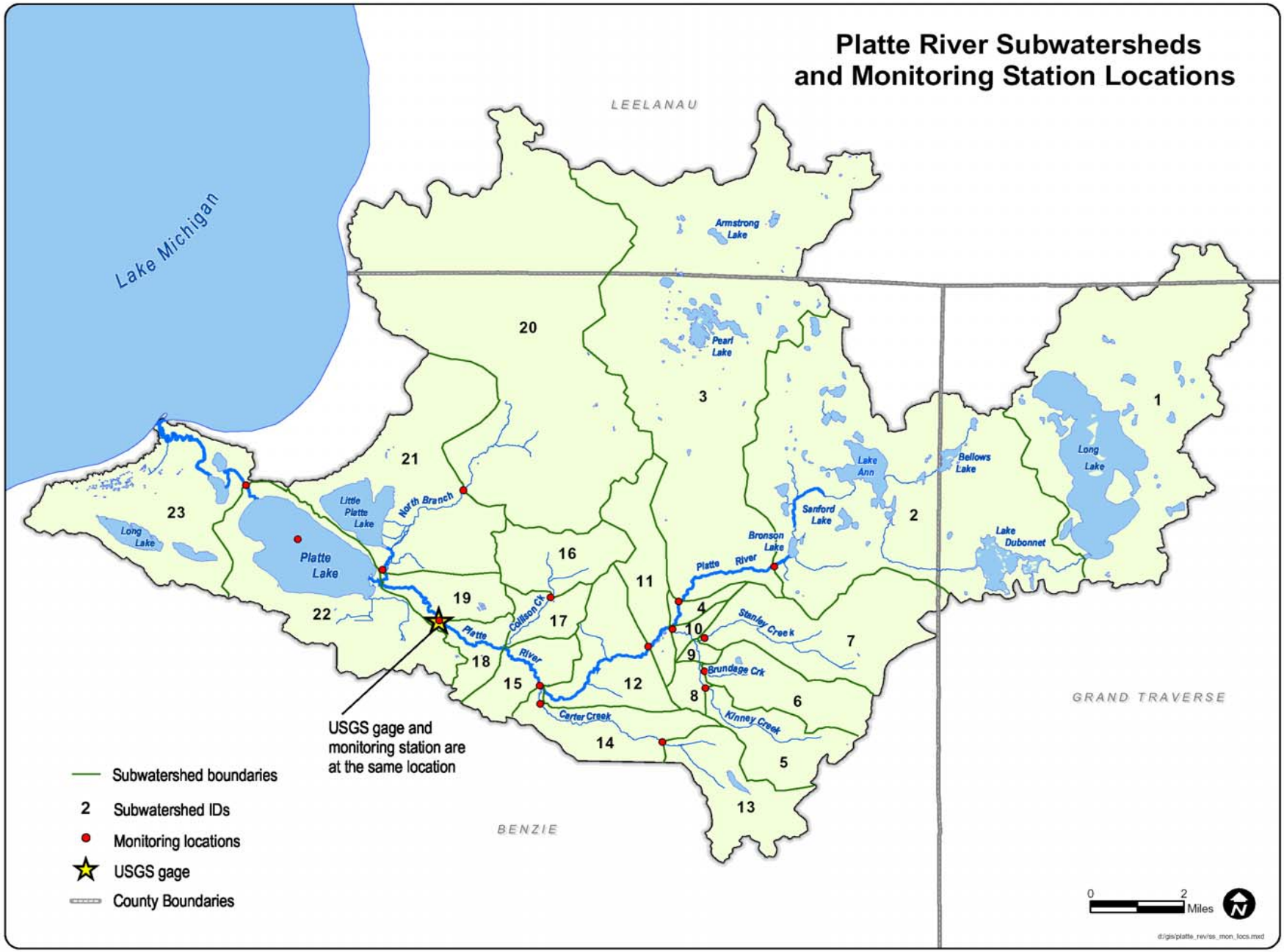
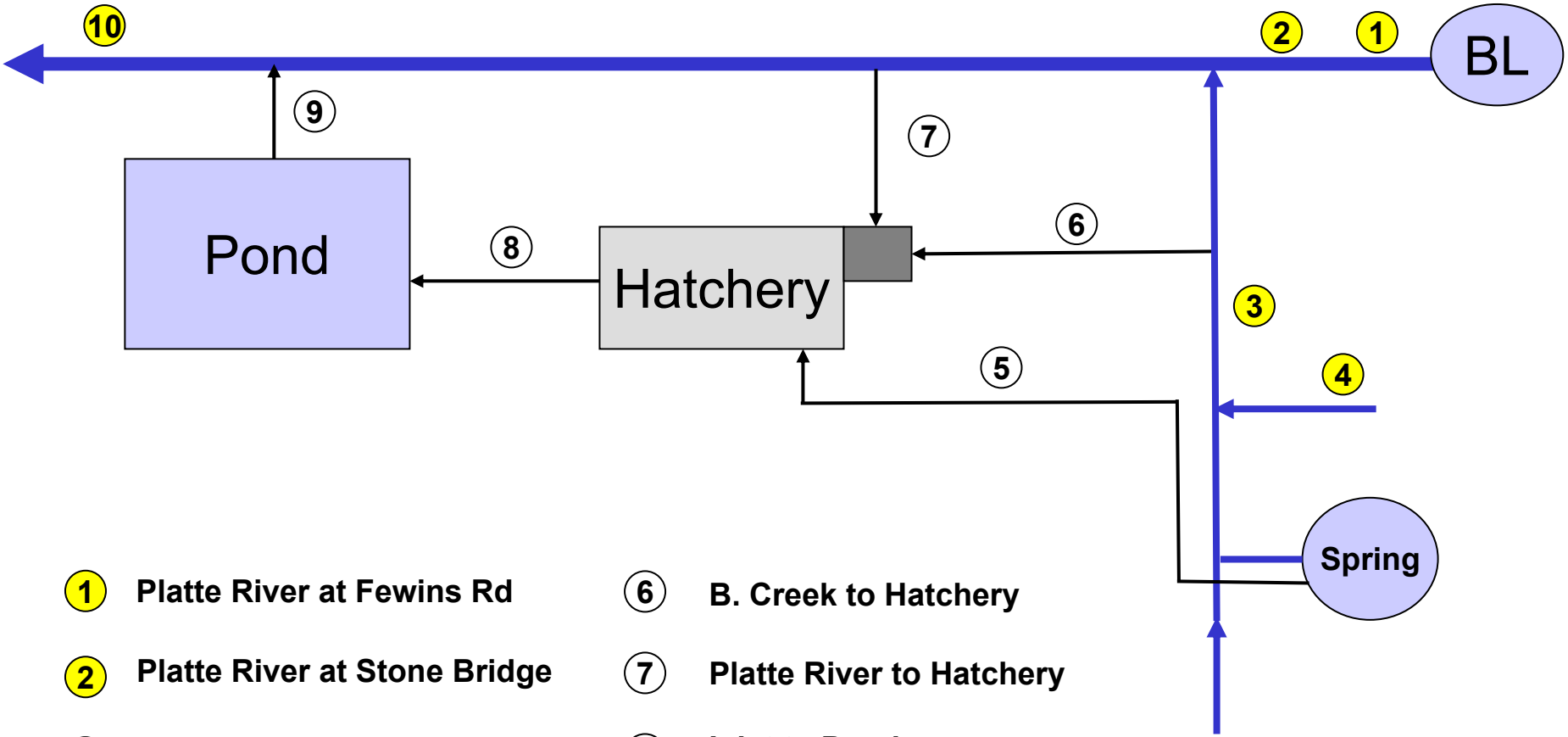


Figure 1. Platte River Sub-Watersheds and Monitoring Locations.



1 Platte River at Fewins Rd

2 Platte River at Stone Bridge

3 Brundage Cr at Old Residence

4 Stanley Creek

5 B. Spring to Hatchery

6 B. Creek to Hatchery

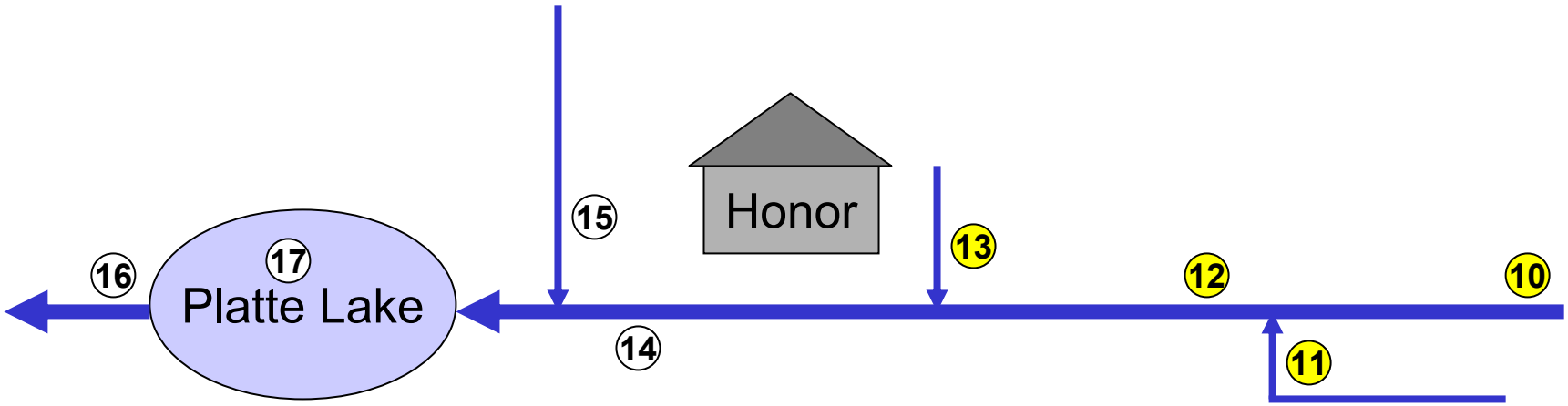
7 Platte River to Hatchery

8 Inlet to Pond

9 Pond Outlet

10 Platte River at Vets Park

Figure 2. Hatchery Sampling Stations



10 Platte River at Vets Park

11 Carter Creek at mouth

12 Platte River at Pioneer Rd

13 Collison Creek

14 Platte River at USGS

15 North Branch at Deadstream

16 Lake Outlet at M - 22

17 Platte Lake at Center - Deep

Figure 3. Lake and Tributary Sampling Stations for 2004.

	Parameter List	Sampling Frequency
Hatchery		
Brundage Spring to Hatchery	S	2 per Week
Brundage Creek to Hatchery	S	2 per Week
Platte River to Hatchery	S	2 per Week
Inlet to Pond	S	2 per Week
Discharge from Pond	S	2 per Week
Construction Bypass	S	2 per Week
Storage Tank	S	1 per Month
Weather Station	S	Event
Production Data	C	1 per Month
Weir Data	C	Seasonal
Stream		
Platte River at Fewins Road	S	1 per Month
Platte River at Stone Bridge	S	1 per Month + Event
Brundage Creek at Old Residence	S	1 per Month + Event
Stanley Creek at Carmean Road	S	1 per Month
Platte River at Vets Park	S	1 per Month + Event
Carter Creek near mouth	S	1 per Month
Platte River Pioneer Road	S	1 per Month
Collison Creek near mouth	S	1 per Month
Platte River at USGS	S	2 per Month
North Branch at Deadstream Road	S	2 per Month
Lake Outlet at M-22	S	2 per Month
Lake		
Platte Lake at center-deep Station	L	2 per Month
Sediments	Special	Special
Macrophytes	Special	Special
Shoreline	Special	Special

List S	List L	List C
Flow	Dissolved Oxygen	Count
Phosphorus	Temperature	Weight
Turbidity	pH	
	ORP	
	Conductivity	
	Phosphorus	
	Chlorophyll	
	Phytoplankton	
	Zooplankton	
	Turbidity	
	Light	
	Secchi Depth	
	Alkalinity	
	TDS	
	Calcium	
	Reactive Silica	
	Nitrate	
	TKN	
	Weather	

Figure 4. Sampling Stations, Sampling Frequency, and Parameters.

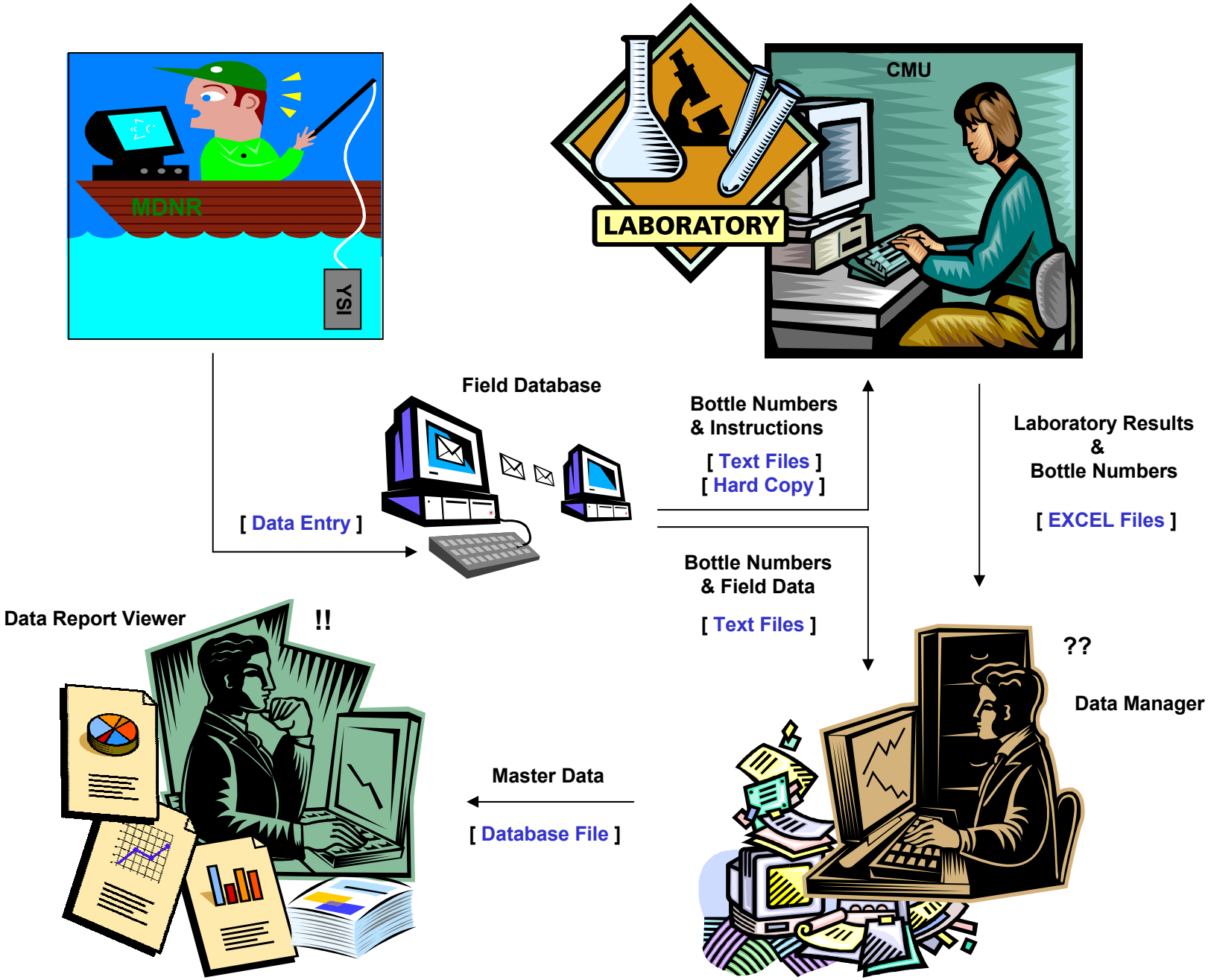


Figure 5. Database Components.

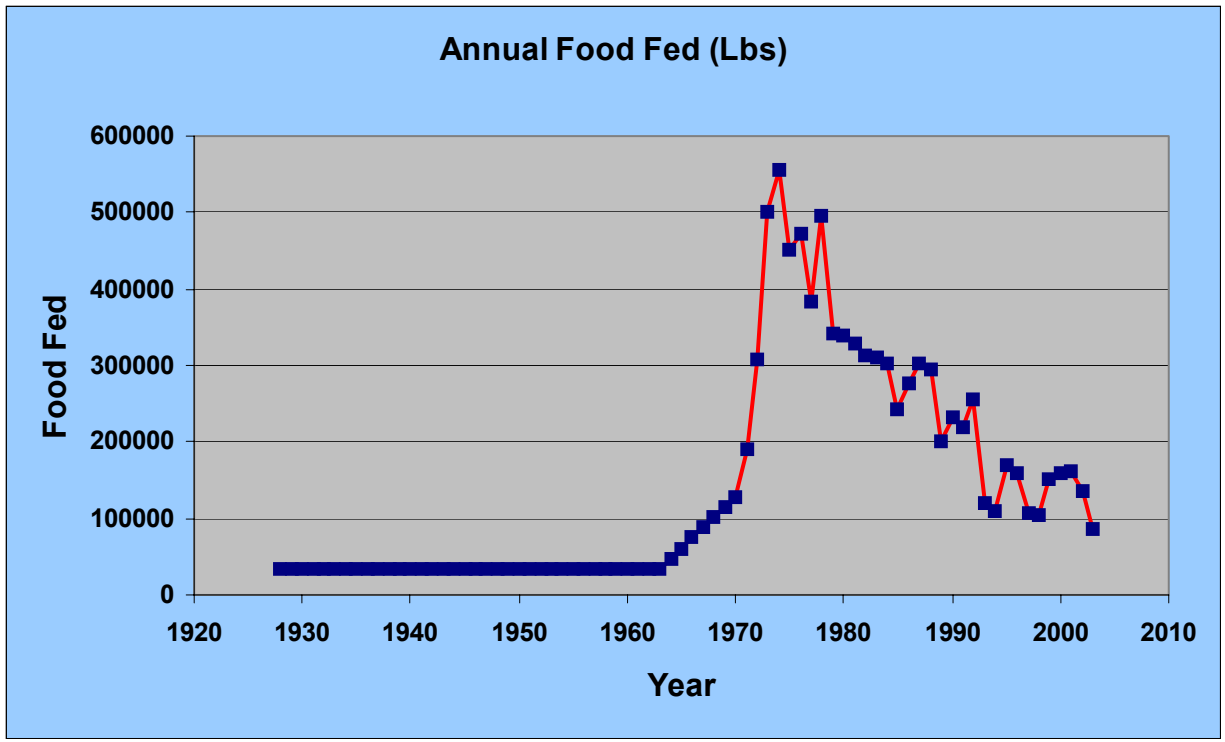


Figure 6. Long-Term Trend of Food Fed at Hatchery.

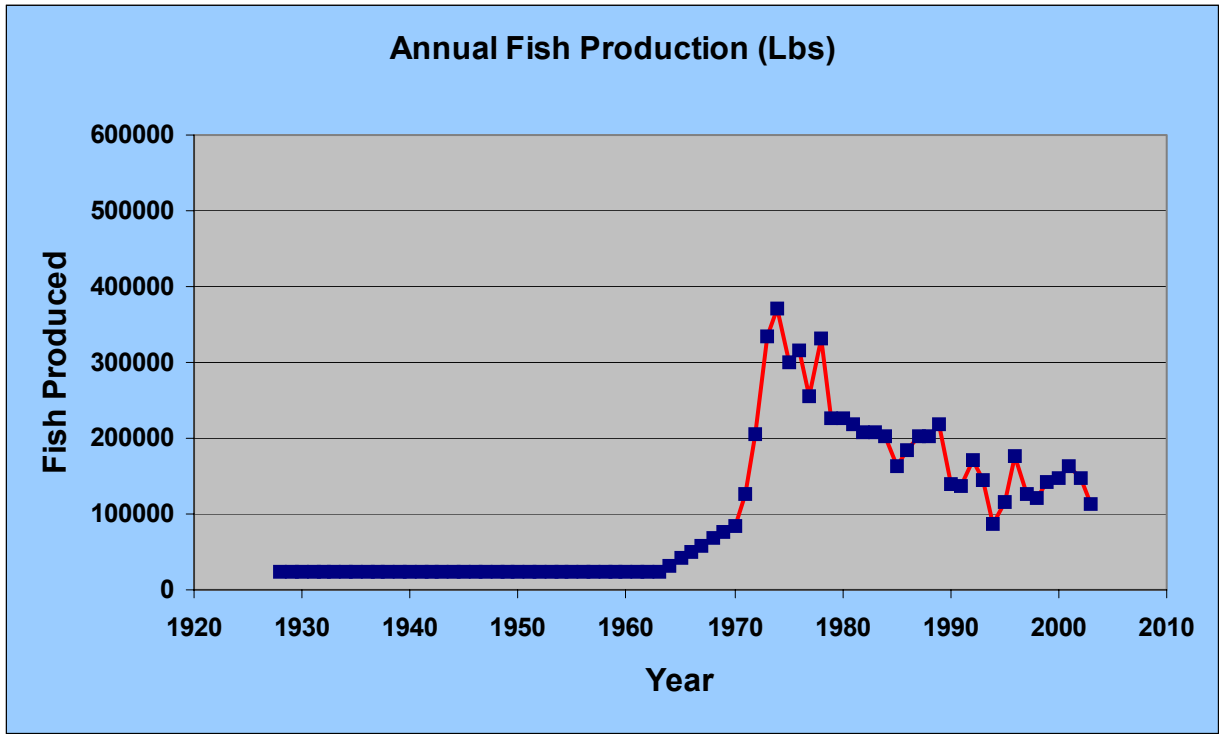


Figure 7. Long-Term Trend Fish Production at Hatchery.

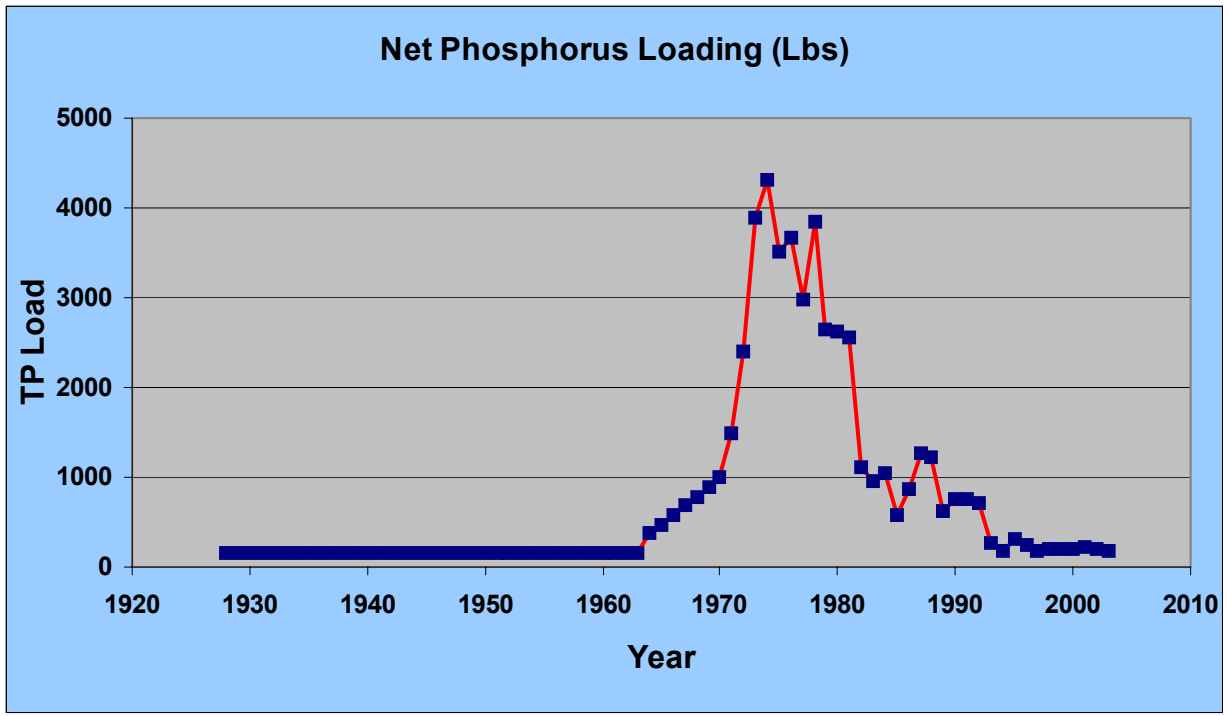


Figure 8. Long-Term Trend of Hatchery Net Total Phosphorus Load.

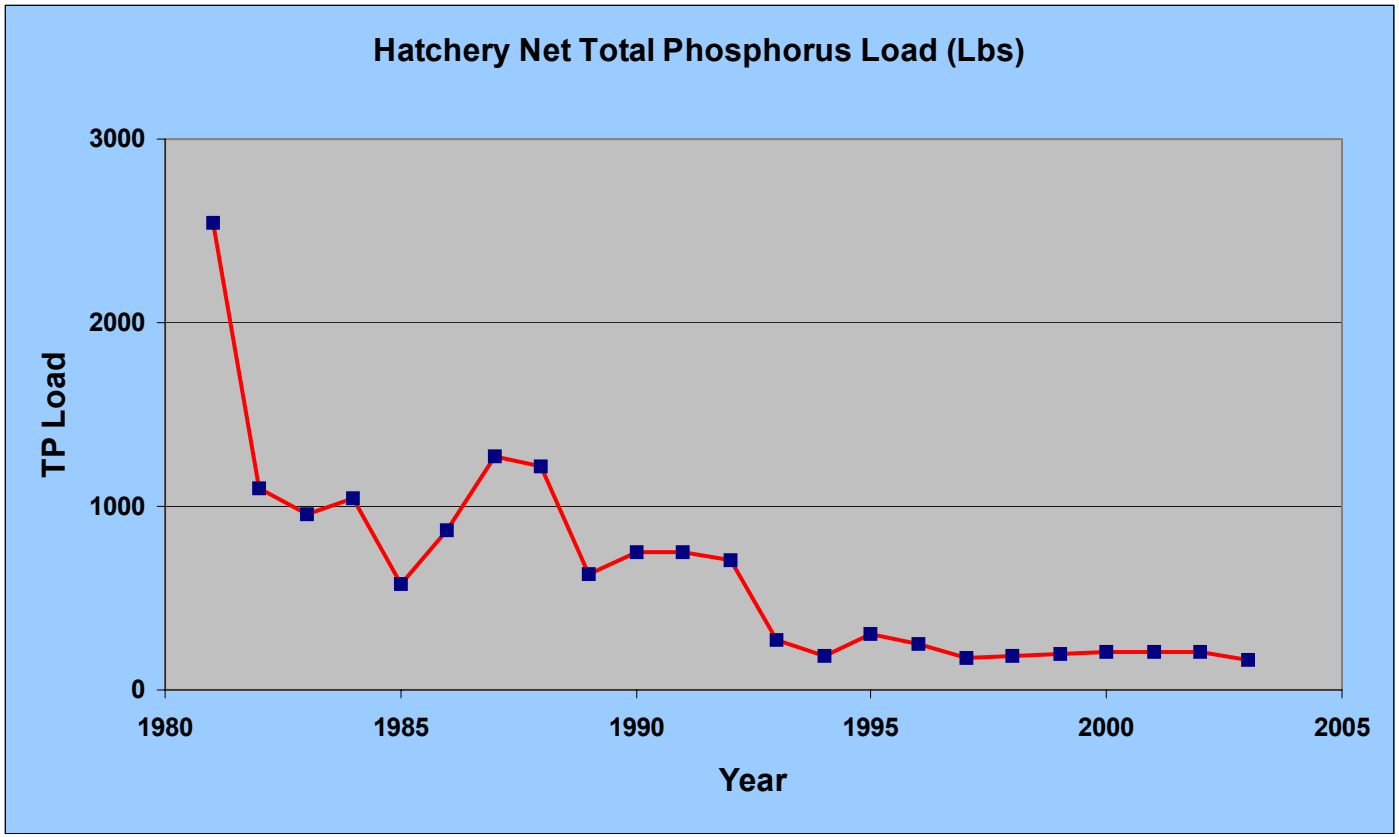


Figure 9. Hatchery Net Total Phosphorus Load.

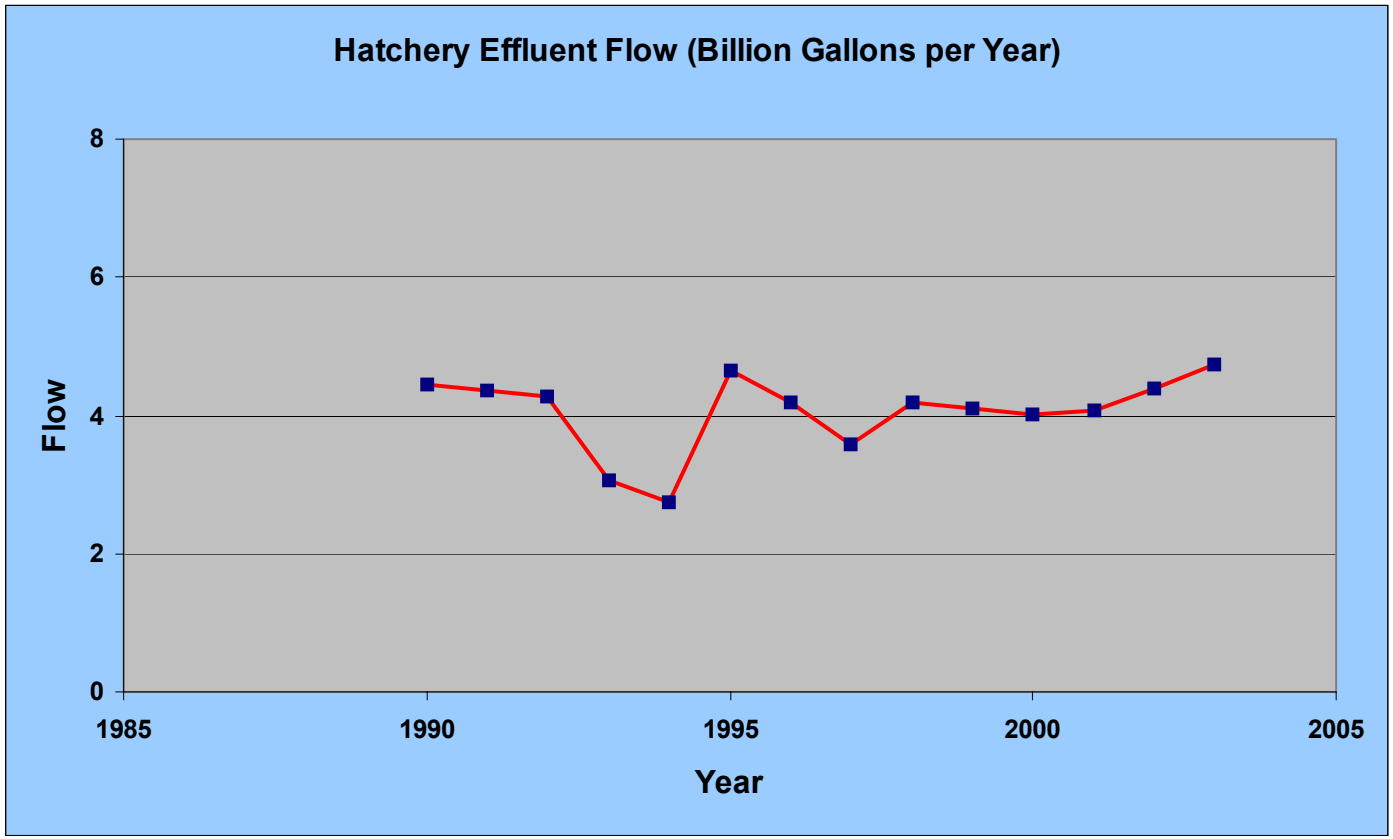
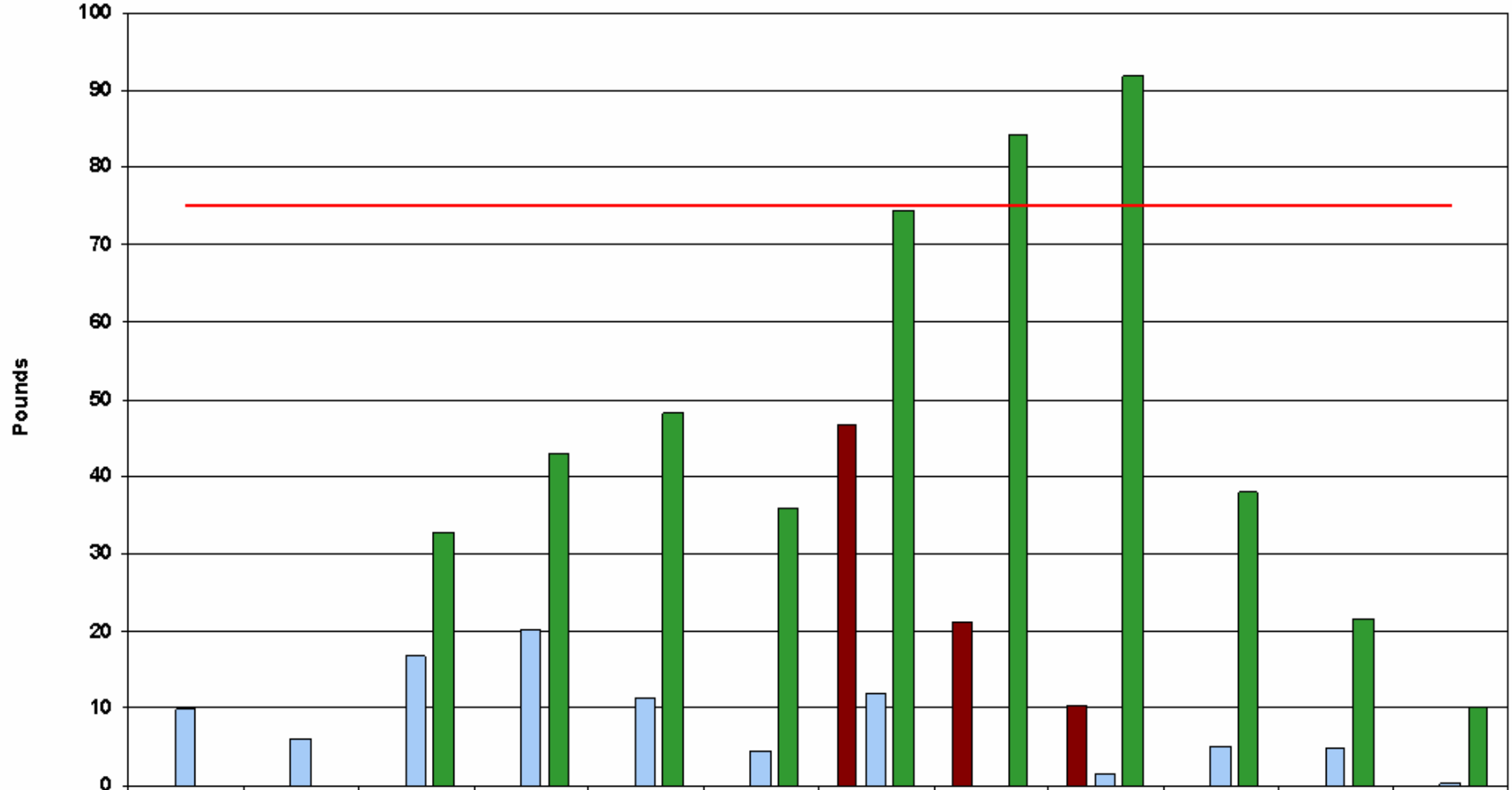


Figure 10. Water Use at Hatchery.

Hatchery Average Monthly Net Load for 2003

Total Net Load is 170.10 Pounds for Method Jug & Needle (J/N)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bypass	0	0	0	0	0	0	46.85	21.1	10.31	0	0	0
Outfall	9.75	6.12	16.75	20.05	11.41	4.34	11.9	0	1.56	4.96	4.79	0.21
3 Mon	0	0	32.61	42.92	48.21	35.8	74.51	84.2	91.72	37.93	21.61	9.96
Limit	75	75	75	75	75	75	75	75	75	75	75	75

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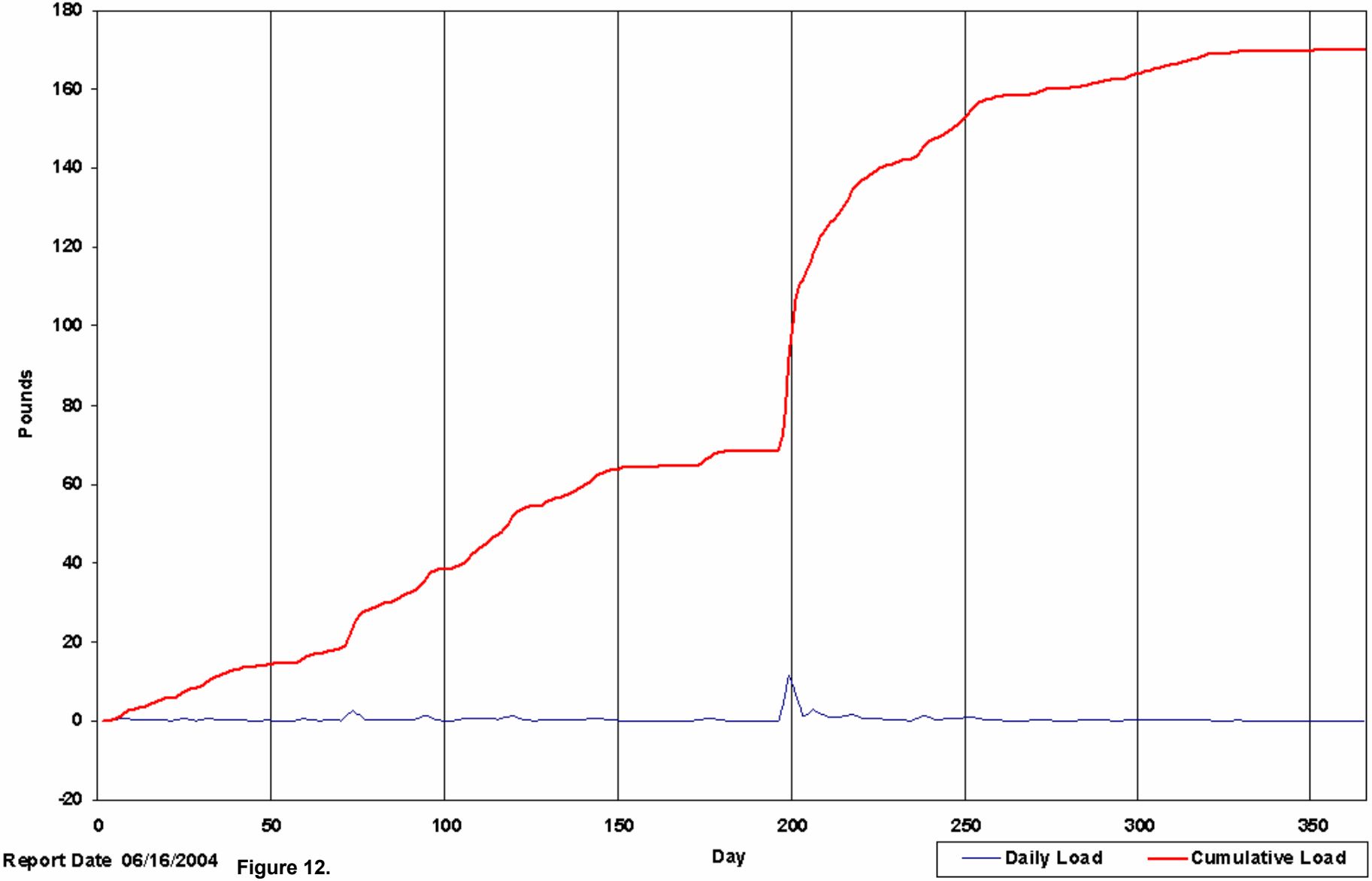
Figure 11.

Cumulative Net Hatchery Phosphorus Loading for Year 2003

Phosphorus Method: J/N, Total Phosphorus Load: 170.10



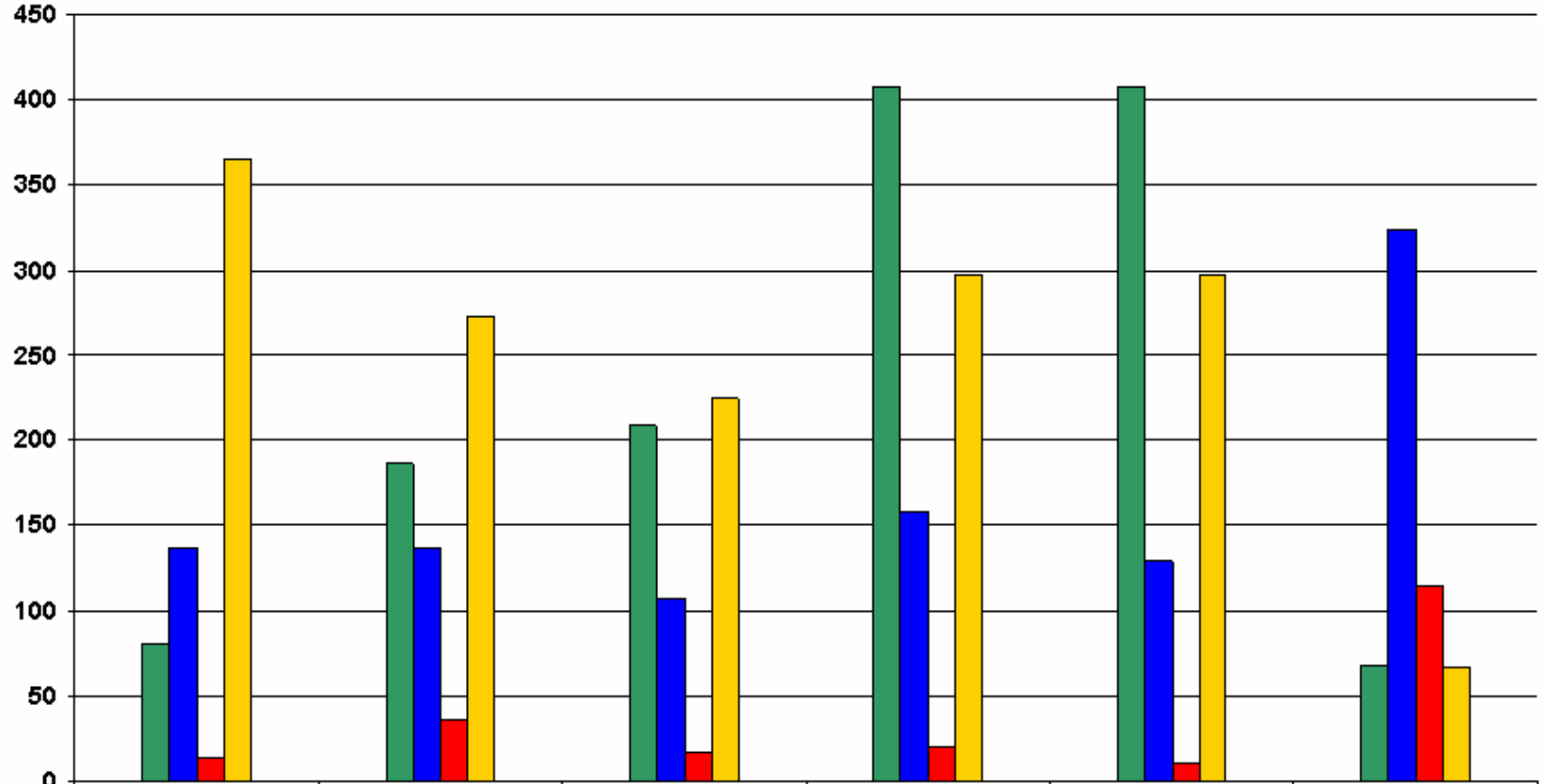
Report Date 06/16/2004

Figure 12.

Hatchery Water Use, Average Phosphorus & Turbidity for 2003

Method: J/N

Input Flows: 4746.86, Output Flow: 4746.86, Phosphorus & Turbidity not counted when Flow equal to Zero



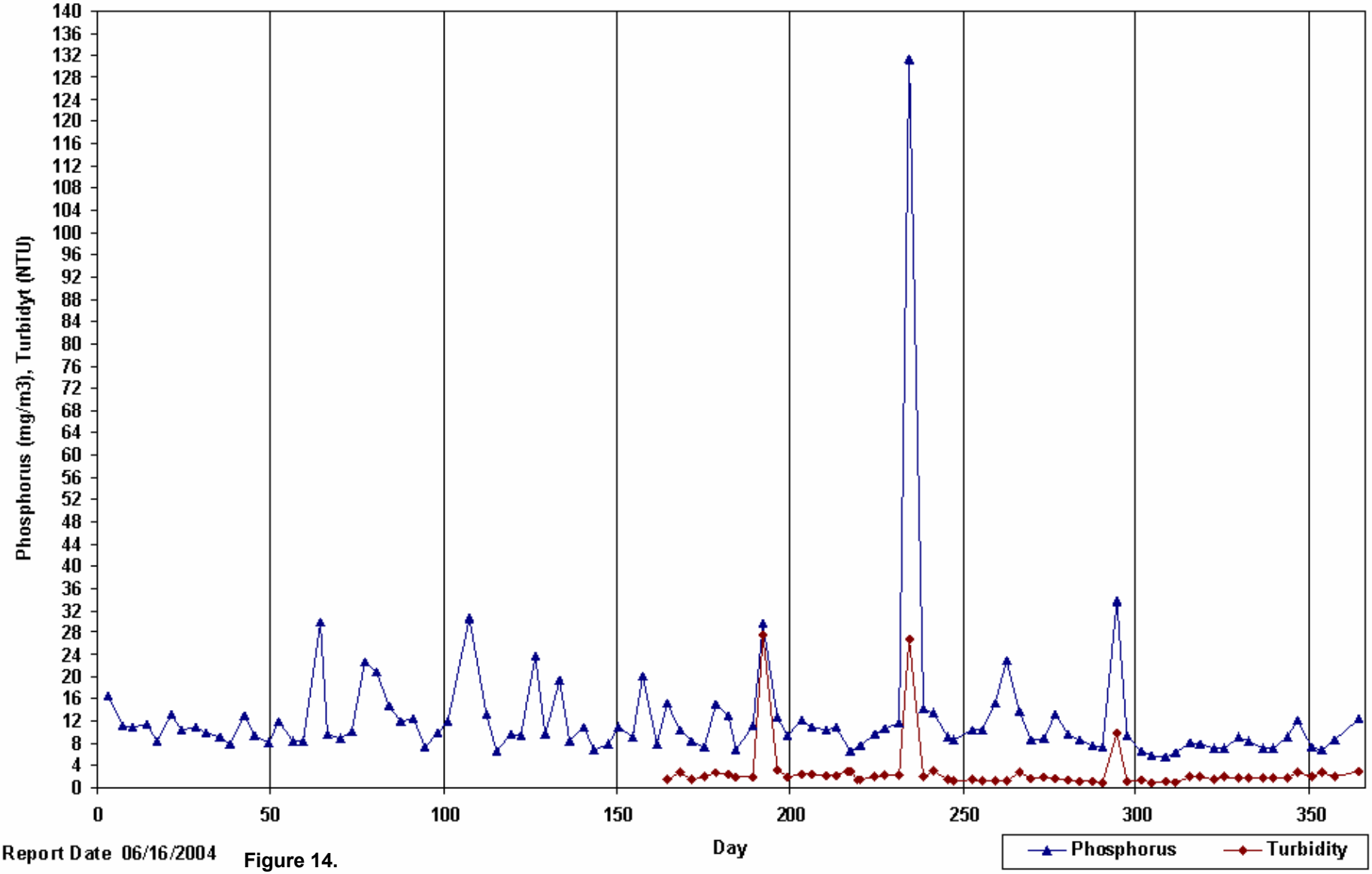
	B Spring (11)	B Creek (12)	Platte River (13)	Pond In (14)	Pond Out (15)	Bypass (19)
Water Flow / 10	80.18	186.2	208.31	407.13	407.13	67.55
Avg Phos X 10	137.02	137.11	107.34	157.92	128.86	324.22
Avg Turb X 10	14.13	36.3	17.1	20.1	10.51	114.28
Days At Rate	365	273	225	298	298	67

Report Date 06/16/2004 Flow in Millions of Gallons per Year / 10, Phosphorus in mg/m³ X 10, Turbidity in NTU X 10

Figure 13.

Brundage Creek at Intake - Phosphorus & Turbidity for Year 2003

Method: Jug & Needle, Average Phos: 12.644, Average Turb: 2.977

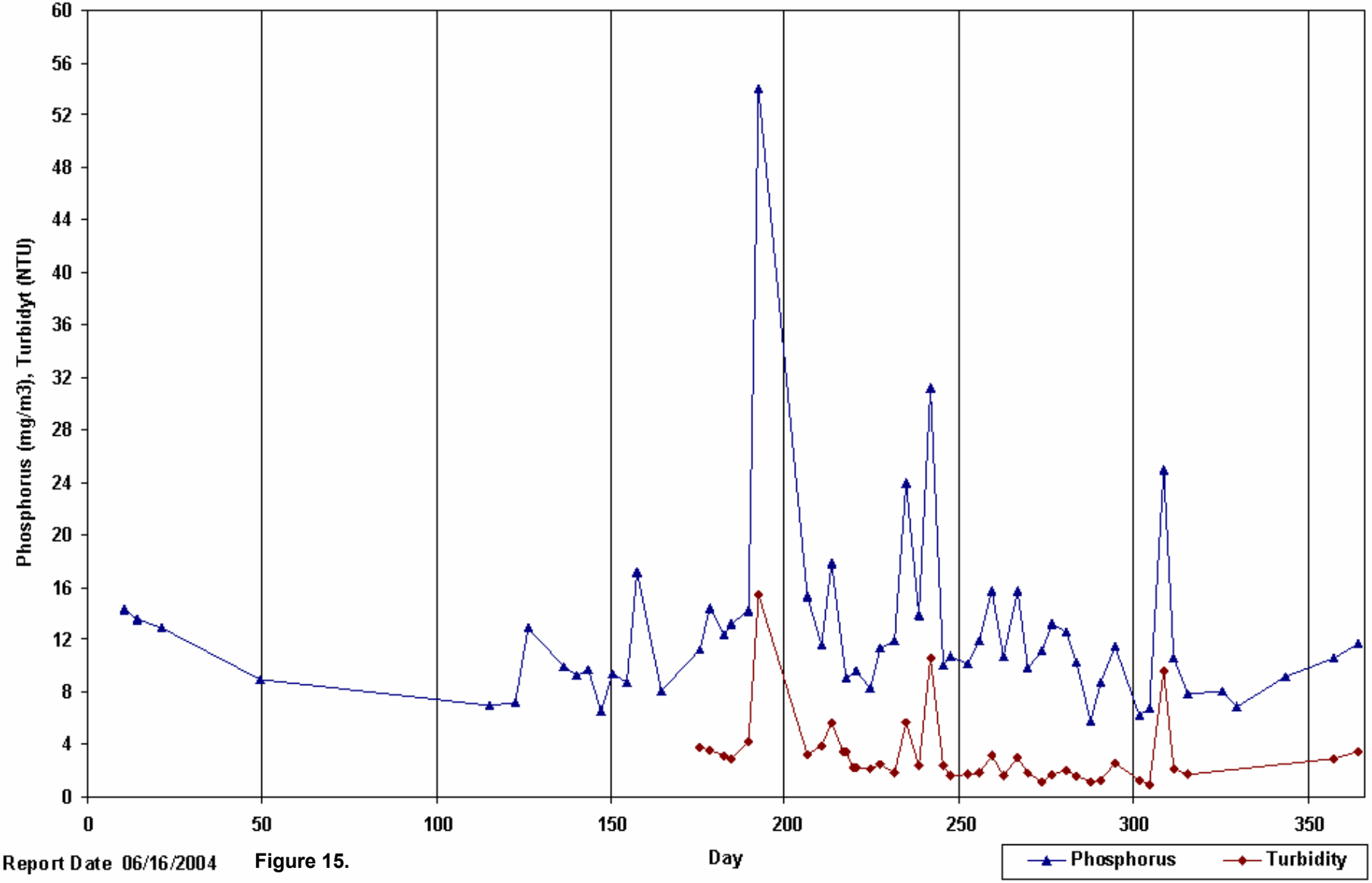


Report Date 06/16/2004

Figure 14.

Brundage Creek at Intake - Phosphorus & Turbidity for Year 2003

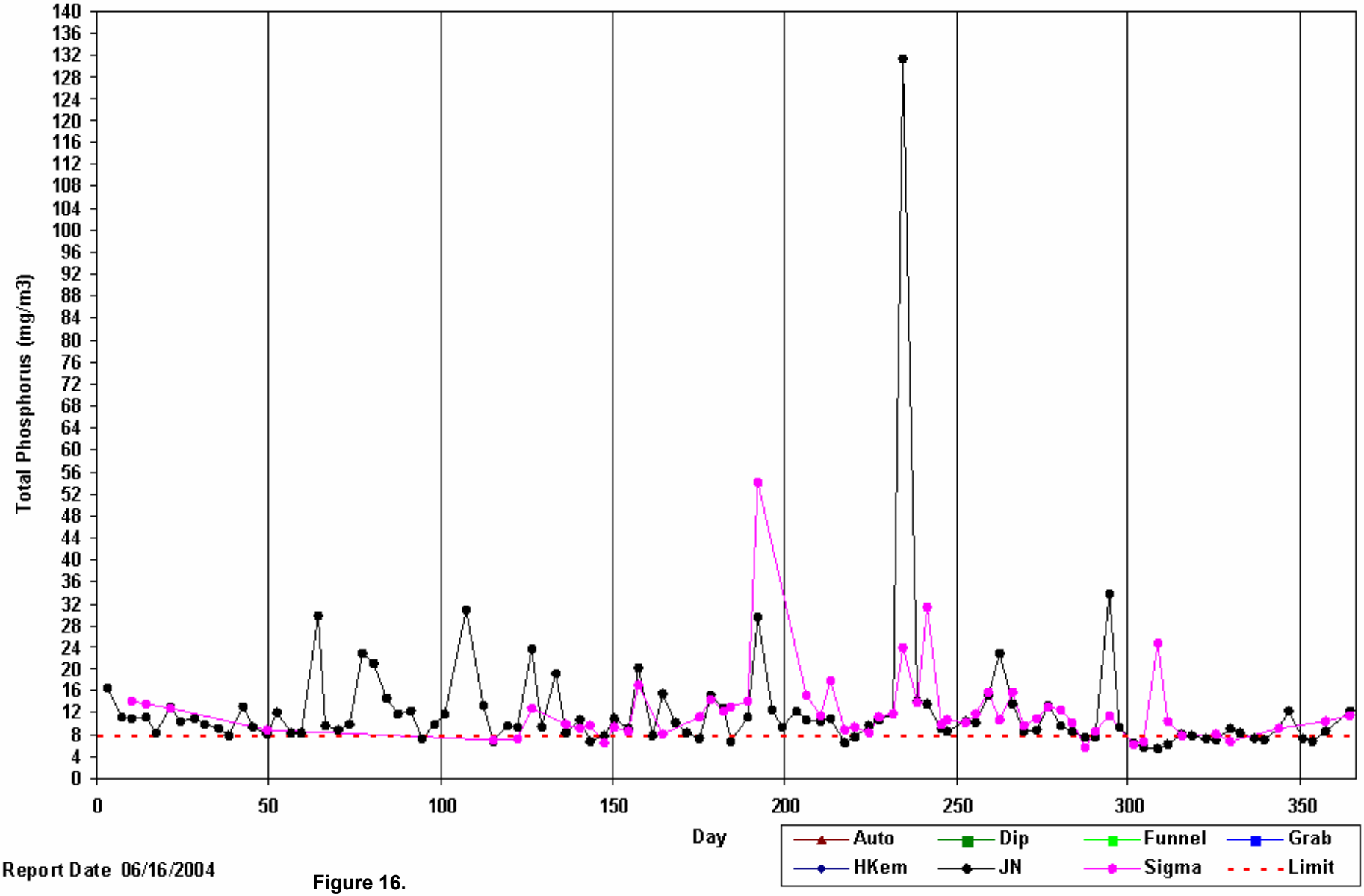
Method: Sigma, Average Phos: 12.473, Average Turb: 3.280



Report Date 06/16/2004 Figure 15.

Brundage Creek at Intake - Phosphorus for Year 2003

Average J/N: 12.64, Average Sigma: 12.47

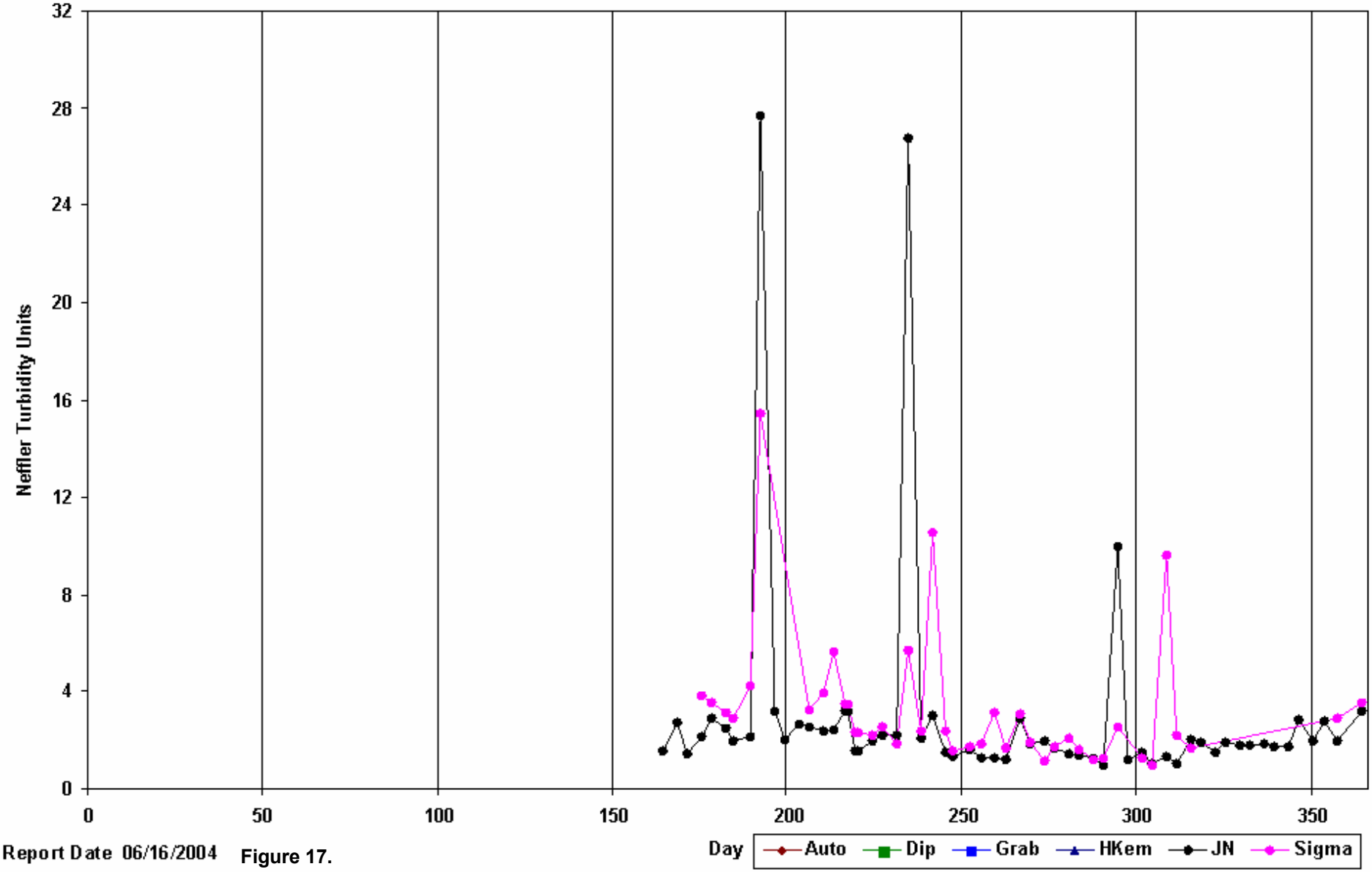


Report Date 06/16/2004

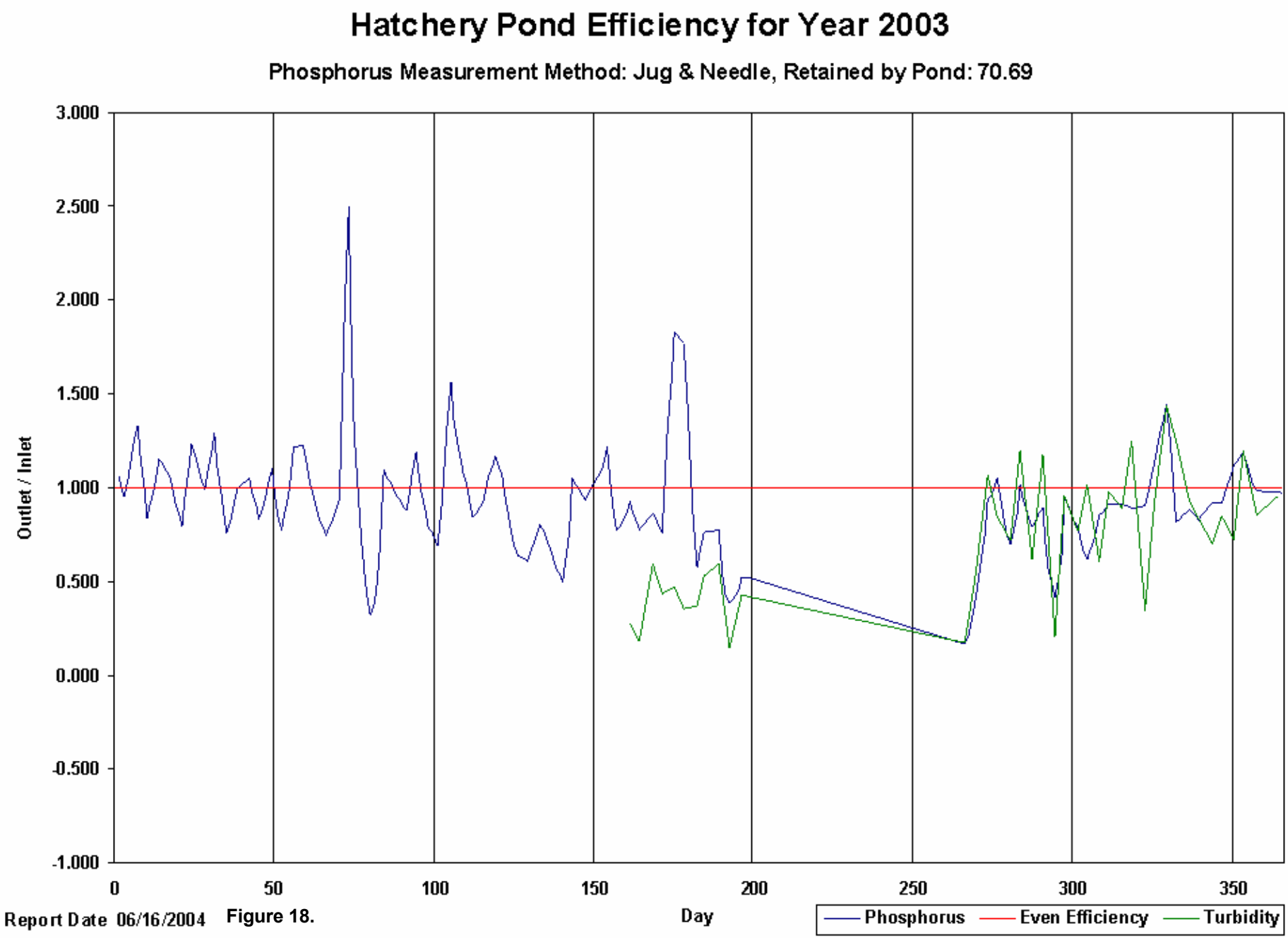
Figure 16.

Brundage Creek at Intake Turbidity for Year 2003

Average J/N: 2.98, Average Sigma: 3.28



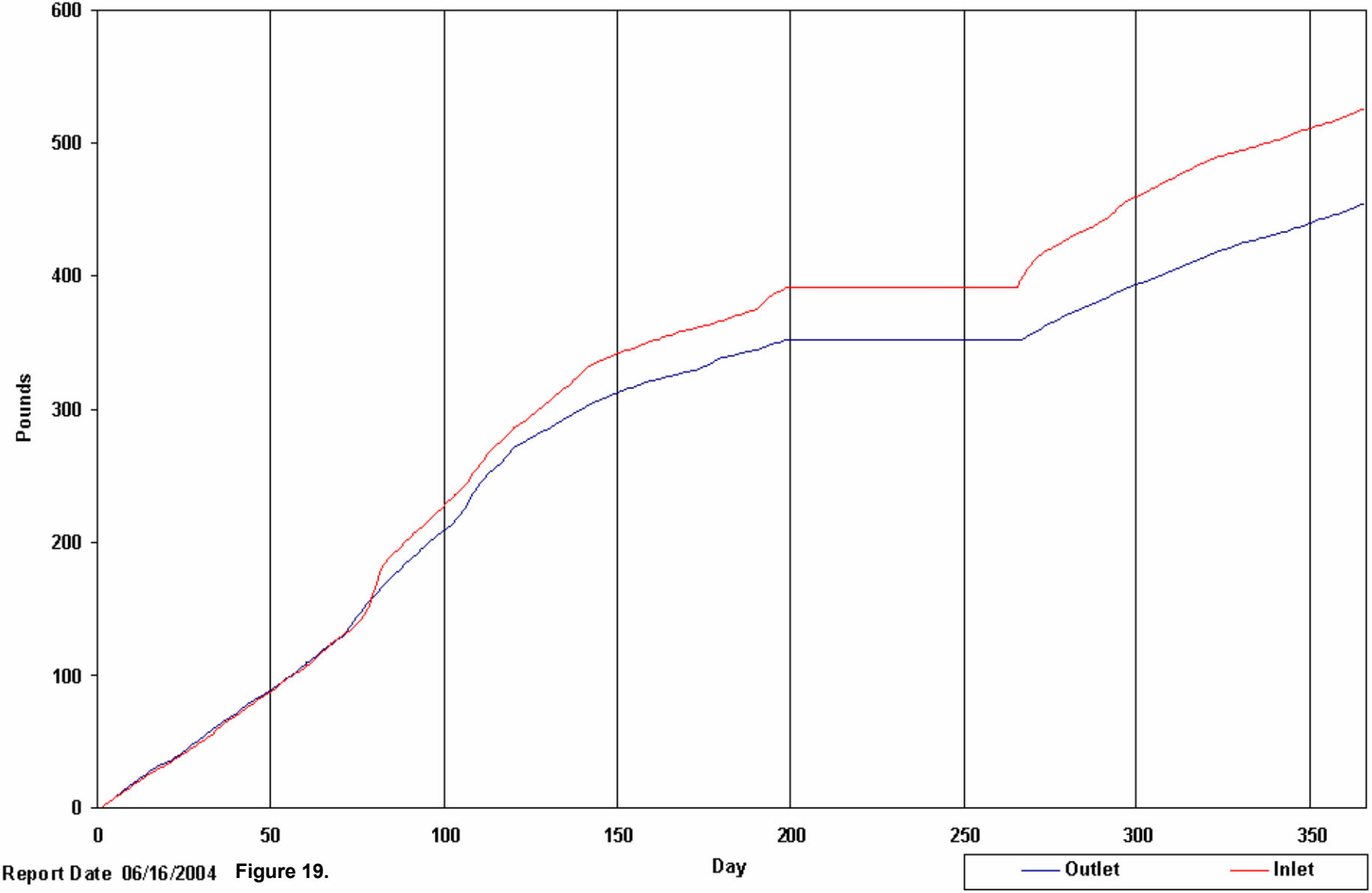
Report Date 06/16/2004 Figure 17.



Report Date 06/16/2004 Figure 18.

Hatchery Pond Retention for Year 2003

Phosphorus Measurement Method: Jug & Needle, Retained by Pond: 70.69



Report Date 06/16/2004 Figure 19.

Fish Production for year 2003

Month	I1	I2	I3	Beginning Weight (kg)	Ending Weight (kg)	Weight Of Food (kg)	% Phos in Food	Mortalities Number	Mortalities Weight (kg)	Shipped Number	Shipped Weight (kg)
January	Eisch, Ed			43,972	46,452	1,573	0.75	442,142	668.0	0	0.0
February	Eisch, Ed			46,483	48,129	2,416	0.82	70,175	287.0	0	0.0
March	Eisch, Ed			48,197	27,926	4,810	0.79	18,805	223.0	836,697	19,016.0
April	Eisch, Ed			28,103	16,771	4,758	0.79	28,621	111.0	774,846	18,076.0
May	Eisch, Ed			17,403	2,514	6,274	0.99	25,855	75.0	3,920,764	31,811.0
June	Eisch, Ed			2,547	7,331	1,938	0.74	1,374	3.0	0	0.0
July	Eisch, Ed			7,420	12,263	4,525	0.73	1,836	10.0	0	0.0
August	Eisch, Ed			12,265	10,514	2,305	0.68	1,104	10.0	520,024	3,653.0
September	Eisch, Ed			10,570	17,054	3,736	0.71	677	16.0	0	0.0
October	Eisch, Ed			17,043	19,357	2,517	0.71	1,349	20.0	0	0.0
November	Eisch, Ed			19,357	21,482	2,231	0.71	220	4.0	0	0.0
December	Eisch, Ed			21,631	23,075	1,739	1.34	484	9.0	0	0.0
Total for Year						**38,822**	**0.81**	**592,642**	**1,436.0**	**6,052,331**	**72,556.0**
Production Weight for Year				**53,095 kg**							

Production = 23,075 + 1,436 + 72,556 – 43972 = 53,095 kg

P/F = 53,095/38,822 = 1.37

P in Feed = 38,822 x 0.0081 x 2.205 = 693.4 lbs

Start Fish P = 43,972 x 2.205 x 0.004465 = 432.9 lbs

End Fish P = 23,075 x 2.205 x 0.004465 = 227.2 lbs

Mort Fish P = 1,436 x 2.205 x 0.004465 = 14.1 lbs

Total Shipped Fish P = 72,556 x 2.205 x 0.004465 = 714.3 lbs

→ **527.1 lbs shipped outside**

→ **187.2 lbs planted to PR**

Egg P = (1207 + 2607) x 2.205 x 1.3% = 109.3 lbs

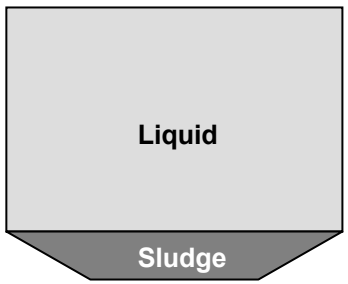
coho **chinook**

Figure 20.

91 x 1500 x 0.003785 x 523 x 2.205 / 1,000,000 = 0.60 lbs

trips gal/trip m3/gal mg/m3 lbs/kg mg/kg

Storage Tank



168,922 x 90% x 0.003785 x 523 x 2.205 / 1,000,000 = 0.66 lbs

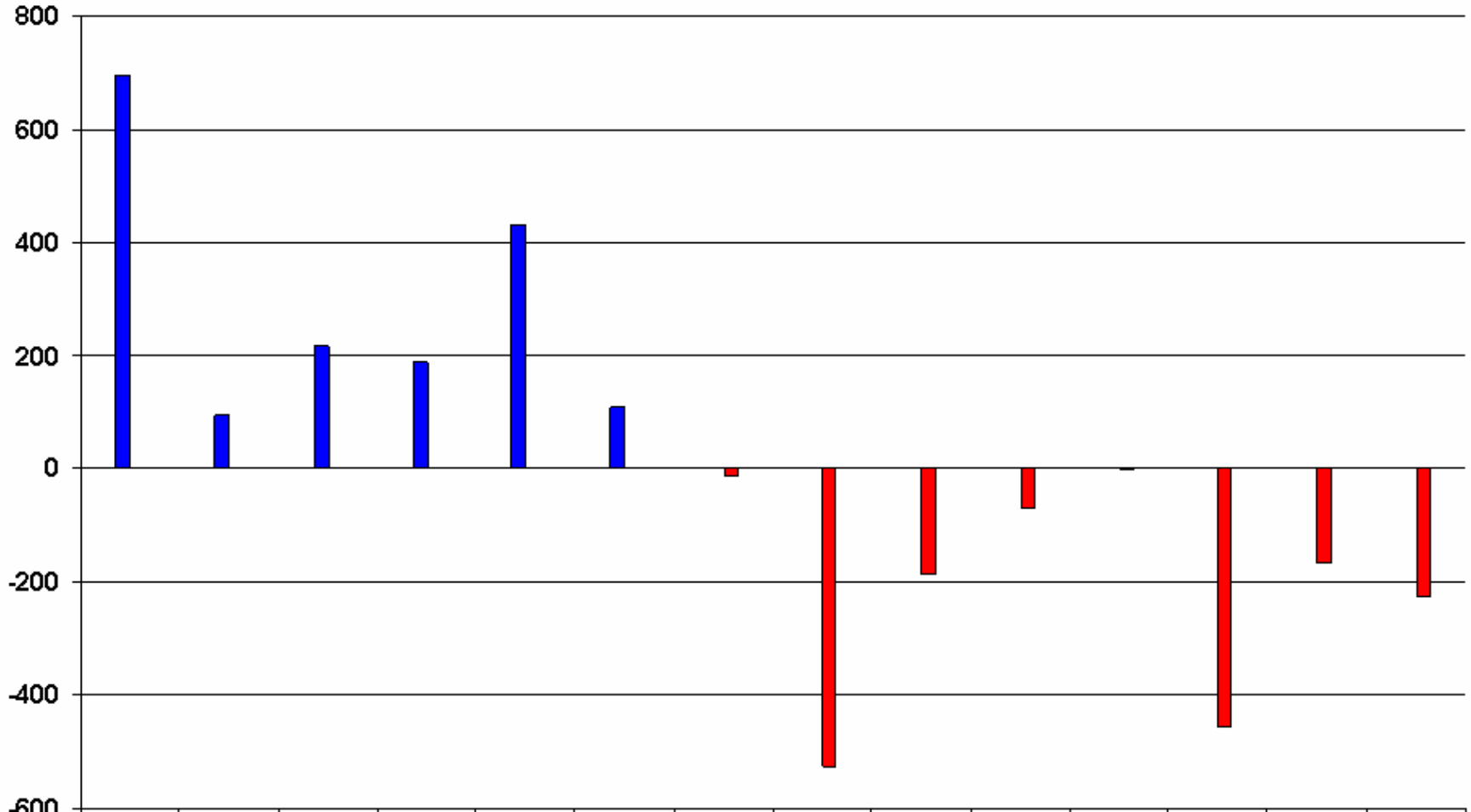
168,922 x 10% x 0.003785 x 15,000 x 2.205 / 1,000,000 = 2.1 lbs

Total Waste Solids = 3.4 lbs

Figure 21.

Hatchery Phosphorus Mass Balance for 2003

Total Sources: 1736.69 lbs, Total Losses: 1648.83 lbs



	Feed	Spring	Creek	River	Fish Strt	FEggs	Morts	Shipped	Planted	Pond	Waste	Outlet	Bypass	Fish End
Sources	696.55	93.54	215.53	188.83	432.92	109.33	0	0	0	0	0	0	0	0
Losses	0	0	0	0	0	0	-14.14	-527.12	-187.22	-70.69	-1.34	-454.62	-166.53	-227.18

Report Date 06/16/2004 Figure 22.

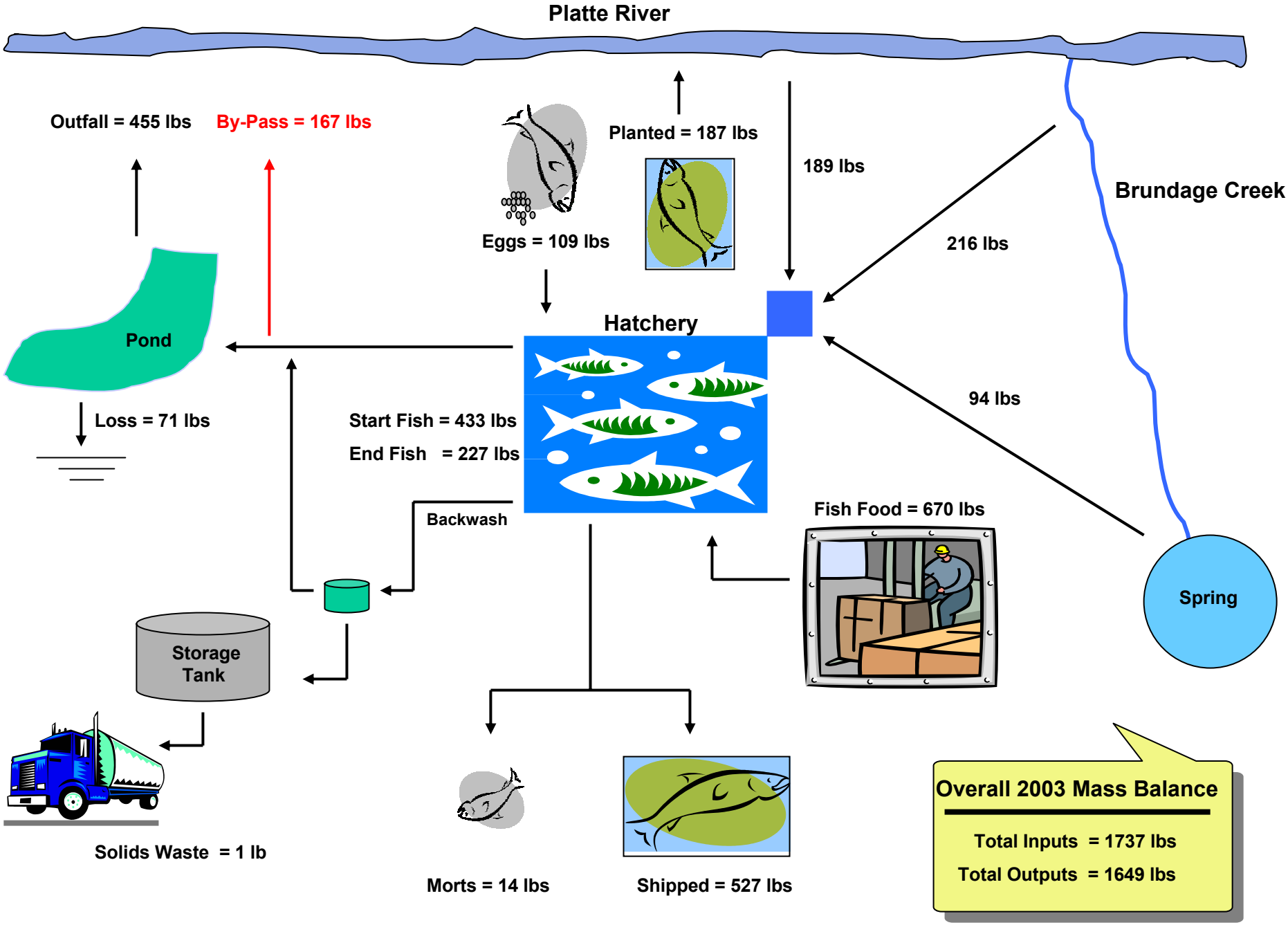

Platte River
Outfall = 455 lbs
By-Pass = 167 lbs
Planted = 187 lbs
189 lbs
Brundage Creek
Eggs = 109 lbs
216 lbs
Pond
Hatchery
Loss = 71 lbs
Start Fish = 433 lbs
End Fish = 227 lbs
94 lbs
Backwash
Fish Food = 670 lbs
Spring
Storage Tank
Solids Waste = 1 lb
Morts = 14 lbs
Shipped = 527 lbs
Overall 2003 Mass Balance
Total Inputs = 1737 lbs
Total Outputs = 1649 lbs

Figure 23.

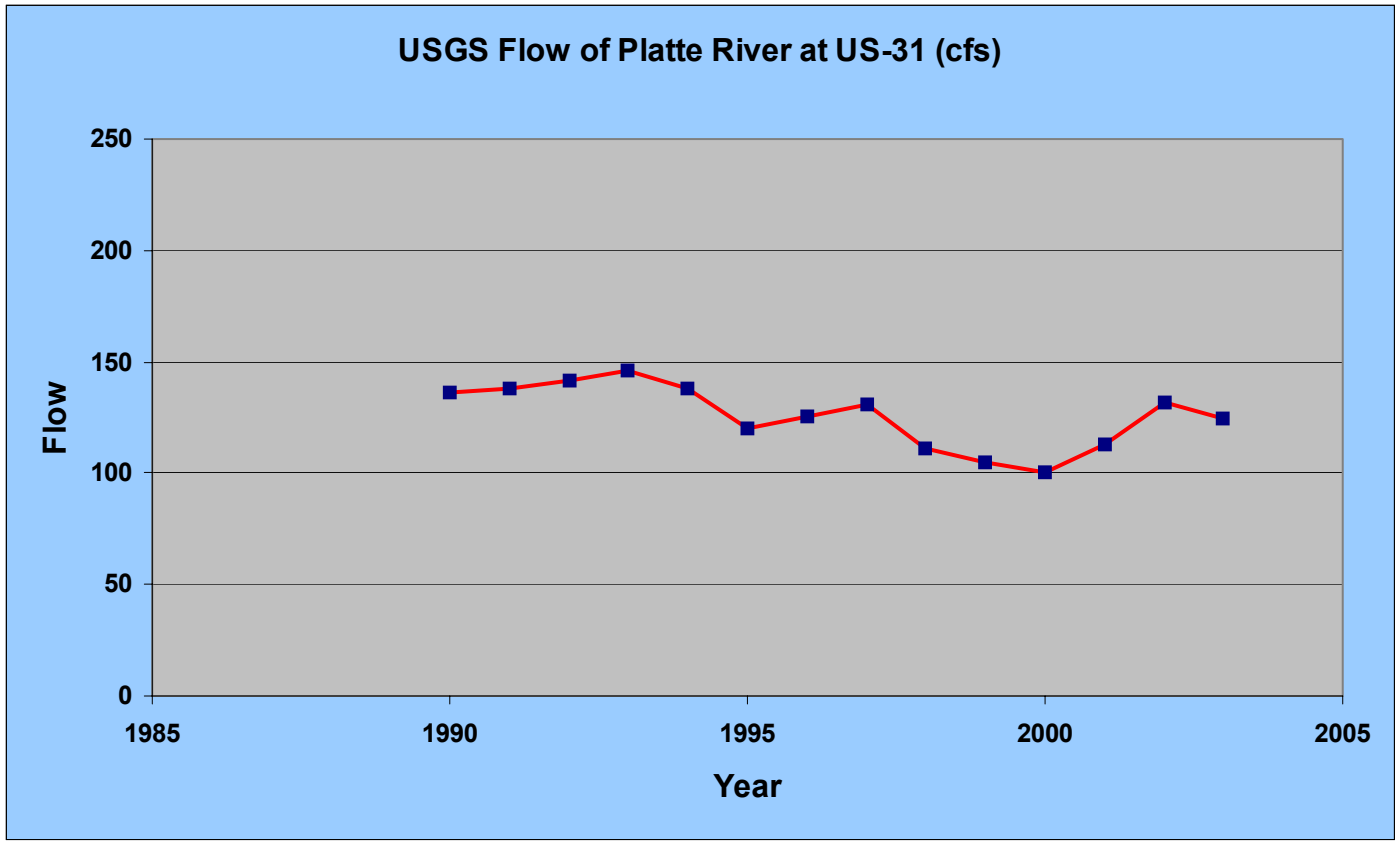

USGS Flow of Platte River at US-31 (cfs)
250
200
150
100
50
0
Flow
1985
1990
1995
2000
2005
Year

Figure 24.

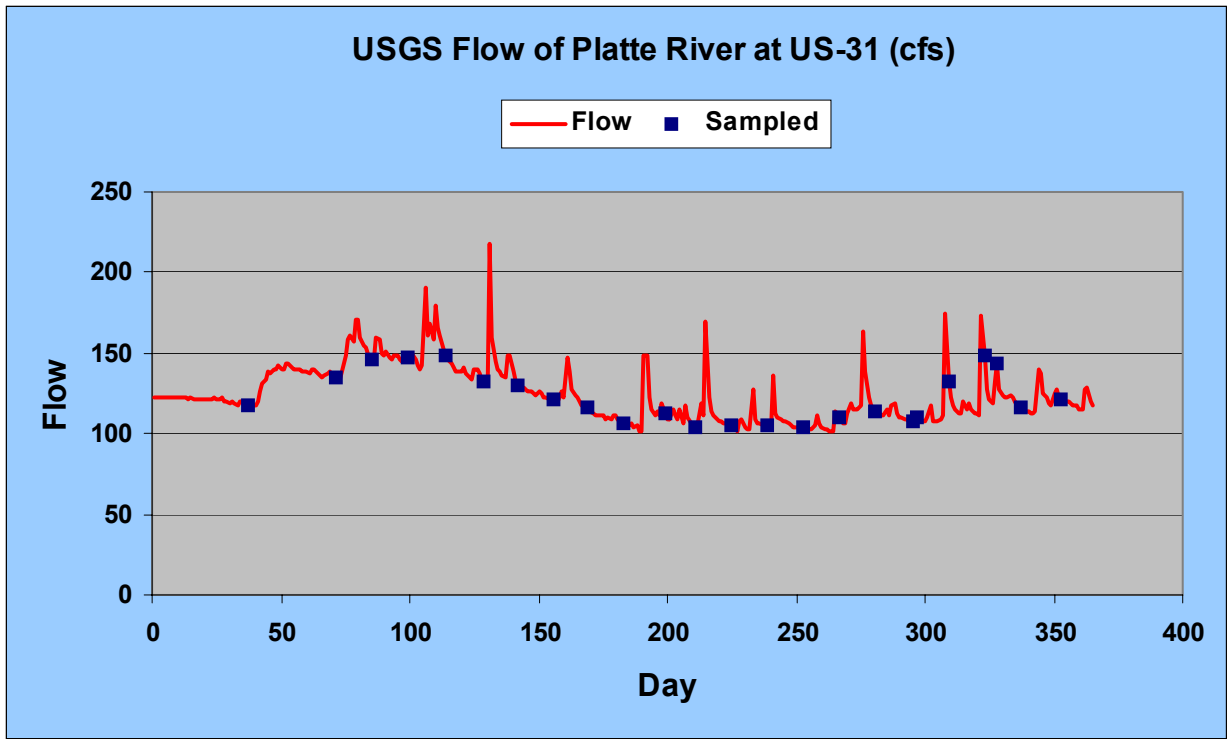

USGS Flow of Platte River at US-31 (cfs)
Flow
Sampled
250
200
150
100
50
0
Flow
0
50
100
150
200
250
300
350
400
Day

Figure 25.

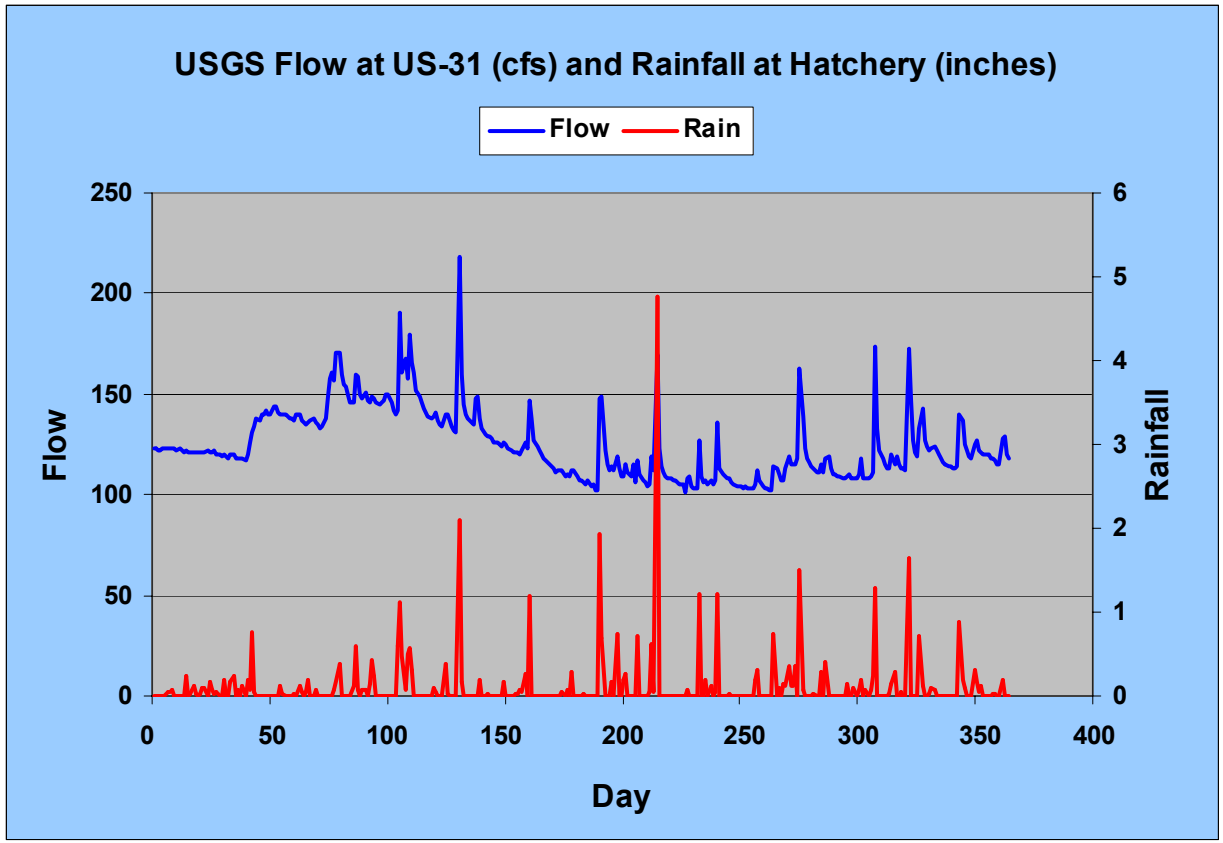

USGS Flow at US-31 (cfs) and Rainfall at Hatchery (inches)
Flow
Rain
250
200
150
100
50
0
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
400
Day
Flow
Rainfall

Figure 26.

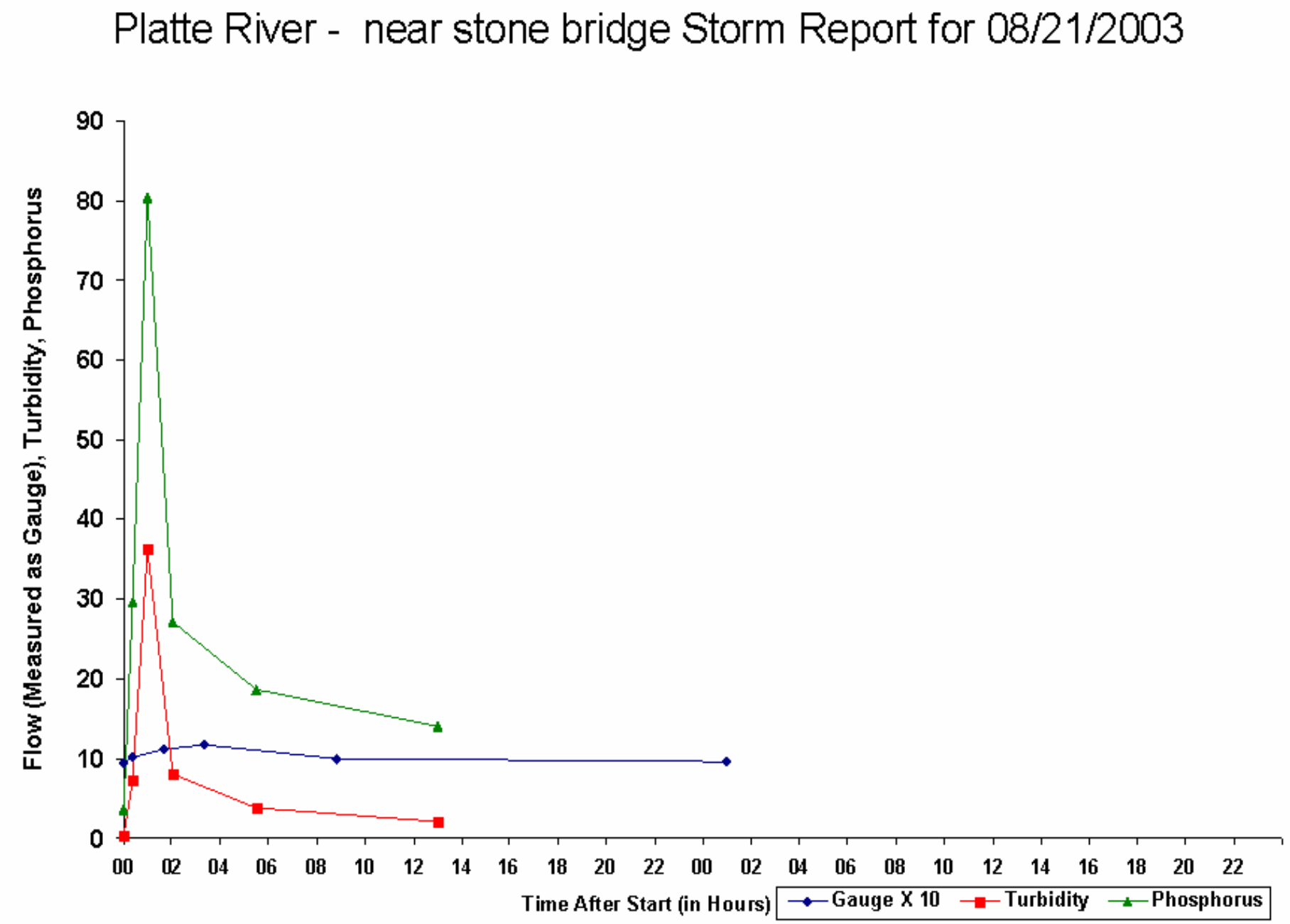


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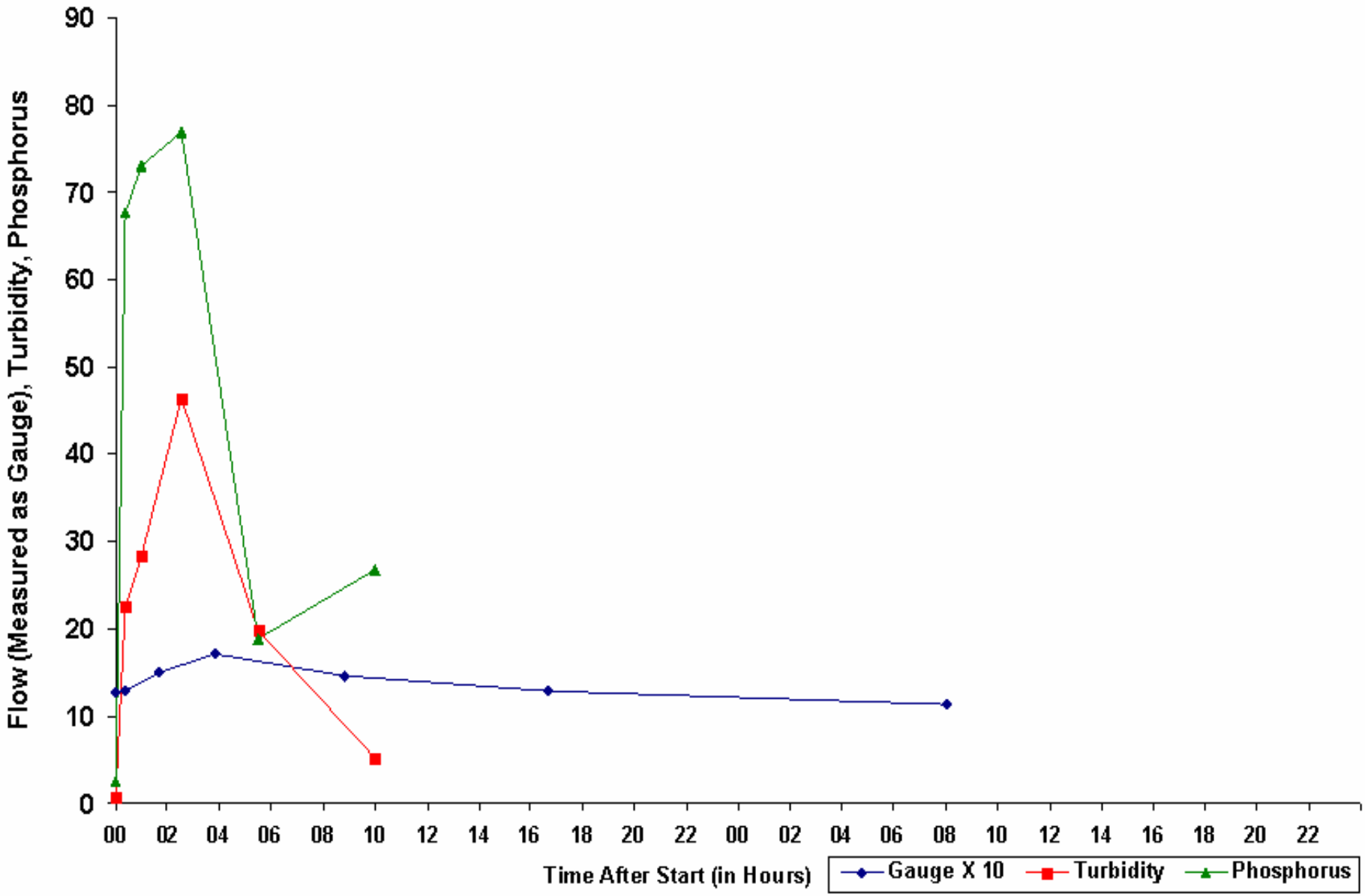
Figure 27.

Brundage Cr - old residence Storm Report for 08/29/2003



Report Date 06/01/2004

Figure 28.

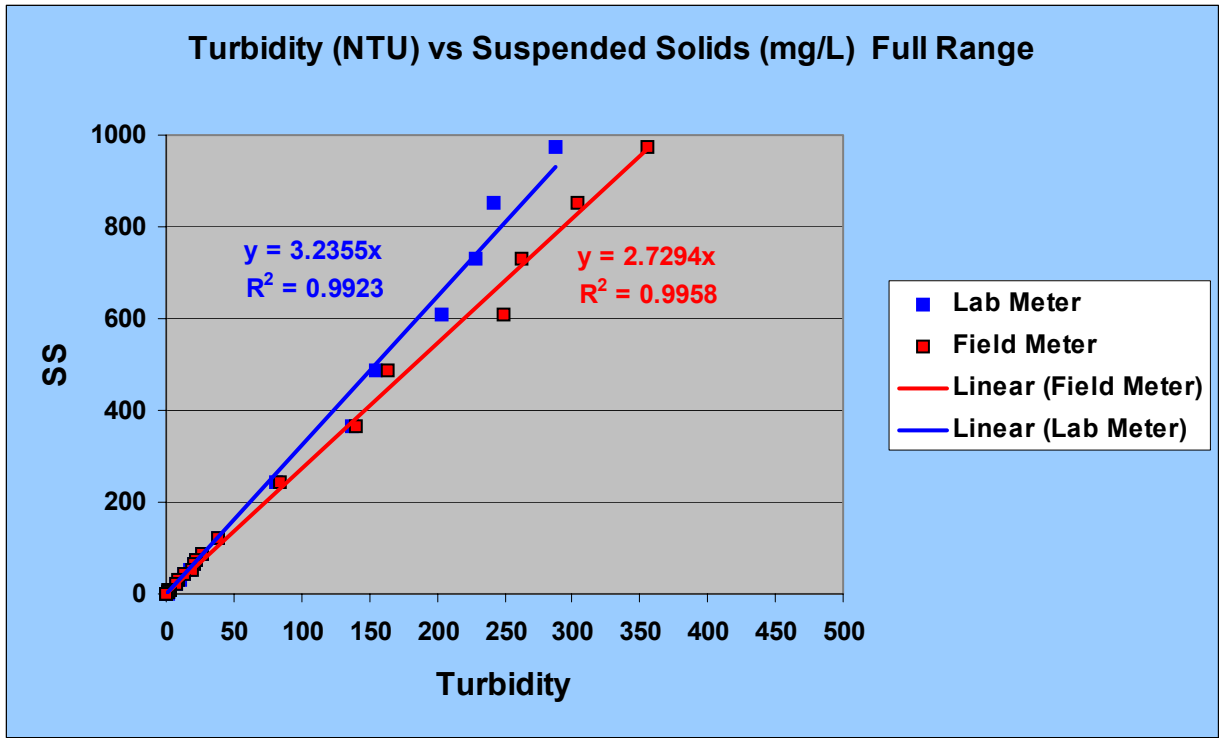

Turbidity (NTU) vs Suspended Solids (mg/L) Full Range
1000
800
600
400
200
0
SS
0
50
100
150
200
250
300
350
400
450
500
Turbidity
y = 3.2355x
R2 = 0.9923
y = 2.7294x
R2 = 0.9958
Lab Meter
Field Meter
Linear (Field Meter)
Linear (Lab Meter)

Figure 29.

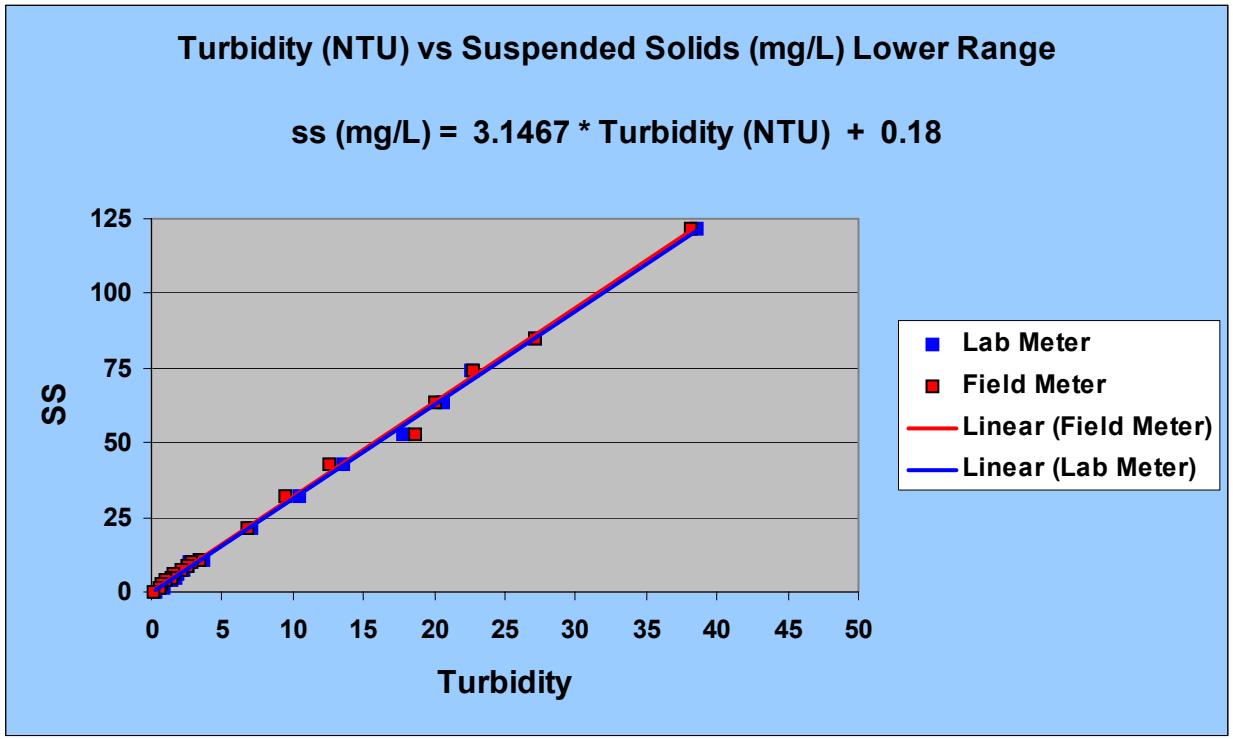
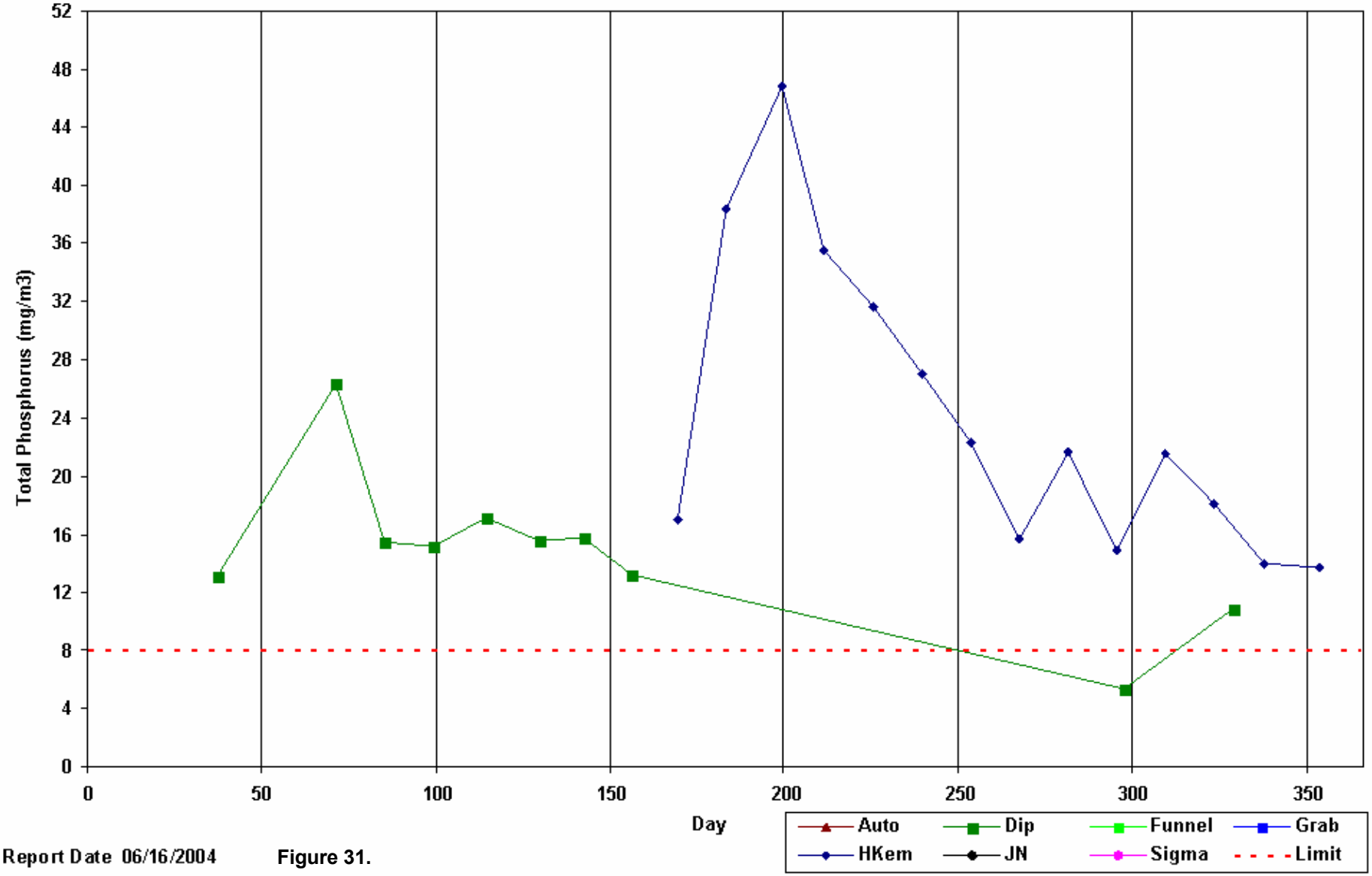

Turbidity (NTU) vs Suspended Solids (mg/L) Lower Range
ss (mg/L) = 3.1467 * Turbidity (NTU) + 0.18
SS
125
100
75
50
25
0
0
5
10
15
20
25
30
35
40
45
50
Turbidity
Lab Meter
Field Meter
Linear (Field Meter)
Linear (Lab Meter)

Figure 30.

Platte River at US 31 - USGS - Phosphorus for Year 2003

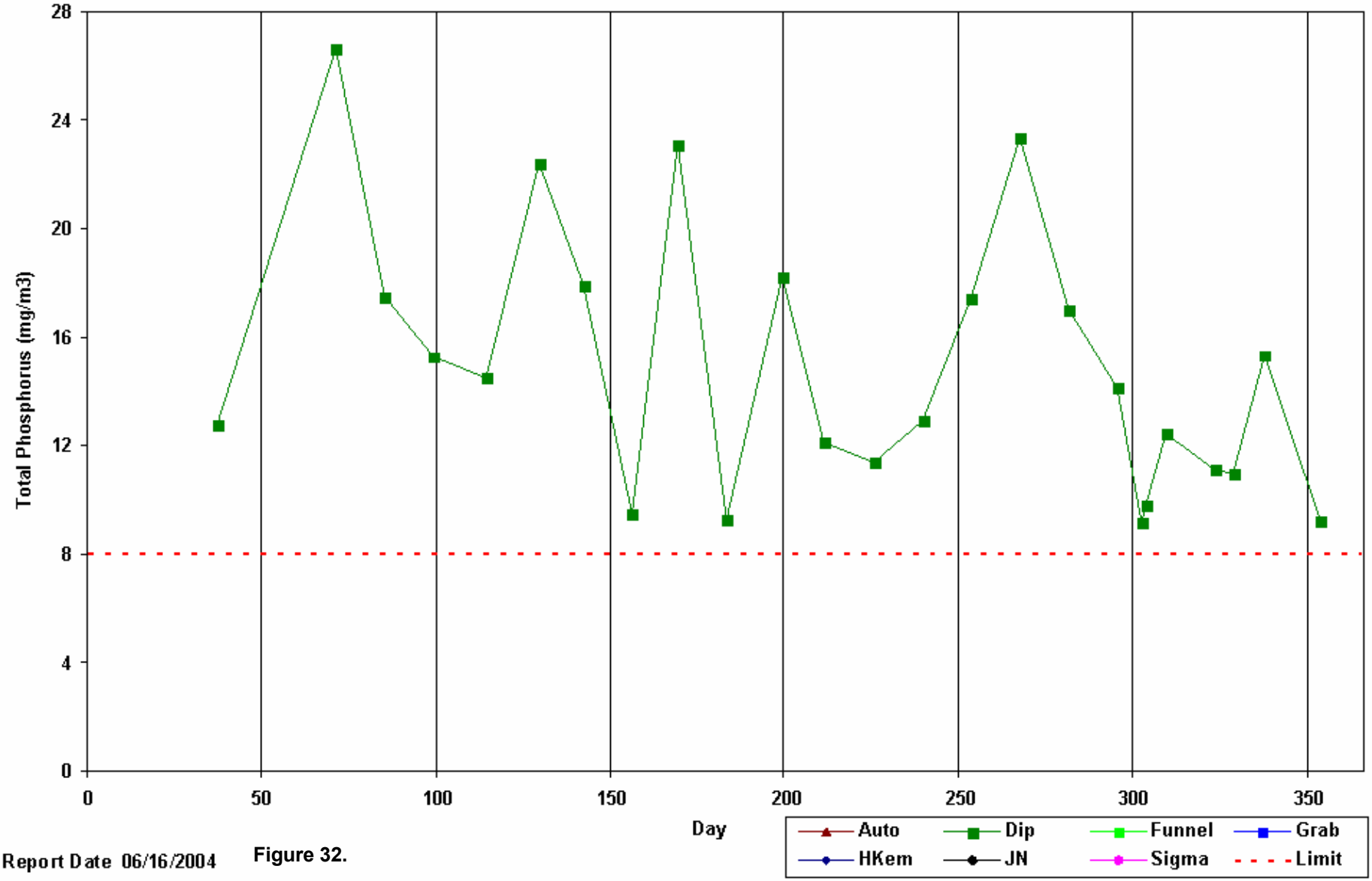
Average Dip: 14.80, Average H Kem: 24.18



Report Date 06/16/2004 Figure 31.

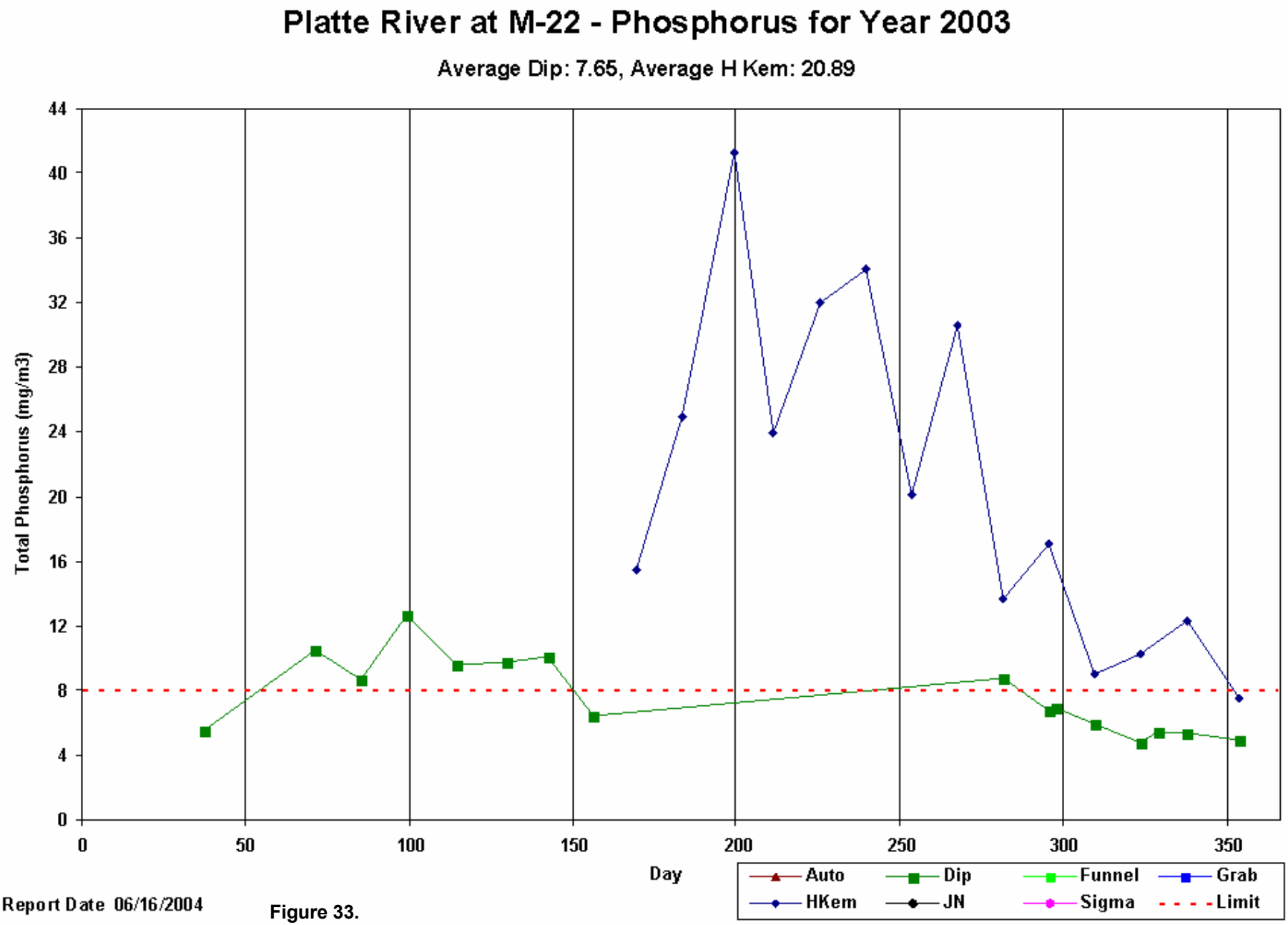
North Branch Deadsteam Dr. - Phosphorus for Year 2003

Average Dip: 14.95



Report Date 06/16/2004

Figure 32.

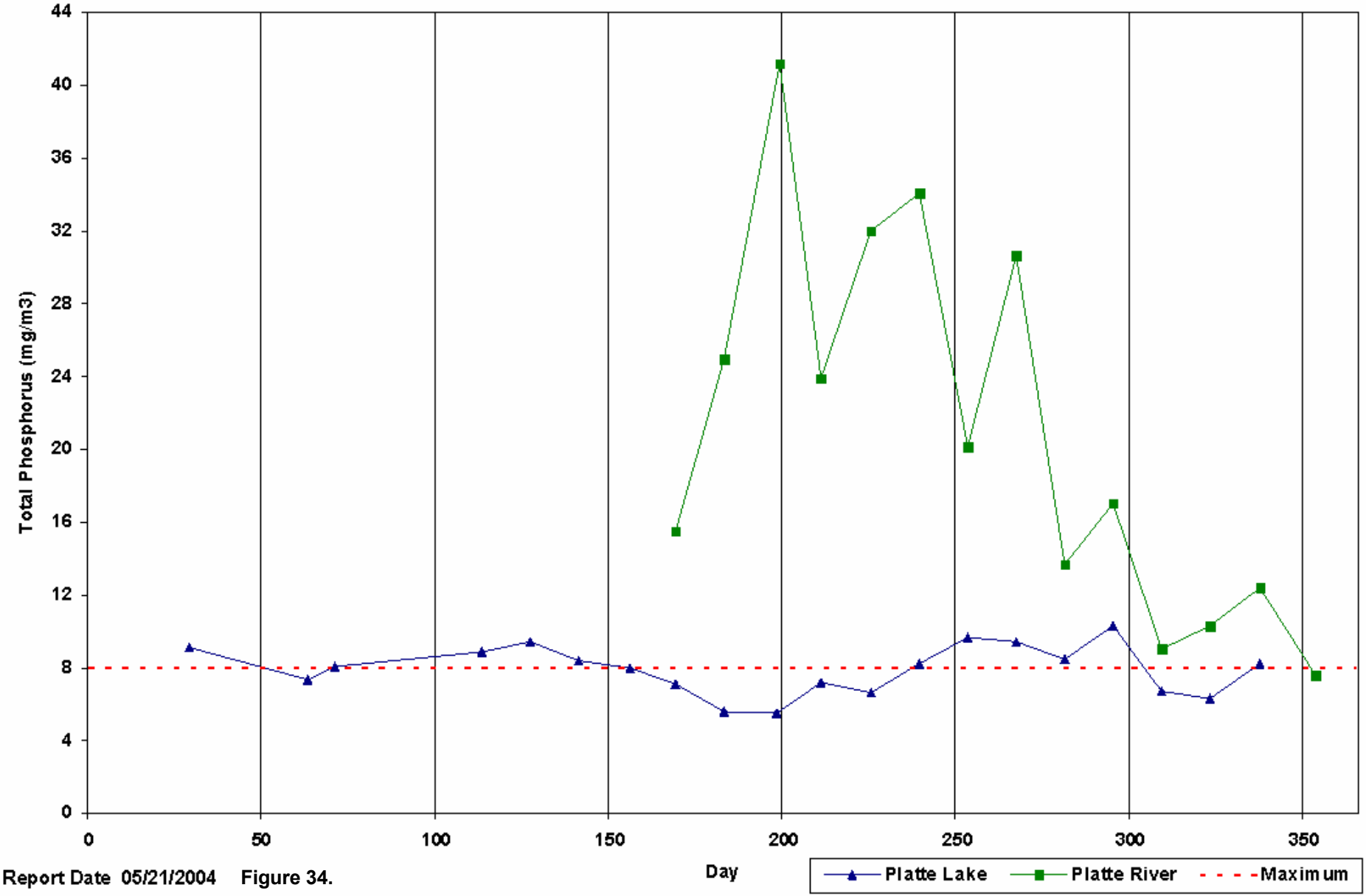


Report Date 06/16/2004

Figure 33.

Platte Lake vs Platte River at M22 - Phosphorus for Year 2003

Platte Lake Depths 0 and 7.5, Platte River Method: H Kem

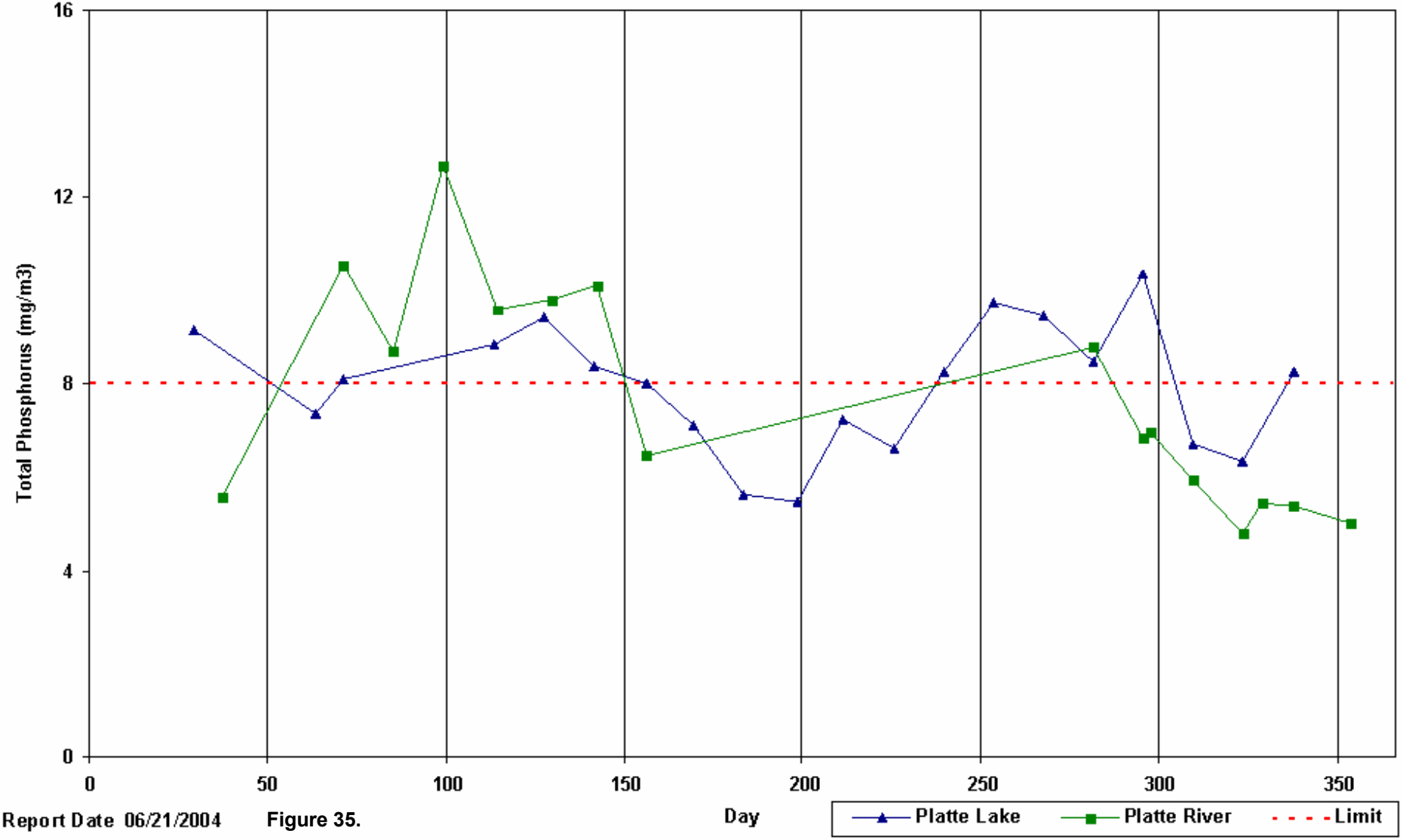


Report Date 05/21/2004 Figure 34.

Platte Lake vs Platte River at M22 - Phosphorus for Year 2003

Platte Lake Depths 0 and 7.5, Platte River Method: Dip

Platte Lake Average: 7.94, Platte River Average: 7.65



Report Date 06/21/2004 Figure 35.

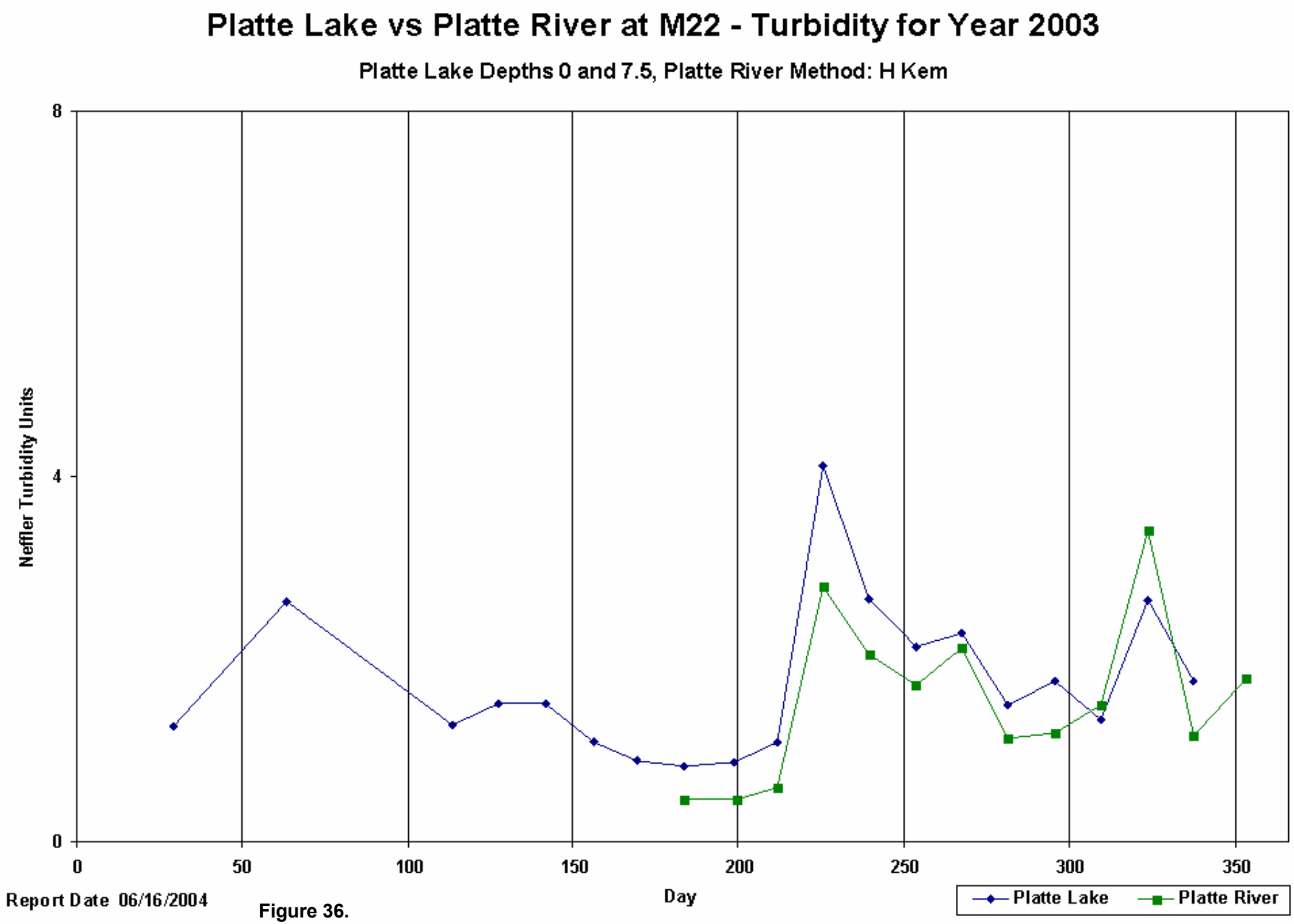

Platte Lake vs Platte River at M22 - Turbidity for Year 2003
Platte Lake Depths 0 and 7.5, Platte River Method: H Kem
Neffler Turbidity Units
8
4
0
0
50
100
150
200
250
300
350
Day
Platte Lake
Platte River
Report Date 06/16/2004

Figure 36.

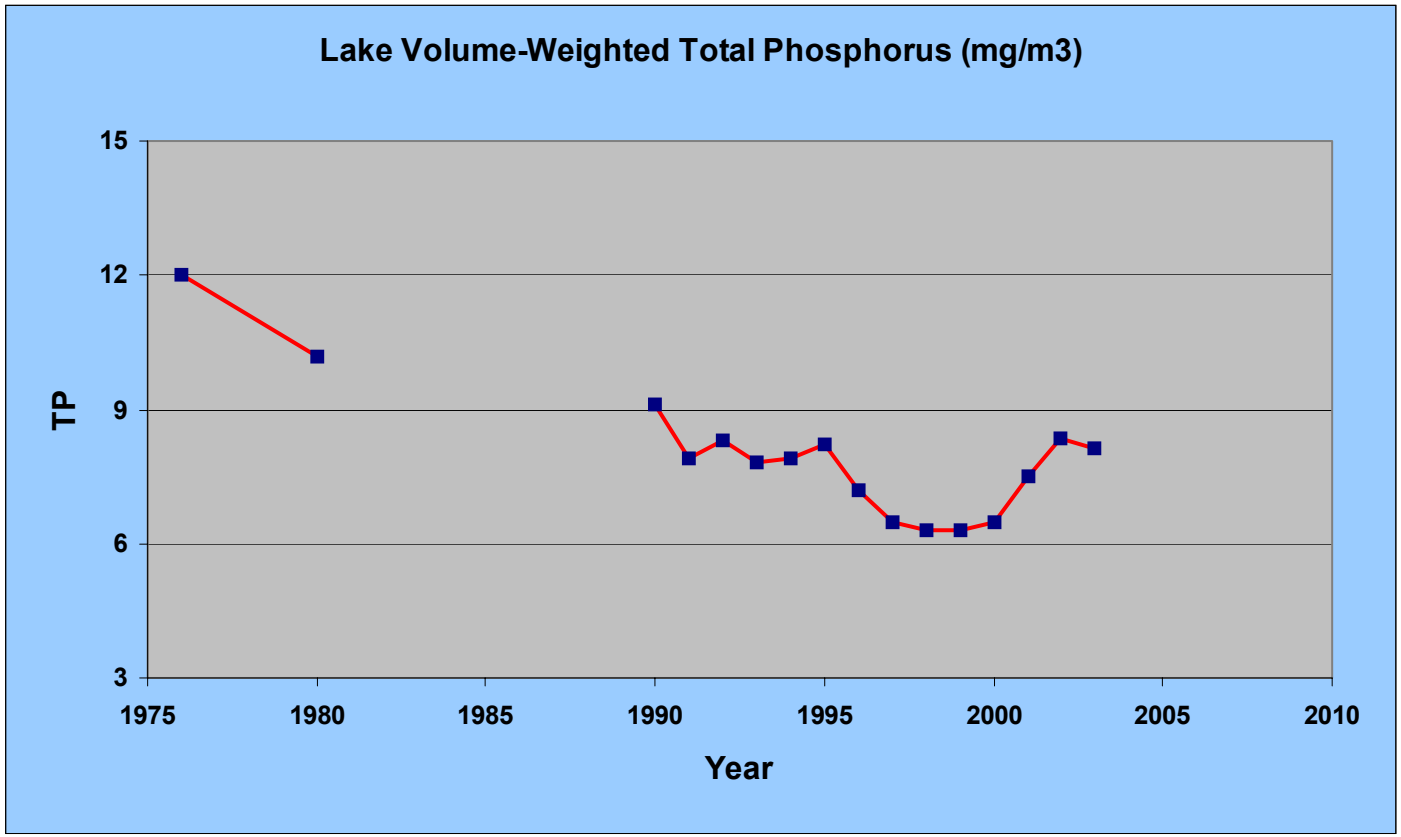

Lake Volume-Weighted Total Phosphorus (mg/m3)
TP
15
12
9
6
3
1975
1980
1985
1990
1995
2000
2005
2010
Year

Figure 37.

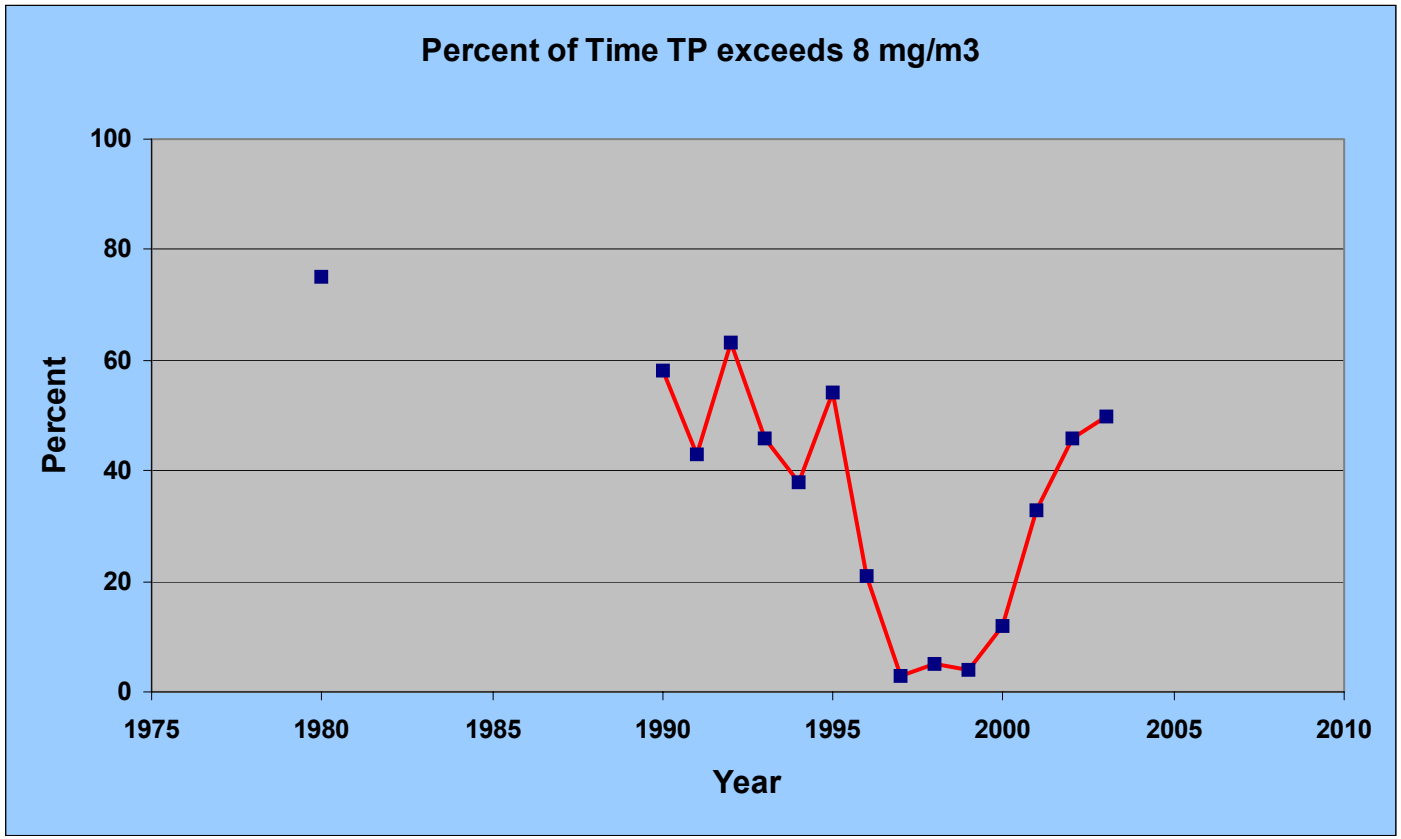
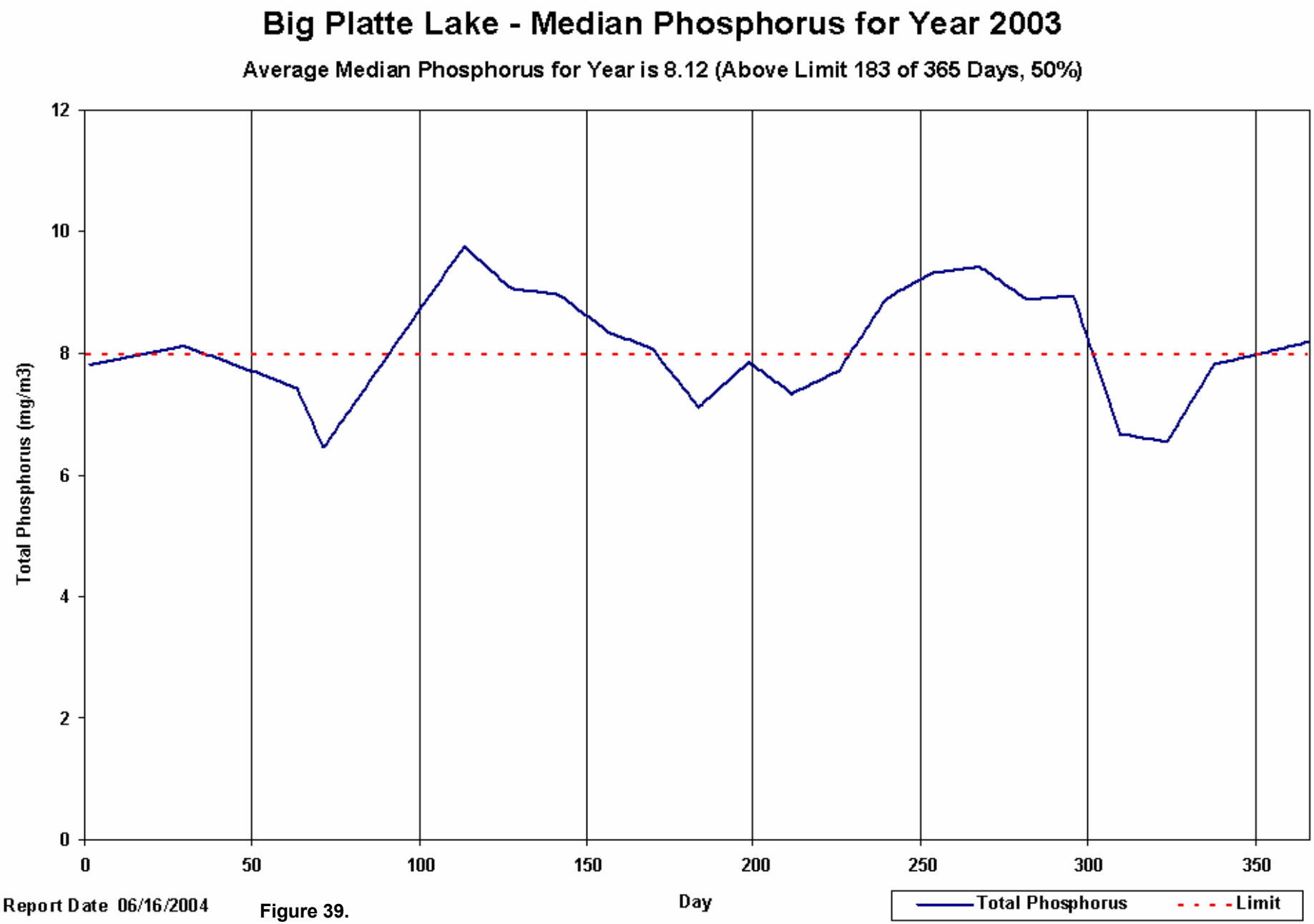
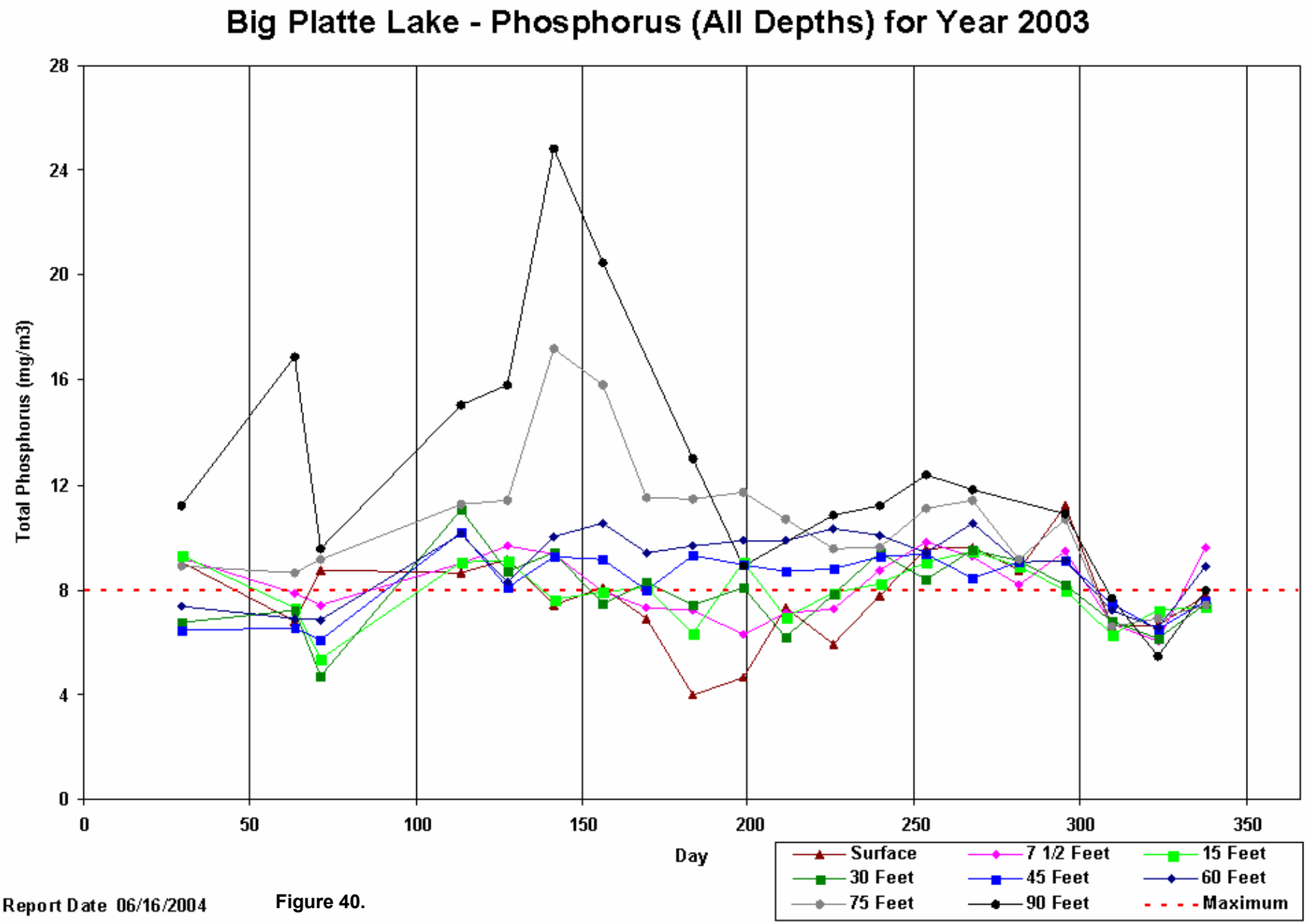

Percent of Time TP exceeds 8 mg/m3
100
80
60
40
20
0
Percent
1975
1980
1985
1990
1995
2000
2005
2010
Year

Figure 38.



Report Date 06/16/2004

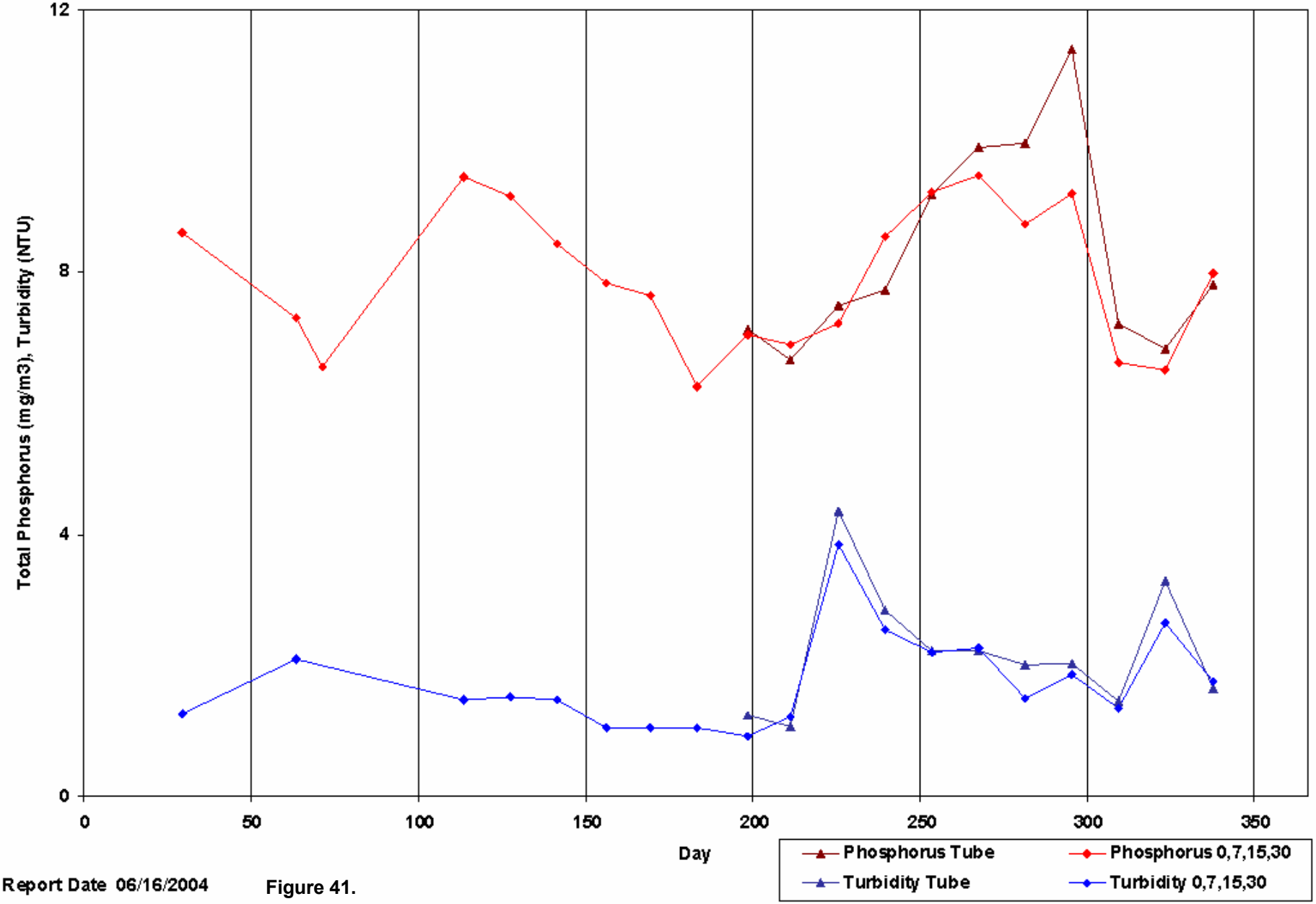
Figure 39.



Report Date 06/16/2004

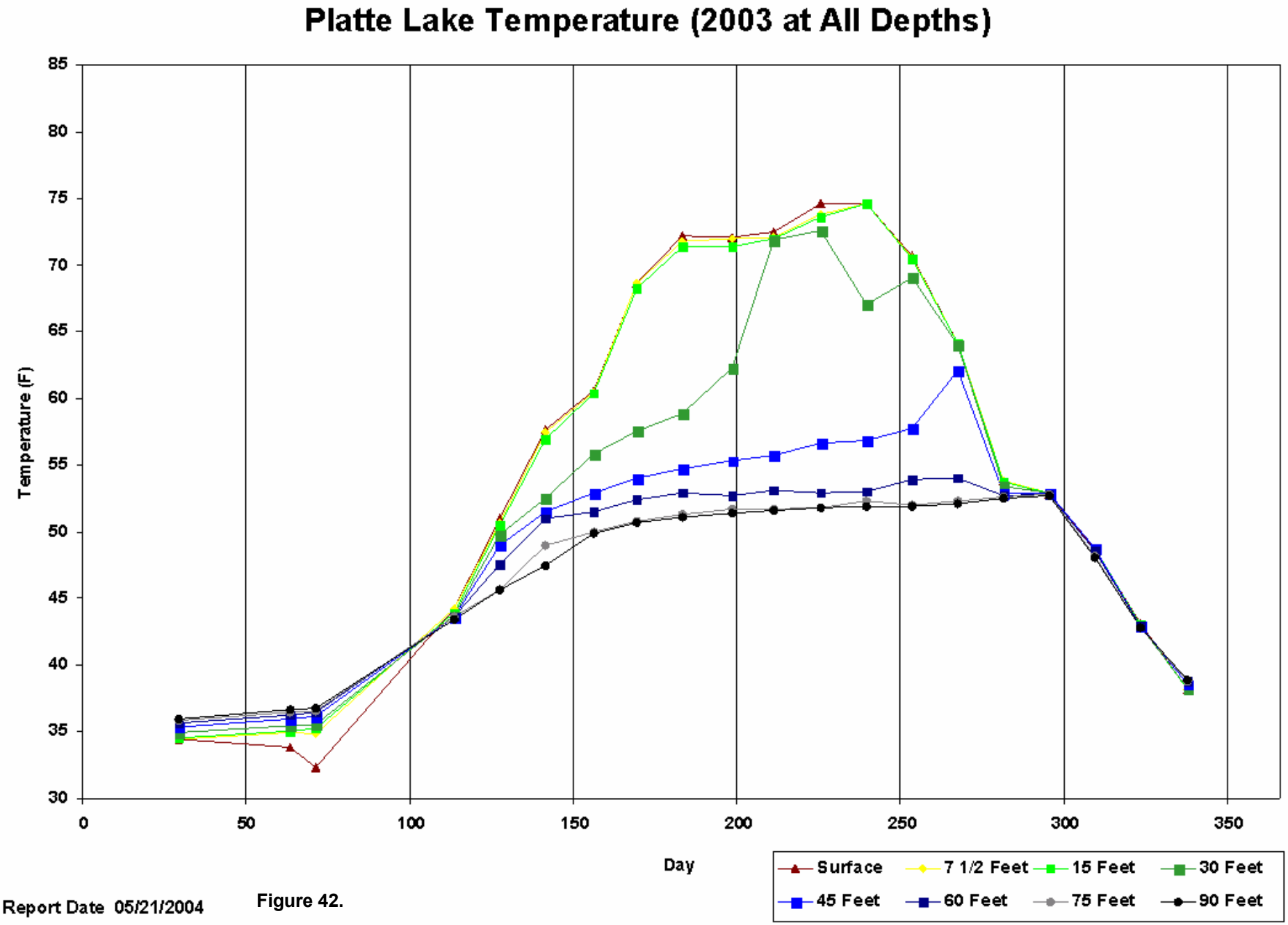
Figure 40.

Big Platte Lake - Phosphorus And Turbidity (0/30 vs Tube) for Year 2003



Report Date 06/16/2004

Figure 41.

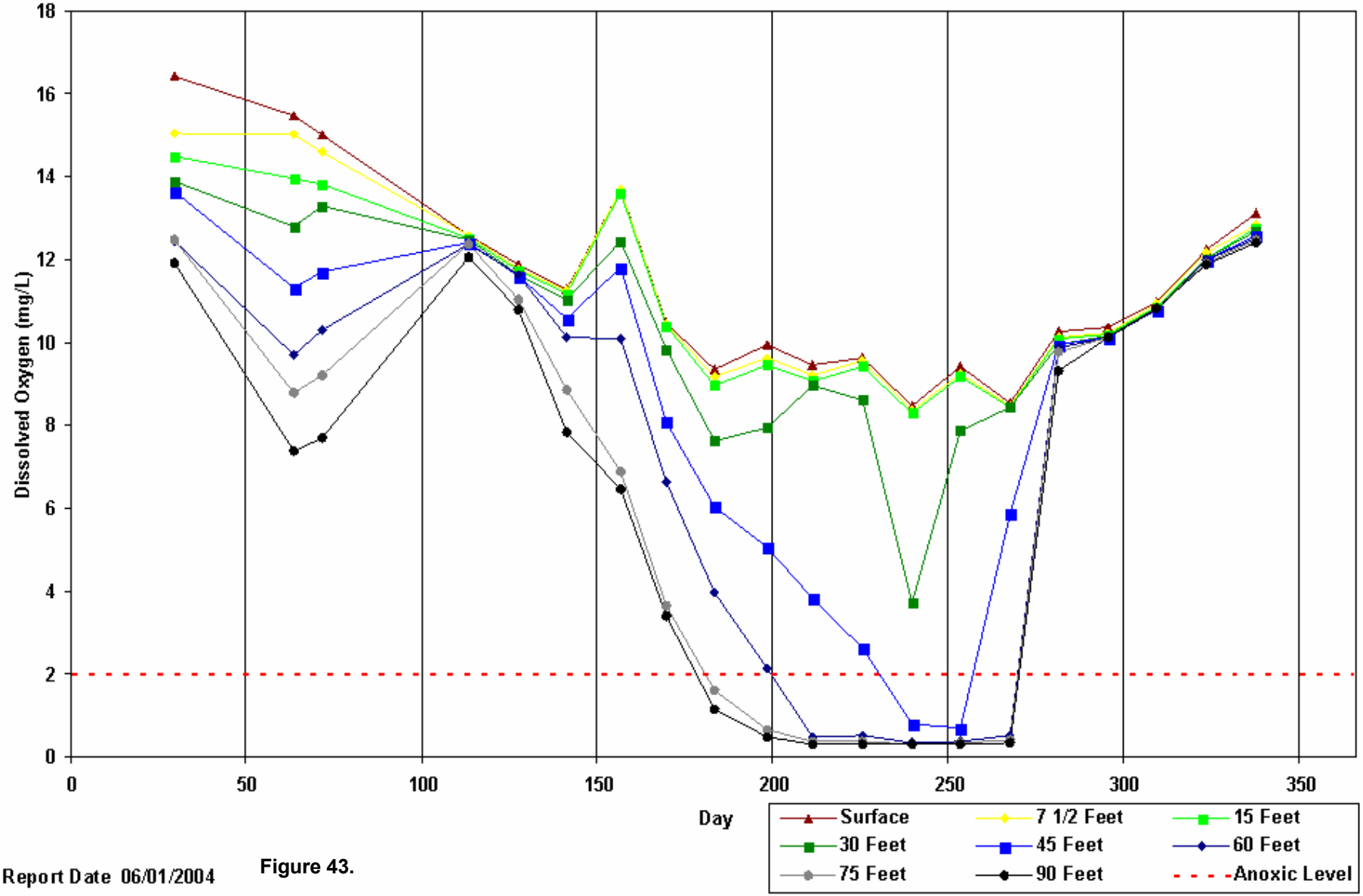


Report Date 05/21/2004

Figure 42.

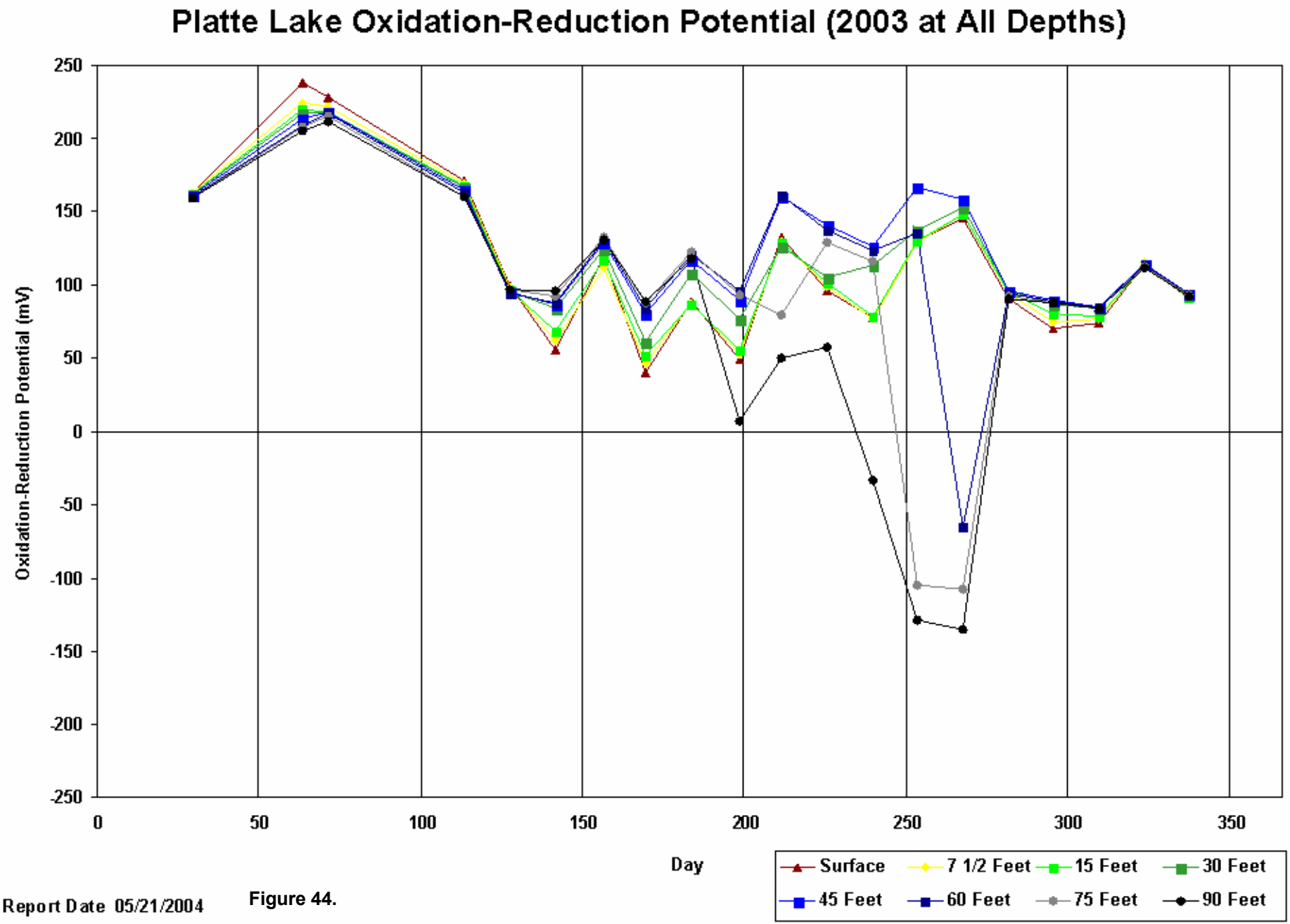
Platte Lake Dissolved Oxygen (2003 at All Depths)

Anoxic at 45 Feet: 26 Days, 60 Feet: 69 Days, 75 Feet: 88 Days, 90 Feet: 91 Days



Report Date 06/01/2004

Figure 43.



Report Date 05/21/2004

Figure 44.

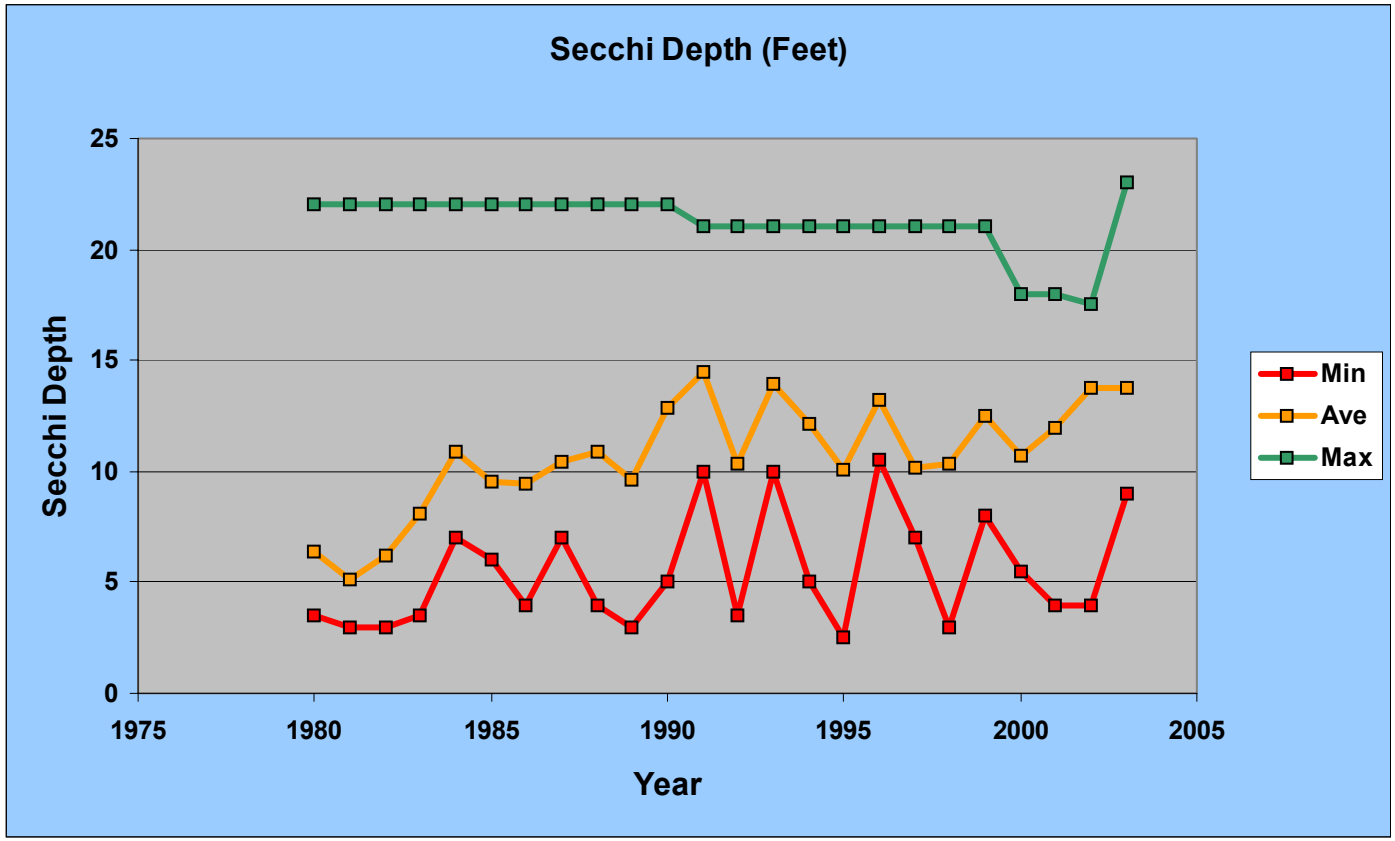
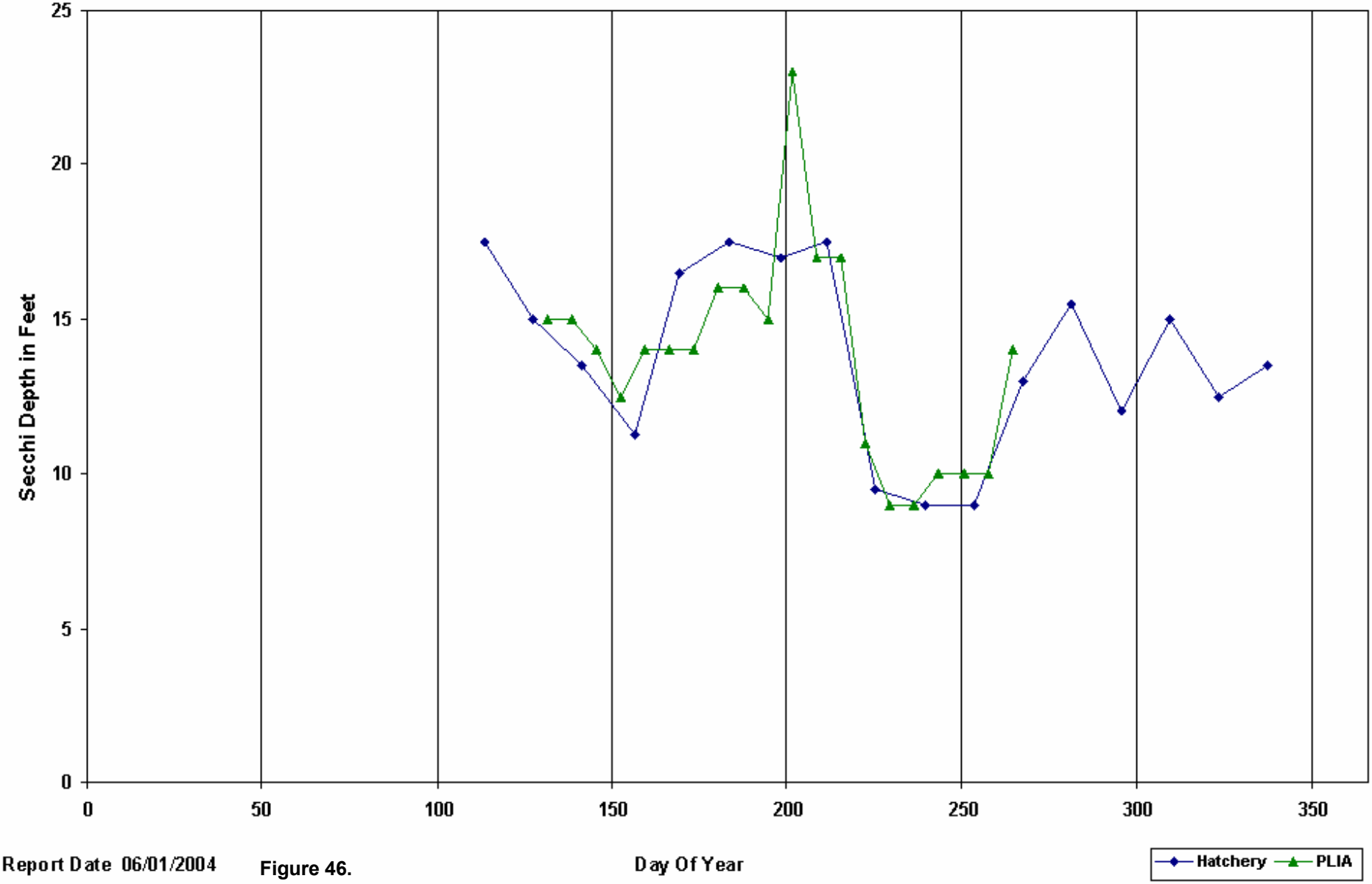

Secchi Depth (Feet)
Secchi Depth
25
20
15
10
5
0
1975
1980
1985
1990
1995
2000
2005
Year
Min
Ave
Max

Figure 45.

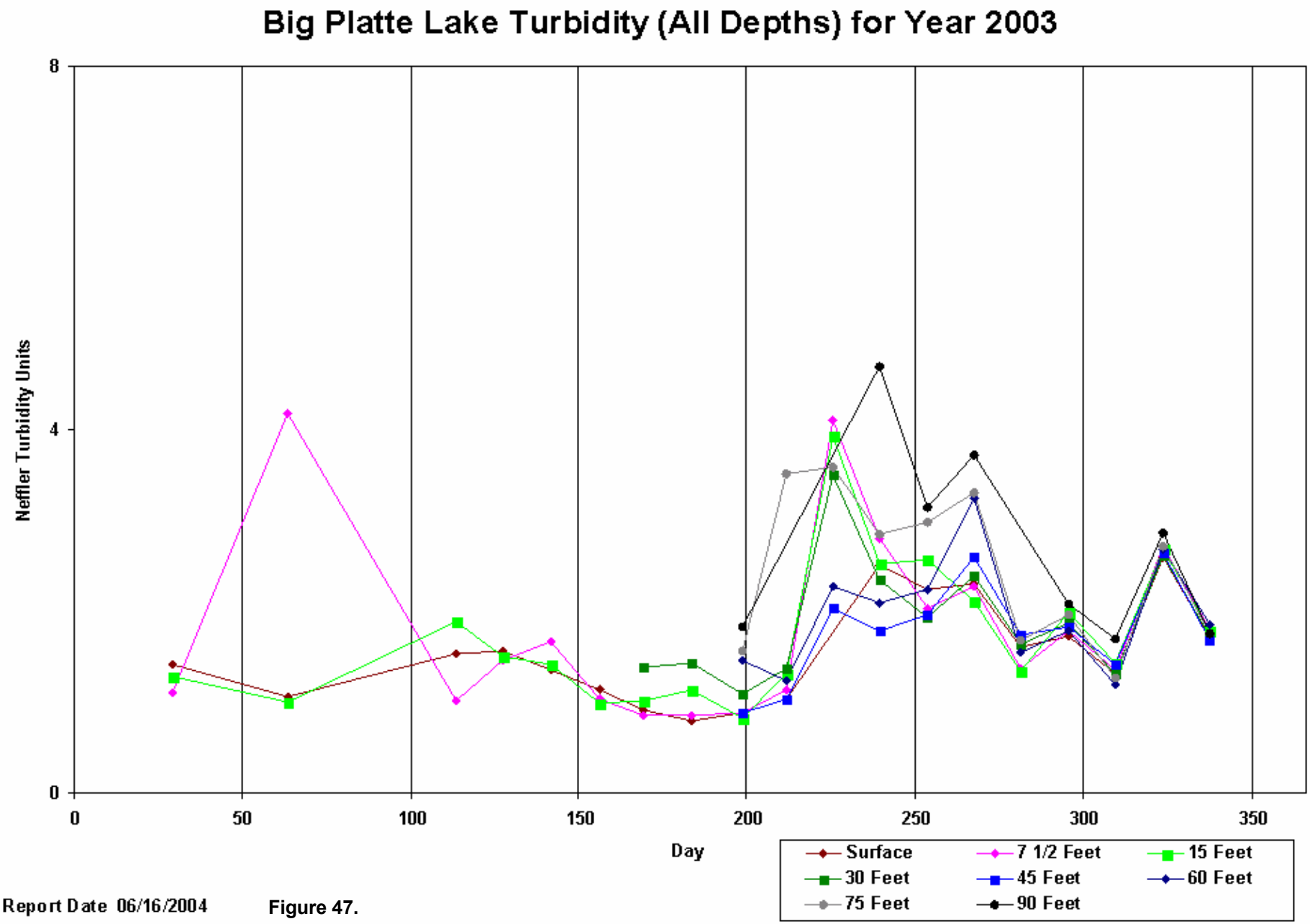
Big Platte Lake - 90 Foot Basin Secchi Depth for 2003

Average Secchi Value: 13.791 (Minimum: 9, Maximum: 23, Hatchery Avg: 13.809, PLIA Avg: 13.775)



Report Date 06/01/2004

Figure 46.

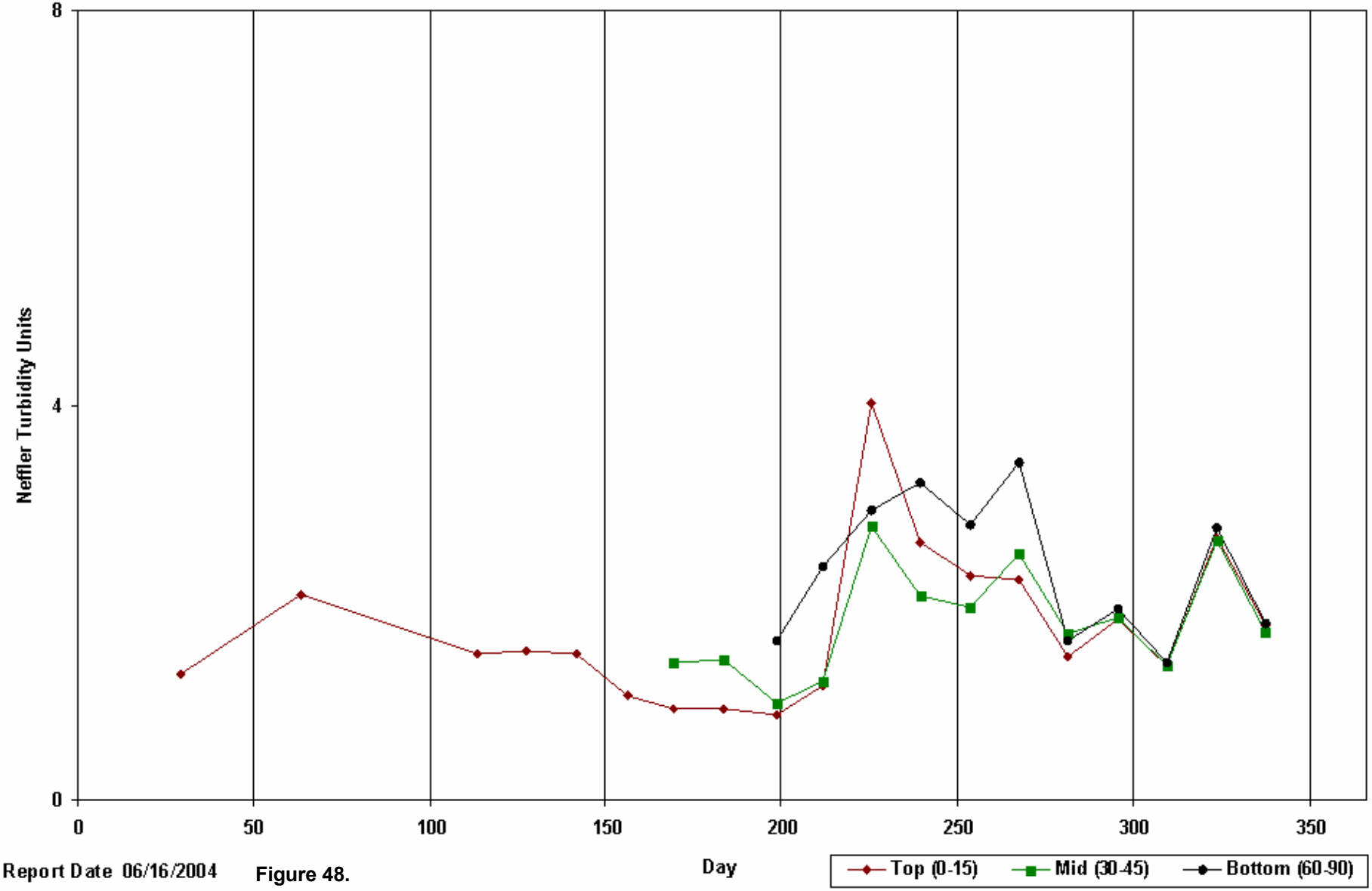


Report Date 06/16/2004

Figure 47.

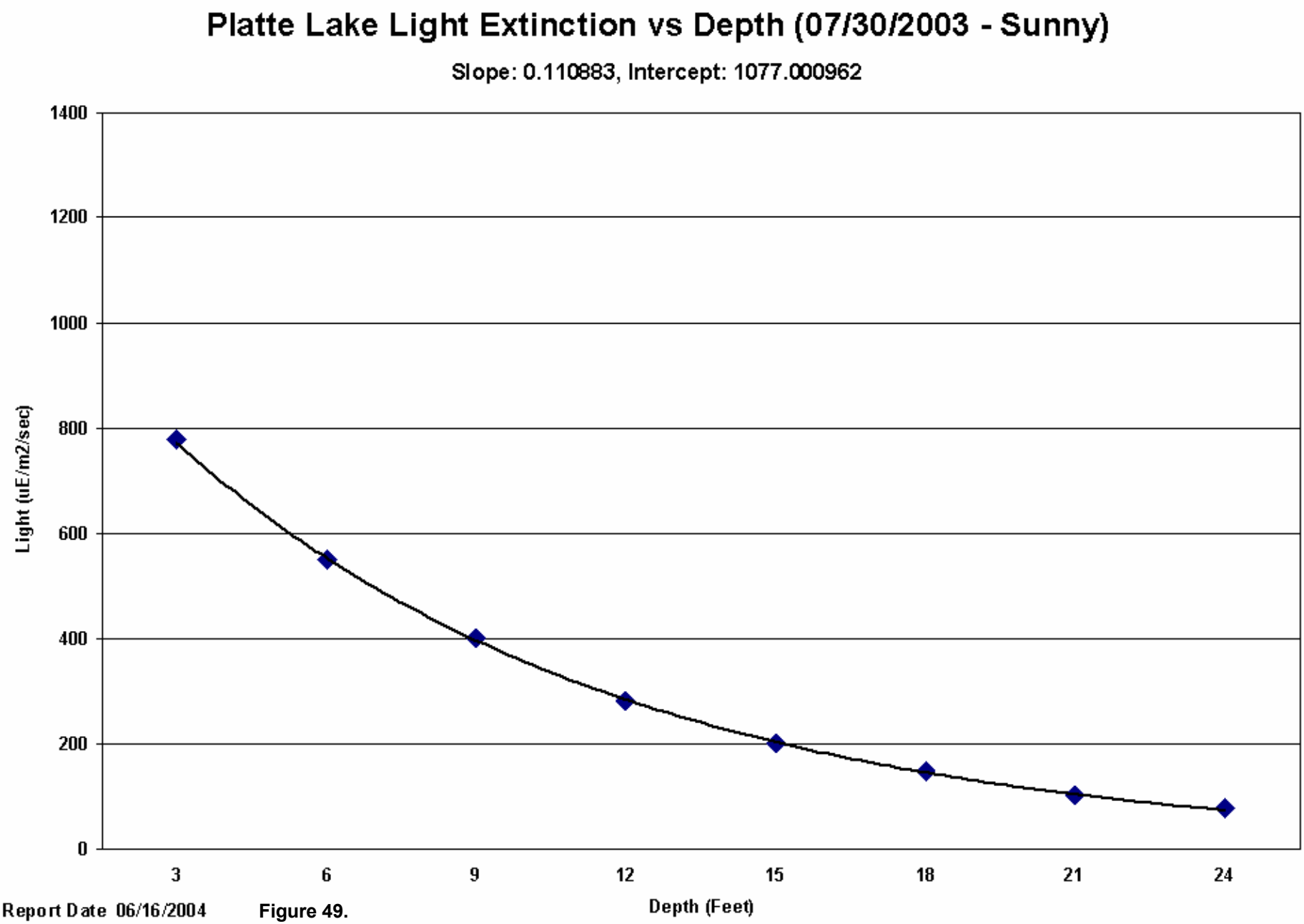
Big Platte Lake Turbidity (Top-Mid-Bottom) for Year 2003

Depths: 0-15 Feet, 30-45 Feet, 60-90 Feet



Report Date 06/16/2004

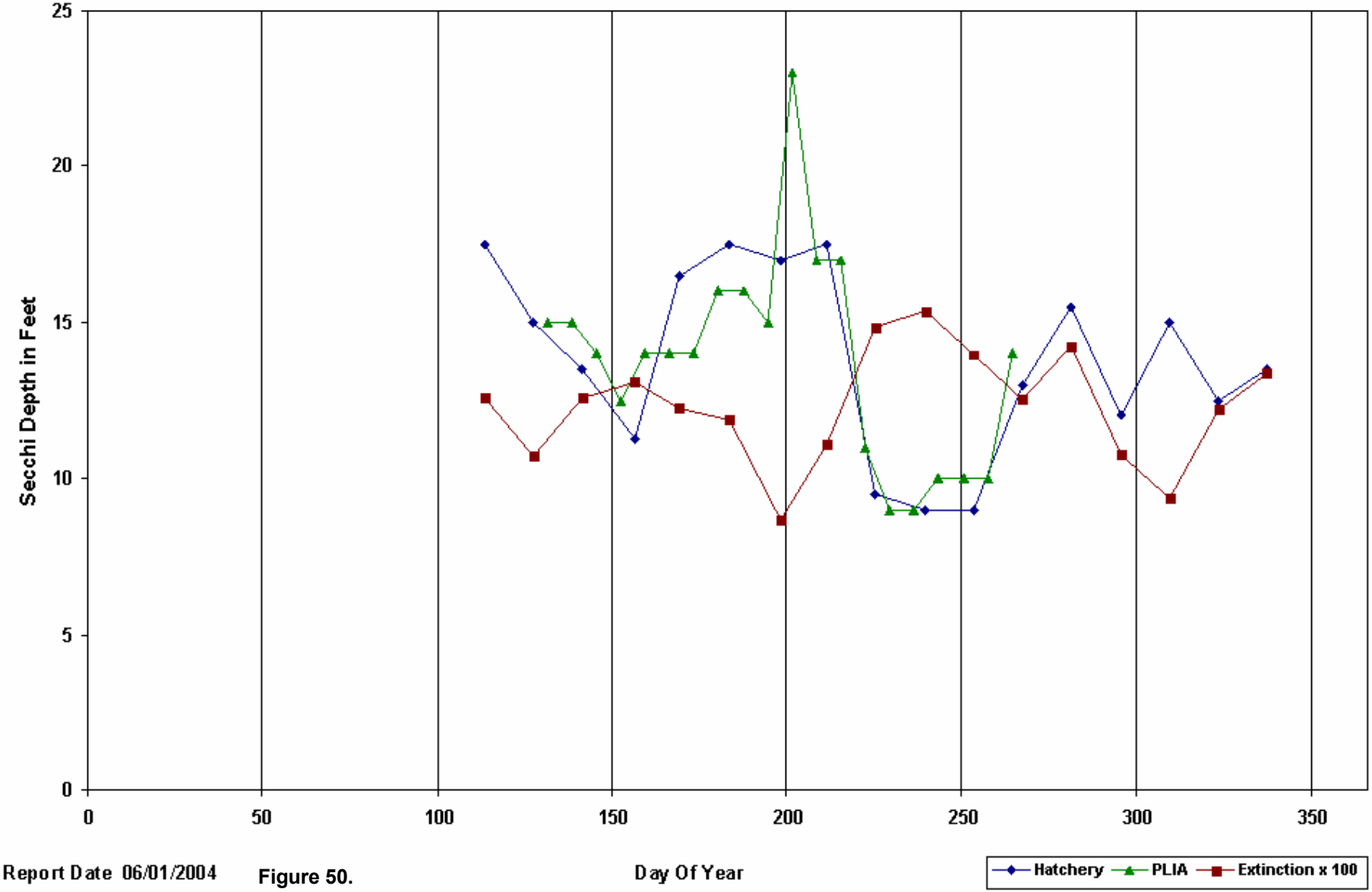
Figure 48.



Report Date 06/16/2004 Figure 49.

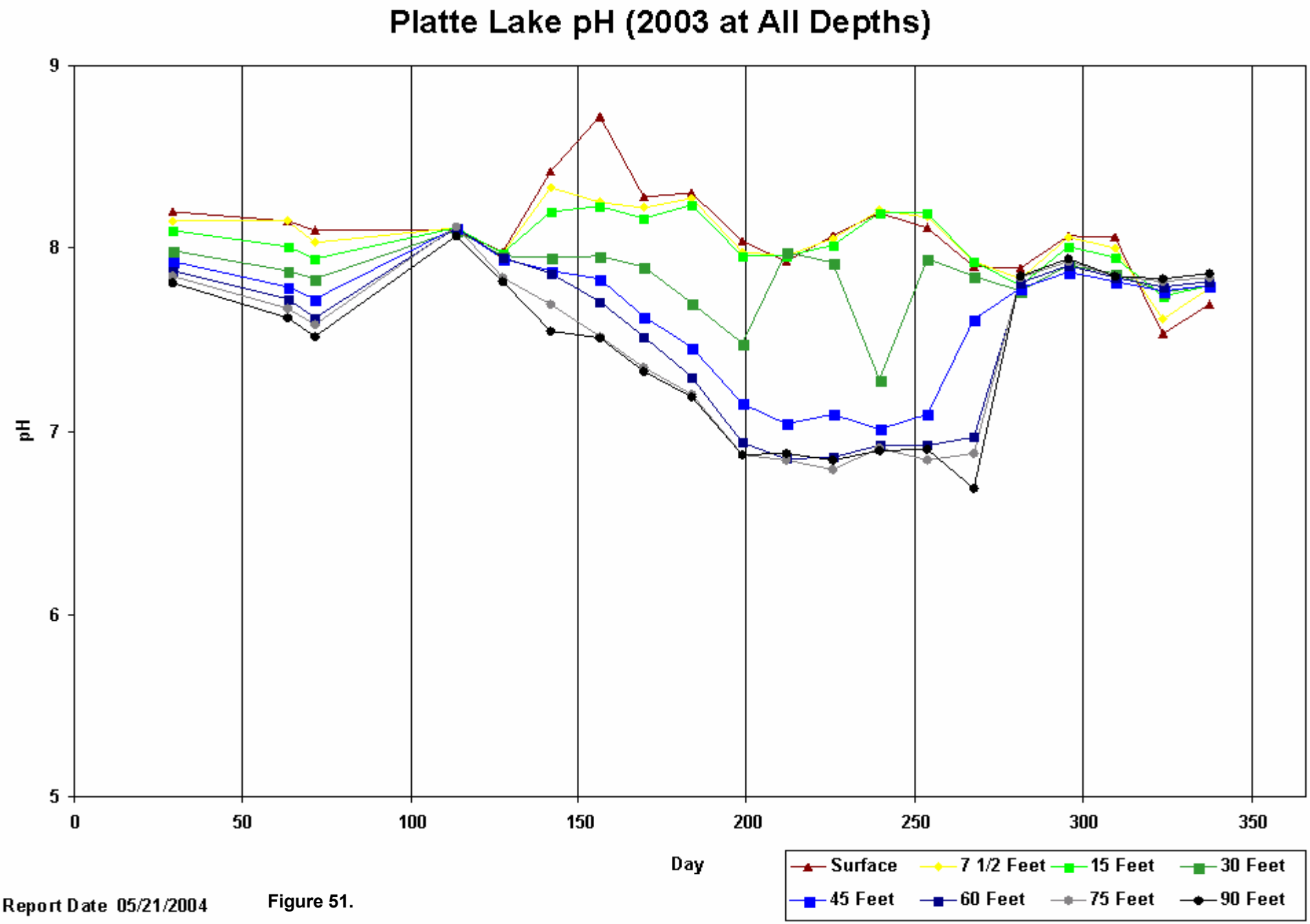
Big Platte Lake - 90 Foot Basin Secchi vs Extinction (x100) for 2003

Average Secchi Value: 13.791 (Minimum: 9, Maximum: 23, Hatchery Avg: 13.809, PLIA Avg: 13.775)



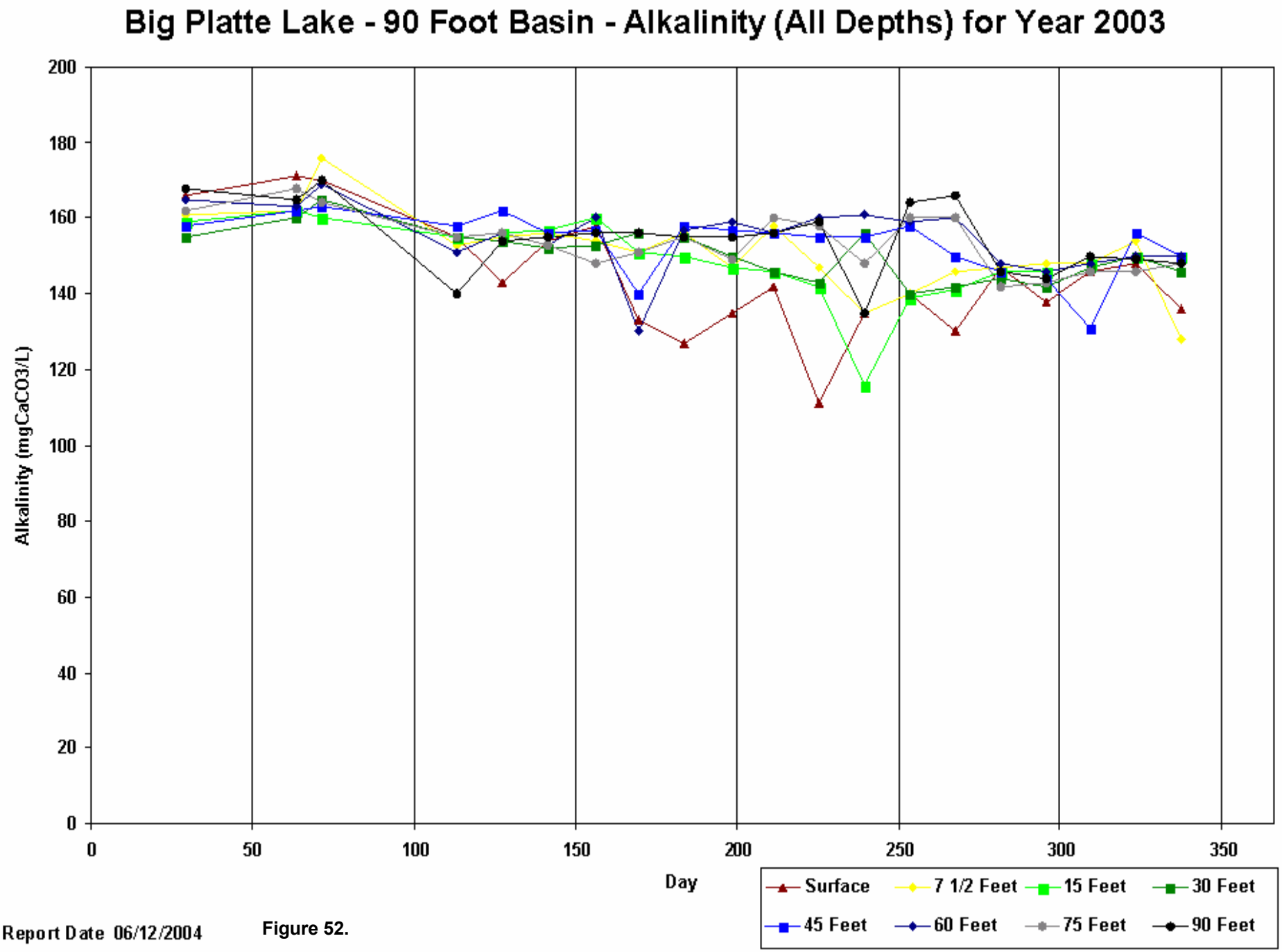
Report Date 06/01/2004

Figure 50.



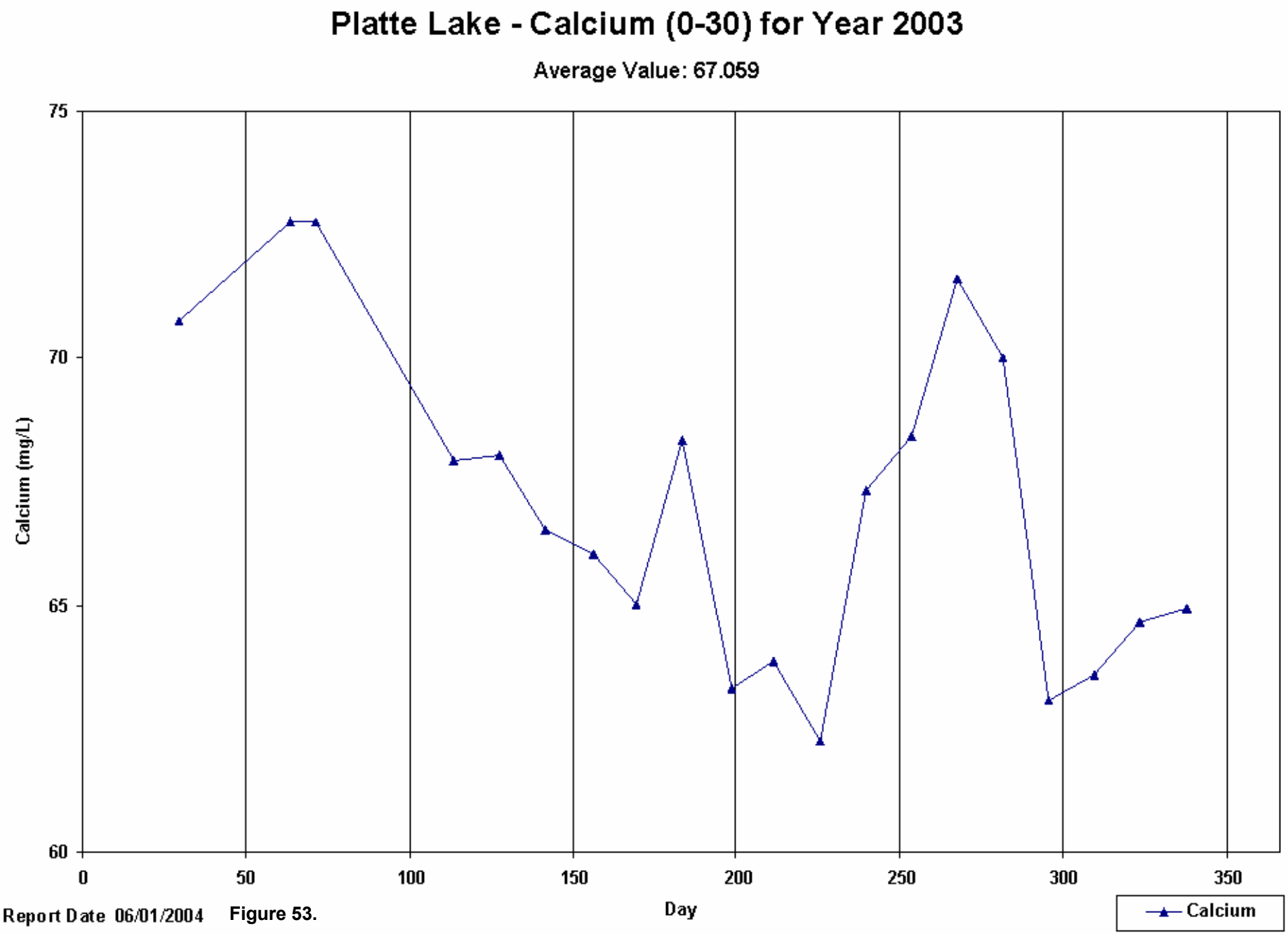
Report Date 05/21/2004

Figure 51.

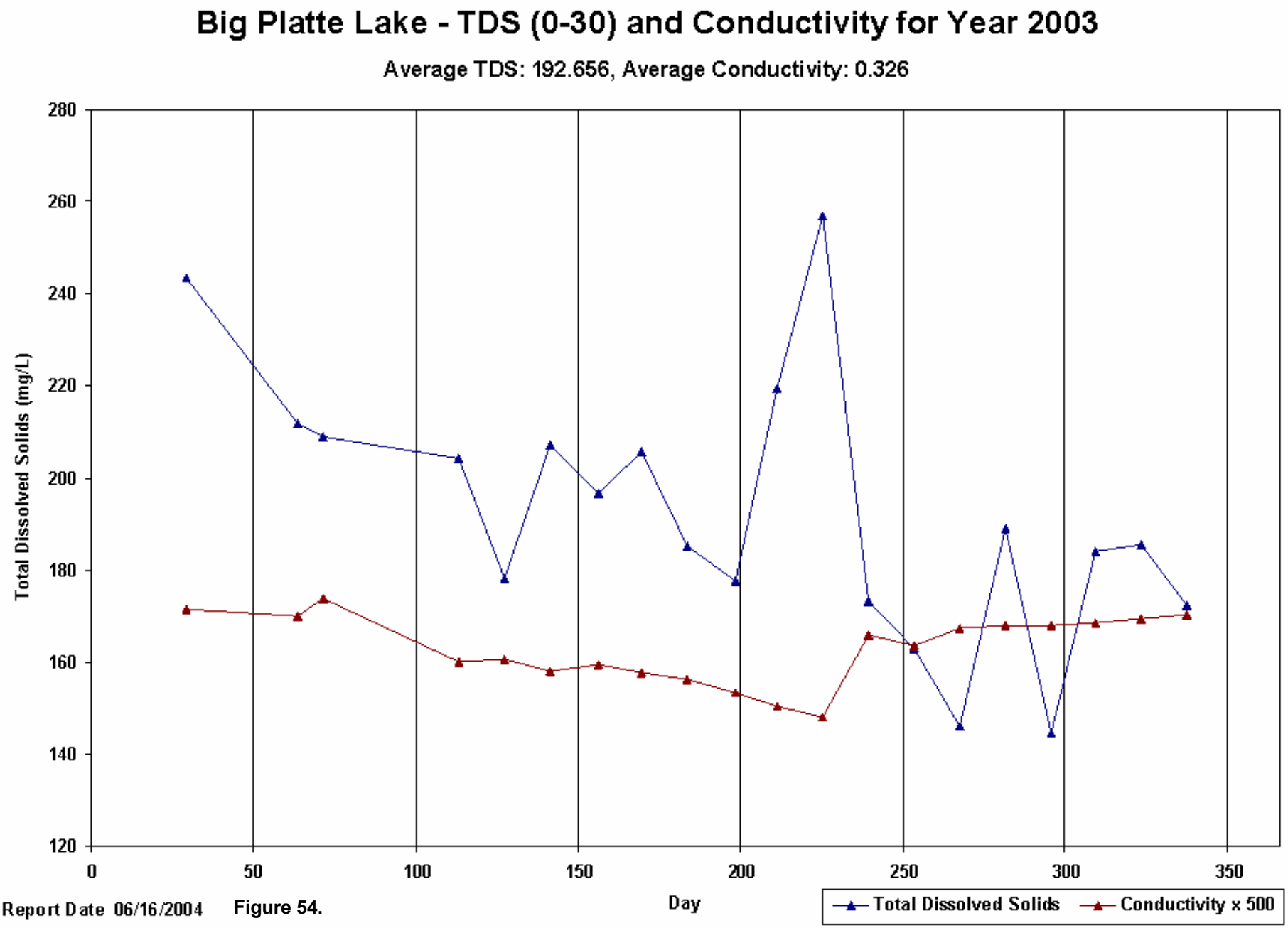


Report Date 06/12/2004

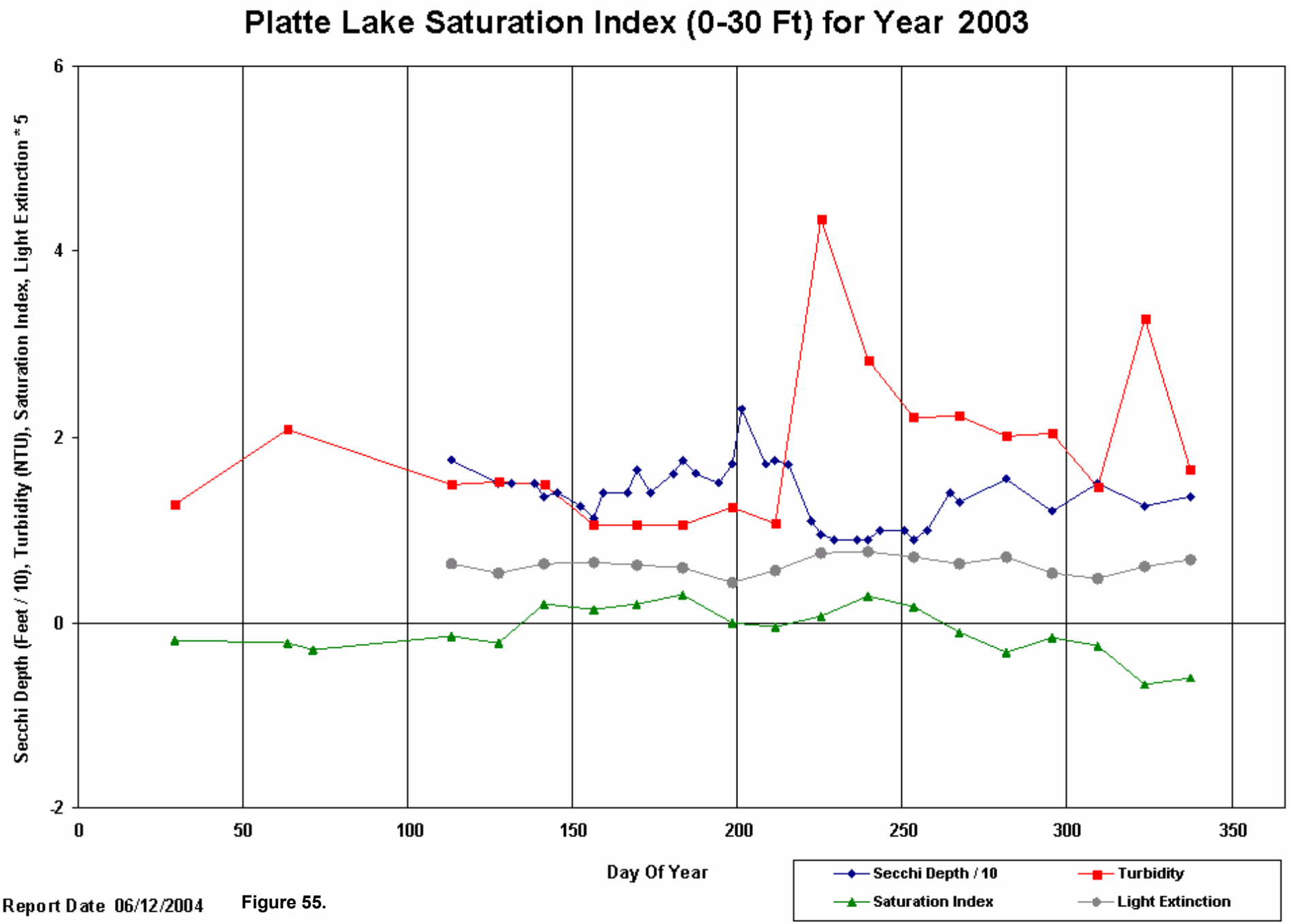
Figure 52.



Report Date 06/01/2004 Figure 53.

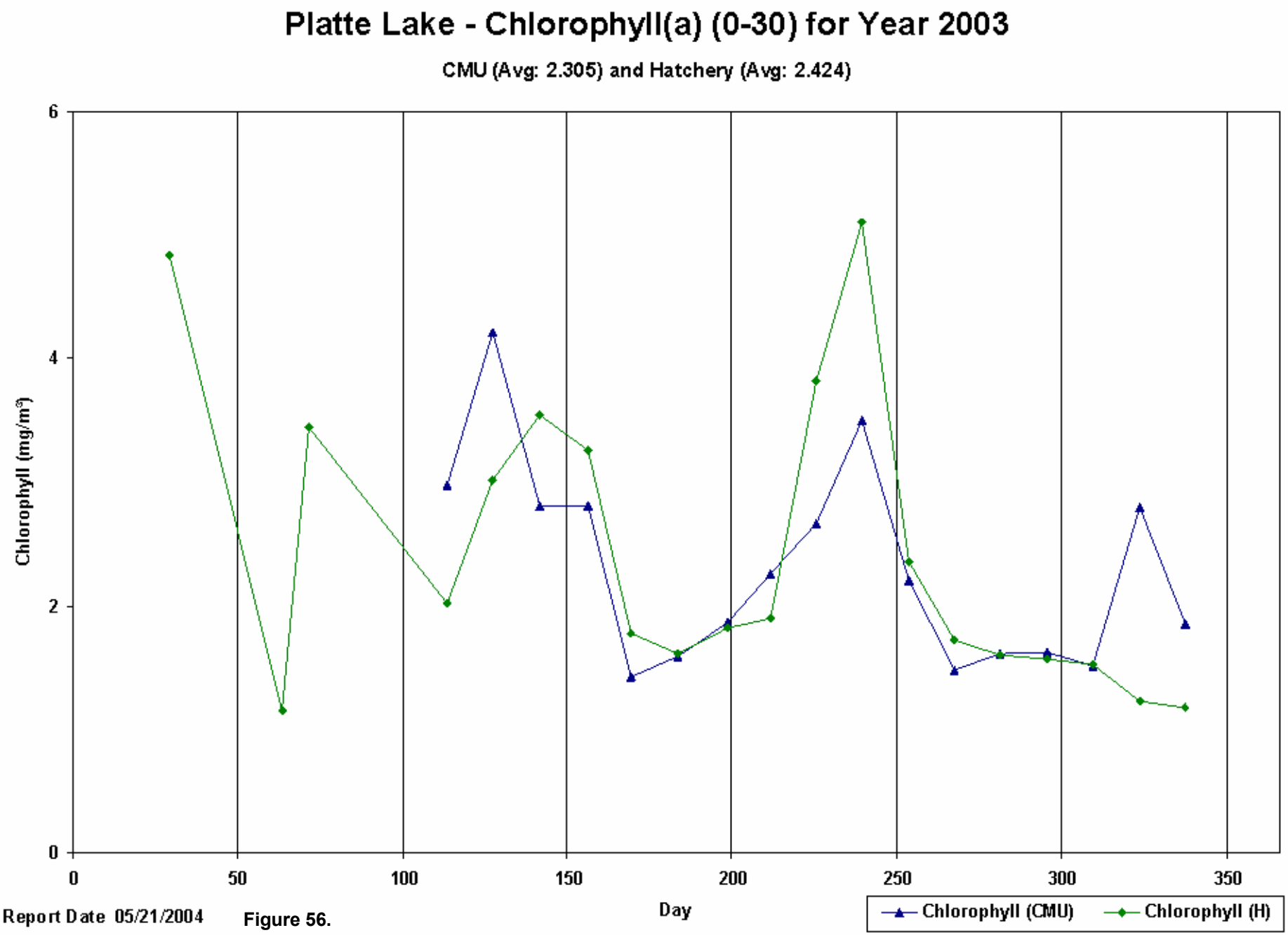


Report Date 06/16/2004 Figure 54.



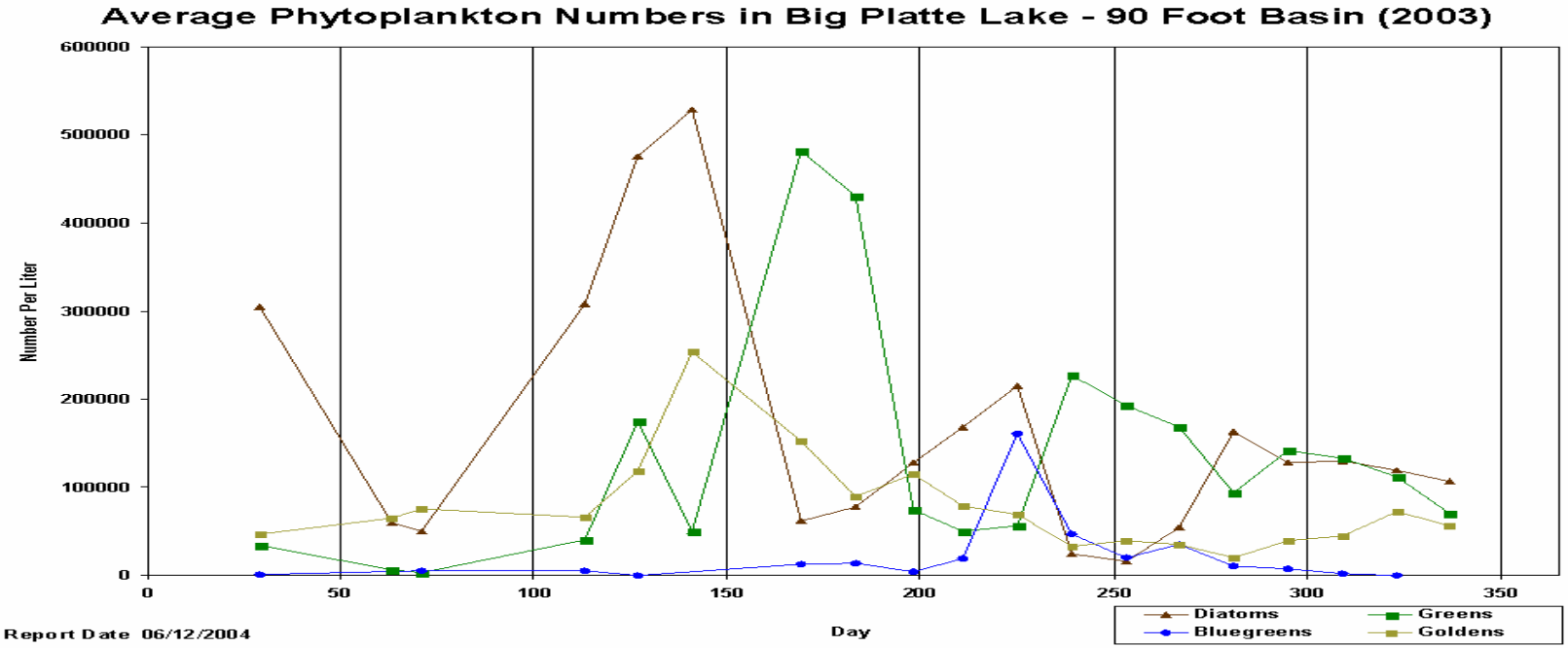
Report Date 06/12/2004

Figure 55.



Report Date 05/21/2004

Figure 56.


Average Phytoplankton Numbers in Big Platte Lake - 90 Foot Basin (2003)
Number Per Liter
600000
500000
400000
300000
200000
100000
0
0
50
100
150
200
250
300
350
Day
Report Date 06/12/2004
Diatoms
Greens
Bluegreens
Goldens

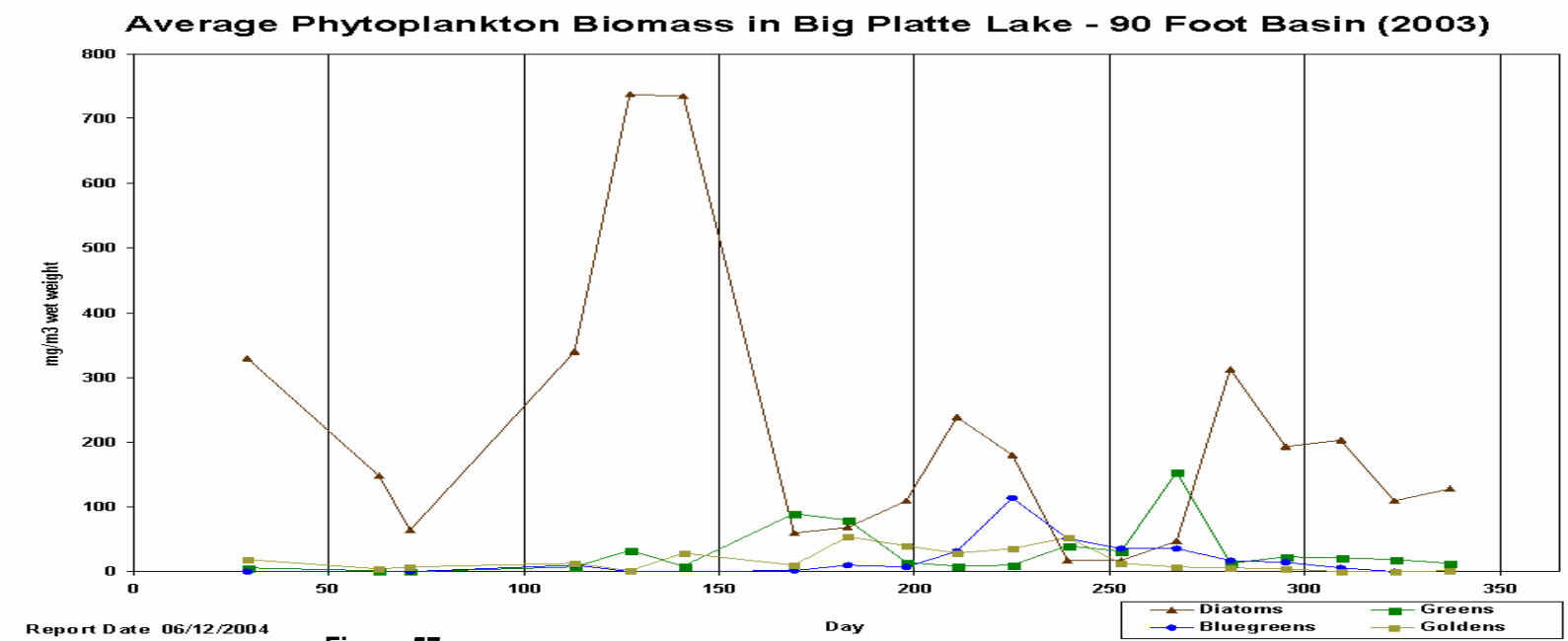
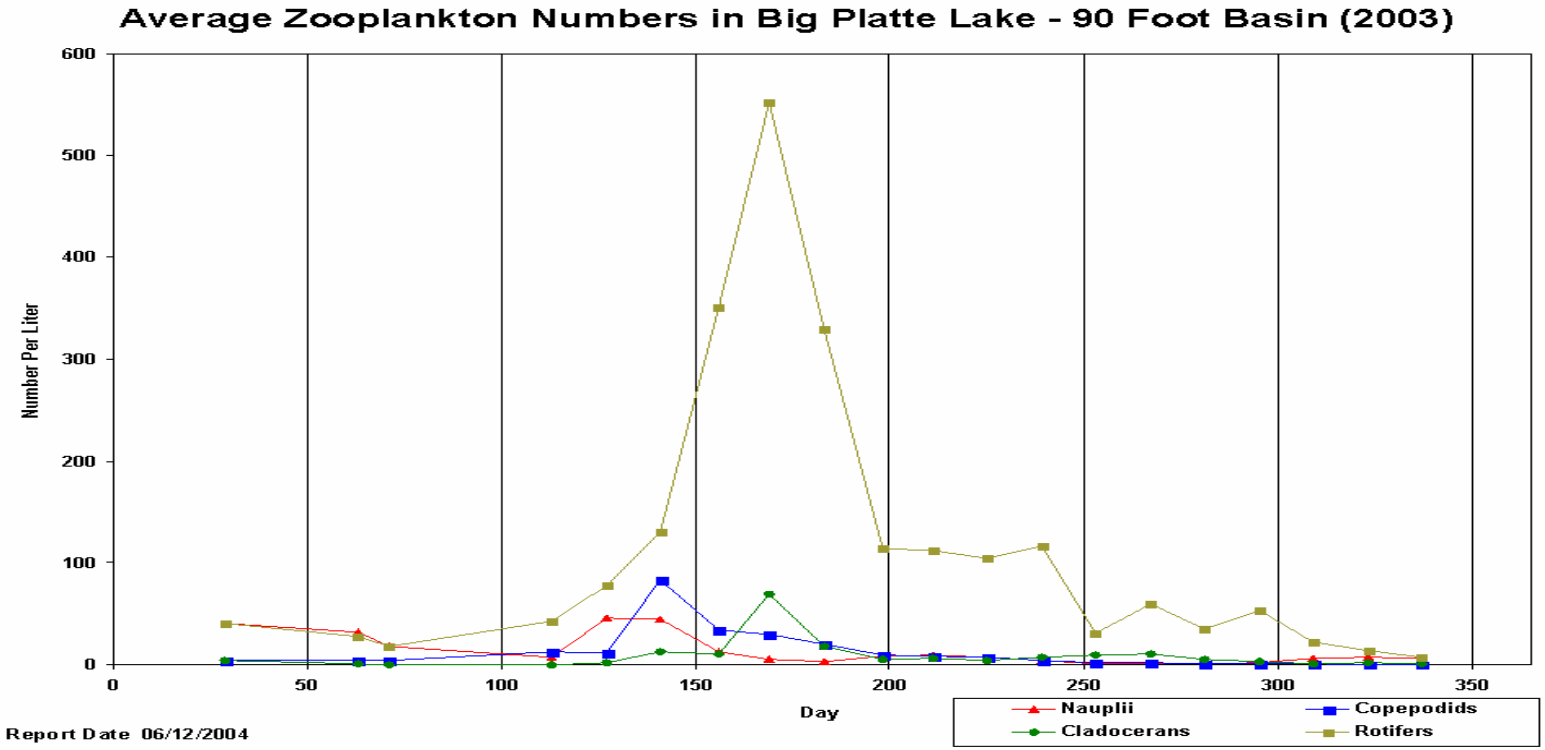

Average Phytoplankton Biomass in Big Platte Lake - 90 Foot Basin (2003)
mg/m3 wet weight
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
Day
Report Date 06/12/2004
Diatoms
Greens
Bluegreens
Goldens

Figure 57.


Average Zooplankton Numbers in Big Platte Lake - 90 Foot Basin (2003)
Number Per Liter
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
Day
Nauplii
Copepodids
Cladocerans
Rotifers
Report Date 06/12/2004

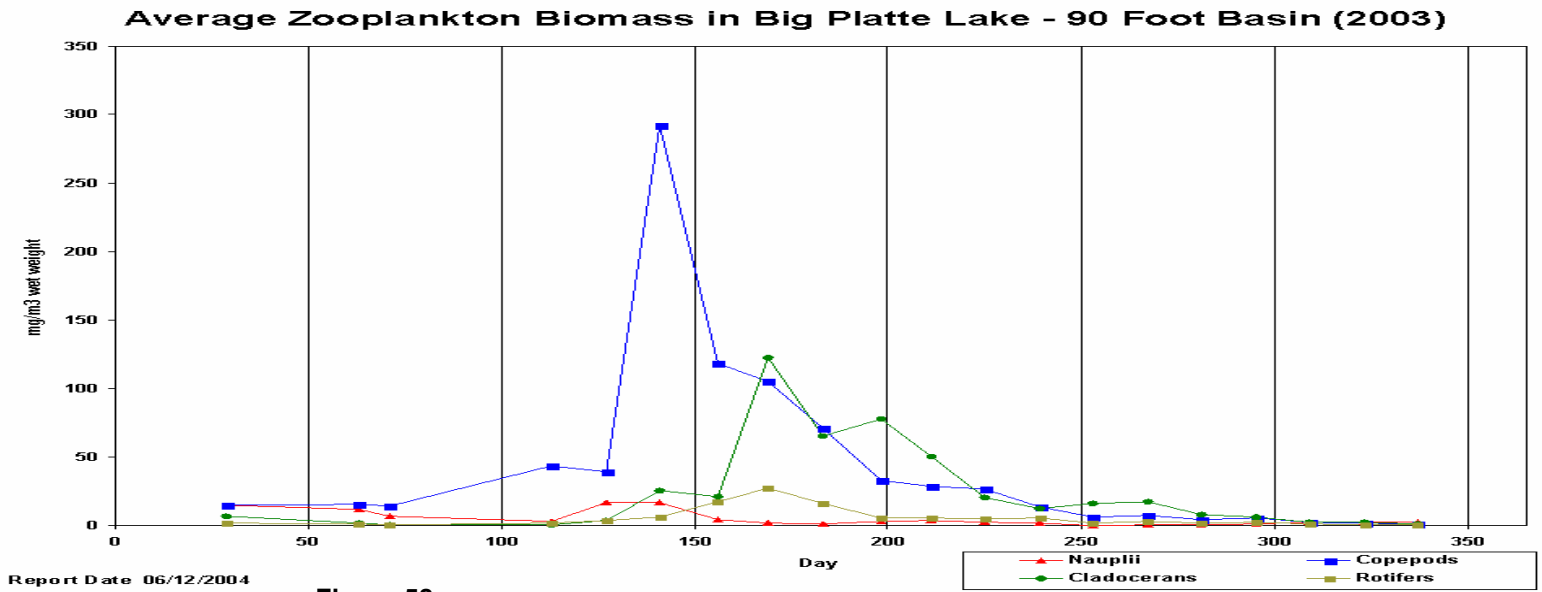

Average Zooplankton Biomass in Big Platte Lake - 90 Foot Basin (2003)
mg/m3 wet weight
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
Day
Nauplii
Copepods
Cladocerans
Rotifers
Report Date 06/12/2004

Figure 58.

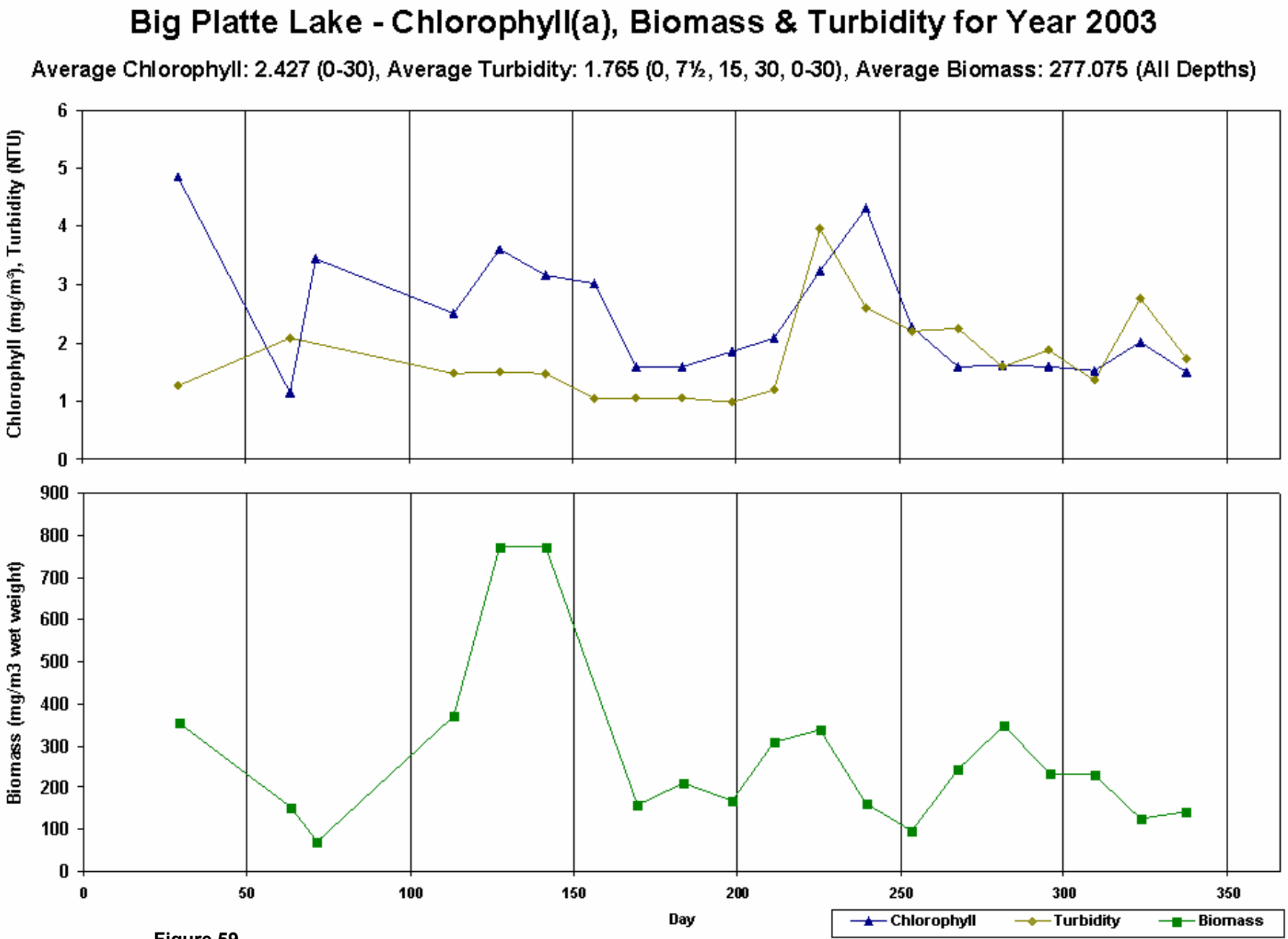

Big Platte Lake - Chlorophyll(a), Biomass & Turbidity for Year 2003
Average Chlorophyll: 2.427 (0-30), Average Turbidity: 1.765 (0, 7½, 15, 30, 0-30), Average Biomass: 277.075 (All Depths)
Chlorophyll (mg/m³), Turbidity (NTU)
Biomass (mg/m3 wet weight)
Day
Chlorophyll
Turbidity
Biomass

Figure 59.

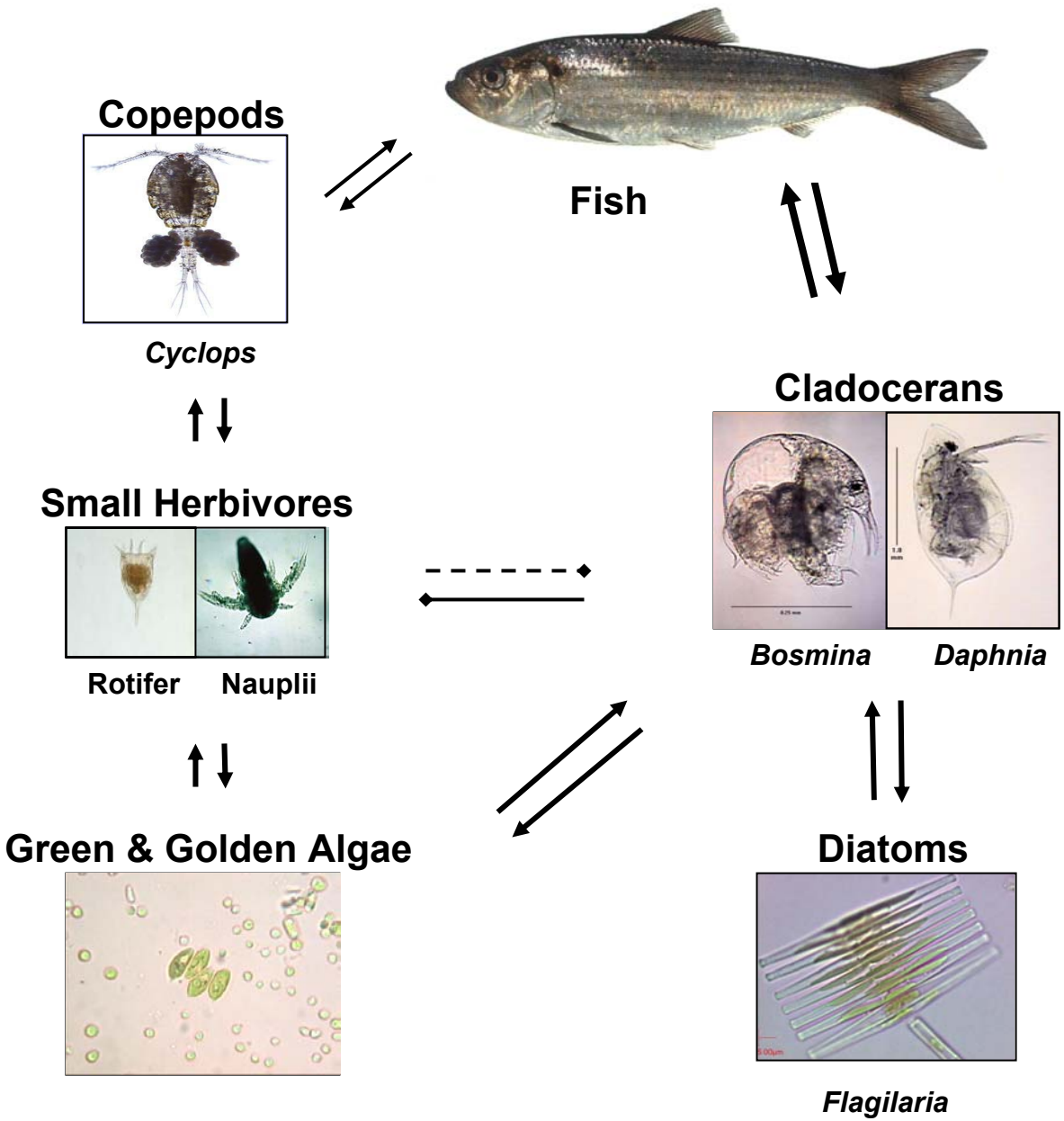
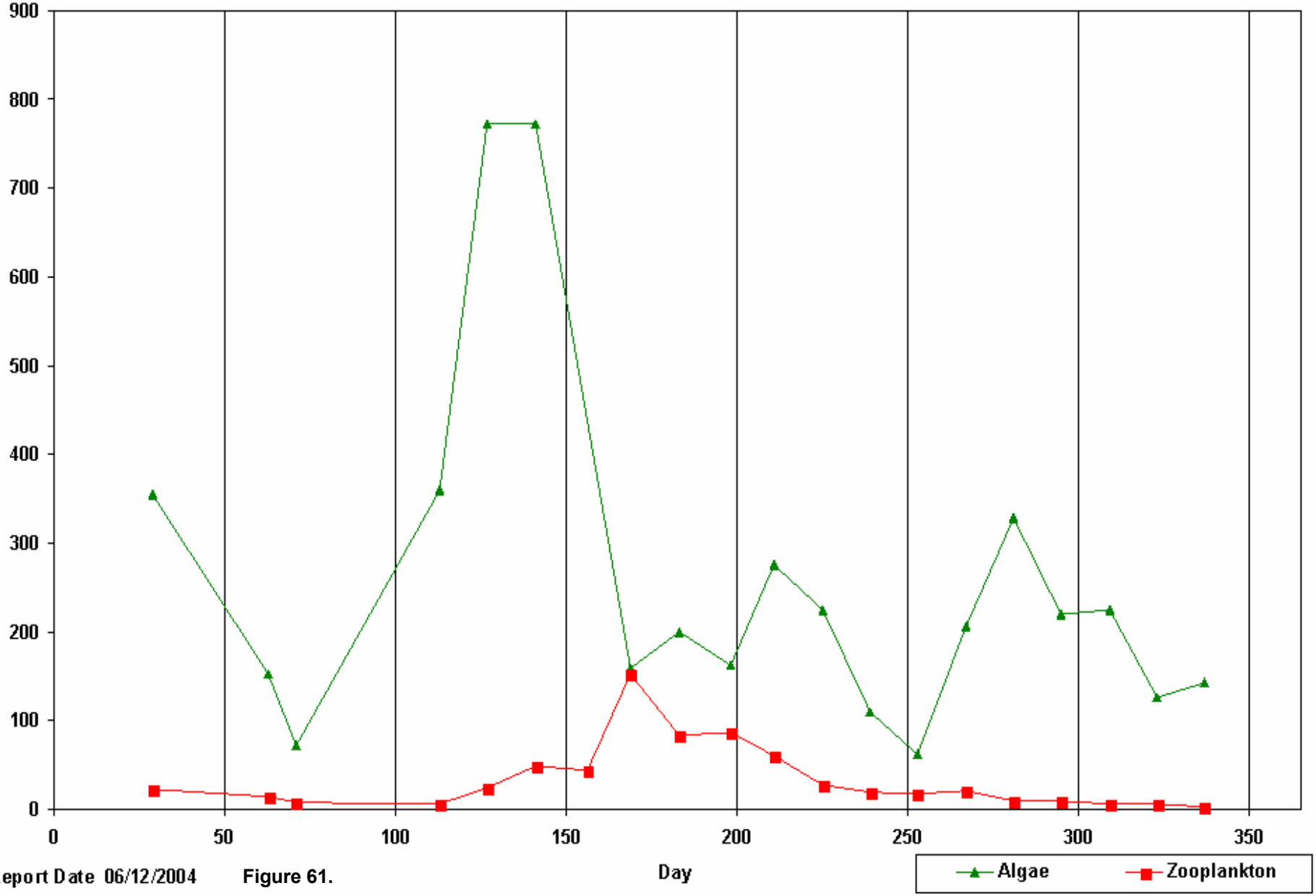

Copepods
Cyclops
Fish
Cladocerans
Bosmina
Daphnia
Small Herbivores
Rotifer
Nauplii
Green & Golden Algae
Diatoms
Flagilaria

Figure 60.

Algae vs Zooplankton in Big Platte Lake - 90 Foot Basin (2003)

Diatoms, Greens & Goldens VS Nauplii, Cladocerans & Rotifers



Report Date 06/12/2004 Figure 61.

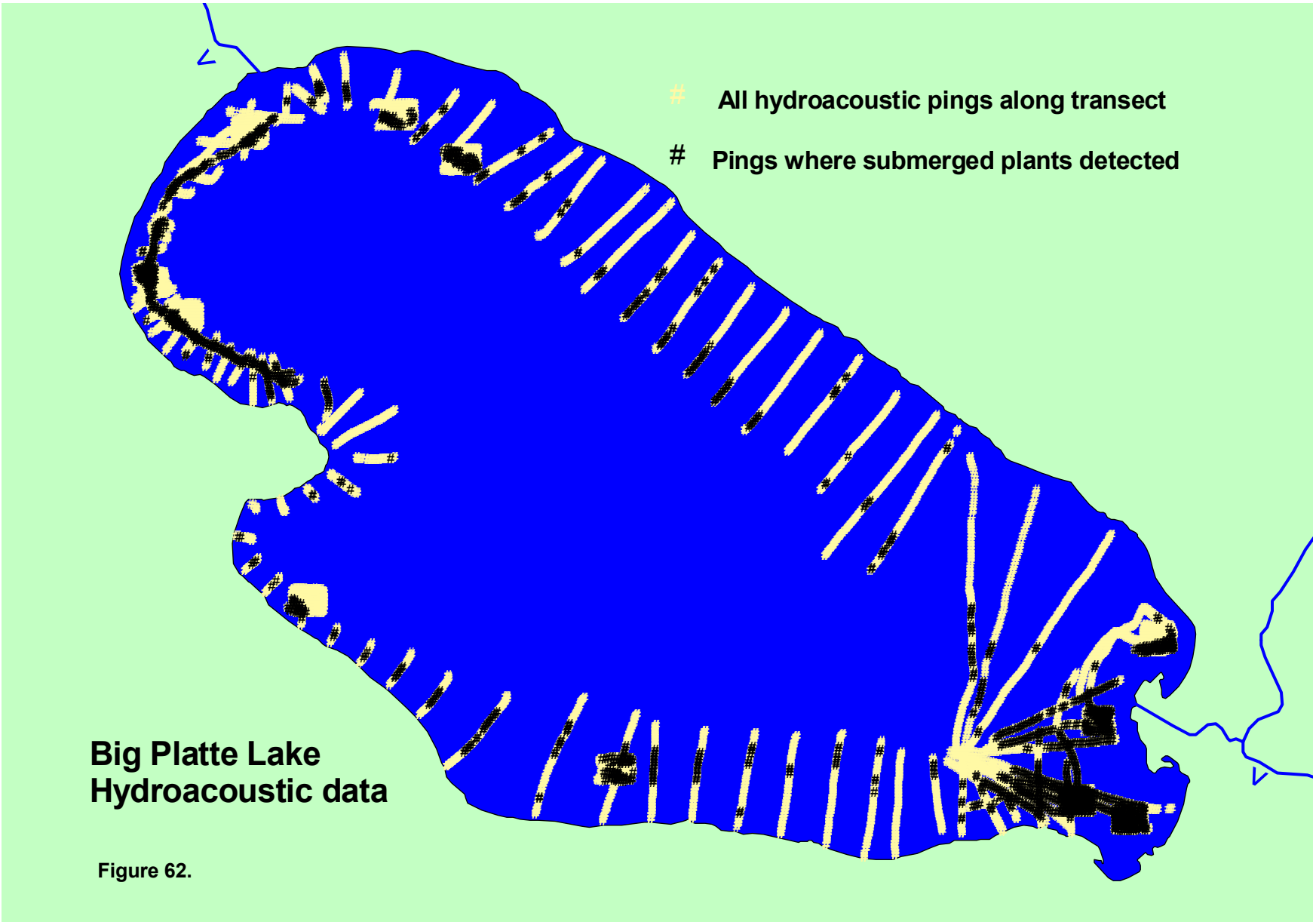

All hydroacoustic pings along transect
Pings where submerged plants detected
Big Platte Lake
Hydroacoustic data

Figure 62.

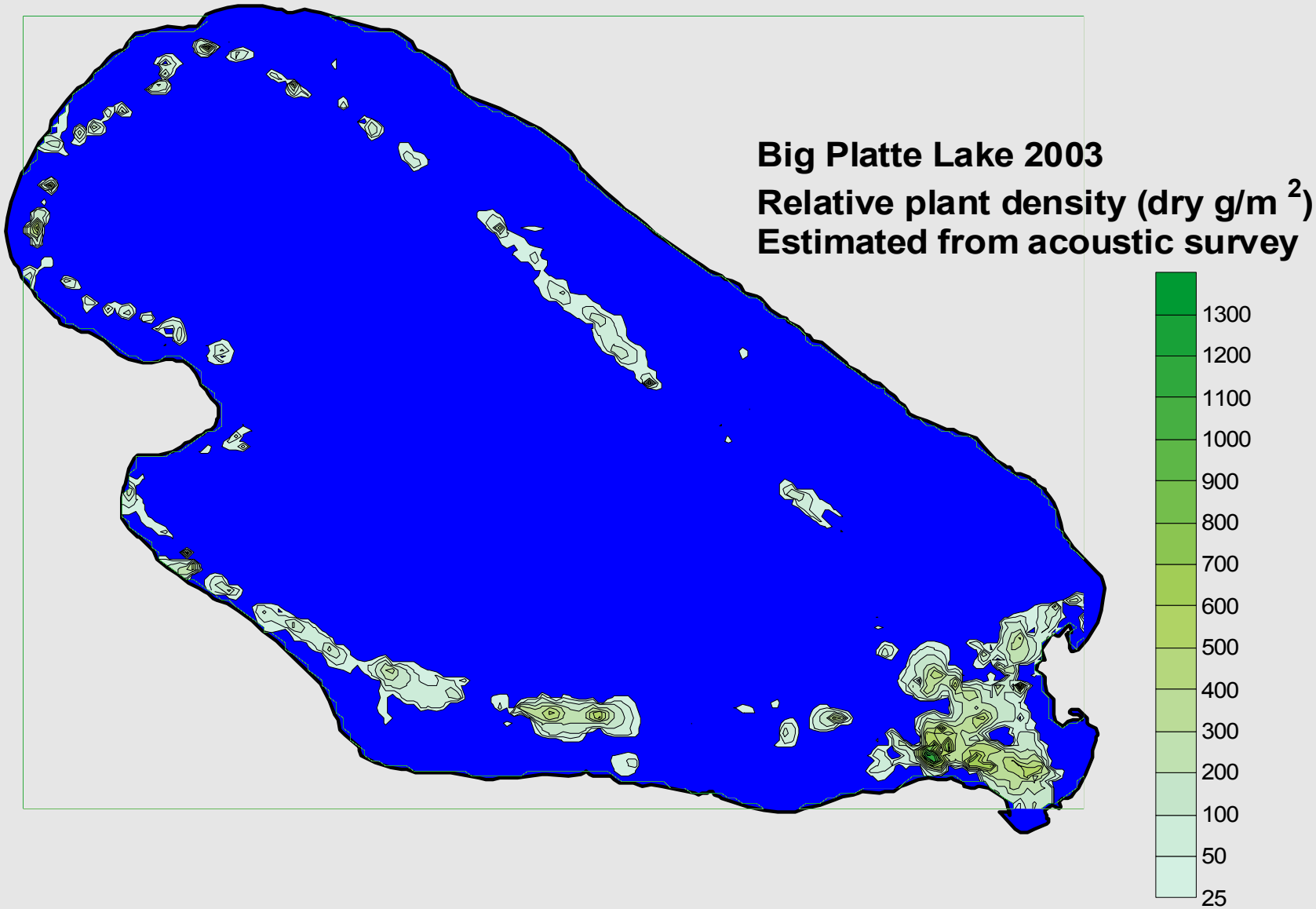

Big Platte Lake 2003
Relative plant density (dry g/m 2)
Estimated from acoustic survey
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
50
25

Figure 63.

Comparison of Nichols, Clifford, and Big Platte lakes						
	Platte Lake	Percent of total vol.	Clifford Lake	Percent of total vol.	Nichols Lake	Percent of total vol.
Surface acres	2,481		197		158	
Total volume (m^3)	79,993,664		3,638,849		14,619,562	
Volume of littoral (4.7m extent)	7,237,355	9.05	821,922	22.59	545,633	3.73
Volume of littoral (8m extent)	13,620,727	17.03	2,182,712	59.98	1,194,824	8.17
Surface acres in 8m littoral zone	1,281		159		100	
Within 8m littoral zone						
Relative acoustic density dry wt. g/m^2	237.35		335.33		552.08	
Plant biomass (relative) lbs/acre	26.60		37.59		61.88	
Mean bottom coverage by plants (%)	5.91		50.18		47.54	
Mean bio-volume (%)	1.92		7.07		9.57	
Est. biomass (lbs) dry wt. of plants	**2,014**		3,003		2,944	

Station	Dry weight	
	Measured	Acoustic
T3grid	38.02	6.44
T5grid	108.87	118.76
T6grid	150.15	300.65

Figure 64.

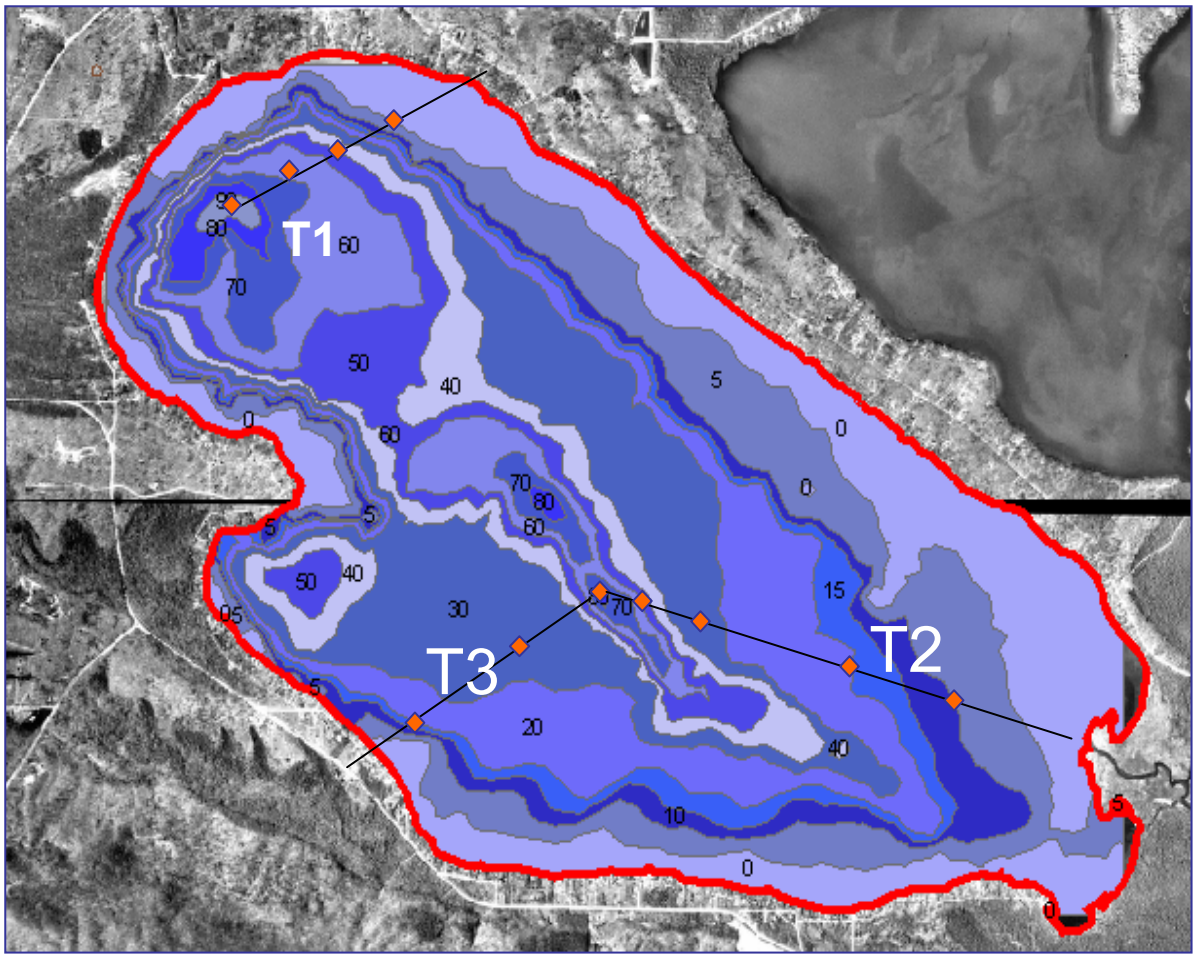
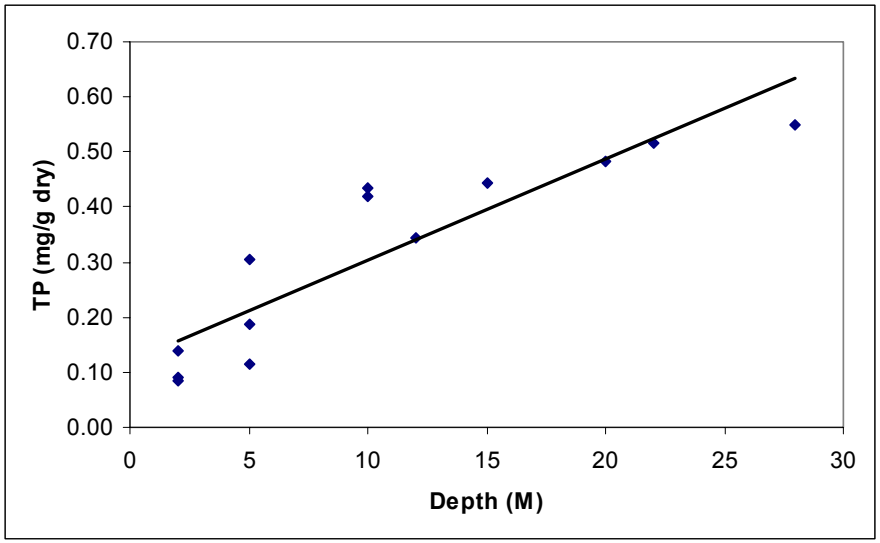


Figure 65. Sediment Sampling Sites.



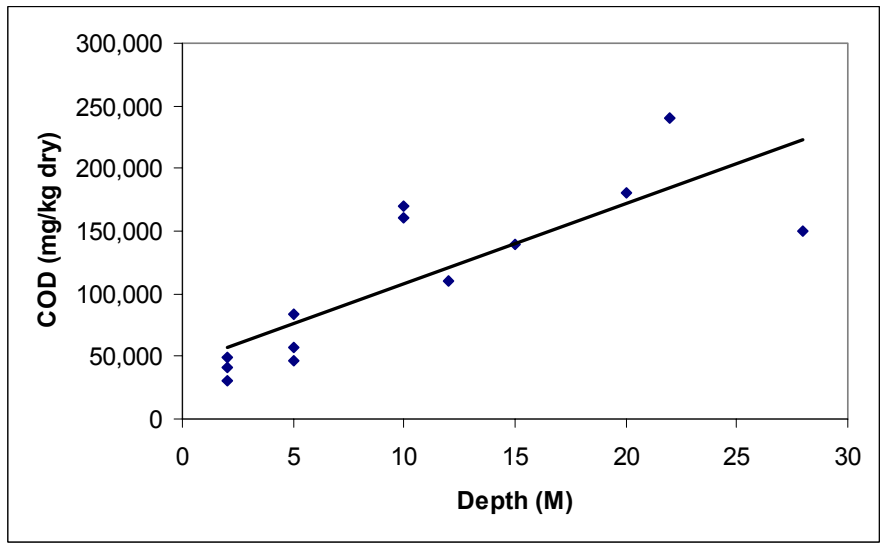


Figure 66. Sediment Characteristics vs. Lake Depth.

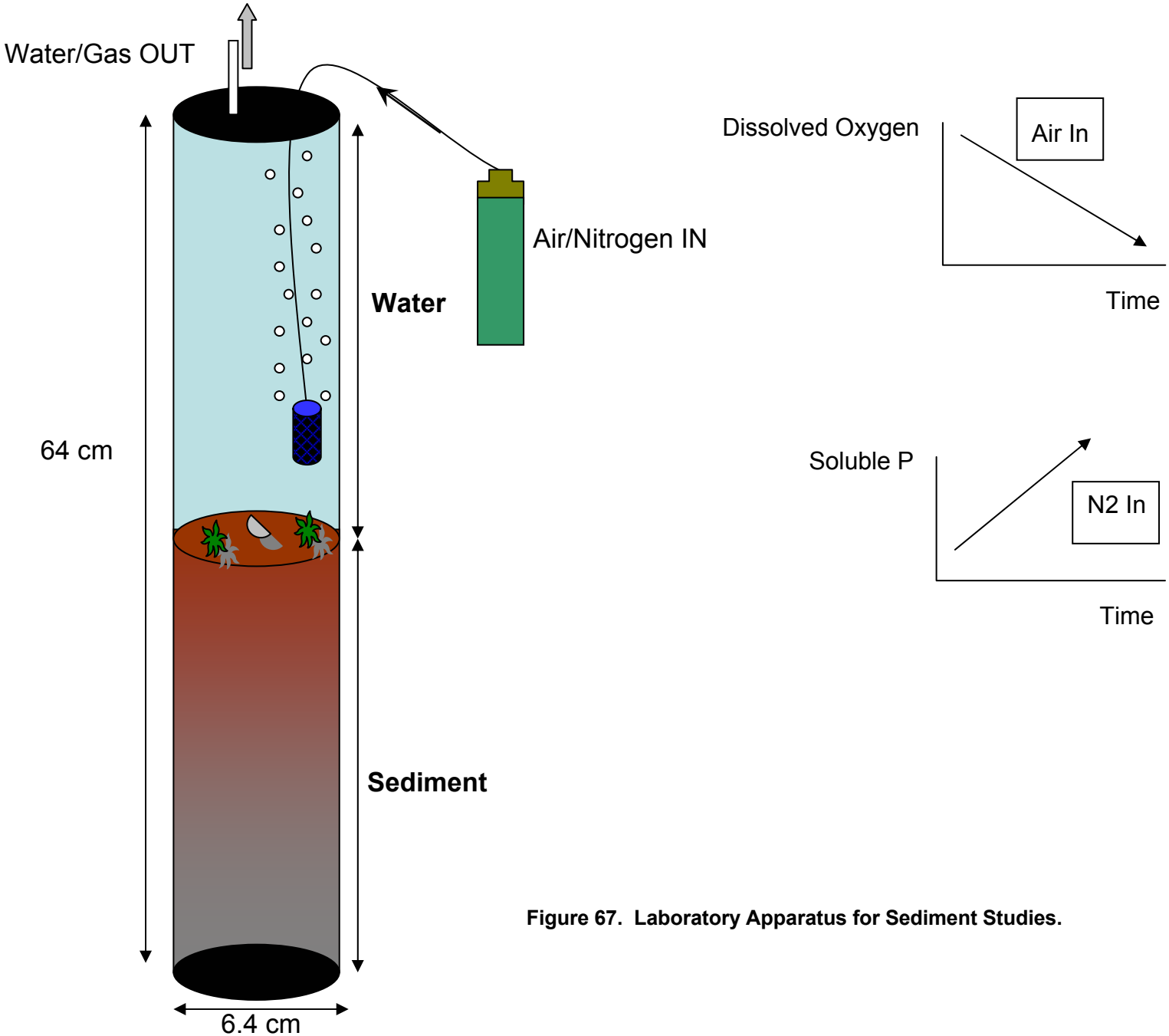
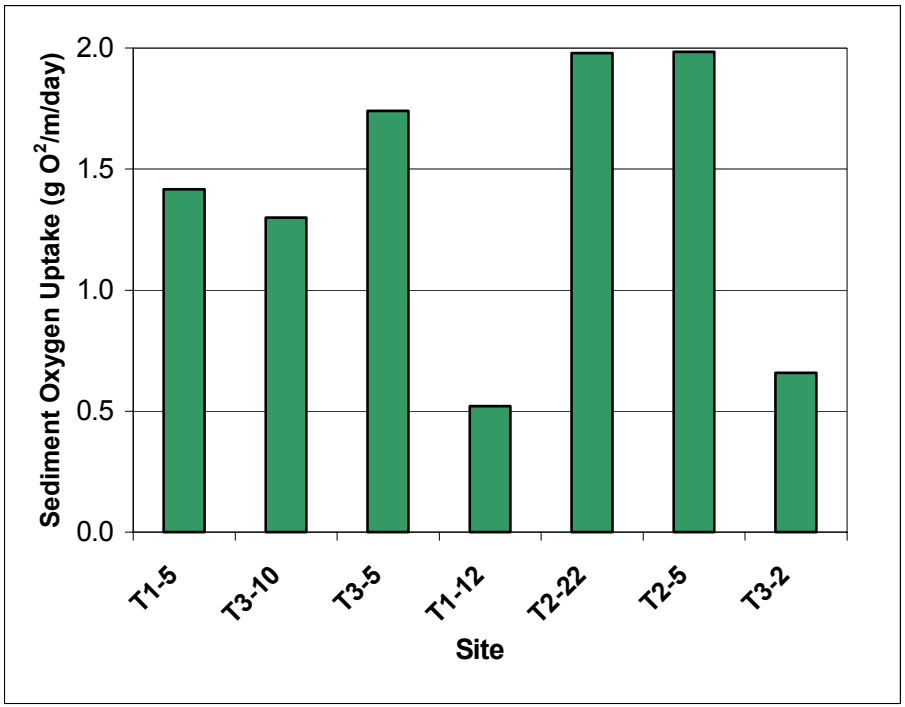


Figure 67. Laboratory Apparatus for Sediment Studies.



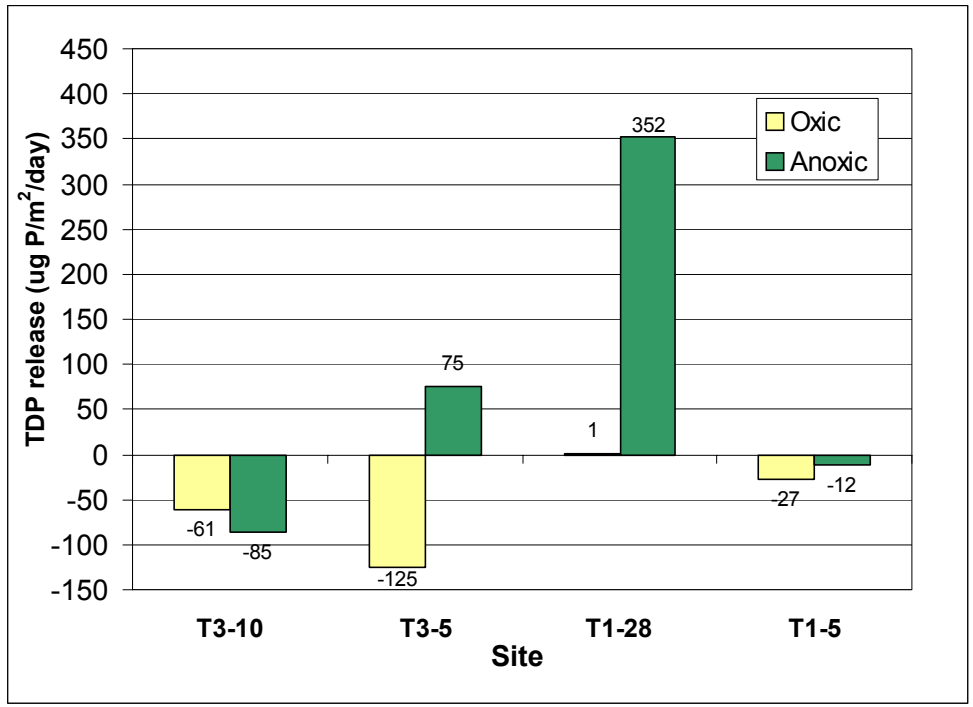


Figure 68. Preliminary Sediment Oxygen Demand and Phosphorus Release Rates.

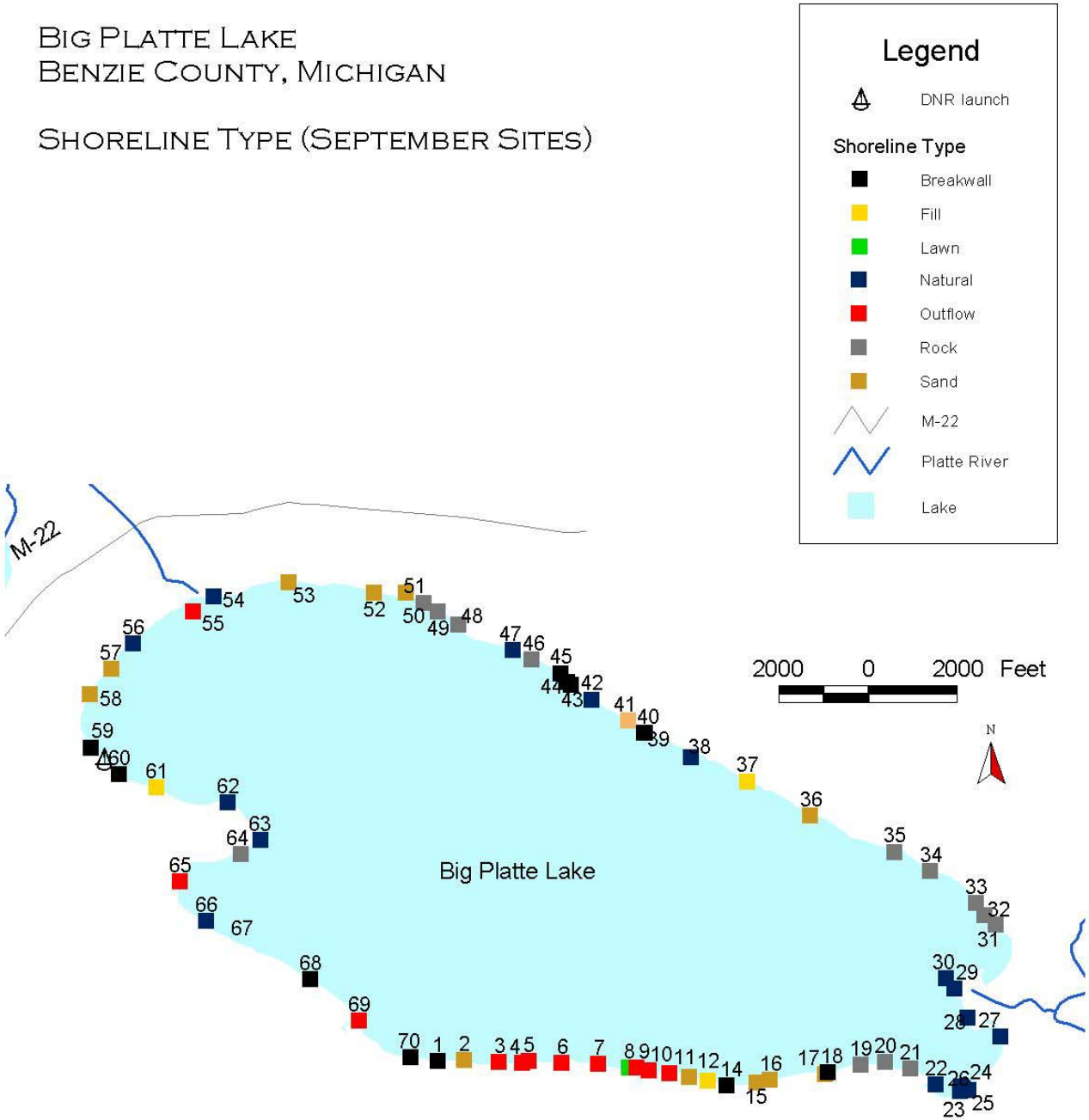

Big Platte Lake
Benzie County, Michigan
Shoreline Type (September Sites)
Legend
DNR launch
Shoreline Type
Breakwall
Fill
Lawn
Natural
Outflow
Rock
Sand
M-22
Platte River
Lake
M-22
Big Platte Lake
2000 0 2000 Feet
N

Figure 69.

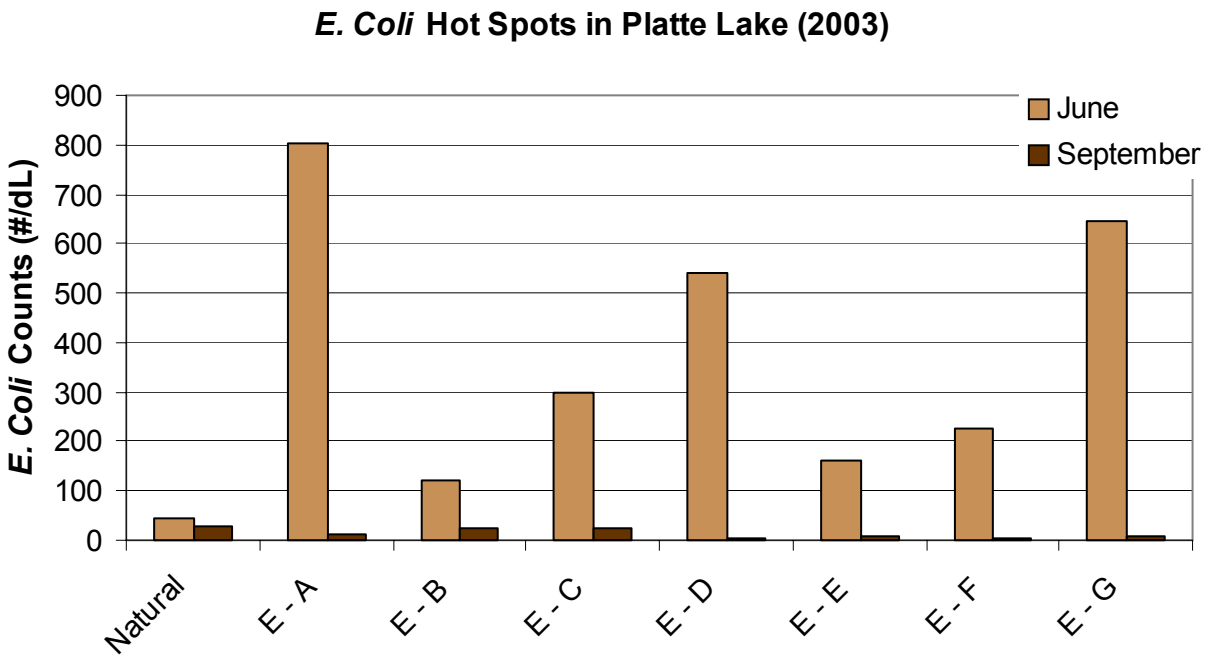

E. Coli Hot Spots in Platte Lake (2003)
E. Coli Counts (#/dL)
900
800
700
600
500
400
300
200
100
0
June
September
Natural
E - A
E - B
E - C
E - D
E - E
E - F
E - G

Figure 70.

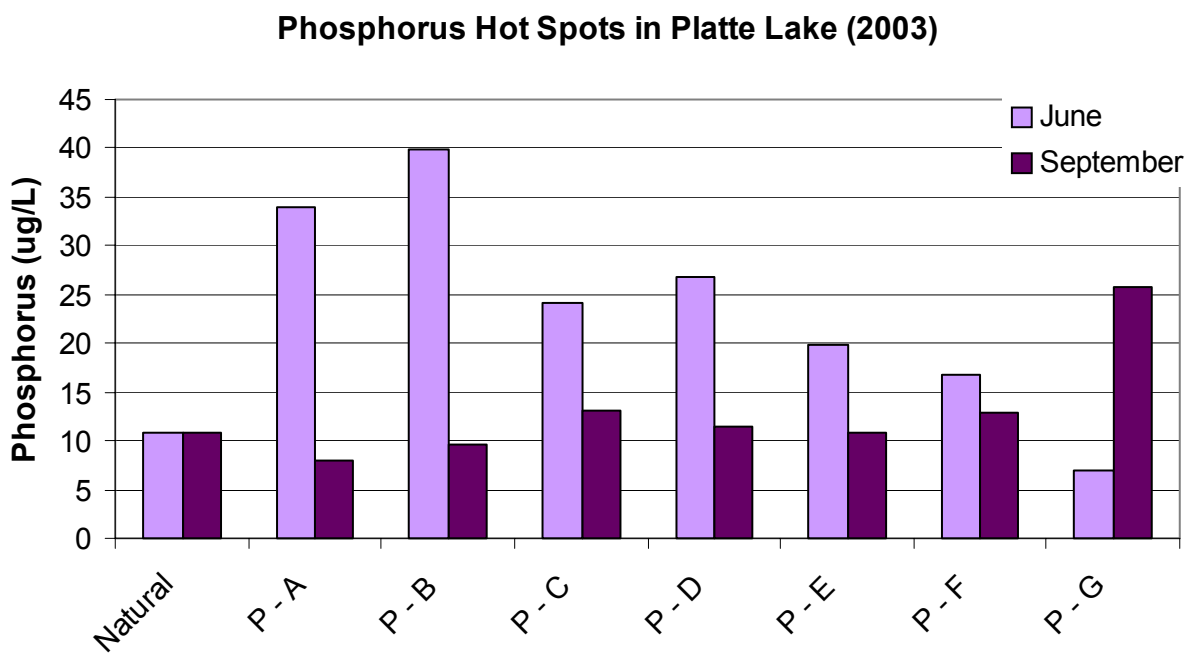

Phosphorus Hot Spots in Platte Lake (2003)
Phosphorus (ug/L)
45
40
35
30
25
20
15
10
5
0
June
September
Natural
P - A
P - B
P - C
P - D
P - E
P - F
P - G

Figure 71.

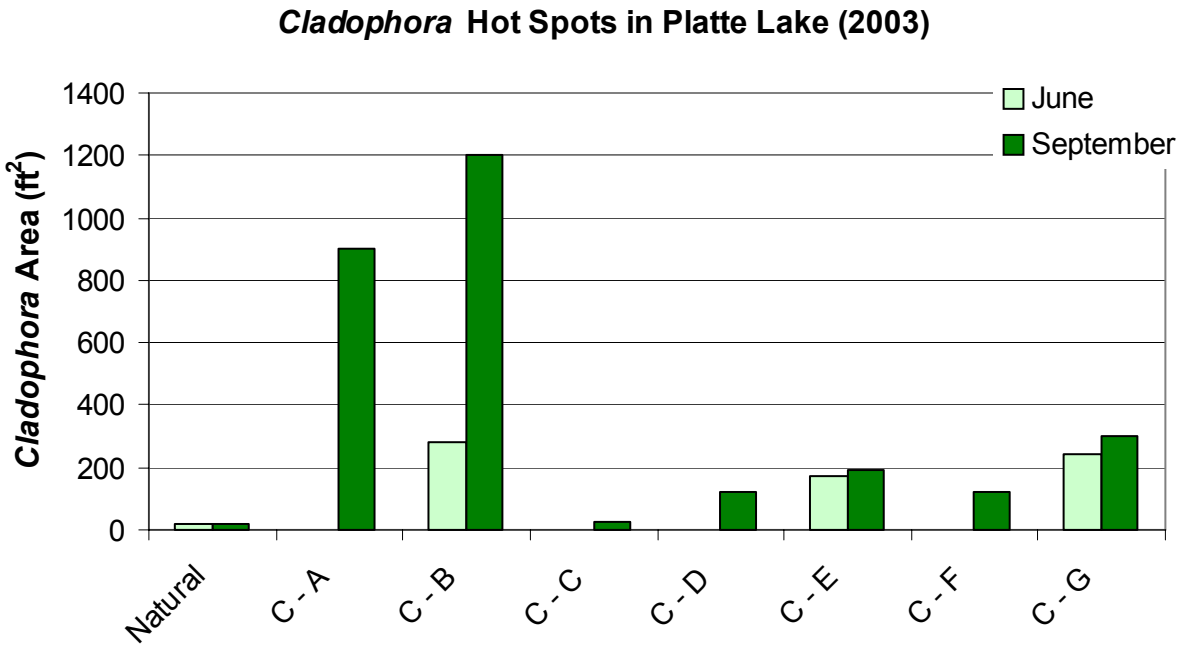

Cladophora Hot Spots in Platte Lake (2003)
Cladophora Area (ft^2)
1400
1200
1000
800
600
400
200
0
June
September
Natural
C - A
C - B
C - C
C - D
C - E
C - F
C - G

Figure 72.

Big Platte Lake
Benzie County, Michigan

Hot Spots

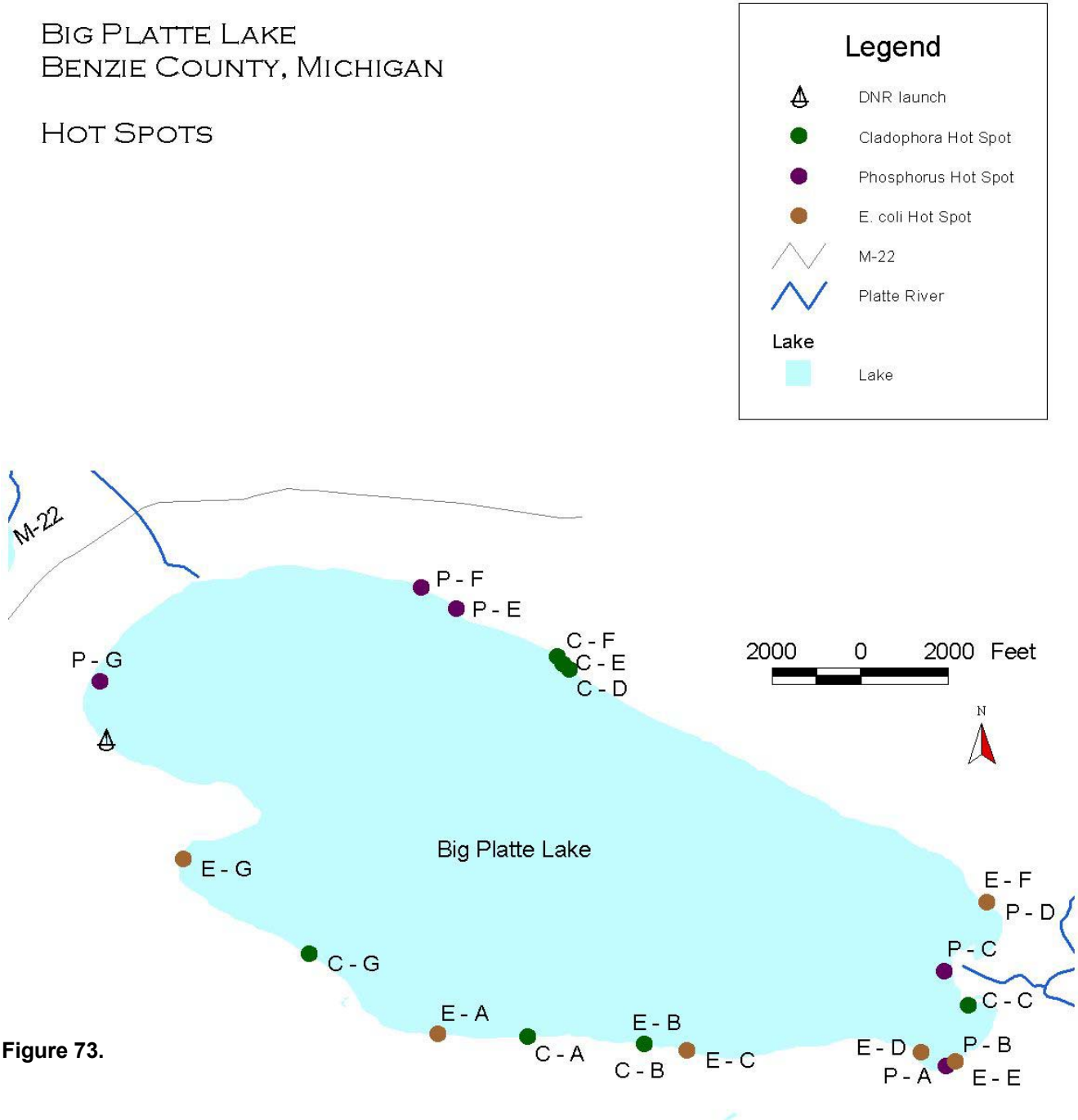


Figure 73.

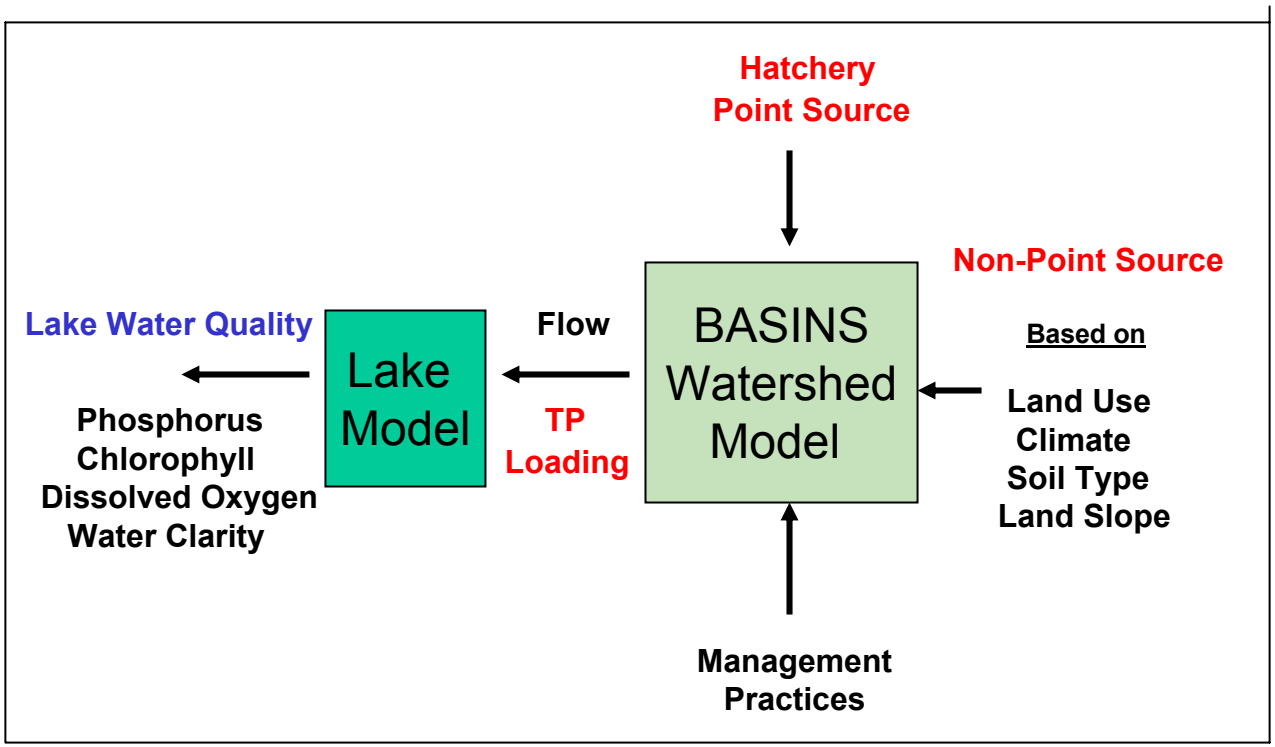


Figure 74. Components of BASINS and Lake Water Quality Model.

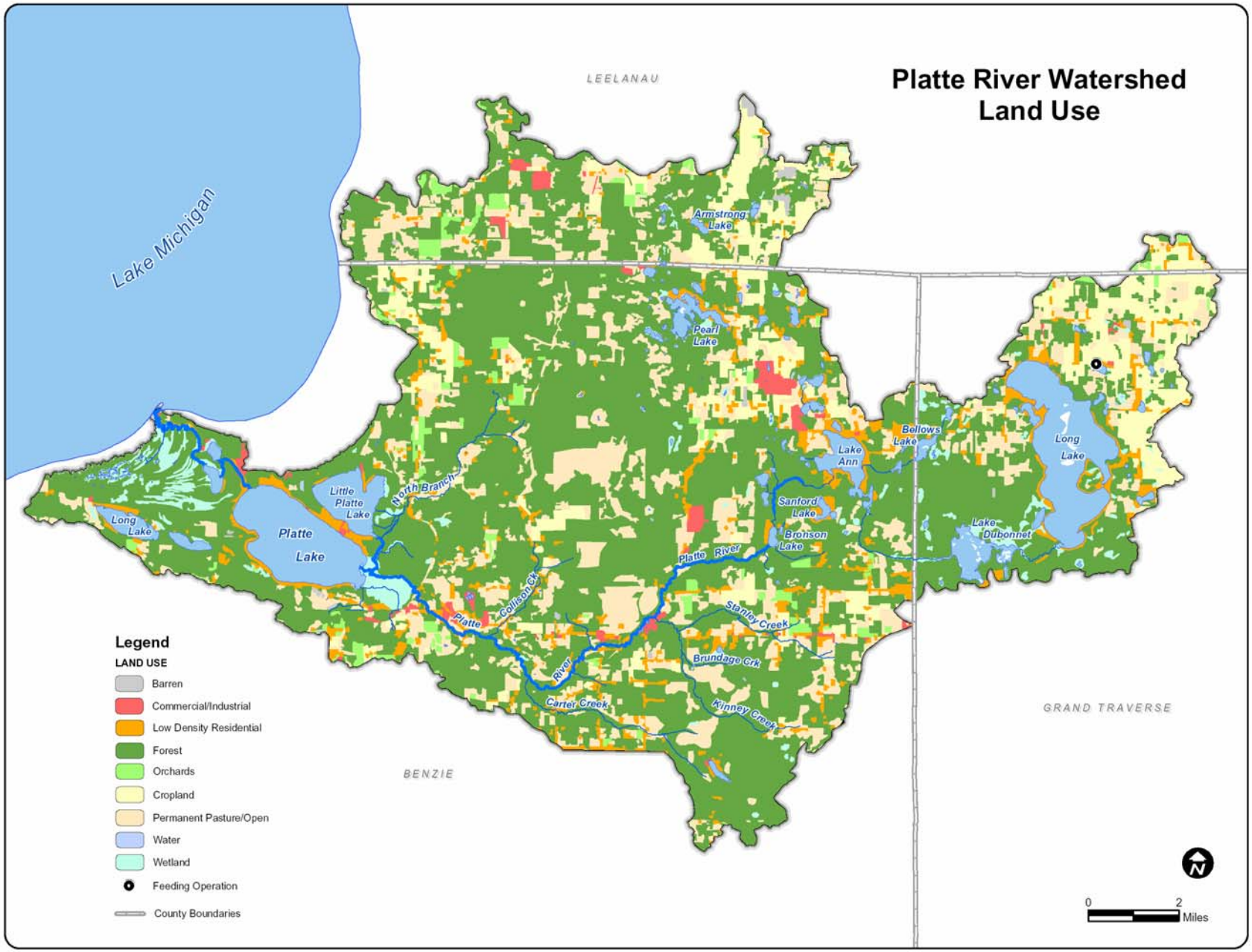


Figure 75. Platte River Watershed Land Use.

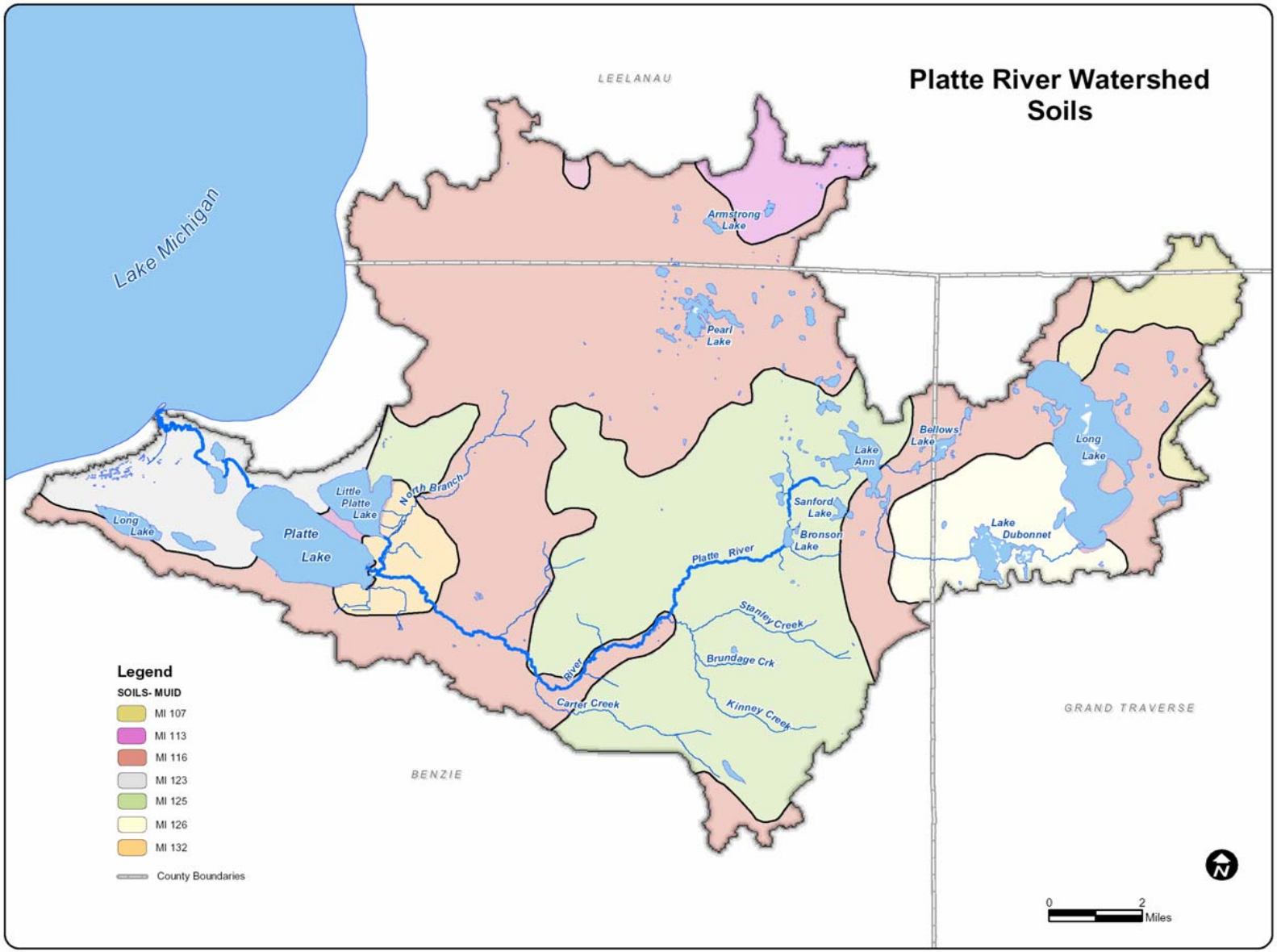


Figure 76. Platte River Watershed Soil Types.

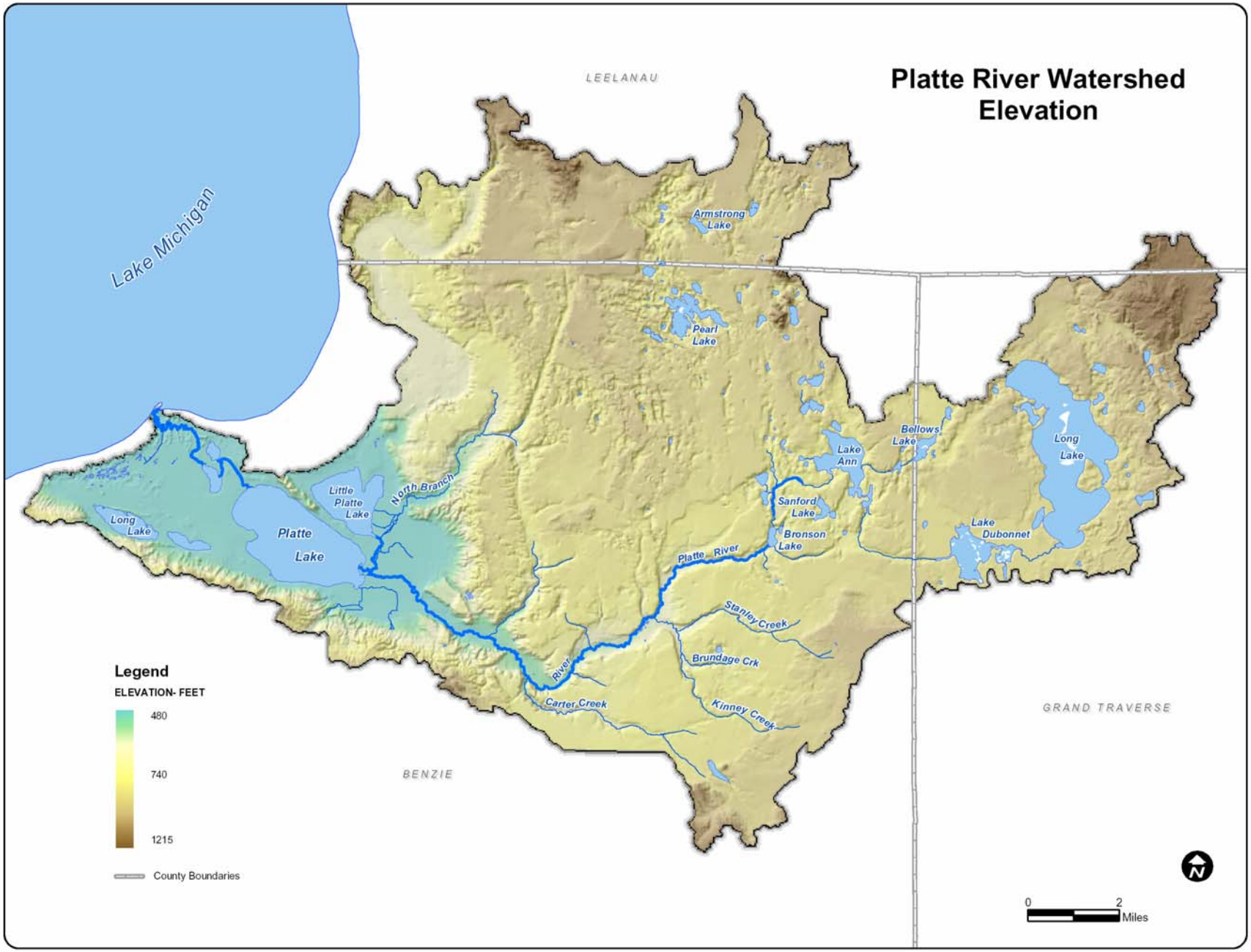


Figure 77. Platte River Watershed Land Elevations.

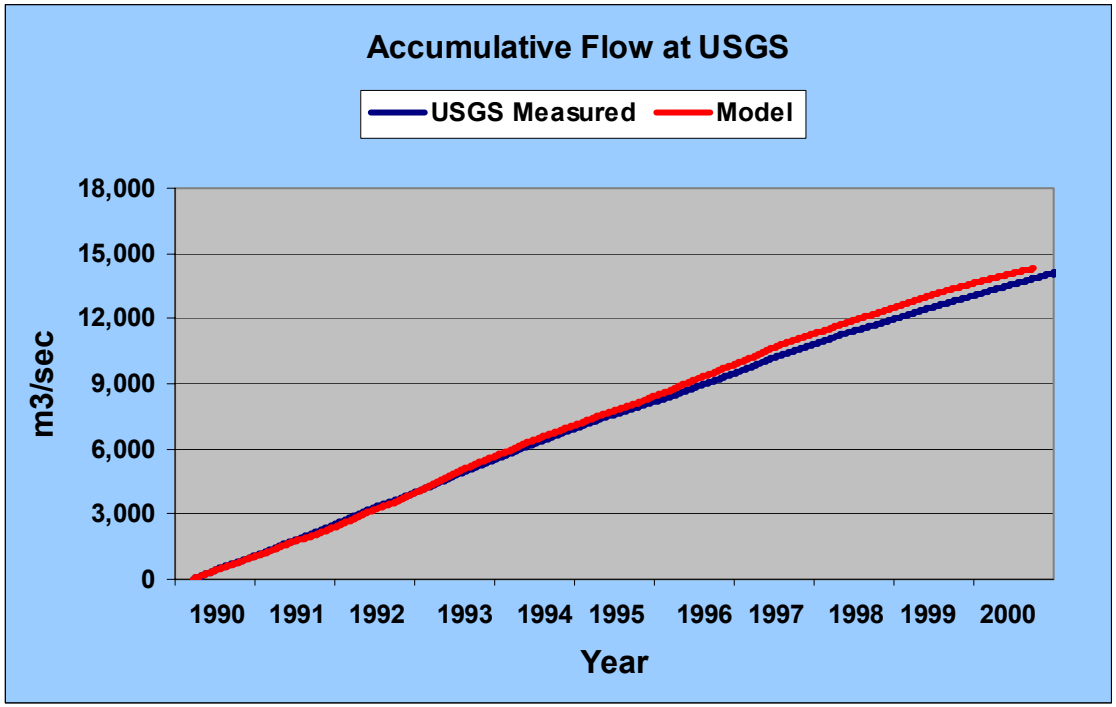


Figure 78. USGS and Model Accumulative Flow (1900 – 2000).

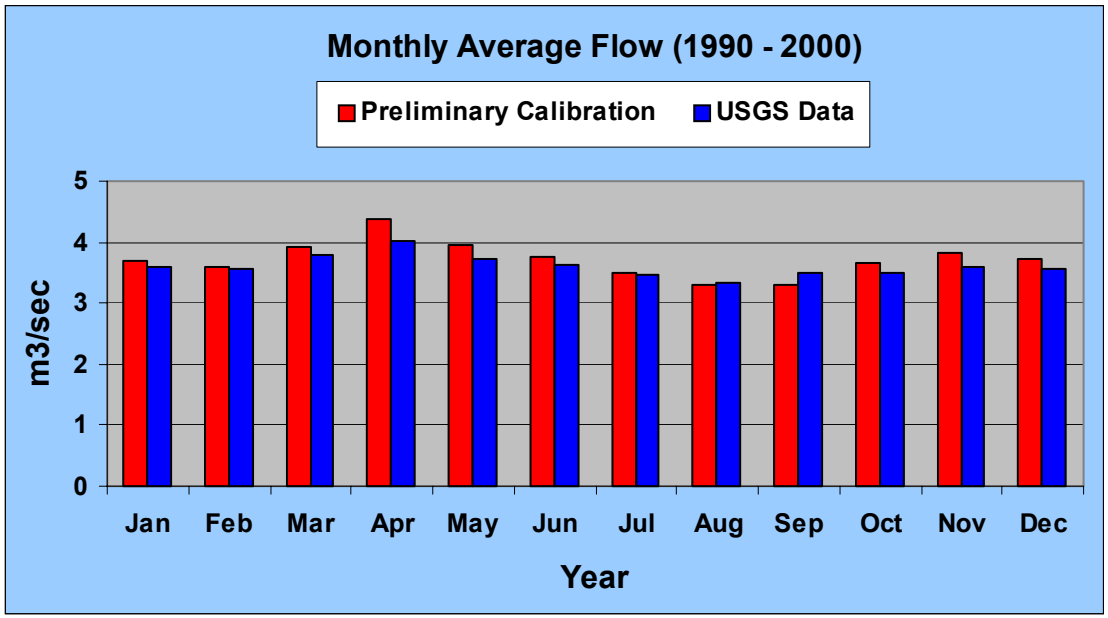


Figure 79. USGS and Model Monthly Average Flow (1900 – 2000).

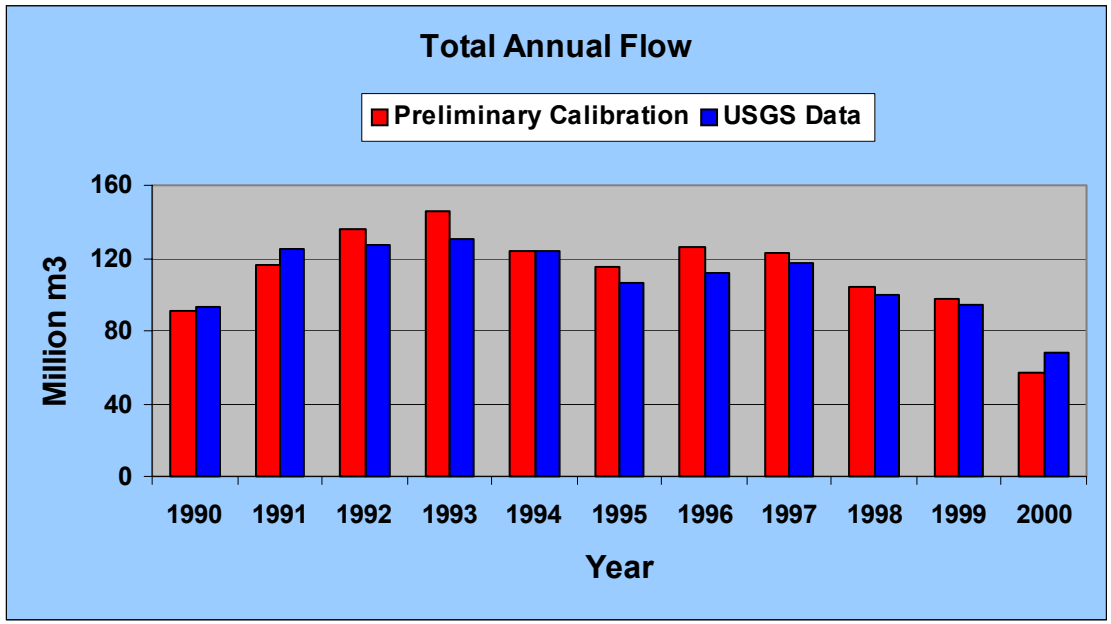


Figure 80. USGS and Model Total Annual Flow (1900 – 2000).

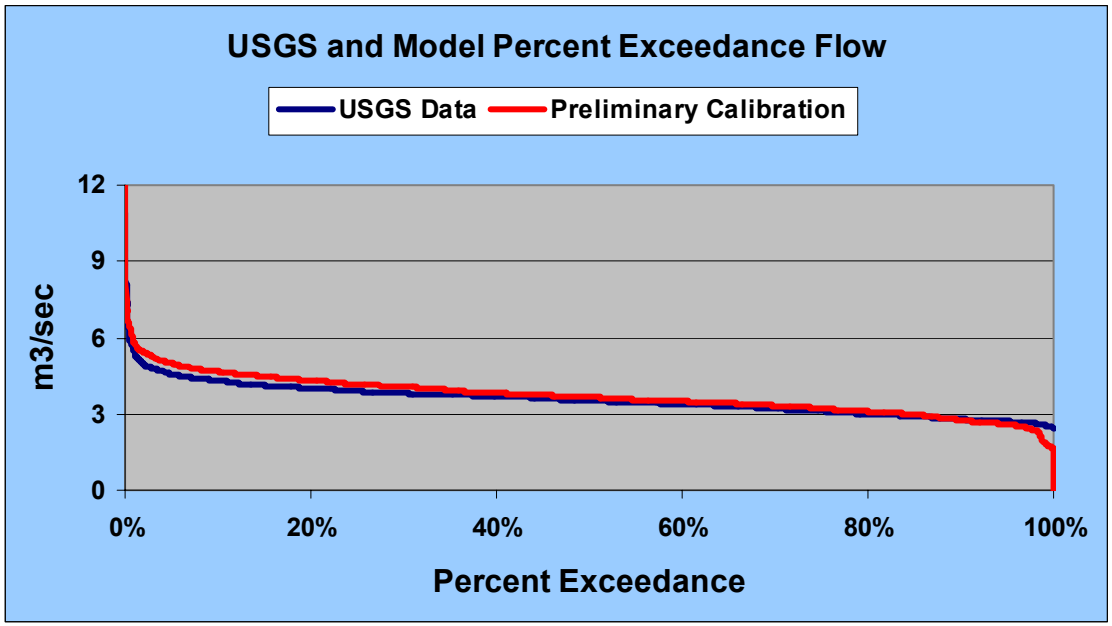


Figure 81. Percent Exceedance of Daily Average Flow (1990 - 2000).

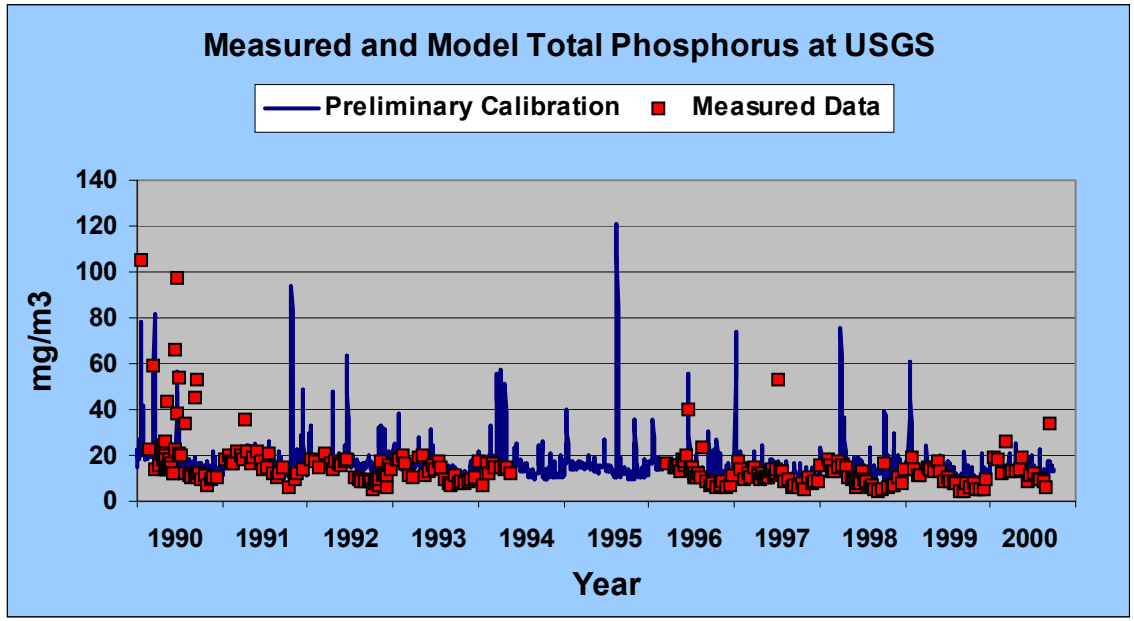


Figure 82. Measured and Model Total Phosphorus at USGS Station.

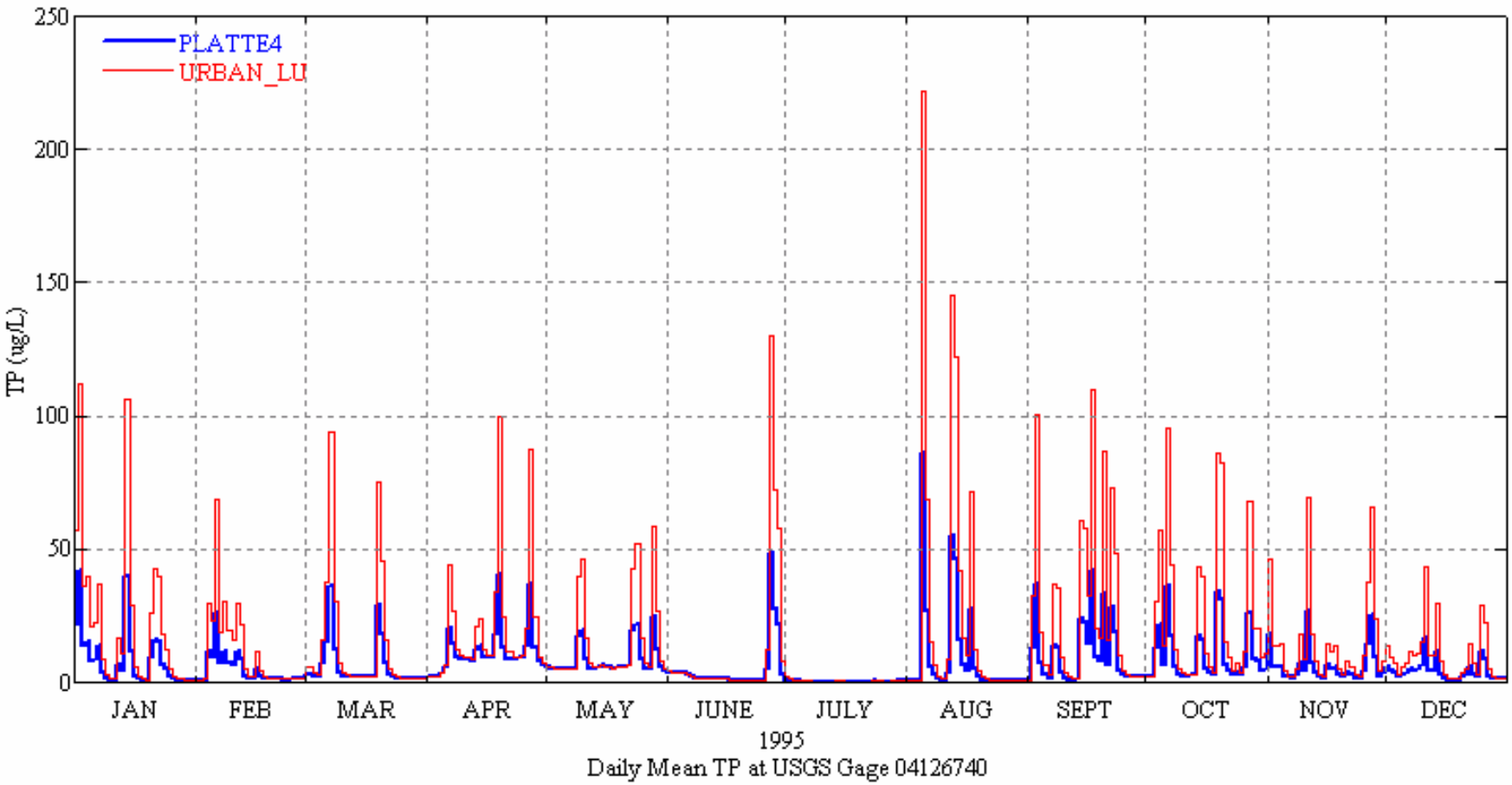


Figure 83. Hypothetical Application of BASINS Model for Urban Development.

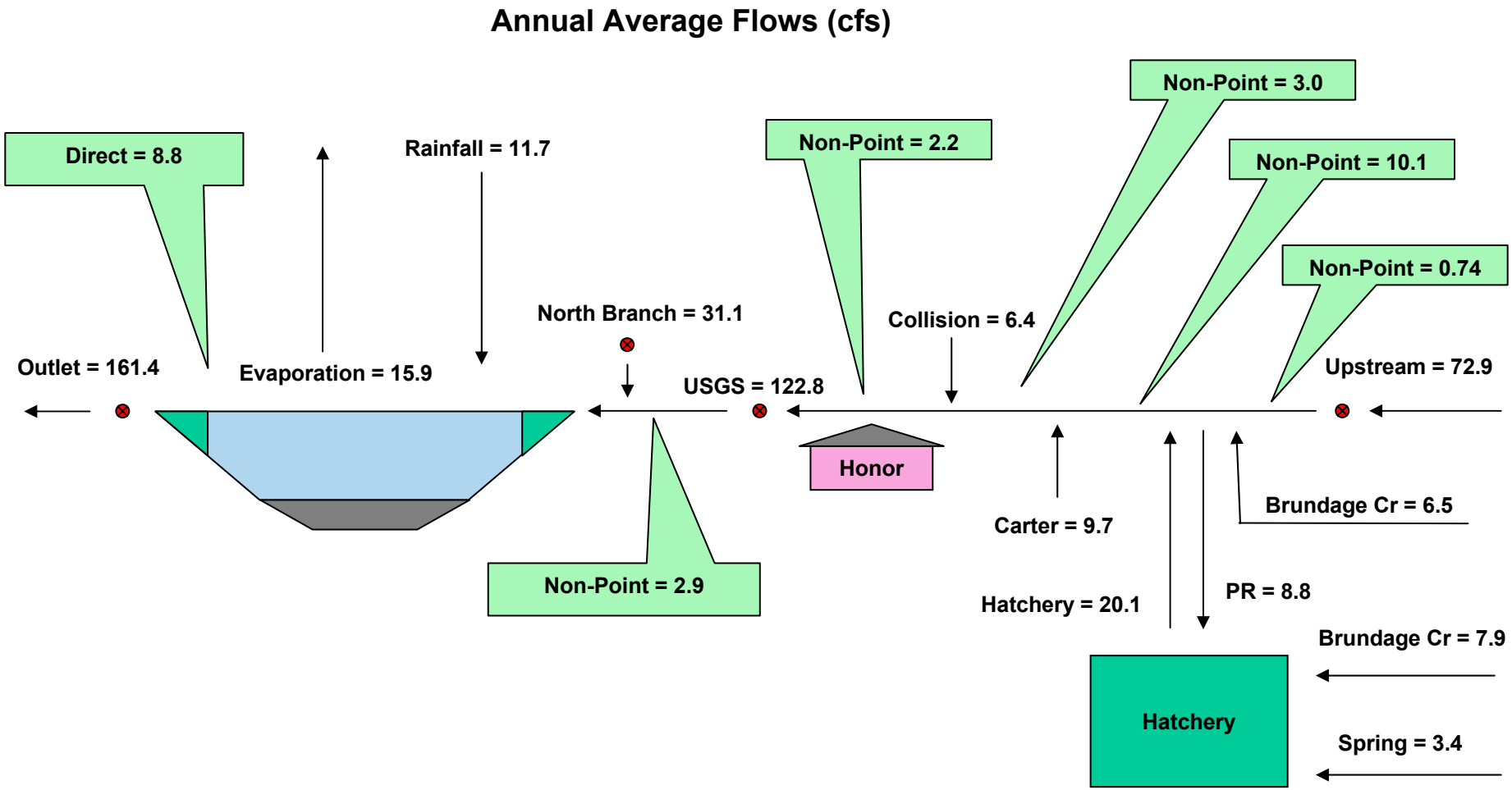


Figure 84. Watershed and Lake Flow Balance for 2003.

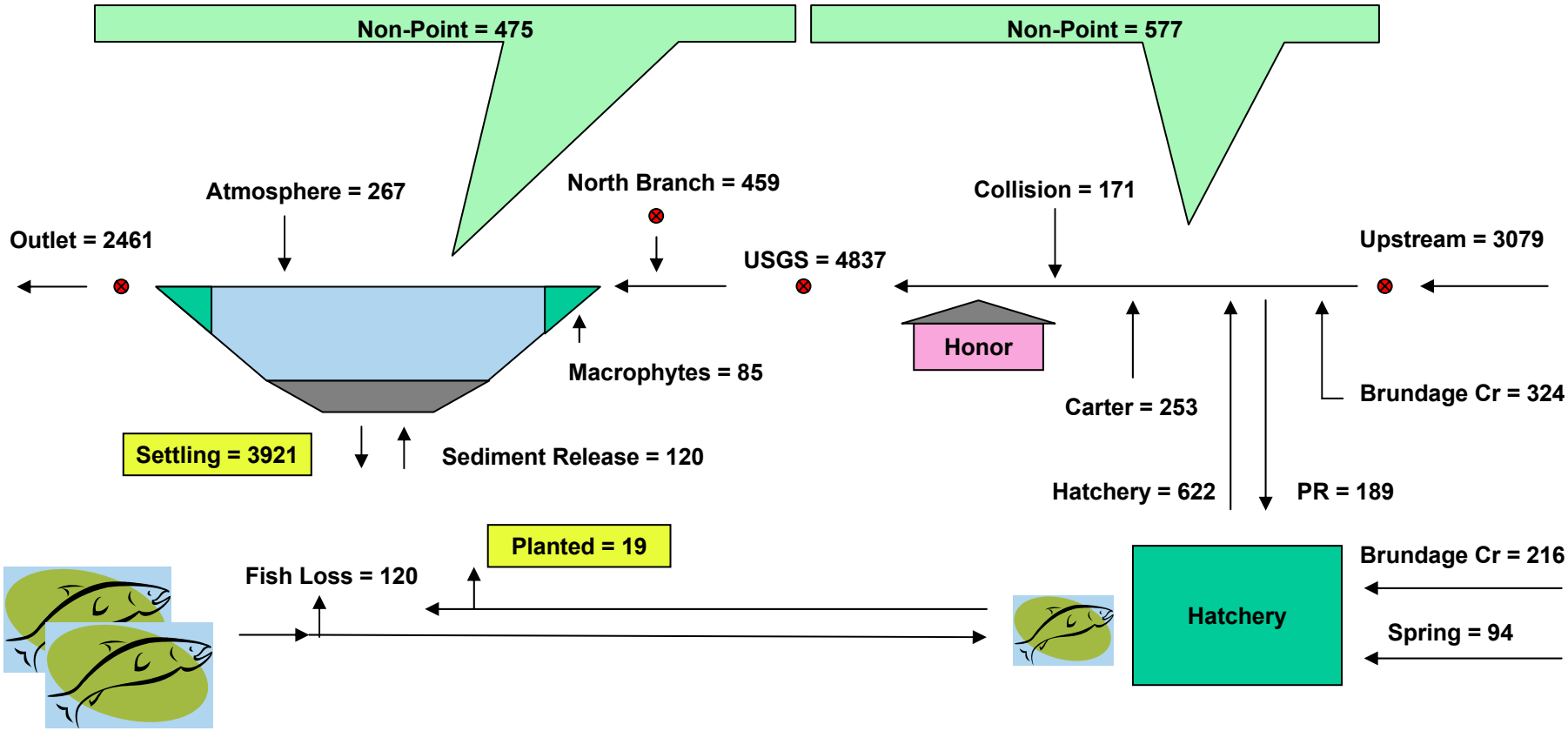


Figure 85. Watershed and Lake Phosphorus Balance (lbs/yr) for 2003.

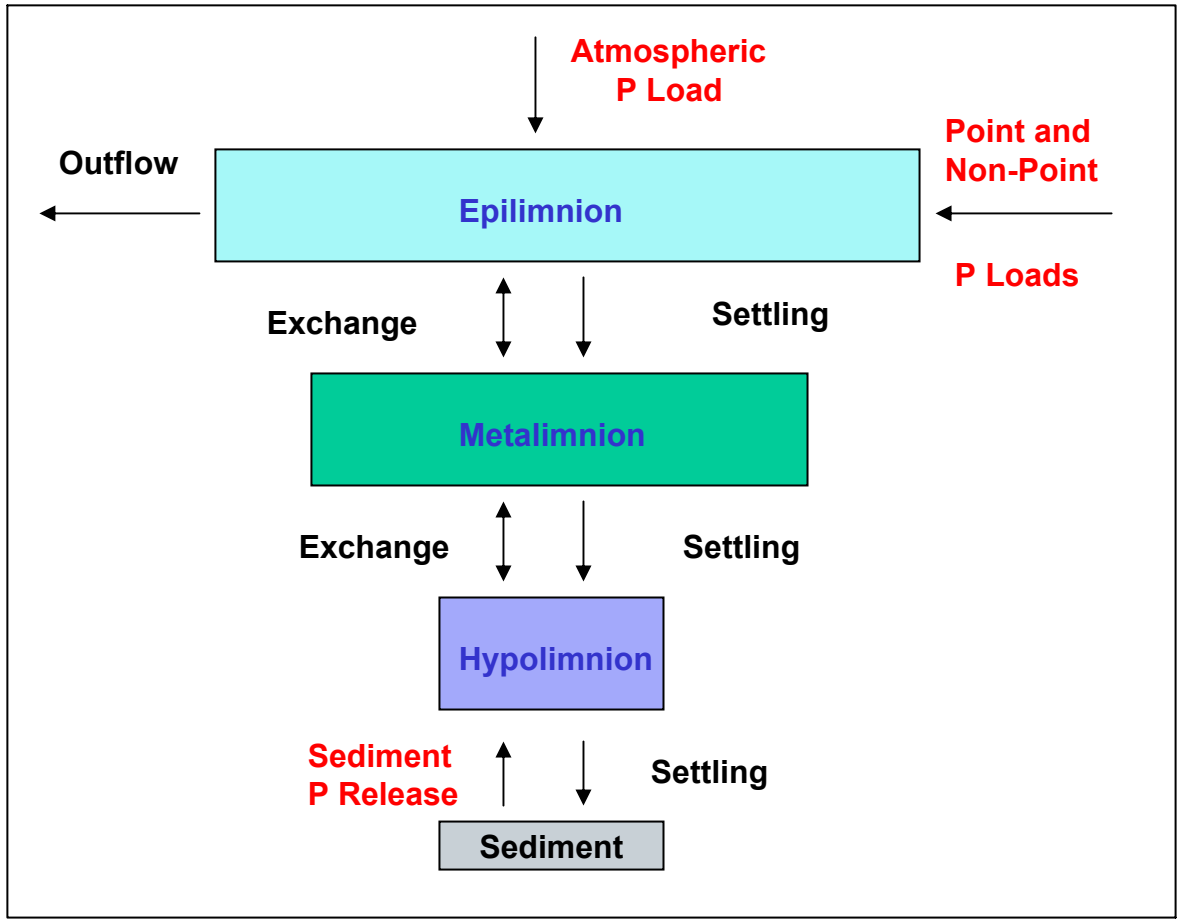


Figure 86. Components of Lake Water Quality Model.

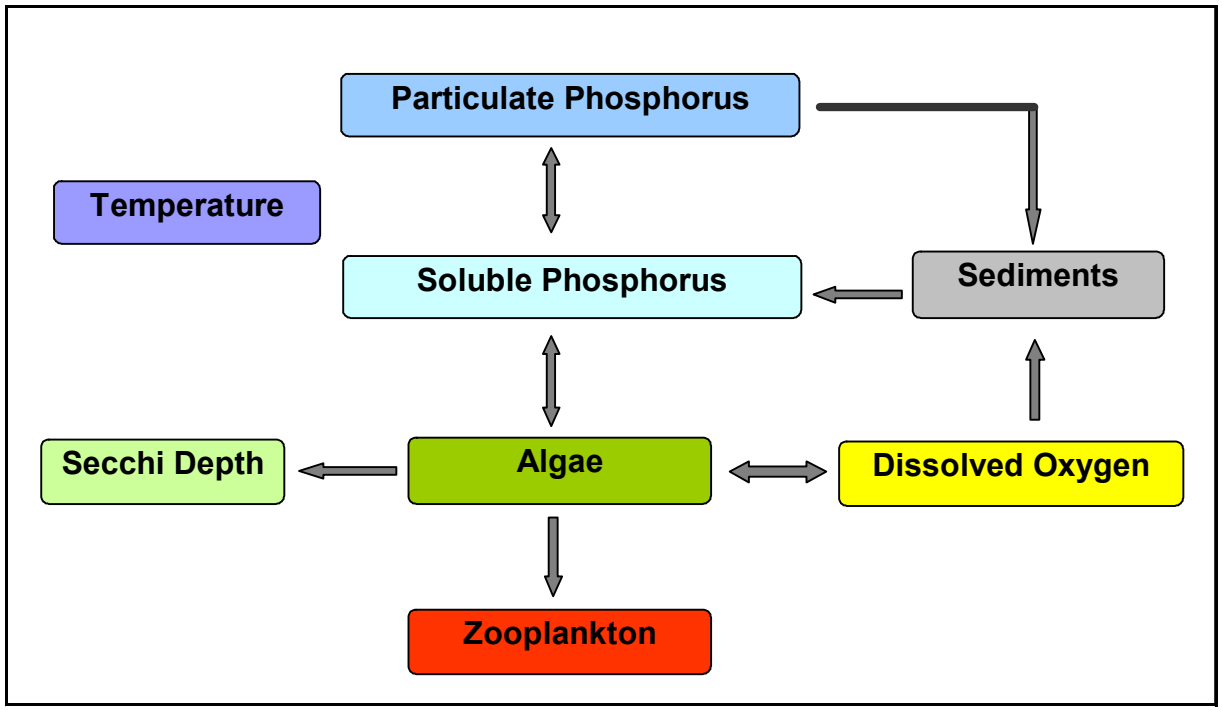


Figure 87. Kinetic Components of Lake Water Quality Model.

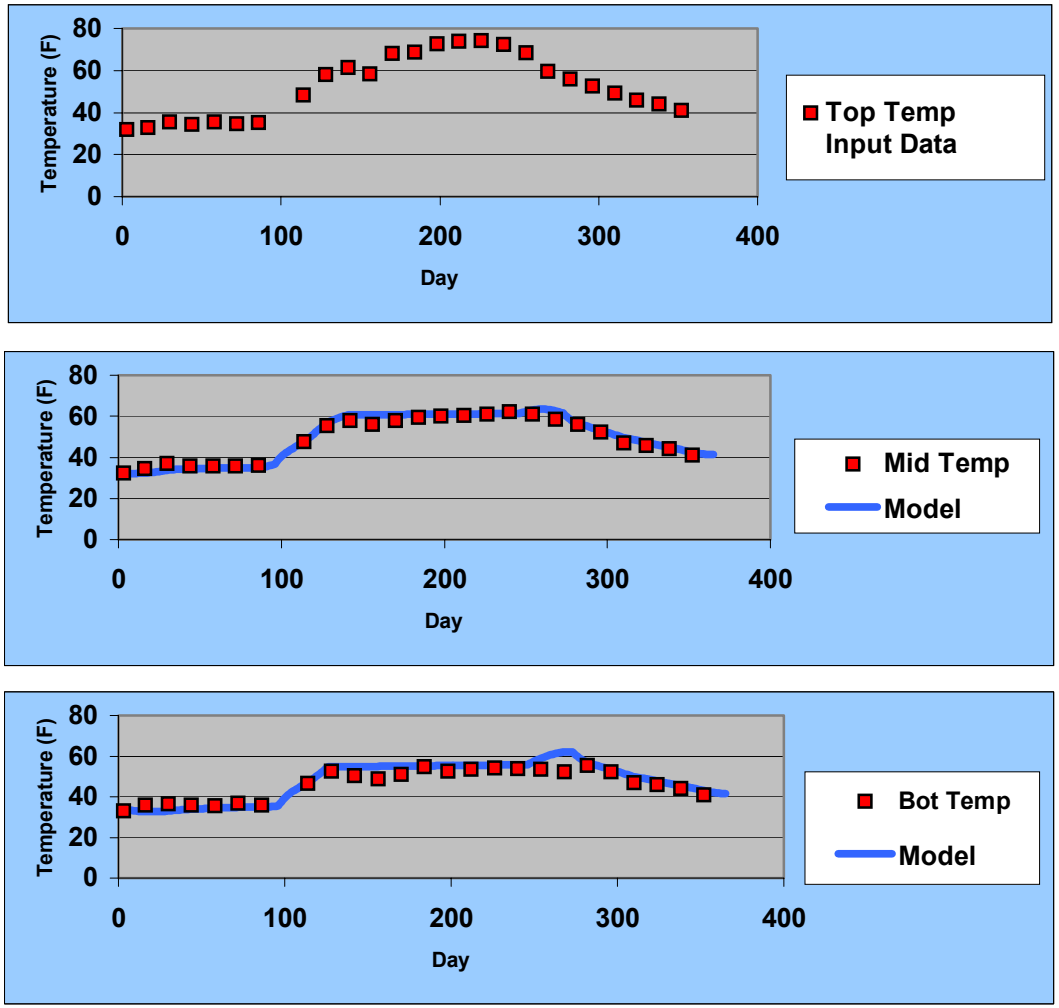


Figure 88: Three Layer Model Results for Temperature for 2000.

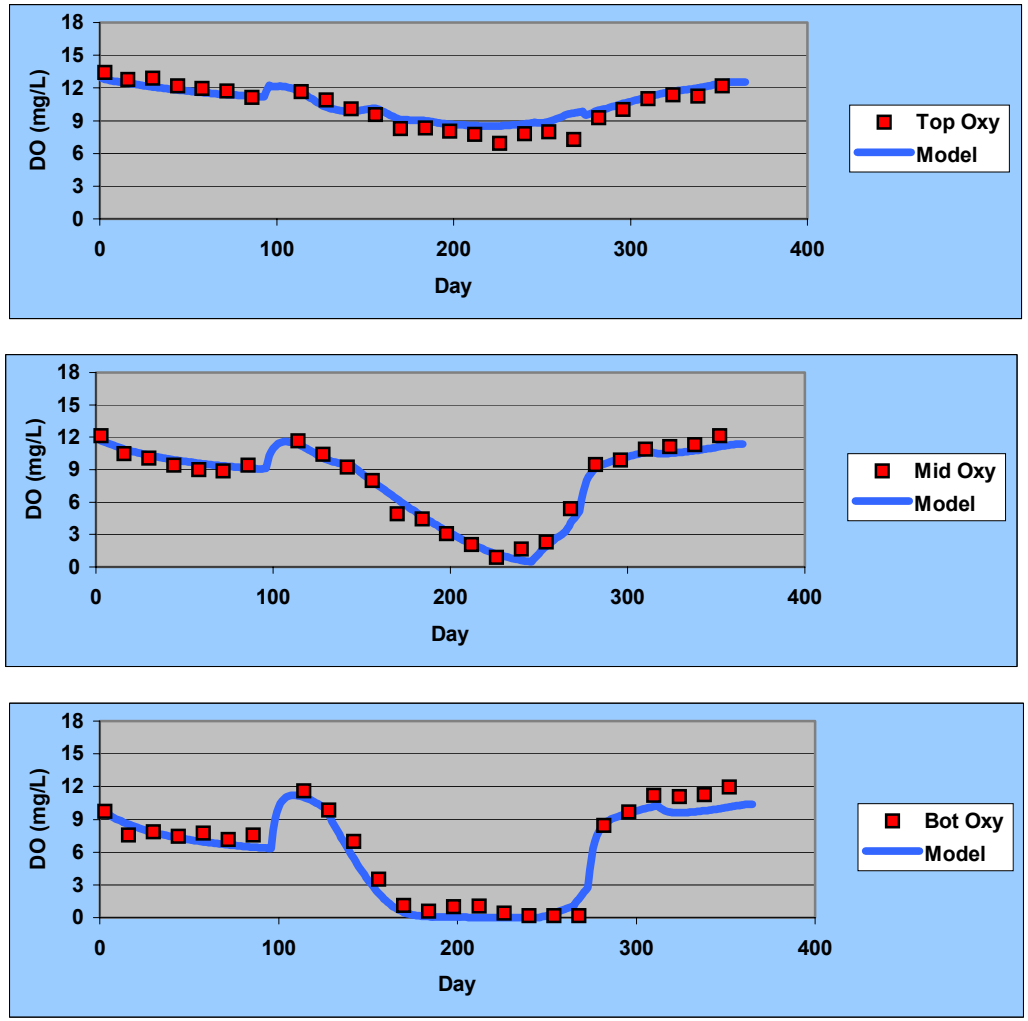


Figure 89: Three Layer Model Results for Dissolved Oxygen for 2000.

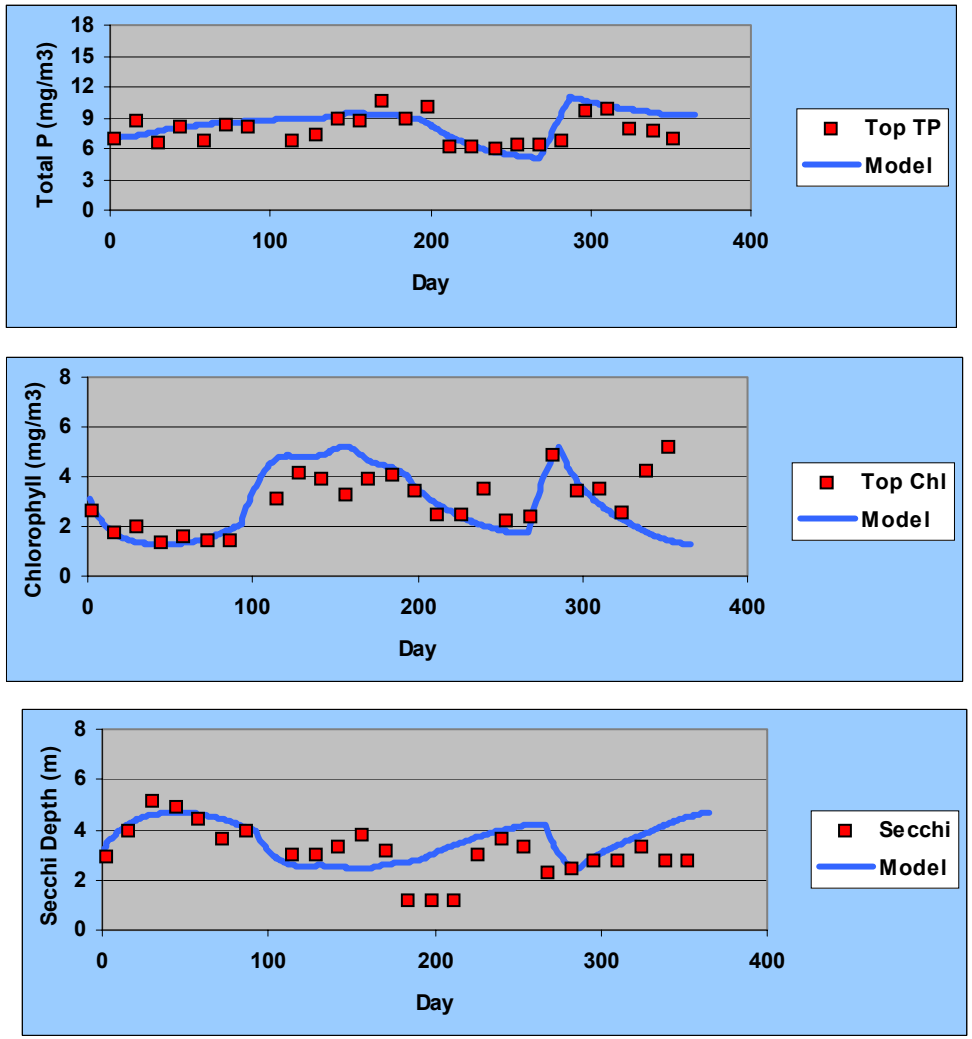


Figure 90: Model Results for Total Phosphorus, Chlorophyll, and Secchi Depth for 2000.