# 2005 Water Quality Monitoring Report



## Wenck File #0002-69

Prepared for:

## CLEARWATER RIVER WATERSHED DISTRICT

Box 481 Annandale, Minnesota 55389

Prepared by:

WENCK ASSOCIATES, INC.

1800 Pioneer Creek Center P.O. Box 249 Maple Plain, Minnesota 55359-0249 (763) 479-4200 January 2006



## **Table of Contents**

1.0 I	NTRO	DUCTION	1-1
2.0 P	PRECII	PITATION	2-1
3.0 S	TREA	MS	<b>3-</b> 1
	3.1 3.2	Runoff and Discharge	
4.0 V	VATE	R QUALITY OF LAKES SAMPLED IN YEAR 2005	<b>4-</b> 1
	4.1 4.2	Cedar Lake Special Monitoring	
5.0 C	CONCL	USIONS	5-1
TAB	SLES		
2.1	Clea	rwater River Watershed 2005 Volunteer Precipitation Records and Normals	
3.1	2005	Runoff Volume and Average Flow	
3.2	Histo	oric Annual Precipitation and Runoff Volume at CR 10.5	
4.1		Trophic Status Index	
4.2		Mean In-Lake Total Phosphorus, Chlorophyll-a, and Secchi Depth and Historica	l
	Rang		
4.3		to 2005 Total Phosphorus in Cedar Lake	
4.4		itoring Results Upstream of Watkins Wetland	
4.5		itoring Results Downstream of Watkins Wetland	
4.6	Expa	anded Watkins Monitoring Results from 9/26-27/2005 Event	

## **Table of Contents (Cont.)**

## **FIGURES**

- 1.1 2005 Monitoring Locations
- 2.1 2005 St. Cloud/ Collegeville Precipitation Record, and Normal Precipitation Record
- 2.2 2005 Watkins Citizen Precipitation Record and Normal Precipitation Record
- 2.3 2005 Annandale Citizen Precipitation Record and Normal Precipitation Record
- 3.1 Clearwater River Discharge at Fairhaven Dam and CSAH 40
- 3.2 Historical Total Phosphorus Loading and Mean Concentration at CR 28.2
- 3.3 Historical Total Phosphorus Loading and Mean Concentration at CR 10.5
- 3.4 Historical Total Phosphorus Loading and Mean Concentration at WR-0.2
- 4.1 2005 Average Total In-Lake Phosphorus
- 4.2 Nutrient Loading and Budget for Cedar Lake Subwatershed

### **APPENDICES**

- A 2005 Monitoring Plan
- B Citizen Precipitation Records
- C Historical Mean Flow, Mean Phosphorus, and Phosphorus Loading
- D Lake Historical Data
- E Secchi Data from Citizen's Lake Monitoring Program
- F 2005 Water Quality Laboratory Reports and Data
- G Field Notes and Measurements

## 1.0 Introduction

The Clearwater River Watershed District has conducted a stream, precipitation, and lake monitoring program since 1980. The monitoring program has focused on collecting baseline data to assess long-term water quality trends within the District. In the past few years, the monitoring plan was expanded to add more fecal coliform and phosphorus monitoring in the watershed. Beginning in 2003, the District returned to baseline monitoring. A Total Maximum Daily Load (TMDL) study is under way for the Clearwater River between Clear Lake and Lake Betsy for dissolved oxygen and bacteria, and for nutrients in Lake Louisa. Additional funding provided by the Minnesota Pollution Control Agency for monitoring to address the impaired waters allowed the District to focus on the Cedar Lake nutrient balance 2005.

In 2005, the Clearwater River was monitored at one long-term station (CR-10.5). Warner Creek was monitored near its inflow to Clearwater Lake at WR-0.2. The long-term station located in the upper reach of the Clearwater River (the listed reach between Clear Lake and Lake Betsy) was to be monitored under the TMDL Phase II contract. However, expected funding for this project was delayed and no monitoring was completed at this location.

Seven lakes were monitored by CRWD including Cedar Lake, Lake Albion, Swartout Lake, Henshaw Lake, Weigand Lake, Lake Betsy and Clear Lake. Cedar Lake and its tributaries, outflow, and tributary watersheds were monitored more frequently during 2005 in response to high total phosphorus concentrations observed in 2003 and 2004. The Minnesota DNR monitored Clearwater Lake, Lake Louisa, Lake Marie, Lake Caroline, Bass Lake, Lake Augusta, and Grass Lake. The MPCA monitored Union, Bass and Pleasant Lakes. Data is not yet available from the DNR and the MPCA. Upon receipt of the additional data, this report shall be appended.

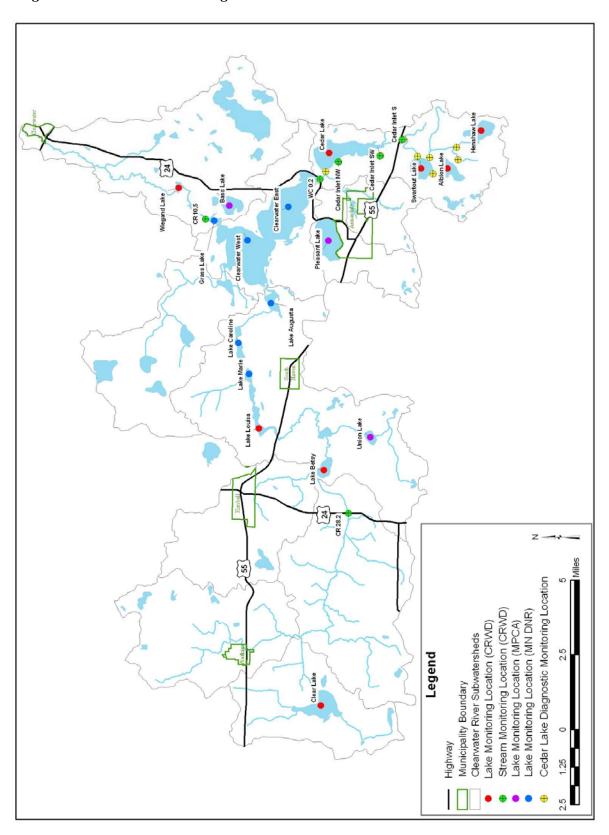
Citizen Precipitation Recorders (CPRs) collecting data in Watkins, and Annandale comprise the precipitation records, one less than in 2004. Citizen volunteers also collect Secchi depths for nine CRWD lakes.

The District continued intensive monitoring in the Cedar Lake subwatershed during 2005. High phosphorus readings in 2003 and 2004 combined with citizen concerns over nuisance algal blooms prompted the District to look more closely at the nutrient balance for Cedar Lake. As such, inflows and outflows to that lake were sampled during 2004.

Citizen concern prompted additional monitoring upstream and downstream of the constructed wetland in Watkins. The monitoring was geared towards determining if the wetland is still functioning, or if maintenance is needed.

Figure 1.1 shows the monitoring locations for 2004 and Appendix A gives the monitoring plan.

Figure 1.1 2005 Monitoring Locations



## 2.0 Precipitation

Precipitation during 2005 was generally below normal during spring and summer, but above normal during the fall. Two 10-year rainfall events were observed in Annandale during 2005: 4.08 inches on Oct 5 and 4.25 inches on Sept 13. These two events contributed to the higher than normal annual precipitation measured in Annandale of 41.47 inches for the year, which is 12.41 inches above normal. Table 2.1 and Figures 2.1-2.3 show the precipitation records for the CRWD (Appendix B).

Table 2.1 Clearwater River Watershed 2005 Volunteer Precipitation Records and Normals (inches)

	2005 St. Cloud (Stearns)	2005 Collegeville St. Johns	1971-2000 Normal (St. Cloud)	2005 Watkins (Meeker)*	1971-2000 Normal (Litchfield)	2005 Annandale/ Corinna (Wright)	1971-2000 Normal (Cokato)
January	1.8	1.9	0.76	0.79	0.79	1.78	0.93
February	0.97		0.59	0.67	0.67	1.08	0.70
March	0.65		1.50	1.27	1.55	0.63	1.69
April	2.11	2.71	2.13	2.65	2.35	2.80	2.33
May	3.3	3.67	2.97	2.98	3.37	4.09	3.30
June	4.37	7.1	4.51	4.53	4.89	8.99	4.62
July	2.11	1.65	3.34	1.84	4.02	3.08	4.04
August	3.64	2.93	3.93	2.72	3.67	2.44	4.00
September	5.54	6.32	2.93	6.62	2.92	8.24	2.78
October			2.24	2.97	2.15	4.84	2.23
November			1.54	3.39	1.50	2.55	1.73
December			0.69	1.87	0.68	0.95	0.71
Total			27.13	32.30	28.56	41.47	29.06

<sup>\*</sup> Normals were used to estimate the annual precipitation in Watkins

T:\0002\69\_2005 Monitoring\[Precip.xls]Summary

Figure 2.1 2005 St. Cloud and Collegeville Precipitation Records, and Normal Precipitation Record (inches)

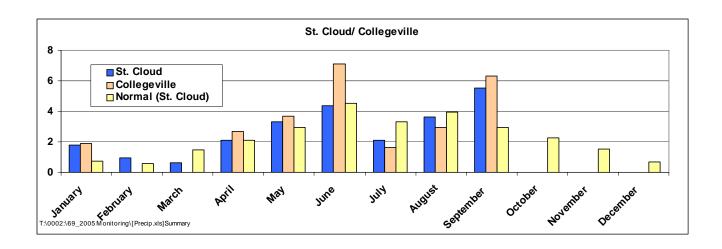


Figure 2.2 2005 Watkins Citizen Precipitation Record and Normal Precipitation Record (inches)

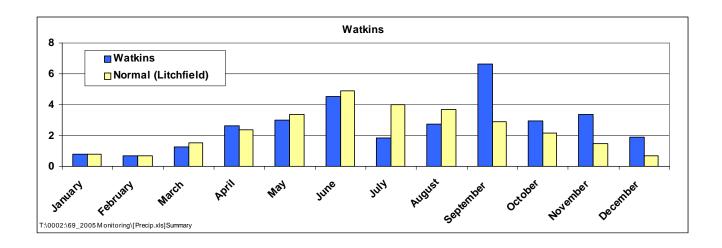
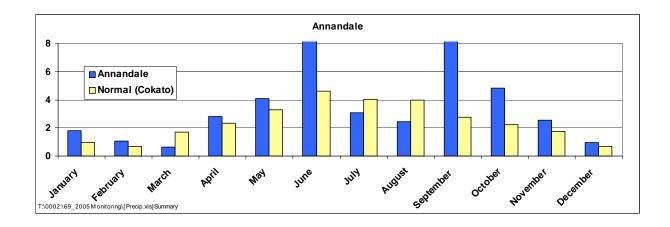


Figure 2.3 2005 Annandale Citizen Precipitation Record and Normal Precipitation Record (inches)

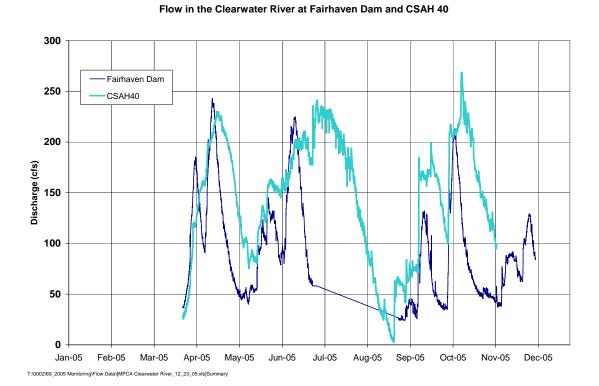


## 3.0 Streams

## 3.1 RUNOFF AND DISCHARGE

The MPCA maintained continuous discharge measurement stations on the Clearwater River at CSAH 40 at the downstream end of the watershed, and at the Fairhaven Dam near the center of the watershed (Figure 3.1). The flow records are complete except for a few weeks in July when the solar panel was stolen from the station.

Figure 3.1 Clearwater River Discharge at Fairhaven Dam and CSAH 40



Runoff over the subwatershed was 8.7 inches at Fairhaven Dam and 7.1 inches at CSAH 40 and average flows were 80 cfs and 142 cfs respectively. Table 3.1 summarizes the runoff volumes and average flows for these two stations. Table 3.2 compares historic annual precipitation and runoff in the District calculated using monthly flow gauging at CR 10.5.

Table 3.1 2005 Runoff Volume and Average Flow

	Tributary Sub- watershed Area (acres)	2005 Runoff Volume (ac-ft)	Runoff Over Watershed (inches)	Average Flow (cfs)
Fairhaven Dam	58,291	42,356	8.7	80
CSAH 40	113,282	66,985	7.1	142

T:\0002\69\_2005 Monitoring\Flow Data\[MPCA Clearwater River\_12\_23\_05.xls]Summary

Table 3.2 Historic Annual Precipitation and Runoff Volume at CR 10.5

					Precipitation	(inc	hes of water)				
Year	Watkins		Kingston		Maine Prairie		Annandale/ Corinna		Area-Weighted Precipitation Average		Runoff (inches)
1981									19.76	(1)	3.6
1982									24.58	(1)	6.8
1983	46.54				42.32		35.02		41.78		17.4
1984	32.23		30.13		32.37		36.07		32.95		13.3
1985	40.72		39.49		45.28				42.22		12.0
1986	40.02		35.63		39.68		33.40		37.26		16.0
1987	18.97		15.40		19.41		16.16		17.52		1.4
1988	16.57		18.98		15.96		15.01		16.48		0.7
1989	22.13		22.68		21.80		16.96		20.68		3.0
1990	40.35		39.18		41.36		32.18		37.94		11.7
1991	41.30		45.11		43.41		36.28		41.01		20.7
1992	23.06		18.41		20.47		24.35		22.01		12.9
1993	40.17		35.27	(2)	37.54	(2)	33.33		36.71		15.5
1994	34.77				30.13		30.26		31.98		9.0
1995	33.80				33.65		28.66		32.21		8.8
1996	31.31				24.32	(2)	26.13	(2)	27.59		4.8
1997	24.18				21.90		27.37		24.43		6.3
1998	30.03				29.39		27.43	(2)	29.05		5.5
1999	22.08				22.31	(2)	27.71		23.84		3.9
2000	23.83				20.56		19.91		21.22		1.0
2001	31.00				33.56		29.57		31.28		2.8
2002	37.50				40.27		44.72		40.57		7.6
2003	22.63				21.34		26.77	(2)	23.02		6.5
2004	33.58				33.58		31.67		33.10		2.8
2005	32.30	(2)					41.47		41.47	(4)	7.1
							Mo Std. D	ean ev.	30.03 8.3		8.0 5.7

T:\0002\69\_2005 Monitoring\[Precip\_Runoff.xls]Historical Runoff

Table 3.2 Notes: Whole watershed runoff is based on time-weighted average flow at Clearwater Lake outlet (station CR 10.5), and total drainage area of 155 square miles.

- 1. Data for single gauge in east-central part of watershed (Camp Heritage on Lake Caroline).
- 2. Average values of other stations in District were used to fill in missing data.
- 3. Location of Watkins Station changed slightly
- 4. Calculated using continuous flow data from MPCA at CSAH 40

Runoff at CR-10.5 was calculated using supplemental data from the CSAH 40 station maintained by the MPCA.

### 3.2 TOTAL PHOSPHORUS

### **Baseline Monitoring:**

Baseline phosphorus levels in the Clearwater River remain low as compared with conditions monitored in the early 1980s. The average TP concentration at the upstream reach of the Clearwater River at Clear Lake was 307  $\mu$ g/L (micrograms per liter, or parts per billion). Total phosphorus concentrations at CR 28.2, just upstream of Lake Betsy, have ranged from 740 to 1,400  $\mu$ g/l in the early 1980s and was 166  $\mu$ g/l in 2004.

Monitoring at the long-term station CR 28.2 was planned under the TMDL contract that was delayed, the result is that CR 28.2 was not monitored in 2005. The Clear Lake sampling results were used as a surrogate to estimate nutrient loading in the upper watershed. Flows were estimated based tributary watershed area and on the runoff volumes at CSAH 40. The TP load downstream of Clear Lake was approximately 4,105 lbs. Figure 3.2 compares the load at Clear Lake to the historical load at CR 28.2 which is located about 10 miles downstream. The concentration and load are higher than those observed at CR 28.2 in recent years.

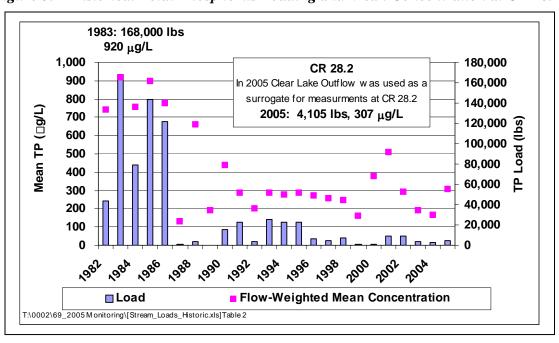


Figure 3.2 Historical Total Phosphorus Loading and Mean Concentration at CR 28.2

The flow-weighted mean TP concentrations at CR-10.5 and WR-0.2 were 23  $\mu$ g/l and 66  $\mu$ g/l respectively. Total phosphorus loads were 130 lbs at CR-10.5 and 48 lbs at WR 0.2, well below historic levels (Figures 3.3 and 3.4). Nutrient loads at these stations were estimated using the runoff volumes at CSAH 40 and the tributary watershed areas to each station.

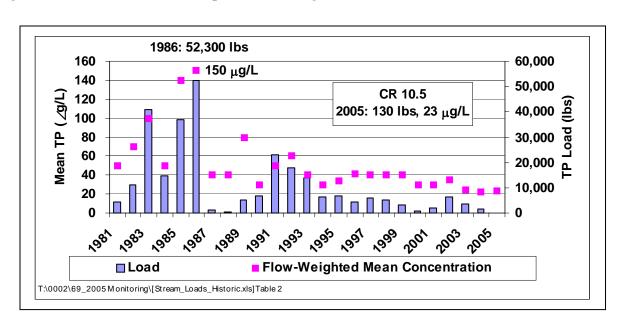
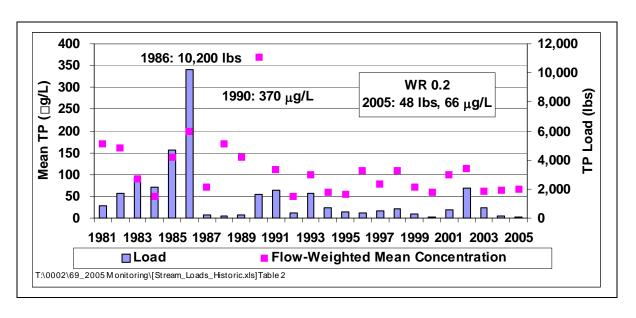


Figure 3.3 Historical Total Phosphorus Loading and Mean Concentration at CR 10.5





Soluble reactive phosphorus (SRP) (dissolved form of phosphorus easily utilized by algae) was also monitored. It represents 22 % of the total phosphorus value at the two stations, WR-0.2 and CR-10.5 (based on the mean of the ratios). This is similar to SRP/TP ratios observed in 2002 and 2003. Figure 3.2 shows historical phosphorus loadings at CR 10.5.

Appendix C shows historical phosphorus loads, stream flows, and flow-weighted mean concentrations.

## 4.0 Water Quality of Lakes Sampled in Year 2005

Seven lake sites were sampled four times in 2005. The sites included Clear Lake, Lake Betsy, Cedar Lake, Swartout Lake, Henshaw Lake, Wiegand Lake and Albion Lake. Parameters analyzed include total phosphorus, soluble reactive phosphorus, chlorophyll-a, total nitrogen, and a field reading of secchi depth. Lake profiles of temperature and dissolved oxygen were collected when the meter was functioning. The DNR monitored Clearwater Lake, Lake Louisa, Lake Marie, Lake Caroline, Bass Lake, Lake Augusta, and Grass Lake, and the MPCA monitored Bass Lake, Union Lake and Lake Louisa. That data is not yet available. This report will be appended with the additional information as it arrives.

Water quality in the lakes monitored in 2005 was generally poor, but comparable to monitoring in recent years. Compared with the MCPA guidelines on lake impairment based on ecoregion, only Cedar and Weigand Lakes are considered "full use" because the average TP concentrations are below 40 ug/L. Lake Betsy, Clear Lake, Swartout Lake, Henshaw Lake, and Albion Lake are considered impaired (Figure 4.1).

-

<sup>•</sup> The MPCA uses total phosphorus as the criteria for swimability. This is called the "Swimable Use Support Classification". The TP values are different for different Ecoregions. For the North Central Hardwood Forest Ecoregion (where CRWD is located), TP concentrations below 40 ug/L are considered "full use"

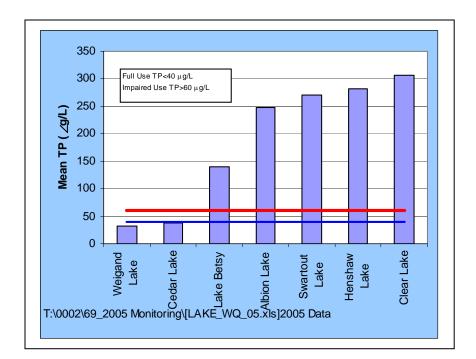


Figure 4.1 2005 Average Total In-Lake Phosphorus

Weigand and Cedar Lakes are considered Mesotrophic based on the Carlson Tropic Status Index (TSI). Lake Betsy is eutrophic; Lake Albion, Swartout Lake, Henshaw Lake and Clear Lake are all hypereutrophic. The TSI for lakes monitored in 2005 is shown in Table 4.1.

Table 4.1 2005 Trophic Status Index

	Avg TSI	TP TSI	Chla-a TSI	Secchi TSI	TSI Based Classification
Weigand Lake	46	54	41	42	Mesotrophic
Cedar Lake	51	56	52	45	
Lake Betsy	65	75	60	59	Eutrophic
Albion Lake	72	84	71	63	Hypereutrophic
Swartout Lake	78	85	79	69	
Henshaw Lake	78	85	79	69	
Clear Lake	72	87	71	59	

T:\0002\69\_2005 Monitoring\[LAKE\_WQ\_05.xls]2005 Data

Water quality observed in most lakes monitored during 2005 is within ranges seen in recent years. However, TP levels in Lake Albion and Clear Lake are higher than those observed in recent years, possibly indicating a decline in water quality for these lakes (Table 4.2).

Table 4.2 2004 Mean In-Lake Total Phosphorus, Chlorophyll-a, and Secchi Depth, and Historical Ranges

	Total 1	Phosphorus µg/l	Chlo	orophyll- <i>a</i> μg/l	Secchi I (mete	•
		Historical		Historical		Historical
Lake	2005	Range	2005	Range	2005 Mean	Range
	Mean	Mean	Mean	Mean	(Citizen Reading)	Mean
Weigand	31	35-61	3	5-12	3.4	1.7-3.0
Cedar	37	26-52	9	6-13.	2.2	1.1-3.0
Lake Betsy	140	120-700	20	5-170	1.1	0.8-2.4
Albion Lake	248	130-220	60	72-224	0.8	0.5-1.0
Swartout Lake	270	200-421	134	151-444	0.5	0.7-1.0
Henshaw Lake	281	150-295	144	53-238	0.5	0.4-0.9
Clear Lake	307	80-228	60	17-134	1.1	0.3-1.2

Figures showing historical lake data and trends are shown in Appendix D. Citizen Secchi depths are shown in Appendix E. Water quality lab reports are in Appendix F, and field notes are in Appendix G.

### 4.1 CEDAR LAKE SPECIAL MONITORING

Additional monitoring was conducted in the Cedar Lake subwatershed to quantify the nutrient budget. Results of the special monitoring are discussed in this section.

First, total phosphorus concentrations in the lake were within normal ranges (about 30  $\mu$ g/L), except one reading of 56  $\mu$ g/L in April. Table 4.2 shows that singular high TP readings 2003-2005 skewed the average values. The rest of the measured TP values were closer to the

historical average of around 30  $\mu$ g/L. This indicates that the water quality is declining, and that the problem in Cedar Lake is episodic in nature.

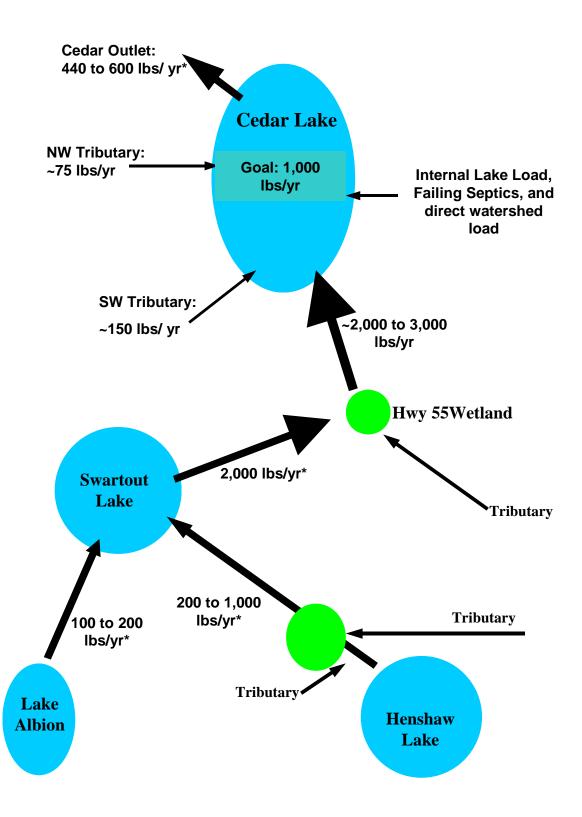
With the exception of one early spring reading in 2005, SRP values in Cedar Lake are below detection limits. The high early spring value is likely indicative of a small annual internal loading.

Table 4.3 2003 to 2005 Total Phosphorus in Cedar Lake

<u>Date</u>	<u>Total</u> <u>Phosphorus</u> (µg/L)	Soluble Reactive Phosphorus (µg/L)	<u>Chlorophyll-a</u> (μg/L)	<u>Secchi Depth</u> (ft)
6/17/2003	33	<5	7	10.5
7/9/2003	28	<5	12	4.5
8/20/2003	33	<5	6	
9/17/2003	<mark>112</mark>	<5	18	
2003 Average	52	<5	11	7.5
6/22/2004	<mark>055</mark>	<5	5.87	
7/20/2004	31	<5	1.07	
8/11/2004	25	<5	< 0.200	8.5
9/16/2004	21	<5	2.14	
2004 Average:	33	<5	3	NA
4/16/2005	<mark>56</mark>	20	10	
5/25/2005	37	<5	5	14
7/5/2005	29	<5	8	7
8/4/2005	30	<5	14	8
9/8/2005	33	<5	6	
2005 Average	37	8	9	

Additional water quality monitoring better defined the nutrient balance for the Cedar Lake subwatershed, and allowed the District to determine a nutrient loading goal for Cedar Lake of 1,000 lbs of TP annually to maintain an in-lake TP concentration of 20  $\mu$ g/L. Presently, nutrient loading to Cedar Lake exceeds the goal by 1,200 to 2,200 lbs of TP annually. Figure 4.2 summarizes the results of the 2005 monitoring.

Figure 4.2 Nutrient Loading and Budget for the Cedar Lake Subwatershed



### 4.2 WATKINS WETLAND SPECIAL MONITORING

Citizen concerns prompted additional monitoring of the constructed wetland south of the City of Watkins. Two monitoring events were geared towards determining if the wetland was still functioning or if it required maintenance. One monitoring event was conducted under the TMDL Program.

The early spring monitoring event generally showed a 70% or greater decrease in total suspended solid (TSS) concentrations from upstream to downstream. The first fall event showed a 42% reduction in TSS concentrations upstream to downstream. The fall sampling event conducted under the TMDL project showed upstream TSS concentrations were below detection limits, and that downstream concentrations were slightly higher. Results may reflect the timing of the sampling with respect to rainfall events, rather than the sediment removal efficiency of the Watkins wetland. Tables 4.4 and 4.5 summarize the results.

Table 4.4 Monitoring Results Upstream of Watkins Wetland

		Wat	kins Upstre	eam	
			TP	SRP	TSS
	Q (cfs)	TP (μg/L)	(lbs/day)	(μg/L)	(mg/L)
4/15/2005	15	263	21.31	176	14
9/15/2005	5	413	11.18		7
9/26/2005	2.24	257	3.11	249	<2

Table 4.5 Monitoring Results Downstream of Watkins Wetland

		Watk	ins Downs	tream	
			TP	SRP	TSS
	Q (cfs)	TP (μg/L)	(lbs/day)	(μg/L)	(mg/L)
4/15/2005	21	220	24.75	173	<4.0
9/15/2005	13	635	45.93		4
9/26/2005	0.828	345	1.54	322	7

T:\0002\69\_2005 MONITORING\DATA\_ANALYSIS\[LOAD AND RUNOFF\_2.XLS]TABLES\_SNAPSHOT (2)

Initial results indicate an increase in SRP from upstream to downstream. However, the expanded monitoring done in the September 26, 2005 event also shows significant increase in bacteria

concentrations from upstream to downstream, and an increase in ultimate biological oxygen demand (BOD-ultimate). Further, all events show increased flow from upstream to downstream (Table 4.6). These factors, combined with the fact that all events were conducted following major precipitation events, seem to indicate that additional intervening tributary sub-watersheds may be contributing to the results. If that is the case, the results do not conclusively quantify the efficiency of the wetland. Additional data is needed to determine of the wetland requires maintenance.

Table 4.6 Expanded Watkins Monitoring Results from 9/26-27/2005 Event

Parameter	Upstream	Downstream
Flow (cfs)	2.24	0.828
Fecal Coliform (#/100mL)	1,300	>60,000
TP (μg/L)	257	345
SRP (μg/L)	249	322
TSS (mg/L)	<2	7
BOD-Ultimate (mg/L)	4	15

 $T: \label{lower_$ 

## 5.0 Conclusions

- 1. Annual precipitation for the Annandale station was 41.47 inches, 12.1 inches above normal for the year.
- 2. Continuous flow measurements recorded at CSAH 40 near Clearwater show that runoff over the watershed was 7.1 inches. This is comparable to runoff measured at CR 10.5 just upstream of CSAH 40 near Grass Lake in years with similar precipitation.
- 3. The Clearwater River phosphorus load was about 130 pounds at CR-10.5. This is low compared with historical averages. The upper watershed load was similar to those measured in previous years for similar runoff conditions.
- 4. The water quality of Cedar and Wiegand Lakes was good; water quality in Lake Betsy, Clear Lake, Lake Albion, Henshaw Lake, and Swartout Lake were poor. Total phosphorus concentrations in Lake Albion and Clear Lake exceed values previously measured, possibly indicating deterioration of water quality.
- 5. Water quality in Cedar Lake continues to decline. The nutrient balance for the watershed shows the cause to be high nutrient loads from shallow lakes in the upper watershed.
- 6. The Watkins wetland reduces suspended sediment load. The soluble phosphorus data is inconclusive.
- 7. After the 2005 MPCA and MDNR results are available, that data will be integrated with the results in this document.

## Appendix A

## **2005 Monitoring Plan**

#### **MEMORANDUM**

TO:

Clearwater River Watershed District Board of Managers

FROM:

Norman C. Wenck

**Engineer for the District** 

DATE:

March 9, 2005

RE:

**Proposed 2005 Water Quality Monitoring Program** 

#### Introduction

The Clearwater River Watershed District conducts annual water quality monitoring at selected lakes and selected locations on streams. The District's proposed 2005 program is intended to provide data throughout the District. Three TMDL studies, currently underway, will focus on the impaired waters. Phase II of the TMDL studies (data collection) will begin in 2005. Additionally, the MPCA is scheduled to perform Lake Assessment Program (LAP) sampling on three District lakes in 2005, and the DNR will conduct sampling and assessments on seven District lakes in 2005.

The 2005 proposed lake monitoring follows the long-term plan shown in Table 1, which has been extended to the year 2010. The proposed stream monitoring sites together with laboratory and field parameters are shown in Table 2.

### Lake Monitoring

The District 2005 regular lake monitoring includes Clear Lake and Lake Betsy (at the upstream and downstream listed reaches of the Clearwater River. The District Lake monitoring will also include Cedar Lake, Swartout Lake, Henshaw Lake Wiegand Lake, and Albion Lake. Clearwater Lake, Lake Louisa, Lake Marie, Lake Caroline, Bass Lake, Lake Augusta, and Grass Lake will be monitored by the DNR. Lake Louisa will also be monitored under the TMDL Grant. The MPCA will be monitoring Union, Bass, and Pleasant Lakes. Stations and the parameters to be monitored are shown on Table 2. Citizens also monitor approximately 14 lakes for secchi depth.

#### **Stream Monitoring**

The Clearwater River will be monitored at station CR10.5, Warner Creek will be monitored at WR 0.2 and three Cedar Lake tributaries will be monitored. CR 28.2 will be monitored under the TMDL program, as it is located in the listed reach of the Clearwater River. These stations will be monitored six times for water quality and flow. Parameters are total phosphorus and soluble reactive phosphorus.

### Cedar Lake Diagnostic

Cedar Lake tributaries were monitored in 2004 to determine the cause of algal blooms, and episodic high total phosphorus in 2003 and 2004. Several potential causes were evaluated. Monitoring in 2005 will be geared towards confirming or eliminating each of these causes.

Given the episodic nature of the issues in Cedar Lake, a highly responsive and flexible sampling schedule is necessary. Lake temperature, pH, DO, and conductivity profiles will be necessary, as well as the collection of deep water samples in Cedar Lake, and flow of the tributaries with a high resolution digital velocity meter to catch low flows. This requires the use of additional equipment, and professional staff.

### **Estimated Cost**

This proposed basic program is estimated to cost \$16,200.

### **Summary**

The proposed monitoring program continues the program in place since 1981, coordinates with other programs, and reflects input from the Board and citizens. Please feel free to call me at 763-479-4201 or Rebecca Kluckhohn at 763-479-4224 with any questions or comments that you may have.

A. A. 1

	Š
	AKE
	DIL
	CRWD
	N FOR
	ΓA
	ZG P
	ORIN
	M M
	ITY
	JALI
	RQI
	ATER (
	1 W/
	ERN
	G-T
	ron
	ED
	OPOS
	PRO
l	

LAK	AKE STATIONS <sup>(1)</sup>	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Clear	Clearwater Lake:														
The state of the s	Clearwater East	×	×	×	×	×	×	×	×	DNR	×	×	×	×	×
	Clearwater West	×	×	×	×	×	×	×	×	DNR	×	×	×	×	×
Main	Main Stem Lakes:			1	(4) j									4	
	Augusta	×		×		×		×	1	DNR		×		×	
	Louisa	×		×		×		×		TMDL/ DNR		×		×	
	Caroline		×				×		×	DNR	×		×		×
	Scott		×	X			X		X		×		×		×
	Marie		×		X		X		X	DNR	X		×		×
	Betsy	×		×		X		X		×		×		×	
Ofher	Other Lakes:			4											
	Cedar			×		×		×	×	X	×		×		×
	Pleasant	×		×	×				×	MPCA		×			×
	School Section	×		×	×				×			×			×
	Nixon	×		×		×			×			×			×
	Otter	×		×		×			X			×			×
	Bass		×	×		X				MPCA/ DNR		-		×	
	Clear		×	×	X			X		×			×		
	Union		X	×			X			MPCA			×		
	Henshaw		×	X			X			×		×			
	Little Mud			×			×				×			×	
	Wiegand			×			×			×				×	
	Swartout			×		-		X		×	×			×	
	Albion			×				X		X	×			X	
	Grass			×				×		DNR			×		
	Number of Lakes														
	Monitored W/														
	CRWD Funding	6	6	20	9	6	6	10	10	7	6	10	6	10	10
	Note.	(1) ake se	Plection	hased	on tota	l lake	size ra	nking s	cores (	selection based on total lake size ranking scores (Lake Priority Ranking, 1990)	Ranki	ng. 199	6		
		Commo						0				Ĝ			

## TABLE 2 Proposed 2005 CRWD Monitoring Plan Summary

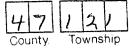
Category	Schedule	Station	Parameters
Lakes:	May 16 -17	The CRWD will monitor Clear, Betsy, Cedar, Henshaw, Wiegand, Swartout, and Albion)	Field: Secchi depth, DO and temperature profiles Lab: surface samples only for total
	June 20 - 21	Lake Louisa will be monitored through the TMDL Study (Clearwater, Augusta, Louisa, Caroline, Marie, Bass, and Grass Lakes will be	phosphorus, soluble reactive phosphorus, chlorophyll-a
	Jul 25 - 26 Aug 29 - 30	monitored by the DNR) (Bass, Pleasant, and Union Lakes will be monitored by the MPCA)	Citizen Secchi: fourteen sites not listed here
Streams	4/11/2005	WRO.2	Field: flows, DO and temperature Lab: total phosphorus, soluble
	5/2/2005 6/6/2005 7/11/2005 8/1/2005 9/5/2005	CR10.5 3 Cedar Lake Tributaries	reactive phosphorus
	Weekly	River Stage at CR10.5	
Precipitation:	Daily	Watkins, Marie Prairie and Corrinna	
Special:	4 events	Cedar Lake Synoptic Surveys	Tributaries Field: DO, temperature, conductivity, pH profiles; Lab: total phosphorus, soluble reactive phosphorus Lakes Field: DO, temperature,
			conductivity, pH profiles; Lab: 3 profile samples for total phosphorus, soluble reactive phosphorus, iron, chlorophyll-a

## Appendix B

## **Citizen Precipitation Records**



## MINNESOTA CLIMATOLOGICAL NETWORK





Range

Section

Name					County Name		Township Name						
Cla	arence a	nd Lue	lla Kl	ein	Meeker	1	Forest Prairie						
Address			***************************************		4,		Telephone No.						
41	7 Luella	a Street	, Unit	8, Watkins, MN 55389			20) 764						
	UR AMO		At the e	nd of each month, forward forms to:	REMARKS:	T	ype of G	iauç	ge: (Check C				
RAIN	SNOW	SNOW	Dei	Office of State Climatology partment of Natural Resources	Give times and comments about events.		Cyl.	X	Test Tube				
SNOW ETC INS	SNOW TENTHS GROUND	GROUND	Univer	sity of Minnesota, 279 North Hall	(Temperature and Phenology Items are very useful).		Wedge		Other				
& HDTHS)		(INCHES)	<u> </u>	St. Paul, Minnesota 55108	ttemo are very decide.				_ <del></del>				
			01										
			02										
			03										
			04										
			05										
			06										
			07				· · · · · · · · · · · · · · · · · · ·						
			08										
			09										
			10										
			11										
			12		· · · · · · · · · · · · · · · · · · ·								
			13										
			14										
			15										
			16						<del></del>				
			17										
		,	18	No.									
			19										
			20										
			21										
			22			<u> </u>							
			23										
			24										
			25	19 · ·					···				
			26			_,							
			27										
			28		· · · · · · · · · · · · · · · · · · ·			<u></u>					
			29										
11.2	7		30										
	•		31						<u></u>				
15	)		TOT	ALS									

MINNESOTA CLIMATOLOGICAL NETWORK

DEPARTMENT OF MARKET REPORTED				t of Natural of Forestry	Resources	05		11	7 #•	OCam (****pm	4	7	12		3 2	2 [	23
Name	<u> </u>					Year		lonth nty Na		Time	Co	unty	Towns		Rang Name		Section
Name (	OONY	Kle	2 \ \ \						ke.	^			Fo	nsnip Ne s	Name F	N cil	rie
								•						phone		<u> </u>	
3,	ID W	leck	2/ 19	Ave.	S $W$	<u>at Ki</u>	15	M	n 5	S 53	8	1	13	20	12	<u>64:</u>	264
	24-HOUR AMOUNTS REMARKS:  Rain Snow Snow Give times and comments									k One):		catch	opening	diame	ter/size	/inch	es)
Rain, Mehed Show,	Snow (ins. &	Snow	1	about events. (Temperature and Phenology items are very useful).		cylin		1		bucket			rum cato				
Etc. (Ins. & Hoths)	Tenths)	Ground (Inches)	(Ten					-		ghing ther			ruler/po				
		<u> </u>	01		<i></i>	wedg	16	<del></del>		u let							
			02							<del> </del>							
	<u> </u>		03						A				•				
	1	<del> </del>															
L.		<b> </b>	04				· · · · · ·										
,28			05									-					
			06								<u></u> -						
			07							. ,							
			08							•							
			09														
V			10														
,87			11											<u> </u>	:		
.73			12														·····
			13												<del></del>		
			14														
.02			15														
.17			16														
. 06			17														
- 00			18										•		<del></del>		
33	<b></b>		19		····································							<del></del>					
300		<del>                                     </del>	20							·		<del></del>					
		<u> </u> 	21											<del></del>	-		
			22						****								
		<del> </del>				· · · · · · · · · · · · · · · · · · ·											
			23	<u> </u>			<del> </del>										<del></del>
			24											<u> </u>			
-06			25														·
.12			26					<del> </del>									
			27														
(0)			28														<del></del>
			29														· · · · · · · · · · · · · · · · · · ·
			30							· · · · · · · · · · · · · · · · · · ·				<u>_</u>			<u></u>
			31														•
265	1		TO.	TALS		•											

						MINN	IESC	DTA CLI	MA	TOL	.00	SICAL	NET	WORK
M	Minne			nt of Natural Resources of Forestry	05	0	5	7 00 am	4	7		21	3	20
MENTAL MENORCE	:	וט	VISION	or Forestry	Year	Mor	L	Ob Time	<u></u>	unty	<u>ا</u> ا ا	ownship	Rang	
Name	$\sim$					County	Name	).		<u> </u>	Ť	Townshi		
(	Oar	y K 1	ein			M	2 e b	(er	-					CIPIC
Address 3	ON	leeka	A	ues Watkin	SM	n.	5	5389	1			Telephon		84-26
24-HO	UR AMO	UNTS	1	I THE WATER OF STATE		auge t		heck One):			<u>-</u> -			
Rain, tehed Show,	Snow (Ins. &	Snow On	Gi	ve times and comments about events.	cylinde			ping bucket					e (inches) es)	
Etc. (Ins.) & Hoths)	Tenths)	Ground (inches)	(Tei	mperature and Phenology items are very useful).	test tul	<del></del>	-	weighing						owyes
,02	<del></del>	(	01	librio de Very decidin.	wedge			Other			,			
100	···		02								· · · · · · · · · · · · · · · · · · ·	····/·		
			03											
			04		<del></del>			· · · · · · · · · · · · · · · · · · ·			·			
			05				• ,					· · · · · · · · · · · · · · · · · · ·		
	· · · · · · · · · · · · · · · · · · ·		06				*	endest		·				
	<del></del>		07			<del></del>	<del></del>					·		
.06			08	N	· · · · · · · · · · · · · · · · · · ·				<del></del>					
,,,,			09			· · · · · · · · · · · · · · · · · · ·			<del></del>					······································
			10		<del> </del>					·				
			11			***************************************								· · · · · · · · · · · · · · · · · · ·
.17	· · · · · · · · · · · · · · · · · · ·		12				**						•	
, o2		-	13											
, 22	·		14											
, , ,			15											
02			16											
,43			17			<del></del>				·	<del></del>	·····		<del></del>
,84			18		:			<del> </del>		•				***************************************
<u>*0  </u>			19											
			20				<del></del>	· · · · · · · · · · · · · · · · · · ·						
.18			21										· · · · · · · · · · · · · · · · · · ·	
10			22		· · · · · · · · · · · · · · · · · · ·									
			23							<del></del>				······
			24		·									
25			25								<del>.</del>			
,85			26		· · · · · · · · · · · · · · · · · · ·					· · · ·		<del></del>		
24			27											
.04			28					,						
002			29		••			**						
			30				····							
			31			~	<del></del>				·			
2.98			_	TALS	<del></del>									

MINNESOTA CLIMATOLOGICAL NETWORK Minnesota Department of Natural Resources 0 Division of Forestry Year Month County Township Range Section Name County Name Township Name Forest Prairie **Address** Telephone No. 24-HOUR AMOUNTS REMARKS: Gauge type (Check One) catch opening diameter/size (inches) Give times and comments Rain, Snow Snow cylinder tipping bucket about events. Mehed Show (Ins. & maximum catch depth (inches) \_ weighing (Temperature and Phenology test tube Etc. (Ins. Tenths) Ground board/ruler/post used for snow \_\_\_yes\_\_ & Hoths) (Inches) items are very useful). wedge Other 01 02 03 04 05 06 084 07 80 09 10 11 12 13 14 15 16 17 18 19 .48 20 21 22 23 24 , O'L 25 26 27 105 28 29 30 31 **TOTALS** 

manipul, office and Declaration Hall Hall and the at the second

MINNESOTA CLIMATOLOGICAL NETWORK Minnesota Department of Natural Resources Division of Forestry Year Month County Township Section Name County Name Township Name eeKel Forest Prairie Address Telephone No. 24-HOUR AMOUNTS REMARKS: catch opening diameter/size (inches) \_\_\_ Give times and comments Rain, Snow cylinder tipping bucket Vehed Show. (Ins. & about events. On maximum catch depth (inches) \_ weighing test tube Ground (Temperature and Phenology Tenths) Etc. (Ins. board/ruler/post used for snow \_\_\_\_yes \_\_ & Hoths) (Inches) items are very useful). wedge Other 01 02 03 04 05 06 07 80 09 10 11 12 13 14 15 16 17 18 19 ,4b 20 21 22 .82 23 24 25 26 27 28 29 30 31 TOTALS AND DESTRUCT A SHIP A SELECTION OF EASTERNING ADDRESS AND A SELECTION OF THE CASE OF THE PARTY O

NA-02732-07 MINNESOTA CLIMATOLOGICAL NETWORK Minnesota Department of Natural Resources Division of Forestry Month Ob Time Township Section Year County County Name.
Meeker Township Name Name Forest Prairie Address WotKinsMn 55389 Gauge type (Check One): **24-HOUR AMOUNTS** REMARKS: catch opening diameter/size (inches) \_ Give times and comments tipping bucket Rain, Snow Snow cylinder about events. maximum catch depth (inches) Vieted Snow, (ins. & On weighing test tube (Temperature and Phenology Etc. (Ins. Tenths) Ground board/ruler/post used for snow \_\_\_\_yes \_ & Hoths) (Inches) items are very useful). wedge Other 01 02 03 04 05 06 07 80 +08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

TOTALS

Page 1/1

Minnesot				en en ser grande de la companya de		Min	IŅE:	SOTA CLI	MA	TOLO	GICAL	NETW	ORK
M				t of Natural Resources of Forestry	03		9	700 am	19	7/	21	32	03
MENTAL REPORTED	3				Year		lonth	Ob Time	Co	unty	Township	Range	Section
Name (	oary	Kle	in				my Na 19	eker			1	stPa	airie
			AL	ies Wath	ins				39		Telephone 320	) 264	1-264
	UR AMO	1	Giv	REMARKS: ve times and comments				(Check One):		catch op	ening diam	eter/size (i	nches)
Rain, Meted Snow,		Snow		about events.	cylin- test t			tipping bucket weighing		maximu	m catch dep	th (inches)	
Etc. (Ins.   & Hoths)	Tenths)	Ground (Inches)	(1¢II	nperature and Phenology tems are very useful).	wedg			Other		board/ru	ler/post use	d for snow	yes
			01									····	
			02										
1,94			03										
			04										
			05										
.22			06										
			07										· · · · · · · · · · · · · · · · · · ·
.12			80							W. 27 7			
			09									,	
			10										
·			11					,					
3.14			12				_					<u> </u>	
			13										
			14										
			15										
			16										
102			17			·							
			18										
			19				<u>.</u>			· · · · · · · · · · · · · · · · · · ·			
			20									4 ************************************	
178			21					A-1-11-00 110 1 1 1 1 1 1 1 1 1 1 1 1 1 1					
			22										
			23										
,22			24										
			25										
			26		·								
.18			27										
			28					·					<del>-</del>
			29					···			!		
			30					`.					
, ; » <u>-</u>		<u> </u>	31	1									<u></u>
6.67		1	TO.	TALS					-		l. 0. <b>5</b> -	NANI 4	FF400 00

NA-02732-07 MINNESOTA CLIMATOLOGICAL NETWORK 00am Minnesota Department of Natural Resources Division of Forestry Year Month **Ob Time** Township Range Section County County Name Township Name Name Sary Klein Meeker Forest Ani Telephone No. Address 310 Meeker Ave S Watkins Mn **24-HOUR AMOUNTS** REMARKS: Gauge type (Check One): catch opening diameter/size (inches) Give times and comments tipping bucket Rain. Snow Snow cylinder maximum catch depth (inches) \_\_\_\_ about events. Method Show (Ins. & On weighing test tube Ground (Temperature and Phenology Etc. (ins. Tenths) board/ruler/post used for snow \_\_\_\_yes \_ & Hoths) (Inches) items are very useful). wedge Other 01 02 03 04 05 06 07 80 09 10 11 12 13 14 15 16 17 94 18 19 20 002 21 22 23 24 25 26 27 28

> 29 30 31

TOTALS

Sent by: WENCK ASSOC. 763 479 4242; 03/30/05 2:51PM;#772; Page 1/1 NA-02732-07

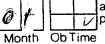
	•							MIN	NES	SOTA (	CLIM.	AT(	OLO	GICAL	NETY	VORK
W	Minne			t of Natural of Forestry		es	05	][1	1		am pm	4 7	7 1	21	3 2	0 3
STATE STATE							Year		nth	Ob Time	)	Coun	ty	Township	Range	
Name	arx 1	Klei.	Δ					Mo	y Nai	Ken				Fores	Prai	rie
Address	) Mp	-Krs	Aυ	es u	latri-	2 C	Mo	)			<i>55</i> 3	3 S	9	Telephor	10 No.	4-265
24-HC	OUR AMO	UNTS		REMAR	RKS:			Sauge :	type	(Check On			•			
Rain,	Snow	Snow	Gir	ve times and		s	cylinde	r	X	tipping but	cket	i i		oening diam		
Method Show, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Ter	about ev nperature ar		ΩУ	test tub	ю		weighin	g	i		m catch de iler/post us		
& Hoths)		(Inches)	i	tems are ver	y useful).		wedge			Other						
			01													
			02													
			03							<b></b>						
			04													
			05													
			06													
			07													
			08													
			09												<del></del>	
			.10										······································			<del></del>
			11													
1,23			12											<u> </u>		
			13			_				•						
			14													
• 32	75	175	15				<del></del>									
			16													
			17								·					
.12		O	18													
			19											-		
			20								·····	,	1		·	
		,	21							····	_,					
			22								<del></del>				·	
			23													
			24													
-22	2,75	2.75	25													
			26	ļ												
169		0	27												V	
166	2 25	2.25	28			<del></del>										
1 500	1 7-	0 (2	29 30			···						••••				
015	1,25	3,50	31				·					<del></del>			<del></del>	
3.30	7.00	3,50		rals				~ <del></del>			<del></del>			w —	<del></del>	<del></del>
C+-+- C	1:1	~441	- 400	n		:	£ . #			*^^* ! !-	<b>n</b>	. <b>-</b>	· ^:	) - O+ D		FF.00 C

MINNESOTA CLIMATOLOGICAL NETWORK Minnesota Department of Natural Resources Division of Forestry Ob Time Year Month County Township County Name Township Name Forest Prairie Address Gauge type (Check One): Give times and comments catch opening diameter/size (inches) Snow Rain, Snow tipping bucket cylinder about events. Method Show, (Ins. & On maximum catch depth (inches) \_\_ Etç. (Ins. & Hoths) test tube weighing (Temperature and Phenology Tenths) Ground board/ruler/post used for snow \_\_\_yes (Inches) items are very useful). wedge Other 01 02 3.75 ,04 1,50 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 TOTALS



### MINNESOTA CLIMATOLOGICAL NETWORK







Township

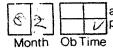
Range

Name					County Name		wnship Na	me		
	Viola N	ovotne			Wright	1	Corinna			
Address	S						lephone N		70	
9	9214 Ki	lbury A	venu	e NW, Annandale, MN 5530	2 -		320) 274			$\overline{}$
24-HC	UR AMO	DUNTS	At the	end of each month, forward forms to: Office of State Climatology	REMARKS: Give times and comments				e:(Check C	·
MELTED	SNOW	SNOW NO	D€	epartment of Natural Resources	about events.		Cyl.	X	Test Tube	
SNOW ETC INS	TENTHS.	GROUND (INCHES)	Unive	rsity of Minnesota, 279 North Hall St. Paul, Minnesota 55108	(Temperature and Phenology Items are very useful).		Wedge		Other	
<del></del>	1.	1.	01							
,60	'.	1:	! }	sey mow and	rein.					
ļ			02	/	»		· · · · · · · · · · · · · · · · · · ·			
			03							
			04							
			05							<del></del>
			06							
	<b>†</b>	<u>†                                     </u>	07							
			08							
	<del> </del>		09							
	<del>                                     </del>		10							
			11							
) 4/2	15,	5	12							
7-22	.   3 !	+>-	13							
	<del></del>	ļ	4							
-			14							
		-	15							
			16					<del>-</del>		
			17							
			18							
			19							
			20				· · · · · · · · · · · · · · · · · · ·		<del></del>	
7			21							
,61	8.	8	22							
101	1	1	23							
<u> </u>	1		24							
		+	25	<i>\$</i>						
	-	-	26							
	+	-								
	<del>- </del>	-	27							
		<del>                                     </del>	28							
			29							
			_  30							
,15	1.5	3	31							
1,7	8		TOT	ALS						

# Department of Natural Resources BY Division of Waters MAR - 3 2005

MINNESOTA CLIMATOLOGICAL NETWORK

0 \$







27 Range



1

Name Viola Novotne Windt Viola Novotne Windt Wright  Corinna  Telephone No. (320) 274-5179  24-HOUR AMOUNTS 24-HOUR AMOUNTS RAIN MELTED SNOW 19N5 A CHORD FIRM SHOW 19N5 A HOTHS INCHES HOTHS A HOTHS
9214 Kilbury Avenue NW, Annandale, MN 55302  24-HOUR AMOUNTS At the end of each month, forward forms to: Office of State Climatology Department of Natural Resources University of Minnesota, 279 North Hall St. Paul. Minnesota 55108  101  102  103  104  105  108  109  100  101  102  103  104  105  106  107  108  109  109  100  101  101  102  103  104  105  106  107  108  109  109  100  100  100  100  100
9214 Kilbury Avenue NW, Annandale, MN 55302  24-HOUR AMOUNTS At the end of each month, forward forms to: Othice of State Climatology MELTED SNOW INS & SNOW GROUND ETC INSTITUTE TENTHS A HOTHS)  01  02  03  04  05  06  07  08  09  10  11  12
At the end of each month, forward forms to:   Office of State Climatology   Operatment of Natural Resources   SNOW GROUND   STROTHS   SNOW GROUND   STROTHS   STROTHS   SNOW GROUND   STROTHS   STROTHS   STROTHS   STROTHS   SNOW GROUND   STROTHS
RAIN MELTED   SNOW NINS a HOTHS  SNOW A HO
SNOW   ETC   INS
BADTHS    SINCHES    SI. Paul. Minnesota 35100   Items die vol.   Cooker
02         03         04         05         06         07         08         09         10         11         12
03
04         05         06         07         08         09         10         11         12
05       06       07       08       09       10       11       12
06       07       08       09       10       11       12
07       08       09       10       11       12
08       09       10       11       12
09 10 11 12
10 11 12
11 12 -
12
13
48 15 15 15 14 BAIN + SNOW MIX
15
16
17
18
19
150 3.0 3 20
21
22
23
10 2.0 4 24
25
26
27
28
29
30
31
1.08 TOTALS



# MINNESOTA CLIMATOLOGICAL NETWORK

Month ObTime

County

Township

					County Name	Township Name
Name T	liola M	ovotne			Wright	Corinna
Addroop						Telephone No.
Address O	011 V;	lbury A	venue	NW, Annandale, MN 5530	)2 -	(320) 274-5179
24-HO	UR AMO	DUNTS	At the en	nd of each month, torward forms to.	UEIMAUUS:	Type of Gauge: (Check One
RAIN	SNOW	SNOW	Dor	Office of State Climatology	Give times and comments about events.	Cyl. X Test Tube
MELTED SNOW ETC INS	INS &	ON GROUND	Univers	sity of Minnesota, 279 North Hall	(Temperature and Phenology Items are very useful).	Wedge Other
& HDTHS)		(INCHES)	<del>                                     </del>	St. Paul. Minnesota 55108	none de ve, e	
			01			
		<u></u>	02			
			03			2
			04			
			05			
			06			
			07			
			08			
	<del>                                     </del>		09	,		
			10			
			11			
			12			
06	_	,5	13	RAIN SNOWMIX &	GLACY MELTED	
			14			
			15			
102	1,5	14	16			
			17			
			18			
			19			
			20			
			21			
			22			
			23			
			24			
			25			
			26			
			27			
			28			
			29			
			30			
.55	5 -		31			
0.6			ТОТ	ALS		

		• •										
0 5	á 4	am Upm	8	6	1	2	1	2	7	1	7	7
Year	Month	Ob Time	Col	unty	To	wnsl	hip	Ra	nge	Sec	ction	

ame Viola	Novotr				Cour Wri			-	Township Name Corinna
Address	*-		 /۱۱ م	V, Annandale, Min					Telephone No. (320) 274-5179
	OUR AMO		147	REMARKS:			· (Check One):		
Rain,	Snow	Snow	Gi	ve times and comments	cylinder	-,, ps	tipping bucket		pening diameter/size (inches)
Melted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Ter	about events. mperature and Phenology	test tube		weighing		m catch depth (inches) uler/post used for snowyesno
& Hdths)		(inches)	i	items are very useful).	wedge		Other	Doard/It	
			01						
			02						
			03						
			04						
			05						
,22			06						
			07						
			80						
			09					<del></del>	
.43			10						
.56			11						
84			12						
			13						
			14						
			15						
3⁴			16						
			17	-					
			18						
.25	ļ		19						
			20						
			21						
			22						
			23						
			24						
			25						
.16			26						
			27						
			28						
		ļ	29						
			30						
			31	14					
28			TO	TALS	~				

### MINNESOTA CLIMATOLOGICAL NETWORK

INITIAL	O . / \ O =								
0 5 2 5	am  // pm	8	6	1	2	1	2 7	J L	7
		_		_			D	Castian	

•					Year	Mor	nth	Ob Time	Co	unty	Township Range Section
Name						County		me			Township Name
Viola	Novotr	ie				Wrig	ınt				Corinna
Address	Kilhun	Δνερι	ıe N\^	/, Annandale, Mir	nesota	a 553	02				Telephone No. (320) 274-5179
	UR AMO		140	REMARKS:				(Check One):			
Rain,	Snow	Snow	Giv	e times and comments	cylinde			tipping bucket		catch o	ppening diameter/size (inches) 5 um catch depth (inches) 16
lelted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Ten	about events.  sperature and Phenology	test tul	be		weighing			ruler/post used for snow <u>// yesno</u>
& Hdths)	rentitio	(Inches)	it	ems are very useful).	wedge			Other		Doard	dicirpost doct for onest
.05			01	SHOW SUCA	LLS	OF	F	AND ON			
			02								
			03								
			04			-					
्०५			05								
./0			06								
			07								
y/wg			08						_		
30			09								
. 16			10			<u>:</u>					
			11								
36			12 13								
.07			14								
418			15								
<u>. 03</u> . つフ			16		****						
· '/_			17								
			18								
1.13			19								
دا ۱۰			20						<del></del>		
			21								
,20			22								
1.15			23								
\$\$5			24								
			25								
			26								
.35			27								
			28								
			29								
			30								
			31								
4.09			TO	TALS							

State Climatology Office, 439 Borlaug Hall, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108-6028

0 5 0 6 am	8	6	1	2	1	2	7	1	7	7

ame	1-,4-				real	County	y Na	me	County	Township Name Corinna
Viola I	vovotr	ie				Wrig	JIII			
Address 9214 I	Kilbury	Avenu	e NV	V, Annandale, Min						Telephone No. (320) 274-5179
24-HO	UR AMO	UNTS		REMARKS:				(Check One):	catch	opening diameter/size (inches)
Rain,	Snow	Snow	Giv	ve times and comments about events.	cylinde	er '	4	tipping bucket	maxin	num catch depth (inches) / 0
Melted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Ten	nperature and Phenology	test tul			weighing	board	/ruler/post used for snowyesno
& Hdths)		(Inches)	Ļ <b></b>	tems are very useful).	wedge			Other		
			01							
./0			02						<u> </u>	
			03							
.40			04							
, 33	***		05							
.44			06							
great to			07							
.96			80			<del></del>				
			09							
57			10		***	··				
.65			11							
)			12	_			-			
27			14							
97			15							
_/3			16						**	
		-	17							
			18							
			19			, ,,,,,,,,				
.55			20							
			21							
			22		-t					
			23				<u> </u>			
07			24							
			25							
			26							
, O2			27							
3.04	Ī		28							
.46			29							
03			30						·	
		ļ	31							
8,99			TO	TALS						

0 5 0 7	am L pm	8 6	1 2 1	2 7	1 7	7
				_		

				Year	Mo	nth	Ob Time	County	Township Range Section
Name Viola	Novotr	ne			County	y Name ght	e		Township Name Corinna
Address	Kilhury	. Δνεηι	ue NW, Annandale, l	Minnesot	a 553	k02			Telephone No. (320) 274-5179
	UR AMO		REMARKS:				heck One):		
Rain,	Snow	Snow	Give times and comment		- 1		pping bucket	catch c	pening diameter/size (inches)
Melted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	about events. (Temperature and Phenok			1	weighing		um catch depth (inches)
& Hdths)	renuis)	(Inches)	items are very useful).	wedge			Other	board/r	uler/post used for snowyesno
	-		01	11111	<u></u>	<b></b>			
			02						
,60			03						
			04						
			05						
			06						
			07		- · · · · · · · · · · · · · · · · · · ·				
			08						
			09		* *				
			10						
			11						
			12						
			13						
			14						
			15						
			16						
			17						
			18		<del></del>				
<i>A</i>			<del>                                     </del>						
1,20			21					· .	
			22		<u> </u>				
0.0			23						
92			24						
./2			25			<u></u>		·	
24			26				·····		
-4.			27						
			28						
			29				****		
			30		M-6		· · · · · · · · · · · · · · · · · · ·		
			31						
3.08	<u> </u>	<b>†</b>	TOTALS						

0 5 0 8 m 8 6 1 2 1 2 7 1	7 7
---------------------------	-----

				Year	М	<b>i</b> onth	Ob Time	County	Township Range Section
<sub>Name</sub> Viola	Novotr	ne				nty Na ight	me		Township Name Corinna
Address		, Aveni	ue NW, Annandale, M	linneset	2 55	302			Telephone No. (320) 274-5179
	OUR AMO		REMARKS:	<del></del>			(Check One):		(020) 214-0110
Rain,	Snow	Snow	Give times and comments				tipping bucket	ı	opening diameter/size (inches)
Melted Snow,	(Ins. &	On	about events. (Temperature and Phenolog				weighing		num catch depth (inches)
Etc. (Ins. & Hdths)	Tenths)	Ground (Inches)	items are very useful).	wedge			Other	board	/ruler/post used for snowyesno
			01		·		•		
			02						
,04			03						
.09			04				·		
			05						
			06						
			07						
10			08						
. /0			09						
			10						
•			11   12						
			13				-		
<u> </u>			14						
			15	· · · · · · · · · · · · · · · · · · ·			24,000		
			16						
02			17					,	
06			18						
			19						
			20						
			21						
			22						
1			23						
			24						
			25						
2.13			26						
			27				<del></del>		
			28						
			29						
			30	···					
	-		31	<u></u>					
2.44			TOTALS						

WR<sub>3</sub>00906-02 Rev. 3/01

			r—¬		т—	Г			Γ	1	
0 5 0 9	L pm	8	6	1	2	1	2	7	1	7	7

					Year	Month	Ob Time	Cou	inty t	ownship Range	Section
Name						County Na	me			Township Name	
Viola	Novotr	ie .				Wright				Corinna	
Address 9214	Kilburv	Avenu	ie NV	V, Annandale, Min	nesota	55302				Telephone No. (320) 274-517	9
	UR AMO			REMARKS:		,	(Check One):				
Rain,	Snow	Snow	Gi	ve times and comments	cylinde	er	tipping bucket			ning diameter/size (in catch depth (inches)	1
Melted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Ter	about events. nperature and Phenology	test tut	pe	weighing			er/post used for snow	
& Hoths)		(Inches)	i	tems are very useful).	wedge		Other				
			01								
			02								
90			03		·						
90 .15			04								
			05								
.35			06								
			07								
.28			80								
			09								
			10								
			11								
9 O			. 12					· · · · ·			
4.25			13								
			14		<u></u>						
			15				-				
			16								
		-	17								
s 2			18								
40		-	19								
			20								
***			21								
.72			23								
		1	24								
, 30			25								
, ) (			26			***					
i			27								
. 29			28								
7			29		.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	<u> </u>					
			30								
<b>)</b> —			31								
8.24		1	1	TALS					-		
U1 = 1		L	_ · •								

am	0		4	2	1		7	1	7	7
U J / V pm	0	O	1	2		2			_ <b>'</b>	<u></u>

					Year	Mo	onth	Ob Time	Co	unty	Township Range Section			
Name Viola	Novotr	ne				Coun Wri		me			Township Name Corinna			
Address											Telephone No.			
9214	Kilbury	ν Avenu	ie NV	V, Annandale, Min	nesota	550	302				(320) 274-5179			
24-HC	UR AMO	UNTS		REMARKS:		Sauge	type	(Check One):		aatab a	ananing diameter/aiza (inches)			
Rain,	Snow	Snow	Gi	ve times and comments about events.	cylinde	r		tipping bucket			opening diameter/size (inches) num catch depth (inches)			
Melted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Tei	mperature and Phenology	foot tubo i i wordhing i						oard/ruler/post used for snowyesno			
& Hdths)		(Inches)	i	items are very useful).	wedge			Other						
			01											
			02								· · · · · · · · · · · · · · · · · · ·			
	*		03											
·			04											
4.08		,	05											
			06											
			07											
			08											
			09											
			10											
			11											
			12											
.//			13			7					-			
			14											
			15											
			16											
.15			17											
			18											
			19											
			20	,										
			21											
			22											
7 <b>9</b>			23											
- :/			24											
			25											
			26											
			27											
			28											
			29											
			30											
42			31											
4.34			TO	TALS										

0 5	///	ar 12 pr	<sup>n</sup> 8	6	1	2	1	2	7	1	7	7
Year	Month	Ob Time	Co	unty	To	wns	hip	Ra	nge	Sec	ction	

					Year	Mon	ıtn	Oblime	Cou	y	Township Range Section			
Name Viola	Novet	٠				County		ne			Township Name Corinna			
	Novotr	IE				Wrig	rit	<del>, , , , , , , , , , , , , , , , , , , </del>		***************************************	Telephone No.			
Address 9214		Avenu	ıe NV	V, Annandale, Min	nesota	a 5530	02				(320) 274-5179			
	UR AMO			REMARKS:				Check One):			noning diameter/pize (inches)			
Rain, Melted Snow,	Snow (Ins. &	Snow On	Gi	ve times and comments about events.	cylinde		4	tipping bucket	1 1		ening diameter/size (inches) n catch depth (inches)			
Etc. (Ins.	Tenths)	Ground	(Ter	mperature and Phenology	test tube   weighing   boa						poard/ruler/post used for snowyesno			
& Hdths)		(inches)	01	items are very useful).	wedge	<u> </u>		Other	LL					
			01		·									
			02											
			03				·/		<del></del>					
			05											
			<del> </del>		······································	<del></del>					,			
			06						<del>, , , , , , , , , , , , , , , , , , , </del>					
			08											
			09						<del></del>					
			10											
			11											
			12											
.70			13			<del></del>								
7.70			14			<del>/</del>								
.49			15							<del> </del>				
.02	7	.7	16											
102		,, /	17			<del>*</del>								
			18			······································								
			19		<del></del>	<del></del>	<del></del>		·····	dunani and 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
			20											
			21											
			22			······································	**************************************		<del></del>					
			23											
			24		<del></del>		·····			·				
.39	4,	4.	25			· · · · · · · · · · · · · · · · · · ·								
1601	. ,	<u> </u>	26											
,			27											
.70		-	28	BAIN					-					
,20	13	.3	29	BAIN +	S N / :	111	M	1 ×						
1,40			30		1311	<u> </u>		^ ^	<del></del>					
			31											
2.55		<u> </u>	1	TALS			<u></u>							
	i	1	, . •	<del> </del>										

0 5	12	am i pm	8 6	1 2 1	2 7	1 7	7
Vana	Manth	Oh Timo	County	Township	Danna	Section	

lame Viola	Novotr	e				nty Na			Township Name Corinna		
Address			ie NV	V, Annandale, Min					Telephone No. (320) 274-5179		
	UR AMO		·	REMARKS:	7.		(Check One):				
Rain,	Snow	Snow	Gi	ve times and comments about events.	cylinder		tipping bucket		ch opening diameter/size (inches)		
letted Snow, Etc. (Ins.	(Ins. & Tenths)	On Ground	(Ten	nperature and Phenology	test tube	igsquare	weighing		rd/ruler/post used for snowyesno		
& Hdths)		(Inches)		tems are very useful).	wedge		Other				
,07	1.7	1,5	01								
			02								
			03					:			
.04	2.	3.	04	LIGHT FL	UFFY S	5N 0	w.		•		
			05								
			06								
			07								
			08								
			09								
			10					-			
	· · · · · · · · · · · · · · · · · · ·		11								
			12								
			13	·							
.30	7.5	9.	14								
114	2,	10.	15								
. 10	1.5	11	16								
			17								
			18								
, , , , , , , , , , , , , , , , , , ,			19			······································					
			20		<u> </u>	<u> </u>					
			21								
,			22								
			23								
			24								
			25				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
			26								
			27			<del></del>					
<del></del>	<b> </b>	<del> </del>	28					***************************************			
		<del> </del>	29								
30	5,0	1	30								
700	310	6.	31								
0.95	<del> </del>	<u> </u>	.1	TALS		<del></del>					

# **Appendix C**

# Historical Mean Flow, Mean Phosphorus, and Phosphorus Loading

## TABLE 1 HISTORICAL SUMMARY OF STREAM FLOWS, PHOSPHORUS CONCENTRATIONS, AND LOADINGS

		Avazaga Stroom	- Flore	Average Total Phosphorus	Total Dhamba	Y
Station	Year	Average Stream (cu m/sec)		Concentration	Total Phosphor	
Main Stem:	i cai	(cu m/sec)	(cfs)	(mg/l)	(kg)	(lb)
CR 28.2	1981 (1)			1.40		
OK 20.2	1982 (1)	0.93	32.8	0.74	19,700	43,500
	1983	2.62	92.6	0.92	76,000	168,000
	1984	1.49	52.6	0.76	35,700	78,800
	1985	2.32	81.9	0.90	65,500	144,000
	1986	3.20	113	0.78	55,200	122,000
	1987	0.11	3.90	0.13	460	1,020
	1988	0.09	3.12	0.66	1,850	4,080
	1989	0.02	0.72	0.19	120	260
	1990	0.51	18.0	0.44	7,040	15,500
	1991	1.11	39.1	0.29	10,200	22,500
	1992	0.26	9.30	0.20	1,660	3,650
	1993	1.28	45.2	0.29	11,600	25,600
	1994	1.17	41.2	0.28	10,100	22,300
	1995	1.15	40.4	0.29	10,400	22,900
	1996	0.33	11.7	0.27	2,860	6,300
	1997	0.27	9.36	0.26	2,170	4,790
	1998	0.41	14.4	0.25	3,190	7,020
*	1999	0.08	2.78	0.16	400	. 870
	2000	0.02	0.72	0.38	240	530
	2001 (4),(5)	0.27	9.46	0.51	4,309	9,500
	2002	0.47	16.50	0.29	4,290	9,460
	2003	0.28	9.92	0.19	1,710	3,770
	2004	0.48	17.04	0.17	1,248	2,751
	2005 (6)	1.11	39.28	0.31	1,862	4,105
	2003 (0)	1.11	37.20	0.51	1,002	4,105
CR 10.5	1981 (1)	1.15	40.6	0.05	2,060	4,550
010 10.5	1982 (1)	2.20	77.8	0.07	4,990	11,000
	1983	5.64	199	0.10	18,500	40,800
	1984	4.28	151	0.05	6,620	14,600
	1985	3.88	137	0.14	16,700	36,800
	1986	5.52	195	0.15	23,700	52,300
	1987	0.46	16.2	0.04	600	1,320
	1988	0.23	7.95	0.04	260	580
	1989	0.97	34.2	0.08	2,340	5,150
	1990	3.77	133	0.03	3,060	6,750
	1991	6.68	236	0.05	10,500	23,200
	1992	4.16	147	0.06	8,090	17,800
	1993	5.01	177	0.04	6,330	14,000
	1994	2.92	103	0.03	2,850	6,290
	1995	2.83	100	0.03	3,040	6,710
	1996	1.53	54.2	0.04	1,970	4,350
	1997	2.06	72.8	0.04	2,690	5,940
	1998	1.78	63.0	0.04	2,330	5,120
	1999	1.25	44.1	0.04	1,520	3,350
	2000	0.31	10.8	0.03	280	610
	2001 (4),(5)	0.90	31.7	0.03	850	1,873
	2002	2.46	87.0	0.04	2,950	6,500
	2003	2.11	74.6	0.024	1,590	3,500
	2004	1.66	58.8	0.022	639	1,409
	2005 (6)	3.05	107.6	0.023	59	130
	(*)		· · <del>-</del>	= : - :: <b>-</b>		

### TABLE 1 HISTORICAL SUMMARY OF STREAM FLOWS, PHOSPHORUS CONCENTRATIONS, AND LOADINGS

#### Clearwater River Watershed District

				Average Total Phosphorus		
		Average Stream	1 Flow	Concentration	Total Phosphor	us Load
Station	Year	(cu m/sec)	(cfs)	(mg/l) _	(kg)	(lb)
Tributaries:						
WR 0.2 (2)	1981 (1)	0.07	2.60	0.17	390	860
	1982 (1)	0.23	8.20	0.16	780	1,720
	1983	0.47	16.50	0.09	1,270	2,800
	1984	0.60	21.20	0.05	950	2,100
	1985	0.48	17.10	0.14	2,130	4,700
	1986	0.86	30.40	0.20	4,630	10,200
	1987	0.04	1.50	0.07	100	230
	1988	0.01	0.40	0.17	60	130
	1989	0.03	1.19	0.14	80	180
	1990	0.06	2.28	0.37	750	1,660
	1991	0.26	9.22	0.11	860	1,900
	1992	0.11	4.02	0.05	170	370
	1993	0.24	8.59	0.10	760	1,670
	1994	0.18	6.34	0.06	320	700
	1995	0.12	4.27	0.05	210	460
	1996	0.05	1.78	0.11	180	380
	1997	0.09	3.15	0.08	220	480
	1998	0.09	3.11	0.11	290	650
	1999	0.06	2.03	0.07	130	280
	2000 (3)	0.01	0.44	0.06	25	56
	2001 (4),(5)	0.08	2.88	0.10	257	567
	2002	0.26	9.17	0.11	930	2,060
	2003	0.16	5.79	0.06	320	710
	2004	0.07	2.6	0.06	78	172
	2005	0.58	20.6	0.07	22	48

NOTES:

Flow values are time-weighted averages unless otherwise noted.

Total phosphorus values are flow- and time-weighted averages unless otherwise noted.

- (1) Values in 1981 and 1982 are arithmetic means
- (2) Station WR 0.2 was designated Station WC 0.2 in 1981-1983
- (3) Phosphorus values in 2000 are flow-weighted and adjusted per log-log regression on flow so as to correspond to annual mean flows.
- (4) 2001 Flow and total phosphorus values are arithmetic averages.
- (5) 2001 total phosphorus loads estimated from arithmetic averages of flow and total phosphorus values.
- (6) Values in 2005 were calculated using suplimental flow data from CSAH 40 near Clearwater

# Appendix D

# **Lake Historical Data**

	Number of Samples	Phosph Mean (3)		ug/l) . Dev.			ll-a (ug/l)		hi Disk trency (m) Std. Dev
	Samples	Ividan (5)	514	. 15011					
<u>ALBION</u>									
1996	4	130		24	20	4	224	0.5	0.3
1999	4(5)	220		65	168	3.7	72	0.8	0.0
2003	4	199		78	11		73	1.0	
2005	4	248		182	60	)	44		
Mean		199	WWW.northumbe	87	13	7	103	0.8	0.1
<u>AUGUSTA</u>									
1981	7	260		400	25		14	1.4	0.3
1982	7	140		120	34		21	1.4	0.6
1983	7	300		90	4		3	1.8	1.0
1984	7	90		30	4		2	1.6	0.8
1985	7	120		120	23		12	1.2	0.2
1986	6	90		40	69		91	1.9	0.5
1987	7	30		10	20		12	1.3	0.3
1988	5	40		10	19		6	1.4	0.3
1989	6	80		30	20		40	1.5	0.4
1990	5	90		20	7.		105	1.7	0.7
1991	3	80		40	50		73 6	1.1 1.6	0.4 0.7
1992	8	30		20	19		19	1.0	0.4
1993	4(1)	68 28	(4)	20 15	42		12	1.8	0.7
1995	4 (2) 4	28 46	(4) (4)	13	20		12	1.7	0.2
1997	4(6)	37	(4)	4	8.		2.7	1.6	0.2
1999	2	48		6	6.		0.0	1.8	0.0
2001 2002	swcd	84.3		U	13		0.0	1.9	0.0
2002	3	42		15	2		23	1.5	
2003	<u> </u>	- Hills to held State of Angelog Constitution	************	(total control to the	CORPORATION OF THE PARTY OF	Tarrie Cara and a rest of the	PROPERTY OF THE PROPERTY OF TH	indexicações a transférir indicatementa de acementar a telefora	entropy was represented the light and a
Mean		90		56	2	7	25	1.5	0.4
<u>BASS</u>									
1994	4	13	(4)	14	4		0.8	3.2	0.4
1998	4	28		11	2		1.0	3.1	0.6
1999	3	22		5	2		1.4	3.1	0.7
2001	2	25	entrante de antes esta	4	2	. 7 estrov <del>aloria (artiklari (b.</del> 14	1.0	4.2	1.8
Mean		22		9	3.	1	1.1	3.4	0.9
<b>BETSY</b>									
1981	7	700		190	7.	7	5.6	2.4	1.1
1982	7	650		90	5	9	50	1.3	0.7
1983	7	560		270	5	;	4	1.1	1.3
1984	7	350		160	7	7	5	0.8	0.2
1985	7	280		230	3		26	1.1	0.6
1987	2	120		0	7		35	0.87	0.41
1995	4 (2)	290		183	ŀ		13	1.0	0.34
1997	4	245		108	10			0.83	0.05
1999	3(8)	247		110		70	85	0.8	0.2
2001	2	420		368		.3	1	0.46	0.0
2003	4	194	namenija je nestanovi a žagravoje indexa	78		5.0	52.0	1.3	* Marit Marie Control of the Control
2005	4	140		58		0.0	11.4		
Mean		350		154	4	15	32	1.1	0.5

		N 1. C		otal	CI.1	t11 - (/1)		hi Disk
		Number of		rous (ug/l)		hyll-a (ug/l)		arency (m)
CAROLI	NIE	Samples	Mean (3)	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<u>CAROLI</u>	<u>NE</u>							
1981		7	220	100	39	33	1.3	0.3
1982		7	260	140	54	35	1.4	0.8
		7				3		1.1
983			300	140	3		1.8	
1984		7	140	50	5	2	1.3	0.3
1985		7	170	150	41	46	1.5	0.6
1987		2	50	10	46	30	1.1	0.4
1994		4	40	18	55	16	0.8	0.2
1996		4	88	33	36	12	1.2	0.2
1998		4	86	24	55	43	1.2	0.1
2001	(SCWD)	5	43	18	12	10	1.8	0.8
2002	(/		95		45		1.6	
2003	(SCWD)	5	66		28.6		1.5	
2004	(50 11 1)	4	45	8	25	18	1.1	0.0
		•	A PROTECTION TO THE OF THE PROPERTY OF THE PRO	hamilto zum meden och mandrydet dille ett samet-	government of the Parish and the State of th	and the second s	Control of the second s	HALLANDERSPORTER AND ALL SECTION AND ALL
Mean			123	63	34	23	1	0
CEDAR								
1993		4	30	10	13.3	5.9	3.0	0.4
996		4	33	8	12.9	6.5	2.4	0.3
999		4	31	8	9.5	4.4	1.1	0.3
001		2	26	5	5.9	1.0	1.8	1.4
						6	1.9	1.7
2003		4	52	41	11.0			1
004		4	33	15	3.0	3	2.6	1 readir
005		5	37	11	9.0	4		
<b>Aean</b>			35	14	9	4	2	0.6
CLEAR								
1994		4	80	24	17	8	1.2	0.3
1998		4	220	141	110	141	1.0	0.1
999		4	188	43	85	47	0.5	0.0
2000		4	228	30	134	42.6	0.3	0.1
2003		4	200	52	72	23	0.7	
2005		4	307	107	60	82	and the organization of the contract of	Person accommodate trades - 100 person
∕lean			204	66	80	57	0.7	0.1
	VATER EAST	r						
.981	, ALLK DASI	7	60	20	11	8	2.6	0.7
982		7	60	30	12	9	2.7	1.6
983		7	90	50 50	3	2	2.7	1.8
						2	1.4	0.2
984		7	90	40	4	20		
985		7	130	60	39	28	1.2	0.3
986		6	80	40	85	132	2.1	0.8
987		7	30	10	18	20	2.6	1.2
988		5	40	10	10	5	2.9	1.8
989		6	60	20	5	4	3.0	1.9
990		5	90	100	18	9	2.0	0.6
991		3	50	20	10	7	1.4	0.2
992		8	30	10	20	10	2.0	0.6
993		4(1)	43	15	42	38	1.5	0.8
994		4	23	5	14	9	1.4	0.2
995		4 (2)	30	8	16	10	1.6	0.4
996		4	33	8	10	3	2.1	0.3
990 997		4	52	17		5) 2	1.6	0.2
			36		11	3	1.9	0.4
998		4 (6)		18				
999		4	54	6	10	2.1	1.8	0.2
.000		4	33	18	10	3.4	2.3	1.0
		2	40	25	7	0.0	2.4	0.7
2001			36		14		1.8	
.001 .002			30					
001 002 003		3	22	5	7	6	2.4	
.001 .002		3 4	29 	5 13 exzención orden a contracto de la Ambiente en tracto de la Ambiente en tractor de la Ambiente		6 3 ***********************************		0

		T.	s+a1			Secchi Disk		
	Number of	Total Phosphorous (ug/l)		Chlorophyll-a (ug/l)		Transparency (m)		
	Samples	Mean (3)	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
OF EADSUATED WI		` '						
CLEARWATER WI	<u> </u>							
1981	7	60	20	45	71	2.6	0.9	
1982	7	100	60	29	25	1.7	0.7	
1983	7	160	100	4	5	1.8	1.4	
1984	. 7	70	30	4	2	1.4	0.2	
1985	7 .	110	80	24	17	1.9	1.3	
1986	6	50	20	77	137	2.6	1.0	
1987	7	40	10	20	12	2.0	0.4	
1988	5	40	10	17	10	2.6	1.2	
1989	6	70	10	8	4	2.3	0.9	
1990	5	50	20	31	15	1.9	0.8	
1991	3	60	40	18	12	1.5	0.0	
1992	8	60	70	29	24	1.9	0.6	
1993	4(1)	40	0	29	6	1.4	0.3	
1994	4	33	15	17	8	1.5	0.2	
1994	4(2)	35 35	11	21	10	1.4	0.3	
			11	9	2	2.0	0.3	
1996	4	43				1.5	0.3	
1997	4	44	3	13	6		0.1	
1998	4 (7)	34	11	14	3	1.5		
1999	4(6)	31 .	4	10.2	2.0	1.6	0.3	
2000	4	41	31	9	2.9	1.9	0.4	
2001	2	42	11	8	1.0	1.4	0.0	
2002		42	_	18		1.9		
2003	3	27	9	14	9	2.2		
2004	4	26	8 Marie de la companya	7	4	1.7	0.0	
Mean		55	25	20	17	2	1	
<u>GRASS</u>								
1996	4	38	26	. 12	5	1.9	0.5	
1998	1 -	30	0					
1999	4	25	2	14	9.3	1.9	0.4	
2003	2	24		1		2.9	gynny v ny ny ny hand a pagamagan a anangan y 1800 di 1	
Mean		29	8	13	7	1.9	0.4	
HENSHAW								
1995	4	270	58	238	67	0.4	0.1	
1998	4 (5)	150	48	53	22	0.9	0.2	
1999	4	295	156	136.3	166	0.9	0.1	
2002	7	210	100	103.0	100	0.7	0,1	
2005	5	281	177	144.0	137.9	ne antoniument d'électro-mé	enticipationismi entreprise pre-	
Mean		241	110	135	98	0.7	0.1	
I YOU'S TO MAKE								
LITTLE MUD								
1995	4	55	50	36	38	1.6	0.5	
1999	3	62	42	4.5	4	2.1	0.1	
2002		49	ione dystice Mass of calculations and a minimal and the contract of the contra	21.0	iii igi elekeykelisikka narganarengkhiran olovelok yarensanar	1.4	Personal Control of Control of the State of the Control of the State of the Control of the State of the Control	
Mean		55	46	20	21	1.7	0.3	

### Clearwater River Watershed District

			otal			Secchi Disk	
	Number of		rous (ug/l)	Chlorophyl			rency (m)
	Samples	Mean (3)	Std. Dev.	Mean S	td. Dev.	Mean	Std. Dev.
<u>LOUISA</u>					- 0		0.4
1981	7	440	110	39	29	1.4	0.4
1982	7	420	140	68	26	1.5	0.5
1983	7	410	170	4	4	1.4	1.4
1984	7	220	80	8	6	1.0	0.1
1985	7	160	100	26	17	1.1	0.3
		190	50	96	86	1.1	0.1
1986	. 6				44	0.8	0.2
1987	7	100	10	70			0.2
1988	5	140	60	101	39	0.6	
1989	6	110	40	69	78	0.8	0.5
1990	5	200	80	55	35	1.3	0.5
1991	3	160	70	31	18	1.5	0.3
1992	8	140	140	46	22	1.1	0.3
1993	4(1)	170	40	35	13	1.2	0.2
		100	36	75	27	0.8	0.2
1995	4 (2)				8	0.9	0.2
1997	4	68	7	59 (5)		1	0.1
1999	4	73	29	37.8	20		0.1
2001	2	33	30	5.1	4	0.9	
2003	3	100	13	68	28.0	1.1	and the state of the state of the state of
		e justificiae consedido de a manchemora.	anacaning considerate is consistently for the consistent of the consistent of the consistency of the consist		Page 1981/1971 School of the San		
Mean		180	67	50	28	1.1	0.3
<u>MARIE</u>							
1981	7	270	130	31	19	1.3	0.5
1982	7	360	120	63	57	1.3	0.6
1983	7	340	160	4	4	0.9	0.3
1984	7	190	60	7	5	0.9	0.3
	7	230	210	34	14	1.0	0.2
1985				92	91	1.1	0.1
1986	6	160	30			0.6	0.1
1987	7	120	30	95	30		
1988	5	220	80	153	91	0.4	0.1
1989	6	120	40	58	. 54	0.6	0.4
1990	5	150	60	101	33	0.8	0.2
1994	4	90	99	71	19	0.6	0.1
1996	4	100	39	37	5	0.8	0.1
	4	76	15	56	12	1.1	0.1
1998				13.5	7.7	2.3	1.0
2000	4	74	18		1.1	1.2	1.0
2002		70		37.0			
2003	3	87	50	81		1.3	en e
2004	4	84	45	34	16	1.1	0.0
2001							
Mean		166	76	58	34	1.0	0.3
		166	76	58		1.0	
Mean NIXON	4			58 5.0 (4)	3.4	1.8	0.7
Mean NIXON 1994		25	(4) 25	5.0 (4)	3.4	1.8	0.7
Mean NIXON 1994 1997	4	25 30	(4) 25 8	5.0 (4) 4.7 (5)	3.4 1.5	1.8 2.8	0.7 0.2
Mean  NIXON  1994 1997 1999	4 4	25 30 39	(4) 25 8 17	5.0 (4) 4.7 (5) 7.0	3.4 1.5 8.7	1.8 2.8 3.3	0.7 0.2 0.5
Mean  NIXON  1994 1997 1999 2001	4 4 2	25 30 39 21	(4) 25 8 17 1	5.0 (4) 4.7 (5) 7.0 5.6	3.4 1.5 8.7 3.0	1.8 2.8 3.3 3.2	0.7 0.2 0.5
Mean  NIXON  1994 1997 1999	4 4	25 30 39	(4) 25 8 17	5.0 (4) 4.7 (5) 7.0	3.4 1.5 8.7	1.8 2.8 3.3	0.7 0.2 0.5

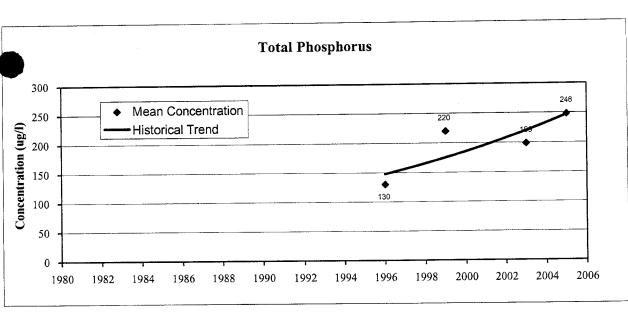
		Tota	1			Seco	chi Disk
	Number of	Phosphorou		Chlorophy	ll-a (ug/l)	Transp	arency (m)
	Samples		Std. Dev.		td. Dev.	Mean	Std. Dev.
OTTER	Sumples	1110411 (3)					
OTTER							
1994	4	13 (4)	4	7.8	1.8	1.9	0.3
	4	23	10	3.7 (5)	1.5	2.1	0.3
1997		34	5	6.6	4.8	3.0	0.4
1999	4					2.8	0.4
2001	2	30	22	4.0	1.0		0.0
2004	4	16	10	3	2	2.2	U.U MARINERE DESCRIPTION OF THE PERSON OF TH
				_	_	_	
Mean		23	10	5	2	2	0
PLEASANT							
1993	4	15 (4)	9	12	8	2.0	0.6
1997	4	51	31	9 (5)	2	2.4	0.6
1999	4(6)	<u>25</u>	<u>5</u>	<u>9.1</u>	<u>5.8</u>	<u>3.0</u>	<u>0.9</u>
2004	4	$\frac{\overline{20}}{20}$	9	4	1	2.3	0.0
200.	•		out which the finished with the market to be the first of	HELLOCOMOS SECURILLA DOS QUARANTES A SEL SEL PROGRAMAS	A New York Committee of the Property of the Committee of	MATERIAL CONTRACTOR OF SERVICE SERVICES	Programme de Portugues de Programme de La constant
Mean		27.8	13.5	8.4	4.3	2.4	0.5
Mean		27.0	13.3	0.1	1.5		
SCHOOL SECTION							
SCHOOL SECTION							
		25 (4)	20	1.4	٥	2.2	0.8
1993	4	35 (4)		14	9		
1997	4	29	9	11 (5)	5	1.6	0.4
1999	4(5)	<u>50</u>	<u>12</u>	<u>12.6</u>	<u>10</u>	1.0	0.5
2004	4	21	9	3	2	2.0	0.0
Mean		38	20	12.4	7.8	1.6	0.6
<u>SCOTT</u>							-
1981	7	660	340	26	27	1.9	0.9
1982	6	540	220	57	39	1.4	0.7
1983	7	450	170	3	3	1.2	1.4
1984	7	270	100	6	5	0.7	0.1
1985	7	260	280	35	29	1.1	0.5
				94	71	0.7	0.1
1994	4	160	117	223	68	0.7	0.1
1996	4	280	174			0.3	0.1
1998	4 (5)	230	176	141	77		0.1
1999	3	223	163	76	30	0.6	U. 1
2002		210		103		0.7	
2003	4	158	52	66	33	0.8	2.2
2004	4	103	20	51	4	0.8	0.0
		IAA IIA Sanda I SANDA II AA	NATIONAL PROPERTY AND	THE PERSON NAMED IN COLUMN TO SERVICE AND ADDRESS OF THE PERSON NAMED IN COLUMN TO SE			
Mean		295	165	. 73	35	0.9	0.4
<b>SWARTOUT</b>							
~ · · · · · · · · · · · · · · · · · · ·							
1996	4	370	181	173	164	1.0	0.7
1999	4(6)	200	75	151	91	0.7	0.2
2003	4(0)	421	293	444	524	0.9	
	4	278	41.8	144	53	AND A SECURITY PROPERTY AND THE PARTY.	and on the communication and action with the second
2005	4	410	41.0	177	55		
M		217	140	220	208	0.9	0.5
Mean		317	148	228	208	0.9	0.5

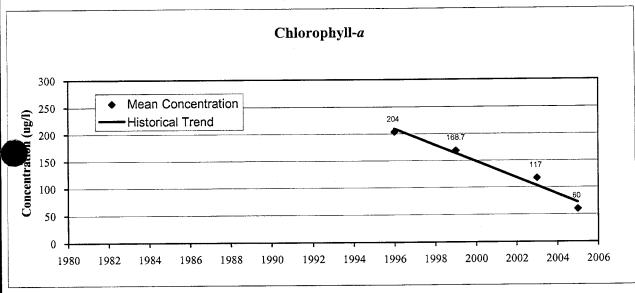
#### **Clearwater River Watershed District**

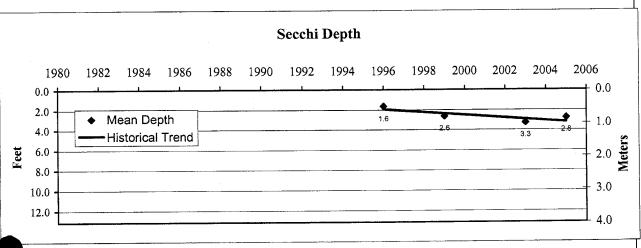
	Number of		otal rous (ug/l)	Chloro	ohyll-a (ug/l)	Secchi Disk Transparency (m)	
	Samples	Mean (3)	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<u>UNION</u>							
1995	4	43	15	15	1	1.4	0.3
1998	4 (5)	50	27	16	9	1.7	0.4
1999	3	31	15	12.4	10	1.8	0.9
2002		88	general ment were any analysis for experience and the control of t	39.0	atoria ka 1855a ka 1888a ta 1880a ta 1885a ta 1	1.0	sortedesignates of the second of the second
Mean		41	19	14	7	1	1
WIEGAND							
1995	4	35	5	12	2	1.7	0.2
1999	4(5)	61	44	6.4	1.1	2.4	0.6
2002		37		5.3		3.0	namentar namentario del como establica e establica e establica e establica e establica e establica e establica
2005	4	31	4	3.0	1.9		The second secon
Mean		41	18	7	2	2.4	0.4

#### Notes:

- (1) The fourth sample was collected on October 6, 1993.
- (2) The fourth sample was collected on October 2 or 3, 1995
- (3) Starting in 1993, Total phosphorus means are rounded to two significant figures. Prior to 1993, the mean values were rounded to the nearest 10 ug/l.
- (4) Values reported as "Less than" the detection limit were estimated as half of the detection limit.
- (5) Three samples were analyzed for chlorophyll-a.
- (6) Three samples were analyzed for total phosphorus.
- (7) Three secchi disk readings were recorded.
- (8) One secchi disk reading was recorded.





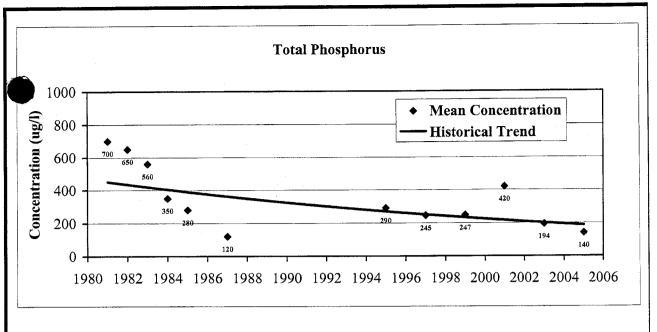


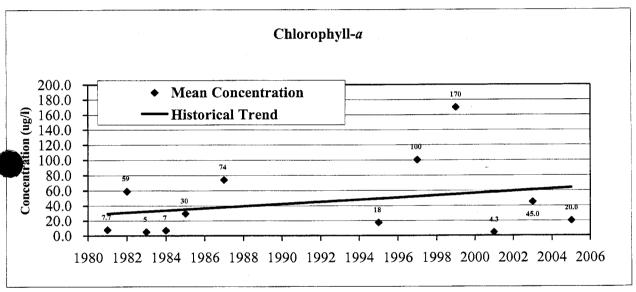
Clearwater River Watershed District

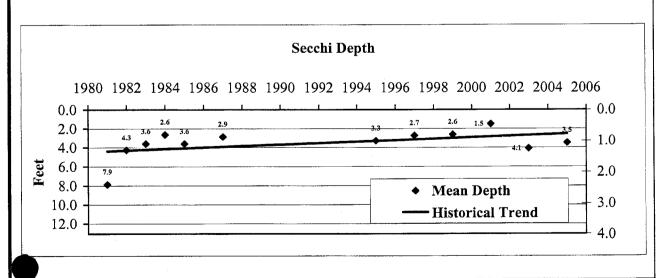
Lake Albion Historical Data

Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359

Figure 1







Jan 2006

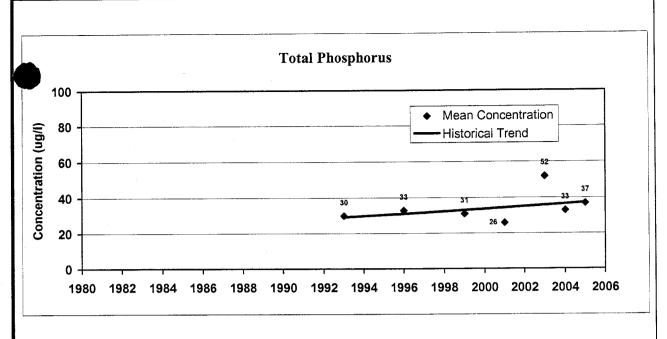
Figure 2

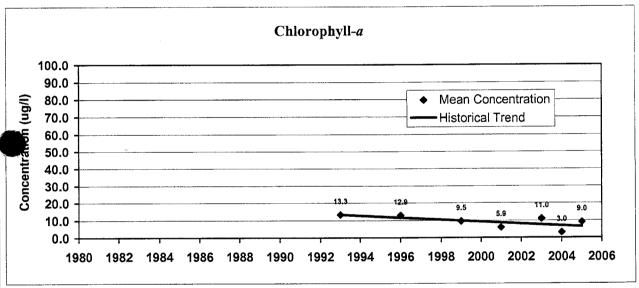
Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359

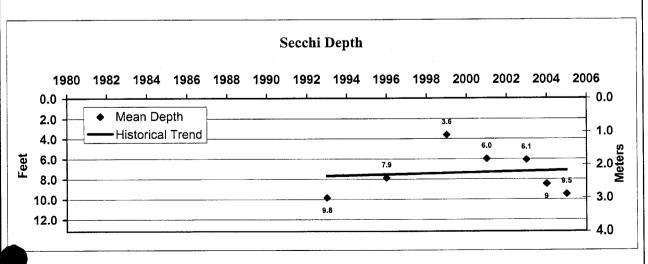
T:\0002\58\report\LAKE\_WQ\_05\Lake Betsy.xls

Clearwater River Watershed District

Lake Betsy Historical Data







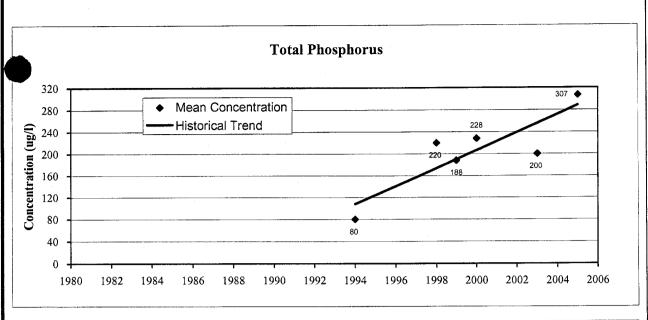
Clearwater River Watershed District

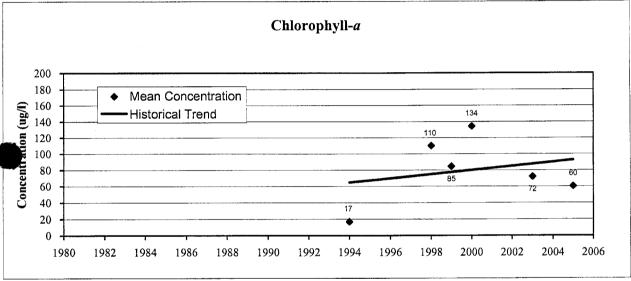
Cedar Lake Historical Data

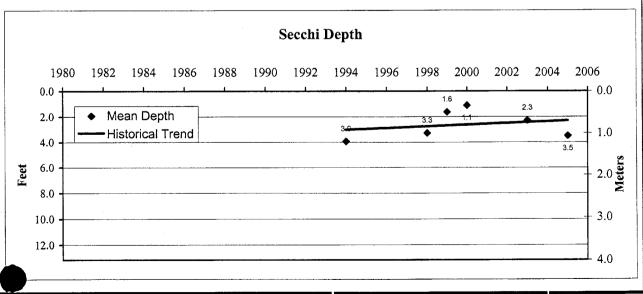
Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359

Jan 2006

Figure 3







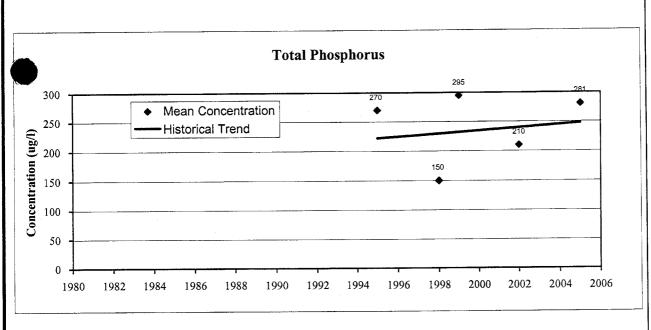
Clearwater River Watershed District

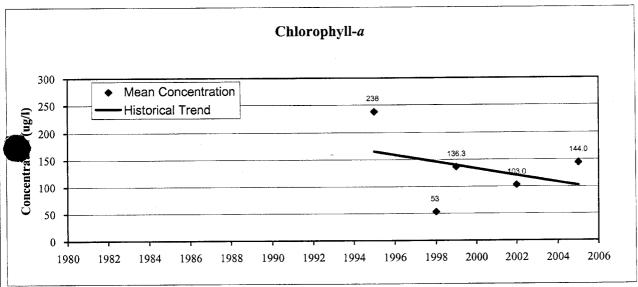
Clear Lake Historical Data

Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359

Jan 2006

Figure 4





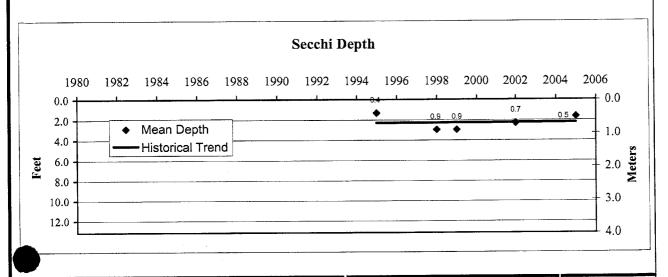
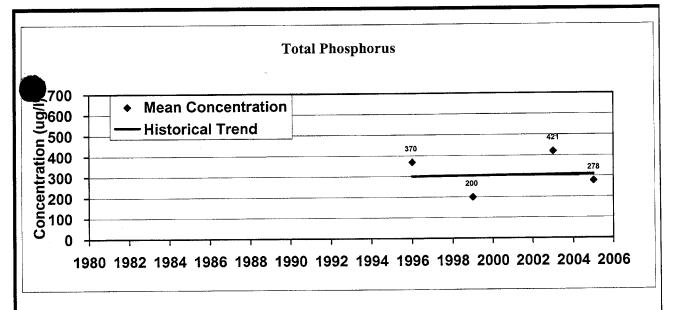
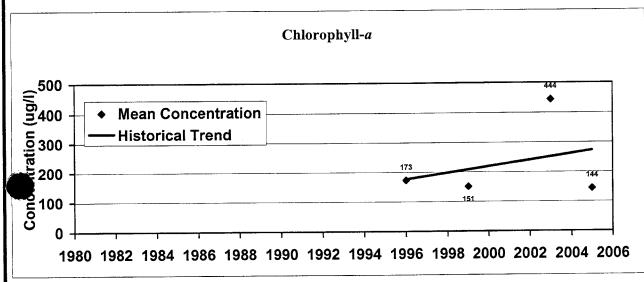


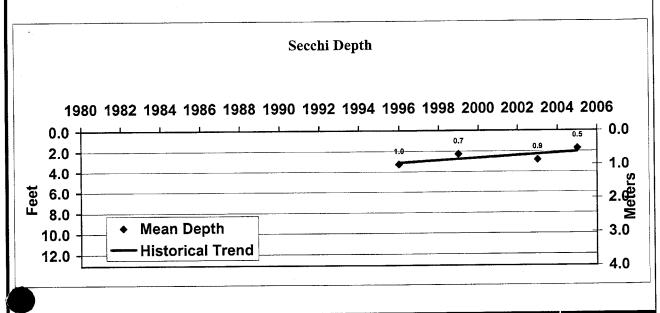
Figure 5

Clearwater River Watershed District

Henshaw Lake Historical Data





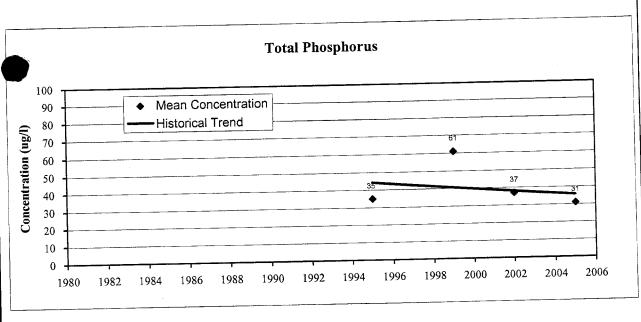


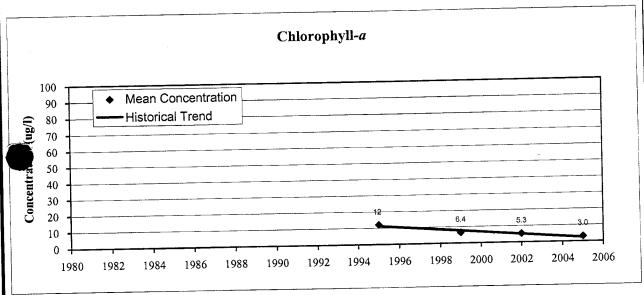
Clearwater River Watershed District Swart Watts Lake Historical Data

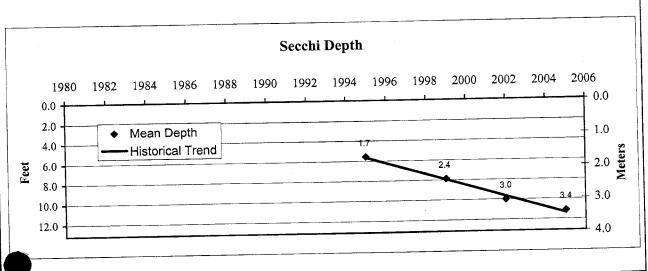
Wenck Associates, Inc. 1800 Pioneer Creek Center

Jan 2006

Figure 6







Jan 2006

Figure 7