.0	0.0	0.0	0.0
Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	5234.0	11057.4	28564.1	100.0
Total NPS Loading (kg)	2374.1	5015.6	12956.6	100.0

Phosphorus Prediction and Uncertainty Analysis Module

Date: 7/27/2011 Antigo Lakes Current
Observed spring overturn total phosphorus (SPO): 42.0 mg/m^3
Observed growing season mean phosphorus (GSM): 81.7 mg/m^3
Back calculation for SPO total phosphorus: 0.0 mg/m^3
Back calculation GSM phosphorus: 0.0 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	73	155	400	73	89
Canfield-Bachmann, 1981 Natural Lake	79	161	395	79	97
Canfield-Bachmann, 1981 Artificial Lake	71	138	304	56	69
Rechow, 1979 General	69	145	375	63	77
Rechow, 1977 Anoxic	75	158	409	76	93
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	55	115	298	33	40
Walker, 1977 General	78	166	428	124	295
Vollenweider, 1982 Combined OECD	56	103	223	41	66
Dillon-Rigler-Kirchner	83	175	453	133	317
Vollenweider, 1982 Shallow Lake/Res.	47	92	211	30	49
Larsen-Mercier, 1976	79	166	429	124	295
Nurnberg, 1984 Oxic	81	172	444	90	110

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter	Back Fit?	Model Calculation (kg/year)	Type
Walker, 1987 Reservoir	89	314	Tw		0	GSM
Canfield-Bachmann, 1981 Natural Lake	50	464	L		1	GSM
Canfield-Bachmann, 1981 Artificial Lake	43	397	FIT		1	GSM
Rechow, 1979 General	80	297	P L qs		0	GSM
Rechow, 1977 Anoxic	93	320	FIT		0	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A		N/A	N/A
Rechow, 1977 water load>50m/year	78	226	Pin		0	GSM
Walker, 1977 General	81	353	FIT		0	SPO
Vollenweider, 1982 Combined OECD	50	204	Tw		0	ANN
Dillon-Rigler-Kirchner	102	355	P L qs p		0	SPO
Vollenweider, 1982 Shallow Lake/Res.	44	186	Tw		0	ANN
Larsen-Mercier, 1976	100	333	P Pin p		0	SPO
Nurnberg, 1984 Oxic	88	360	P L qs		0	ANN

D

APPENDIX D

Aquatic Plant Survey Data

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	*Myriophyllum spicatum*	*Potamogeton crispus*	*Elodea canadensis*	*Ceratophyllum demersum*	*Myriophyllum sibiricum*	*Potamogeton zosteriformis*	*Spirodela polyrhiza*	*Lemna turionifera*	*Typha angustifolia*	*Nymphaea odorata*	*Potamogeton pusillus*	*Lemna trisulca*	*Potamogeton epihydrus*	*Ranunculus aquatilis*	*Phalaris arundinacea*	Filamentous algae
1	45.1421945	-89.15007617				Unreachable																	
2	45.1419245	-89.15008018	13	M	P	No Vegetation																	
3	45.1416545	-89.15008419	5	R	P		1			1	1	1	1				1						
4	45.1421917	-89.14969463	10	M	P	No Vegetation																	
5	45.1419217	-89.14969864	12	M	P	No Vegetation																	
6	45.1416517	-89.14970266	7	M	P	No Vegetation																	
7	45.1424589	-89.14930907	4	M	P		1			1			1										
8	45.1421889	-89.14931309	10	M	P	No Vegetation																	
9	45.1419188	-89.1493171	11	M	P	No Vegetation																	
10	45.1416488	-89.14932112	6	M	P		1			1	1												
11	45.142186	-89.14893155	10	M	P	No Vegetation																	
12	45.141916	-89.14893557	7	M	P	No Vegetation																	
13	45.141646	-89.14893958	7	M	P	No Vegetation																	
14	45.1421832	-89.14855001	9	M	P	No Vegetation																	
15	45.1419132	-89.14855403	9	M	P		1						1										
16	45.1416431	-89.14855805	7	M	P		1				1												
17	45.1421803	-89.14816847	6	M	P	No Vegetation																	
18	45.1419103	-89.14817249	9	S	P	No Vegetation																	
19	45.1416403	-89.14817651	8	S	P		1					1											
20	45.1413703	-89.14818053	2	M	P		2			2	1	1				1						1	1
21	45.1421775	-89.14778693	5	M	P		1			1		1				1							
22	45.1419075	-89.14779095	9	S	P		1						1										
23	45.1416374	-89.14779498	9	M	P				1														
24	45.1413674	-89.147799	3	S	P		1			1	1					1	1	1					
25	45.1419046	-89.14740942	8	M	P	No Vegetation																	
26	45.1416346	-89.14741344	8	M	P		2				1	2	1										
27	45.1413646	-89.14741747	9	M	P		1					1	1										
28	45.1419018	-89.14702788	6	S	P		1						1										
29	45.1416317	-89.1470319	9	S	P		2						1										
30	45.1413617	-89.14703593	9	S	P		2			1		1					1						
31	45.1410917	-89.14703996	4	S	P		2			1	1												1
32	45.1416289	-89.14665037	5	M	P		3			1	1	1	2										1
33	45.1413589	-89.1466544	7	S	P		3			1	1	1	1										1
34	45.1410889	-89.14665843	5	M	P		2			1	1	1	1										1
35	45.141356	-89.14627286	4	R	P	No Vegetation																	
36	45.1418932	-89.14588327	6	M	P		2			2	1												1
37	45.1416232	-89.1458873	7	M	P	No Vegetation																	
38	45.1413532	-89.14589133	9	M	P	No Vegetation																	
39	45.1421604	-89.14549769				Unreachable																	
40	45.1418904	-89.14550173	6	M	P		2			1	1	1											1
41	45.1416203	-89.14550576	9	M	P	No Vegetation																	
42	45.1413503	-89.1455098	6	M	P		1						1										
43	45.1421575	-89.14511616	3	M	P		1			1	1			1		1							1
44	45.1418875	-89.14512019	7	M	P		1				1	1											1
45	45.1416175	-89.14512423	9	M	P		2				1	2											
46	45.1413475	-89.14512826	4	S	P		1			1	1	1				1							
47	45.1418846	-89.14473865	8	M	P		1			1	1	1											1
48	45.1416146	-89.14474269	10	S	P		1						1										
49	45.1413446	-89.14474673				Unreachable																	
50	45.1418818	-89.14435712	10	M	P	No Vegetation																	
51	45.1416118	-89.14436116	9	M	P		1					1											
52	45.1418789	-89.14397558	9	M	P	No Vegetation																	
53	45.1416089	-89.14397962	8	M	P		1											1		1			
54	45.1491666	-89.14348487				Unreachable																	
55	45.1486266	-89.14349296				Unreachable																	
56	45.1483566	-89.143497				Unreachable																	
57	45.1480865	-89.14350104				Unreachable																	
58	45.1418761	-89.14359404	9	S	P		1			1													
59	45.141606	-89.14359809	8	S	P		1											1					
60	45.1478137	-89.14312351				Unreachable																	
61	45.1418732	-89.14321251	7	S	P		1			1													
62	45.1416032	-89.14321655	3	M	P		1			1	1			1		1							
63	45.1478108	-89.14274193				Unreachable																	
64	45.1418703	-89.14283097	7	S	P		1			1	1		1										
65	45.1478079	-89.14236036				Unreachable																	
66	45.1418675	-89.14244943	4	R	P	No Vegetation																	

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	*Myriophyllum spicatum*	*Potamogeton crispus*	*Elodea canadensis*	*Ceratophyllum demersum*	*Myriophyllum sibiricum*	*Potamogeton zosteriformis*	*Spirodela polyrhiza*	*Lemna turionifera*	*Typha angustifolia*	*Nymphaea odorata*	*Potamogeton pusillus*	*Lemna trisulca*	*Potamogeton epihydrus*	*Ranunculus aquatilis*	*Phalaris arundinacea*	Filamentous algae
67	45.1478051	-89.14197878	3	S	P		1		1	1	1												
68	45.1424047	-89.1420598				Unreachable																	
69	45.1421346	-89.14206385				Unreachable																	
70	45.1418646	-89.1420679	7	R	P		1			1											1		
71	45.1478022	-89.14159721				Unreachable																	
72	45.1424018	-89.14167826	5	M	P		1			1	1					1	1						1
73	45.1421318	-89.14168231	8	M	P																		
74	45.1418617	-89.14168636	8	M	P	No Vegetation																	
75	45.1475293	-89.14121968				Unreachable																	
76	45.1464492	-89.1412359				Unreachable																	
77	45.1426689	-89.14129266				Unreachable																	
78	45.1423989	-89.14129672	6	M	P		2					2											1
79	45.1421289	-89.14130077	10	M	P	No Vegetation																	
80	45.1418589	-89.14130482	4	M	P		2			2	1			1					1				
81	45.1469864	-89.14084622				Unreachable																	
82	45.1467164	-89.14085028	4	S	P		1		1	1													
83	45.1464464	-89.14085434				Unreachable																	
84	45.1426661	-89.14091112	6	M	P		1			1	1	1											1
85	45.1423961	-89.14091518	10	M	P	No Vegetation																	
86	45.142126	-89.14091923	9	M	P	No Vegetation																	
87	45.1464435	-89.14047277	4	S	P		2		1	2				1	1								
88	45.1429332	-89.14052552	6	M	P		1			1	1	1											
89	45.1426632	-89.14052958	9	M	P	No Vegetation																	
90	45.1423932	-89.14053364	7	M	P		2			1	2		1										
91	45.1421232	-89.14053769				Unreachable																	
92	45.1464406	-89.1400912				Unreachable																	
93	45.1461706	-89.14009526				Unreachable																	
94	45.1434704	-89.14013586	6	M	P		2			1	1		1										1
95	45.1432004	-89.14013992	10	M	P		2			1	1	1	1										
96	45.1429303	-89.14014398	10	M	P	No Vegetation																	
97	45.1426603	-89.14014804	7	M	P	No Vegetation																	
98	45.1423903	-89.14015209				Unreachable																	
99	45.1464377	-89.13970963	4	S	P		1		1	1													
100	45.1461677	-89.1397137				Unreachable																	
101	45.1440076	-89.13974619				Unreachable																	
102	45.1437375	-89.13975025	8	M	P		3			1	1	1	2										1
103	45.1434675	-89.13975431	9	M	P	No Vegetation																	
104	45.1431975	-89.13975837	8	M	P		1			1		1											
105	45.1429275	-89.13976243	6	M	P		1			1													
106	45.1426575	-89.13976649				Unreachable																	
107	45.1464349	-89.13932807	3	S	P		2		1	2	1			1	1								
108	45.1461648	-89.13933213				Unreachable																	
109	45.1442747	-89.13936057				Unreachable																	
110	45.1440047	-89.13936464	6	S	P		2			1	1												
111	45.1437347	-89.1393687	6	S	P		2			2	1												
112	45.1434646	-89.13937276	9	M	P		3			3	1												
113	45.1431946	-89.13937683	7	M	P		1				1												
114	45.1429246	-89.13938089				Unreachable																	
115	45.146162	-89.13895067	2	S	P		2		1	2													
116	45.1450819	-89.13896683				Unreachable																	
117	45.1448119	-89.13897089				Unreachable																	
118	45.1445418	-89.13897496	4	R	P		2			1	1	1	1	1	1								
119	45.1442718	-89.13897902	5	S	P		1		1	1		1											
120	45.1440018	-89.13898309				Unreachable																	
121	45.1437318	-89.13898715				Unreachable																	
122	45.1461591	-89.138569				Unreachable																	
123	45.1458891	-89.13857307	3	S	P		2		1	2				1	1								
124	45.1456191	-89.13857714	4	S	P		2		1	2				1	1								
125	45.145349	-89.1385812	5	S	P		2		1	2			1	1	1								
126	45.145079	-89.13858527	5	S	P		2			1	1	1		1	1								
127	45.144809	-89.13858934	5	R	P		2		1	2	1												
128	45.1458862	-89.1381915				Unreachable																	
129	45.1456162	-89.13819557				Unreachable																	
130	45.1453462	-89.13819964				Unreachable																	
131	45.1450761	-89.13820371				Unreachable																	
132	45.1448061	-89.13820778				Unreachable																	
133	45.1453433	-89.13781808				Unreachable																	
134	45.1450733	-89.13782215				Unreachable																	
135	45.1448032	-89.13782622				Unreachable																	
136	45.1453404	-89.13743652				Unreachable																	
137	45.1450704	-89.1374406				Unreachable																	

E

APPENDIX E

USACOE Endothall Herbicide Monitoring Summary, 2012

Draft: Antigo Lake, Langlade County, Endothall Herbicide Monitoring Summary, 2012

8 November 2012

John Skogerboe
US Army Engineer Research and Development Center (ERDC)

On 8 May, 2012 Antigo Lake, infested with curly-leaf pondweed, was treated with a liquid formulation of endothall, applied as Aquathol K (Figure 1) (Onterra LLC 2012). Antigo Lake is divided into 3 distinct basins connected by narrow channels. Water flows from basin 3 to basin 2, then to basin 1 and then out of the lake. Curly-leaf pondweed was treated at application rates that would yield basin wide concentrations of 710 ug/L ae (1.0 mg/L ai). Based on the Aquathol K label, application rates are computed based on active ingredient, while herbicide concentrations are reported as acid equivalent. A concentration of 0.71 mg/ae is equal to 1.00 mg/L ai. Two water sample locations were established in each basin (Figure 2).

Water samples were collected using an integrated water sampler which collects a water sample from the entire water column. Water samples were collected at intervals of .25, 1, 2, 5, 6, 9, 10, 13, 20, 27 and 35 days after treatment (DAT). Samples were taken to shore after completion of each sample interval, and 3 drops of muriatic acid were added to each sample bottle to fix the herbicide and prevent degradation. Samples were then stored in a refrigerator, until shipped to the ERDC laboratory in Gainesville, FL for analysis of endothall.

Initial endothall concentrations in the upstream Basin 1 exceeded the basin wide target concentration of 710 ug/L ae through 2 DAT (Figure 3). Endothall dissipated steadily and was less than 100 ug/L ae by approximately 18 DAT.

Initial endothall concentrations in the middle Basin 2 also exceeded the basin wide target concentration of 710 ug/L ae through 2 DAT (Figure 4). Endothall dissipated steadily and was less than 100 ug/L ae by approximately 20 to 21 DAT.

Initial endothall concentrations in Basin 1 were variable through 1 DAT, but were nearly equal to the basin wide target concentration of 710 ug/L ae by 2 DAT (Figure 5). Endothall concentrations remained steady through 13 DAT, before dissipating. Concentrations were less than 100 ug/L ae by 26 to 27 DAT.

Initial mean endothall concentrations in basins 2 and 3 were both greater than the basin wide target concentration of 710 ug/L ae, while mean concentrations in basin 1 less than the target (Figure 6). Dissipation rates from Basin 2 and 3 rates were similar to each other, but dissipation from Basin 2 appeared to be slightly less than from Basin 3. Movement of herbicide from Basin 3 into Basin 2 was likely the cause of the differences in dissipation rates. Initial mean concentrations in Basin 1 appeared to be slightly less the basin wide target concentration. The mean lake wide endothall concentration for 0 to 7 DAT was 740 ug/L ae compared to the target concentration of 710 ug/L ae. Herbicide did not appear to dissipate from Basin 1 through 13 DAT, but this likely resulted form herbicide flowing into the basin from Basin 2 and Basin 3. Overall endothall concentrations and exposure times in Antigo Lake appeared to be more than sufficient to kill curly-leaf pondweed.

Figure 1. Antigo Lake Endothall Treatment Locations, 2012 (Onterra LLC)

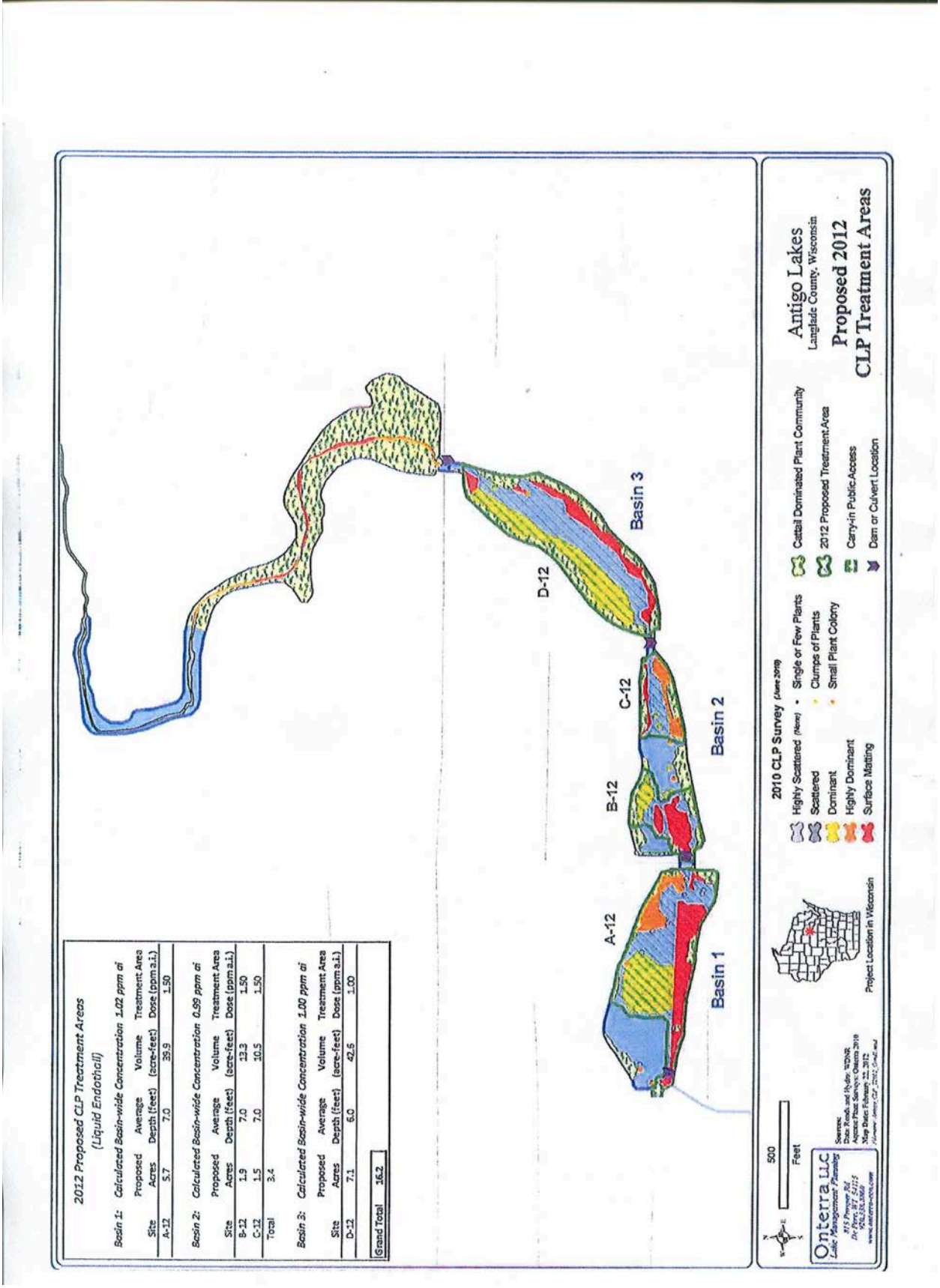


Figure 2. Antigo Lake 2,4-D Sample Locations, 2012 (Onterra LLC)

Figure 3

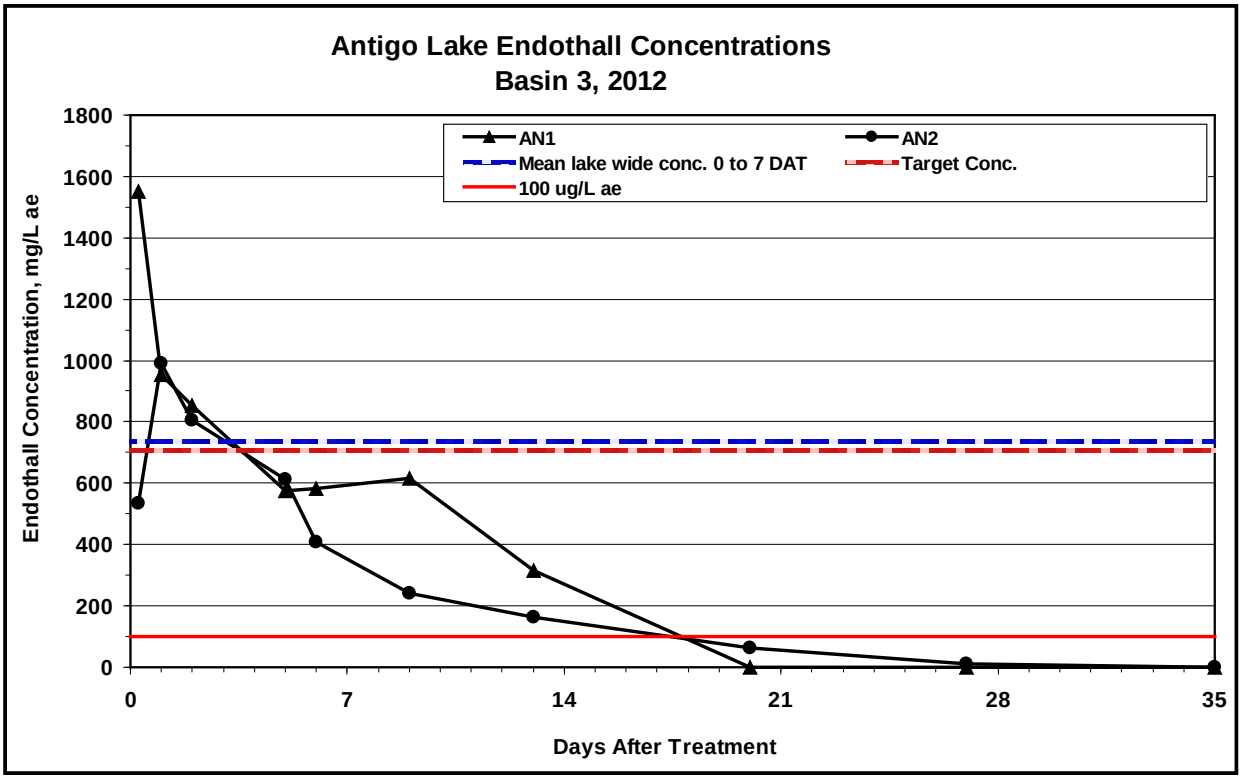


Figure 4

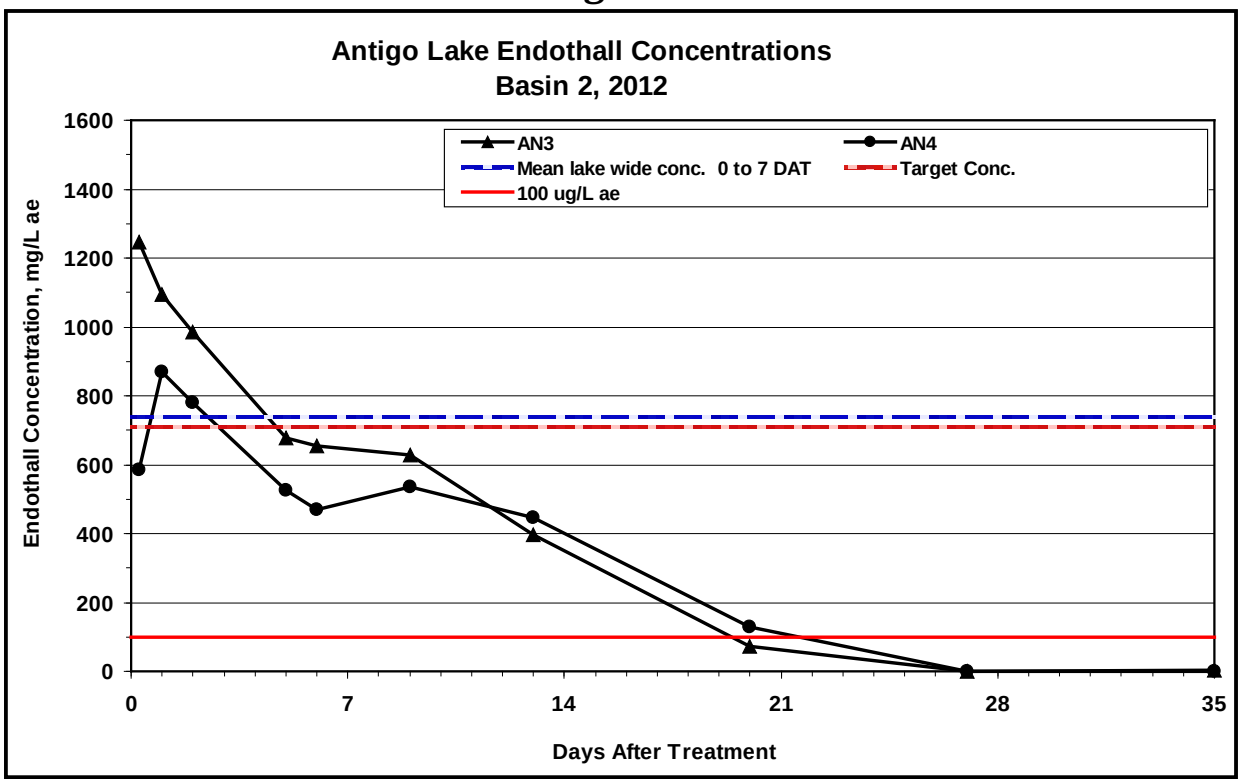


Figure 5

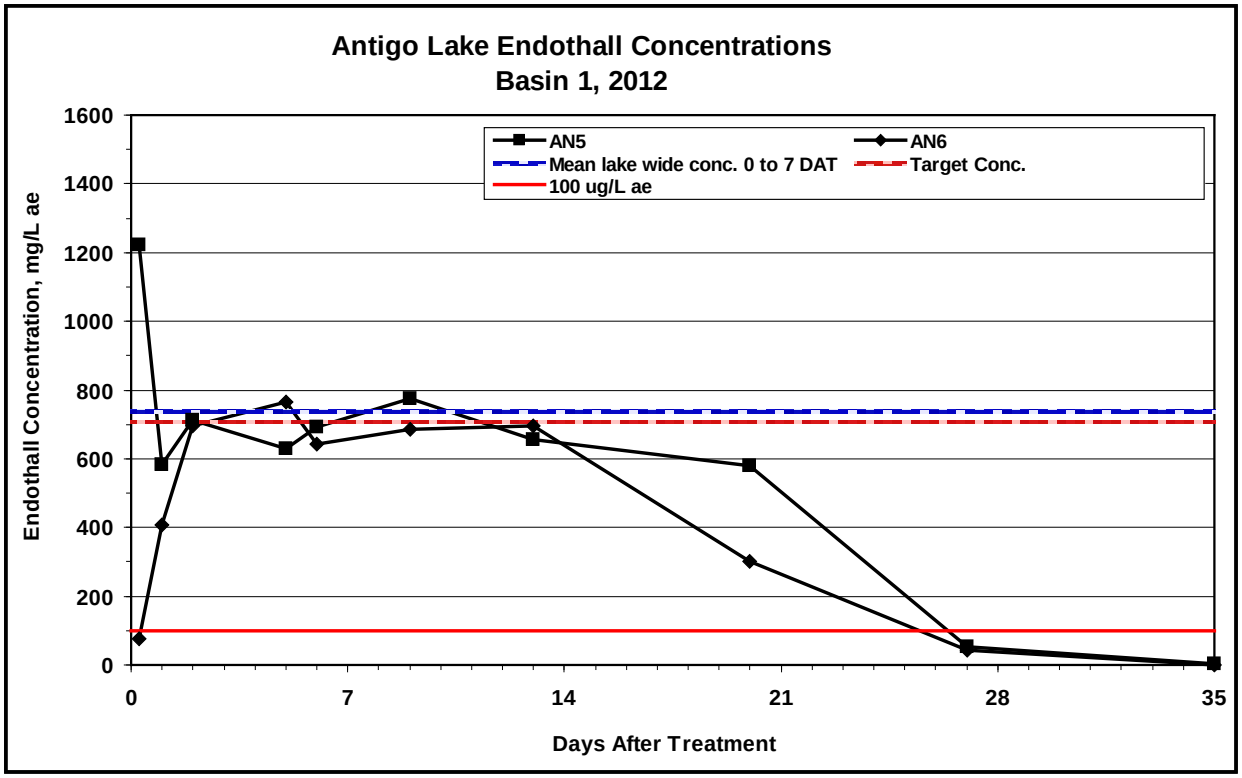


Figure 6