Long-term turbidity patterns at Lake Wister…

Steve Patterson

bioXdesign

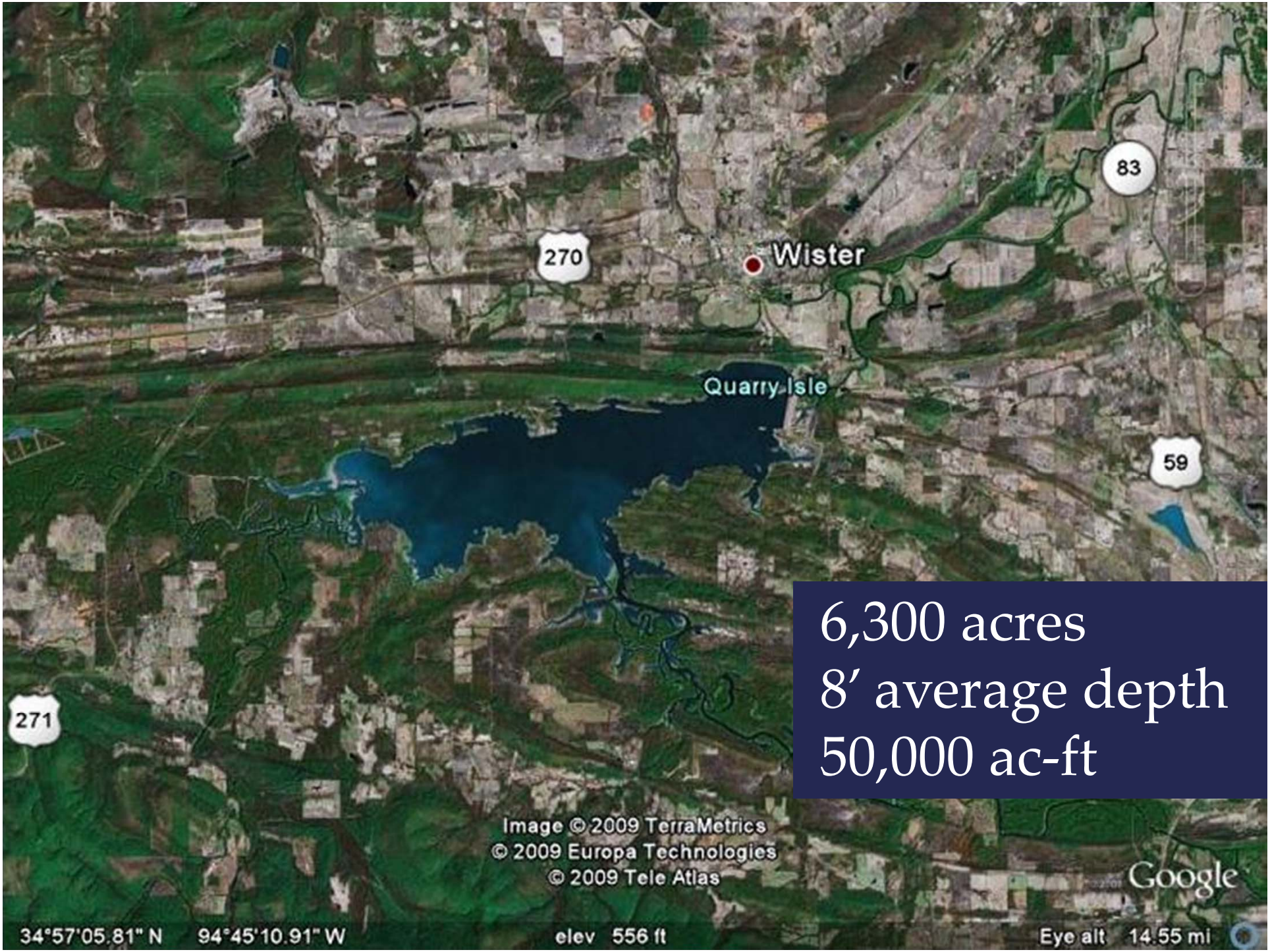
OCLWA April 13, 2012

…and their implications for restoration and management

Acknowledgements:

Choctaw Nation
City of Poteau
AES Corporation

- Long-term lake turbidity pattern
- Seasonality in turbidity
- What's the limiting factor(s)?
- Implications for lake modeling & lake restoration


83
270
Wister
Quarry Isle
59
271
6,300 acres
8’ average depth
50,000 ac-ft
Image © 2009 TerraMetrics
© 2009 Europa Technologies
© 2009 Tele Atlas
Google
34°57'05.81" N 94°45'10.91" W
elev 556 ft
Eye alt 14.55 mi

Lake Wister Beneficial Uses

Beneficial Use	Status	Cause
Public and Private Water Supply	**Not Supporting**	Chlorophyll-a
Warm Water Aquatic Community (Fish & Wildlife Propagation)	**Not Supporting**	Dissolved Oxygen Turbidity pH
Aesthetics	**Not Supporting**	Total Phosphorus
Primary Body Contact Recreation	**Not Supporting**	*Enterococcus*
Fish Consumption	**Not Assessed**	Mercury
Agriculture	**Supporting**	

(ODEQ 2010)

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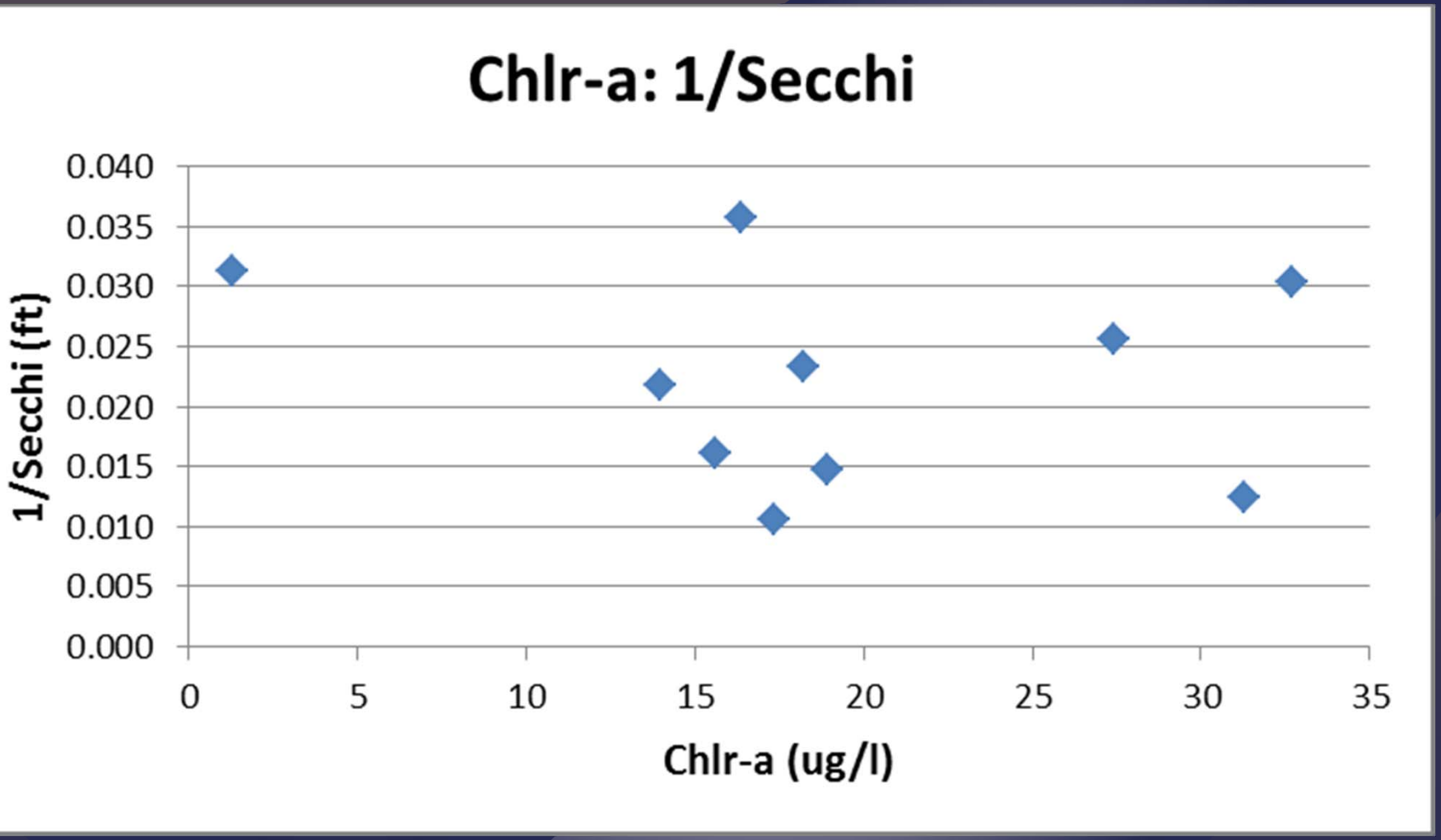
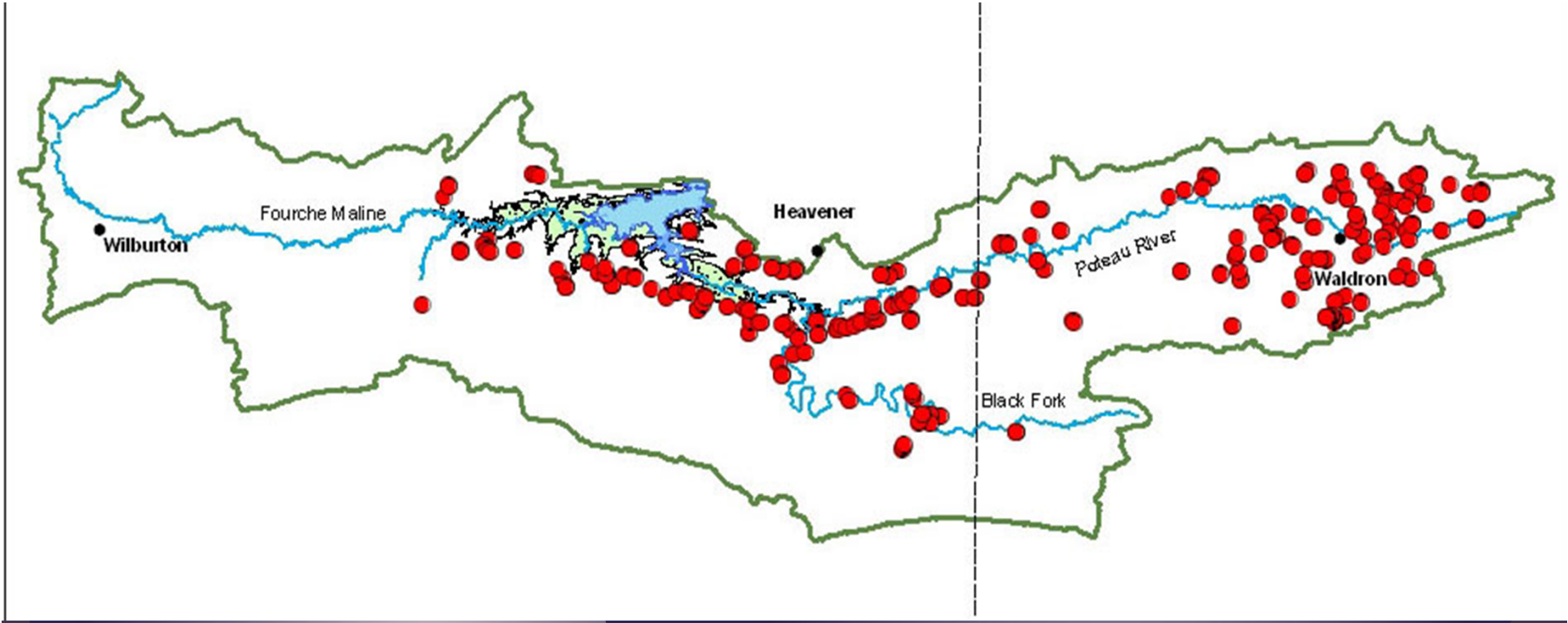
(ODEQ 2010)

Two components:

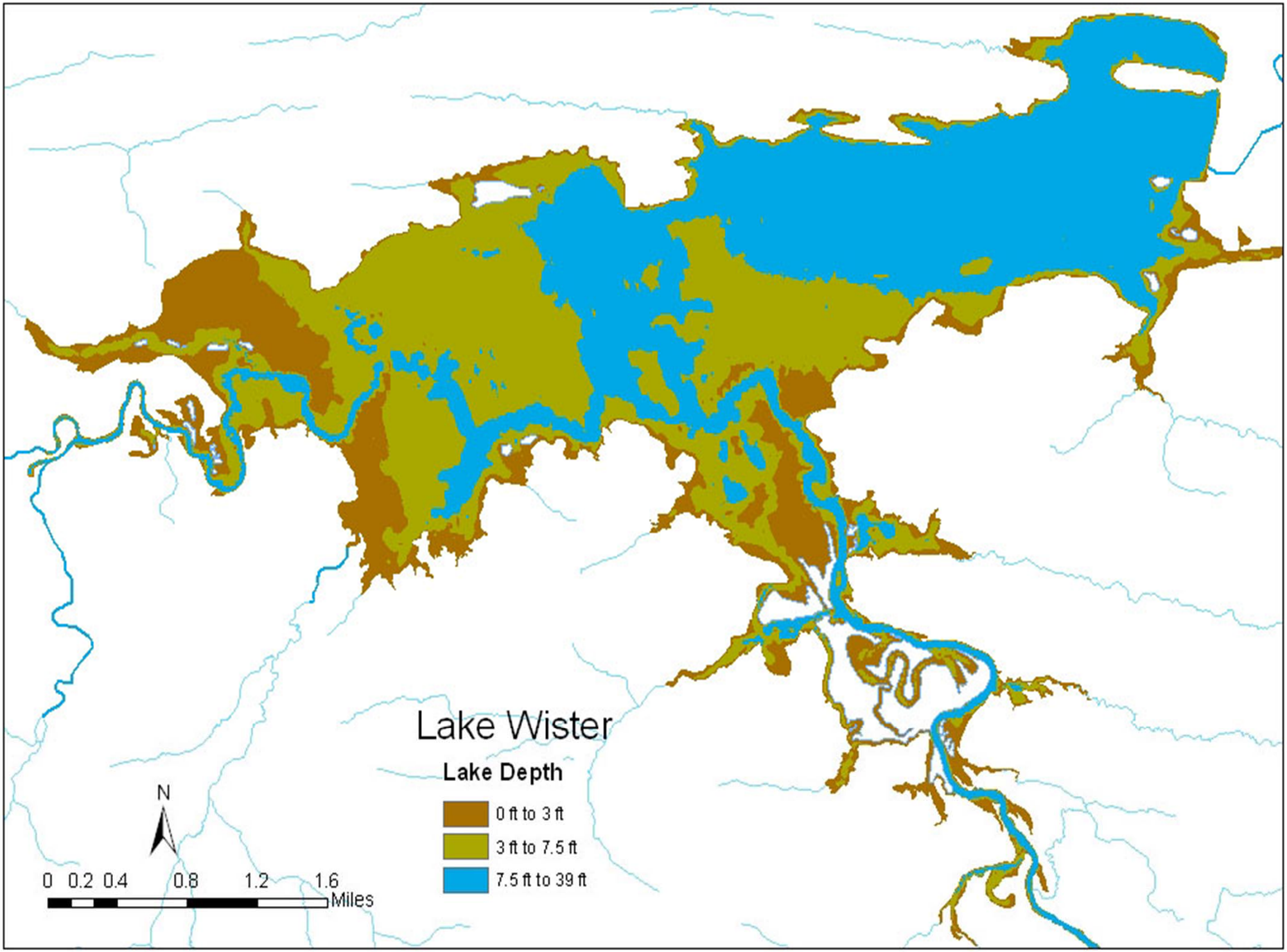
- organic
- mineral

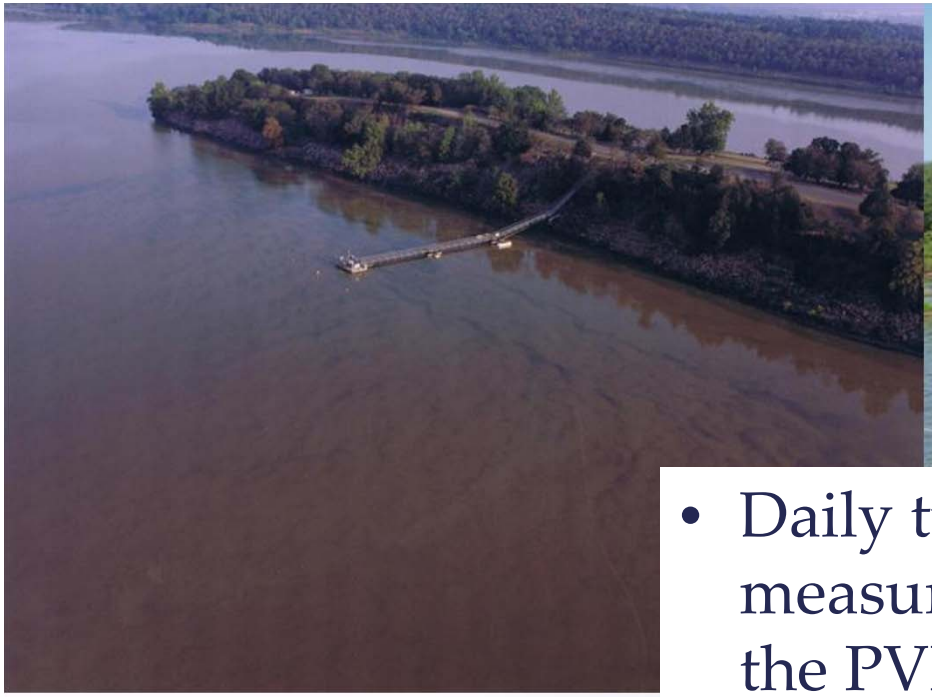

Chlr-a: 1/Secchi
1/Secchi (ft)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
5
10
15
20
25
30
35
Chlr-a (ug/l)



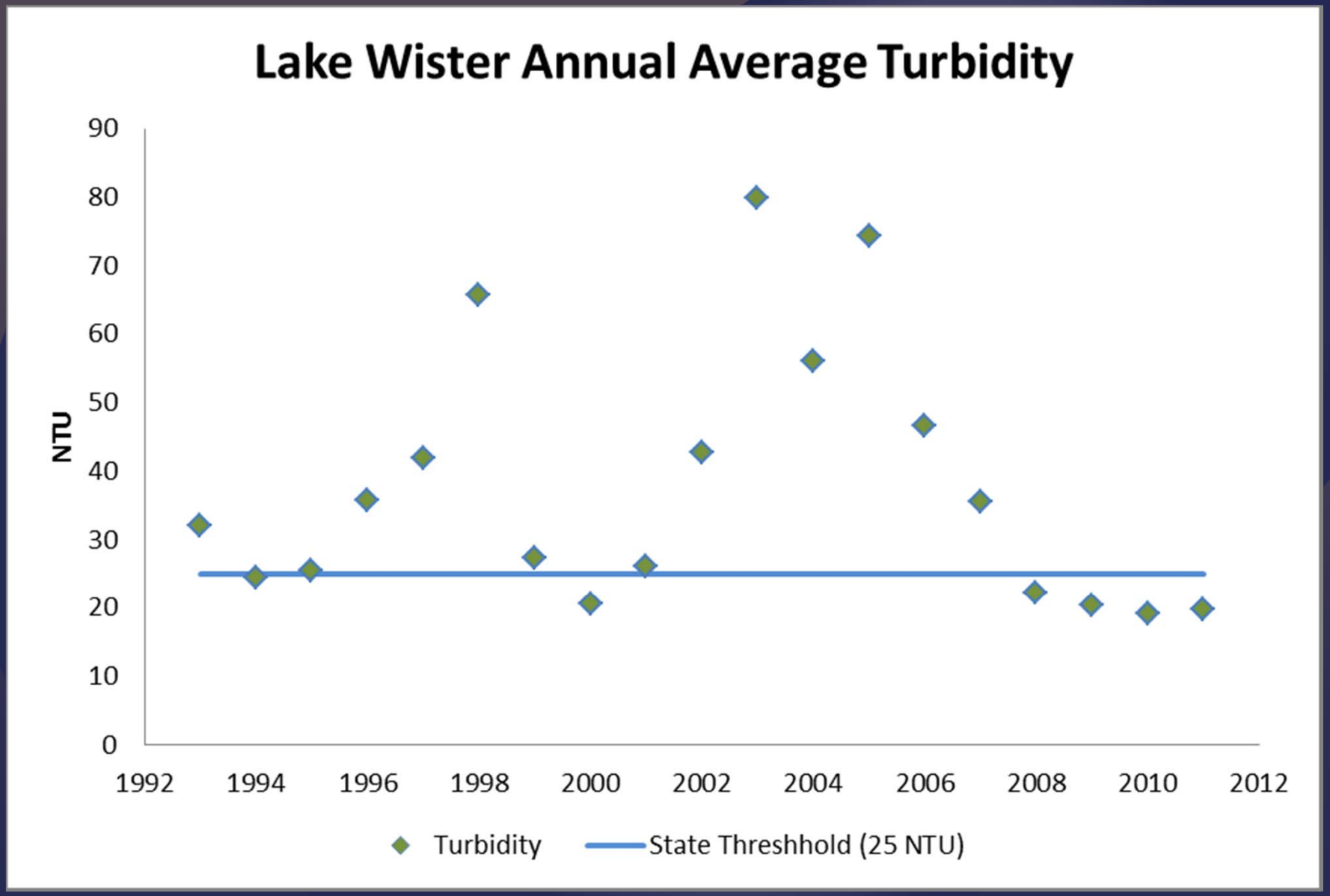
- Watershed soils, alluvial sediments, high clay
- 34,000 T chicken litter produced in LeFlore Cty (2011)
- 24,000 T applied (highest county total in the state)
- Less than half the amount applied in 2001
- =12.2 million pounds of phosphorus applied since 2001
- 5.5 million kilograms; 500,000 kg per year average
- 190,000 kg/yr estimated phosphorus load (1996)

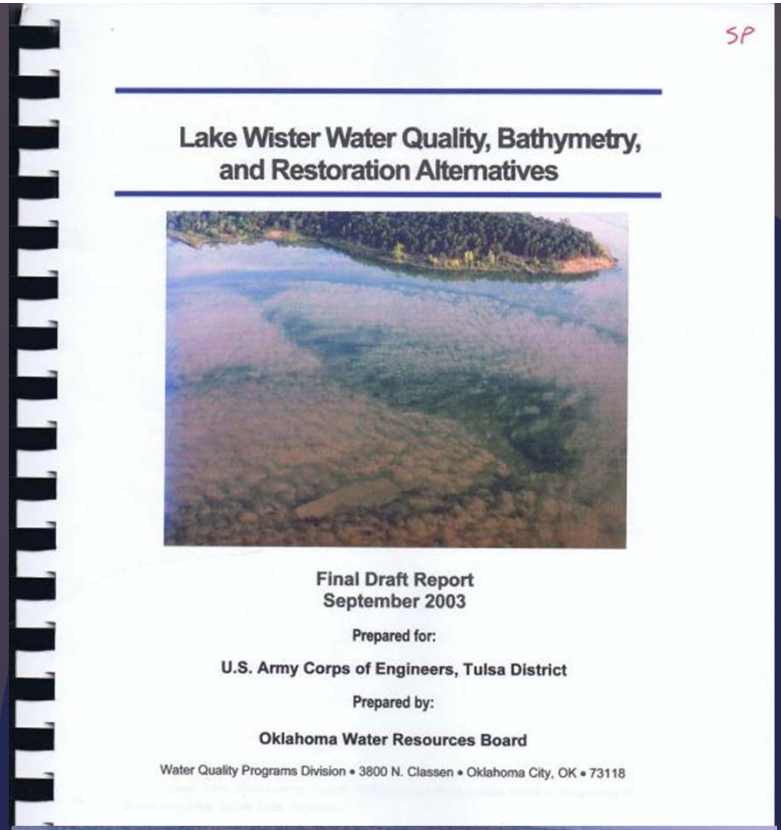

ONE WAY
DO NOT
ENTER

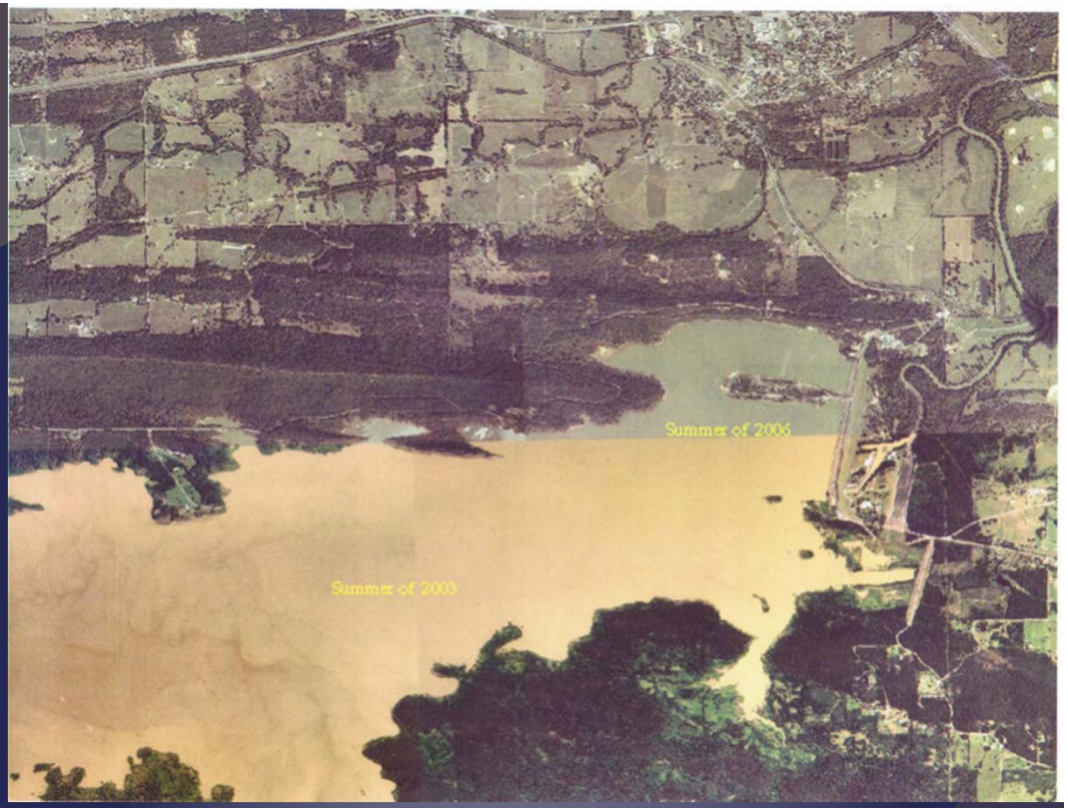

Lake Wister
Lake Depth
0 ft to 3 ft
3 ft to 7.5 ft
7.5 ft to 39 ft
N
0 0.2 0.4 0.8 1.2 1.6
Miles

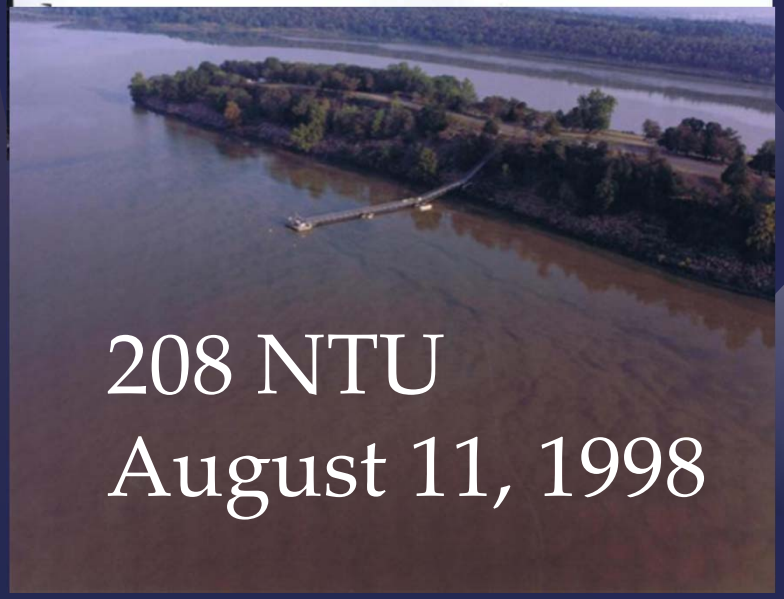


- Daily turbidity measurements at the PVIA plant, 1991 - 2011


Lake Wister Annual Average Turbidity
NTU
90
80
70
60
50
40
30
20
10
0
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Turbidity
State Threshhold (25 NTU)



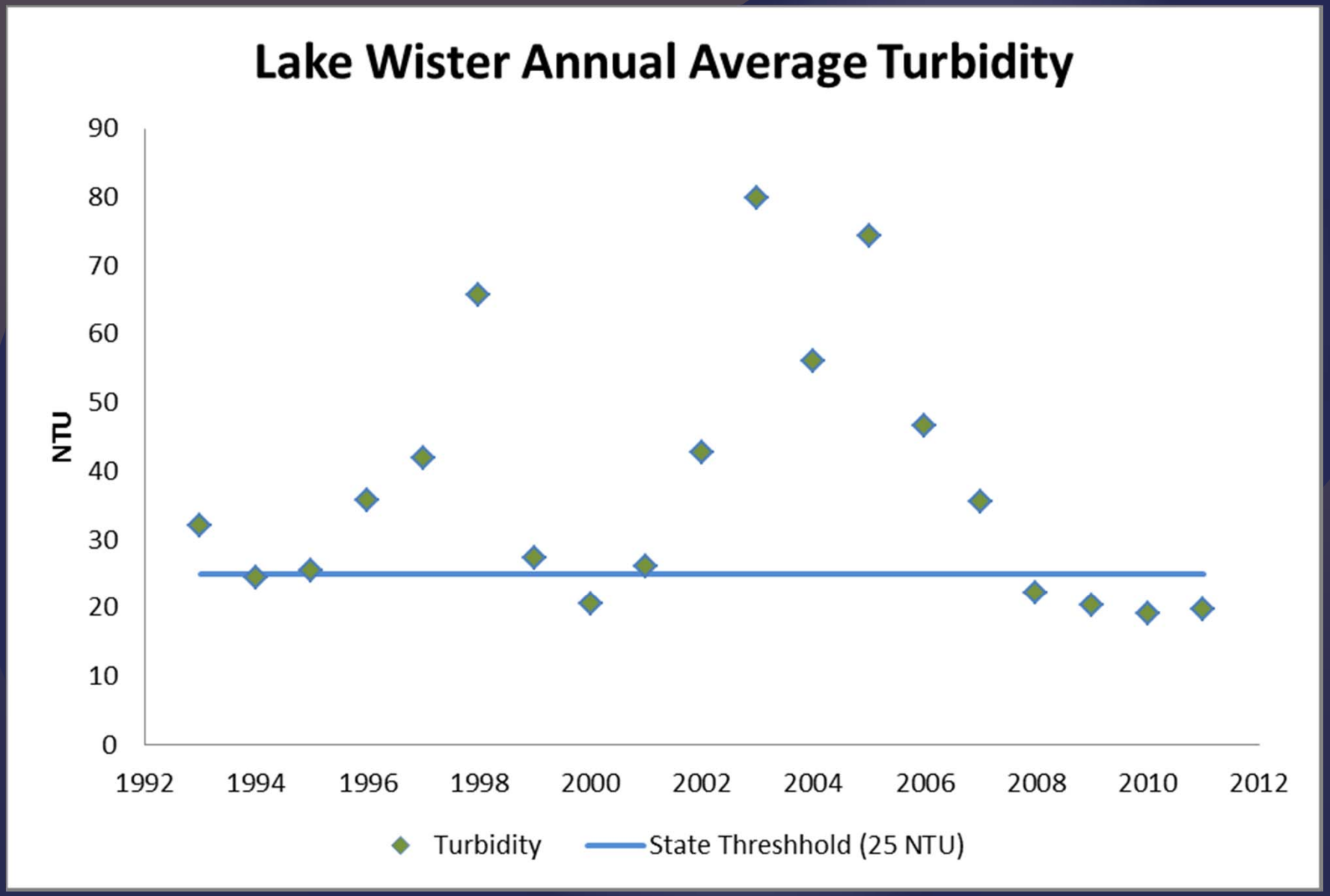




208 NTU
August 11, 1998

128 NTU, Sept. 2003

49 NTU, June 2006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NTU
90
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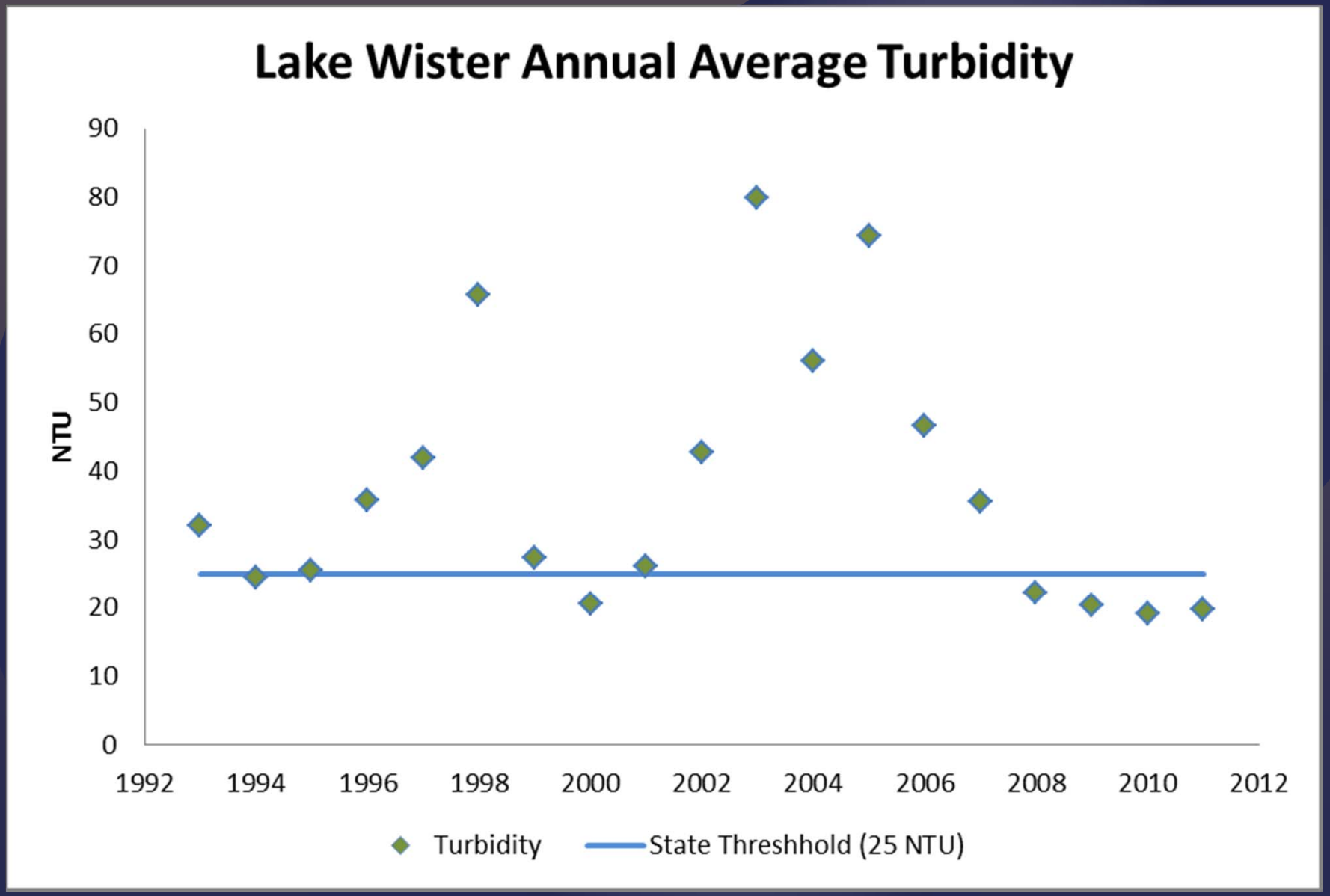
60
50
40
30
20
10
0
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Turbidity
State Threshhold (25 NTU)

Given high inorganic turbidity, there is a presumed light limitation on algae growth in Lake Wister.

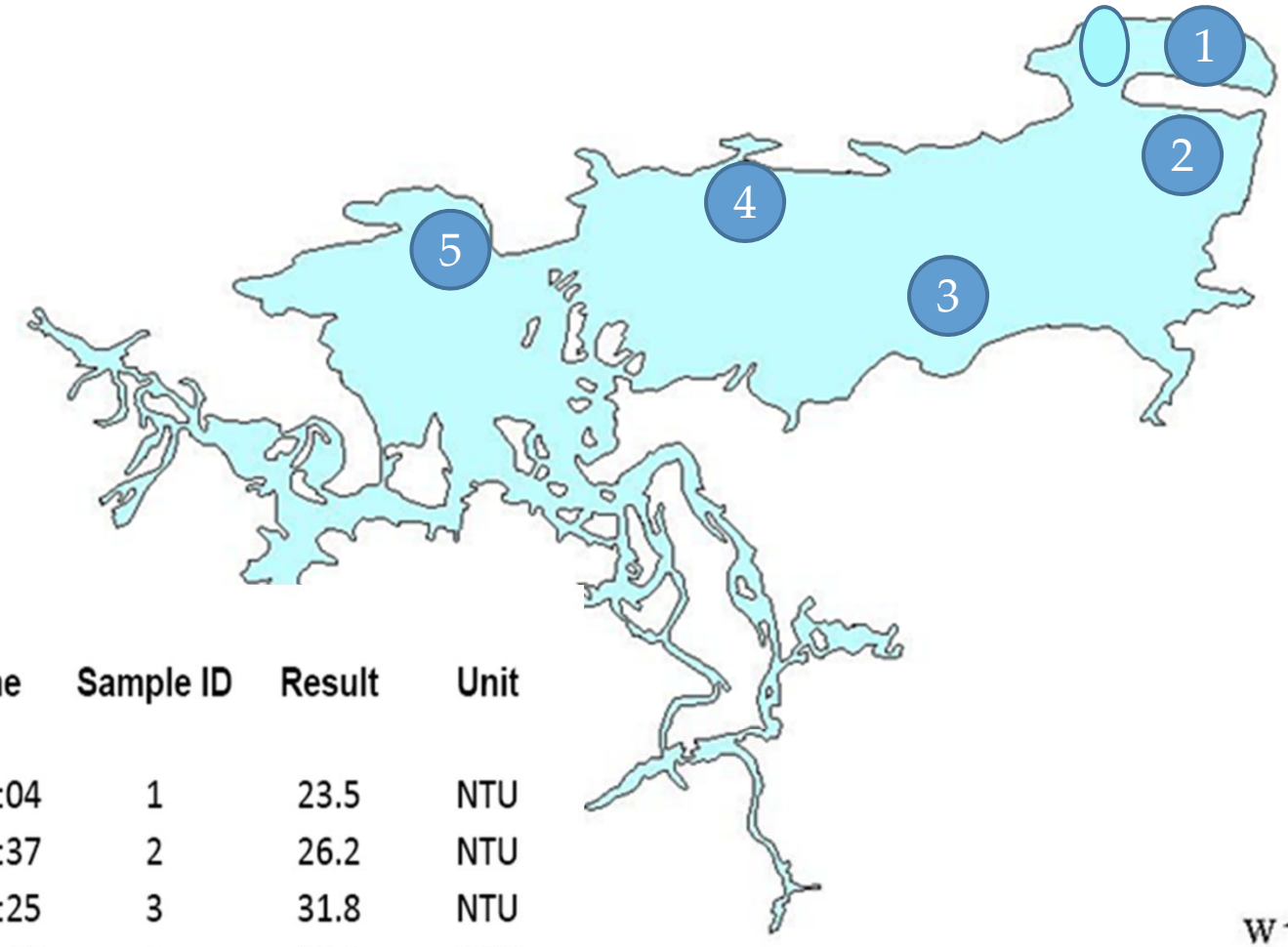
…suspended solids control…should not proceed until nutrient controls are also implemented (OWRB 2003: 28)


Lake Wister Annual Average Turbidity
NTU
90
80
70
60
50
40
30
20
10
0
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Turbidity
State Threshhold (25 NTU)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Jan		44	47	37	14	26.1	25.6	40.8	27	20.7	20	34	39.4	74	34.1	73	34.5	26.2	26.9	25.7	10.2
Feb		36	51.8	48	22	43	47	24	31	17	34.7	44	34.9	48.6	26.8	66	29	26	23.8	23.3	10.9
Mar		52.2	47	38	41	39	38	25.8	49	29	18	39	30.1	40.7	41	63	32.3	27.3	22.6	21.6	12
Apr	67.1	48	56	43	54	60	48.5	30	50.4	25	30	28	44.1	58.1	54.5	46	66.9	20.6	23.3	16.8	20.8
May	39	44	37.7	26	35.9	52	47	31	60	24	22	25	81.3	54	101.1	43	53	16.5	23.8	18.9	20.5
Jun	47	23	10.6	12.8	20.1	39.9	34	74.5	15.5	31	24	41	101.2	138.5	111	49	53	26.6	12.6	13.4	14.7
Jul	40	26.9	20.4	20.7	17.2	34	45	144.8	9.1	22	21	56	107.4	80.9	113.1	48	45.3	21.6	17	18.4	14.9
Aug	33.8	35	18.5	18	16	25.2	49.9	168	16	9.2	22	50	114.6	50.1	92.6	33	16.3	19.5	18.7	19.5	14.8
Sep	37	30	19.5	12.9	25.4	34	60.2	139	25.6	16	34.9	53	127.6	40.3	87	39	24.1	15.6	21.5	23.3	23.2
Oct	25	29	19.6	7.6	20.7	23	52	60	12	12	30	50	99.6	26.1	78.7	30	26.6	19	17.5	19.5	21
Nov	29	32	21	15	21	31	28	25	11.2	17.9	24	47	88.6	28.5	77.9	36	23.8	23.2	16	14.9	33.9
Dec	47.5	44	37	13.5	19.8	24	27	25	22	22	33	46	90.8	33.4	76.4	45	21	25.5	19.6	14.7	41.4

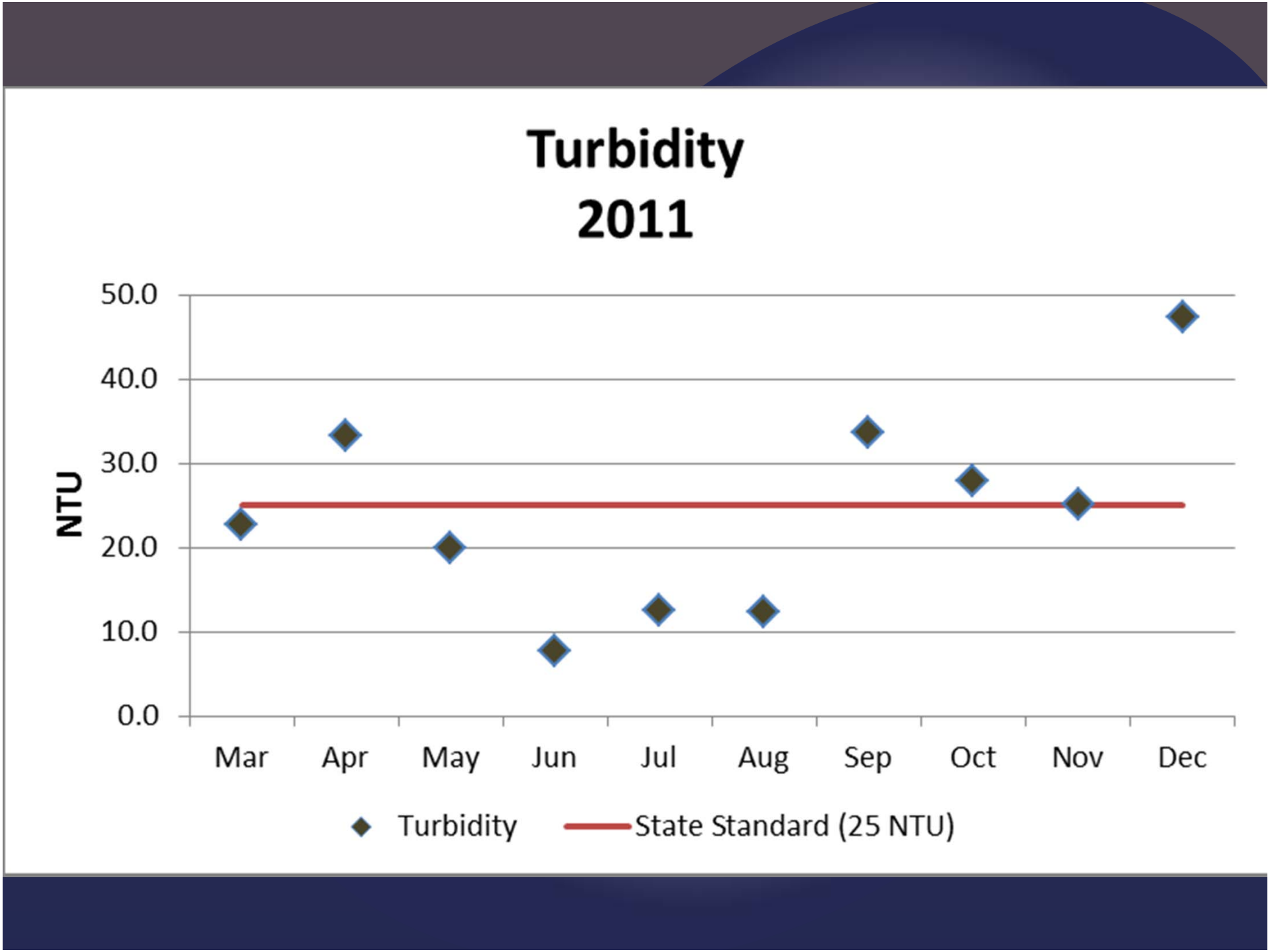
1997	1998	1999	2000	2001	2002	2003
25.6	40.8	27	20.7	20	34	39.4
47	24	31	17	34.7	44	34.9
38	25.8	49	29	18	39	30.1
48.5	30	50.4	25	30	28	44.1
47	31	60	24	22	25	81.3
34	74.5	15.5	31	24	41	101.2
45	144.8	9.1	22	21	56	107.4
49.9	168	16	9.2	22	50	114.6
60.2	139	25.6	16	34.9	53	127.6
52	60	12	12	30	50	99.6
28	25	11.2	17.9	24	47	88.6
27	25	22	22	33	46	90.8

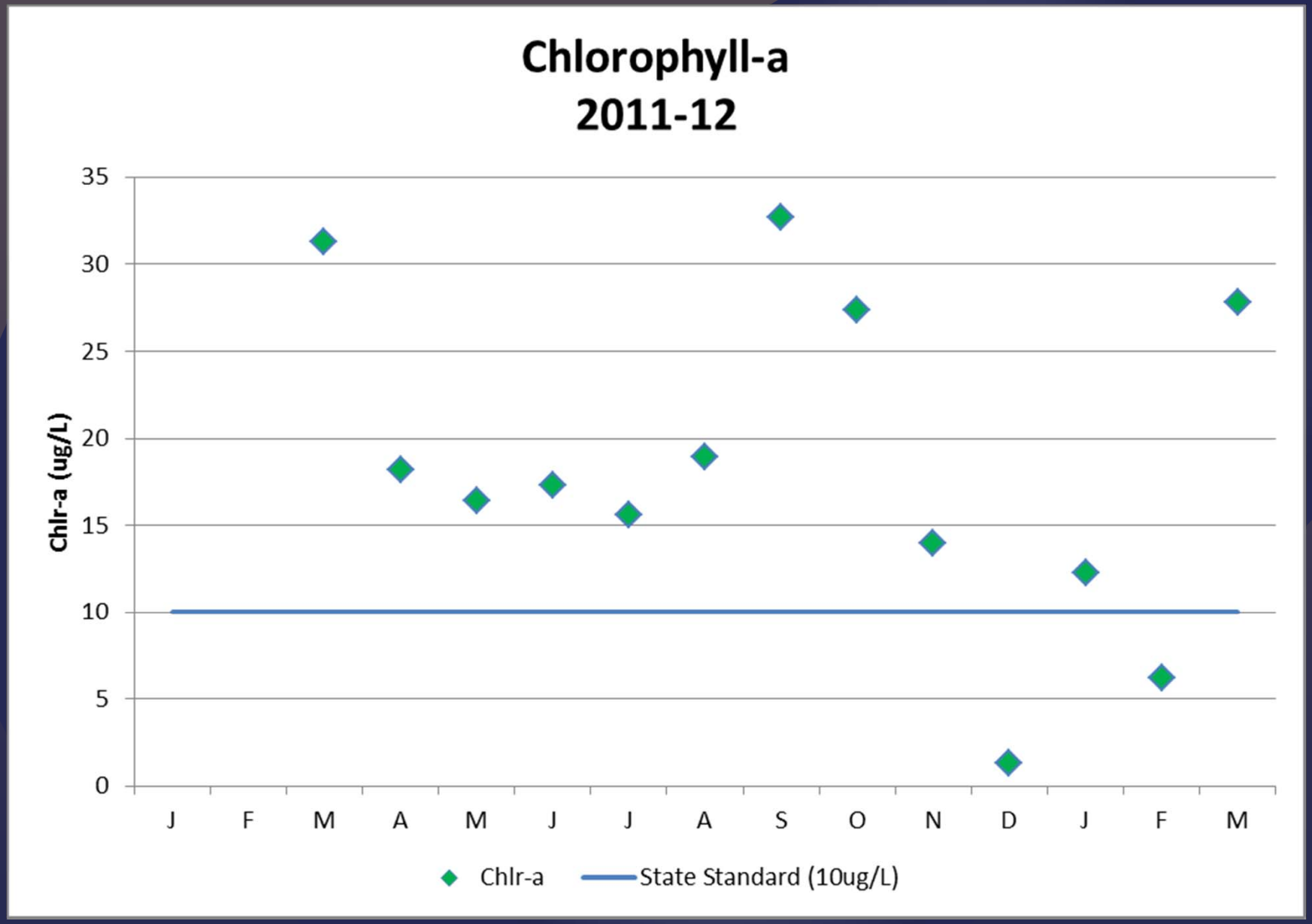
2005	2006	2007	2008	2009	2010	2011
34.1	73	34.5	26.2	26.9	25.7	10.2
26.8	66	29	26	23.8	23.3	10.9
41	63	32.3	27.3	22.6	21.6	12
54.5	46	66.9	20.6	23.3	16.8	20.8
101.1	43	53	16.5	23.8	18.9	20.5
111	49	53	26.6	12.6	13.4	14.7
113.1	48	45.3	21.6	17	18.4	14.9
92.6	33	16.3	19.5	18.7	19.5	14.8
87	39	24.1	15.6	21.5	23.3	23.2
78.7	30	26.6	19	17.5	19.5	21
77.9	36	23.8	23.2	16	14.9	33.9
76.4	45	21	25.5	19.6	14.7	41.4

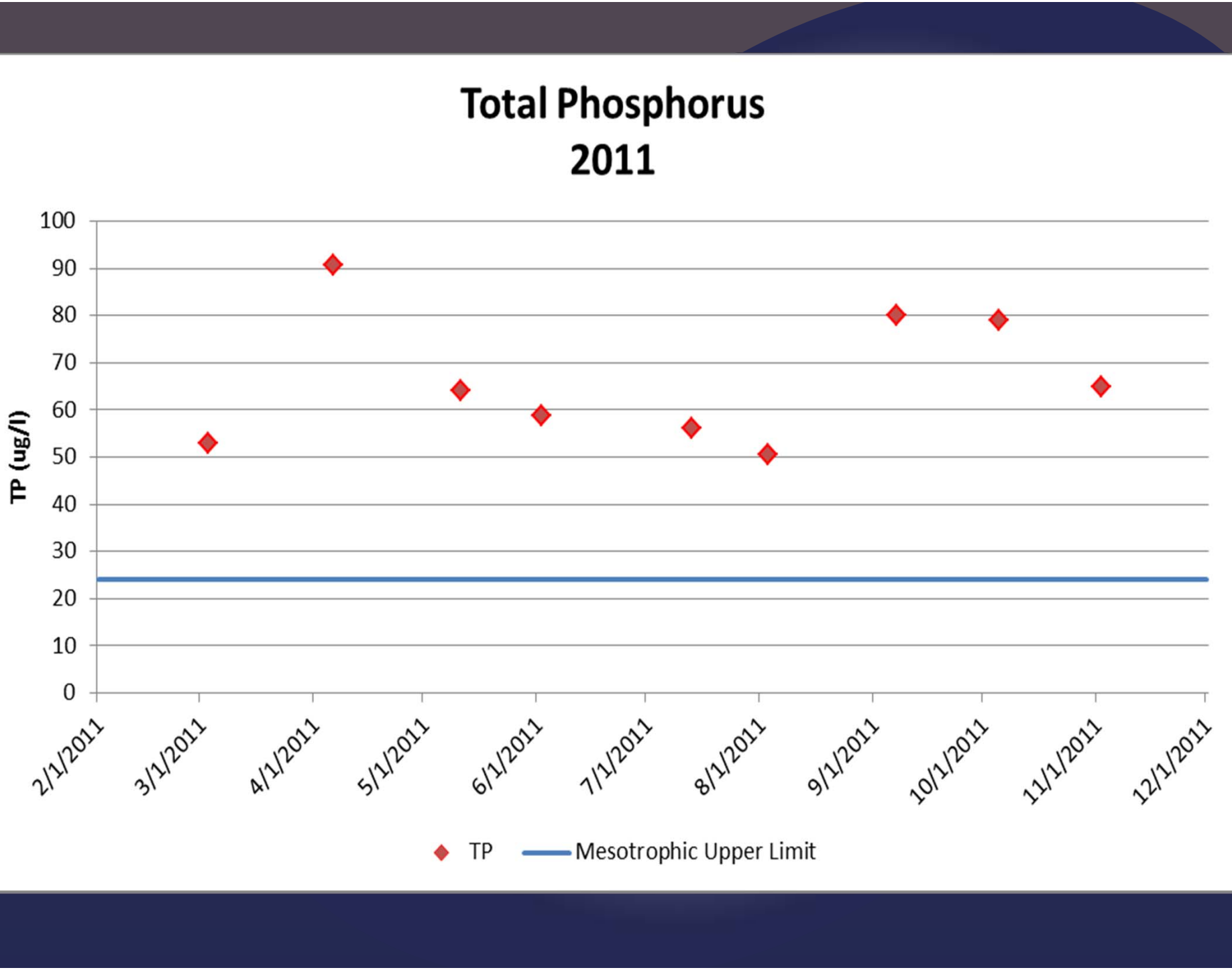


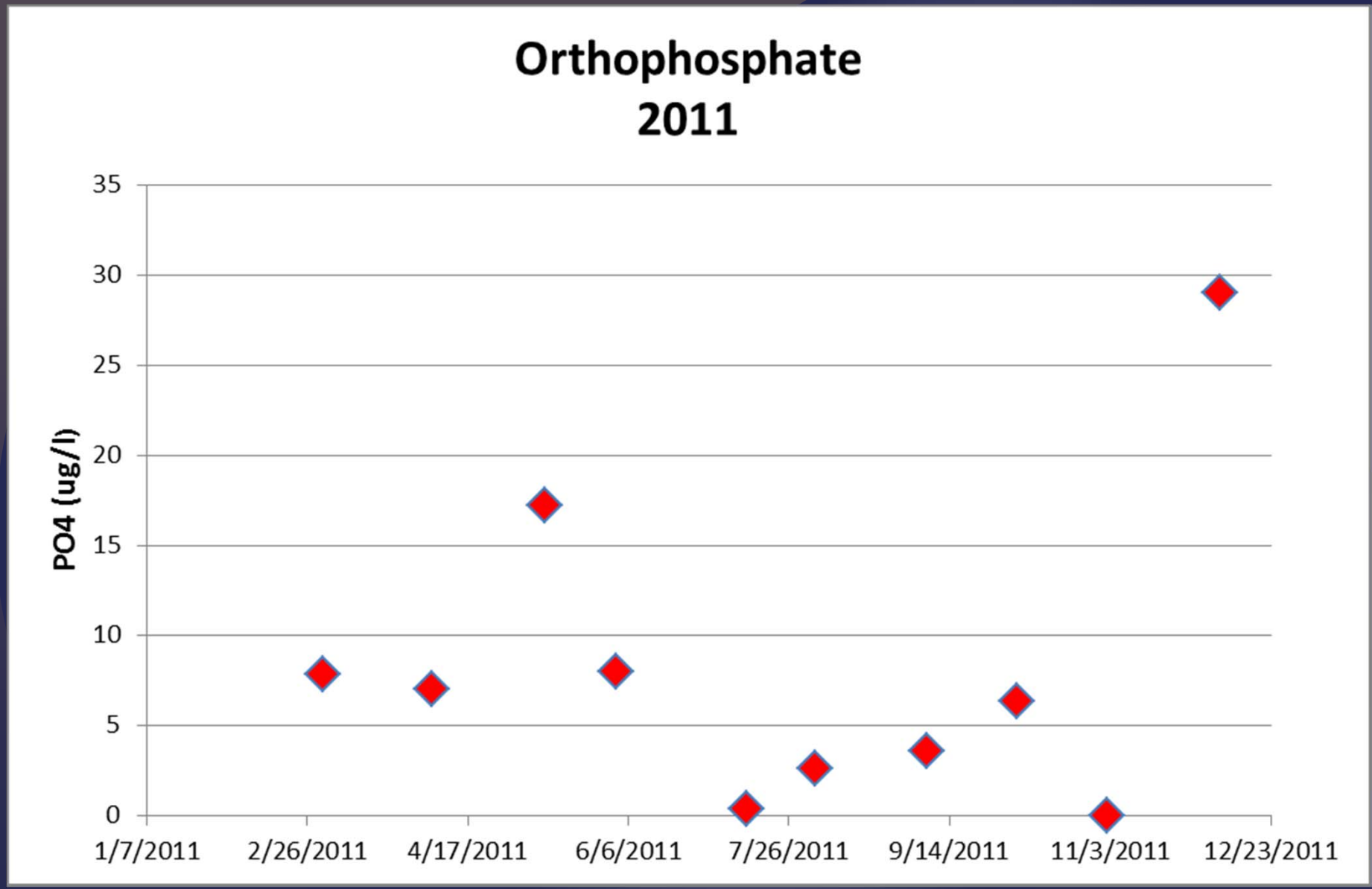
Date & Time	Sample ID	Result	Unit
4/6/2011 10:04	1	23.5	NTU
4/6/2011 10:37	2	26.2	NTU
4/6/2011 11:25	3	31.8	NTU
4/6/2011 11:47	4	36.8	NTU
4/6/2011 12:11	5	47.7	NTU

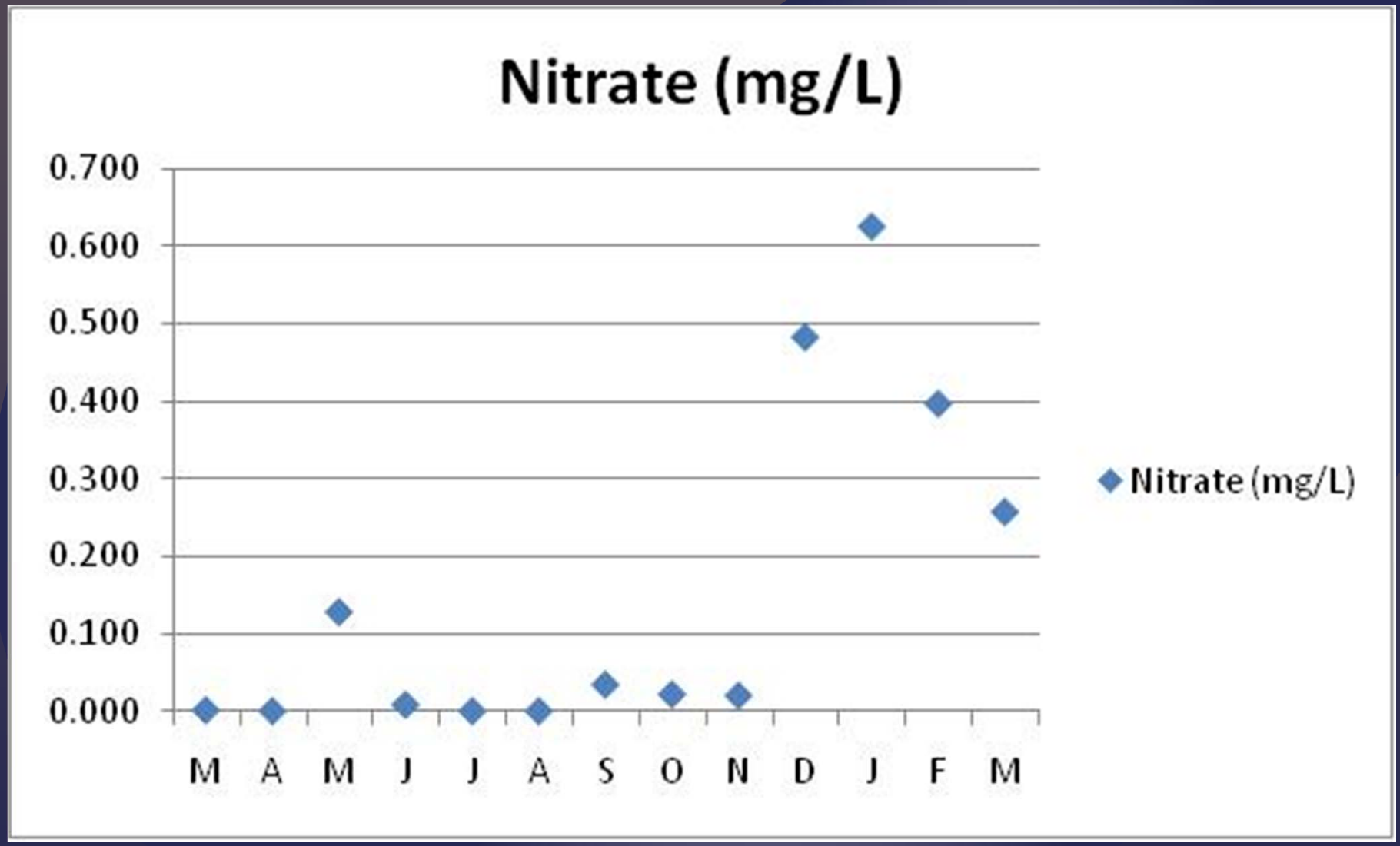
Lake Wister Monitoring


Turbidity
2011
NTU
50.0
40.0
30.0
20.0
10.0
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Turbidity
State Standard (25 NTU)

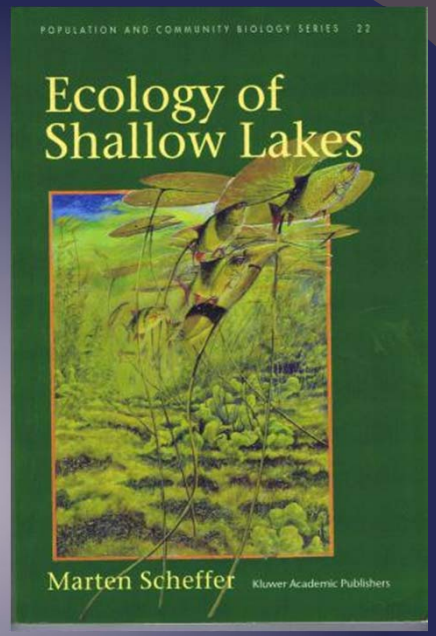

Chlorophyll-a
2011-12
Chlr-a (ug/L)
35
30
25
20
15
10
5
0
J
F
M
A
M
J
J
A
S
O
N
D
J
F
M
Chlr-a
State Standard (10ug/L)


Total Phosphorus
2011
TP (ug/l)
100
90
80
70
60
50
40
30
20
10
0
2/1/2011
3/1/2011
4/1/2011
5/1/2011
6/1/2011
7/1/2011
8/1/2011
9/1/2011
10/1/2011
11/1/2011
12/1/2011
TP
Mesotrophic Upper Limit


Orthophosphate
2011
PO4 (ug/l)
35
30
25
20
15
10
5
0
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011


Nitrate (mg/L)
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
M
A
M
J
J
A
S
O
N
D
J
F
M
Nitrate (mg/L)

Shallow lakes theory



Shallow lakes--

- 3 m deep or less,
- & therefore can be largely colonized by submerged macrophytes;
- water column frequently mixed (polymictic)

Often show a set of alternate stable states (or regimes):

- Either clear and well-vegetated, or
- Turbid, with little or no vegetation

Paul Koenig places a starter plant in a pond near Lake Wister

Lake Study Growing

Heavener Ledger 3-5-98

by Fran Johnson

Knee-deep in water, Paul Koenig carefully places a freshly potted plant into a pond near Lake Wister. On shore, his assistant readies several more starter plants for placement in the watery 'nursery'.

From the pond, the dozens of aquatic plants will be transplanted into Lake Wister.

Why are plants being introduced into the lake?

According to Koenig, Environmental Specialist Supervisor for the Maline Arm were selected fr available areas for test plantings.

Plantings will include species t survive at varying planting depth from those commonly found at edge of the water to plants liv completely under water.

Planting units will be monito monthly by OWRB personnel.

After monitoring is complete July 1998, the Corps and Lewisville Aquaqtic Ecosys Research Facility will work OWRB personnel to analyze res

- Floating wetland breakwaters
- Breakwaters, annual vegetation establish behind them
- Nutrient load reductions—watershed & internal

- Continue monthly monitoring
- New lake model in 2 to 3 years

Questions?

April 2010

Ken Hammond, center, chairman of Poteau Valley Improvement Authority, helps area students prepare floating rafts Wednesday at Wister Lake. The rafts are designed to absorb harmful nutrients and phosphates from the water. The event was hosted by Choctaw Nation of Oklahoma and Poteau Valley Improvement Authority in an effort to clean up Lake Wister.

PHOTOS BY KAIA LARSEN • TIMES RECORD

WATER WORKS

STUDENTS PITCH IN TO HELP CLEAN UP LAKE WISTER WATERSHED

By Pam Cloud
TIMES RECORD • PCLOUD@TIMES.COM

WISTER

water quality for some time, according to Steve Patterson, environmental consultant for PVIA, which treats and distributes the water.

that flood levels at Lake Wister kill off the vegetation along the shoreline that help keep the water cleaner.

"Watershed restoration is essential."