



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

December 9, 2013

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

**Subject: 2013 Water Quality Monitoring Report
Big Falls Flowage (P-2390-01) and Thornapple Flowage (P-2475)**

Dear Secretary:

Enclosed is the 2013 Water Quality Monitoring Report for Big Falls and Thornapple flowages conducted by Northern States Power Company – Wisconsin (NSPW). The results are summarized for the past eight years and while there appears to be some variability in the parameters analyzed, for the most part, the results have been relatively consistent. Licensee also confirmed that the water quality monitoring results for Turtle Flambeau Reservoir (P-2390-02) have been posted on the WDNR's website.

The WDNR and USFWS were provided 30 days to submit comments on the report. Licensee concurs with their recommendations. Agency correspondence is included in Appendix E. 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,

A handwritten signature in cursive script that reads 'William Zawacki'.

William Zawacki
Director, Hydro Plants

Enclosure: Water Quality Monitoring Report

c: Mr. Jeff Scheirer – WDNR (cover letter only – via e-mail)
Ms. Cheryl Laatsch – WDNR (cover letter only – via email)
Mr. Nick Utrup – USFWS (cover letter only – via e-mail)
Project Files

**2013 Water Quality Monitoring Report for Big Falls Flowage
(P-2390-01) and Thornapple Flowage (P-2475)**

Northern States Power Company – WI
An Xcel Energy Company

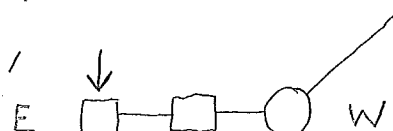
October 2013

APPENDIX A

2013 Water Quality Fieldwork Data Sheets & Lab Analysis For Big Falls and Thornapple Flowages

Water Quality Sampling - Big Falls FlowageDate: 5-29-13Temperature: 59°Weather Conditions: MASTLY CLOUDY, LIGHT SE WINDSDepth of Bottom Sample: 38 FT (12.5 M)Secchi Disk Reading: 4.5 FT**Dissolved Oxygen and Temperature Profile**

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	15.3	9.22
2	15.3	9.17
4	15.2	9.13
6	15.2	9.13
8	15.2	9.11
10	15.2	9.10
12	15.2	9.07
14	15.2	9.07
16	15.2	9.07
18	15.2	9.07
20	15.2	9.06
22	15.2	9.06
24	15.2	9.05
26	15.2	9.05
28	15.2	9.04
30	15.2	9.04
32	15.2	9.04
34	15.2	9.03
36	15.2	9.01
38	Bottom	
40		
42		
44		
46		

Remarks: *RIVER FLOWS ≈ 2800 CFS**NO NAVIGATION HAZARDS**2 EAGLE NESTS 150' APART - UNSURE OF ACTIVE NEST OR BOTH**- NEAR RECORD LATE ICE OUT ≈ MAY 1**- SAMPLE SITE 3RD BUOY FROM WEST*

Water Quality Sampling - Thornapple Flowage

Date: 5-29-13

Temperature: 62°

Weather Conditions: MOSTLY CLOUDY - LIGHT WINDS

Depth of Bottom Sample: 20 FT

Secchi Disk Reading: 4 FT

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	15.7	8.95
2	15.2	8.95
4	15.2	8.96
6	15.2	8.94
8	15.2	8.94
10	15.2	8.95
12	15.2	8.94
14	15.2	8.94
16	15.2	8.93
18	15.2	8.92
20	15.2	8.92
22	BOTTOM	
24		
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks: - NO NAVIGATION HAZARDS
 - RIVER FLOWS ≈ 3,200 CFS
 - ONE MATURE EAGLE AT NEST SITE + 1 EAGLET OBSERVED ON NEST

- SAMPLE SITE 4TH BUOY FROM WEST

E ↓ □ — □ — □ — □ W



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Big Falls Hydro	Project Name/Location: Phosphorus	Reported:
1400 Western Ave		
Eau Claire WI, 54701	Project Manager: Matt J Miller	06/21/2013 07:38

Surface

M3E0428-01 (Water) - Custody Number: 227374

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	< 0.05	0.05	mg/L		1	10230835	6/11/13 0:00	6/11/13 0:00	SM 4500-P E	Pace
-----------------------	--------	------	------	--	---	----------	--------------	--------------	-------------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Big Falls Hydro	Project Name/Location: Phosphorus	Reported:
1400 Western Ave		
Eau Claire WI, 54701	Project Manager: Matt J Miller	06/21/2013 07:38

Bottom

M3E0428-02 (Water) - Custody Number: 227374

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	0.061	0.05	mg/L		1	10230835	6/11/13 0:00	6/11/13 0:00	SM 4500-P E	Pace
------------------------------	--------------	------	------	--	---	----------	--------------	--------------	-------------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Thornapple Hydro	Project Name/Location: Phosphorus	Reported:
W 5506 Dam Road		
Glen Flora WI, 54563	Project Manager: Matt J Miller	06/21/2013 07:07

Surface

M3E0429-01 (Water) - Custody Number: 227374

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	0.066	0.05	mg/L		1	10230835	6/11/13 0:00	6/11/13 0:00	SM 4500-P E	Pace
------------------------------	--------------	------	------	--	---	----------	--------------	--------------	-------------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Thornapple Hydro	Project Name/Location: Phosphorus	Reported:
W 5506 Dam Road		06/21/2013 07:07
Glen Flora WI, 54563	Project Manager: Matt J Miller	

Bottom

M3E0429-02 (Water) - Custody Number: 227374

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	0.072	0.05	mg/L		1	10230835	6/11/13 0:00	6/11/13 0:00	SM 4500-P E	Pace
------------------------------	--------------	------	------	--	---	----------	--------------	--------------	-------------	------

Northern Lake Service, Inc.

Chlorophyll Results

Customer: Xcel Energy

Project: 197914

Big Falls - Thornapple

<u>Sample</u>	<u>Description</u>	<u>CC a</u>	<u>Pheo a</u>	<u>TC a</u>	<u>TC b</u>	<u>TC c</u>
722208	Big Falls Flowage, Grab	2	0.81	2.6	0.068	0.45
722209	Thornapple Flowage, Grab	0.76	0.84	1.3	0.036	0.41

CC a = Corrected Chlorophyll a

Pheo a = Pheophytin a

TC a = Trichromatic Chlorophyll a

TC b = Trichromatic Chlorophyll b

TC c = Trichromatic Chlorophyll c

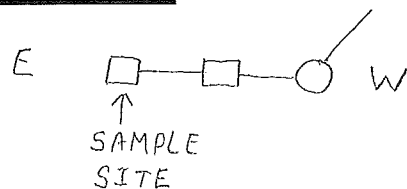
Units = ug/L for Water, ug/cm² for periphyton samplers

*: The complex calculations used to differentiate the various chlorophyll species magnify error at low concentrations and sometimes produce negative values, which are reported as 0.0 on this report.

Water Quality Sampling - Big Falls FlowageDate: 7-30-13Temperature: 64°Weather Conditions: OVERCAST, LIGHT WINDSDepth of Bottom Sample: 11.0 MSecchi Disk Reading: 4 FT**Dissolved Oxygen and Temperature Profile**

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	20.8	7.89
2	20.7	7.83
4	20.6	7.75
6	20.5	7.62
8	19.8	7.81
10	19.4	7.56
12	19.0	7.60
14	18.9	7.39
16	18.5	7.63
18	18.4	7.66
20	18.3	7.86
22	18.1	7.98
24	18.0	7.99
26	18.0	8.01
28	18.0	7.85
30	18.0	7.88
32	17.9	8.02
34	17.9	7.81
36	17.9	7.71
38	Bottom	
40		
42		
44		
46		

Remarks: RIVER FLOWS ≈ 915 CFS
 NO NAVIGATION HAZARDS
 NO EAGLE ACTIVITY

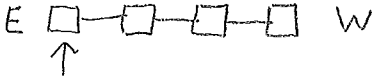


Water Quality Sampling - Thornapple Flowage

Date: 7-30-13Temperature: 65°Weather Conditions: OVERCAST, LIGHT WINDSDepth of Bottom Sample: 5 M 19.5' (SONAR)Secchi Disk Reading: 5 FT

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	22.7	7.30
2	22.5	7.25
4	22.5	7.29
6	22.5	7.27
8	22.3	7.16
10	22.2	7.00
12	21.9	6.62
14	21.1	6.42
16	20.6	6.14
18	20.3	5.87
20	20.1	5.73
22	BOTTOM	BOTTOM
24		
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks:
 - SAMPLE SITE 4TH BOUY FROM WEST 
 - NO NAVIGATION HAZARDS
 - RIVER FLOWS ≈
 - IMMATURE EAGLE ON NEST + YOY SOARING IN VICINITY
 MATURE EAGLE SOARING OVER DAM



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Big Falls Hydro	Project Name/Location: Phosphorus	Reported:
1400 Western Ave		08/30/2013 08:36
Eau Claire WI, 54701	Project Manager: Matt J Miller	

Surface

M3H0028-01 (Water) - Custody Number: 228699

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	< 0.05	0.05	mg/L		1	NA	8/21/13 18:22	8/21/13 18:22	SM4500P-E	Pace
-----------------------	--------	------	------	--	---	----	---------------	---------------	-----------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Big Falls Hydro	Project Name/Location: Phosphorus	Reported:
1400 Western Ave		
Eau Claire WI, 54701	Project Manager: Matt J Miller	08/30/2013 08:36

Bottom

M3H0028-02 (Water) - Custody Number: 228699

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	< 0.05	0.05	mg/L		1	NA	8/21/13 18:22	8/21/13 18:22	SM4500P-E	Pace
------------------------------	------------------	------	------	--	---	----	---------------	---------------	-----------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Thornapple Hydro	Project Name/Location: Phosphorus	Reported:
W 5506 Dam Road		
Glen Flora WI, 54563	Project Manager: Matt J Miller	08/30/2013 08:42

[BATCHQC]

M3H0029-01 (Water) - Custody Number: 228699

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

SM4500P-E

Phosphate, Total as P	< 0.05	0.05	mg/L		1	NA	8/21/13 18:23	8/21/13 18:23	SM4500P-E	Pace
------------------------------	------------------	------	------	--	---	----	---------------	---------------	-----------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Thornapple Hydro	Project Name/Location: Phosphorus	Reported:
W 5506 Dam Road		
Glen Flora WI, 54563	Project Manager: Matt J Miller	08/30/2013 08:42

[BATCHQC]

M3H0029-02 (Water) - Custody Number: 228699

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
SM4500P-E										
Phosphate, Total as P	0.052	0.05	mg/L		1	NA	8/21/13 18:23	8/21/13 18:23	SM4500P-E	Pace

Northern Lake Service, Inc.
Chlorophyll Results

Customer: Xcel Energy

Project: 201780

Big Falls-Thornapple

<u>Sample</u>	<u>Description</u>	<u>CC a</u>	<u>Pheo a</u>	<u>TC a</u>	<u>TC b</u>	<u>TC c</u>
734319	Big Falls Flowage	2.9	0.2	3.1	0.12	0.16
734320	Thornapple Flowage	1.2	0.23	1.3	0.077	0.13

CC a = Corrected Chlorophyll a

Pheo a = Pheophytin a

TC a = Trichromatic Chlorophyll a

TC b = Trichromatic Chlorophyll b

TC c = Trichromatic Chlorophyll c

Units = ug/L for Water, ug/cm² for periphyton samplers

*: The complex calculations used to differentiate the various chlorophyll species magnify error at low concentrations and sometimes produce negative values, which are reported as 0.0 on this report.

Water Quality Sampling - Big Falls Flowage

Date: AUGUST 27, 2013Temperature: 85Weather Conditions: MOSTLY CLOUDY, CALM WINDSDepth of Bottom Sample: 38 FTSecchi Disk Reading: 5.0 FT

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	26.0	7.35
2	26.0	7.31
4	25.9	7.27
6	25.9	7.23
8	25.9	7.22
10	25.8	7.25
12	25.7	7.22
14	25.7	7.26
16	25.7	7.30
18	25.4	7.10
20	25.2	7.00
22	24.8	6.94
24	24.7	6.77
26	24.6	6.68
28	24.5	6.54
30	24.4	6.29
32	23.9	5.69
34	23.8	5.40
36	23.3	4.01
38	BOTTOM	
40		
42		
44		
46		

Remarks: - NO NAVIGATION HAZARDS
 - NEAR RECORD HIGH TEMPERATURES
 - 2 HEAVY RAIN EVENTS JUST PRIOR TO SAMPLING
 - RIVER FLOWS ~

Water Quality Sampling - Thornapple FlowageDate: AUGUST 27, 2013Temperature: 88°Weather Conditions: PARTLY SUNNY, LIGHT WINDSDepth of Bottom Sample: 20 FTSecchi Disk Reading: 4.5 FT**Dissolved Oxygen and Temperature Profile**

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	26.2	8.32
2	26.0	8.34
4	25.1	7.36
6	24.8	7.23
8	24.7	7.08
10	24.7	6.94
12	24.5	6.68
14	24.3	6.69
16	23.9	6.59
18	23.7	6.23
20	23.7	6.18
22	Bottom	
24		
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks:



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Big Falls Hydro	Project Name/Location: Phosphorus	Reported:
1400 Western Ave		09/19/2013 07:12
Eau Claire WI, 54701	Project Manager: Matt J Miller	

Surface

M3H0446-01 (Water) - Custody Number: 230521

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	< 0.05	0.05	mg/L		1	NA	9/17/13 14:43	9/17/13 14:43	SM 4500-P E	Pace
-----------------------	--------	------	------	--	---	----	---------------	---------------	-------------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Big Falls Hydro	Project Name/Location: Phosphorus	Reported:
1400 Western Ave		09/19/2013 07:12
Eau Claire WI, 54701	Project Manager: Matt J Miller	

Bottom

M3H0446-02 (Water) - Custody Number: 230521

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
Phosphate, Total as P	0.063	0.05	mg/L		1	NA	9/17/13 14:45	9/17/13 14:45	SM 4500-P E	Pace

Wet Chemistry



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Thornapple Hydro	Project Name/Location: Phosphorus	Reported:
W 5506 Dam Road		
Glen Flora WI, 54563	Project Manager: Matt J Miller	09/19/2013 07:13

Surface

M3H0447-01 (Water) - Custody Number: 230521

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
---------	--------	-----------------	-------	-------------------	----------	-------	----------	----------	--------	---------

Wet Chemistry

Phosphate, Total as P	< 0.05	0.05	mg/L		1	NA	9/17/13 14:46	9/17/13 14:46	SM 4500-P E	Pace
-----------------------	--------	------	------	--	---	----	---------------	---------------	-------------	------



Minneapolis Testing Laboratory
 1518 Chestnut Ave N
 Minneapolis, MN 55043
 Certification # MN-027-053-197
 WI-999071150
 Christine Keefe, Supervisor (806) 381-6485

Thornapple Hydro	Project Name/Location: Phosphorus	Reported:
W 5506 Dam Road		09/19/2013 07:13
Glen Flora WI, 54563	Project Manager: Matt J Miller	

Bottom

M3H0447-02 (Water) - Custody Number: 230521

Analyte	Result	Reporting Limit	Units	Analyte Qualifier	Dilution	Batch	Prepared	Analyzed	Method	Analyst
Wet Chemistry										
Phosphate, Total as P	< 0.05	0.05	mg/L		1	NA	9/17/13 14:46	9/17/13 14:46	SM 4500-P E	Pace

Northern Lake Service, Inc.

Chlorophyll Results

Customer: Xcel Energy

Project: 203723

Big Falls - Thornapple

<u>Sample</u>	<u>Description</u>	<u>CC a</u>	<u>Pheo a</u>	<u>TC a</u>	<u>TC b</u>	<u>TC c</u>
740587	Big Falls Flowage	4.2	0.95	5	0.16	0.53
740588	Thornapple Flowage	18	0.0*	18	6.5	0.69

CC a = Corrected Chlorophyll a

Pheo a = Pheophytin a

TC a = Trichromatic Chlorophyll a

TC b = Trichromatic Chlorophyll b

TC c = Trichromatic Chlorophyll c

Units = ug/L for Water, ug/cm² for periphyton samplers

*: The complex calculations used to differentiate the various chlorophyll species magnify error at low concentrations and sometimes produce negative values, which are reported as 0.0 on this report.

APPENDIX B

Summary Of Total Phosphorous And Chlorophyll A Data For Big Falls And Thornapple Flowages 2005 - 2013

Summary of Water Quality Data for Big Falls and Thornapple Flowages (2005-2012)

Date	<u>Big Falls Flowage</u>			<u>Thornapple Flowage</u>		
	Surface Total Phosphorus (mg/L P)	Surface Chlorophyll-A (ug/L)	Bottom Total Phosphorus (mg/L P)	Surface Total Phosphorus (mg/L P)	Surface Chlorophyll-A (ug/L)	Bottom Total Phosphorus (mg/L P)
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
4/28/2010	0.025	4.2	0.048	0.029	7.2	0.016
7/27/2010	0.07	1.8	0.05	0.07	0.76	0.07
8/31/2010	0.05	3.8	0.06	0.01	0.69	0.06
4/29/2011	NA*	NA*	NA*	0.03	2.70	0.03
7/26/2011	0.04	7.3	0.06	0.05	5.40	0.04
8/24/2011	0.04	3.8	0.04	0.04	2.50	0.05
4/24/2012	0.03	6.9	0.04	0.03	2.30	0.03
7/23/2012	0.07	6.1	0.10	0.04	11.00	0.05
8/28/2012	0.02	3.3	0.04	0.03	8.60	0.03
5/29/2013	<0.05	2.6	0.06	0.07	1.3	0.07
7/30/2013	<0.05	3.1	<0.05	<0.05	1.3	0.05
8/27/2013	<0.05	5.0	0.06	<0.05	18.0	0.05
<i>Average (Ice-out sample)</i>	0.02	2.57	0.04	0.04	3.67	0.04
<i>Average (July sample)</i>	0.04	3.77	0.06	0.04	4.79	0.05
<i>Average (August sample)</i>	0.03	3.56	0.05	0.03	6.02	0.04

* No sampling conducted as reservoir was drawdown for repairs to left embankment

APPENDIX C

**Summary Of Dissolved Oxygen And Temperature
Data For Big Falls Flowage
2005 - 2013**

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2005.

Date: 4/19/2005
 Secchi Disk (ft.): 5.5
 Depth of Bottom Sample: 11 m
 Weather Conditions: partly cloudy, S wind, 70 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.4	10.1
2.0	15.2	10.2
4.0	14.9	10.2
6.0	14.8	10.2
8.0	14.8	10.2
10.0	14.8	10.2
12.0	14.8	10.2
14.0	14.8	10.2
16.0	14.8	10.2
18.0	14.7	10.1
20.0	14.6	10.1
22.0	14.7	9.8
24.0	14.8	9.9
26.0	14.7	10.0
28.0	14.7	10.0
30.0	14.7	10.0
32.0	14.6	10.0
34.0	14.6	10.0
36.0	14.6	10.0
38.0	14.5	9.9
40.0	14.3	9.6

Date: 7/25/2005
 Secchi Disk (ft.): 4
 Depth of Bottom Sample: 12.5 m
 Weather Conditions: cloudy, S wind, 75 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	26.5	6.3
2.0	26.4	6.2
4.0	26.2	6.0
6.0	26.1	5.9
8.0	26.1	5.9
10.0	26.0	5.7
12.0	25.9	5.9
14.0	25.7	5.6
16.0	25.5	5.3
18.0	25.4	5.0
20.0	25.2	5.2
22.0	25.1	5.0
24.0	25.1	5.0
26.0	25.1	5.1
28.0	25.1	5.2
30.0	25.0	5.5
32.0	24.9	5.3
34.0	24.9	5.1
36.0	24.8	4.2
38.0	22.4	0.2

Date: 8/31/2005
 Secchi Disk (ft.): 7
 Depth of Bottom Sample: 37 ft.
 Weather Conditions: Mostly sunny, 65 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	21.6	8.2
2.0	21.5	8.2
4.0	21.3	8.3
6.0	21.2	8.1
8.0	21.1	8.0
10.0	21.1	8.0
12.0	21.0	8.0
14.0	21.0	8.0
16.0	21.0	8.0
18.0	20.9	8.0
20.0	20.9	7.9
22.0	20.9	7.7
24.0	20.8	7.5
26.0	20.8	7.4
28.0	20.6	6.9
30.0	20.5	6.7
32.0	20.5	6.6
34.0	20.5	6.5
36.0	20.5	6.4
38.0	20.5	2.3

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2006.

Date: 4/26/2006
 Secchi Disk (ft.): 4
 Depth of Bottom Sample: 13 m
 Weather Conditions: sunny, west wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	12.4	9.9
2.0	12.1	10.0
4.0	12.0	10.0
6.0	12.0	10.0
8.0	11.9	10.0
10.0	11.3	10.0
12.0	11.2	10.2
14.0	11.2	10.2
16.0	11.2	10.2
18.0	11.1	10.1
20.0	11.1	10.0
22.0	11.1	9.8
24.0	11.1	9.8
26.0	11.0	9.9
28.0	11.0	9.9
30.0	11.0	9.9
32.0	11.0	9.9
34.0	11.0	9.9
36.0	11.0	9.9
38.0	11.0	9.9
40.0	Bottom	Bottom

Date: 7/24/2006
 Secchi Disk (ft.): 6
 Depth of Bottom Sample: 15 m
 Weather Conditions: Partly cloudy, south wind at 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.9	7.6
2.0	25.4	7.5
4.0	25.2	7.3
6.0	25.1	7.2
8.0	25.0	6.9
10.0	24.9	6.8
12.0	24.8	6.4
14.0	24.7	6.1
16.0	24.5	5.8
18.0	24.5	5.6
20.0	24.2	6.1
22.0	24.0	6.4
24.0	24.0	6.4
26.0	23.9	6.3
28.0	23.8	6.3
30.0	23.8	6.2
32.0	23.8	5.9
34.0	23.7	5.5
36.0	21.8	0.6
38.0	Bottom	Bottom
40.0		

Date: 8/23/2006
 Secchi Disk (ft.): 5
 Depth of Bottom Sample: 38 ft.
 Weather Conditions: Cloudy, south wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	23.3	8.3
2.0	23.3	8.3
4.0	23.1	8.2
6.0	23.1	8.1
8.0	23.1	8.1
10.0	23.1	8.1
12.0	23.1	8.0
14.0	23.0	7.9
16.0	22.9	7.5
18.0	22.8	7.1
20.0	22.7	7.0
22.0	22.7	7.0
24.0	22.5	6.8
26.0	22.3	6.3
28.0	22.2	6.0
30.0	22.1	5.8
32.0	22.1	5.8
34.0	22.0	5.6
36.0	22.0	5.3
38.0	22.0	5.1
40.0	Bottom	Bottom

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

Date: 4/30/2007
 Secchi Disk (ft.): 4
 Depth of Bottom Sample: 12 m
 Weather Conditions: Partly cloudy, light wind

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.8	9.40
2.0	15.8	9.59
4.0	15.7	9.74
6.0	15.5	9.82
8.0	15.4	9.76
10.0	15.4	9.74
12.0	15.4	9.66
14.0	15.3	9.54
16.0	15.2	9.47
18.0	15.2	9.39
20.0	15.2	9.35
22.0	15.2	9.33
24.0	15.2	9.28
26.0	15.2	9.23
28.0	15.2	9.08
30.0	15.2	9.05
32.0	14.8	8.99
34.0	13.9	8.85
36.0	12.9	8.75
38.0	Bottom	Bottom
40.0		

Date: 7/31/2007
 Secchi Disk (ft.): 7
 Depth of Bottom Sample: 12 m
 Weather Conditions: Mostly sunny, south wind at 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	28.1	7.43
2.0	27.8	7.46
4.0	27.4	7.41
6.0	27.3	7.30
8.0	27.2	7.28
10.0	27.1	6.82
12.0	27.0	6.68
14.0	26.9	6.47
16.0	26.8	6.26
18.0	26.8	6.08
20.0	26.6	5.45
22.0	26.4	5.18
24.0	26.3	5.15
26.0	26.0	4.85
28.0	25.8	4.78
30.0	25.5	4.27
32.0	25.4	4.00
34.0	24.0	0.43
36.0	Bottom	Bottom
38.0		
40.0		

Date: 8/29/2007
 Secchi Disk (ft.): 6
 Depth of Bottom Sample: 12 m
 Weather Conditions: Mostly sunny N wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface		
2.0		
4.0		
6.0	DO/Temperature profile was not taken due to equipment problems	
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		
40.0		

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2008.

Date: 4/30/2008
 Secchi Disk (ft.): 4.5
 Depth of Bottom Sample: 11 m
 Weather Conditions: 50 F, sunny, south wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	5.8	11.8
2.0	5.9	11.8
4.0	5.7	11.9
6.0	5.7	11.9
8.0	5.7	11.9
10.0	5.7	11.9
12.0	5.7	11.9
14.0	5.7	11.9
16.0	5.7	11.9
18.0	5.7	11.9
20.0	5.7	11.9
22.0	5.7	11.9
24.0	5.7	11.9
26.0	5.7	11.9
28.0	5.7	11.9
30.0	5.7	11.9
32.0	5.7	11.9
34.0	5.7	11.8
36.0	5.7	11.8
38.0	5.7	6.0
40.0	Bottom	Bottom

Date: 7/23/2008
 Secchi Disk (ft.): 5.5
 Depth of Bottom Sample: 10 m
 Weather Conditions: 73 F, sunny, south wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.7	7.60
2.0	24.4	7.58
4.0	24.2	7.58
6.0	24.1	7.50
8.0	24.0	7.36
10.0	23.9	7.31
12.0	23.8	7.27
14.0	23.7	7.27
16.0	23.7	7.19
18.0	23.7	7.09
20.0	23.5	6.95
22.0	23.5	6.84
24.0	23.5	6.75
26.0	23.3	6.06
28.0	23.3	6.05
30.0	23.2	5.61
32.0	23.1	5.34
34.0	23.1	4.82
36.0	Bottom	Bottom

Date: 8/26/2008
 Secchi Disk (ft.): 5.5
 Depth of Bottom Sample: 11 m
 Weather Conditions: 71 F, sunny, southeast wind 5-10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.7	7.04
2.0	22.5	6.95
4.0	22.3	6.91
6.0	22.3	6.77
8.0	22.3	6.31
10.0	22.2	6.39
12.0	21.9	6.71
14.0	21.8	6.82
16.0	21.8	6.93
18.0	21.7	6.91
20.0	21.7	6.80
22.0	21.6	6.80
24.0	21.6	6.82
26.0	21.6	6.91
28.0	21.6	6.91
30.0	21.5	6.82
32.0	21.5	6.81
34.0	21.4	6.83
36.0	21.4	6.71
38.0	Bottom	Bottom

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

Date: 4/28/2009
 Secchi Disk (ft.): 5.0
 Depth of Bottom Sample (ft): 38
 Weather Conditions: mostly sunny, wind NE @ 10
 Temperature (F): 51

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	9.4	10.65
2.0	9.4	10.65
4.0	9.4	10.64
6.0	9.3	10.64
8.0	9.3	10.64
10.0	9.3	10.63
12.0	9.3	10.62
14.0	9.2	10.62
16.0	9.2	10.61
18.0	9.2	10.61
20.0	9.2	10.60
22.0	9.2	10.60
24.0	9.2	10.59
26.0	9.2	10.58
28.0	9.2	10.57
30.0	9.2	10.57
32.0	9.2	10.56
34.0	9.2	10.56
36.0	9.2	10.54
38.0	9.2	10.14
40.0	Bottom	Bottom

Date: 7/28/2009
 Secchi Disk (ft.): 6.5
 Depth of Bottom Sample (ft): 36
 Weather Conditions: partly sunny, wind W @ 15
 Temperature (F): 66

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.7	7.86
2.0	22.8	7.82
4.0	22.7	7.81
6.0	22.7	7.79
8.0	22.7	7.79
10.0	22.7	7.75
12.0	22.5	7.55
14.0	22.4	7.03
16.0	22.3	6.59
18.0	22.1	6.22
20.0	22.0	6.07
22.0	21.7	5.95
24.0	21.6	5.91
26.0	21.6	5.69
28.0	21.4	5.41
30.0	21.3	5.20
32.0	21.2	4.58
34.0	20.3	2.52
36.0	Bottom	Bottom

Date: 8/24/2009
 Secchi Disk (ft.): 6.5
 Depth of Bottom Sample: 36
 Weather Conditions: sunny, wind S @ 10
 Temperature (F): 80

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	21.0	8.61
2.0	20.8	8.70
4.0	20.0	8.55
6.0	19.9	8.38
8.0	19.7	7.69
10.0	19.5	7.26
12.0	19.3	7.29
14.0	19.2	7.51
16.0	19.0	7.71
18.0	18.8	8.33
20.0	18.7	8.19
22.0	18.7	8.22
24.0	18.7	8.19
26.0	18.7	8.17
28.0	18.5	7.95
30.0	18.5	7.93
32.0	18.5	7.92
34.0	18.5	7.84
36.0	18.4	7.48
38.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2010.

Date: 4/28/2010
 Secchi Disk (ft.): 5.0
 Depth of Bottom Sample (ft): 36
 Weather Conditions: mostly sunny, light winds
 Temperature (F): 50

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	14.8	10.79
2.0	14.2	10.52
4.0	14.1	10.41
6.0	14.0	10.23
8.0	14.0	10.10
10.0	13.9	10.04
12.0	13.8	9.94
14.0	13.8	9.87
16.0	13.7	9.85
18.0	13.4	9.70
20.0	13.2	9.63
22.0	13.1	9.52
24.0	13.1	9.57
26.0	13.0	9.53
28.0	13.0	9.44
30.0	13.0	9.33
32.0	13.0	9.20
34.0	13.0	9.19
36.0	12.9	9.12
38.0	Bottom	Bottom

Date: 7/27/2010
 Secchi Disk (ft.): 3.0
 Depth of Bottom Sample (ft): 36
 Weather Conditions: cloudy, S wind @ 7
 Temperature (F): 75

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.7	6.44
2.0	24.7	6.29
4.0	24.6	6.35
6.0	24.6	6.26
8.0	24.6	6.49
10.0	24.6	6.34
12.0	24.6	6.27
14.0	24.6	6.34
16.0	24.6	6.26
18.0	24.4	6.21
20.0	24.4	6.22
22.0	24.4	6.20
24.0	24.2	6.21
26.0	24.1	6.17
28.0	23.9	6.13
30.0	23.8	6.06
32.0	23.6	6.02
34.0	23.5	5.95
36.0	23.4	5.7
38.0	Bottom	Bottom

Date: 8/31/2010
 Secchi Disk (ft.): 3.0
 Depth of Bottom Sample: 36
 Weather Conditions: partly cloudy, S wind @ 10
 Temperature (F): 79

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.2	6.70
2.0	24.2	6.68
4.0	24.2	6.68
6.0	24.2	6.67
8.0	24.2	6.66
10.0	24.2	6.66
12.0	24.2	6.66
14.0	24.2	6.66
16.0	24.1	6.63
18.0	24.0	6.60
20.0	24.0	6.59
22.0	24.0	6.60
24.0	24.0	6.60
26.0	24.0	6.58
28.0	24.0	6.60
30.0	24.0	6.59
32.0	23.9	6.59
34.0	23.9	6.55
36.0	23.8	6.34
38.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2011.

Date: 4/29/2011
 Secchi Disk (ft.):
 Depth of Bottom Sample (ft):
 Weather Conditions: mostly sunny, light winds
 Temperature (F):

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface		

Not Sampled Due To Reservoir Drawdown

Bottom	Bottom
--------	--------

Date: 7/26/2011
 Secchi Disk (ft.): 4.0
 Depth of Bottom Sample (ft): 36
 Weather Conditions: mostly sunny, light winds
 Temperature (F): 76

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.8	6.58
2.0	25.8	6.56
4.0	25.6	6.66
6.0	25.2	6.56
8.0	25.2	6.59
10.0	25.2	6.58
12.0	25.2	6.53
14.0	25.1	6.52
16.0	24.9	6.38
18.0	24.5	6.32
20.0	24.5	6.32
22.0	24.3	6.29
24.0	24.3	6.33
26.0	24.2	6.27
28.0	24.1	6.31
30.0	24.1	6.25
32.0	24.1	6.20
34.0	24.1	6.18
36.0	24.1	6.11
38.0	Bottom	Bottom

Date: 8/24/2011
 Secchi Disk (ft.): 3.0
 Depth of Bottom Sample: 36
 Weather Conditions: sunny, wind NW @ 10-15
 Temperature (F): 72

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.3	7.51
2.0	22.3	7.52
4.0	22.3	7.53
6.0	22.2	7.54
8.0	22.1	7.60
10.0	22.0	7.59
12.0	21.9	7.46
14.0	21.8	7.45
16.0	21.7	7.52
18.0	21.6	7.49
20.0	21.6	7.55
22.0	21.6	7.52
24.0	21.5	7.55
26.0	21.5	7.53
28.0	21.5	7.56
30.0	21.5	7.58
32.0	21.5	7.57
34.0	21.5	7.56
36.0	21.5	7.52
38.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2012.

Date: 4/24/2012
 Secchi Disk (ft.): 4.0
 Depth of Bottom Sample (ft) 32
 Weather Conditions: mostly sunny, light winds
 Temperature (F): 58

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	11.9	10.90
2.0	11.7	10.94
4.0	11.2	10.91
6.0	11.2	10.91
8.0	11.1	10.88
10.0	11.1	10.87
12.0	11.1	10.85
14.0	11.0	10.83
16.0	11.0	10.81
18.0	11.0	10.81
20.0	11.0	10.77
22.0	11.0	10.73
24.0	11.0	10.72
26.0	11.0	10.72
28.0	11.0	10.72
30.0	11.0	10.72
32.0	11.0	10.71
34.0	Low battery	Low battery
36.0	Low battery	Low battery

Date: 7/23/2012
 Secchi Disk (ft.): 4.0
 Depth of Bottom Sample (ft) 34
 Weather Conditions: mostly sunny, NW wind @ 1
 Temperature (F): 82

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	27.2	7.68
2.0	27.1	7.68
4.0	27.1	7.70
6.0	26.9	7.73
8.0	26.6	7.50
10.0	26.3	7.32
12.0	26.2	7.33
14.0	26.0	6.95
16.0	25.8	6.89
18.0	25.5	6.55
20.0	25.2	6.28
22.0	25.1	6.02
24.0	25.0	5.98
26.0	24.9	5.77
28.0	24.7	5.51
30.0	24.6	5.26
32.0	24.4	4.91
34.0	24.3	4.28
36.0	Bottom	Bottom

Date: 8/28/2012
 Secchi Disk (ft.): 5.5
 Depth of Bottom Sample: 34
 Weather Conditions: sunny, light winds
 Temperature (F): 65

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.4	8.15
2.0	24.3	8.14
4.0	24.3	8.10
6.0	24.3	8.04
8.0	24.3	8.16
10.0	24.2	7.82
12.0	23.7	7.38
14.0	23.5	7.15
16.0	23.4	6.85
18.0	23.4	6.75
20.0	23.4	6.64
22.0	23.3	6.44
24.0	23.2	6.23
26.0	23.0	5.84
28.0	22.7	5.38
30.0	22.6	5.25
32.0	22.2	4.62
34.0	20.8	3.82
36.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2013.

Date: 5/29/2013
 Secchi Disk (ft.): 4.5
 Depth of Bottom Sample (ft) 38
 Weather Conditions: mostly cloudy, light winds
 Temperature (F): 59

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.3	9.22
2.0	15.3	9.17
4.0	15.2	9.13
6.0	15.2	9.13
8.0	15.2	9.10
10.0	15.2	9.10
12.0	15.2	9.07
14.0	15.2	9.07
16.0	15.2	9.07
18.0	15.2	9.07
20.0	15.2	9.06
22.0	15.2	9.06
24.0	15.2	9.05
26.0	15.2	9.05
28.0	15.2	9.04
30.0	15.2	9.04
32.0	15.2	9.04
34.0	15.2	9.03
36.0	15.2	9.01
38.0	Bottom	Bottom

Date: 7/30/2013
 Secchi Disk (ft.): 4.0
 Depth of Bottom Sample (ft) 36
 Weather Conditions: overcast, light winds
 Temperature (F): 64

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	20.8	7.89
2.0	20.7	7.83
4.0	20.6	7.75
6.0	20.5	7.62
8.0	19.8	7.81
10.0	19.4	7.56
12.0	19.0	7.60
14.0	18.9	7.39
16.0	18.5	7.63
18.0	18.4	7.66
20.0	18.3	7.86
22.0	18.1	7.98
24.0	18.0	7.99
26.0	18.0	8.01
28.0	18.0	7.85
30.0	18.0	7.88
32.0	17.9	8.02
34.0	17.9	7.81
36.0	17.9	7.7
38.0	Bottom	Bottom

Date: 8/27/2013
 Secchi Disk (ft.): 5.0
 Depth of Bottom Sample: 38
 Weather Conditions: mostly cloudy, calm winds
 Temperature (F): 65

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	26.0	7.35
2.0	26.0	7.31
4.0	25.9	7.27
6.0	25.9	7.23
8.0	25.9	7.22
10.0	25.8	7.25
12.0	25.7	7.22
14.0	25.7	7.26
16.0	25.7	7.30
18.0	25.4	7.10
20.0	25.2	7.00
22.0	24.8	6.94
24.0	24.7	6.77
26.0	24.6	6.68
28.0	24.5	6.54
30.0	24.4	6.29
32.0	23.9	5.69
34.0	23.8	5.40
36.0	23.3	4.0
38.0	Bottom	Bottom

APPENDIX D

**Summary Of Dissolved Oxygen And Temperature
Data For Thornapple Flowage
2005 - 2013**

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

Date: 4/19/2005			Date: 7/25/2005			Date: 8/31/2005		
Secchi Disk (ft.): 5			Secchi Disk (ft.): 4			Secchi Disk (ft.): 5.5		
Depth of Bottom Sample: 6 m			Depth of Bottom Sample: 6 m			Depth of Bottom Sample: 6 m		
Weather Conditions: cloudy, S wind, 70 F			Weather Conditions: cloudy, S wind, 82 F			Weather Conditions: sunny, S wind, 70 F		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	10.2	10.7	Surface	25.4	7.4	Surface	22.4	8.1
2.0	10.2	10.7	2.0	25.0	7.0	2.0	21.9	7.9
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

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2006.

Date: 4/26/2006			Date: 7/24/2006			Date: 8/23/2006		
Secchi Disk (ft.): 4			Secchi Disk (ft.): 6			Secchi Disk (ft.): 4		
Depth of Bottom Sample: 6 m			Depth of Bottom Sample: 5 m			Depth of Bottom Sample: 6 m		
Weather Conditions: sunny, W wind @15 mph			Weather Conditions: Mostly sunny, S wind@10mph			Weather Conditions: cloudy, S wind@5 mph		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (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 2007.

Date: 4/30/2007			Date: 7/31/2007			Date: 8/29/2007		
Secchi Disk (ft.): 5			Secchi Disk (ft.): 5			Secchi Disk (ft.): 5		
Depth of Bottom Sample: 6 m			Depth of Bottom Sample: 6 m			Depth of Bottom Sample: 6 m		
Weather Conditions: cloudy, S wind @10 mph			Weather Conditions: Mostly sunny, S wind @ 5 mph			Weather Conditions: Mostly sunny, S wind @ 5 mph		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.3	11.26	Surface	27.1	8.50	Surface	DO/Temperatures profiles were not taken due to equipment malfunction	
2.0	14.7	11.27	2.0	26.7	8.31			
4.0	14.4	11.33	4.0	25.9	7.54			
6.0	14.3	11.32	6.0	25.8	7.35			
8.0	14.3	11.28	8.0	25.8	7.27			
10.0	14.1	11.28	10.0	25.7	7.22			
12.0	14.0	11.20	12.0	25.7	7.04			
14.0	13.9	11.13	14.0	25.5	6.81			
16.0	13.8	10.90	16.0	25.5	6.79			
18.0	13.1	10.43	18.0	25.1	6.27			
20.0	Bottom	Bottom	20.0	24.7	5.78	20.0		
22.0			22.0	Bottom	Bottom			

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2008.

Date: 4/30/2008			Date: 7/23/2008			Date: 8/26/2008		
Secchi Disk (ft.): 4			Secchi Disk (ft.): 5			Secchi Disk (ft.): 5		
Depth of Bottom Sample: NA			Depth of Bottom Sample: 5.5 m			Depth of Bottom Sample: 5 m		
Weather Conditions: 55 F, sunny, south wind @ 10 mph			Weather Conditions: 78 F, partly cloudy, south wind @ 5 mph			Weather Conditions: 76 F, sunny, southeast wind @ 5-10 mph		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (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/temperature profile not taken due to problems with DO meter		6.0	23.5	6.95	6.0	21.6	8.99
8.0			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

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2009.

Date: 4/28/2009			Date: 7/28/2009			Date: 8/24/2009		
Secchi Disk (ft.): 5.5			Secchi Disk (ft.): 7			Secchi Disk (ft.): 6.5		
Depth of Bottom Sample (ft) 20			Depth of Bottom Sample (ft) 18			Depth of Bottom Sample (ft) 18		
Weather Conditions: mostly sunny, wind NE @ 10			Weather Conditions: cloudy, wind W @ 5			Weather Conditions: sunny, wind S @ 10-15		
Temperature (F): 57			Temperature (F): 67			Temperature (F): 77		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	8.3	10.90	Surface	22.4	8.65	Surface	21.1	9.95
2.0	8.3	10.95	2.0	22.3	8.42	2.0	20.9	9.79
4.0	8.2	10.96	4.0	21.8	7.18	4.0	20.6	9.41
6.0	8.2	10.93	6.0	21.4	6.78	6.0	20.1	8.76
8.0	8.2	10.93	8.0	21.1	6.16	8.0	19.7	8.68
10.0	8.2	10.94	10.0	21.0	5.97	10.0	19.6	8.86
12.0	8.2	10.92	12.0	20.7	6.16	12.0	19.5	8.27
14.0	8.2	10.91	14.0	18.1	3.71	14.0	19.2	6.89
16.0	8.2	10.90	16.0	17.0	1.45	16.0	19.1	6.65
18.0	8.1	10.90	18.0	15.7	0.00	18.0	18.6	5.23
20.0	8.1	10.86	20.0	Bottom	Bottom	20.0	Bottom	Bottom
22.0	Bottom	Bottom						

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2010.

Date: 4/28/2010			Date: 7/27/2010			Date: 8/31/2010		
Secchi Disk (ft.): 5.0			Secchi Disk (ft.): 3			Secchi Disk (ft.): 3		
Depth of Bottom Sample (ft) 20			Depth of Bottom Sample (ft) 20			Depth of Bottom Sample (ft) 20		
Weather Conditions: p. cloudy, S winds 5-10			Weather Conditions: p. cloudy, S wind @ 5			Weather Conditions: cloudy, S wind @ 10		
Temperature (F): 59			Temperature (F): 84			Temperature (F): 81		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	13.8	11.90	Surface	25.4	4.46	Surface	23.0	5.82
2.0	13.7	11.74	2.0	25.0	4.44	2.0	22.8	5.75
4.0	12.6	11.83	4.0	24.6	4.37	4.0	22.8	5.74
6.0	12.4	11.70	6.0	24.5	4.38	6.0	22.7	5.71
8.0	12.3	12.02	8.0	24.5	4.37	8.0	22.6	5.71
10.0	12.2	12.01	10.0	24.5	4.30	10.0	22.6	5.71
12.0	11.8	10.50	12.0	24.3	4.23	12.0	22.6	5.71
14.0	11.5	10.63	14.0	24.3	4.23	14.0	22.6	5.71
16.0	11.2	10.44	16.0	24.2	4.35	16.0	22.6	5.70
18.0	11.2	10.37	18.0	24.2	4.37	18.0	22.6	5.70
20.0	11.2	10.25	20.0	24.2	4.3	20.0	22.6	5.7
			22.0	Bottom	Bottom	22.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2011.

Date: 4/29/2011			Date: 7/26/2011			Date: 8/24/2011		
Secchi Disk (ft.): 3.5			Secchi Disk (ft.): 4.5			Secchi Disk (ft.): 3		
Depth of Bottom Sample (ft) 22			Depth of Bottom Sample (ft) 20			Depth of Bottom Sample (ft) 20		
Weather Conditions: sunny, wind S @ 5-10			Weather Conditions: sunny, light winds			Weather Conditions: sunny, NW wind 15-20		
Temperature (F): 45			Temperature (F): 80			Temperature (F): 78		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	6.9	12.5	Surface	26.4	6.56	Surface	23.7	6.52
2.0	6.8	12.4	2.0	26.3	6.54	2.0	23.7	6.50
4.0	6.8	12.4	4.0	25.9	6.54	4.0	23.0	6.36
6.0	6.8	12.4	6.0	25.6	6.47	6.0	22.7	6.26
8.0	6.8	12.4	8.0	25.7	6.46	8.0	22.7	6.23
10.0	6.8	12.4	10.0	25.5	6.45	10.0	22.6	6.16
12.0	6.8	12.4	12.0	25.4	6.41	12.0	22.5	6.08
14.0	6.8	12.3	14.0	24.6	6.14	14.0	22.3	5.94
16.0	6.8	12.3	16.0	24.2	5.76	16.0	22.1	5.73
18.0	6.8	12.3	18.0	24.2	5.68	18.0	22.0	5.60
20.0	6.8	12.3	20.0	23.7	5.00	20.0	22.0	5.60
22.0	6.8	12.3	22.0	Bottom	Bottom	22.0	Bottom	Bottom
24.0	Bottom	Bottom						

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2012.

Date: 4/24/2012			Date: 7/23/2012			Date: 8/28/2012		
Secchi Disk (ft.): 4.0			Secchi Disk (ft.): 3.5			Secchi Disk (ft.): 5.5		
Depth of Bottom Sample (ft) 20			Depth of Bottom Sample (ft) 18			Depth of Bottom Sample (ft) 18		
Weather Conditions: sunny, light NW winds			Weather Conditions: sunny, winds W @ 5-10			Weather Conditions: overcast, calm		
Temperature (F): 67			Temperature (F): 85			Temperature (F): 78		
Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)	Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.4	10.99	Surface	30.6	8.45	Surface	23.6	8.37
2.0	13.2	11.22	2.0	28.3	7.66	2.0	23.3	7.98
4.0	12.8	11.25	4.0	27.4	7.03	4.0	23.7	7.83
6.0	12.4	11.27	6.0	26.8	6.30	6.0	23.1	7.72
8.0	12.1	11.24	8.0	26.5	6.04	8.0	23.1	7.84
10.0	11.9	11.10	10.0	26.3	5.70	10.0	23.1	7.68
12.0	11.9	11.06	12.0	25.6	4.99	12.0	23.0	7.16
14.0	11.7	11.04	14.0	25.2	4.88	14.0	22.8	6.57
16.0	11.6	10.97	16.0	24.6	4.08	16.0	22.6	6.22
18.0	11.6	10.95	18.0	24.2	3.08	18.0	22.0	3.31
20.0	11.6	10.92	20.0	Bottom	Bottom	20.0	Bottom	Bottom
22.0	Bottom	Bottom						

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2013.

Date: 5/29/2013
 Secchi Disk (ft.): 4.0
 Depth of Bottom Sample (ft) 20
 Weather Conditions: mostly cloudy, light winds
 Temperature (F): 62

Date: 7/30/2013
 Secchi Disk (ft.): 5
 Depth of Bottom Sample (ft) 19.5
 Weather Conditions: overcast, light winds
 Temperature (F): 65

Date: 8/27/2013
 Secchi Disk (ft.): 4.5
 Depth of Bottom Sample (ft) 20
 Weather Conditions: partly sunny, light winds
 Temperature (F): 88

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.7	8.95
2.0	15.2	8.95
4.0	15.2	8.96
6.0	15.2	8.94
8.0	15.2	8.94
10.0	15.2	8.95
12.0	15.2	8.94
14.0	15.2	8.94
16.0	15.2	8.93
18.0	15.2	8.92
20.0	15.2	8.92
22.0	Bottom	Bottom

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.7	7.30
2.0	22.5	7.25
4.0	22.5	7.29
6.0	22.5	7.27
8.0	22.3	7.16
10.0	22.2	7.00
12.0	21.9	6.62
14.0	21.1	6.42
16.0	20.6	6.14
18.0	20.3	5.87
20.0	20.1	5.73
22.0	Bottom	Bottom

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	26.2	8.32
2.0	26.0	8.34
4.0	25.1	7.36
6.0	24.8	7.23
8.0	24.7	7.08
10.0	24.7	6.94
12.0	24.5	6.68
14.0	24.3	6.69
16.0	23.9	6.59
18.0	23.7	6.23
20.0	23.7	6.18
22.0	Bottom	Bottom

APPENDIX E

Agency Correspondence



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

October 24, 2013

Ms. Cheryl Laatsch – Statewide FERC Coordinator
WI Dept. of Natural Resources
N7725 Hwy 28
Horicon, WI 53032

**Subject: 2013 Water Quality Monitoring Report for Big Falls Flowage (P-2390-01),
Thornapple Flowage (P-2475) and Turtle-Flambeau Flowage (P-2390-02).**

Dear Ms. Laatsch:

Enclosed are the results of the water quality sampling for Big Falls and Thornapple flowages that Northern States Power Company – Wisconsin (NSPW) conducted during the 2013 field season. 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. The results are summarized for the past nine years and while there appears to be some variability in the parameters analyzed, for the most part, the results have been relatively consistent.

Annual water quality monitoring for the Turtle Flambeau Flowage is conducted by the Citizens Lake Monitoring Program and the results are published on the WDNR's website. The link is <http://dnr.wi.gov/lakes/clmn/Stations.aspx?location=26>. Should citizen monitoring be discontinued in the future, NSPW shall provide replacement services.

Please provide me with any comments that you might have by December 6, 2013. Should you have any questions concerning this report, you may contact me by telephone at (715) 737-1353 or by electronic mail at matthew.j.miller@xcelenergy.com.

Sincerely,

A handwritten signature in cursive script that reads 'Matthew J. Miller'.

Matthew J. Miller
Hydro Licensing Specialist

Enclosure: 2013 Water Quality Monitoring Report

c: Nick Utrup – USFWS
Project Files



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

October 24, 2013

Mr. Nick Utrup
U.S. Fish & Wildlife Service
2661 Scott Tower Drive
New Franken, WI 54229

**Subject: 2013 Water Quality Monitoring Report for Big Falls Flowage (P-2390-01),
Thornapple Flowage (P-2475) and Turtle-Flambeau Flowage (P-2390-02).**

Dear Mr. Utrup:

Enclosed are the results of the water quality sampling for Big Falls and Thornapple flowages that Northern States Power Company – Wisconsin (NSPW) conducted during the 2013 field season. 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. The results are summarized for the past nine years and while there appears to be some variability in the parameters analyzed, for the most part, the results have been relatively consistent.

Annual water quality monitoring for the Turtle Flambeau Flowage is conducted by the Citizens Lake Monitoring Program and the results are published on the WDNR's website. The link is <http://dnr.wi.gov/lakes/clmn/Stations.aspx?location=26>. Should citizen monitoring be discontinued in the future, NSPW shall provide replacement services.

Please provide me with any comments that you might have by December 6, 2013. Should you have any questions concerning this report, you may contact me by telephone at (715) 737-1353 or by electronic mail at matthew.j.miller@xcelenergy.com.

Sincerely,

A handwritten signature in cursive script that reads 'Matthew J. Miller'.

Matthew J. Miller
Hydro Licensing Specialist

Enclosure: 2013 Water Quality Monitoring Report

c: Cheryl Laatsch – WDNR (via e-mail)
Project Files

Miller, Matthew J

From: Laatsch, Cheryl - DNR [Cheryl.Laatsch@wisconsin.gov]
Sent: Monday, November 25, 2013 2:00 PM
To: Miller, Matthew J
Subject: FW: wq data for 2013

Here are our comments on the wq data.

Xcel was unable to run the P samples in house this year. They sent them out to another lab. Matt had noticed that the reported levels were different than last year, and in years past as did WDNR. Matt thought that Xcel would return to doing P the sample analysis in house next year. Matt said the detection limit Xcel had on previous samples was 0.01 mg/L. That limit is fine. Matt understood that the 0.05 limit was not as useful. Matt made a couple of notes to make sure they have the samples run differently next year.

The data entered into swims would be nice. It would be nice if they had a summary of 5 years or so of data in the reports. I doubt I would go to swims and run a query, but if the data can be summarized I can get a feel for it from year to year and it helps spot inconsistencies like this year. Matt and Cheryl will work on improving the reporting, and adding the data into the DNR database.

From: Laatsch, Cheryl - DNR [<mailto:Cheryl.Laatsch@wisconsin.gov>]
Sent: Tuesday, November 05, 2013 8:09 AM
To: Miller, Matthew J
Subject: wq data for 2013

There are a few questions about the data that was submitted. Can we discuss?

Cheryl Laatsch
Statewide FERC Coordinator
Wisconsin Dept of Natural Resources
N7725 Hwy 28
Horicon WI 53032
(T) 920-387-7869 (Fax) 920-387-7888
Cheryl.laatsch@wisconsin.gov

Miller, Matthew J

From: Utrup, Nick [nick_utrup@fws.gov]
Sent: Wednesday, November 20, 2013 11:50 AM
To: Miller, Matthew J
Cc: Laatsch, Cheryl - DNR; Lisa Mandell
Subject: 2013 Water Quality Monitoring Report for Big Falls, Thornapple and Turtle-Flameau
Matt,

We have received the 2013 water quality reports for Big Falls (P-2390), Thornapple (P-2475) and Turtle-Flameau (P-2390) dated October 24, 2013 (received November 18, 2013) and will not be providing comments.

In general, the USFWS defers to the State DNR on matters of water quality. Also, if possible, it would be helpful for us to receive electronic copies of your reports (e.g., water quality, invasive species, etc...) by email rather than paper copies. We can discuss at our next agency meeting if interested.

Thanks,

Nick

Nicholas J. Utrup
U.S. Fish and Wildlife Service
Wisconsin/Minnesota Ecological Services Field Office
4101 American Boulevard East
Bloomington, MN 55425

Office: 612-725-3548 Ext. 2204
Cell: 920-530-9937
FAX: 612-725-3609
Email: Nick_Utrup@fws.gov

Document Content(s)

20131024 Water Quality Report.PDF.....1-47