

1414 West Hamilton Avenue P.O. Box 8 Eau Claire, WI 54702-0008

January 29, 2010

Ms. Kimberly D. Bose, Secretary Federal Energy Regulatory Commission 888 First Street, NE Washington, D.C. 20426

### Subject: <u>2009 Water Quality Monitoring Report For Big Falls Hydro (FERC</u> <u>Project #2390-01) And Thornapple Hydro (FERC Project #2475)</u>

Dear Secretary:

Enclosed are the results of the water quality monitoring that Northern States Power Company – Wisconsin (NSPW), an Xcel Energy Company, conducted during the 2009 field season on the Big Falls and Thornapple Flowages. The samples were obtained after ice-out, in late July, and late August per the Federal Energy Regulatory Commission's license requirement to monitor long-term changes in water quality.

Included in the report is a summary of water quality data for the two flowages since 2003. While there appears to be variability in some of the parameters analyzed, overall, the results have been relatively consistent. The data collected in 2009 is consistent with data from the previous years' sampling.

This report was filed with the Wisconsin Department of Natural Resources (WDNR) on December 17, 2009. The WDNR was provided 30 days to submit comments and to date no correspondence has been received. Should you have any questions regarding this report, feel free to contact Matthew Miller of this office at (715) 737-1353 or by electronic mail at matthew.j.miller@xcelenergy.com.

Sincerely,

Villian Jawash

William Zawacki) Director, Hydro Plants

Enclosure: Water Quality Monitoring Report

C: Mr. Jeff Scheirer (WDNR)

H:\References\All Plants\Water Quality Monitoring\Annual Reports\ 2010 Letter to FERC 012910.doc

## Agency Correspondence



December 17, 2009

1414 West Hamilton Avenue P.O. Box 8 Eau Claire, WI 54702-0008

Mr. Jeff Scheirer Wisconsin DNR 875 South 4<sup>th</sup> Avenue Park Falls, WI 54552

### Subject: <u>2009 Water Quality Monitoring Report For Big Falls Flowage (FERC Project</u> <u>#2390-01), Thornapple Flowage (FERC Project #2475) And Turtle-Flambeau</u> Flowage (FERC Project 2390-02).

Dear Mr. Scheirer:

Enclosed are the results of the water quality sampling that Northern States Power Company – Wisconsin (NSPW) conducted during the 2009 field season on Big Falls and Thornapple Flowages. The samples were taken after ice-out and in late July and August. The samples were acquired from the deepest point of the reservoirs immediately upstream from the boat restraining barriers. Northern Lake Service, Inc. of Crandon, WI performed the chlorophyll analysis and NSPW's Chestnut Service Center performed the phosphorous analysis.

Also included in this year's report are the water quality sampling results for the Turtle-Flambeau Flowage (TFF) conducted by the citizen's self-help lake monitoring program. The results of the TFF sampling are being provided to you pursuant to Item J of the Water Quality Certificate of the October 14, 2008 Federal Energy Regulatory Commission's order amending the Big Falls Hydro Project to include the Turtle-Flambeau Flowage. The TFF results are also available on the WDNR's website.

The results for Big Falls and Thornapple are summarized for the past six years. While there appears to be some variability in some of the parameters analyzed, for the most part, the results have been relatively consistent. The data collected in 2009 is consistent with data from the previous years' sampling.

Please provide me with any comments that you might have concerning the sampling results by January 20, 2010 so that I can file the report and any comments that you might have to the Federal Energy Regulatory Commission by the end of January. You can provide your response either by telephone call, e-mail, or written letter. NSPW will continue to work with the WDNR to begin entering water quality data directly into the state database thus eliminating the need to file a hard copy report. Should you have any questions concerning this report, feel free to give me a call at (715) 737-1353 or email me at matthew.j.miller@xcelenergy.com.

Sincerely,

matten J. milh

Matthew J. Miller Hydro Licensing Specialist

Enclosure: Water quality monitoring results

H:\MLLM40\References\All Plants\Water Quality Monitoring\Annual Reports\2009\2009 Letter To DNR 121709.doc

Summary Of Total Phosphorous And Chlorophyll A Data For The Big Falls And Thornapple Flowages 2003 - 2009 Summary of Water Quality Data for the Big Falls and Thornapple Flowages (2003 - 2009).

		ig Falls Flowag	e	The	ornapple Flowa	ge
	Surface	Surface	Bottom	Surface	Surface	Bottom
	Total Phosphorus	Chlorophyll-A	Total Phosphorus	<b>Total Phosphorus</b>	Chlorophyll-A	<b>Total Phosphorus</b>
Date	(mg/L P)	(ng/L)	(mg/L P)	(mg/L P)	(ng/L)	(mg/L P)
5/12/2003	0.03	0.7	0.03	0.04	0.5	0.04
7/28/2003	0.06	9.4	0.05	0.06	5.0	0.05
8/13/2003	0.03	5.9	0.06	0.07	10.7	0.06
5/5/2004	0.053	1.55	0.031	0.035	1.80	0.036
7/28/2004	0.037	3.10	0.084	0.050	4.60	0.049
8/25/2004	0.024	3.35	0.042	0.029	4.10	0.027
4/19/2005	0.050	0.50	0.057	0.055	0.70	0.051
7/25/2005	0.031	0.60	0.044	0.031	1.50	0.045
8/31/2005	0.020	1.50	0.092	0.029	2.75	0.030
4/26/2006	0.023	0.94	0.035	0.026	2.35	0.024
7/24/2006	0.029	0.50	0.099	0.035	4.03	0.041
8/23/2006	0.048	1.50	0.035	0.050	2.11	0.040
4/30/2007	0.028	1.95	0.067	0.039	4.50	0.033
7/31/2007	0.029	4.81	0.043	0.037	3.35	0.032
8/29/2007	0.052	4.45	0.027	0.049	2.93	0.033
4/30/2008	0.024	0.579	0.031	0.030	0.961	0.029
7/23/2008	0.032	2.80	0.043	0.041	11.0	0.051
8/26/2008	0.030	3.70	0.047	0.032	13.0	0.034
4/28/2009	0.030	5.5	0.033	0.040	11.0	0.033
7/28/2009	0.033	6.9	0.099	0.021	4.8	0.053
8/24/2009	0.021	5.0	0.032	0.023	3.6	0.075
Arrendo (loc out comple)	0.02	13 1	0.0		C7 C	
Average (ice-our sample)	0.00	10.1	40.0	40.5	0.14	+0.0
Average (July sample)	0.04	4.02	0.07	0.04	4.90	0.05
Average (August sample)	0.03	3.63	0.05	0.04	5.60	0.04

2009 Water Quality Laboratory Analysis

For The Big Falls And Thornapple Flowages

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Report To:	Hydro R	Regulatory-WI						
Attention	Envirom	iental Services-WI				Work F	Request #	WIHY0409
Attention.	Leroy W	/ilder				Date of	Report	0/2/2000
Sample Desc	ription:	воттом				LabV	Vorks I.D.	EG37474
Location:	•	BIG FALLS FLOWAG	ЗЕ			Labo	ratory I.D.:	234.40
Looution.		DIOTALLOTLOTIA				Colle	ction Date:	4/28/2009
Customer Sa	mple I.D.:					Date	Submitted:	4/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Total Phosphorus		0.033	mg/L P	HSD	0.001	0.01	EPA 365.3	5/14/2009
Comments rel	ated to sa	mple number EG37474	i:					

Xcel Energy-

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:	Hydro R Envirom	egulatory-WI ental Services-WI				Work	Request #	WIHY0409
Attention:	Matt Mil Leroy W	ler /ilder				Date c	f Report	6/2/2009
Sample Desc	cription:	SURFACE				Lab	Works I.D.	EG37475
	•					Lab	oratory I.D.:	235.01
Location: Customer Sample I.D.		BIG FALLS FLOWAG				Colle	ection Date:	4/28/2009
Customer Sa	mple I.D.:					Date	Submitted:	4/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Chlorophyll-a		5.5	ug/L	_SERVICE	0.041	0.5	SM 19th 10200 H	4/30/2009
Send Chlorophyll	A	Completed		MJM				4/28/2009
Total Phosphorus		0.030	mg/L P	HSD	0.001	0.01	EPA 365.3	5/14/2009
Comments rel	ated to sa	mple number EG37475						

Page 2 of 5

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:	Hydro R Envirom	egulatory-WI ental Services-WI				Work R	Pequest #	
Attention:	Matt Mil Leroy W	ler /ilder				Date of	Report	6/2/2009
Sample Desc	ription:	воттом				LabV Labo	Vorks I.D. ratory I.D.:	EG37476 235.01
Location:		THORNAPPLE FLO	WAGE			Colle	ction Date:	4/28/2009
Customer Sa	mple I.D.:					Date	Submitted:	4/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Total Phosphorus		0.033	mg/L P	HSD	0.001	0.01	EPA 365.3	5/14/2009
Comments rel	ated to sa	mple number EG37476	3:					

Page 3 of 5

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:	Hydro R Envirom	egulatory-WI ental Services-WI				Work	Request #	WIHY0409
Attention:	Matt Mill Leroy W	ler lilder				Date o	of Report	6/2/2009
						Lab	Works I D	EG37477
Sample Desc	sription:	SURFACE				Lab	oratory I D ·	235.01
Location:		THORNAPPLE FLOV	VAGE			Colle	ection Date:	4/28/2009
Customer Sa	mple I.D.:					Date	e Submitted:	4/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Chlorophyll-a		11	ug/L	_SERVICE	0.041	0.5	SM 19th 10200 H	4/30/2009
Send Chlorophyll	Ą	Completed		MJM				4/28/2009
Total Phosphorus		0.040	mg/L P	HSD	0.001	0.01	EPA 365.3	5/14/2009
Comments rel	ated to sa	mple number EG37477	:					

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1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

I certify that this analysis report was prepared under my direction or supervision under a system designed to assure that qualified personnel analyzed the submitted samples. All protocols for analysis were followed as required by Minnesota Rules and the Applicible Management Plan.

Christine M. Keele

Christine M. keefe System Chemist 612-630-4506

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:	Hydro O Envirom	peration ental Services-WI					-	
Attention:	Matt Mill Leroy W	er ilder				Work R Date of	Request # Report	WIHY0709 8/24/2009
Sample Desc	cription:	воттом				LabV	Vorks I.D.	EG45575
Location:		BIG FALLS FLOWAG	GE			Labo	ction Date:	7/28/2009
Customer Sa	mple I.D.:					Date	Submitted:	7/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Total Phosphorus		0.099	mg/L P	СМК	0.001	0.01	EPA 365.3	8/20/2009
Comments rel	ated to sar	nple number EG45575	i:					

Results are representative of submitted samples and not necessarily the original sample source.

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Report To:	Hydro R Envirom	egulatory-WI ental Services-WI						
Attention:	Matt Mil	ler				Work I Date o	Request # f Report	8/24/2009
	Leroy W	/ilder						
Sample Desc	ription:	SURFACE				Lab	Works I.D.	EG45574
						Lab	oratory I.D.:	1016.26
Location:		BIG FALLS FLOWAG	θE			Colle	ection Date:	7/28/2009
Customer Sa	mple I.D.:					Date	Submitted:	7/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Chlorophyll-a		6.9	ug/L	NLS INC	0.041	0.5	SM 19th 10200 H	8/13/2009
Send Chlorophyll /	A	Completed		MJM				7/28/2009
Total Phosphorus		0.033	mg/L P	CMK	0.001	0.01	EPA 365.3	8/20/2009
Comments rel	ated to sa	mple number EG45574	:					

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:

Attention:	ERAD- \ Leroy W Matt Mill	WI Vilder Ier				Work F Date of	Request # 7 Report	WIHY0709 8/24/2009
Sample Desc	ription:	воттом			territori (14 contesta	LabV	Vorks I.D.	EG45577
Location:		THORNAPPLE FLO	WAGE			Labo	oratory I.D.:	1016.29
Customer Sa	mple I.D.:					Date	Submitted:	7/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Total Phosphorus		0.053	mg/L P	СМК	0.001	0.01	EPA 365.3	8/20/2009
Comments rel	ated to sai	mple number EG45577	7:					



1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:

Attention:	ERAD-V Leroy W Matt Mil	VI /ilder ler				Work F Date o	Request # f Report	MIHY0709 8/24/2009
Sample Des	cription:	SURFACE				Lab	Works I.D.	EG45576
Location		THORNAPPI E ELON	VAGE			Labo	oratory I.D.:	1016.28
Looution.			inter i			Colle	ection Date:	7/28/2009
Customer Sa	ample I.D.:					Date	Submitted:	7/30/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Chlorophyll-a		4.8	ug/L	NLS INC	0.041	0.5	SM 19th 10200 H	8/13/2009
Send Chlorophyll	A	Completed		MJM				7/28/2009
Total Phosphorus		0.021	mg/L P	CMK	0.001	0.01	EPA 365.3	8/20/2009
Comments re	lated to sa	mple number EG45576	:	T				

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

I certify that this analysis report was prepared under my direction or supervision under a system designed to assure that qualified personnel analyzed the submitted samples. All protocols for analysis were followed as required by Minnesota Rules and the Applicable Management Plan.

Christine M. Keefe

Christine M. Keefe Laboratory Supervisor 612-630-4506

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

Report To:	Hydro O Envirom	peration ental Services-WI						
Attention:	Matt Mill Leroy W	er ilder				Work F Date of	Request # F Report	WIHY0809 9/17/2009
Sample Desc	cription:	BOTTOM				LabV	Vorks I.D.	EG47613
Location:		BIG FALLS FLOWAG	GE			Labo Colle	ction Date:	1020.11 8/24/2009
Customer Sa	mple I.D.:					Date	Submitted:	8/26/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Total Phosphorus		0.032	mg/L P	CMK	0.001	0.01	EPA 365.3	9/16/2009
Comments rel	ated to sar	nple number EG47613	3:					

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1518 Chestnut Avenue N Minneapolis, MN 55403

Report To:	Hydro C	peration						
	Envirom	ental Services-WI						
						Work	Request #	WIHY0809
Attention:	Matt Mil	ler				Date c	of Report	9/17/2009
	Leroy W	/ilder						
Sample Desc	ription:	SURFACE				Lab	Works I.D.	EG47614
Location		BIG FALLS FLOWA	25			Lab	oratory I.D.:	1020.12
Location.		DIG FALLS FLOWA	36			Colle	ection Date:	8/24/2009
Customer Sa	mple I.D.:					Date	e Submitted:	8/26/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Chlorophyll-a		5	ug/L	NLS	0.041	0.5	SM 19th 10200 H	9/3/2009
Send Chlorophyll /	4	complete		MJM				8/24/2009
Total Phosphorus		0.021	mg/L P	CMK	0.001	0.01	EPA 365.3	9/16/2009
Comments rel	ated to sa	mple number EG47614	i:					

Xcel Energy-

1518 Chestnut Avenue N Minneapolis, MN 55403

Report To:	Hydro O Envirom	peration ental Services-WI					laguast #	
Attention:	Matt Mil Leroy W	ler /ilder				Date of	Report	9/17/2009
Sample Desc	ription:	воттом				LabV	Vorks I.D.	EG47615
Location: THOR		THORNAPPLE FLO	WAGE			Colle	ction Date:	8/24/2009
Customer Sa	mple I.D.:					Date	Submitted:	8/26/2009
Constituent		Result	Units	Analyst	Detection Limit	Reporting Limit	Analytical Method	Analysis Start Date
Total Phosphorus		0.075	mg/L P	СМК	0.001	0.01	EPA 365.3	9/16/2009
Comments rel	ated to sa	mple number EG47615	5:					

Xcel Energy

1518 Chestnut Avenue N Minneapolis, MN 55403

Report To:	Hydro O	peration						
	Envirom	ental Services-WI						
						Work I	Request #	WIHY0809
Attention:	Matt Mil	ler				Date o	f Report	9/17/2009
	Leroy W	llder						
Sample Desc	ription:	SURFACE				Lab	Works I.D.	EG4/616
Location:		THORNAPPLE FLOW	NAGE			Colle	oratory I.D.:	8/24/2009
Customer Sa	mple I.D.:					Date	Submitted:	8/26/2009
						<b>D</b>		
Constituent		Result	Units	Analyst	Limit	Limit	Method	Start Date
Chlorophyll-a		3.6	ug/L	NLS	0.041	0.5	SM 19th 10200 H	9/3/2009
Send Chlorophyll	4	Completed		MJM				8/24/2009
Total Phosphorus		0.023	mg/L P	CMK	0.001	0.01	EPA 365.3	9/16/2009
Comments rel	ated to sa	mple number EG47616	:		7			



1518 Chestnut Avenue N Minneapolis, MN 55403

Phone: (612)630-4506 Fax: (612) 630-4367 Contact: Christine Keefe Lab Certification MN ID: 027-053-197 Lab Certification WI ID:999071150

I certify that this analysis report was prepared under my direction or supervision under a system designed to assure that qualified personnel analyzed the submitted samples. All protocols for analysis were followed as required by Minnesota Rules and the Applicable Management Plan.

Christine M. Keefe

Christine M. Keefe Laboratory Supervisor 612-630-4506

This report is confidential.

Page 5 of 5

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Results are representative of submitted samples and not necessarily the original sample source.

Summary Of Dissolved Oxygen And Temperature

Data For The Big Falls Flowage

2003 - 2009

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tte:	5/19/2003	Ļ	Date:	7/28/2003	¢	Date:	8/13/2000	, m
cchi Dis pth of B ather C	k (ft.): ottom Sample: onditions:	4.5 37 ft. cloudy, S wind, 65 F	Secchi Disk Depth of Bo Weather Co	. (ft.): ttom Sample: onditions:	6 11.5 m clear, calm, 70 F	Secchi Dis Depth of B Weather C	k (ft.): ottom Sample: conditions:	6 11 m sunny, calm, 80 F
		Dissolved			Dissolved			Dissolved
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth	Temperature	Oxygen
(ft.)	(celsius)	(l/ <u>bu</u> )	( <del>f1</del> .)	(celsius)	(mg/l)	(ft.)	(celsius)	(mg/l)
urface	16.1	8.50	Surface	26.3	7.83	Surface	25.9	8.30
2.0	16.1	8.61	2.0	25.8	7.82	2.0	25.6	8.33
4.0	16.1	8.73	4.0	25.2	7.58	4.0	25.0	8.39
6.0	16.1	8.68	6.0	25.0	7.42	6.0	24.8	7.96
8.0	16.1	8.68	8.0	25.0	7.35	8.0	24.6	7.19
10.0	16.1	8.68	10.0	24.9	7.28	10.0	24.4	6.86
12.0	16.1	8.66	12.0	24.8	7.06	12.0	24.3	6.71
14.0	16.1	8.65	14.0	24.8	6.91	14.0	24.2	6.58
16.0	16.1	8.65	16.0	24.7	6.91	16.0	24.1	6.44
18.0	16.1	8.68	18.0	24.6	6.88	18.0	23.9	6.16
20.0	16.1	8.63	20.0	24.5	6.78	20.0	23.9	6.03
22.0	16.1	8.65	22.0	24.4	6.70	22.0	23.8	6.23
24.0	16.1	8.65	24.0	24.3	6.62	24.0	23.8	6.20
26.0	16.1	8.66	26.0	24.2	6.44	26.0	23.7	5.83
28.0	16.1	8.66	28.0	23.7	6.12	28.0	23.5	5.81
30.0	16.1	8.65	30.0	23.1	5.67	30.0	23.5	5.78
32.0	16.1	8.67	32.0	22.8	5.44	32.0	23.5	5.75
34.0	16.1	8.67	34.0	22.6	4.95	34.0	23.4	5.18
36.0	16.1	8.67	36.0	21.9	4.45	36.0	22.9	3.55
38.0	16.1	8.63	38.0	21.3	3.95			

e earlier due to excessively high river flows	kygen and Temperature Profiles for the Big Falls Flowage in 2004.
Could not sample earlier due te	Dissolved Oxygen and 1

i Disk (ft.):         5.5         Secchi Disk (ft.):         6.5         Secchi Disk (ft.):         6.5         Secchi Disk (ft.):         6.5         Secchi Disk (ft.):         6.5         Secchi Disk (ft.):         0.5         Secchi Disk (ft.):         Depth of Bottom           ner Conditions:         cloudy, S wind, 50 F         Weather Conditions:         Lear, S wind, 75 F         Weather Conditions:         Depth of Bottom           ner Conditions:         Dissolved         Dissolved         Dissolved         Dissolved         Depth of Bottom           no         12.4         10.4         Dissolved         Depth of Bottom         Norther Conditions:         Depth of Bottom           o         12.4         10.4         Dissolved         Depth of Bottom         Norther Conditions:         Depth of Bottom           o         12.4         10.4         Ecelsius)         Ing/ID         Surface         Zio           o         12.4         10.4         2.0         2.1         Surface         Zio         Zio           o         12.2         10.4         12.2         10.4         2.0         Surface         Zio         Zio           o         12.2         10.4         2.0         2.1         Zio         Zio         Zio		5/5/2004		Date:	7/28/2004		Date:	8/25/2004	
Conditions:         cloudy, S wind, 50 F         Weather Conditions:         clear, S wind, 75 F         Weather Conditions:           Dissolved         Dissolved         Dissolved         Dissolved         Dissolved         Depth           12.4         10.1         Surface         24.2         7.4         Dissolved         Depth           12.4         10.4         2.0         24.2         7.4         Dissolved         Depth           12.4         10.4         2.0         24.1         8.1         E         2.0           12.4         10.4         2.0         24.0         7.6         10.0         2.0           12.1         10.4         10.2         8.0         2.4.0         7.6         4.0         2.0           12.1         10.6         10.4         10.0         2.3.9         7.1         11.2.0         10.0           12.1         10.6         14.0         2.3.3         5.7         10.0         10.0           12.1         10.6         16.0         2.3.3         5.7         14.0         12.0           12.1         10.6         16.0         2.3.3         5.7         14.0         12.0           11.1         10.3         2.	sk (ft. 3ottor	): n Sample:	5.5 11.5 m	Secchi Disk Depth of Bo	(ft.): ttom Sample:	6.5 12 m	Secchi Disl Depth of Bo	k (ft.): ottom Sample:	6.5 37 ft.
Dissolved Temperature         Dissolved Oxygen         Dissolved Temperature         Dissolved Oxygen         Depth Temperature         Temperature Oxygen         Dissolved Temperature         Dissolved Depth         Depth Temperature         Temperature Oxygen         Dissolved Temperature         Dissolved Depth         Depth Tem         Tem Tem           12.4         10.1         Surface         24.2         8.0         24.0         7.4         Surface           12.4         10.4         2.0         24.1         8.1         6.0         24.0         7.6         8.0         2.0           12.1         10.6         12.1         10.4         2.0         24.0         7.6         8.0         2.0         1.1.0         10.0         2.0         1.1.0         2.0         1.0.0         2.0         1.0.0         1.0.0         1.0.0         2.0         1.0.0         1.0.0         1.1.0         2.0	Cond	tions:	cloudy, S wind, 50 F	Weather Co	nditions:	clear, S wind, 75 F	Weather C	onditions:	cloudy, 75 F
TemperatureOxygenDepthTemperatureOxygenDepthTemperatureOxygen $(celsius)$ (mg/l) $(mg/l)$ $(mg/l)$ $(mg/l)$ $(mg/l)$ $(mg/l)$ $(mg/l)$ $12.4$ $10.4$ $2.4.2$ $7.4$ $8.0$ $2.2.2$ $7.4$ $2.0$ $12.4$ $10.4$ $2.0$ $24.2$ $7.4$ $8.0$ $2.0$ $12.4$ $10.4$ $10.4$ $4.0$ $24.1$ $8.1$ $4.0$ $12.4$ $10.4$ $10.4$ $10.4$ $4.0$ $24.1$ $8.1$ $4.0$ $12.2$ $10.4$ $10.4$ $12.0$ $24.0$ $7.6$ $8.0$ $2.0$ $12.1$ $10.6$ $12.1$ $10.6$ $12.0$ $24.0$ $7.1$ $4.0$ $12.1$ $10.6$ $12.1$ $10.6$ $12.0$ $24.0$ $7.1$ $4.0$ $12.1$ $10.6$ $12.0$ $24.0$ $23.3$ $6.1$ $14.0$ $10.0$ $11.9$ $10.5$ $22.0$ $23.3$ $6.1$ $11.0$ $10.0$ $11.8$ $10.3$ $22.0$ $23.1$ $5.6$ $22.0$ $22.0$ $11.6$ $10.3$ $22.0$ $23.1$ $5.6$ $24.0$ $22.0$ $11.6$ $10.2$ $23.0$ $22.1$ $4.1$ $22.0$ $11.0$ $11.6$ $10.2$ $23.0$ $22.1$ $4.1$ $22.0$ $24.0$ $11.6$ $10.2$ $22.0$ $22.1$ $4.1$ $22.0$ $24.0$ $11.6$ $10.2$ $22.0$ $22.1$ $24.0$ $22.0$			Dissolved			Dissolved			Dissolved
(celsius)         (mg/h)         (ff.)         (celsius)         (mg/h)         (ff.)         (celsius)         (mg/h)         (ff.)         (ff.)         (ff.)         (ff.)         (celsius)         (mg/h)         (ff.)         (ff.)         (ff.)         (celsius)         (mg/h)         (ff.)         (ff.) <th< td=""><td>Te</td><td>mperature</td><td>Oxygen</td><td>Depth</td><td>Temperature</td><td>Oxygen</td><td>Depth</td><td>Temperature</td><td>Oxygen</td></th<>	Te	mperature	Oxygen	Depth	Temperature	Oxygen	Depth	Temperature	Oxygen
12.4       10.1       Surface       24.2       7.4       Surface         12.4       10.4       2.0       24.2       8.0       2.0         12.4       10.4       2.0       24.1       8.1       4.0         12.4       10.2       8.1       8.0       2.0       2.0         12.3       10.3       8.0       24.0       8.1       4.0         12.1       10.4       10.2       8.0       7.1       4.0         12.1       10.4       10.3       8.0       24.0       8.1       4.0         12.1       10.4       12.0       23.3       6.1       14.0       10.0         12.1       10.6       14.0       23.3       6.1       14.0       10.0         11.2       10.6       18.0       23.3       6.1       14.0       10.0         11.1       10.3       22.0       23.3       5.7       18.0       11.0         11.1       10.3       22.0       23.1       5.6       24.0       26.0       20.0         11.1       10.3       22.0       23.1       5.6       24.0       28.0       22.0         11.1.6       10.3       22.1 </td <td></td> <td>(celsius)</td> <td>(mg/l)</td> <td>(<del>ft</del>.)</td> <td>(celsius)</td> <td>(mg/l)</td> <td>(<del>ff</del>.)</td> <td>(celsius)</td> <td>(mg/l)</td>		(celsius)	(mg/l)	( <del>ft</del> .)	(celsius)	(mg/l)	( <del>ff</del> .)	(celsius)	(mg/l)
12.4 $10.4$ $2.0$ $24.2$ $8.0$ $2.0$ $12.4$ $10.4$ $10.2$ $6.0$ $24.1$ $8.1$ $4.0$ $12.4$ $10.2$ $6.0$ $24.1$ $8.1$ $4.0$ $12.1$ $10.2$ $6.0$ $24.1$ $8.1$ $6.0$ $12.1$ $10.3$ $8.0$ $24.0$ $7.6$ $8.0$ $12.1$ $10.4$ $10.4$ $10.2$ $8.0$ $7.1$ $12.1$ $10.4$ $12.0$ $23.3$ $6.4$ $11.0$ $12.1$ $10.6$ $14.0$ $23.3$ $6.1$ $14.0$ $12.1$ $10.6$ $14.0$ $23.3$ $5.7$ $14.0$ $11.2$ $10.6$ $12.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.5$ $22.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.3$ $22.0$ $23.0$ $5.3$ $5.7$ $11.6$ $10.3$ $22.0$ $23.0$ $5.3$ $22.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $22.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.2$ <		12.4	10.1	Surface	24.2	7.4	Surface	21.2	8.9
12.4 $10.4$ $4.0$ $24.1$ $8.1$ $4.0$ $12.4$ $10.2$ $6.0$ $24.0$ $7.6$ $8.0$ $12.3$ $10.3$ $8.0$ $24.0$ $7.6$ $8.1$ $12.1$ $10.4$ $10.2$ $8.0$ $7.1$ $10.4$ $12.1$ $10.4$ $10.6$ $24.0$ $7.6$ $8.1$ $12.1$ $10.4$ $12.0$ $10.4$ $12.0$ $7.6$ $8.1$ $12.1$ $10.4$ $12.0$ $23.3$ $6.4$ $12.0$ $12.1$ $10.6$ $14.0$ $23.3$ $6.4$ $12.0$ $12.0$ $10.6$ $16.0$ $23.3$ $5.7$ $6.1$ $11.2$ $10.6$ $12.0$ $23.3$ $5.7$ $6.1$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $4.1$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $4.9$ $11.6$ $10.3$ $22.0$ $22.3$ $5.1$ $22.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $22.2$ $4.2$ $32.0$ $11.6$ $10.2$ $32.0$ $23.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $20.4$ $4.1$ $30.0$ </td <td></td> <td>12.4</td> <td>10.4</td> <td>2.0</td> <td>24.2</td> <td>8.0</td> <td>2.0</td> <td>21.2</td> <td>8.9</td>		12.4	10.4	2.0	24.2	8.0	2.0	21.2	8.9
12.4 $10.2$ $6.0$ $24.0$ $8.1$ $6.0$ $12.3$ $10.3$ $10.3$ $8.0$ $24.0$ $7.6$ $8.0$ $12.1$ $10.4$ $10.4$ $12.0$ $23.9$ $7.1$ $10.0$ $12.1$ $10.6$ $12.0$ $23.9$ $6.4$ $12.0$ $12.1$ $10.6$ $14.0$ $23.3$ $6.4$ $12.0$ $12.1$ $10.6$ $14.0$ $23.3$ $6.1$ $14.0$ $12.1$ $10.6$ $14.0$ $23.3$ $5.7$ $14.0$ $11.9$ $10.5$ $22.0$ $23.3$ $5.7$ $14.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.1$ $5.6$ $11.6$ $10.3$ $22.0$ $23.3$ $5.1$ $22.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.1$ $22.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.1$ $22.0$ $11.6$ $10.3$ $22.0$ $22.3$ $4.1$ $22.0$ $11.6$ $10.3$ $22.0$ $22.7$ $4.9$ $22.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $23.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $30.0$ $11.5$ $10.2$ $32.0$ $22.2$ $4.1$ $30.0$ $11.5$ $10.2$ $32.0$ $22.2$ $4.1$ $30.0$ $11.5$ $10.2$ $32.0$ $22.2$ $4.2$ $32.0$ $11.3$ $9.7$ $30.0$ $20.4$ $1.1$ $30.0$ $36.0$ $20.4$ $1.1$		12.4	10.4	4.0	24.1	8.1	4.0	19.8	8.8
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		12.4	10.2	6.0	24.0	8.1	6.0	19.7	8.8
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		12.3	10.3	8.0	24.0	7.6	8.0	19.6	8.7
12.1 $10.4$ $12.0$ $23.3$ $6.4$ $12.0$ $12.1$ $10.6$ $10.6$ $14.0$ $23.7$ $6.1$ $14.0$ $12.0$ $10.6$ $16.0$ $23.3$ $5.7$ $6.1$ $14.0$ $12.0$ $10.6$ $16.0$ $23.3$ $5.7$ $6.1$ $14.0$ $11.9$ $10.5$ $20.0$ $23.3$ $5.7$ $18.0$ $23.3$ $11.7$ $10.3$ $22.0$ $23.3$ $5.7$ $18.0$ $11.7$ $10.3$ $22.0$ $23.3$ $5.7$ $18.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.7$ $18.0$ $11.6$ $10.3$ $22.0$ $23.3$ $5.1$ $20.0$ $11.6$ $10.3$ $22.0$ $22.1$ $4.9$ $22.0$ $11.6$ $10.3$ $22.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.3$ $22.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.2$ $30.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.2$ $33.0$ $11.6$ $10.1$ $32.0$ $22.17$ $3.9$ $33.0$ $11.3$ $10.1$ $30.0$ $20.4$ $1.1$ $30.0$ $11.3$ $10.1$ $30.0$ $20.4$ $1.1$ $30.0$ $11.3$ $9.7$ $38.0$ $20.4$ $3.9$		12.2	10.4	10.0	23.9	7.1	10.0	19.6	8.7
12.1 $10.6$ $14.0$ $23.7$ $6.1$ $14.0$ $12.1$ $10.6$ $10.6$ $16.0$ $23.5$ $6.0$ $16.0$ $12.0$ $10.6$ $16.0$ $23.3$ $5.7$ $18.0$ $23.3$ $11.9$ $10.5$ $20.0$ $23.3$ $5.7$ $18.0$ $20.0$ $11.7$ $10.3$ $22.0$ $23.1$ $5.6$ $20.0$ $11.7$ $10.3$ $22.0$ $23.0$ $5.3$ $22.0$ $11.6$ $10.3$ $22.0$ $23.0$ $5.3$ $22.0$ $11.6$ $10.3$ $22.0$ $22.0$ $22.3$ $4.1$ $11.6$ $10.3$ $22.2$ $22.2$ $4.1$ $26.0$ $11.6$ $10.3$ $22.2.6$ $22.2.6$ $4.1$ $28.0$ $11.6$ $10.2$ $33.0$ $22.2.6$ $4.1$ $28.0$ $11.6$ $10.2$ $33.0$ $22.2.6$ $4.1$ $28.0$ $11.6$ $10.2$ $33.0$ $22.2.6$ $4.1$ $28.0$ $11.6$ $10.2$ $33.0$ $22.2.6$ $4.1$ $28.0$ $11.6$ $10.2$ $33.0$ $22.2$ $4.2$ $33.0$ $11.6$ $10.2$ $38.0$ $20.4$ $1.1$ $38.0$ $11.3$ $10.1$ $38.0$ $20.4$ $1.1$ $38.0$ $11.3$ $9.7$ $38.0$ $20.4$ $1.1$ $38.0$		12.1	10.4	12.0	23.9	6.4	12.0	19.6	8.6
12.1 $10.6$ $16.0$ $23.5$ $6.0$ $16.0$ $12.0$ $10.6$ $10.6$ $18.0$ $23.3$ $5.7$ $18.0$ $11.9$ $10.5$ $20.0$ $23.1$ $5.6$ $20.0$ $11.7$ $10.3$ $22.0$ $23.1$ $5.6$ $20.0$ $11.7$ $10.3$ $22.0$ $23.0$ $5.1$ $22.0$ $11.6$ $10.3$ $22.0$ $23.0$ $5.1$ $24.0$ $11.6$ $10.3$ $22.0$ $22.7$ $4.9$ $26.0$ $11.6$ $10.3$ $22.6$ $22.7$ $4.9$ $26.0$ $11.6$ $10.2$ $30.0$ $22.4$ $4.4$ $30.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.2$ $32.0$ $22.4$ $4.4$ $30.0$ $11.6$ $10.2$ $33.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.2$ $33.0$ $22.4$ $4.4$ $30.0$ $11.6$ $10.2$ $33.0$ $22.4$ $4.1$ $33.0$ $11.6$ $10.2$ $33.0$ $22.17$ $3.9$ $33.0$ $11.3$ $10.1$ $38.0$ $20.4$ $1.1$ $33.0$ $11.3$ $9.7$ $38.0$ $20.4$ $1.1$ $33.0$ $38.0$ $20.4$ $1.1$ $33.0$ $33.0$ $38.0$ $20.4$ $1.1$ $33.0$ $33.0$ $38.0$ $20.4$ $1.1$ $33.0$ $33.0$		12.1	10.6	14.0	23.7	6.1	14.0	19.6	8.5
12.010.618.023.3 $5.7$ 18.011.910.510.520.0 $23.1$ $5.6$ $20.0$ 11.710.3 $22.0$ $23.1$ $5.6$ $20.0$ 11.710.3 $22.0$ $23.1$ $5.6$ $20.0$ 11.610.3 $22.0$ $23.0$ $5.1$ $24.0$ 11.610.3 $26.0$ $22.8$ $5.1$ $24.0$ 11.610.3 $26.0$ $22.7$ $4.9$ $26.0$ 11.610.3 $28.0$ $22.7$ $4.9$ $28.0$ 11.610.2 $30.0$ $22.4$ $4.4$ $30.0$ 11.610.2 $32.0$ $22.2$ $4.1$ $28.0$ 11.510.2 $32.0$ $22.2$ $4.2$ $33.0$ 11.510.2 $33.0$ $22.1$ $3.9$ $34.0$ 11.3 $9.7$ $38.0$ $20.4$ $1.1$ $38.0$ 11.3 $9.7$ $38.0$ $20.4$ $1.1$ $38.0$		12.1	10.6	16.0	23.5	6.0	16.0	19.6	8.4
11.9 $10.5$ $20.0$ $23.1$ $5.6$ $20.0$ $11.8$ $10.3$ $10.3$ $22.0$ $23.0$ $5.3$ $22.0$ $11.7$ $10.3$ $22.0$ $23.0$ $5.1$ $24.0$ $11.6$ $10.3$ $24.0$ $22.8$ $5.1$ $24.0$ $11.6$ $10.3$ $26.0$ $22.7$ $4.9$ $26.0$ $11.6$ $10.3$ $26.0$ $22.7$ $4.9$ $26.0$ $11.6$ $10.3$ $28.0$ $22.5$ $4.1$ $28.0$ $11.6$ $10.2$ $32.0$ $22.4$ $4.4$ $30.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $28.0$ $11.6$ $10.2$ $32.0$ $22.4$ $4.4$ $30.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.1$ $30.0$ $11.3$ $10.1$ $32.0$ $22.2$ $4.2$ $32.0$ $11.3$ $10.1$ $38.0$ $20.4$ $1.1$ $38.0$ $11.3$ $9.7$ $38.0$ $20.4$ $1.1$ $38.0$		12.0	10.6	18.0	23.3	5.7	18.0	19.5	8.3
11.8 $10.3$ $22.0$ $23.0$ $5.3$ $22.0$ $11.7$ $10.3$ $24.0$ $23.0$ $5.3$ $22.0$ $11.6$ $10.3$ $24.0$ $22.8$ $5.1$ $24.0$ $11.6$ $10.3$ $26.0$ $22.7$ $4.9$ $26.0$ $11.6$ $10.3$ $28.0$ $22.5$ $4.1$ $28.0$ $11.6$ $10.3$ $28.0$ $22.4$ $4.9$ $26.0$ $11.6$ $10.2$ $30.0$ $22.4$ $4.4$ $30.0$ $11.6$ $10.2$ $32.0$ $22.2$ $4.2$ $32.0$ $11.6$ $10.2$ $33.0$ $22.2$ $4.2$ $32.0$ $11.5$ $10.2$ $33.0$ $22.2$ $4.2$ $32.0$ $11.3$ $10.1$ $38.0$ $20.4$ $1.1$ $38.0$ $11.3$ $9.7$ $38.0$ $20.4$ $1.1$ $38.0$		11.9	10.5	20.0	23.1	5.6	20.0	19.4	8.4
11.7 $10.3$ $24.0$ $22.8$ $5.1$ $24.0$ $11.6$ $10.3$ $26.0$ $22.7$ $4.9$ $26.0$ $11.6$ $10.3$ $26.0$ $22.7$ $4.9$ $26.0$ $11.6$ $10.3$ $28.0$ $22.5$ $4.1$ $28.0$ $11.6$ $10.2$ $30.0$ $22.4$ $4.4$ $28.0$ $11.6$ $10.2$ $33.0$ $22.2$ $4.2$ $30.0$ $11.6$ $10.2$ $33.0$ $222.2$ $4.2$ $32.0$ $11.5$ $10.2$ $34.0$ $22.2$ $4.2$ $32.0$ $11.3$ $10.1$ $38.0$ $20.4$ $1.1$ $38.0$ $11.3$ $9.7$ $38.0$ $20.4$ $1.1$ $38.0$		11.8	10.3	22.0	23.0	5.3	22.0	19.2	8.3
11.610.3 $26.0$ $22.7$ $4.9$ $26.0$ 11.610.3 $28.0$ $22.5$ $4.1$ $28.0$ 11.610.2 $30.0$ $22.4$ $4.4$ $30.0$ 11.610.2 $30.0$ $22.4$ $4.4$ $30.0$ 11.610.2 $32.0$ $22.2$ $4.2$ $30.0$ 11.610.2 $32.0$ $22.2$ $4.2$ $30.0$ 11.510.2 $34.0$ $22.2$ $4.2$ $34.0$ 11.310.1 $38.0$ $20.4$ $1.1$ $38.0$ 11.39.7 $38.0$ $20.4$ $1.1$ $38.0$		11.7	10.3	24.0	22.8	5.1	24.0	19.2	8.2
11.6       10.3       28.0       22.5       4.1       28.0         11.6       10.2       30.0       22.4       4.4       30.0         11.6       10.2       30.0       22.4       4.4       30.0         11.6       10.2       32.0       22.2       4.2       32.0         11.6       10.2       32.0       22.2       4.2       32.0         11.6       10.2       34.0       22.2       4.2       34.0         11.5       10.2       36.0       21.7       3.9       34.0         11.3       10.1       38.0       20.4       1.1       38.0		11.6	10.3	26.0	22.7	4.9	26.0	19.0	8.2
11.6     10.2     30.0     22.4     4.4     30.0       11.6     10.2     32.0     22.2     4.2     32.0       11.6     10.2     32.0     22.2     4.2     34.0       11.5     10.2     34.0     22.0     3.9     34.0       11.5     10.2     36.0     21.7     3.2     36.0       11.3     10.1     38.0     20.4     1.1     38.0		11.6	10.3	28.0	22.5	4.1	28.0	18.8	7.8
11.6     10.2     32.0     22.2     4.2     32.0       11.6     10.2     34.0     22.0     3.9     34.0       11.5     10.2     36.0     21.7     3.2     36.0       11.3     10.1     38.0     20.4     1.1     38.0       11.3     9.7     38.0     20.4     1.1     38.0		11.6	10.2	30.0	22.4	4.4	30.0	18.7	7.8
11.6     10.2     34.0     22.0     3.9     34.0       11.5     10.2     36.0     21.7     3.2     36.0       11.3     10.1     38.0     20.4     1.1     38.0       11.3     9.7     38.0     20.4     1.1     38.0		11.6	10.2	32.0	22.2	4.2	32.0	18.4	7.4
11.5         10.2         36.0         21.7         3.2         36.0           11.3         10.1         38.0         20.4         1.1         38.0           11.3         9.7         38.0         20.4         1.1         38.0		11.6	10.2	34.0	22.0	3.9	34.0	18.2	7.2
11.3         10.1         38.0         20.4         1.1         38.0           11.3         9.7         38.0         20.4         1.1         38.0		11.5	10.2	36.0	21.7	3.2	36.0	17.9	5.4
11.3 9.7		11.3	10.1	38.0	20.4	1.1	38.0	17.6	4.4
		11.3	9.7						

xcessively high river flows	mperature Profiles for the Big Falls Flowage in 2005.
ould not sample earlier due to excessively high river flows	issolved Oxygen and Temperature Profiles for the Big Fall

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Date:	4/30/2007	×	Date:	7/31/2007		Date:	8/29/2007	
Secchi Dis	k (ft.):	4	Secchi Disk	(ft.):	7	Secchi D	isk (ft.):	9
Depth of B	ottom Sample:	12 m	Depth of Bo	ttom Sample:	12 m	Depth of	Bottom Sample:	12 m
<b>Weather</b> C	onditions:	Prtly cloudy, light wind	Weather Co	nditions:	Mostly sunny, south	Weather	Conditions:	Mostly sunny
		Dissolved			wind at 5 mpn Dissolved			Dissolved
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth	Temperature	Oxygen
( <del>f1</del> .)	(celsius)	(l/bm)	( <del>[[</del> .])	(celsius)	( <u>I/bu)</u>	( <del>ft</del> .)	(celsius)	(mg/l)
Surface	15.8	9.40	Surface	28.1	7.43	Surface		
2.0	15.8	9.59	2.0	27.8	7.46	2.0		
4.0	15.7	9.74	4.0	27.4	7.41	4.0		
6.0	15.5	9.82	6.0	27.3	7.30	6.0	DO/Temperature	profile was not taker
8.0	15.4	9.76	8.0	27.2	7.28	8.0	due to equip	ment problems
10.0	15.4	9.74	10.0	27.1	6.82	10.0		
12.0	15.4	9.66	12.0	27.0	6.68	12.0		
14.0	15.3	9.54	14.0	26.9	6.47	14.0		
16.0	15.2	9.47	16.0	26.8	6.26	16.0		
18.0	15.2	9.39	18.0	26.8	6.08	18.0		
20.0	15.2	9.35	20.0	26.6	5.45	20.0		
22.0	15.2	9.33	22.0	26.4	5.18	22.0		
24.0	15.2	9.28	24.0	26.3	5.15	24.0		
26.0	15.2	9.23	26.0	26.0	4.85	26.0		
28.0	15.2	9.08	28.0	25.8	4.78	28.0		
30.0	15.2	9.05	30.0	25.5	4.27	30.0		
32.0	14.8	8.99	32.0	25.4	4.00	32.0		
34.0	13.9	8.85	34.0	24.0	0.43	34.0		
36.0	12.9	8.75	36.0	Bottom	Bottom	36.0		
38.0	Bottom	Bottom	38.0			38.0		
40.0			40.0			40.0		

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2007.

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	5.5 11 m , sunny, southe 5-10 mph	Dissolved	Oxygen	( <u>I/6m</u> )	6 95	6.91	6.77	6.31	6.39	6.71	6.82	6.93	6.91	6.80	6.80	6.82	6.91	6.91	6.82	6.81	6.83	6.71	Bottom	
	8/26/2008 t.): om Sample: ditions: 71 F wind		emperature	(celsius)	22.5	22.3	22.3	22.3	22.2	21.9	21.8	21.8	21.7	21.7	21.6	21.6	21.6	21.6	21.5	21.5	21.4	21.4	Bottom	
	Date: Secchi Disk (f Depth of Botto Weather Cond		Depth T	(ft.) S.:(522	201 ace	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	
	5.5 10 m 73 F, sunny, south wind @ 5 mph	Dissolved	Oxygen	( <u>mg/l</u> )	7.58	7.58	7.50	7.36	7.31	7.27	7.27	7.19	7.09	6.95	6.84	6.75	6.06	6.05	5.61	5.34	4.82	Bottom		
	7/23/2008 (ft.): ttom Sample: inditions:		Temperature	(celsius)	24.4	24.2	24.1	24.0	23.9	23.8	23.7	23.7	23.7	23.5	23.5	23.5	23.3	23.3	23.2	23.1	23.1	Bottom		
Date: Secchi Disk ( Depth of Bott Weather Con	Date: Secchi Disk Depth of Bo Weather Co		Depth	(ff.)	2 0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0		
	4.5 11 m 50 F, sunny, south wind @ 10 mph	Dissolved	Oxygen	(mg/l)	11.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.8	11.8	6.0	
	4/30/2008 (ft.): ttom Sample: nditions:		Temperature	(celsius)	0.0	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	:
	Date: Secchi Disk Depth of Bo Weather Cc		Depth	( <del>[[</del> ])	2 0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	0.01

8/24/200 isk (ft.): 6.5 Bottom Sample: 36 Conditions: sunny, wind S @ 10 ture (F): 80	Temperature Dissolve (celsius) (mg/l)	20.8 8.70	20.0 8.55	19.9 8.38	19.7 7.69	19.5 7.26	19.3 7.29	19.2 7.51	19.0 7.71	18.8 8.33	18.7 8.19	18.7 8.22	18.7 8.19	18.7 8.17	18.5 7.95	18.5 7.93	18.5 7.92	18.5 7.84	18.4 7.48
Date: Secchi D Depth of Weather Tempera	Depth (ff.)	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0
7/28/2009 6.5 ) 36 sunny, wind W @ 15 66	Dissolved Oxygen (mg/l) 7 86	7.82	7.81	7.79	7.79	7.75	7.55	7.03	6.59	6.22	6.07	5.95	5.91	5.69	5.41	5.20	4.58	2.52	Bottom
< (ft.): ottom Sample (ft onditions: partly re (F):	Temperature (celsius)	22.8	22.7	22.7	22.7	22.7	22.5	22.4	22.3	22.1	22.0	21.7	21.6	21.6	21.4	21.3	21.2	20.3	Bottom
Date: Secchi Dish Depth of Bo Weather Co Temperatu	Depth (ft.)	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0
:8/2009 5.0 38 ny, wind NE @ 10 51	solved vygen <u>ng/l)</u>	0.65	0.64	0.64	0.64	0.63	0.62	0.62	0.61	0.61	0.60	0.60	0.59	0.58	0.57	0.57	0.56	0.56	0.54
4/2 > (ft) ostly sum	e Dis O Dis		~	-	~	~	-	~	~	τ.	1	1	~	~	~	~	-	-	~
sk (ft.): 3ottom Sample Conditions: mu ure (F):	Temperatur (celsius)	9.4 9.4	9.4	9.3	9.3	9.3	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Date: Secchi Di Depth of E Veather ( Temperat	Depth (ff.)	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2009.

Summary Of Dissolved Oxygen And Temperature

Data For The Thornapple Flowage

2003 - 2009

Dissolved (	<b>Oxygen and Te</b>	mperature Profiles for th	le Thornapp	le Flowage in 2	003.				
Date:	5/19/2003	~	Date:	7/28/2003		Date:	8/13/2003		
Secchi Disk	(ft.):	4.5	Secchi Disł	< (ft.):	6.5	Secchi Disk	(ft.):	Q	
Depth of Bo	ttom Sample:	19 ft.	Depth of Bo	ottom Sample:	6 m	Depth of Bo	ttom Sample:	6m	
Weather Co	inditions:	cloudy, S wind, 65 F	Weather Co	onditions:	clear, calm, 70 F	Weather Co	inditions:	clear, calm, 75 F	
		Dissolved			Dissolved			Dissolved	
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	
( <del>ff</del> .)	(celsius)	(I/bm)	( <del>ft</del> .)	(celsius)	( <u>I/6m</u> )	( <del>fi</del> .)	(celsius)	( <u>I/bu</u> )	
Surface	13.8	9.72	Surface	24.5	6.73	Surface	24.5	8.73	
2.0	13.7	9.75	2.0	24.4	7.00	2.0	24.3	8.78	
4.0	13.7	9.77	4.0	24.3	6.97	4.0	24.2	8.68	
6.0	13.7	9.77	6.0	24.3	6.89	6.0	24.0	8.00	
8.0	13.7	9.71	8.0	24.3	6.79	8.0	23.7	7.55	
10.0	13.7	9.71	10.0	24.3	6.79	10.0	23.4	5.95	
12.0	13.7	9.72	12.0	24.0	6.29	12.0	23.4	5.79	
14.0	13.7	9.69	14.0	22.9	5.43	14.0	23.2	6.03	
16.0	13.7	9.69	16.0	22.6	5.18	16.0	23.0	4.68	
18.0	13.7	9.67	18.0	22.3	4.71	18.0	22.5	2.62	
20.0	13.7	9.67	20.0	21.9	3.75	20.0	22.1	1.34	
Could not com	into oarliar due to h	ich river flows							
			Doto.			Inato.	RIJEIJUUN		
Date:	-002/0/0	•	Dale.	5007/07/1	ı		01201200	L	
Secchi Disk	: (ft.):	5	Secchi Dis	κ (π.):	Q	Seccni UISI	с (п.):	0.0	
Depth of Bc	ottom Sample:	6 m cloudy Swind 60 E	Depth of B	ottom Sample:	19.5 ft narfly sunny 75 F	Depth of Bo	ottom Sample:	6 m overcast 70 F	
	DIMINOUS.	Discolved		oliginolis.	Discolved			Dissolved	
Honth	Tomporphire	Owner	Danth	Tamnaratiira	Ownen	Danth	Temperature	Oxygen	
	(coleine)		(#)	(celeine)	(ma/l)		(celsius)	(ma/l)	
Surface	10.0	10.1	Surface	23.2	7.6	Surface	20.4	9.4	
2.0	10.0	10.3	2.0	23.2	7.6	2.0	20.3	9.2	
4.0	10.0	10.4	4.0	22.6	7.1	4.0	20.2	9.0	
6.0	10.0	10.6	6.0	22.1	6.5	6.0	20.1	8.8	
8.0	10.0	10.6	8.0	21.9	6.2	8.0	19.9	8.4	
10.0	9.9	10.6	10.0	21.9	6.2	10.0	19.8	8.4	
12.0	9.9	10.6	12.0	21.8	6.2	12.0	19.5	8.0	
14.0	9.9	10.6	14.0	21.3	5.8	14.0	19.4	7.9	
16.0	9.8	10.6	16.0	21.1	6.2	16.0	19.4	7.9	
18.0	9.8	10.6	18.0	20.4	2.4	18.0	19.3	7.7	
20.0	9.8	10.3	20.0	19.2	0.9	20.0	18.6	5.9	
Could not san	ple earlier due to h	nigh river flows							

				100012012			200011010		
Secchi Dis	4/13/200 sk (ft.):	ى م	Date. Secchi Disk	(ft.):	4	Secchi Disl	6/2/1/2002 k (ft.):	5.5	
Depth of E	Sottom Sample:	6 m	Depth of Bo	ottom Sample:	6 m	Depth of Bo	ottom Sample:	6 H	
Weather (	conditions:	cloudy, S wind, /U F	vveather Co	onditions:	Clay, 5 Wind, 82 F	vveather C	onaltions:	Sunny, S Wind, 70 F	
	-	Dissolved			Dissolved			Dissolved	
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth	l emperature	Oxygen	
	(ceisius)	1011	Curfood	Celsius)	1/6111	Curfood	Celsius)		
Sunace	10.2	10.1	ourace	4.07	4. 1	ounace	4.77	- 0 1	
2.0	10.2	10.7	2.0	25.0	7.0	2.0	21.9	6.7	
4.0	10.1	10.8	4.0	24.7	6.7	4.0	21.5	7.7	
6.0	10.1	10.8	6.0	24.5	6.4	6.0	21.4	7.4	
8.0	10.1	10.8	8.0	24.4	6.0	8.0	21.3	7.4	
10.0	10.0	10.8	10.0	23.8	5.2	10.0	21.3	7.4	
12.0	9.9	10.8	12.0	23.5	5.3	12.0	21.3	7.3	
14.0	9.8	10.8	14.0	23.3	4.8	14.0	21.2	7.3	
16.0	9.8	10.8	16.0	23.2	4.6	16.0	21.2	7.2	
18.0	9.8	10.8	18.0	22.3	0.8	18.0	21.2	7.2	
20.0	9.8	10.8	20.0			20.0	21.2	7.1	
Dissolve	I Oxygen and T∉	emperature Profiles for the	e Thornapp	le Flowage in 2	006.				
Date:	4/26/200	9	Date:	7/24/2006		Date:	8/23/2006		
Secchi Di	sk (ft.):	4	Secchi Disk	c (ft.):	Q	Secchi Dis	k (ft.):	4	
Depth of F	Sottom Sample:	6 m	Depth of Bo	ottom Sample:	5 m	Depth of B	ottom Sample:	6 m	
Weather (	Conditions:	sunny, W wind @15 mph	Weather Co	onditions:	Mstly sunny, S wind@10mph	Weather C	onditions:	Cloudy, S wind@5 mph	
		Dissolved			Dissolved			Dissolved	
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	
(ft.)	(celsius)	(mg/l)	(ft.)	(celsius)	(mg/l)	(ft.)	(celsius)	(mg/l)	
Surface	13.9	10.1	Surface	25.1	7.6	Surface	24.3	9.6	
2.0	13.9	10.2	2.0	24.6	7.4	2.0	24.1	9.4	
4.0	13.7	10.2	4.0	24.3	7.2	4.0	23.6	8.6	
6.0	13.3	10.1	6.0	24.0	6.8	6.0	23.3	7.9	
8.0	13.0	10.0	8.0	23.8	6.7	8.0	23.3	7.8	
10.0	12.4	9.9	10.0	23.6	6.4	10.0	23.2	7.6	
12.0	12.3	9.8	12.0	23.5	6.2	12.0	23.2	7.4	
14.0	12.3	9.7	14.0	22.8	5.0	14.0	23.1	7.0	
16.0	12.3	9.7	16.0	19.7	0.3	16.0	23.0	6.7	
18.0	12.3	9.7	18.0	Bottom	Bottom	18.0	22.9	5.6	
20.0	12.3	9.5				20.0	Bottom	Bottom	
22.0	Bottom	Bottom							

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2005.

Date:	4/30/200	7 6	Date: Socchi Dict	7/31/2007	La N	Date:	8/29/2007 # \:	ш	
Depth of E Weather C	sk (IL.): 3ottom Sample: 2onditions:	о 6 m cldy, S wind @10 mph	Depth of Bo Weather Co	۲ (۱۱.). ottom Sample: onditions:	6 m Sunny, S wind@5mph	Depth of Botto Weather Con	u.). om Sample: ditions:	о 6 m Mstly sny, S wind@5 mph	
		Dissolved			Dissolved			Dissolved	
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth T	emperature	Oxygen	
( <del>ff</del> .)	(celsius)	( <u>mg/l)</u>	(ft.)	(celsius)	( <u>mg/l)</u>	( <del>fi</del> .)	(celsius)	(mg/l)	
Surface	15.3	11.26	Surrace	27.1	0.5.0	Surrace			
2.0	14.7	11.27	2.0	26.7	8.31	2.0	DO/Temperat	ures profiles were not taken	
4.0	14.4	11.33	4.0	25.9	7.54	4.0	due to e	equipment malfunction	
6.0	14.3	11.32	6.0	25.8	7.35	6.0			
8.0	14.3	11.28	8.0	25.8	7.27	8.0			
10.0	14.1	11.28	10.0	25.7	7.22	10.0			
12.0	14.0	11.20	12.0	25.7	7.04	12.0			
14.0	13.9	11.13	14.0	25.5	6.81	14.0			
16.0	13.8	10.90	16.0	25.5	6.79	16.0			
18.0	13.1	10.43	18.0	25.1	6.27	18.0			
20.0	Bottom	Bottom	20.0	24.7	5.78	20.0			
22.0			22.0	Bottom	Bottom				
					H:\refere	nces/biofalls/WaterQu	alitySummary.xls		
Dissolvec	I Oxygen and Te	emperature Profiles for the	Thornapp	le Flowage in 2	:008.	0			
Date:	4/30/200	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Date:	7/23/2008		Date:	8/26/2008		
Secchi Dis	sk (ft.):	4	Secchi Disl	k (ft.):	5	Secchi Disk (1	ft.):	5	
Depth of E	Sottom Sample:	NA	Depth of Bo	ottom Sample:	5.5 m	Depth of Botto	om Sample:	5 m	
Weather (	Conditions:	55 F, sunny,	Weather C	onditions:	78 F, partly cloudy,	Weather Con	ditions:	76 F, sunny,	
		south wind @ 10 mph			south wind @ 5 mph			southeast wind @ 5-10 mph	
		Dissolved	C		Dissolved		e.	Dissolved	
Depth	Temperature	Oxygen	Depth	Temperature	Oxygen	Depth T	emperature	Oxygen	
(ft.)	(celsius)	(mg/l)	( <del>ff</del> .)	(celsius)	(I/bm)	( <del>f</del> t.)	(celsius)	(mg/l)	
Surface			Surface	25.1	7.56	Surface	22.3	9.64	
2.0			2.0	24.7	7.43	2.0	22.0	9.46	
4.0			4.0	24.2	7.27	4.0	21.8	9.25	
6.0	DO/tei	mperature profile not taken	6.0	23.5	6.95	6.0	21.6	8.99	
8.0	due t	o problems with DO meter	8.0	23.1	6.70	8.0	21.5	8.82	
10.0			10.0	23.1	6.70	10.0	21.4	8.73	
12.0			12.0	22.9	6.46	12.0	21.4	8.70	
14.0			14.0	22.4	5.48	14.0	21.3	8.65	
16.0			16.0	21.8	4.36	16.0	21.3	8.62	
18.0			18.0	21.6	4.12	18.0	21.3	8.60	
20.0			20.0	Bottom	Bottom	20.0	Bottom	Bottom	
22.0			22.0						

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2007.

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09 10-15	ed	Ľ,	7											F		
8/24/20 6.5 18 wind S @	Dissolv	Oxyge	[/bm)	9.95	9.79	9.41	8.76	8.68	8.86	8.27	6.89	6.65	5.23	Bottor		
k (ft.): ottom Sample (ft onditions: sunny, v re (F):		Temperature	(celsius)	21.1	20.9	20.6	20.1	19.7	19.6	19.5	19.2	19.1	18.6	Bottom		
Date: Secchi Disl Depth of B Weather C Temperatu		Depth	( <del>ff.</del> )	Surface	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0		
7/28/2009 7 18 wind VV @ 5 67	Dissolved	Oxygen	(I/bm)	8.65	8.42	7.18	6.78	6.16	5.97	6.16	3.71	1.45	0.00	Bottom		
(ft.): ttom Sample (ft) nditions: cloudy, e (F):		Temperature	(celsius)	22.4	22.3	21.8	21.4	21.1	21.0	20.7	18.1	17.0	15.7	Bottom		
Date: Secchi Disk Depth of Bol Weather Co Temperature		Depth	( <del>[[</del> .]	Surface	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0		
<b>@</b> 10																
4/28/2009 5.5 20 sunny, wind NE 57	Dissolved	Oxygen	(I/bm)	10.90	10.95	10.96	10.93	10.93	10.94	10.92	10.91	10.90	10.90	10.86	Bottom	
(ft.): ttom Sample (ft): nditions: mostly e (F):		Temperature	(celsius)	8.3	8.3	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.1	8.1	Bottom	
Date: Secchi Disk Depth of Bo Weather Co Temperatur		Depth	(ft.)	Surface	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	

2009 Water Quality Fieldwork Data Sheets For

The Big Falls And Thornapple Flowages

# Water Quality Sampling - Big Falls Flowage

Date: <u>4-28-09</u> Temperature: <u>51°</u> Weather Conditions: <u>MOSTLY SUMMY</u> <u>WINDS NE</u>10 Depth of Bottom Sample: <u>38 FT</u> Secchi Disk Reading: <u>5.0 FT</u>

## **Dissolved Oxygen and Temperature Profile**

)

		Dissolved
Depth	Temperature (C)	Oxygen (mg/l):
Surface	9.4	10.65
2	9.4	10.65
4	9.4	10.64
6	9.3	10.64
8	9.3	10.64
10	9.3	10.63
12	9.3	10.62
14	9.2	10.62
16	9.2	10.61
18	9.2	10.61
20	9.2	10.60
22	9,2	10.60
24	9.2	10.59
26	9.2	10.58
28	9.2	10.57
30	9, 2	10.57
32	9.2	10.56
34	9,2	10.56
36	9.2	10.54
38	9.2	10.14
40	BOTTOM	BOTTOM
42		
44		
46		

Remarks: - SPOTTED I MATURE EAGLE ABOVE SPILLWAY + SAME EAGLE ON NEST . - FLOW = 2800 CFS (INCLUDES = 1 FT GATE)

- BOTTOM SAMPLE @ 11.5 M @ 1050 HRS

- NO NAVIGATIONAL HAZAADS

H:lexcel5\bigfalls\wqsheet - 5AMPLES TAKEN AT 4TH BUDY FROM WEST

EAST D-D-O WEST

\*

## Water Quality Sampling - Thornapple Flowage

Date: <u>4-.28-09</u> Temperature: <u>57°F</u> Weather Conditions: <u>SUNNY, WIND NE @ 10</u> Depth of Bottom Sample: <u>20 FT</u> Secchi Disk Reading: <u>5,5</u>

## **Dissolved Oxygen and Temperature Profile**

		Dissolved
Depths.	Jemperature (C)	Oxygen (mg/l)
Surface	8.3	10.90
2 -	8.3	10.95
4	8.2	10.96
6	8.2	10.93
8	8.2	10.93
10	8.2	10.94
12	8.2	10.92
14	8.2	10.91
16	8.2	10.90
18	8.1	10.90
20	8.1	10.86
22	BOTTOM	BOTTOM
24		
26		
28		
30		
32 -		`
34		
36		
38		
40		
42		
44		
46		

Remarks: SAMPLES TAKEN AT 4TH BUOY FROM WEST

- BOTTOM SAMPLE (TOTAL PHOS PHOROUS) TAKEN AT 6M (19.5 FT)@ 1330 HRS

- FLOW AT 3000 CFS (FULL GENERATION + 8FT GATE)

- / MATURE EAGLE PERCHED NEXT TO NEST H:\excel5\thomapp\wgsheet

- NO NAVIGATIONAL HAZARDS

## Water Quality Sampling - Big Falls Flowage

. . . . deine

 Date:
 7-28-09

 Temperature:
 66° F

 Weather Conditions:
 PARTLY SUNNY ~ WIND W @ 15

 Depth of Bottom Sample:
 36 FT

 Secchi Disk Reading:
 6.5 FT

## **Dissolved Oxygen and Temperature Profile**

		Dissolved
Depth	Lemperature (C)	Oxygen (mg/l):
Surface	22.7	7.86
2	22,8	7.82
4	22.7	7,81
6	22.7	7.79
8	22.7	7.79
10	22.7	7,75
12	22.5	7.55
14	22.4	7.03
16	22.3	6.59
18	22,1	6.22
20	22.0	6.07
22	21.7	5,95
24	21.6	5.91
26	21.6	5.69
28	21.4	5.41
30	21.3	5,20
32	21.2	4.58
34	20,3	2,52
36	BOTTOM	BOTTOM
38		
40		
42		
44		
46		

-LOW RIVER FLOWS, / GEN @ 40% Remarks: BOTTOM P SAIALE COLLECTED @ 11.5 M

OBSERVED I LOON UPSTREAM OF SPILLWAY (WEST SHORE) 200 YARDS NO NAVI GATIONAL HAZARDS SAMPLES TAKEN @ 4 TH BUDY FROM WEST

H:\excel5\bigfalls\wqsheet

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# Water Quality Sampling - Thornapple Flowage

Date: 7-28-09 Temperature: 67° Weather Conditions: <u>CLOUPY</u>, wrwp wEST@5 Depth of Bottom Sample: 6 M Secchi Disk Reading: 7FT

## **Dissolved Oxygen and Temperature Profile**

		Dissolved
Depth	Temperature (C)	Oxygen (mg/l)
Surface	22,4	8.65
2 -	22.3	8,42
4	21.8	7,18
6	21.4	6.78
8	21.1	6.16
10	21.0	5.97
12	20.7	6.16
14	18.1	3.71
16	17.0	1.45
18	15.7	0.00
20	BOTTOM	
22	,	
24		
26		
28		
30		
32 -		1
34		
36	0	
38		
40		
42		
44		
46		

Remarks: BOTTOM SAMAPLE COLLECTED & & M NO NAVIGATIONAL HAZARDS TWO IMMATURE EAGLES PERCHED & NEST SITE WEAR RECORD LIGH FLOWS ON FLAMBERU H:Lexcel5\thomapp\wqsheet

SAMPLES TAKEN @ 4TH BUOY FROM WEST

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# Water Quality Sampling - Big Falls Flowage

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Date: <u>8-24-09</u> Temperature: <u>80°</u> Weather Conditions: <u>SUNNY SOUTH WIND @ 10</u> Depth of Bottom Sample: <u>36 F T.</u> Secchi Disk Reading: <u>6.5'</u>

## **Dissolved Oxygen and Temperature Profile**

		Dissolved
, Depthy -	· Temperature (C)	Oxygen (mg/l)
Surface	21.0	8,61
2	20.8	8.70
4	20.0	8.55
6	19.9	8.38
8	19.7	7:69
10		7.26
12	19,3	7.29
14	19.2	7.51
16	19.0	7, 7/
18	18.8	8,33
20	18.7	8.19
22	18.7	8.22
24	18.7	8.19
26	18.7	8.17
28	18.5	7.95
30	18.5	7.93
32	18.5	7,92
34	18.5	7.84
36	18.4	7.48
38	BOTTIM	BOTTAM
40		
42		
44		•
46		

Remarks: I MATURE BALD EAGLE SPOTTED SOARING NEAR NEST SITE - NO NAVIGATIONAL HAZARDS

- LOW RIVER FLOWS - HODERATE TO SEVERE DROUGHT IN THE FLAMBEAU RIVER WATERSHED H:lexcel5/bigfalls/wqsheet

## Water Quality Sampling - Thornapple Flowage

Date: 8-24-09Temperature: 77 Weather Conditions: <u>MOSTLY SUMMY</u>, wind South @ 10-15 Depth of Bottom Sample: <u>19 F 7</u> Secchi Disk Reading: <u>6.5</u>

### **Dissolved Oxygen and Temperature Profile**

		Dissolved
Depth	Temperature (C)	Oxyden (mg/l)
Surface	21.1	9.95
2 -	20.9	9.79
4	20.1.	9.41
6	20.1	8.76
8	19.7	8.68
10	19.6	8.86
12	19.5	8.27
14	19.2	6.89
16	19.1	6.65
18	18.6	5.23
20	BOTTOM	BOTTOM
22		
24		
26		
28		
30		
32 -		*
34		
36		
38		
40		
42		
44		4
46		

Remarks: - SAMPLES TAKEN @ 4TH BUNY FROM WEST

- 2 IMMATURE BALD EAGLES NEAR NEST SITE AND ONE MATURE BALD EAGLE AT UPPER END OF FLOWAGE

- LOW RIVER FLOWS

H:lexcel5\thomapp\wqsheet - NO NAVIGATIONAL HAZARDS

## 2009 Water Quality Monitoring Report

(Developed by Citizens Self-Help Lake Monitoring Program)

Turtle-Flambeau Flowage (FERC Project No. 2390-02)

### Lake Water Quality 2009 Annual Report

Turtle Flambeau Flowage Iron County Waterbody ID Number: 2294900 Lake Type: DRAINAGE DNR Region: NO GEO Region: NW

Site Name	Station ID
Turtle Flambeau Flowage - Deep Hole	263059

Date	SD	SD	Hit	CHL	TP	TSI	TSI	TSI	Lake Level	Staff	Clarity	Color	Perception
	(feet)	(meters)	Bottom?			(SD)	(Chl)	(TP)		Gauge	1000		
04/29/2009				3.79	25		45	53					2-Verv
05/28/2009	8	2.4	NO		18	47		51	HIGH		CLEAR	BROWN	minor aesthetic problems
06/24/2009	7.5	2.3	NO	2.24	16	48	41	50	NORMAL		MURKY	BROWN	2-Very minor aesthetic problems
06/25/2009				3.05	45		43	58					
07/26/2009	5	1.5	NO	5.39	32	54	48	55	LOW		MURKY	BROWN	2-Very minor aesthetic problems
08/04/2009				3.19	34		44	55					
08/26/2009	6	1.8	NO	6.56	26	51	49	53	LOW		MURKY	BROWN	2-Very minor aesthetic problems
09/03/2009				3.34	17		44	50					

	05/28/2009		[		06/24/2009				07/26/2009	
Depth	Temp.	D.O.		Depth	Temp.	D.O.		Depth	Temp.	D.O.
FEET	DEGREES C	MG/L		FEET	DEGREES C	MG/L	] [	FEET	DEGREES C	MG/L
0	16.8	7.96		0	25.6	7.57	1 1	0	20.6	7.41
3	16.4	7.93		3	25.4	7.59		3	20.5	7.38
6	16.1	7.89		6	24.9	7.62		6	20.4	7.37
9	15.8	7.89		9	19.8	5.86		9	20.3	7.25
12	15.7	7.88		12	17.2	4.38		12	20.1	7.3
15	15.4	7.78		15	15.6	4.89		15	19.6	6.99

SD = Secchi depth measured in feet converted to meters; ChI = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

Wisconsin Department of Natural Resources \* Wisconsin Lakes Partnership Report Generated: 10/22/2009

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	05/28/2009	
Depth	Temp.	D.O.
FEET	DEGREES C	MG/L
20	14.4	7.41
25	14	7.3
30	13	6.98
35	10.7	4.42
40	9.4	2.77
45	9.6	2.48

08/26/2009					
Depth	Temp.	D.O.			
0	21.9	7.83			
3	20.4	7.87			
6	19.9	7.68			
9	19.8	7.45			
12	19.6	6.91			
15	19.3	6.54			
20	18.2	4.89			
25	14.3	.06			
30	11.7	.07			
35	11.1	.09			
40	11	.15			

Denth	Temp	DO
FEET	DEGREES C	MG/L
20	14.9	4.92
25	13.9	4.6
30	12.8	2.84
35	11.1	.06
40	10.3	.09
45	10.1	.14

Denth	Temp	DO	
FEET	DEGREES C	MG/L	
20	17	3.75	
25	13.8	.04	
30	12	.04	
35	11.1	.06	
40	10.6	.09	
45	10.7	.15	

Date	Lab Comment	
06/25/2009	MATRIX DUPLICATE Q.C. EXCEEDED	
08/04/2009	LOST POWER TO COOLER- STANDARD TEMP NOT MAINTAINED	
09/03/2009	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED	

Date	Data Collectors	Project
04/29/2009	USGS	TURTLE FLAMBEAU FLOWAGE TRADE LAKE PROPERTY: Turtle Flambeau Flowage Water Quality Monitoring
05/28/2009	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
06/24/2009	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
06/25/2009	USGS	TURTLE FLAMBEAU FLOWAGE TRADE LAKE PROPERTY: Turtle Flambeau Flowage Water Quality Monitoring

SD = Secchi depth measured in feet converted to meters; ChI = Chlorophyll a in micrograms per liter (ug/I); TP = Total phosphorus in ug/I, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

Wisconsin Department of Natural Resources \* Wisconsin Lakes Partnership Report Generated: 10/22/2009

Date	Data Collectors	Project
07/26/2009	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
08/04/2009	USGS	
08/26/2009	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
09/03/2009	USGS	

SD = Secchi depth measured in feet converted to meters; ChI = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

Wisconsin Department of Natural Resources \* Wisconsin Lakes Partnership Report Generated: 10/22/2009

# **Turtle Flambeau Flowage - Deep Hole 2009 Results**

X

Eutrophic Mesotrophic Oligotrophic

**Turtle Flambeau Flowage - Deep Hole** was sampled **8** different days during the 2009 season. Parameters sampled included:

- water clarity
- temperature
- dissolved oxygen
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - Deep Hole (Iron County, WBIC: 2294900) was 5.5 feet. The average for the Northwest Georegion was 9.8 feet. Typically the summer (July-Aug) water was reported as **MURKY** and **BROWN**. This suggests that the secchi depth may have been mostly impacted by suspended sediments, tiny particles of soil or organic matter that are suspended in the water. Shallow lakes are often turbid because wind stirs up sediment from the bottom. High suspended sediments are often found in flowages and impoundments where precipitation runoff from the watershed transports solids via an incoming stream.

Chemistry data was collected on Turtle Flambeau Flowage - Deep Hole. The average summer Chlorophyll was 5  $\mu$ g/l (compared to a Northwest Georegion summer average of 14.7  $\mu$ g/l). The summer Total Phosphorus average was 42.8  $\mu$ g/l. Lakes that have more than 20  $\mu$ g/l and impoundments that have more than 30  $\mu$ g/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - Deep Hole was 47. The TSI suggests that Turtle Flambeau Flowage - Deep Hole was **mesotrophic**. Mesotrophic lakes are characterized by moderately clear water, but have a increasing chance of low dissolved oxygen in deep water during the summer.



Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1999	4.3	4.25	4.25	1
2000	5.6	4.7	6.5	2
2001	5.5	5.3	5.6	2
2002	5.8	5.5	6	3
2003	5.8	5.5	6	2
2004	5.5	5	6	2
2005	5.8	5	6.5	2
2006	6.3	6	6.5	2
2007	5.3	5	5.5	2
2008	4.5	4.5	4.5	2
2009	5.5	5	6	2

#### Report Generated: 10/22/2009



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### Trophic State Index Graph



### Monitoring Station: Turtle Flambeau Flowage - Deep Hole, Iron County Past Summer (July-August) Trophic State Index (TSI) averages.

TSI(ChI) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.				
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate				
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation				
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus				
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass				

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We base the overall TSI on the Chlorophyll TSI when we have Chlorophyll data. If we don't have chemistry data, we use TSI Secchi. We do this rather than averaging, because the TSI is used to predict biomass. This makes chlorophyll the best indicator. Visit Bob Carlson's website, <u>dipin.kent.edu/tsi.htm</u>, for more info.

http://prodoasjava.dnr.wi.gov/swims/public/reporting.do?report=33&action=run&format... 10/22/2009

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