we energies

231 W. Michigan Street
Milwaukee, WI 53203
www.we-energies.com

March 8, 2006

Ms. Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

RE: Way Dam Hydroelectric Project, FERC No. 1759-036
Article 418-Low Dissolved Oxygen Mitigation- 2005 Progress Report

Dear Ms. Salas:

Article 418 of the new license issued January 12, 2001 for the subject project, required Wisconsin Electric Power Company (WE),conducting business as We Energies, to submit, within one year of the effective date of new license issuance, a Plan to address the periodic release of low D.O.-containing water from the Way Dam Project. In correspondence dated December 18, 2002, this plan was filed with the Commission. In an order dated March 18, 2004, the Commission approved this plan

The Plan called for WE to conduct a review of feasible modifications to the Project that could correct the low DO problem as well as their related costs. Alternatives included modifications to the Project that would allow for continued water extraction for the purposes of power generation without impacting the State of Michigan's water quality standard for D.O. in the Project's tailrace.

As a result of this analysis, WE concluded that the only cost effective alternative to correct the low D.O. problem downstream of the Way Dam Project would be to suspend flow through the turbine (cease generation) when D.O. levels in the intake water fall below 3.0 mg/l. This will, for the most part, prevent problems in the river segment downstream of Way Dam. However, approximately 800 ft of the Project's tailrace (which is physically separated from the spillway channel) will continue to experience low D.O. conditions as a result of leakage through the unit and the project's underwater gate. In light of this concern, initial testing with an air diffuser system was conducted in 2004 to correct low D.O associated with the leakage flow. Follow-up work with a modified air diffuser system was conducted in 2005.

The results of testing conducted in 2005 showed that the modified air diffuser was unable to maintain DO above 5.0 mg / l. However, use of the underwater gate to provide the license-required minimum flow to the Michigamme River from this project did appear to solve the low DO problem in the Project's tailrace. Monitoring planned for 2006 should confirm that this operational procedure will resolve the low DO problem at this project.

We Energies is hereby filing one original and eight copies of this progress report to the Commission for its approval. Several exhibits constitute this filing; specifically:

Exhibit 1	We Energies' draft progress report as submitted to the agencies for their review
Exhibit 2	We Energies' consultation with agencies- documentation of requests and replies (initial as well as follow-up)
Exhibit 3	We Energies' Final Progress Report

Also enclosed in this filing is a proof of service on the agencies listed in the copy list. Please call me at (906) 779-2547 if you have questions on this matter.

Sincerely,

William Rauscher

William Rauscher, Manager
Hydroelectric Operations

Encl

cc: Jessica Mistak, MDNR
John Suppnick, MDEQ

Certificate of Service

I hereby certify that I have this day served the foregoing document upon all entities specified in the order to issue license to be consulted on matters related to the Commission filing. Service was done pursuant to Rule 2010 of FERC's Rules of Practice and Procedure 18 CFR, Section 385.2010

Dated this day Thursday, March 09, 2006

Annie M. Salmona

Annie Salmona
We Energies

Annie Salmona
We Energies
333 W. Everett Street
Milwaukee, WI 53203
(414) 221-4151

Way Dam – 2005 Hydro Monitoring Data Submittal

There are 3 excel and one word files in this submittal:

2005 Way Dam Appendix A.xls

Figures 1 through 15 showing the DO measurements in the Way Dam Tailrace under various flow regimen, especially when the underwater gate is opened. Starting with the week of June 14, 2005 through week September 18, 2005.

2005 Way Dam Appendix B, verticals.xls

This file is the Appendix B pages 1 through 8. Appendix B contains the vertical profile data and also includes the continuous monitoring data for the time period when the vertical profile was performed.

2005 Way Dam Appendix A, summary table .xls

This file contains tables A-1 through A-3

Appendix C, 2005 sonde QA summary.doc

Quality Assurance records for continuous monitoring data sondes
This file contains Tables C-1 through C-6.

Exhibit 1

We Energies' Draft Progress Report as Submitted to The Agencies For Their Review

Way Dam Hydroelectric Project, FERC No. 1759-036
Article 418

Low Dissolved Oxygen Mitigation Plan
Draft Progress Report Year 2005

(without Vertical Profile Tables)

DRAFT

March xx, 2006

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The Plan called for WE to conduct a review of feasible modifications to the Project that could correct the low DO problem as well as their related costs. Alternatives included modifications to the Project that would allow for continued water extraction for the purposes of power generation without impacting the State of Michigan's water quality standard for D.O. in the Project's tailrace.

As a result of this analysis, WE concluded that the only cost effective alternative to correct the low D.O. problem downstream of the Way Dam Project would be to modify flow through the project when D.O. levels in the intake water fall below5.0 mg/l. The flow modifications include using the generator, under water gate, spillway and bubbler system. WE has developed an operational strategy that shows continual progress in addressing the long term goal of maintaining the D.O. level above the state standard. This will, for the most part, prevent problems in the river segment downstream of Way Dam. The results of which are summarized in the attached Progress Report.

The alternative analyses that WE performed in 2003 to correct low DO conditions at the Project did not consider turbine venting, because information available at the time indicated the technology would not provide the necessary improvement to meet the state standard for low DO. Additional information has become available that suggests the technique may allow Way Dam to continue operation when low DO conditions develop in the upstream water column and still meet the state DO standard. We Energies will evaluate this technology when engineering is performed for the Way Dam runner replacement.

We Energies is hereby filing one original and eight copies of this progress report to the Commission for its approval. Several exhibits constitute this filing; specifically:

Exhibit 1	We Energies' draft progress report as submitted to the agencies for their review
Exhibit 2	We Energies' responses to agency comments
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Sincerely,

William Rauscher, Manager
Hydroelectric Operations

Encl

cc: Jessica Mistak, MDNR
John Suppnick, MDEQ

Way Dam, FERC Project No.1759-036
Article 418, Dissolved Oxygen Mitigation Plan
2005 Progress Report

INTRODUCTION

In a letter dated January 28, 2004, the MDNR requested that We Energies continue to move forward with the mitigation plan that was filed with FERC in December, 2002, which was prepared in response to Article 418 of the new license. The purpose of this plan is to correct the seasonal occurrence of low DO at Way Dam. In its January 28th letter, the MDNR also recommended that the company investigate other low DO correction alternatives including siphoning and bubbling, which according to the MDNR has been successful at other utilities.

In response to this request, the company initiated an evaluation of the bubbling alternative in 2004. In 2005, additional testing of a modified diffuser system was performed, the operation of which, is summarized in this report. The company also conducted continuous temperature and DO monitoring in the Way Dam tailrace during the summer and twice-monthly vertical profile measurements of temperature and DO in the Michigamme Reservoir immediately upstream of the intake structure for the Way Dam generating unit. In addition, temperature and DO were monitored within the plant using continuous monitoring equipment.

BUBBLING TECHNOLOGY –DESIGN

In early 2004, the company contracted Environmental Dynamics Inc. (EDI) to design a bubbler system for the Way Dam tailrace. EDI is a company that primarily designs oxygenating systems for waste water treatment. Sketches of the power house tailrace and the following operating parameters / requirements were provided to EDI:

- Estimated leakage flow from the generating unit-2 cubic feet per second (CFS)
- Total water volume present in tailrace area: ~1.6 million gallons (this was estimated using the bathymetry drawings for the tailrace area)

- Maintain DO above 3.0 parts per million (ppm) in the tailrace arm of the Michigamme River at all times. In 2005 we modified our approach to maintain the DO above 5.0 ppm.
- Maximum temperature of the leakage flow: ~ 70 F (21.1 C)(actual tailrace range in 2004; 16.2-18.9 C)

EDI designed a system that consisted of six fine bubble aerators that were to be submerged to a depth of 19 ft. EDI's design flow assumption was 1.3 million gallons per day, the approximate static volume of the entire tailrace segment. The actual oxygen required per day was estimated to be 65 pounds. The standard oxygen transfer efficiency was assumed to be 28.5%. Total airflow to the aerators was estimated to be 24 scfm, assuming an air delivery system operating pressure of 9.6 psig at the top of the drop pipe.

In 2004, We Energies used its existing Gast pumps (bubbler pumps used at the project to prevent icing near the tainter gates in winter) to supply the air for the system. The Gast pumps have a design flow of 21 scfm; therefore two pumps were used to meet the required air flow. In 2005 the Gast Pumps were replaced with a Roots Blower (rating-50 scfm) because of the high number of pump failures experienced in 2004. In 2005, the Roots Blower experienced no failures.

MONITORING PLAN-2005

During the times of the year when low DO is unlikely, the Way Dam in-plant DO instrument is calibrated monthly. Beginning in June, the calibrations were increased to weekly to closely monitor the DO in the bearing cooling water line (monitoring this water line provides a reasonable measure of DO levels in the lower reaches of the reservoir). When the DO approached 5.0 PPM, the calibrations were increased to three times weekly. In addition, to assure that the in-plant DO measurements were indicative of what was occurring in the tailrace, Winkler analyses of grab samples taken in the tailrace were obtained beginning in mid-June. The grab samples were obtained from two areas: off the corner of the power house to the right of the draft tube in about 15' of water and at a point about 75' downstream in the tailrace near the first of two continuous recording sondes.

Continuous recording sondes were deployed in two locations: the first location was as described above; the second was located approximately 500 ft downstream of the first sonde. The sondes were deployed June 14 and were changed out every two weeks until they were retrieved September 22.

Vertical profile measurements in the reservoir were taken twice per month during the period monitored with continuous recording sondes. The results of these measurements are attached to this report.

BUBBLING TECHNOLOGY-OBSERVATIONS

Monitoring-Overview

In 2005, the following operation plan for the Way Dam Plant had been adopted:

- When DO drops below 5.0 ppm, as measured by the in-plant DO instrument, the total flow released by the project will be split between the under water gate and the generator. The percentage split will be based on the flow available when this condition arises.
- When DO drops below 5.0 ppm, as measured by the Winkler grab samples described earlier, all flow released by the project will be through the under water gate.
- Due to scheduled maintenance at Way Dam this year, (installation of new tailrace closure gates) all flow through the under water gate and generator will need to be stopped at some point in the summer to facilitate the maintenance project. At that time, all flow will be diverted to the spillway and the tailrace diffuser system will be deployed.

On 6/24/05, the DO dropped below 5.0 ppm as measured by the in plant DO monitor. At this time the flow was split between the underwater gate and the generator.

On 6/30/05 the DO in the tailrace dropped below 5.0 ppm as measured by one of the Winkler grab samples. On 7/1/05 all available flow was passed through the under water gate.

From 7/1/05 until 7/19/05 the DO in the tailrace, as measured by the Winkler grab samples, remained above the 5.0 ppm limit.

On 7/19/05 the under water gate was closed for the maintenance project as was the head gate for the generator. At this time the diffuser system was deployed. On 7/20/05, it was determined that the diffuser location was going to conflict with the maintenance project. Beginning on 7/20/05 and continuing through part of 7/21/05, the location of the diffuser system was changed from the front of the downstream face of the power house to the side of the power house.

No other changes in diffuser equipment deployment were made during the remaining summer monitoring period

Monitoring-Detailed Observations

Figures depicting the weekly monitoring results for the continuous recording sonde closest to the power house are provided in Appendix A of this report. Tables summarizing the data for both continuous monitors as well as the results of titration measurements are also provided in Appendix A. Figure 1 below provides a summary of the monitoring results for the continuous recording data sonde located within 70 ft of the power house.

The results of the vertical profile measurements made in the flowage immediately upstream of the Way Dam Plant are provided in Appendix B. Appendix B also contains the results of vertical profile measurements made in the tailrace.

The results of the Quality Assurance results for the continuous recording sondes are provided in Appendix C. Fouling problems encountered during the 2005 monitoring period are described in Appendix C.

The continuous monitoring sonde located in the tailrace closest to the plant provided inaccurate data from 6/22/05 – 6/30/05. It was lower than both Winkler grab samples and the downstream data sonde.

When the flows were split between the generator and the under water gate on 6/24/05, The DO as measured by the working continuous data sonde downstream, was maintained above 5.0 ppm. Additionally, the Winkler grab samples were above 5.0 ppm.

On 6/30/05, the Winkler grab sample 70' downstream read 4.8 ppm. The data sonde closest to the plant had been replaced at this time and read 4.9 ppm for the same hour, a very good correlation.

On 7/1/05, when all flow was passed through the under water gate the DO went from approximately 5.0 ppm to approximately 8.0 ppm as read by the continuous data sonde closest to the plant.

From 7/1/05 through 7/19/05, the DO as measured by both continuous data sondes read above 5.0 ppm. The sonde closest to the plant had a low reading of 6.8 ppm during this time frame, while the sonde located further downstream had a low reading of 5.7 ppm.

On 7/20/05, the diffuser system was turned off and was relocated from the front of the power house to the corner of the power house. The DO, as measured by the continuous sondes was as follows for 7/19/05 through 7/20/05; for the sonde closest to the plant, lowest reading during this time frame was 4.2 ppm and for the one further downstream the lowest reading was 2.9 ppm.

The diffuser relocation was completed on 7/21/05. The DO, as measured by the continuous sondes, was as follows for 7/20/05 through 7/21/05; for the sonde closest to the plant, the lowest reading was 0.4 ppm and for the one further downstream, the lowest reading was 1.3 ppm.

On 7/21/05, the diffuser system was turned back on. It is important to note that when the diffuser system had been installed in the front of the plant, the diffuser was situated at an approximate depth of 19 feet. When the system was relocated to the corner of the plant the approximate depth was 15 feet. It is reasonable to assume that the lesser depth would affect the oxygen transfer of the aeration system.

From 7/23/05 through the rest of the summer the DO, as measured by the continuous sondes was as follows; for the sonde closest to the plant, the lowest reading was 1.5 ppm and for the one located further downstream, the lowest reading was 2.2 ppm. The majority of the readings remained above 3.0 ppm for both sondes.

BUBBLING TECHNOLOGY-CONCLUSIONS, PROPOSED REVISIONS FOR 2006

The new Roots Blower did not at any time fail during 2005.

When the diffuser system was moved from the front of the power house to the corner of the power house, we believe that the effectiveness of the diffuser system was diminished, primarily by not being operated at its design depth. We cannot quantify the difference in performance. The majority of the closure gate maintenance project was completed during 2005. The remaining tasks should not affect any testing/operating plans planned for 2006.The tail race closure gate maintenance project could benefit future use of the diffuser system. There are two closure gates that can be used to dewater the draft tube and gain access to the lower half of the turbine runner. The diffuser system could be installed on one of the closure gates, which would facilitate its seasonal installation and removal.

Conclusions:

July was a hot dry month for the most part, which tends to promote stratification of the reservoir and subsequent low DO conditions in the lower portions of the water column in the reservoir. Following our operating procedure developed for 2005, we were able to maintain DO above 5.0 ppm using split flows between the under water gate and the generator and later on passing all available flow through the under water gate. The data obtained when the aeration system was relocated indicated that leakage flow through the unit resulted in very low DO conditions in the tailrace. The continuous use of the under water gate to keep the DO above the 5.0 ppm level appears promising.

By contrast, the use of the diffusion system to keep the tailrace DO above 5.0 ppm was unsuccessful. This could partly be due to it being relocated this year and not being operated at its design depth. After reviewing the data, it does not appear that even if it had been operated at the location it had been operated in 2004, it is unlikely that the diffuser system would have maintained tailrace DO above 5.0 ppm. However, it does appear that the diffuser system can maintain DO above 3.0 ppm in spite of the low DO present in the leakage and toe drain flows, which are typically less than 1.0 ppm.

Recommendations:

In 2006, we will continue to monitor the DO closely during the onset to the critical low DO period (late June to early July). This will be accomplished by utilizing the in-plant DO instrument. We will similarly increase in-plant instrument calibrations cycles to one per week starting in June. Due to fouling problems that compromised DO readings in 2005, continuous monitoring utilizing the sondes will not be performed in the tailrace from mid-June through mid-September in 2006. Winkler grab sampling will instead be used to assure that the DO standard is being met.

When the DO approaches 5.0 ppm as measured by the plant's internal DO monitor, operations will split the flow between the generator and the underwater gate. This will be done to determine if the combined flow through the generator and the under water gate is sufficient to entrain water enriched with DO above the thermocline into the intake for both.
When DO falls below 5.0 ppm, flow released by the project will be routed through the under water gate.
To monitor the effect that the under water gate has on the DO, two readings will be obtained by the operator using Winkler titration. The titration readings will be obtained three times weekly. The first will be between the corner of the powerhouse and the under water gate. The second will be ~70' downstream of the powerhouse. A comparison will be made between the readings to determine if the under water gate is adding sufficient DO to keep the tailrace above 5.0 ppm. If this is successful, we will continue in this mode of operation for the duration of low DO conditions in 2006 as well as in future years.

If maintenance is planned for the generator or for the under water gate, that render the underwater gate unavailable, the diffusion system will be used to treat the low DO leakage / toe drain flows in the tailrace. It should be noted that during most years there will be minimal maintenance scheduled during the summer months.

If the DO drops below 5.0 ppm while flow is split between the generator and the underwater gate, as determined by titration, the generator will be taken off line and virtually all of the required minimum flow from the project will be passed through the underwater gate.

If the DO in the tailrace cannot be maintained at or above 5.0 ppm by the flow being passed through the underwater gate, the underwater gate will be closed. At this time, the tailrace aeration system will be turned on to counteract the low DO present in the leakage flow. We will continue to monitor the DO at the two locations described above by titration. In 2006, the diffuser system will be moved back to the front of the power house to optimize its effectiveness.

If the DO in the tailrace can not be maintained above 5.0 ppm with the aeration system deployed, we can investigate doubling the aerators to bring the level up to 5.0 ppm. This could be done by installing an additional set of 6 aerators to the second closure gate.

If the DO in the powerhouse tailrace area to the confluence of the spillway tailrace area can not be maintained above 5.0 ppm, but can be maintained above 3.0 ppm the Company may petition the MDEQ to allow the entire tailrace length to become a mixing zone, wherein DO transitions to the standard of 5.0 ppm prior to joining the main river. To accomplish this, the Company will need to conduct environmental studies per Michigan water quality law (323.1082). The Company will consult with the MDEQ as to the exact site-specific requirements for this petition.

Figure 1 DO continuous monitoring vs. water use,June-September, 2005

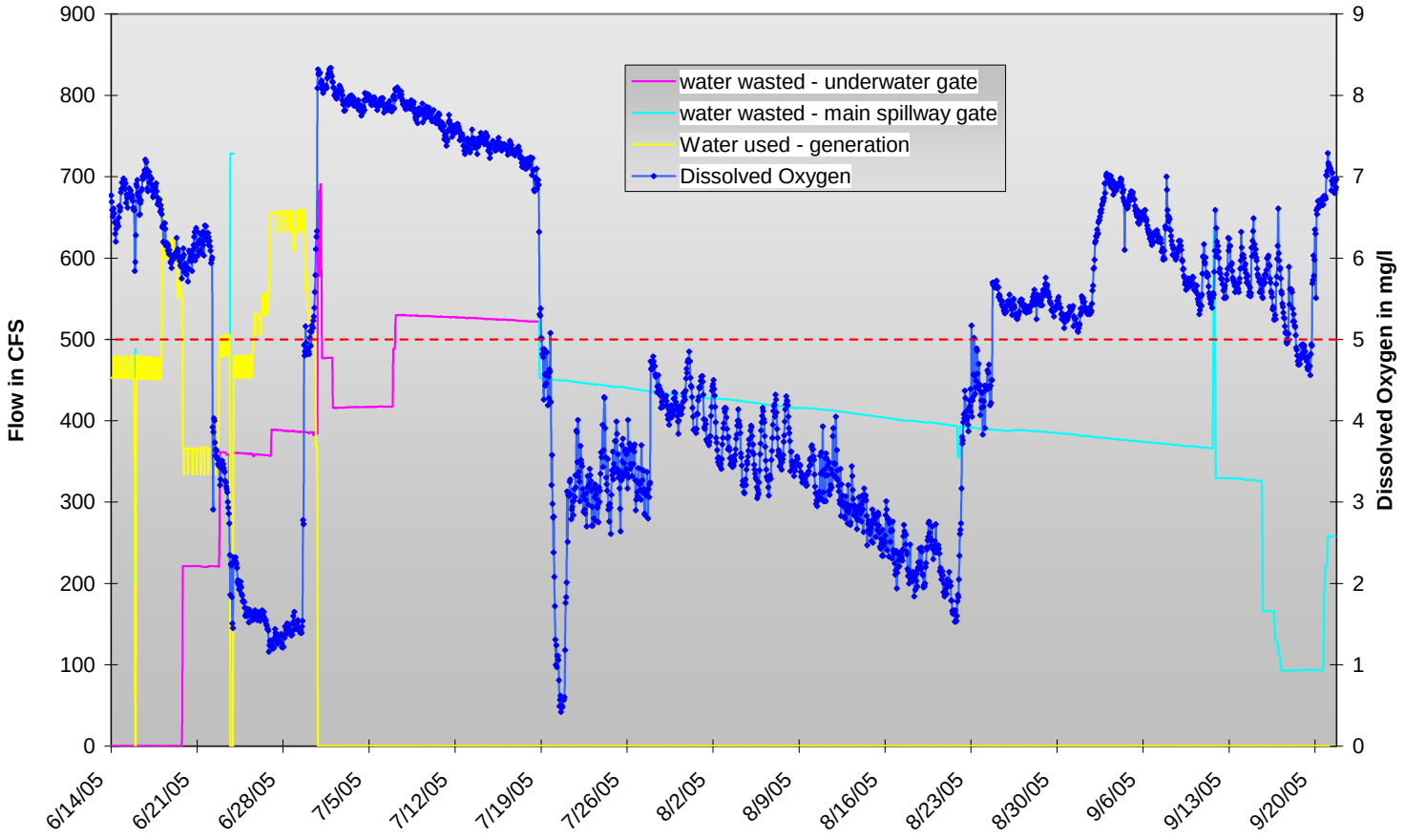

Exhibit 2

We Energies Consultation With Agencies – Documentation of Requests and Replies

Way Dam Hydroelectric Project, FERC 1759-036
Article 418
Low Dissolved Oxygen Mitigation Plan
Draft Progress Report

Salmona.Annie

From: Michaud.Dave
Sent: Wednesday, January 11, 2006 2:34 PM
To: Jessica Mistak (mistakjl@michigan.gov); Suppnick,John (suppnicj@michigan.gov)
Cc: Cevigney.Scott
Subject: Draft Article 418 Way Dam- Low DO Evaluation Progress Report for FERC

Greetings and Happy New Year!

Included in this note are the following:

- A draft progress report for activities that took place in 2005, including our second year of work with an aeration system for Way Dam tailrace
- A draft cover letter to FERC for the progress report
- Data files for tailrace monitoring
- Data files for vertical profile measurements taken in Michigamme Reservoir upstream of the dam

As you will see, we believe that we have a valid solution for correcting low DO conditions in the tailrace attributable to leakage flows. Passing the entire minimum flow through the underwater gate appears to entrain sufficient, well oxygenated epilimnion water to mitigate the low DO present in unit leakage flows. We proposing this as a final solution to this problem.

We'd appreciate your comments by February 23rd on the progress report and letter so as to allow us sufficient time to complete a FERC filing by March 1, 2006.
Please feel free to call me (414-221-2187)if you have questions concerning these materials.

Salmona.Annie

From: Jessica Mistak [mistakjl@michigan.gov]
Sent: Friday, January 27, 2006 7:41 AM
To: John Suppnick; Michaud.Dave
Cc: Cevigney.Scott
Subject: Re: Draft Article 418 Way Dam- Low DO Evaluation ProgressReport for FERC

Dave,
I have reviewed the draft progress report and have minor comments:

- In the draft cover letter, you are ambiguous regarding your results; instead, I would suggest being more clear on your monitoring conclusions and recommendations (similar to page 5 of the report).
- There is inconsistency with some of the terms used, for example: bubbler system and diffuser system. I assume these terms mean the same thing and would clarify to reduce confusion.
- Please explain turbine venting, mentioned in paragraph four of the cover letter. The Recommendations section of the report doesn't mention turbine venting evaluation or Way Dam runner replacement- do you plan to complete this evaluation in 2006?
- I recommend that you retitle the Recommendations section (page 5) to "MONITORING PLAN-2006 UNDERWATER GATE AND BUBBLING TECHNOLOGY" to make it clear that use of the underwater gate is a part of your strategy.
- I will defer to DEQ for technical comments.

Thank you,
Jessica

<>< <>< <>< <>< <>< <>< <>< <><
Jessica Mistak, Senior Fisheries Biologist
MDNR Marquette Fisheries Station
484 Cherry Creek Rd
Marquette, MI 49855
906-249-1611 ext. 308
FAX 906-249-3190
><> ><> ><> ><> ><> ><> ><> ><>

>>> "Michaud.Dave" <Dave.Michaud@we-energies.com> 01/11/2006 3:33 PM >>>

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Michaud.Dave

From: Michaud.Dave
Sent: Tuesday, February 07, 2006 2:09 PM
To: 'John Suppnick'
Cc: Jessica Mistak; Cevigney.Scott; Rauscher.Bill
Subject: RE: Draft Article 418 Way Dam- Low DO Evaluation ProgressReport for FERC

John, thanks for the timely review. We'll revise the report accordingly and file the report with FERC by March 1.

-----Original Message-----
From: John Suppnick [mailto:SUPPNICJ@michigan.gov]
Sent: Tuesday, February 07, 2006 1:26 PM
To: Michaud.Dave
Cc: Jessica Mistak
Subject: Re: Draft Article 418 Way Dam- Low DO Evaluation ProgressReport for FERC

Dave,

We have reviewed the draft report titled "Way Dam, FERC Project No. 1759-036 Article 418, Dissolved Oxygen Mitigation Plan 2005 Progress Report" that you sent us on January 11, 2006. We have the following comments:

The report should include a plan view drawing of the area immediately around the turbine discharge to show locations of all sampling points, the turbine discharge location, the underwater gate discharge location, the diffuser locations and the sampling locations. I could not tell from the draft report or the supplemental information you sent whether the sampling locations were appropriate or not.

The second paragraph of the section titled Recommendations is confusing and should be rewritten. It is not clear how the two Winkler readings will be compared to determine the effect of the underwater gate.

You should plan to conduct a study of the dissolved oxygen throughout the tailrace during the time when the flow is mixed between the turbines and the underwater gate and then again during the time when the underwater gate is the sole source of flow. The purpose of this study would be to determine whether the two locations where samples will be collected for Winkler analysis are representative or not.

Grab samples 3 days a week are adequate when the system is stable however additional grabs should be taken after each change in operating characteristics as soon as the system has had adequate time to stabilize. All grab samples should be before 9 AM to ensure sampling near the low point for the day.

Figure 1 should show the scale for dissolved oxygen as well as flow. You should indicate on Figure 1 which monitoring location the data are from.

Appendix C looks like the details of what went into Figure 1 and not QA data as stated in the text. I could not find a description of the fouling problem in appendix C.

If you have any questions about these comments give me a call.

John

John Suppnick
Michigan Department of Environmental Quality Water Bureau
517-335-4192
suppnicj@michigan.gov

>>> "Michaud.Dave" <Dave.Michaud@we-energies.com> 1/11/2006 3:33 PM >>>

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Salmona.Annie

From: Jessica Mistak [mistakjl@michigan.gov]
Sent: Tuesday, February 21, 2006 8:21 AM
To: Michaud.Dave
Subject: RE: Draft Article 418 Way Dam- Low DO EvaluationProgressReport for FERC

MDNR has no further comments.
Jessica

>>> "Michaud.Dave" <Dave.Michaud@we-energies.com> 02/16/2006 4:24 PM >>>
Here are my revisions to the cover letter and progress report. I am also including a copy of the correct Appendix C. I'd appreciate your review of these changes / recommendations by Feb. 24th.

-----Original Message-----
From: John Suppnick [mailto:SUPPNICJ@michigan.gov]
Sent: Tuesday, February 07, 2006 1:26 PM
To: Michaud.Dave
Cc: Jessica Mistak
Subject: Re: Draft Article 418 Way Dam- Low DO Evaluation ProgressReport for FERC

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John

John Suppnick
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517-335-4192
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>>> "Michaud.Dave" <Dave.Michaud@we-energies.com> 1/11/2006 3:33 PM >>>

Greetings and Happy New Year!

Included in this note are the following:

* A draft progress report for activities that took place in 2005, including our second year of work with an aeration system for Way Dam tailrace
* A draft cover letter to FERC for the progress report
* Data files for tailrace monitoring
* Data files for vertical profile measurements taken in Michigamme Reservoir upstream of the dam

As you will see, we believe that we have a valid solution for correcting low DO conditions in the tailrace attributable to leakage flows. Passing the entire minimum flow through the underwater gate appears to entrain sufficient, well oxygenated epilimnion water to mitigate the low DO present in unit leakage flows. We proposing this as a final solution

to this problem.

We'd appreciate your comments by February 23rd on the progress report and letter so as to allow us sufficient time to complete a FERC filing by March 1, 2006.
Please feel free to call me (414-221-2187)if you have questions concerning these materials.

<<Appendix A, 2005 way dam summary tables.xls>> <<Appendix B, 2005 way dam verticals.xls>> <<Appendix C, 2005 rep.xls>> <<figure 1,DO vs. water use-Way Dam,2005.xls>> <<Way Dam-art.418 progress rep.filing ,3-2006.doc>> <<Progress Report Way Dam DO, 2005 Rev 2.doc>>

Michaud.Dave

From: John Suppnick [SUPPNICJ@michigan.gov]
Sent: Monday, March 06, 2006 9:27 AM
To: Michaud.Dave
Subject: RE: Draft Article 418 Way Dam- Low DO EvaluationProgressReport for FERC

Dave,
I won't have an opportunity to review this draft any time soon. If you made the changes I suggested previously then it should be OK.

John

John Suppnick
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517-335-4192
suppnicj@michigan.gov

>>> "Michaud.Dave" <Dave.Michaud@we-energies.com> 2/16/2006 4:24 PM >>>
Here are my revisions to the cover letter and progress report. I am also including a copy of the correct Appendix C. I'd appreciate your review of these changes / recommendations by Feb. 24th.

-----Original Message-----
From: John Suppnick [mailto:SUPPNICJ@michigan.gov]
Sent: Tuesday, February 07, 2006 1:26 PM
To: Michaud.Dave
Cc: Jessica Mistak
Subject: Re: Draft Article 418 Way Dam- Low DO Evaluation ProgressReport for FERC

Dave,

We have reviewed the draft report titled "Way Dam, FERC Project No. 1759-036 Article 418, Dissolved Oxygen Mitigation Plan 2005 Progress Report" that you sent us on January 11, 2006. We have the following comments:

The report should include a plan view drawing of the area immediately around the turbine discharge to show locations of all sampling points, the turbine discharge location, the underwater gate discharge location, the diffuser locations and the sampling locations. I could not tell from the draft report or the supplemental information you sent whether the sampling locations were appropriate or not.

The second paragraph of the section titled Recommendations is confusing and should be rewritten. It is not clear how the two Winkler readings will be compared to determine the effect of the underwater gate.

You should plan to conduct a study of the dissolved oxygen throughout the tailrace during the time when the flow is mixed between the turbines and the underwater gate and then again during the time when the underwater gate is the sole source of flow. The purpose of this study would be to determine whether the two locations where samples will be collected for Winkler analysis are representative or not.

Grab samples 3 days a week are adequate when the system is stable however additional grabs should be taken after each change in operating characteristics as soon as the system has had adequate time to stabilize. All grab samples should be before 9 AM to ensure sampling near the low point for the day.

Figure 1 should show the scale for dissolved oxygen as well as flow.
You should indicate on Figure 1 which monitoring location the data are from.

Appendix C looks like the details of what went into Figure 1 and not QA data as stated in the text. I could not find a description of the fouling problem in appendix C.

If you have any questions about these comments give me a call.

John

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Exhibit 3

We Energies' Final Progress Report

Way Dam Hydroelectric Project, FERC No. 1759-036
Article 418
Low Dissolved Oxygen Mitigation Plan

Way Dam, FERC Project No.1759-036
Article 418, Dissolved Oxygen Mitigation Plan
2005 Progress Report

INTRODUCTION

In a letter dated January 28, 2004, the MDNR requested that We Energies continue to move forward with the mitigation plan that was filed with FERC in December, 2002, which was prepared in response to Article 418 of the new license. The purpose of this plan is to correct the seasonal occurrence of low DO at Way Dam. In its January 28th letter, the MDNR also recommended that the company investigate other low DO correction alternatives including siphoning and bubbling, which according to the MDNR has been successful at other utilities.

In response to this request, the company initiated an evaluation of an air diffuser system in 2004. In 2005, additional testing of a modified diffuser system was performed, the operation of which, is summarized in this report. The company also conducted continuous temperature and DO monitoring in the Way Dam tailrace during the summer and twice-monthly vertical profile measurements of temperature and DO in the Michigamme Reservoir immediately upstream of the intake structure for the Way Dam generating unit. In addition, temperature and DO were monitored within the plant using continuous monitoring equipment.

AIR DIFFUSER SYSTEM –DESIGN

In early 2004, the company contracted Environmental Dynamics Inc. (EDI) to design an air diffuser system for the Way Dam tailrace. EDI is a company that primarily designs oxygenating systems for waste water treatment. Sketches of the power house tailrace and the following operating parameters / requirements were provided to EDI:

- Estimated leakage flow from the generating unit-2 cubic feet per second (CFS)
- Total water volume present in tailrace area: ~1.6 million gallons (this was estimated using the bathymetry drawings for the tailrace area)

- Maintain DO above 3.0 parts per million (ppm) in the tailrace arm of the Michigamme River at all times. In 2005 we modified our approach to maintain the DO above 5.0 ppm.
- Maximum temperature of the leakage flow: ~ 70 F (21.1 C)(actual tailrace range in 2004; 16.2-18.9 C)

EDI designed a system that consisted of six fine bubble aerators that were to be submerged to a depth of 19 ft. EDI's design flow assumption was 1.3 million gallons per day, the approximate static volume of the entire tailrace segment. The actual oxygen required per day was estimated to be 65 pounds. The standard oxygen transfer efficiency was assumed to be 28.5%. Total airflow to the aerators was estimated to be 24 scfm, assuming an air delivery system operating pressure of 9.6 psig at the top of the drop pipe.

In 2004, We Energies used its existing Gast pumps (bubbler pumps used at the project to prevent icing near the tainter gates in winter) to supply the air for the system. The Gast pumps had a design flow of 21 scfm; therefore two pumps were used to meet the required air flow. In 2005 the Gast Pumps were replaced with a Roots Blower (rating-50 scfm) because of the high number of pump failures experienced in 2004. In 2005, the Roots Blower experienced no failures.

MONITORING PLAN-2005

During the times of the year when low DO is unlikely, the Way Dam in-plant DO instrument is calibrated monthly. Beginning in June, the calibrations were increased to once per week to closely monitor the DO in the bearing cooling water line (monitoring this water line provides a reasonable measure of DO levels in the lower reaches of the reservoir). When the DO approached 5.0 PPM, the calibrations were increased to three times per week. In addition, to assure that the in-plant DO measurements were indicative of what was occurring in the tailrace, Winkler analyses of grab samples taken in the tailrace were obtained beginning in mid-June. The grab samples were obtained from two areas: off the corner of the power house to the right of the draft tube in about 15' of water and at a point about 75' downstream in the tailrace near the first of two continuous recording sondes (see Figure 1 for sonde, vertical profile measurement locations in tailrace).

Continuous recording sondes were deployed in two locations: the first location was as described above; the second was located approximately 500 ft downstream of the first sonde off shore of the left side of the tailrace (looking upstream at the plant). The sondes were deployed June 14 and were changed out every two weeks until they were retrieved September 22.

Vertical profile measurements in the reservoir were taken twice per month during the period monitored with continuous recording sondes. The results of these measurements are summarized in Appendix B to this report.

AIR DIFFUSER PERFORMANCE-2005

2005 Monitoring Results-Overview

In 2005, the following operation plan for the Way Dam Plant had been adopted:

- When DO drops below 5.0 ppm, as measured by the in-plant DO instrument, the total flow released by the project will be split between the under water gate and the generator. The percentage split will be based on the flow available when this condition arises.
- When DO drops below 5.0 ppm, as measured by the Winkler grab samples described earlier, all flow released by the project will be through the under water gate.
- Due to scheduled maintenance at Way Dam this year, (installation of new tailrace closure gates) all flow through the under water gate and generator will need to be stopped at some point in the summer to facilitate the maintenance project. At that time, all flow will be diverted to the spillway and the tailrace diffuser system will be deployed.

On 6/24/05, the DO dropped below 5.0 ppm as measured by the in plant DO monitor. At this time the flow was split between the underwater gate and the generator (see Figure 1 below).

On 6/30/05, the DO in the tailrace dropped below 5.0 ppm as measured by one of the Winkler grab samples. On 7/1/05, all available flow was passed through the under water gate.

From 7/1/05 until 7/19/05, the DO in the tailrace, as measured by the Winkler grab samples, remained above the 5.0 ppm limit (see Figure 2).

On 7/19/05 the under water gate was closed for the maintenance project as was the head gate for the generator. At this time the diffuser system was deployed. On 7/20/05, it was determined that the diffuser location was going to conflict with the maintenance project. Beginning on 7/20/05 and continuing through part of 7/21/05, the location of the diffuser system was changed from the front of the downstream face of the power house to the side of the power house.

No other changes in diffuser equipment deployment were made during the remaining summer monitoring period.

Monitoring Results-Detailed Observations

Figures depicting the weekly monitoring results for the continuous recording sonde closest to the power house are provided in Appendix A of this report. Tables summarizing the data for both continuous monitors as well as the results of titration measurements are also provided in Appendix A. Figure 2 below provides a summary

of the monitoring results for the continuous recording data sonde located within 70 ft of the power house.

The results of the vertical profile measurements made in the flowage immediately upstream of the Way Dam Plant are provided in Appendix B. Appendix B also contains the results of vertical profile measurements made in the tailrace.

The results of the Quality Assurance records for the continuous recording sondes are provided in Appendix C. Fouling problems encountered during the 2005 monitoring period are described in Appendix C.

The continuous monitoring sonde located in the tailrace closest to the plant provided inaccurate data from 6/22/05 – 6/30/05. It was lower than both Winkler grab samples and the downstream data sonde.

When the flows were split between the generator and the under water gate on 6/24/05, The DO as measured by the working continuous data sonde downstream, was maintained above 5.0 ppm. Additionally, the Winkler grab samples were above 5.0 ppm.

On 6/30/05, the Winkler grab sample 70' downstream read 4.8 ppm. The data sonde closest to the plant had been replaced at this time and read 4.9 ppm for the same hour, a very good correlation.

On 7/1/05, when all flow was passed through the under water gate the DO in the tailrace went from approximately 5.0 ppm to approximately 8.0 ppm as read by the continuous data sonde closest to the plant.

From 7/1/05 through 7/19/05, the DO as measured by both continuous data sondes read above 5.0 ppm. The sonde closest to the plant had a low reading of 6.8 ppm during this time frame, while the sonde located further downstream had a low reading of 5.7 ppm.

On 7/20/05, the diffuser system was turned off and was relocated from the front of the power house to the corner of the power house. The DO, as measured by the continuous sondes was as follows for 7/19/05 through 7/20/05; for the sonde closest to the plant, lowest reading during this time frame was 4.2 ppm and for the one further downstream the lowest reading was 2.9 ppm.

The diffuser relocation was completed on 7/21/05. During the period when the diffuser was turned off, the DO, as measured by the continuous sondes, was as follows: for the sonde closest to the plant, the lowest reading was 0.4 ppm and for the one further downstream, the lowest reading was 1.3 ppm.

On 7/21/05, the diffuser system was turned back on. It is important to note that when the diffuser system had been installed in the front of the plant, the diffuser was situated at an approximate depth of 19 feet.

When the system was relocated to the corner of the plant, the diffuser system was suspended at a depth of approximately 15 feet. It is reasonable to assume that the response of DO levels in the tailrace when the diffuser was placed at a shallower depth would be negative; e.g., the shallower depth would affect the oxygen transfer of the aeration system (e.g., it would no longer influence deeper water in the tailrace).

From 7/23/05 through the rest of the summer the DO, as measured by the continuous sondes was as follows; for the sonde closest to the plant, the lowest reading was 1.5 ppm and for the one located further downstream, the lowest reading was 2.2 ppm. The majority of the readings remained above 3.0 ppm for both sondes (see Figures in Appendix A).

AIR DIFFUSER RESULTS-CONCLUSIONS, PROPOSED REVISIONS FOR 2006

Conclusions

The new Roots Blower did not at any time fail during 2005. It appears that the design of this piece of equipment is appropriate for the length of service required on an annual basis.

When the diffuser system was moved from the front of the power house to the corner of the power house, we believe that the effectiveness of the diffuser system was diminished, primarily by not being operated at its design depth. We cannot quantify the difference in performance. The majority of the closure gate maintenance project was completed during 2005. The remaining tasks should not affect any testing/operating plans planned for summer, 2006.

The tail race closure gate maintenance project could benefit future use of the diffuser system. There are two closure gates that can be used to dewater the draft tube and gain access to the lower half of the turbine runner. The diffuser system could be installed on one of the closure gates, which would facilitate its seasonal installation and removal. July was a hot dry month for the most part, which tends to promote stratification of the reservoir and subsequent low DO conditions in the lower portions of the water column in the reservoir. Following our operating procedure developed for 2005, we were able to initially maintain DO above 5.0 ppm using split flows between the under water gate and the generator. When this technique was no longer able to maintain DO above 5.0 ppm, routing all flow through the underwater gate corrected the problem.

The continuous use of the under water gate to keep the DO above the 5.0 ppm level appears promising. Testing of this alternative will be continued in 2006.

By contrast, the use of the diffusion system to maintain tailrace DO above 5.0 ppm was unsuccessful. This could partly be due to it being relocated to a shallower depth in 2005which was not its design depth. However, after reviewing the data, if it had been operated at the location where it had been operated in 2004, it is unlikely that the

diffuser system would have maintained tailrace DO above 5.0 ppm. On the other hand, it does appear that the diffuser system can maintain DO above 3.0 ppm in spite of the low DO present in the leakage and toe drain flows, which can typically be less than 1.0 ppm.

Recommendations- Monitoring Plan for 2006:

In 2006, we will continue to monitor the DO closely during the onset to the critical low DO period (late June to early July). This will be accomplished by utilizing the in-plant DO instrument. We will similarly increase in-plant instrument calibration cycles to one per week starting in June. Due to fouling problems that compromised DO readings in 2005, continuous monitoring utilizing the sondes will not be performed in the tailrace from mid-June through mid-September in 2006. Winkler grab sampling will instead be used to assure that the DO standard is being met. Grab samples will be taken before 9:00 a.m. or as early as staff availability permits.

To monitor the effect that 2006 operational changes have on DO in the tailrace, DO measurements will be obtained by the operator using Winkler titration three times weekly in two locations. The first location sampled will be between the corner of the powerhouse and the under water gate. The second location sampled will be ~70' downstream of the powerhouse; this is the same location monitored by grab sample / continuous recording data sondes in 2004 and 2005. If both of the two DO measurements remain above 5.0 ppm, we will continue in this mode of operation for the duration of low DO conditions in 2006 as well as in future years.

To assure that these DO compliance measurement locations are representative of DO conditions in the entire tailrace area, we will conduct a study of DO distribution throughout the tailrace area during the time when the flow is mixed between the turbines and the underwater gate and then again during the time when the underwater gate is the sole source of flow.

When the DO approaches 5.0 ppm as measured by the plant's internal DO monitor, the company will split the flow between the generator and the underwater gate. This will be done to determine if the combined flow through the generator and the under water gate is sufficient to keep the DO above 5.0 ppm. The use of the under water gate provides DO enhancement for two reasons. The first, it provides an unrestricted flow of water from the reservoir which draws DO enriched water from above the thermocline into the under water gate. Secondly, when the water exits the under water gate it hits a dissipater wall, causing turbulence which increases the DO level in the water.

Should tailrace DO fall below 5.0 ppm, flow released by the project will be routed solely through the under water gate as was done in 2005.

If maintenance is planned for the generator or for the under water gate in 2006 or in any subsequent year, that render the underwater gate unavailable, the diffusion system will be used to treat the low DO leakage / toe drain flows in the tailrace. It should be noted that during most years there will be minimal maintenance scheduled during the summer months.

If the DO in the tailrace cannot be maintained at or above 5.0 ppm by the flow being passed through the underwater gate as measured by Winkler titration of grab samples, the underwater gate will be closed. At this time, the tailrace air diffuser system will be turned on to counteract the low DO present in the leakage flow. In 2006, the diffuser system will be moved back to the front of the power house to optimize its effectiveness. We will continue to monitor the DO at the two locations described above by titration, three times per week. .

If the DO in the tailrace can not be maintained above 5.0 ppm with the aeration system deployed, we can investigate doubling the aerators to bring the level up to 5.0 ppm. This could be done by installing an additional set of 6 aerators to the second closure gate.

If the DO in the tailrace area between the power house and the confluence of the spillway / tailrace area can not be maintained above 5.0 ppm, but can be maintained above 3.0 ppm the Company may petition the MDEQ to allow the entire tailrace length to become a mixing zone, wherein DO transitions to the standard of 5.0 ppm prior to joining the main river. To accomplish this, the Company acknowledges that it will need to conduct environmental studies per Michigan water quality law (323.1082). The Company will consult with the MDEQ as to the exact site-specific requirements for this petition.

We Energies is presently evaluating the runner on the unit at Way Dam. The runner will either be replaced or repaired. If the runner is replaced, options will be considered that may increase the DO in the water discharged from the Unit. This evaluation will be completed in 2006.

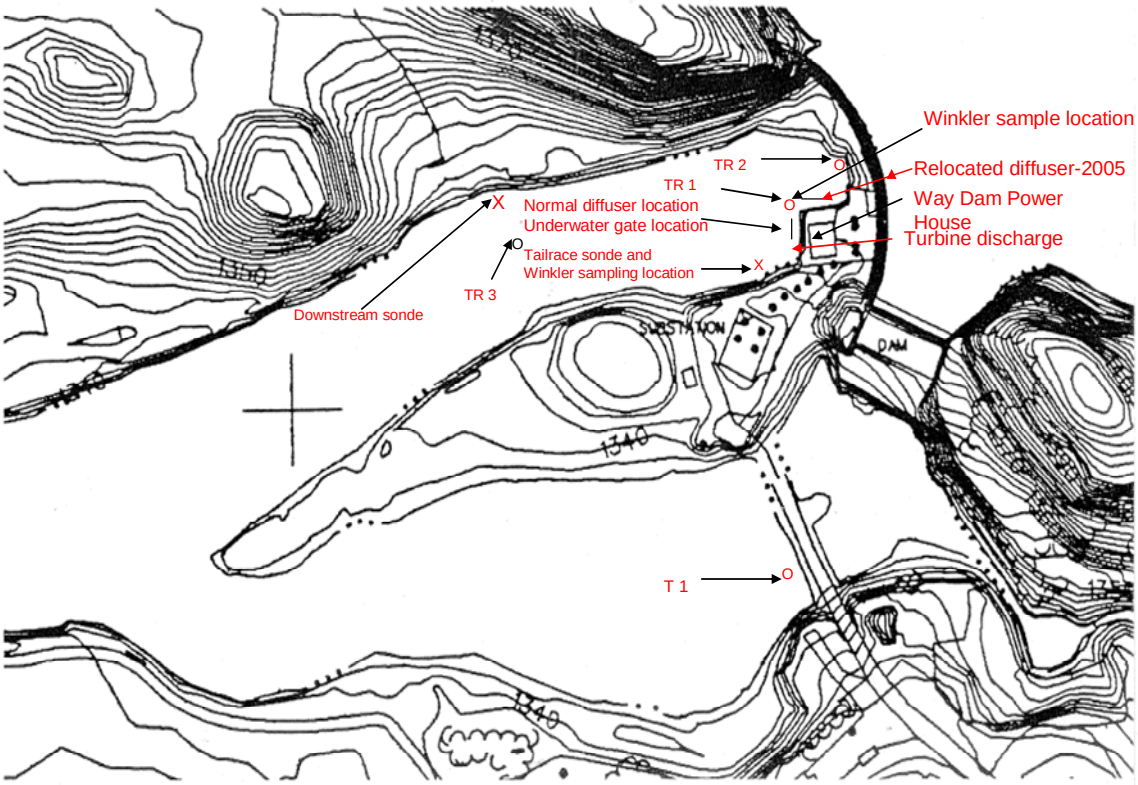


Figure 1 Location of vertical profile measurements (O), continuous recording data sondes (X) during 2005

Figure 2 DO continuous monitoring in Way Dam tail race(~70 ft downstream) vs. water use,June-September, 2005

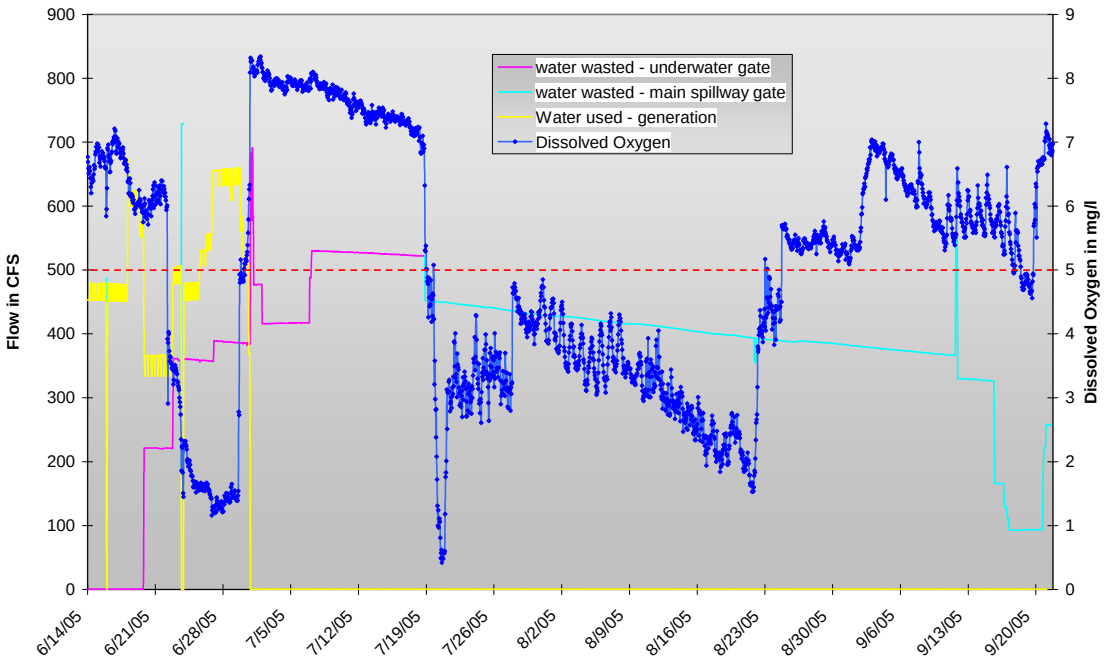


Table A-1

Way Dam Water Quality Monitoring Data
Data from June 14 through September 22, 2005

Hour of Reading	Way Dam Tailrace			Number of DO < 5 readings when unit is off line
	<5	<4	<3	
0	46	38	14	38
100	46	35	14	38
200	44	36	18	36
300	47	38	20	44
400	47	38	16	39
500	47	38	20	44
600	47	38	19	39
700	47	38	19	39
800	47	38	19	39
900	47	36	20	40
1000	45	36	17	38
1100	45	37	16	38
1200	44	35	17	39
1300	44	33	15	38
1400	45	32	17	38
1500	45	32	18	37
1600	45	27	17	37
1700	44	30	17	36
1800	46	29	17	38
1900	46	30	16	38
2000	45	33	18	38
2100	45	35	17	38
2200	46	37	15	37
2300	46	38	16	38
totals	1096	837	412	924
	% of readings while plant off line			84.3%
Total Observations				2395
% of total observations below 5 mg/l				45.8%
% of total observations below 4 mg/l				34.9%

Hour of Reading	Way Dam Downstream			Number of DO < 5 readings when unit is off line
	<5	<4	<3	
0	48	41	11	48
100	51	41	11	51
200	50	42	13	50
300	51	43	12	51
400	50	42	18	50
500	50	42	16	50
600	49	41	13	49
700	48	41	8	48
800	46	34	5	46
900	46	26	1	46
1000	41	22	1	41
1100	31	20	1	31
1200	23	18	1	23
1300	23	12	1	23
1400	23	15	1	23
1500	22	12	1	22
1600	22	14	1	22
1700	31	15	2	31
1800	40	16	1	40
1900	46	22	4	46
2000	49	32	7	49
2100	50	36	10	50
2200	50	35	11	50
2300	49	35	11	49
totals	989	697	161	989
	% of readings while plant off line			100.0%
Total Observations				2395
% of total observations below 5 mg/l				41.3%
% of total observations below 4 mg/l				29.1%

Table A-2

Way Dam Water Quality Monitoring Data
Data from June 14 through September 22, 2005

Dissolved Oxygen Limit 5.0 mg/l

Monthly Average		Degree F	Degree C
Temperature limits	June	80	26.7
	July	83	28.3
	August	81	27.2
	September	74	23.3

Tailrace

Month	# of observation	Temperature F			DO % Saturation			Dissolved Oxygen (mg/l)		
		Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
June	392	17.1	19.8	14.2	45.4	75.4	12.6	4.3	7.2	1.2
july	744	19.7	21.4	17.4	67.2	96.4	4.5	6.0	8.3	0.4
August	745	19.3	21.2	18.1	40.9	63.7	18.1	3.7	5.8	1.5
September	514	19.5	21.1	18.4	65.9	80.9	49.2	6.0	7.3	4.6
total	2395									
data recovery	100.00%									

Downstream

Month	# of observation	Temperature F			DO % Saturation			Dissolved Oxygen (mg/l)		
		Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
June	392	16.8	19.2	14.4	76.4	100.6	58.9	7.2	9.2	5.7
july	744	19.6	23.6	17.9	62.8	93.1	12.8	5.6	8.1	1.2
August	745	19.5	21.8	18.0	48.4	81.9	22.1	4.4	7.6	2.0
September	514	19.0	20.5	17.5	56.1	91.7	26.6	5.1	8.5	2.4
total	2395									
data recovery	100.00%									

Table A-3

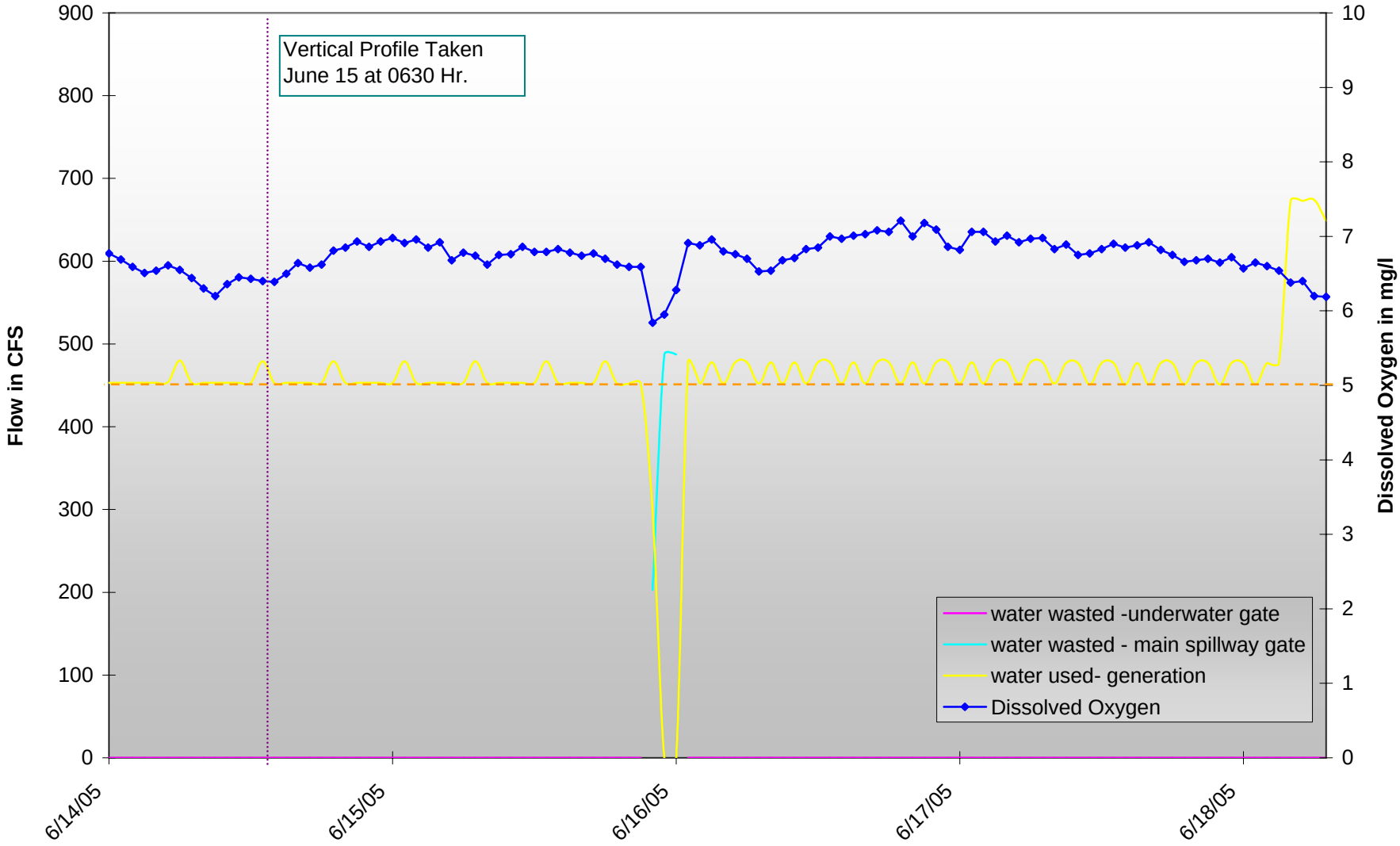
Way Dam Project
Dissolved Oxygen Comparison Table

Date	Time	Continuous DO monitor (in plant)	DO grab samples (corner power house)	DO grab samples (70' Downstream)	Continuous DO Sonde monitor ~ 70' downstream)	Continuous DO monitor sonde (Downstream ~300 feet)
6/14/2005	16:00				6.8	6.6
6/20/2005	9:15	5.10	5.2	5.6	5.9	5.8
6/21/2005	14:00	5.58	6.2	6.8	6.4	7.8
6/22/2005	9:30	5.50	6.8	6.2	6.4	7.7
6/23/2005	8:15	4.90	6.2	6.0	3.5	7.4
6/24/2005	7:30	4.90	6.1	5.4	2.7	7.8
6/27/2005	10:30	4.95	6.2	5.3	1.4	7.6
6/28/2005	9:15	5.20	6.7	5.3	1.4	7.4
6/29/2005	9:30	5.20	7.1	5.2	1.4	6.8
6/30/2005	10:45	4.50	6.3	4.8	4.8	7.5
7/1/2005	9:00	5.50	6.7	6.0	6.3	7.6
7/4/2005	8:20	3.90	7.8	7.8	7.9	7.0
7/5/2005	13:15	4.20	7.5	7.7	8.0	7.5
7/6/2005	8:15	3.51	7.4	7.7	7.8	7.1
7/8/2005	15:30	2.50	7.4	7.7	7.8	7.3
7/12/2005	9:00	2.12	7.1	7.5	7.6	7.0
7/14/2005	11:00				7.3	6.9
7/15/2005	9:00	1.30	7.0	7.5	7.3	6.6
7/18/2005	13:30	1.15	6.6	7.5	7.2	6.3
7/21/2005	13:30	n/a	0.8	1.3	0.6	1.6
7/22/2005	13:30	n/a	4.0	5.0	3.9	3.7
7/29/2005	10:00	n/a	2.1	4.4	4.2	5.2
8/3/2005	9:30	n/a	1.5	4.1	3.5	4.4
8/5/2005	9:45	n/a	1.9	4.7	3.4	4.1
8/9/2005	8:30	n/a	1.4	4.1	3.4	3.1
8/11/2005	8:45	n/a	2.4	5.5	3.1	3.7
8/16/2005	11:00	n/a	2.4	4.1	2.7	3.7
8/18/2005	10:00	n/a	1.6	3.3	2.4	3.7
8/25/2005	13:30	n/a	4.9	6.7	5.7	6.7

sondes change-out

14-Jun Sonde installed
20-Jun Underwater gate opened
23-Jun Underwater gate flow increased by a factor of 3
24-Jun Gate turned completely off and restarted at high flow. Resultant high flow and on/off cycling appears to have dislodged quantities of slime and algae fouling continuous monitors
19-Jul flow through underwater gate shut off
20-Jul Bubbler off at 10:45 am
21-Jul Bubbler back in operation 14:15 pm
22-Jul For the period July 22 to August 18, 2005, the continuous tailrace monitor DO data seems consistent with the grab sample DO data. The DO value is between the value for both grab samples. The technique of taking grab samples with the "sewage sampler" collection device can cause variability with depth and these numbers possibly reflect taking one of the samples slightly deeper or the set of continuous monitors being slightly deeper or shallower in the water. The downstream continuous monitor had a weed bed grow and expand around the area of the set as summer progressed. Under low flow conditions, the potential for weed and algal interference increases, differences between this station and the upstream, nearer plant station, are not unusual.

Appendix A, Figure 1
Way Dam Tailrace DO vs Underwater Gate Flow, Week of June 14, 2005



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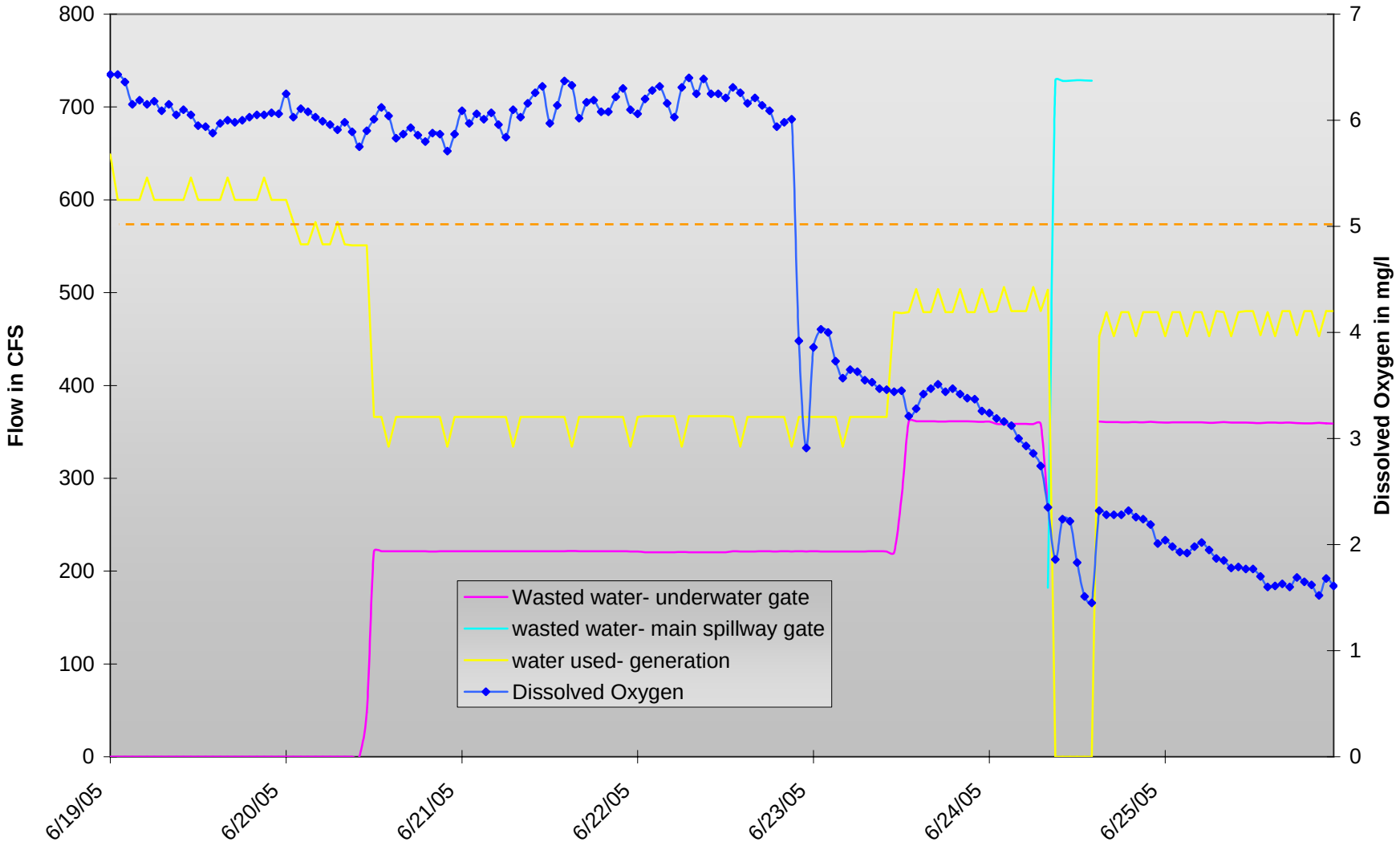
Appendix A, Figure 2
Way Dam Tailrace DO vs. Underwater Gate Flow, Week of June 19, 2005



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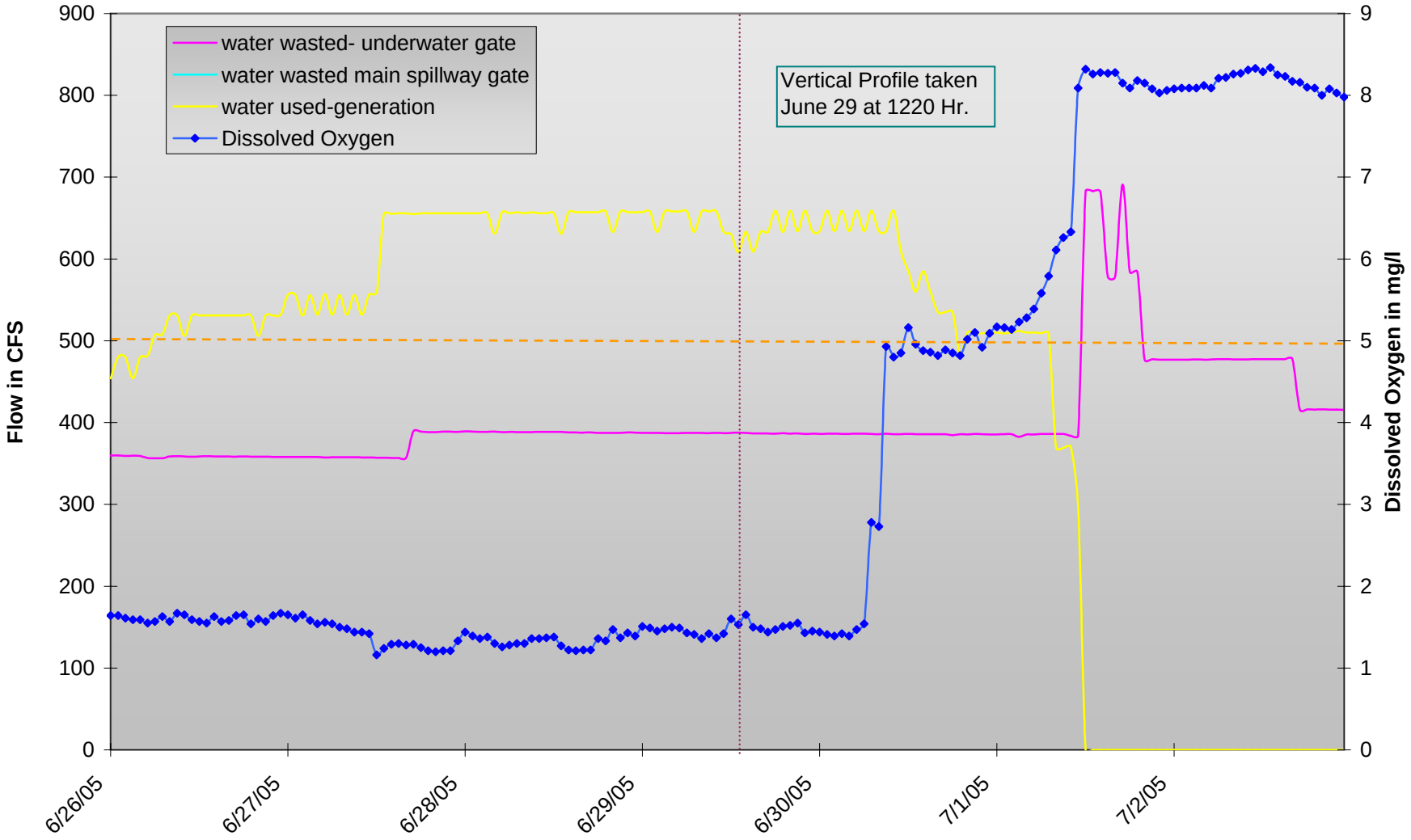
Appendix A, Figure 3
Way Dam Tailrace DO vs Underwater Gate Flow, Week of June 26, 2005



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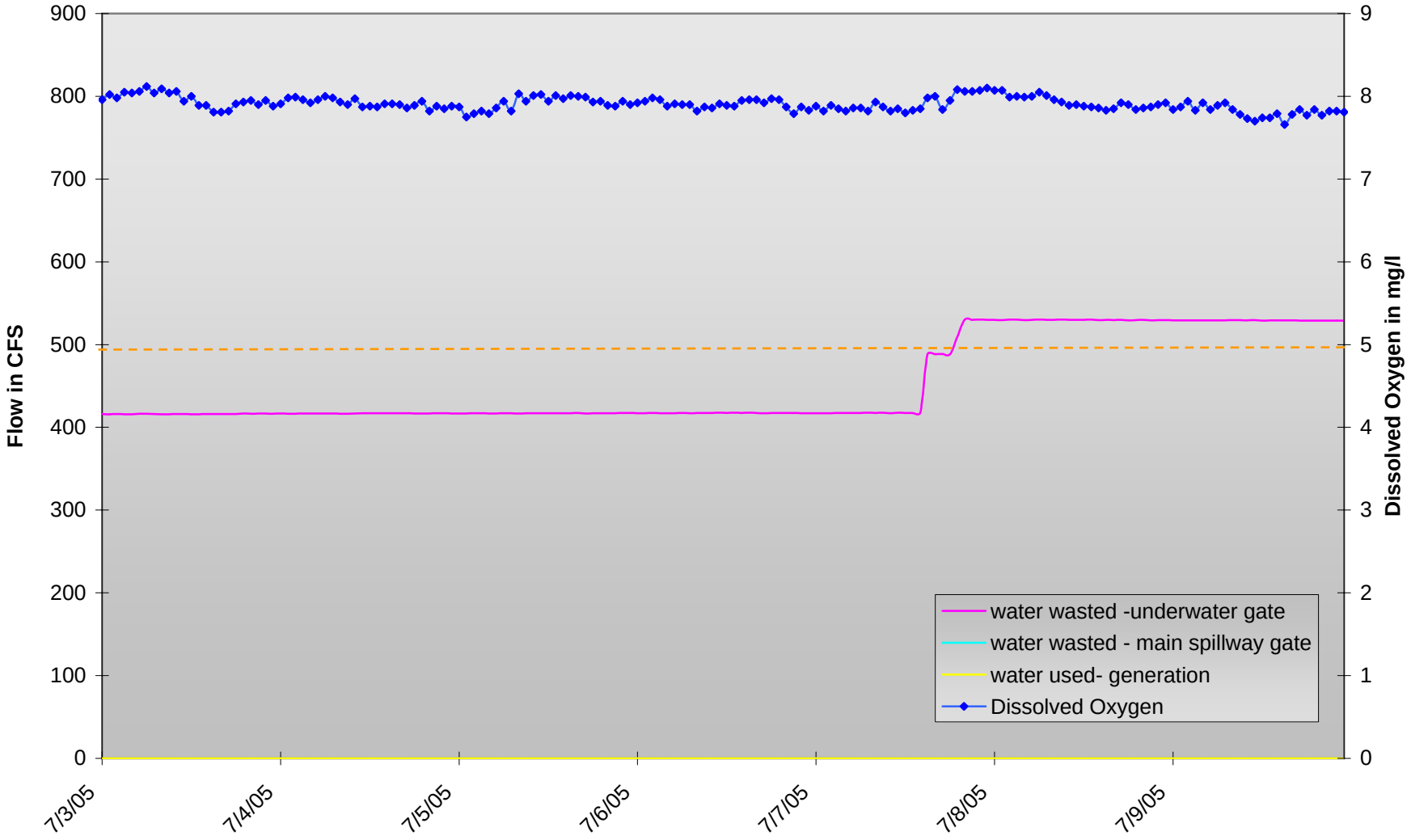
Appendix A, Figure 4
Way Dam Tailrace DO vs. Underwater Gate Flow, Week of July 3, 2005



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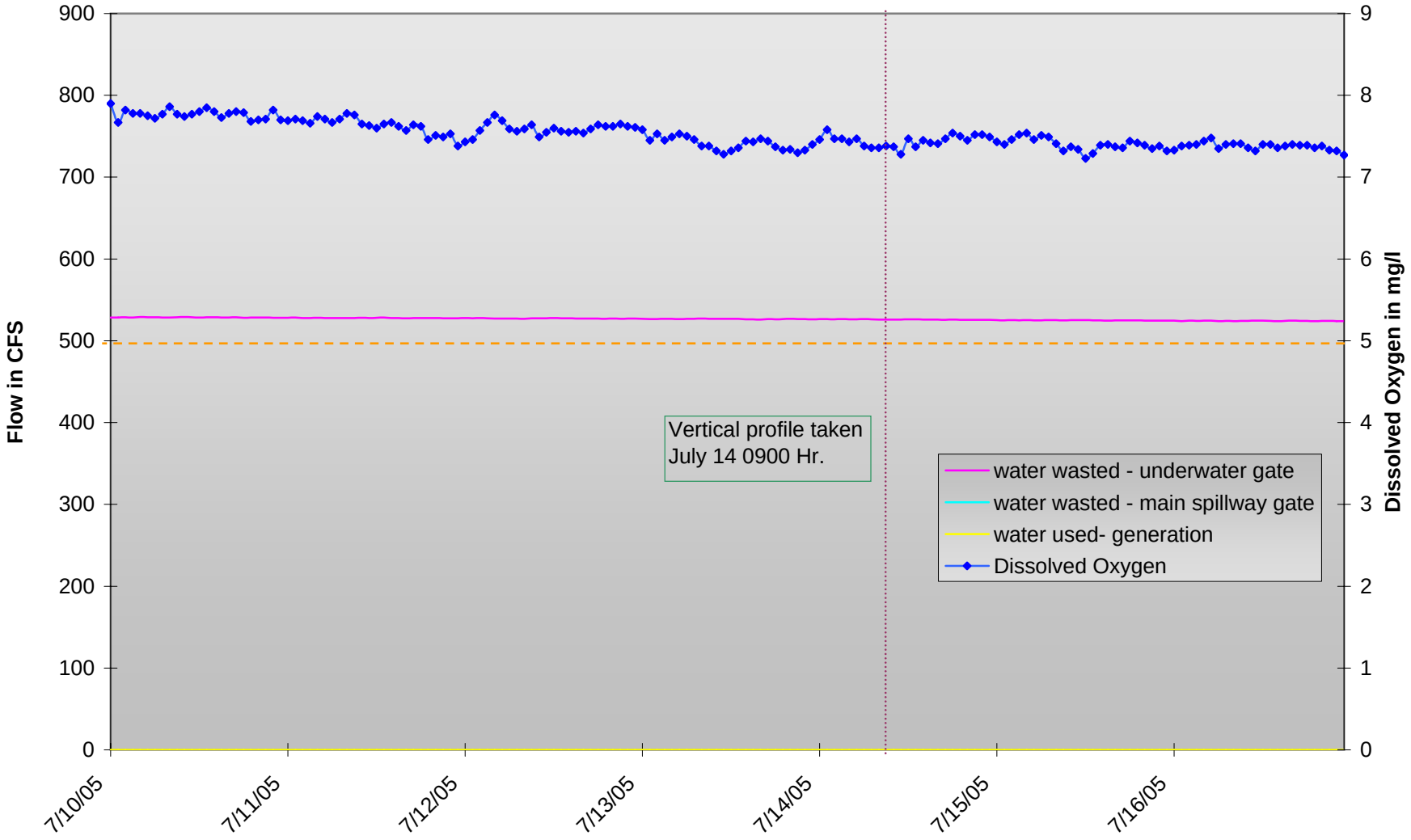
Appendix A, Figure 5
Way Dam Tailrace DO vs Underwater Gate Flow, Week of July 10



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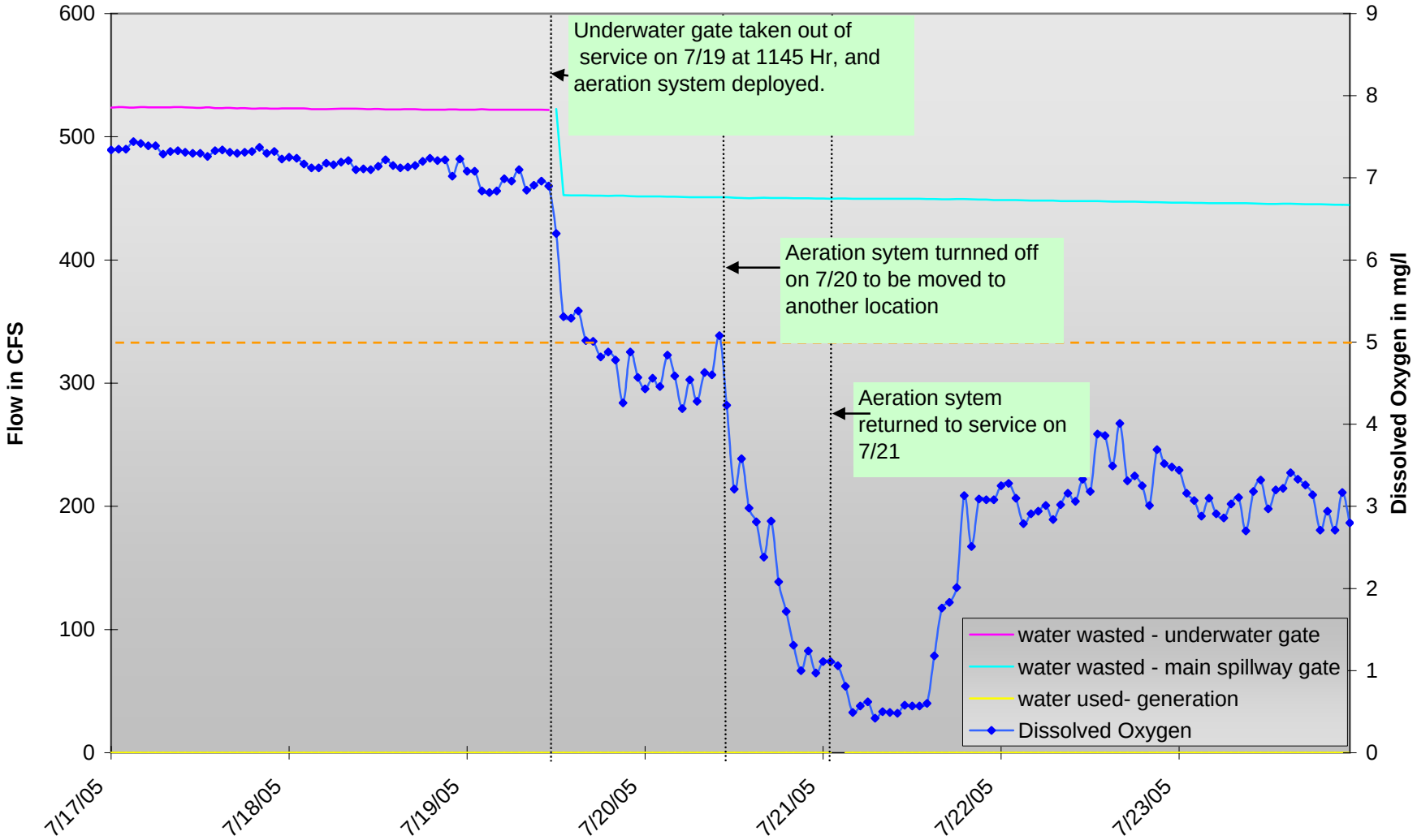
Appendix A, Figure 6
Way Dam Tailrace DO vs. Underwater Gate Flow, Week of July 17, 2005



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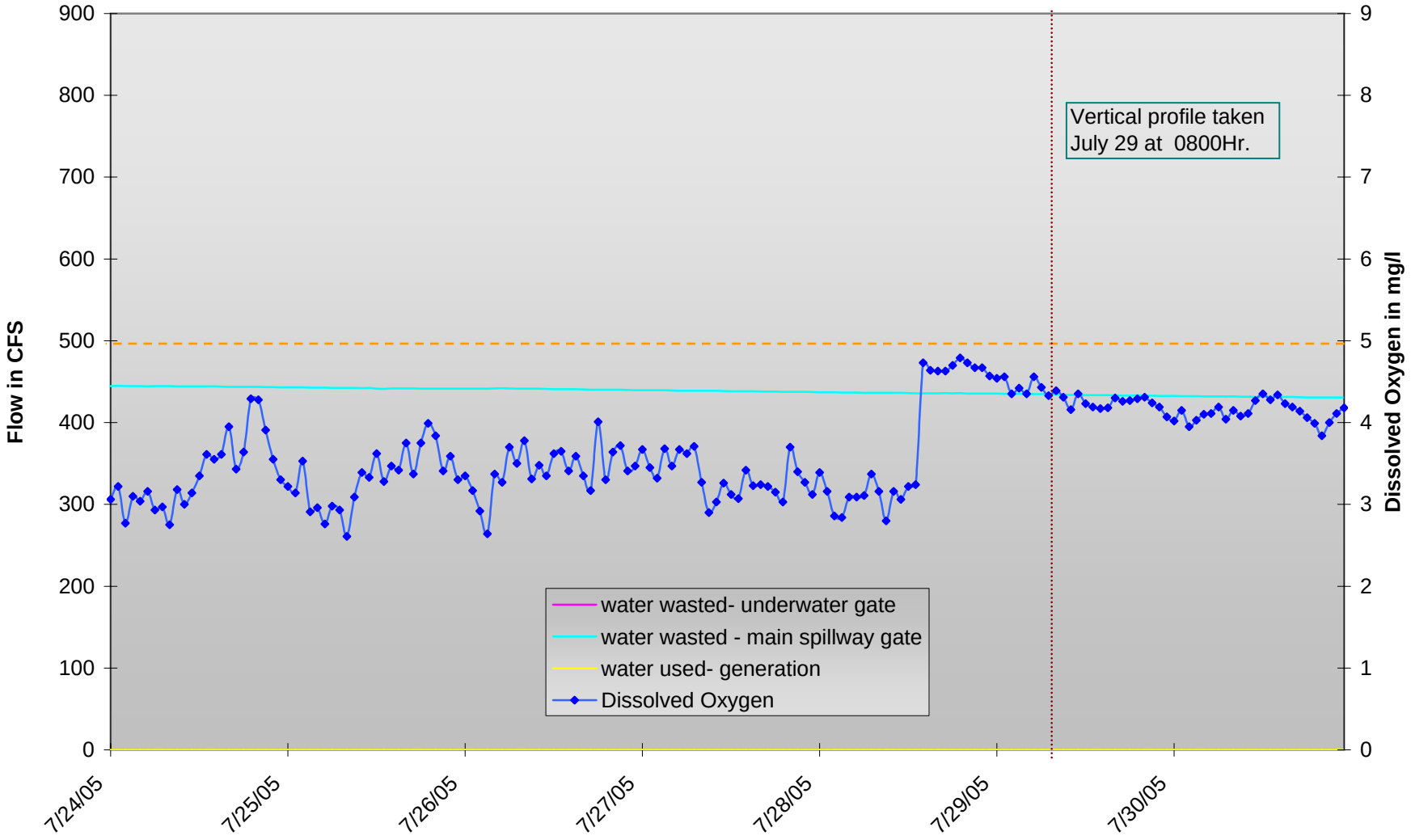
Appendix A, Figure 7
Way Dam Tailrace DO vs Underwater Gate Flow, Week of July 24, 2005



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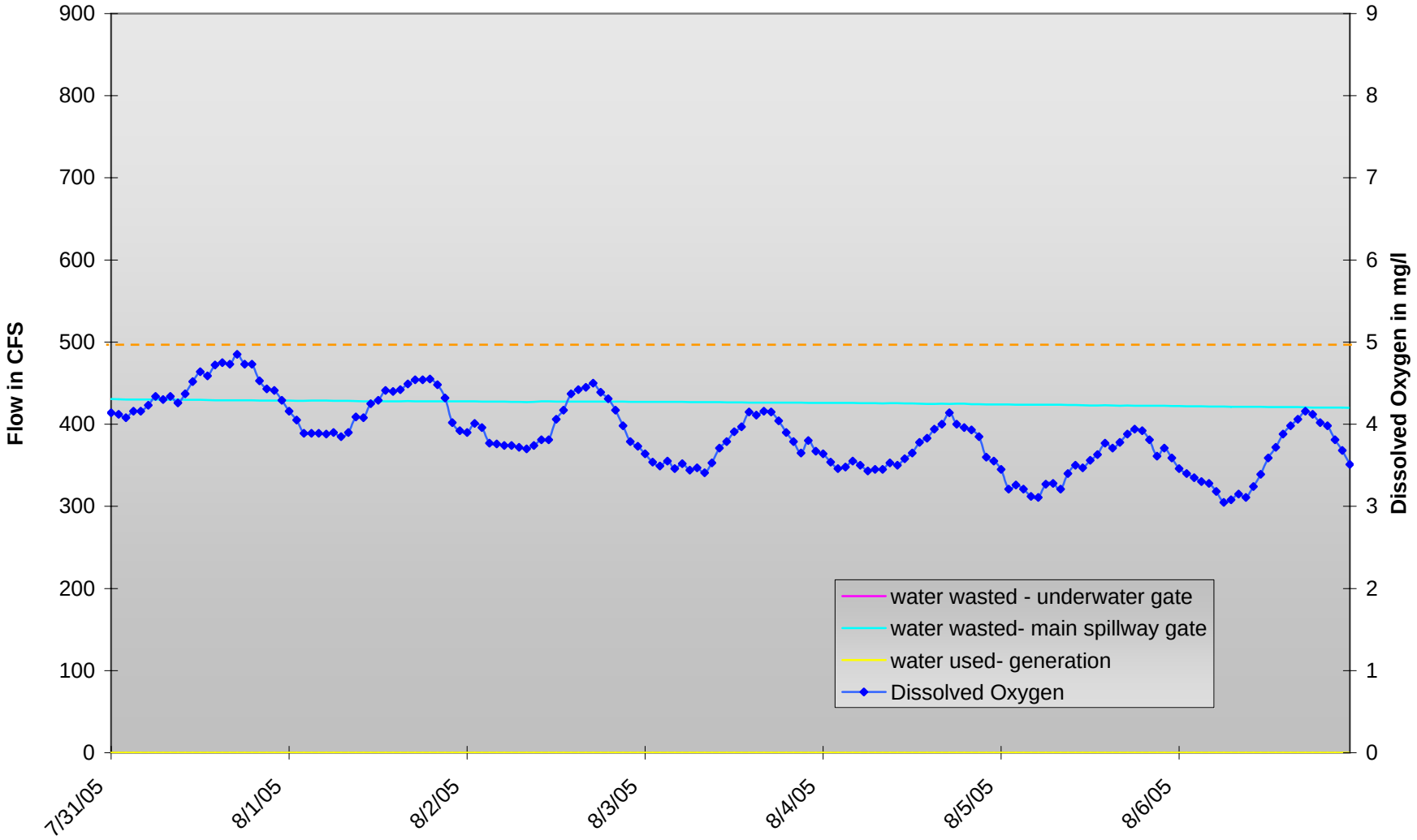
Appendix A, Figure 8
Way Dam Tailrace DO vs Underwater Gate Flow, Week of July 31, 2005



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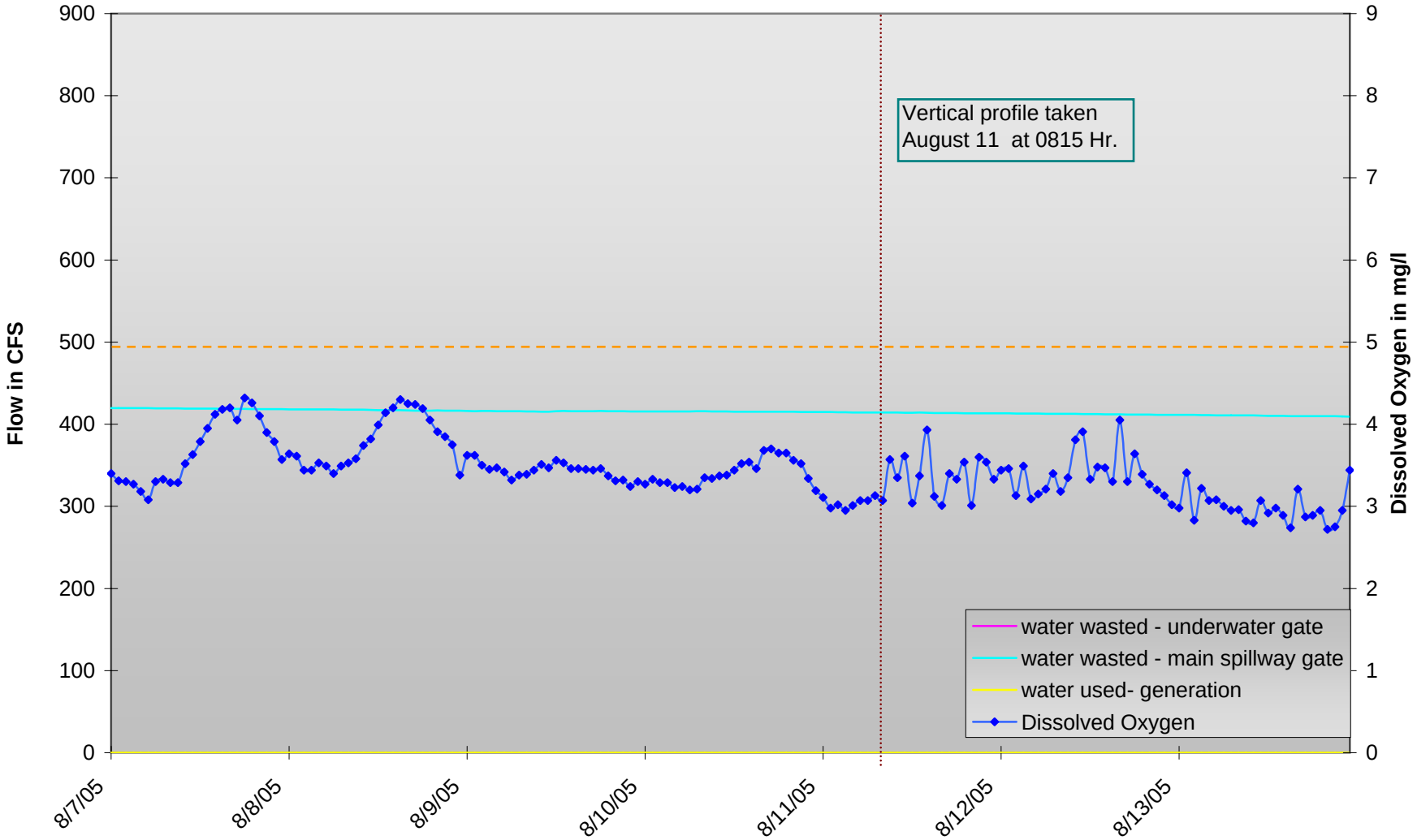
Appendix A, Figure 9
Way Dam Tailrace DO vs Underwater Gate Flow, Week of August 7, 2005



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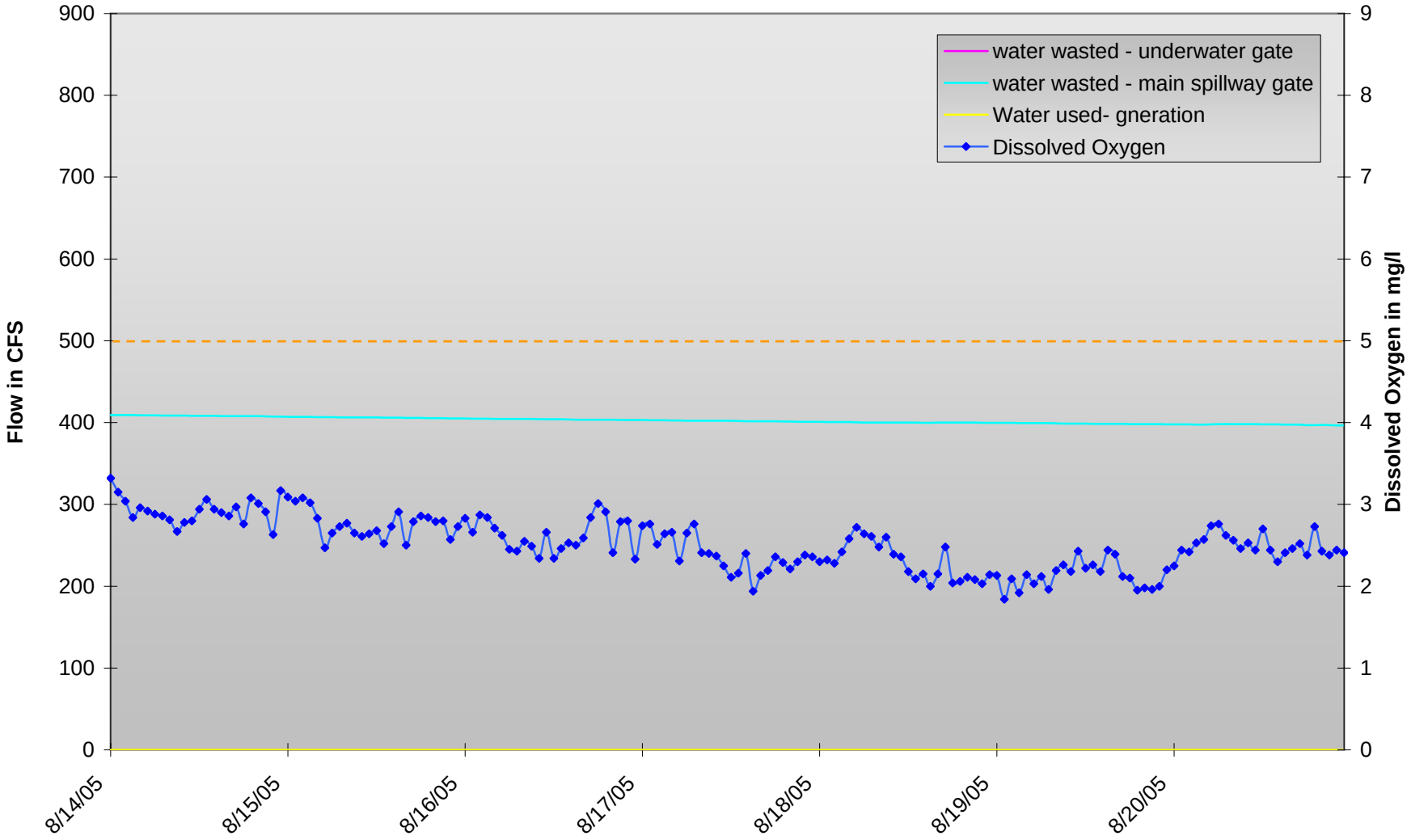
Appendix A, Figure 10
Way Dam DO vs. Underwater Gate Flow, Week of August 14, 2005



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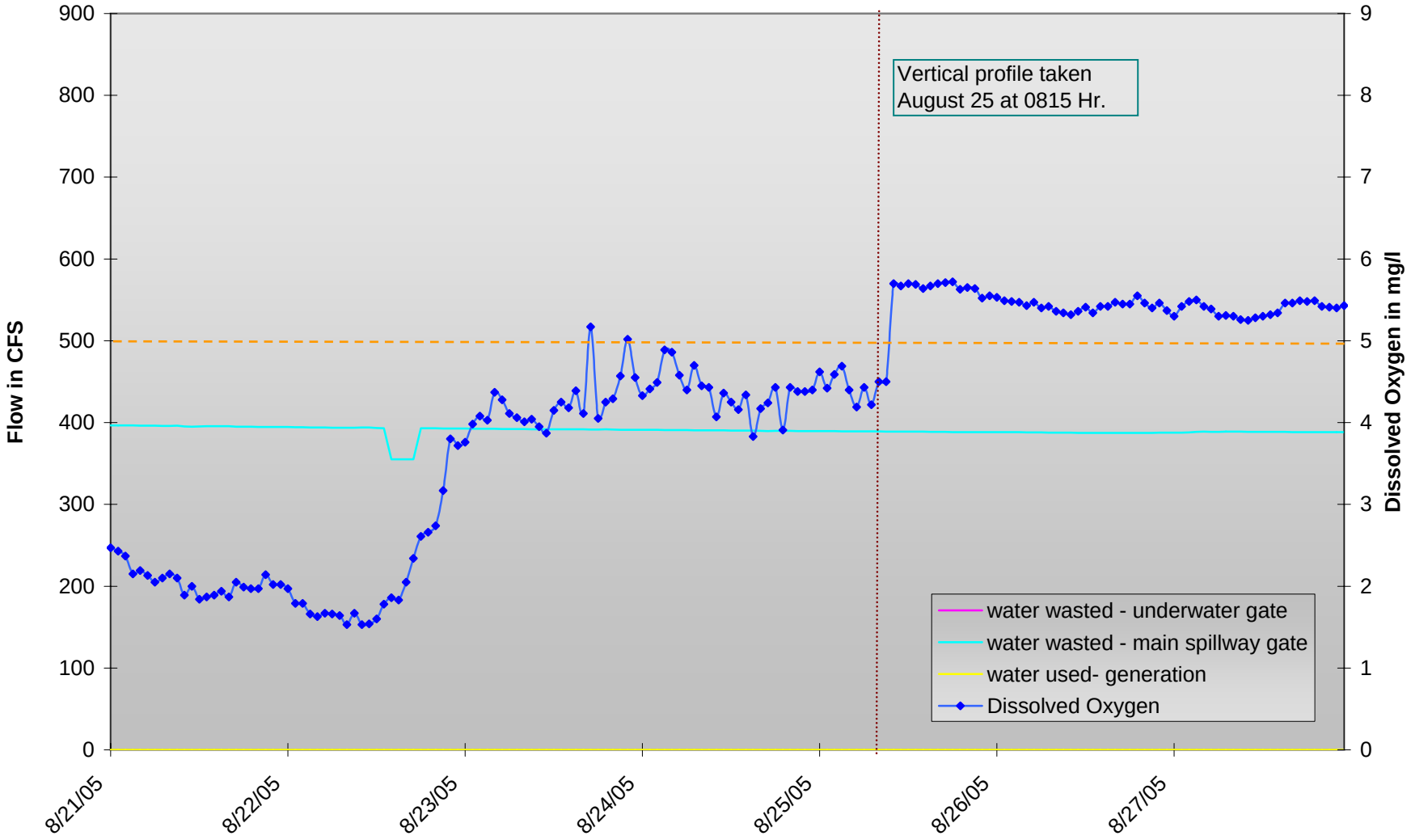
Appendix A, Figure 11
Way Dam Tailrace DO vs Underwater Gate Flow, Week of August 21, 2005



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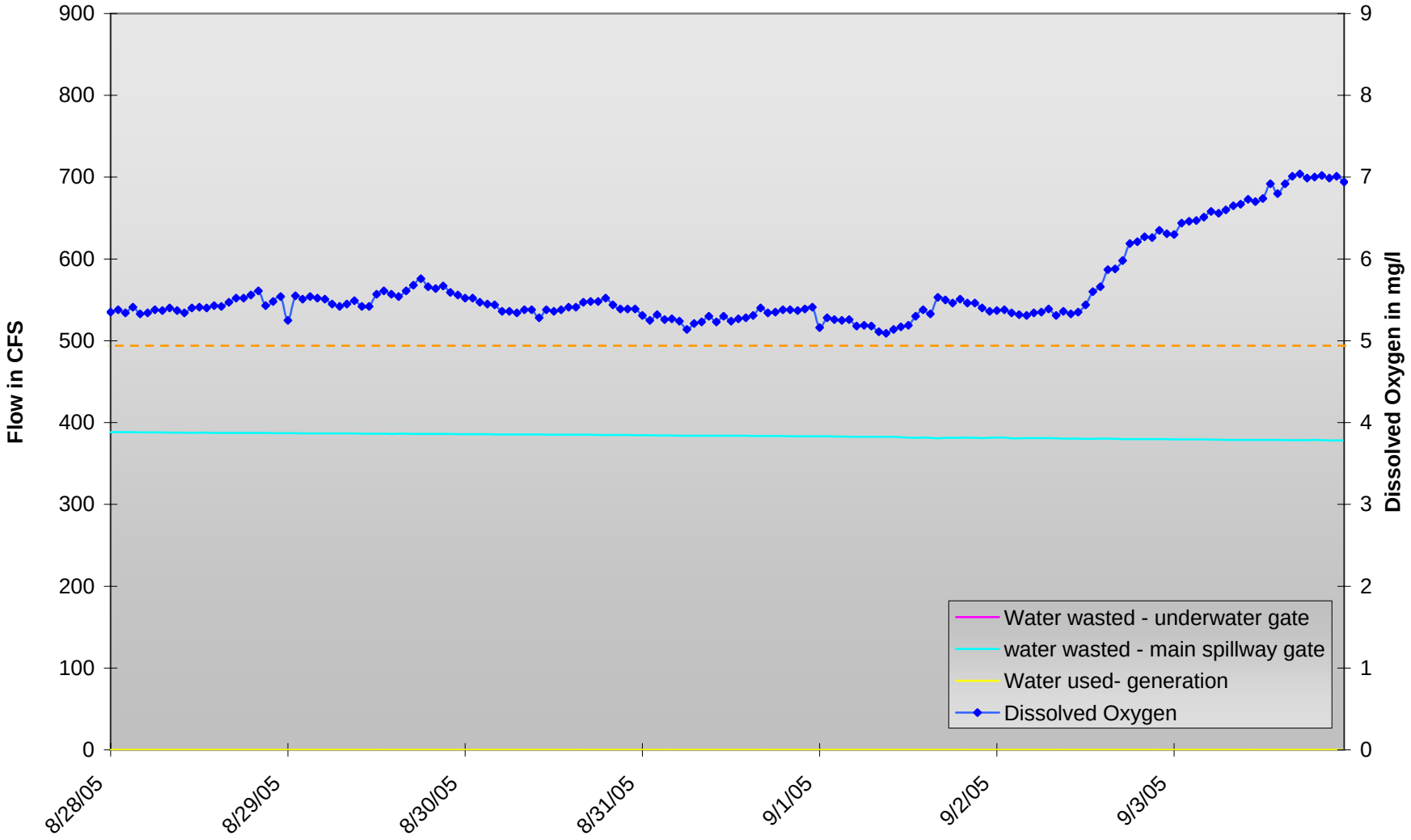
Appendix A, Figure 12
Way Dam Tailrace DO vs. Underwater Gate Flow, Week of August 28, 2005



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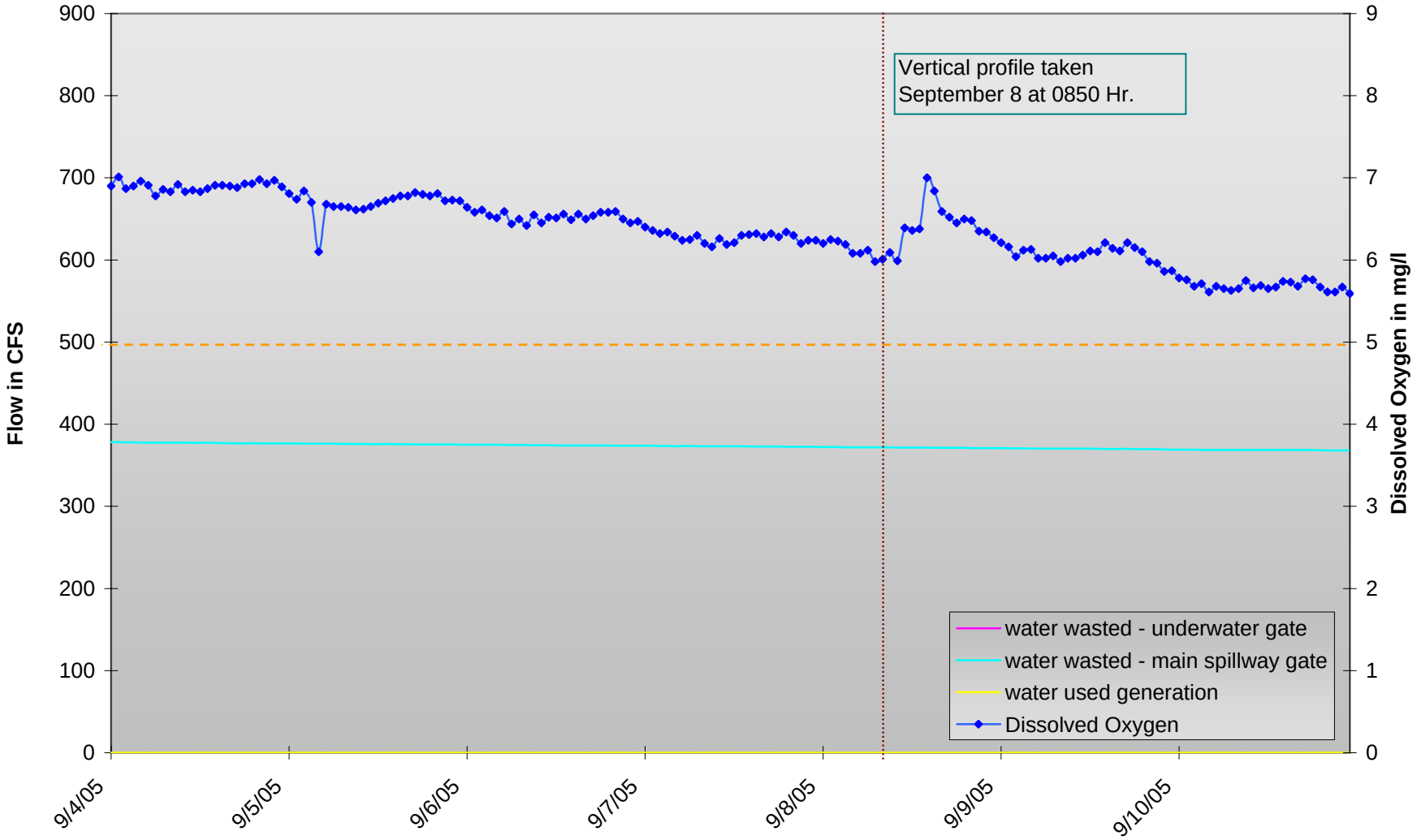
Appendix A, Figure 13
Way Dam Tailrace DO vs Underwater Gate Flow, Week of September 4, 2005



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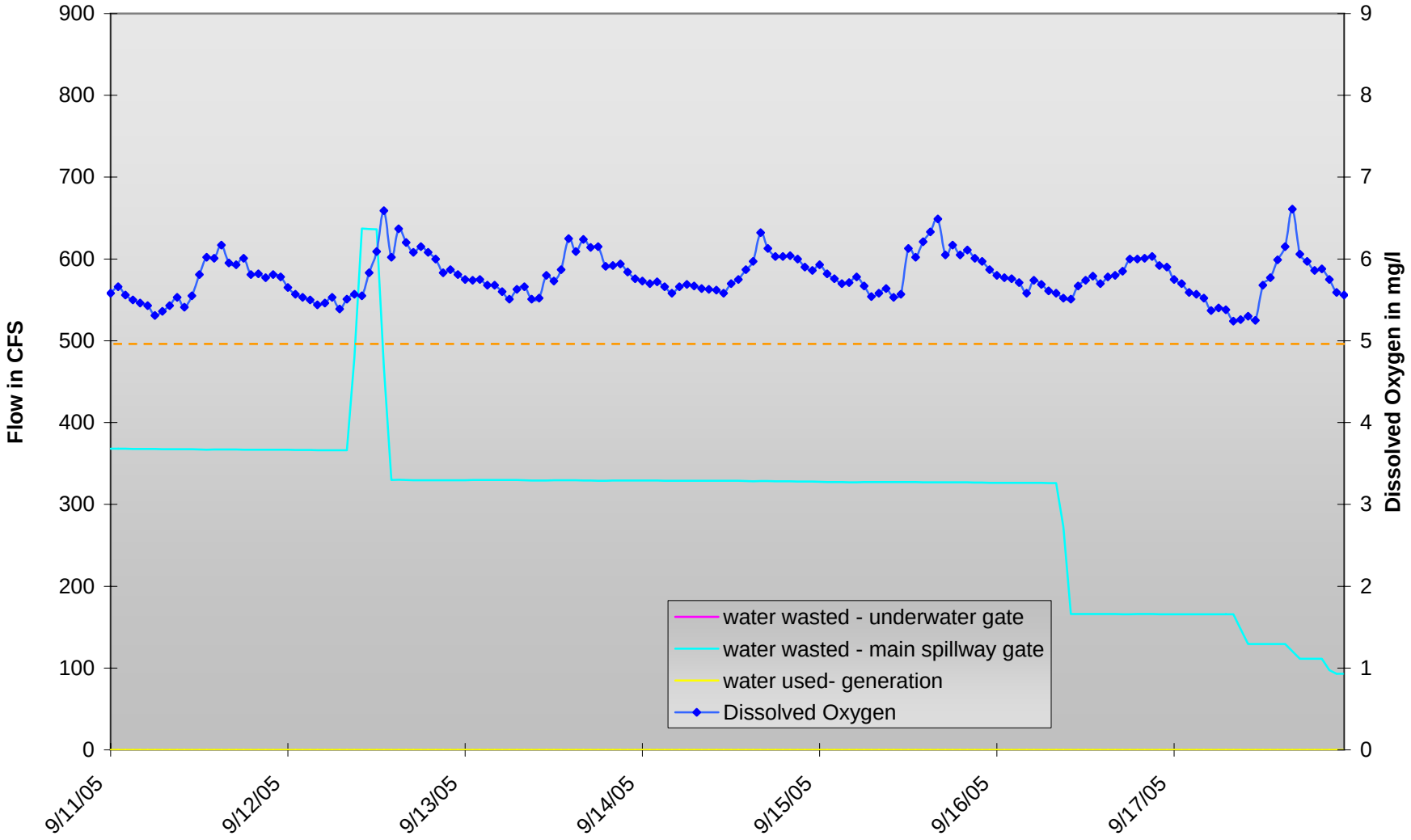
Appendix A, Figure 14
Way Dam Tailrace DO vs. Underwater Gate Flow, Week of September 11, 2005



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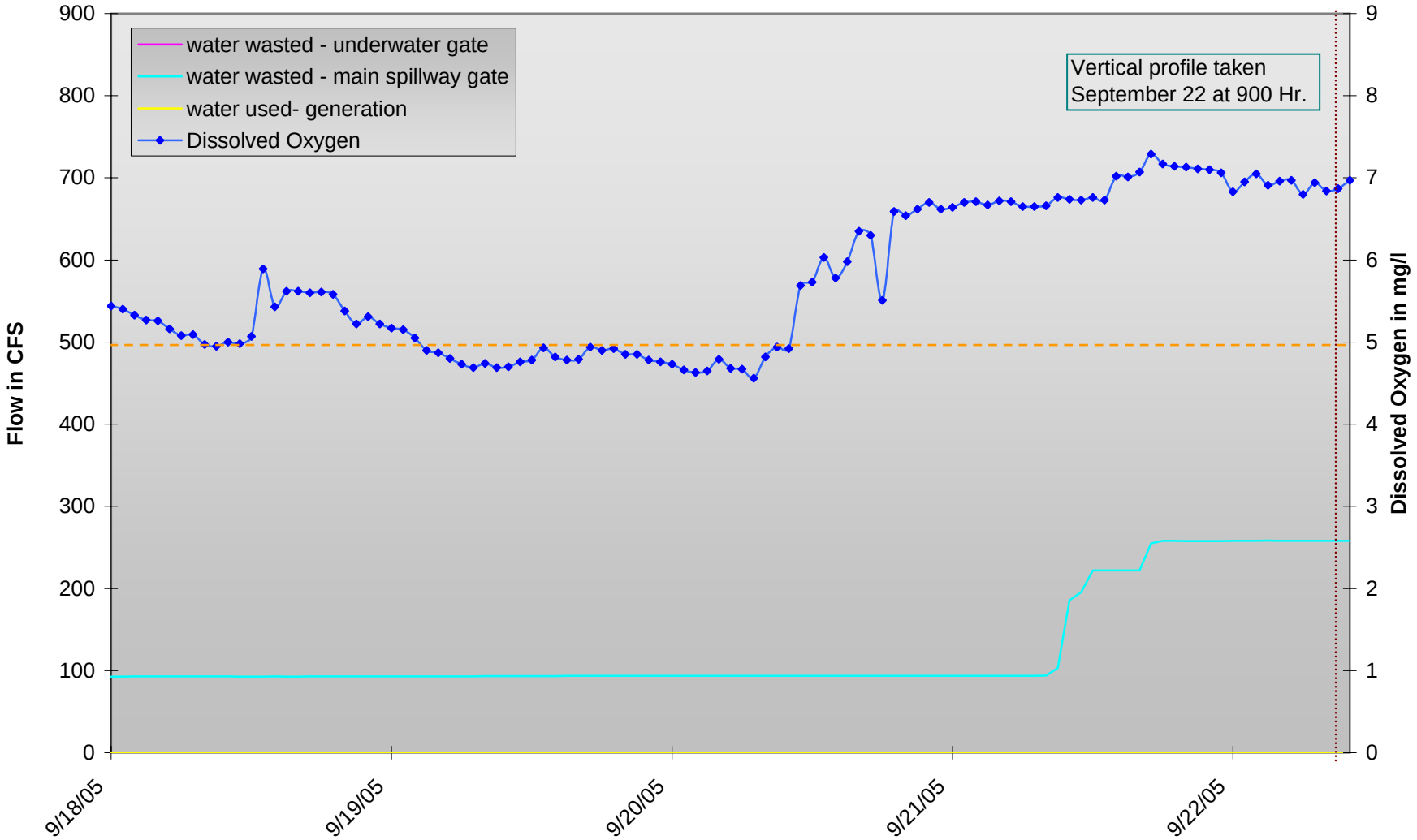
Appendix A, Figure 15
Way Dam Tailrace DO vs Underwater Gate Flow, Week of September 18, 2005



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15-Jun-05

Approximate air temp: 14.4 C
Secci Depth:6.5 40' *Time:0630*
Winds N 21-28 mph *overcast*
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	21.6	8.2	95.5	89	7.1
0.5	21.6	8.2	95.7	89	7.1
1.0	21.6	8.2	95.7	89	7.1
1.5	21.6	8.2	95.5	90	7.1
2.0	21.6	8.2	95.5	90	7.1
2.5	21.6	8.2	95.2	89	7.1
3.0	21.6	8.2	95.3	89	7.1
3.5	21.6	8.2	95.1	90	7.1
4.0	21.6	8.2	95.1	90	7.1
4.5	21.6	8.2	95.2	89	7.1
5.0	21.6	8.2	95.2	89	7.1
5.5	21.6	8.2	95.3	89	7.1
6.0	21.6	8.2	95.0	89	7.1
6.5	21.6	8.2	95.0	89	7.1
7.0	21.6	8.1	94.7	89	7.1
7.5	17.7	6.8	74.9	94	7.1
8.0	16.2	6.6	65.7	88	7.2
8.5	15.9	6.5	65.7	88	7.2
9.0	15.7	6.1	64.6	87	7.2
9.5	14.2	5.3	55.8	89	7.2
10.0	14.5	5.2	52.1	88	7.0
10.5	13.8	5.2	52.0	92	7.1
11.0	13.6	5.6	53.3	91	7.1
11.5	13.5	5.6	55.6	94	7.1
12.0	13.1	5.7	54.7	95	7.1
12.5	bottom				

Indicates opening of intake forebay (10-15.5m)

14-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:1605*
Sswest winds 8-12 mph *overcast*
Tailrace- TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	13.9	7.4	73.2	94	7.4
0.5	13.9	7.3	72.7	94	7.4
1.0	13.9	7.3	72.6	94	7.3
1.5	13.9	7.3	72.1	94	7.3
2.0	13.9	7.2	72.0	94	7.2
2.5	13.9	7.2	71.0	94	7.2
3.0	13.9	7.2	71.9	94	7.2
3.5	13.9	7.2	72.0	94	7.1
3.9	13.9	7.2	71.7	94	7.1

14-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:1620*
Sswest winds 8-12 mph *overcast*
Tailrace- TR2

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	8.0	0.7	6.0	190	7.4

14-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:1625*
Sswest winds 8-12 mph *overcast- threat of t storm*
Tailrace-TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	14.0	7.2	71.2	94	7.0
0.5	14.0	7.1	70.4	94	7.0
1.0	14.0	7.1	70.4	94	7.0

14-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:1635*
Sswest winds 8-12 mph *overcast- threat of t storm*
Tainter Gate- T1 *Flow from creek only*

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.0	7.0	79.7	177	7.0
0.5	19.9	7.0	81.5	176	6.9
1.0	16.6	6.7	71.0	120	7.1
1.5	12.3	7.3	70.1	142	7.3

Tailrace data for same time period as the the flowage vertical profile on 6/15/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
600	14.8	6.4	64.8	87
700	15.1	6.5	66.3	87
800	15.5	6.6	68.3	87

29-Jun-05

Approximate air temp: 21.1 C
Secci Depth:6.5 40' *Time:1220*
Winds NNE 4-8 mph *10% clouds*
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	24.4	8.6	105.7	96	7.2
0.5	24.4	8.6	106.1	96	7.2
1.0	24.3	8.6	105.3	96	7.3
1.5	24.2	8.6	104.9	96	7.3
2.0	24.1	8.5	104.3	96	7.3
2.5	24.1	8.4	102.9	96	7.1
3.0	24.0	8.3	101.3	96	7.4
3.5	23.9	8.3	101.3	96	7.4
4.0	23.9	8.2	100.0	96	7.4
4.5	23.7	8.2	100.0	96	7.4
5.0	23.3	9.1	97.8	95	7.4
5.5	22.3	7.1	84.7	95	7.4
6.0	21.2	6.1	71.7	95	7.4
6.5	20.7	6.1	69.1	93	7.4
7.0	20.1	5.5	61.7	94	7.3
7.5	19.8	5.2	58.6	94	7.3
8.0	19.5	4.9	54.7	93	7.3
8.5	18.9	4.3	47.5	93	7.3
9.0	18.8	4.3	47.2	94	7.3
9.5	18.6	4.4	48.1	95	7.3
10.0	18.2	4.3	47.7	96	7.3
10.5	18.1	4.3	47.4	95	7.3
11.0	17.9	4.4	47.1	97	7.3
11.5	15.8	3.9	39.8	103	7.3
12.0	16.1	4.0	40.9	101	7.3
12.5	15.3	3.7	36.7	101	7.3

Indicates opening of intake forebay (10-15.5m)

30-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:0845*
SSW winds 18-24 *rain in am 50% clouds*
Tairace -TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	not taken	Strong Currents, dangerous			

30-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:0845*
SSW winds 18-24 *rain in am 50% clouds*
Tailrace -TR2

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	not taken	Strong Currents, area submerged			

30-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:0845*
SSW winds 18-24 *rain in am 50% clouds*
Tailrace-TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	18.5	8.1	86.7	100	7.3
0.5	18.5	7.9	86.6	100	7.4
1.0	18.6	8.0	92.5	103	7.3

30-Jun-05

Approximate air temp:
Secci Depth:not taken *Time:0845*
SSW winds 18-24 *rain in am 50% clouds*
T1 Tainter gate side

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.7	6.9	80.9	128	7.4
0.5	20.5	6.7	76.6	127	7.4
1.0	20.4	6.6	76.6	153	7.3

Tailrace data for same time period as the the flowage vertical profile on 6/29/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
1100	19.4	1.4	15.8	92
1200	19.5	1.6	17.9	92
1300	19.5	1.5	17.2	92

14-Jul-05

Approximate air temp: 18.3 C
Secci Depth: 8.4 40' *Time:0900*
Winds NNE 8-12 mph *10% clouds*
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	26.4	8.3	107.7	102	7.3
0.5	26.4	8.3	105.1	102	7.4
1.0	26.4	8.2	104.8	102	7.4
1.5	26.3	8.2	104.8	102	7.5
2.0	26.3	8.2	104.3	102	7.6
2.5	26.3	8.2	104.1	102	7.6
3.0	26.2	8.1	103.5	102	7.6
3.5	25.7	7.7	95.4	101	7.7
4.0	21.8	7.2	84.2	100	7.8
4.5	21.4	6.6	77.0	99	7.8
5.0	21.1	6.2	71.5	99	7.7
5.5	21.0	6.2	71.9	100	7.7
6.0	21.0	6.1	69.7	100	7.6
6.5	20.6	5.2	59.1	101	7.6
7.0	20.6	4.8	54.5	103	7.5
7.5	20.5	4.6	52.9	102	7.5
8.0	20.3	4.2	46.3	102	7.4
8.5	20.3	3.3	38.0	101	7.3
9.0	20.1	2.6	29.2	101	7.3
9.5	19.9	2.7	29.7	104	7.1
10.0	19.8	2.1	25.1	105	7.1
10.5	19.6	2.5	27.9	108	7.1
11.0	17.2	0.8	7.6	117	7.2
11.5	16.7	0.5	5.6	117	7.3
12.0	16.4	0.5	5.4	117	7.4
12.5	16.4	0.5	5.6	116	7.4
13.0	16.5	0.6	5.9	119	7.4

Indicates opening of intake forebay (10-15.5m

14-Jul-05

Approximate air temp: 28.3 C
Secci Depth: not taken *Time:1050*
Winds NNE 8-12 mph *10% clouds*
tailrace- TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.0	8.1	89.5	106	7.1
0.5	20.0	7.7	90.0	106	7.1
1.0	20.0	8.0	89.7	106	7.0
1.5	20.0	7.9	89.2	106	7.0
2.0	20.0	7.6	88.4	106	7.0
2.5	20.0	7.9	89.5	106	7.4
3.0	19.8	7.5	82.4	106	7.0
3.5	19.8	7.5	83.9	107	7.0
4.0	19.3	7.8	85.5	107	7.0

14-Jul-05

Approximate air temp: 28.3 C
Secci Depth: not taken *Time:*
Winds NNE 8-12 mph *10% clouds*
tailrace- TR2

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	not taken		Strong currents, area submerged		

14-Jul-05

Approximate air temp: 28.3 C
Secci Depth: not taken *Time:1100*
Winds NNE 8-12 mph *10% clouds*
tailrace- TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.1	8.0	89.9	105	7.0
0.5	20.1	7.9	90.0	106	7.0
1.0	20.1	8.0	91.1	106	7.0

14-Jul-05

Approximate air temp: 28.3 C
Secci Depth: not taken *Time:1110*
Winds NNE 8-12 mph *10% clouds*
Tainter Gate -T1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.7	8.2	93.7	136	7.1
0.5	20.8	8.2	93.0	136	7.1
1.0	20.2	7.9	90.5	140	7.2

Tailrace data for same time period as the the flowage vertical profile on 7/14/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
800	20.0	7.4	84.0	99
900	19.9	7.4	84.2	100
1000	20.0	7.4	84.1	99

29-Jul-05

Approximate air temp: 12.7 C
Secci Depth: 6.5 40' *Time:0800*
calm to light and variable winds *clear blue stky*
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	21.3	7.8	90.4	106	7.0
0.5	22.0	7.5	88.4	105	7.0
1.0	21.9	7.5	88.1	105	7.0
1.5	22.0	7.5	87.8	105	7.0
2.0	22.0	7.5	87.7	105	7.0
2.5	22.0	7.4	87.1	105	7.0
3.0	22.0	7.4	86.8	105	7.1
3.5	22.0	7.4	86.3	105	7.1
4.0	22.0	7.3	86.2	105	7.1
4.5	22.0	7.3	86.1	105	7.1
5.0	22.0	7.3	86.1	105	7.1
5.5	21.9	7.3	86.4	104	7.1
6.0	22.0	7.3	86.1	105	7.1
6.5	21.9	5.5	65.9	107	7.0
7.0	21.3	3.5	41.3	110	6.9
7.5	21.2	3.0	34.1	111	6.9
8.0	20.6	0.5	5.7	109	6.8
8.5	20.0	0.2	2.4	111	6.8
9.0	19.6	0.2	2.0	112	6.7
9.5	19.1	0.2	1.9	114	6.7
10.0	18.6	0.2	1.6	115	6.7
10.5	18.1	0.2	1.9	114	6.7
11.0	17.6	0.1	1.5	110	6.7
11.5	17.2	0.1	1.5	106	6.7
11.9	16.7	0.1	1.4	114	6.7

Indicates opening of intake forebay (10-15.5m)

28-Jul-05

Approximate air temp: 21.1 C
Secci Depth:5' *Time: 1345*
winds nw 8-12 mph *ligth drizzle 100%*
tailrace- TR1 *overcast*

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	18.8	5.0	54.5	113	7.7
0.5	18.8	4.9	54.0	112	7.6
1.0	18.9	5.0	55.6	112	7.6
1.5	18.9	4.9	54.3	112	7.6
2.0	18.9	4.9	53.4	112	7.6
2.5	18.9	4.8	53.3	112	7.5
3.0	18.9	4.8	53.2	112	7.5
3.5	18.8	4.8	53.0	112	7.5
4.0	18.8	4.7	51.4	112	7.5
4.5	18.8	4.5	50.0	112	7.5
5.0	18.8	4.7	51.7	112	7.4
5.5	18.8	4.7	51.8	113	7.4
6.0	18.8	4.6	50.5	112	7.4

28-Jul-05

Approximate air temp: 21.1 C
Secci Depth:5' *Time: 1345*
winds nw 8-12 mph *ligth drizzle 100%*
tailrace- TR3 *overcast*

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.5	6.7	74.9	109	7.3
0.5	19.7	5.5	62.6	113	7.3
1.0	19.2	5.3	58.7	112	7.3

28-Jul-05

Approximate air temp: 21.1 C
Secci Depth:5' *Time: 1410*
winds nw 8-12 mph *ligth drizzle 100%*
Tainter Gate- T1 *overcast*

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	22.2	8.7	102.8	107	7.3
0.5	22.2	8.7	103.1	107	7.3
0.9	22.2	8.7	102.9	105	7.4

Tailrace data for same time period as the the flowage vertical profile on 7/29/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
700	17.5	4.3	46.0	103
800	17.6	4.4	46.7	103
900	17.6	4.3	45.8	103

11-Aug-05

Approximate air temp: 18.3 C
Secci Depth: 7.5 38-40' *Time:0815*
Light to variable winds *60% clouds*
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	23.7	7.5	90.9	114	7.9
0.5	23.7	7.6	91.1	114	7.9
1.0	23.7	7.6	91.3	114	7.9
1.5	23.7	7.6	91.6	114	7.9
2.0	23.7	7.6	91.6	113	7.8
2.5	23.7	7.5	89.0	114	7.8
3.0	23.7	7.4	89.1	114	7.8
3.5	23.7	7.4	89.3	114	7.8
4.0	23.7	7.4	89.5	114	7.8
4.5	23.6	7.4	88.2	114	7.8
5.0	23.4	6.8	81.3	112	7.8
5.5	22.5	3.9	46.5	112	7.7
6.0	22.2	3.3	37.9	113	7.7
6.5	21.8	2.7	31.0	114	7.6
7.0	21.7	2.4	27.9	114	7.6
7.5	21.3	1.9	21.6	117	7.5
8.0	20.9	1.4	15.8	120	7.5
8.5	20.6	1.0	11.6	120	7.4
9.0	20.4	0.9	10.0	120	7.4
9.5	20.0	0.3	3.5	122	7.4
10.0	19.6	0.2	1.8	120	7.3
10.5	19.1	0.1	1.7	121	7.3
11.0	18.6	0.1	1.4	122	7.3
11.5	18.2	0.1	1.6	121	7.3
12.0	17.4	0.1	1.5	127	7.3

Indicates opening of intake forebay (10-15.5m)

11-Aug-05

Approximate air temp: 21.1 C
Secci Depth: 7.5 38-40' *Time:1010*
SW winds 1-3 mph *80% clouds*
Tailrace - TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.2	4.1	45.3	120	7.3
0.5	19.2	4.0	44.3	120	7.3
1.0	19.2	3.8	42.3	120	7.3
1.5	19.3	3.9	42.9	120	7.3
2.0	19.2	3.8	42.3	120.0	7.3
2.5	19.4	3.7	41.1	120	7.3
3.0	19.4	3.9	42.3	119	7.2
3.5	19.4	3.6	40.3	120	7.2
4.0	19.4	3.7	41.4	120	7.2
4.5	19.3	4.1	41.4	120	7.2
5.0	19.3	4.1	45.1	120	7.2
5.5	19.3	4.1	45.3	120	7.2
6.0	19.3	4.1	45.3	120	7.2

11-Aug-05

Approximate air temp: 21.1 C
Secci Depth: not taken *Time:1020*
SW winds 1-3 mph *80% clouds*
Tailrace -TR2

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	11.0	0.4	4.0	192	7.4

11-Aug-05

Approximate air temp: 21.1 C
Secci Depth: not taken *Time:1030*
SW winds 1-3 mph *80% clouds*
Tailrace -TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	21.6	6.7	78.0	116	7.3
0.5	20.0	4.9	55.6	119	7.2
1.0	19.6	4.5	49.7	119	7.3

11-Aug-05

Approximate air temp: 21.1 C
Secci Depth: not taken *Time:1045*
SW winds 1-3 mph *80% clouds*
Tainter Gate- T1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	23.4	8.0	96.2	113	7.4
0.5	23.4	8.0	96.4	113	7.4
1.0	23.4	8.0	96.4	113	7.5

Tailrace data for same time period as the the flowage vertical profile on 8/11/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
800	18.9	3.1	33.6	111
900	19.0	3.6	39.1	113
1000	19.2	3.4	37.0	111

25-Aug-05

Approximate air temp:10 C *Time: 0815*
Secci Depth:8.0ft. *60 % clouds*
Winds light SSW 4-7 mph
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.3	7.6	86.4	117	7.9
0.5	20.3	7.6	85.8	117	7.9
1.0	20.3	7.6	85.3	117	7.9
1.5	20.3	7.6	85.3	117	7.9
2.0	20.3	7.5	85.1	117	7.8
2.5	20.3	7.6	85.3	117	7.8
3.0	20.3	7.5	85.3	117	7.8
3.5	20.3	7.5	85.8	117	7.8
4.0	20.3	7.5	84.2	116	7.8
4.5	20.3	7.4	84.1	116	7.8
5.0	20.3	7.4	84.0	117	7.8
5.5	20.3	7.5	84.1	117	7.8
6.0	20.3	7.4	84.1	116	7.8
6.5	20.3	7.4	83.9	116	7.8
7.0	20.3	7.4	83.7	116	7.7
7.5	20.3	7.4	82.7	117	7.8
8.0	20.2	7.0	79.5	117	7.7
8.5	20.2	7.0	79.2	117	7.7
9.0	20.2	7.0	79.2	117	7.7
9.5	20.1	6.4	71.8	118	7.7
10.0	20.0	6.0	67.2	120	7.7
10.5	19.9	5.5	61.6	119	7.6
11.0	19.7	4.3	47.8	121	7.6
11.5	18.9	1.8	19.4	128	7.5
11.8	18.6	1.4	19.4	131	7.5

Indicates opening of intake forebay (10-15.5m)

25-Aug-05

Approximate air temp:14.4 C *Time: 1005*
Secci Depth:8.0ft. *30 % clouds*
Winds light SSW 4-7 mph
Tailrace -TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.5	5.9	64.9	122	7.5
0.5	19.5	5.8	64.4	122	7.5
1.0	19.4	5.9	65.6	122	7.5
1.5	19.4	5.9	65.7	122	7.5
2.0	19.4	5.9	65.5	122.0	7.5
2.5	19.4	5.9	65.6	122	7.5
3.0	19.4	5.9	65.4	122	7.5
3.5	19.5	5.9	65.0	122	7.4
4.0	19.4	5.9	65.1	122	7.4
4.5	19.4	5.9	65.1	122	7.4
5.0	19.4	5.9	65.2	122	7.4
5.5	19.4	5.9	65.1	122	7.4
6.0	19.4	5.9	65.3	122	7.4
6.3	19.4	5.8	64.7	122	7.4

25-Aug-05

Approximate air temp:14.4 C *Time: 1025*
Secci Depth: not taken *30 % clouds*
Winds light SSW 4-7 mph
Tailrace - TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.7	6.2	69.6	123	7.3
0.5	19.4	6.3	69.7	123	7.3
1.0	19.1	5.7	63.6	123	7.4

25-Aug-05

Approximate air temp:14.4 C *Time: 1030*
Secci Depth: not taken *30 % clouds*
Winds light SSW 4-7 mph
Tainter Gate - T1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	20.3	9.0	101.2	116	7.5
0.5	20.3	8.9	101.0	116	7.5
1.0	20.3	8.9	100.9	117	7.6

Tailrace data for same time period as the the flowage vertical profile on 8/25/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
800	19.1	4.5	49.6	118
900	19.1	4.5	49.6	118
1000	19.3	5.7	62.6	112

8-Sep-05

Approximate air temp:11.6 C
Secci Depth:8.5ft. *Time: 0850*
Winds light SSW 1-3 mph *20 % clouds*
Taken in the flowage

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	18.7	9.0	98.5	126	7.5
0.5	18.7	9.0	98.5	126	7.5
1.0	18.7	9.0	98.4	126	7.5
1.5	18.7	9.0	98.3	126	7.6
2.0	18.7	9.0	98.0	126	7.6
2.5	18.7	8.9	97.9	126	7.6
3.0	18.7	8.9	98.0	126	7.6
3.5	18.7	8.9	97.8	126	7.6
4.0	18.7	8.9	97.8	126	7.6
4.5	18.6	8.6	94.5	126	7.6
5.0	18.6	8.1	88.5	126	7.6
5.5	18.5	7.8	85.2	126	7.6
6.0	18.4	7.7	85.2	126	7.6
6.5	18.3	7.3	79.6	126	7.6
7.0	18.2	7.1	77.4	126	7.5
7.5	18.2	7.0	75.3	127	7.5
8.0	18.2	6.8	74.1	127	7.5
8.5	18.2	6.8	73.8	127	7.5
9.0	18.1	6.5	70.7	126	7.5
9.5	18.1	6.4	69.5	127	7.5
10.0	18.1	6.2	67.4	127	7.4
10.5	18.0	5.9	63.7	127	7.4
11.0	18.0	5.3	57.2	128	7.4
11.5	17.8	4.7	50.4	129	7.4
11.9	17.6	2.5	27.1	132	7.3

Indicates opening of intake forebay (10-15.5m)

8-Sep-05

Approximate air temp:15.5C
Secci Depth:8.5ft. *Time: 1040*
Winds light and variable *20 % clouds*
Tailrace -TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	18.6	6.9	75.7	128	7.2
0.5	18.6	6.9	75.2	128	7.2
1.0	18.6	6.7	73.7	128	7.3
1.5	18.6	6.7	73.3	128	7.3
2.0	18.6	6.8	74.7	128.0	7.3
2.5	18.6	6.8	74.8	128	7.3
3.0	18.6	6.8	74.2	128	7.3
3.5	18.6	6.8	74.4	128	7.3
4.0	18.6	6.8	74.4	128	7.3
4.5	18.6	6.8	74.1	128	7.3
5.0	18.6	6.8	74.0	128	7.3
5.5	18.6	6.8	74.0	128	7.2
6.0	18.5	6.8	74.8	128	7.2
6.3	bottom				

8-Sep-05

Approximate air temp:15.5C
Secci Depth: not taken *Time: 1055*
Winds light and variable *20 % clouds*
Tailrace - TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	18.8	7.1	78.5	128	7.3
0.5	18.4	7.2	77.6	129	7.3
1.0	18.2	7.1	77.0	129	7.3

8-Sep-05

Approximate air temp:11.6 C
Secci Depth: not taken *Time: 1110*
Winds light and variable *20 % clouds*
Tainter Gate - T1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.7	8.9	99.7	122	7.6
0.5	19.7	8.9	99.7	122	7.6
1.0	19.7	8.9	99.8	122	7.6

Tailrace data for same time period as the the flowage vertical profile on 9/8/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
800	18.4	6.0	64.7	118
900	18.5	6.1	65.6	118
1000	18.5	6.0	64.6	118

22-Sep-05

Approximate air temp:15 C
Secci Depth:8.5ft. *Time: 0900*
Winds light SSW 1-3 mph *100 % clouds*
Taken in the flowage *on and off slight drizzle*

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.4	8.1	90.0	129	7.4
0.5	19.4	8.0	89.9	128	7.4
1.0	19.5	8.1	90.8	129	7.4
1.5	19.5	8.1	90.8	128	7.4
2.0	19.5	8.2	90.5	128	7.5
2.5	19.5	8.2	90.7	128	7.5
3.0	19.5	8.1	90.1	129	7.5
3.5	19.4	7.6	84.6	128	7.6
4.0	19.4	7.6	84.8	128	7.6
4.5	19.4	7.6	84.9	129	7.6
5.0	19.4	7.6	84.9	128	7.6
5.5	19.4	7.6	84.8	129	7.6
6.0	19.4	7.6	84.8	129	7.6
6.5	19.4	7.6	84.6	128	7.6
7.0	19.4	7.6	84.1	128	7.6
7.5	19.4	7.6	84.0	128	7.6
8.0	19.4	7.5	83.8	128	7.6
8.5	19.4	7.5	83.6	128	7.6
9.0	19.4	7.5	83.4	128	7.6
9.5	19.4	7.5	83.3	128	7.6
10.0	19.4	7.5	83.3	128	7.6
10.5	19.4	7.3	80.7	128	7.6
11.0	19.3	7.2	80.0	127	7.2
11.5	19.3	7.2	79.7	127	7.6
12.0	19.0	5.7	62.7	129	7.6

Indicates opening of intake forebay (10-15.5m)

22-Sep-05

Approximate air temp:16 C
Secci Depth: not taken *Time: 1035*
winds NNE 8-12 mph *95 % clouds 5% blue sky*
Tailrace -TR1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.2	7.9	87.6	131	7.2
0.5	19.2	7.9	87.2	131	7.2
1.0	19.2	7.9	87.1	131	7.2
1.5	19.2	7.9	87.0	131	7.2
2.0	19.2	7.9	86.9	131.0	7.3
2.5	19.2	7.8	86.6	131	7.2
3.0	19.2	7.8	86.6	131	7.2
3.5	19.2	7.8	86.6	131	7.2
4.0	19.2	7.8	86.6	131	7.3
4.5	19.2	7.8	86.5	131	7.2
5.0	19.2	7.8	86.6	131	7.3
5.5	19.2	7.8	86.5	131	7.3
6.0	19.2	7.8	86.4	130	7.3
6.5	19.2	7.8	86.4	130	7.3

22-Sep-05

Approximate air temp:16 C
Secci Depth: not taken *Time: 1045*
winds NNE 8-12 mph *95 % clouds 5% blue sky*
Tailrace - TR3

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.3	7.9	87.4	131	7.4
0.5	19.3	7.9	86.8	131	7.4
1.0	19.2	7.3	81.0	131	7.4

22-Sep-05

Approximate air temp:16 C
Secci Depth: not taken *Time: 1055*
winds NNE 8-12 mph *95 % clouds 5% blue sky*
Tainter Gate - T1

Depth (m)	Temp. (C)	D.O. (mg/l)	D.O. % Saturation	Cond. (uS/cm)	pH (S.U.)
0.0	19.4	9.2	101.8	129	7.6
0.5	19.4	9.1	101.3	129	7.6
1.0	19.4	9.1	101.1	129	7.6

Tailrace data for same time period as the the flowage vertical profile on 9/22/05

time	Temp C	DO (mg/l)	DO (% Sat)	Cond
800	19.2	6.8	74.8	123
900	19.1	6.9	75.1	123
1000	19.2	7.0	76.2	123

Appendix C

Summary of Quality Assurance Procedures

June-September, 2005 Continuous Monitoring Program

FERC Project No. 1759-036

December 10, 2005

To: Dave Michaud,

Re: 2005 Hydro Project Monitoring-Quality Assurance Summary

As in past monitoring seasons, prior to any deployment, all equipment is prepped, checked and calibrated per manufacturer's recommendations. The calibration records which include deployment records and other field notes are in my files. In addition to those initial calibrations, we evolved the following post deployment criteria and procedures to assure that accurate data was being collected and submitted.

2005 Post Deployment Dissolved Oxygen / QC checks And Temperature Checks On Hydrolab Recorder Datasondes

Please find attached three pages of tables which depict a tally of the 2005 Post Deployment Dissolved Oxygen/ QC Checks for the five stations monitored in 2005. The tables also list the various monitors' serial numbers to allow tracking of meter deployment and use. The stations monitored were the Way Dam Tailrace (Table C-1), Way Dam Tailrace Downstream (Table C-2), Peavy Tailrace (Table C-3), Peavy Tailrace Downstream or P2 (Table C-4) and the Peavy Tainter Gate Channel or P5 (Table C-5). As in previous years, a sixth table depicts the results of the temperature checks by sonde (Table C-6).

In addition to regularly cleaning the instrument probes, changing the permeable membranes of the DO probe and calibration of the instruments prior to each deployment, two different Post Deployment Dissolved Oxygen (DO) QC checks and approaches were used to monitor data quality.

Sonde insitu/ Scout insitu Dissolved Oxygen method:

All records are kept on the Hydrolab Calibration Datasheets. Following sonde calibration and deployment, there was a concern that biofouling, instrument drift, battery power, or physical damage might cause the DO data being collected to have drifted to a less than desirable level of accuracy. The goal for these checks was to assure consistent, accurate information was being collected and that differences between the deployed (used) instruments and an independently calibrated reference instrument were less than 1.0 ppm DO. Differences of greater than 1.0 ppm DO would trigger a closer look or inspection of the equipment to resolve a potential problem and bring results back into line.

The comparisons were achieved by looking at the continuous record of readings from each deployed Hydrolab sonde. DO data was examined and the last insitu DO reading on that record prior to instrument changeout (Sonde insitu column) was compared to a insitu DO reading taken with a Hydrolab Scout at the deployed instrument location during changeout (Scout insitu column). This comparison (Difference Column) between two different instruments calibrated independently had very mixed results. The poorest agreement of these numbers occurred at the

two Way Dam Tailrace locations (Tables C-1 and C-2). The three Peavy Tailrace locations also had some instances of poor agreement.

I felt that the Way Dam comparison problems were mostly related to the forceful, turbulent discharge of the underwater gate and subsequent fouling of the DO membrane on the continuous monitors. This discharge caused extreme turbulence in the tailrace area where the continuous monitors were located and it not only dislodged much of the dark algal slimes on the rocks and substrate but also changed the eddy currents bringing the now suspended slimes back onto the monitors. The continuous monitors and probes were visibly heavily slimed upon retrieval, much of which would come off the probes in the protector cups during transport back to the motel where Post Deployment DO Checks were conducted.

The Peavy Tailrace comparison problems were harder to explain, but seemed also related to fouling of the DO membrane. The P5 (Peavy Tainter Gate Channel) monitor (Table C-5) always seemed to collect quite a bit of heavy red floc on the deployment system. The P2 (Peavy Tailrace Downstream, Table C-4)) always was more silty and particle covered.

For the 6/14/2005 data, the comparison was made at the start of deployment.

For the 9/22/2005 data, the poor comparison on the Way Dam Downstream table was caused by the stirrer being fouled by weeds.

Post Deployment DO Check :

This check was conducted as soon as possible after the sondes were retrieved from their respective deployment stations. In some cases several hours may have elapsed. The method was achieved by setting up the retrieved sonde (while data was being recovered) for a DO air calibration check. This air calibration check (Post DO column) was compared with the expected air calibration DO value (Expected DO column) corrected for Iron Mountain, Michigan elevation and current barometric pressure obtained from the local weather channel . This comparison worked very well and only one comparison out of a possible thirty-six (Difference column) was found that exceeded 1.0 ppm DO. In that instance, on 6/30/2005, several things were happening. The underwater gate had been opened and the turbulent current kept us from getting a Scout insitu DO value for an insitu comparison. We observed the heavy slime coating of the sonde upon retrieval and when conducting the Post Deployment DO Check, did the check with the residual slime on the DO probe membrane. The difference was 2.54 ppm DO. The slime was making the recovered continuous monitor read 2.54 ppm lower than expected. I wiped the slime off the membrane and repeated the Post Deployment DO Check and the difference improved to 0.11 ppm. The wiped clean recovered continuous monitor was only reading 0.11 less than expected in an air calibration. This is reflected in the Way Dam Tailrace Table C-1 and is the reason there are two entries for the same date, 6/30/2005.

In addition, on 8/25/2005, similar slime was noted and again two Post Deployment DO Checks were done, one with slime, one without. In this instance, as shown in the Way Dam Tailrace Table C-1, both difference readings were in the acceptable, <1.0 ppm range. The slimed membrane produced a difference of 0.37 ppm DO between measured and expected values and

the wiped clean membrane improved to 0.16 ppm DO difference between measured and expected DO.

Temperature Checks

Highly accurate temperature comparisons require special temperature controlled and stirred fluid baths which can be time consuming and costly. For the last couple of years, a less expensive, easy to use comparison was used for these checks which may have sacrificed a small amount of accuracy which was considered a good tradeoff. Electronic digital thermometers were calibrated with a three point reference curve. These thermometers could then be placed in the Hydrolab sonde calibration cup while a calibration for another parameter was being conducted. The temperature of the solution from both the calibrated thermometer and the sonde under calibration was recorded. Later the difference between those readings was compared. This comparison is shown as the Temperature Deviation per check under the serial number for each sonde in Table C-6. For example: for Check date 6/14/2005, under Sonde 32653, the corrected temperature (of the calibrated thermometer) was 21.4 degrees C, the sonde was reading 21.1 degrees C so the difference is reflected as a negative (-0.3) degrees C. The sonde was reading 0.3 degrees lower than the corrected calibrated reference.

All temperature checks seemed to be slightly wider than last year. The battery failed on the reference thermometer shortly after the last trip. I will be looking into a new reference since the change appears across all the continuous monitors so it may have been the reference. All differences were less than one degree C, but one. One meter will be double checked because the temperature seemed off by possibly one degree C.

General 2005 Comments:

Data collection started 6/14/2005 and continued until 9/22/2005. In 2005, an air bubbler system was deployed by the Iron Mountain Hydro group in the Way Dam Tailrace discharge next to the plant to see if improvement in DO levels could be obtained with such a system. In addition, the underwater gate was opened for part of the summer monitoring time since that gate draws oxygenated water from the surface and mixes it with the de-oxygenated water from the deeper area of the reservoir. In conjunction with that effort a second downstream continuous monitor was continued in the Way Dam Tailrace to help characterize the effect of those changes.

We have 11 Hydrolab instruments in house that can be deployed for continuous monitoring. Seven of those are older, " Recorder Value Packs" and four are newer " DS4" models. In spring 2004, we had two of the older "Recorder Value Packs" upgraded with improved stirrer assemblies. This upgrade worked very well except for an undocumented program glitch that was identified only after several deployments. The glitch caused the stirrer to be "disabled" or off, even when specifically programming "enable stirrer" as part of the set up instructions for the deployment run. Because of the age of the instruments, a general programming instruction to "enable" the stirrer must be activated prior to the "enable" command in the specific run sequence for the stirrer to correctly turn on. The correct sequence was identified and used as the 2004

season progressed. Two additional instruments were modified in spring of 2005 and used this season.

As an anecdotal comment, slime and biofouling seemed more of a problem this year at all locations that were monitored. In addition, in the past we have always noted comments about colorful insect egg masses and insect larvae that would be deposited on and associated with the continuous monitors. Very few egg masses and insect larvae were observed at all locations this year.

Please let me know if you need further explanations or would like to discuss data.

John Hrobar
Environmental Tech.

cc: Russ Rick w/attachments
Annie Salmona w/attachments

Table C-1 Plant: Way Dam
Tailrace -~70 ft
downstream

Date Retrieved	Meter SN	Sonde insitu	Scout Insitu	Difference	Post DO	Expected DO	Difference
6/14/2005	38654	6.77	7.30	-0.53	n/a	n/a	n/a
6/30/2005	38655	2.73	n/a	n/a	5.62	8.16	-2.54
6/30/2005	38655	4.93	n/a	n/a	7.75	7.86	-0.11
7/14/2005	38652	7.37	8.00	-0.63	7.53	7.71	-0.18
7/28/2005	38653	3.24	5.00	-1.64	8.99	8.69	0.30
8/11/2005	38654	3.57	4.50	0.93	7.94	8.14	-0.20
8/25/2005	38655	4.50	5.90	-1.40	7.77	8.14	-0.37
8/25/2005	38655	4.50	6.20	-1.70	7.98	8.14	-0.16
9/8/2005	38652	5.99	6.70	-0.71	8.28	8.30	-0.02
9/22/2005	38652	6.97	7.90	-0.93	9.02	8.79	0.23

Table C-2 Plant: Way Dam Tailrace
Downstream

Date Retrieved	Meter SN	Sonde insitu	Scout Insitu	Difference	Post DO	Expected DO	Difference
6/14/2005	38652	6.62	7.10	-0.48	n/a	n/a	n/a
6/30/2005	38653	7.08	8.00	-0.92	8.32	8.16	0.16
7/14/2005	38654	7.03	8.00	-0.97	7.86	7.71	0.15
7/28/2005	38655	3.36	5.30	-1.94	8.41	8.70	-0.29
8/11/2005	38652	3.89	4.50	-0.61	8.00	8.20	-0.20
8/25/2005	38653	5.73	5.70	0.03	8.01	8.10	-0.09
9/8/2005	38654	7.65	7.10	0.55	8.33	8.30	0.03
9/22/2005	38654	4.98	7.30	-2.32	8.92	8.88	0.04

Table C-3 Plant: Peavy
Tailrace

Date Retrieved	Meter SN	Sonde insitu	Scout Insitu	Difference	Post DO	Expected DO	Difference
6/14/2005	32653	7.31	7.50	-0.18	n/a	n/a	n/a
6/30/2005	32657	5.18	6.40	-1.22	7.79	7.86	-0.07
7/14/2005	32658	6.31	7.10	-0.79	7.90	7.71	0.19
7/28/2005	32657	4.58	4.20	0.38	8.06	8.84	-0.78
8/11/2005	32658	n/a	5.00	n/a	7.87	8.40	-0.53
8/25/2005	32657	6.46	7.20	-0.74	7.96	8.21	-0.25
9/8/2005	32653	7.18	7.90	-0.72	8.48	8.54	-0.06
9/22/2005	32653	5.90	7.50	-1.60	8.90	8.75	0.15

Table C-4 Plant: Peavy Tailrace
Downstream (P1)

Date Retrieved	Meter SN	Sonde insitu	Scout Insitu	Difference	Post DO	Expected DO	Difference
6/14/2005	32654	7.62	7.50	0.12	n/a	n/a	n/a
6/30/2005	32656	5.79	6.50	-0.71	7.75	7.71	0.04
7/14/2005	32653	5.48	6.30	-0.72	7.47	7.71	-0.24
7/28/2005	32656	3.86	6.50	-2.64	8.10	8.45	-0.35
8/11/2005	32654	4.91	5.10	0.19	8.79	8.40	0.39
8/25/2005	32655	6.34	7.20	-0.86	7.84	8.19	-0.35
9/8/2005	32654	7.82	7.80	0.02	8.30	8.45	-0.15
9/22/2005	32654	7.09	7.40	-0.31	8.98	8.70	0.28

Table C-5 Plant: Peavy Tainter Gate Channel (P5)

Date Retrieved	Meter SN	Sonde insitu	Scout Insitu	Difference	Post DO	Expected
6/14/2005	32658	7.46	7.8	-0.34	n/a	n/a
6/30/2005	32655	6.38	6.5	-0.12	7.74	
7/14/2005	32654	4.45	5.1	-0.65	7.71	
7/28/2005	32655	5.48	6.3	-0.82	8.42	
8/11/2005	32653	5.59	5.7	-0.11	7.99	
8/25/2005	32656	8.06	8.4	-0.32	8.25	
9/8/2005	32658	7.49	8.1	-0.61	8.31	
9/22/2005	32658	5.77	7.6	-1.93	8.8	

Table C-6 Temp. C Deviation per check	Hydrolab Instruments by Serial Number										
	32652	32653	32654	32655	32656	32657	32658	38652	38653	38654	38655
6/14/2005		-0.3	-0.4				-0.4	-0.5		-0.5	
6/30/2005				n/a	n/a	-0.5			-1		n/a
7/14/2005		-0.3	-0.4				-0.3	-0.5		-0.5	
7/28/2005				-0.6	-0.4	-0.3			-1		-0.6
8/11/2005		-0.5	-0.6				-0.6	-0.6		-0.7	
8/25/2005				-0.6	-0.4	-0.5			-1		
9/8/2005		-0.6	-0.5				-0.5	-0.6		-0.9	-0.6
Average											
Deviation	not used	-0.425	-0.475	-0.6	-0.4	-0.433	-0.45	-0.55	-1	-0.65	-0.6