Yadkin Hydroelectric Project (FERC No. 2197)
Water Quality Issue Advisory Group Meeting
May 4, 2004

Alcoa Conference Center
Badin, North Carolina

Final Meeting Summary

Meeting Agenda

See Attachment 1.

Meeting Attendees

See Attachment 2.

Introductions, Review Agenda

Jane Peeples, Meeting Director, opened the meeting with a welcome and introductions. Jane explained that because the NC Division of Water Quality (NCDWQ) staff were running late, the meeting would begin with a review and discussion of Normandeau's analysis of dissolved oxygen data collected at the Project. The overview of the Yadkin Pee Dee River basin water quality would then follow.

As background, Wendy Bley, Long View Associates, explained that at the last Water Quality IAG meeting (February 3, 2004) Don Kretchmer, Normandeau Associates, presented some preliminary water quality data with a focus on dissolved oxygen and temperatures in the Project tailwaters. At the conclusion of the February 2004 meeting, the IAG asked Yadkin to consider alternatives that could improve dissolved oxygen conditions in the tailwaters and to investigate the alternatives in summer 2004 as part of the Project relicensing. Don Kretchmer was tasked with completing his analysis of the water quality data and evaluating the potential for controlled spills, unit characteristics, changes in reservoir operations, and alternative gate settings to improve dissolved oxygen in the tailwaters.

Review and Discussion of Additional Yadkin Project Dissolved Oxygen Data Analysis

Don Kretchmer said that the objectives of the water quality studies are: to characterize baseline water quality in the Project reservoirs and tailwaters and to evaluate the effects of Project operations on reservoir and tailwtaer water quality (see Attachment 3 – Meeting Presentation). He explained that Normandeau collected monthly profile data at 20 reservoir stations from 1999-2003 and continuous dissolved oxygen and temperature data below Narrows and Falls dams from 2001-2004, below High Rock in 2003-2004 and below Tuckertown in 2003. Normandeau has also completed a series of lateral transects in the tailwaters to confirm the placement of the continuous monitors. Also, in 2001, Normandeau completed a specific test of air injection at Narrows' Unit No. 4. Don said that Normandeau will complete a longitudinal dissolved oxygen

and temperature survey above and below the Project dams in 2004 (this work could not be completed in 2003 because of high river flows).

Review of Continuous Tailwater Data

Don reviewed flow at the Yadkin College gage for the period January 1999 through January 2004 and the minimum daily DO and average daily DO in each of the Project tailwaters (see Attachment 3). He noted several instances when the DO levels in the tailwaters did not meet the minimum daily (4.0 mg/l) or average daily (5.0 mg/l) standards.

Longitudinal Look at Dissolved Oxygen from High Rock through Falls

Next, Don addressed the question, "What is the longitudinal variability of DO and temperature throughout the four reservoir system?" Don explained that since water quality data was collected at all four reservoirs within the same day or within two days, it was hard to see (from the existing data) exactly what happens to a parcel of water as it travels through the Yadkin reservoir system, because of the time of travel. To demonstrate what he meant, Don showed a table of estimated residence times (based on 3,828 cfs inflow – the average inflow 1996-2000). Based on these estimates, Don indicated that under these conditions of flow, it would take water as much as 23 days to move through the four Project reservoirs. Chris Goudreau, NC Wildlife Resources Commission (NCWRC), asked if the residence times were based on total volume storage. Don answered, yes it is assumed that there is no change in storage and that the reservoirs are full.

Gerrit Jobsis, SC Coastal Conservation League and American Rivers, commented that 23 days seems like an awful long time. Larry Jones, High Rock Lake Association, asked if Don had data to support his estimate that it was the velocity of the water in the channel versus water in the coves. Don answered that he did not have with him the details on how the travel time calculation was done. However, he noted that the point of showing the travel times was simply to illustrate that water quality data collected on all four reservoirs on the same day, would not be providing information about the same parcel of water, since it takes a number of days for water to travel through all four reservoirs.

Continuing, Don showed the DO and temperature by river mile from High Rock through Falls for the years 2000 through 2003. He showed how DO drops as water moves through High Rock and then rises slightly in Tuckertown to drop again in Narrows and rise again in Falls. With respect to longitudinal variability, Don concluded that the time of travel through the system makes synoptic data difficult to interpret (i.e. the data does not represent one parcel of water as it moves down through the system, rather it represents different parcels of water because of the retention time). Mark Oden, High Rock Lake Business Owners Group, asked if the water was sampled at the surface. Don said no, the samples were profiles of the water column.

Don suggested that the interaction between each reservoir and tailwater may be a better way to look at upstream/downstream relationships.

Relationship Between Water Level, Reservoir DO, and Tailwater DO at High Rock and Narrows

To address the question, "What is the relationship between water level, reservoir and tailwater DO?", Don reviewed monthly tailrace data for 2001 and 2002 and continuous data for 2003 at High Rock and continuous data for 2001-2003 at Narrows (see DO profiles in Attachment 3). In looking at the High Rock DO profile for 2002, Don noted that the water level, when below the dam's intake gates, corresponded to a bump in DO. He said that lower water levels in High Rock Reservoir seemed to help DO in the tailwater. Don also showed how a pool of low DO water in Narrows Reservoir corresponded to a drop in DO in the tailwater.

Larry Jones asked that Normandeau use consistent units of measure when including these figures in the study report (e.g. reservoir elevations are expressed in USGS datum, meters, and feet). Mark Oden suggested that the figures also include precipitation events.

Don concluded 1) at full pond, during summer, intakes may entrain cooler water with low DO content and 2) at lower water levels, intakes may entrain warmer water with somewhat higher DO content.

Effect of Generating Units on Tailwater DO Concentrations

Continuing, Don addressed the question, "How do generation and air injection into Unit No. 4 affect tailwater DO at Narrows?" Don showed a schematic of the Narrows development (see Attachment 3). He noted that any water spilled through the spillway is beyond the continuous monitor and therefore not correlated to the conditions recorded in the tailwater. Larry Jones asked if there was a problem with the placement of the continuous monitor in the tailwater. Don said no, because there were no spill events during the monitoring period. Larry said that there was a spill in 2003 and suggested that the data might not really represent what happened. Don stated that the continuous monitors had been placed in the tailwaters based on direction from resource agency personnel. Gerrit Jobsis commented that Don had discussed the series of lateral transects taken in the tailwaters to confirm monitor placement and had concluded that the monitors were collecting representative data.

Darlene Kucken, NCDWQ, asked where spill connects back to the river channel. Don responded about a ¼ mile downstream of the dam. Don advised against moving the monitor because it would no longer be representative of what is coming out of the dam. Ben West, US Environmental Protection Agency (USEPA), said that the study was designed to evaluate the effects of generation on DO, so any spill influence would affect the evaluation. Darlene asked how spill is being captured in the water quality monitoring. Wendy Bley said that APGI does not have good data on how spills through the spillway might affect DO.

Don said that APGI had decided to evaluate Narrows because 1) Narrows is the only development equipped with air injection and 2) Narrows is the deepest impoundment and has the greatest DO deficit. A runner test was performed at Narrows in August 2001. Several settings were evaluated. Don summarized the results as:

Status	No air	1 valve	2 valves
No units	6.6-4.6		

Unit No. 4	7.6-2.6	2.5-5.5	5.5-6.0
All units	5.6-3.0		4.7-6.2

Generally, Normandeau concluded that the previous survey did affect the subsequent survey, which helps to explain some of the results. Mark Oden asked which of the settings has the best results. Based on the information in the table above, Don said that the setting which had 2 valves open on Unit No. 4 and all units running resulted in the biggest bump in DO (from 4.7 mg/l to 6.2 mg/l – a 1.5 mg/l bump). For clarification, Don explained that the first DO number was the starting condition and the second number was the ending condition.

Darlene Kucken asked about the typical operating scenario at the Narrows development. Don said that operations probably depend upon availability of water and demand for power. He noted that APGI uses Unit No. 4 to inject air into the water column May through October. He assumed that APGI would always bring Unit No. 4 online first. Wendy Bley agreed. She explained that when APGI upgraded Unit No. 4 it took the opportunity to also install two air injection valves. She noted that Unit No. 4 is the only unit with air injection capability. When asked about air injection's effect on efficiency, Gene Ellis answered that efficiency decreases with air injection.

Gerrit Jobsis observed that the enhancement in DO is extraordinary when all four units are operating (+1.5 mg/l) rather than just Unit No. 4 alone (+0.5 mg/l). Gene Ellis hypothesized that the additional turbulence created by all four of the units being on could enhance the DO. Don said that the water could also be being pulled from higher up in the water column. Gerrit still questioned why the increase is so great when all four units are operating rather than just Unit No. 4 along with air injection. Don said that he did not have a better explanation than what he had already given.

Larry Jones commented that the most accurate way to measure the influence of air injection on DO is to measure DO at the powerhouse. Don replied that measuring DO at the powerhouse might not be physically possible. Don said that based on the lateral transect data, DO levels do not change much from the dam down to the monitor (1 ppm at most). Gerrit asked about DO levels across the lateral transects. He supposed that the water immediately below Unit No. 4 would be of higher quality than the water below the other units. Don Kretchmer said he thought the water was well mixed and consistent across the river channel, but he agreed to take another look at the data.

Darlene said that Don had demonstrated the importance of air injection during generation to meet the state standard. She said a bigger question is whether air injection at Narrows Unit No. 4 is enough or is it necessary for APGI to do more. Darlene suggested that Normandeau look at a scenario in between just Unit No. 4 running and all units running.

Lawrence Dorsey, NCWRC, asked if the discharge from each of the four units is the same. Wendy Bley said that the units are all sized very similarly. She said that the normal efficiency at Unit No. 4 represents ¼ of total operations at Narrows. Wendy noted that the units may have individual characteristics (e.g. different operating efficiency points), which should also be considered.

Chris Goudreau asked if Don was going to make any recommendations for additional investigations. He said that if APGI is not planning to do anything different in the future (e.g. unit upgrades and additional air injection capabilities) any additional investigations may be useless. Wendy said that further evaluation of the issues would be useful as the idea of adding aeration to other units is clearly something that APGI will continue to consider. John Ellis, US Fish and Wildlife Service (USFWS) commented that he was not sure if air injection at the Project developments would be considered a PME (protection, mitigation, enhancement) measure or rather just a cost of doing business to meet the state water quality standards.

John Dorney, NCDWQ, asked if it is possible that the air injection values jam or break. Don said yes. He said that it is also possible that Unit No. 4 could go down for service.

Don showed a graphic representation of the effect of various settings (all units generating, no units generating, and Unit No. 4 aeration) on DO (see Attachment 3). He said that clearly Unit No. 4 increases DO by 1-2 mg/l when it is on. Gerrit Jobsis asked if the DO and temperatures were averaged. Don said yes, hourly averages. Gerrit questioned the spike in DO around May 15, 2003, when Unit No. 4 was not operating. Don explained that there is some air injection between the time when the units are turned on and when they reach full power.

Don made several conclusions:

- When no units are operated, DO decreases significantly
- When one or more units are operated, DO increases
- When Unit No. 4 air valves are open, DO increases 2-3 mg/l
- There is a time lag before operational changes alter water quality in the tailwater and the DO reaches equilibrium
- This time lag can obscure effects of the operational change unless adequate time is allowed to reach equilibrium

Based on all of his data analysis, Don suggested that the following scenarios might be good candidates for further testing at High Rock and Narrows:

- Units running in various combinations and at various power levels
- Multiple units at full power and one or more units at lower power levels with and without air injection
- Run tests longer to allow more equilibrium particularly at low flows.

Chris Goudreau stated that the continuous data showed an enhancement in DO at Narrows of about 2 mg/l when Unit No. 4 is running. He asked if this 2 mg/l enhancement is a constant or a percentage of change through the year. Don said that water temperatures may effect the enhancement. When Chris asked if the surveys were run at maximum or best efficiency, Wendy answered best efficiency. Larry asked what the best efficiency of the units at Narrows is. He thought the best efficiency was about 8,800 cfs. Wendy said that she did not know.

Overview of Yadkin Pee Dee River Basin Water Quality

Dianne Reid, NCDWQ, presented an overview of water quality in the Yadkin Pee Dee River basin. She explained that the survey unit oversees the North Carolina ambient lakes monitoring program, which covers 1,800 lakes of 10 acres or more. She said that ambient monitoring (temperature, dissolved oxygen, Ph, conductivity, secchi depth, biological, chlorophyll a and phytoplankton) is conducted in 160 lakes on a rotating schedule during the months of June, July, and August. She noted that that the survey unit also conducts special sampling for bacteria, toxicants, sediment, and other data necessary to support the TMDL (Total Maximum Daily Load) program.

Dianne showed a map of the ambient monitoring stations at High Rock Reservoir and reviewed historical data collected at these stations (see Attachment 4). She said that High Rock Reservoir is eutrophic, meaning there is an abundance of nutrients present in the reservoir. She estimated that about 69% of the nutrients were from non-point sources of pollution. Randy Benn asked Dianne if she had any sense for the sources of the NPS. She said that development and construction in the basin contribute to the high input of NPS pollution. Dianne said that back in 1973, approximately 90% of the nutrients were from NPS pollution. Gerrit Jobsis commented that while NPS pollution has increased, point sources of pollution have decreased. Debra Owen, NCDWQ, agreed that the current issue is NPS pollution.

Robert Petree questioned the difference between turbidity and secchi depth. Diane explained that both are measurements of water quality, although one is more scientific (turbidity).

When reviewing the total phosphorus data, Gerrit Jobsis asked if there exists a standard for total phosphorus. Dianne answered no, but the DWQ uses 0.05 mg/l as a rule of thumb. Larry Jones commented that phosphorus looks better now than it did years ago. Diane explained that the phosphorus problems can be masked by High Rock's retention time. Dianne said that phosphorus 0.05 mg/l or higher is generally excessive in Piedmont, NC lakes. She said that generally, phosphorus levels tend to decrease from upstream to downstream.

Gerrit Jobsis asked if since 1973 water quality in the basin had worsened, improved, or stayed the same (i.e. is the nutrient loading up or down). Based on the chlorophyll a and turbidity data, Dianne said that there has been an increase in the number of times these standards have been exceeded.

Mark Oden asked why the DWQ does not sample for metals or fecal coliform. Debra Owen responded that he DWQ does collect some metals data. She explained that it is difficult to collect fecal coliform samples because the samples have to be back to the lab within four hours. Also, the DWQ sampling stations are generally along the mainstem rather than closer to the shoreline where people are swimming.

Andy Abramson, Land Trust Central North Carolina, said that one of the goals of the relicensing process is to understand the impacts that the Yadkin Project is having on water quality in the reservoirs. He said that if the NPS pollution is really coming from upstream sources it would be

difficult for Yadkin to unilaterally handle the problem. He asked what could be done. Dianne said that the development of a TMDL is one step that needs to be taken.

John Dorney commented that stream buffers are very important in helping to protect and improve water quality. Larry Jones asked why stream buffers had not been mandated on the Yadkin River as on the Catawba. Darlene Kucken said that there was legislation introduced specific to the Catawba in what was a very political process.

Review and Discussion of State 401 Water Quality Certification Program

Darlene Kucken distributed a handout titled, "Systematic Planning and High Rock Lake TMDLs" (see Attachment 5). Darlene explained that High Rock Reservoir is on North Carolina's 303(d) (impaired waters) list. She said that North Carolina is required to develop a TMDL for High Rock to address the impairment. Darlene explained that 42% of the Yadkin River basin drains to High Rock Reservoir, which presents both challenges and opportunities. She said that the NCDWQ will use the data quality objectives process developed by the US EPA to develop a TMDL for High Rock Reservoir, which is scheduled to begin mid to late 2004. Darlene reviewed the five basic steps of the data quality objectives process: 1) state the problem; 2) identify the decision; 3) identify inputs to the decision; 4) define the study boundaries; and 5) develop a decision rule. Darlene encouraged members of the IAG to participate in the process. She noted that Todd Kennedy, NCDWQ, will lead the process. She warned that the development of a TMDL for High Rock Reservoir may not happen fast. Darlene said that the NCDWQ will begin collecting data in 2004 and begin modeling in 2005-06.

Larry Jones asked if the impaired status of High Rock Reservoir has had any affect on a hog farm expansion planned in Rowan County. Darlene suggested that Larry contact the Yadkin Pee Dee River basin planner (Mr. David Toms).

<u>What is a 401 Water Quality Certification?</u>

Next, John Dorney, NCDWQ, described North Carolina's 401 water quality certification process (see Attachment 6). He explained that Section 401 of the Clean Water Act requires states to issue certifications for federally issued permits or licenses, such as a FERC hydro project license, to ensure that water quality standards are met by the project. He noted that the conditions of the certification are binding on the applicant. The certification can be appealed.

<u>What are the major Issues with respect to FERC Licenses and 401 Certification?</u>

John said that when reviewing an application for a 401 water quality certification for a FERC license, he would focus on the effect of the operation of the dam on water quality standards rather than the physical existence of the dam. John said that reopener clauses are standard in 401 certifications to ensure continued compliance with water quality standards. He noted that modeling, upgrade schedules, and monitoring related to dam operation can be conditions of a 401 water quality certificate.

<u>Which issues will NCDWQ handle in the 401 Certification for the APGI License?</u>

John said that low flow, low dissolved oxygen, and bypass reaches are the issues that will be addressed in the 401 water quality certificate. Other issues such as eutrophication, sedimentation, interbasin transfer of water, and pollutant allocation (TMDL) are not necessarily caused or affected by Project operations and therefore will not be addressed in the 401 water quality certificate.

Larry Jones asked why the water quality in High Rock Reservoir would not be a certification issue. John answered that water quality in the reservoir would be addressed through the development of a TMDL. John said that he did not think that reservoir water quality is directly connected to the operation of the Project dams and therefore, it would not be an issue for the certification.

Gerrit Jobsis commented that the operation of the dam is linked to how the reservoir is managed and if the reservoir is drawn down, there are impacts on water quality. Gerrit asked if lake level maintenance would be addressed in the 401 certificate. John answered probably not. John said that reservoir water quality is affected on a larger scale by uses and activities in the entire watershed. John said that the 401 certificate would be narrowly constrained to what can be related to the operation of the dam (i.e. if water moves through the turbines at the dam, it has to meet state water quality standards).

Mark Oden asked how the NCDWQ would decide whether or not to certify the Yadkin Project. John replied that Yadkin would have to show that the water quality standards are being met at the four Project dams and if not, Yadkin would have to implement measures to meet the standards at the dams. Pete Petree asked if these measures would have to be completed immediately. John said no, Yadkin can propose an implementation schedule. If Yadkin fails to meet the schedule, then the NCDWQ can invoke penalties. Pete asked if a reasonable schedule would be within 5 years or 20 years. John said 20 years would not be reasonable.

Ben West asked if the reopener clause would be used if Yadkin failed to accomplish the objectives of the 401 certificate. John said that the reopener clause hinges on monitoring. If water quality standards are not being met, they NCDWQ will notify Yadkin and the public about what needs to be done. John explained that the primary purpose of the reopener clause is to ensure that water quality standards are met over the long-term and to address any new situations that may come up over the license term.

Gerrit Jobsis stated that the in the Yadkin Pee Dee river system, six dams are up for relicensing with FERC (the four APGI dams and two Progress Energy dams). He said that the operation of these dams, especially the operation of High Rock Dam, affects how the lower dams can be operated and the flows released from those dams. He asked if a 401 certification could be linked to another action. John said that a similar issue came up during the Roanoke Rapids relicensing and a link was not able to be established.

For clarification, Darlene Kucken said that the NCDWQ will issue one water quality certificate for each of the two Projects on the Yadkin Pee Dee River. Given this, Larry Jones asked if the

NCDWQ would only be monitoring water quality below Falls Dam. Gene explained that while Yadkin would receive only one certificate, it would include all four Project dams.

Gerrit Jobsis asked if the 401 certification process could address a situation whereby the licensee allows development around the project reservoirs, which leads to water quality impacts. John said that while what happens on the reservoir shorelines is important, what is happening in the larger watershed is more important.

Ben West asked if the development of the TMDL would be included in the 401 certificate. John said that it could be.

Discussion of Additional Water Quality Study Needs in 2004

Based on Don Kretchmer's earlier presentation of water quality data and his suggestions for possible further investigations of DO at High Rock and Narrows, Wendy Bley said that the IAG could explore 1) further evaluation of Unit No. 4 at Narrows to determine if aeration technology is a viable option and/or 2) further investigation of unit characteristics such as efficiency points. She said that Normandeau had not had an opportunity to talk with Yadkin's operations/engineering staff and suggested that Normandeau do this and then prepare a study outline or draft study plan, which would be distributed to the IAG for review and comment in 3-4 weeks.

Darlene Kucken asked if Yadkin would prepare a summary of the decision-making process that led to the determination of need for unit upgrades at the Yadkin Project, as originally proposed (i.e. are unit upgrades standard operating procedure or were there specific reasons for the upgrades). Wendy said that Yadkin could, based on the record, prepare a chronology of the decision-making process. Wendy explained that the decision to upgrade units at the Project was 1) a maintenance requirement and 2) an economic decision. She said that it was a business decision to upgrade Unit No. 4 and to add the air injection as it was upgraded. Wendy said that APGI, Yadkin is in a different place right now and the economics of the upgrades are being reevaluated. She said that Yadkin understands the need to improve DO below the Project dams. Gene Ellis added that the decision to upgrade a unit is a complicated one, because each unit is a multi-million dollar investment. He said that internally, a number of criteria must be met and Alcoa's Board of Directors must approve projects of this size. Gene said that he was hopeful that APGI, Yadkin would have an opportunity to make a presentation to the Board later this year.

Ben West said that requirement to get a 401 water quality certification should factor heavily in the context of the business decision to pursue unit upgrades. Gene agreed and said that a critical factor in the decision to pursue the upgrades is the DO issue.

Gerrit Jobsis asked if Yadkin would propose the unit upgrades with aeration technology or just the aeration technology. Gene said that APGI was evaluating both scenarios.

The meeting adjourned at about 12:15 p.m.

Attachment 1 – Meeting Agenda Yadkin Project
(FERC No. 2197)
Communications Enhanced Three-Stage Relicensing Process

Water Quality Issue Advisory Group Meeting

Tuesday, May 4, 2004
Alcoa Conference Center
Badin, North Carolina

9:00 AM – 12:30 PM

Preliminary Agenda

1. Introductions, Review Agenda

2. Overview of Yadkin-Pee Dee River Basin Water Quality (NCDWQ staff)

3. Review and Discussion of State 401 Water Quality Certification Program (John Dorney, NCDENR)

4. Review and Discussion of Additional Yadkin Project Dissolved Oxygen Data Analysis (Don Kretchmer, NAI)

5. Discussion of Additional Water Quality Study Needs in 2004 (IAG)

6. Schedule and Agenda for Next Meeting

Attachment 2 – Meeting Attendees

Name	Organization
Andy Abramson	Land Trust Central NC
Ben West	US Environmental Protection Agency
Chris Goudreau	NC Wildlife Resources Commission
Coralyn Benhart	Alcoa
Darlene Kucken	NC Division of Water Quality
Dean Vick	Concerned Property Owners High Rock Lake
Debra Owen	NC Division of Water Quality
Dianne Reid	NC Division of Water Quality
Don Kretchmer	Normandeau Associates
Donley Hill	US Forest Service
Gene Ellis	APGI, Yadkin Division
Gerrit Jobsis	SC Coastal Conservation League and American Rivers
Gifford DelGrande	Yadkin Pee Dee Lakes Project
Jane Peeples	Meeting Director
Jody Cason	Long View Associates
John Dorney	NC Division of Water Quality
John Ellis	US Fish and Wildlife Service
John Vest	Salisbury-Rowan Utilities
Larry Jones	High Rock Lake Association
Lee Hinson	Concerned Property Owners High Rock Lake
Mark Oden	High Rock Business Owners Group
Max Walser	Davidson County
Randy Benn	Yadkin Counsel
Randy Tinsley	City of Salisbury
Ray Johns	US Forest Service
Raymond Allen	City of Albemarle
Rick Simmons	Normandeau Associates
Robert Petree	SaveHighRockLake.org
Roy Rowe	Piedmont Boat Club
Ryan Heise	NC Wildlife Resources Commission
Steve Padula	Long View Associates
Todd Ewing	NC Wildlife Resources Commission
Wendy Bley	Long View Associates

Attachment 3 – Normandeau Associates' Presentation

Yadkin Project
Reservoir and Tailwater Temperature/Dissolved Oxygen Monitoring 1999-2003

May 4, 2004

Normandeau Associates

Water Quality Study Objectives

- Characterize baseline water quality in reservoirs and tailwaters
- Evaluate effects of project operations on reservoir water quality
- Evaluate effects of project operations on tailwater water quality

Temperature/Dissolved Oxygen Data

- Continuous monitoring of dissolved oxygen and temperature below Falls and Narrows from 2001 through 2004
- Continuous monitoring of dissolved oxygen and temperature below Tuckertown in 2003. High Rock 2003-2004
- Monthly profile data at 20 stations, 1999-2003
- Series of lateral transects in tailraces to confirm monitor placement
- Specific test of Air injection at Unit 4 – Narrows - 2001
- Lateral DO/temp survey above & below dams, 2004

Today's Discussion

- Quick review of continuous tailwater data
- Longitudonal look at DO from High Rock through Falls
- Relationship between water level, reservoir DO and tailwater DO at High Rock and Narrows
- Effect of generating units on tailwater dissolved oxygen concentrations.
- Recommendations for testing

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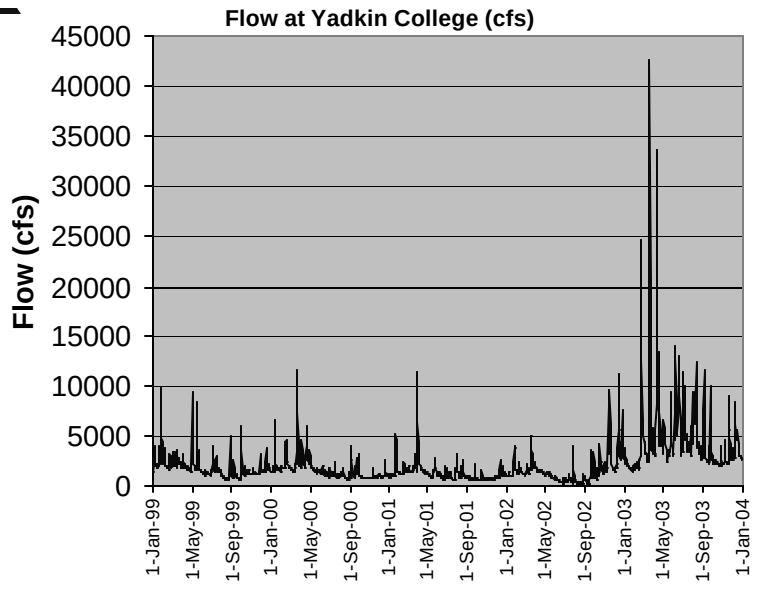
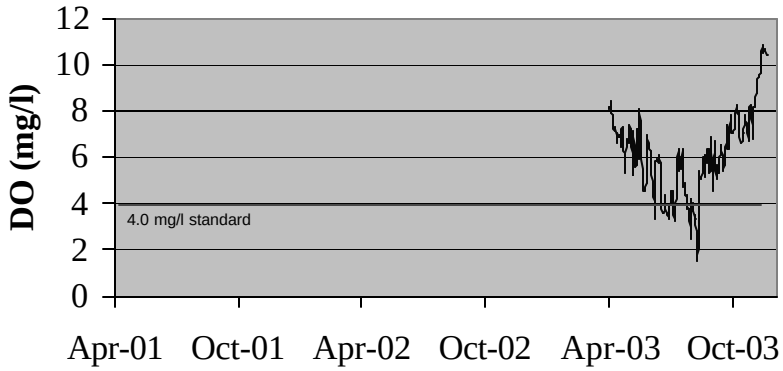
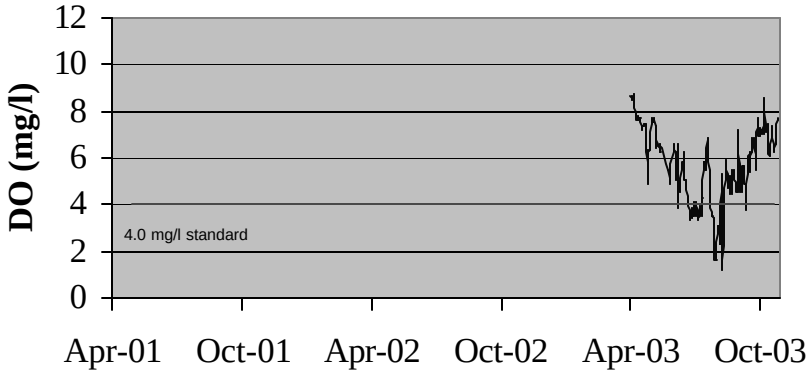


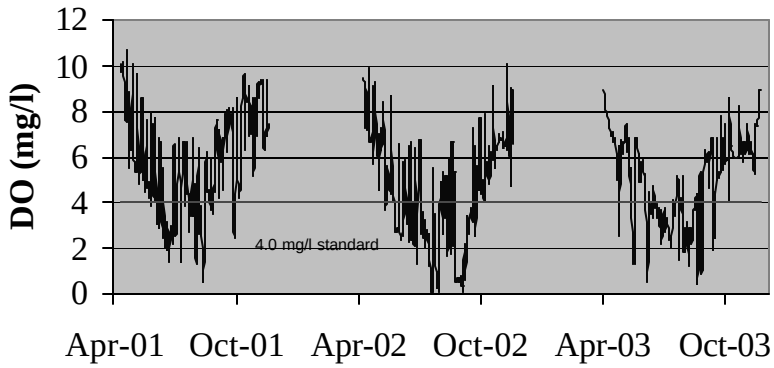
High Rock Tailwater
Minimum Daily DO



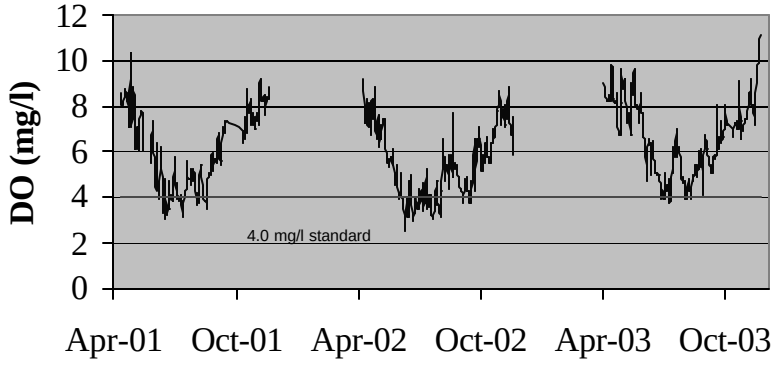
Tuckertown Tailwater
Minimum Daily DO



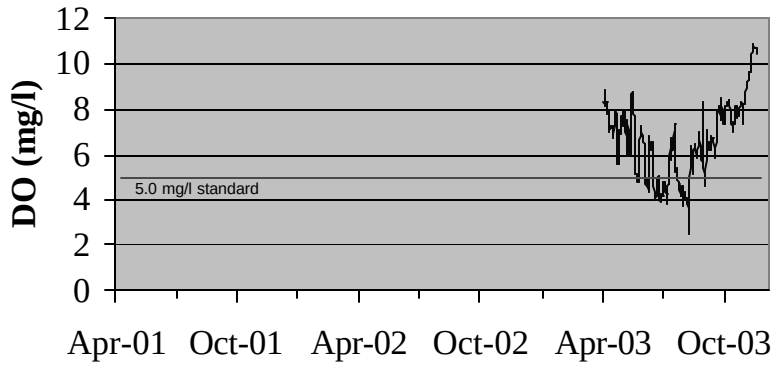
Narrows Tailwater
Minimum Daily DO



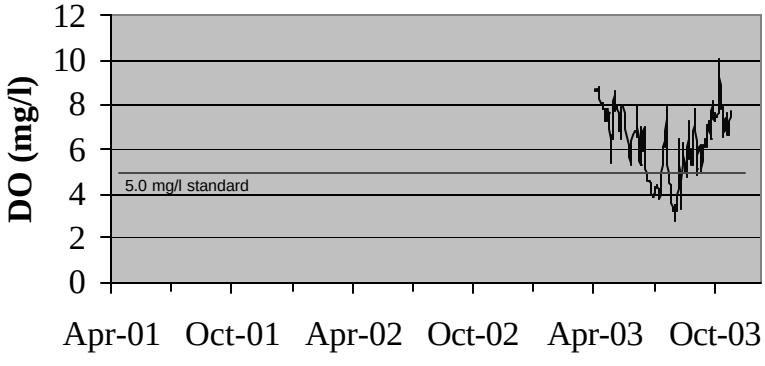
Falls Tailwater
Minimum Daily DO



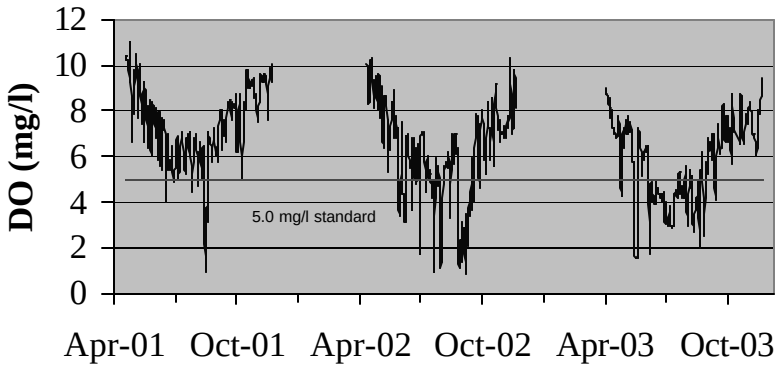
High Rock Tailwater
Daily Average DO



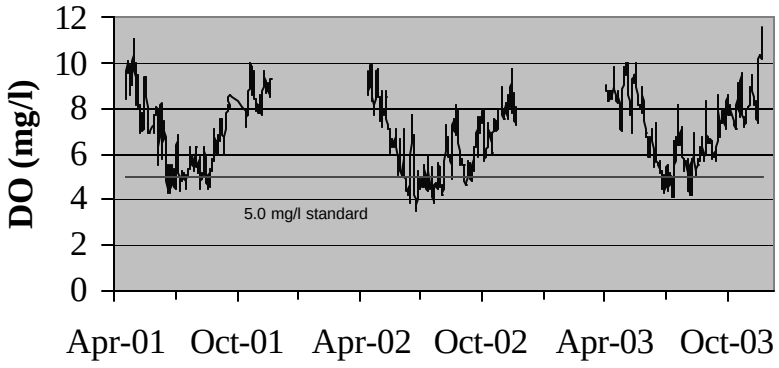
Tuckertown Tailwater
Daily Average DO



Narrows Tailwater
Daily Average DO



Falls Tailwater
Daily Average DO



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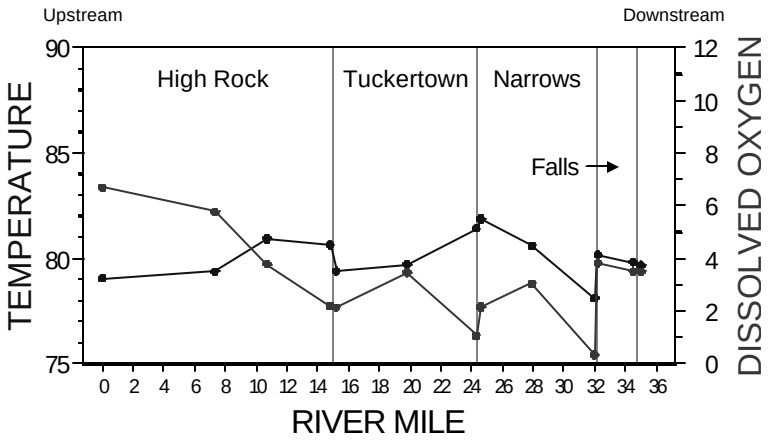
- Effect of generating units on tailwater dissolved oxygen concentrations
- Recommendations for testing

What is the longitudinal variability of dissolved oxygen and temperature throughout the four reservoir system?

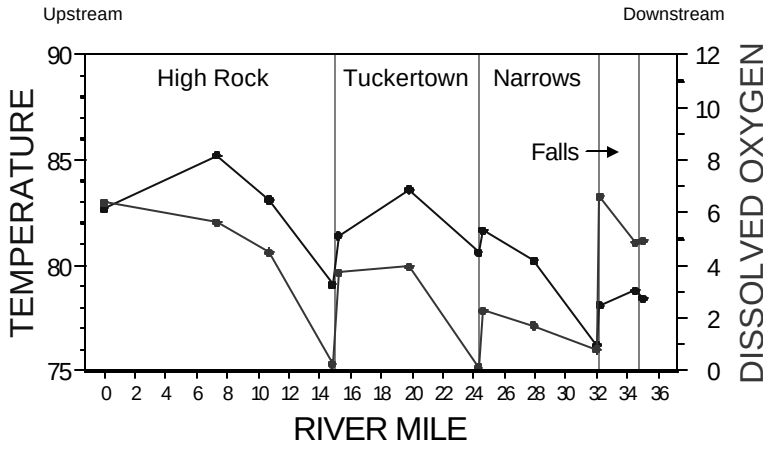
Based on 3828 cfs inflow (ave 1996-2000)

Reservoir	Operating Range (ft, Yadkin)	Operating Storage (ac-ft)	Residence Time
High Rock	**655' - 642'**	**150,459**	**19.8 days**
Tuckertown	**596' - 593'**	**6,910**	**21.8 hours**
Narrows	**541.1' - 528.1'**	**15,842**	**2.1 days**
Falls	**364' - 361'**	**525**	**1.7 hours**

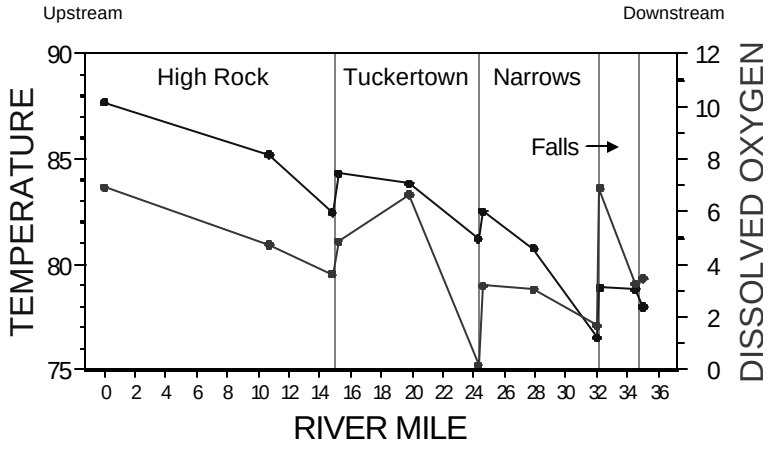
August 21-22, 2000
Temperature (°F) and DO (mg/L) by River Mile



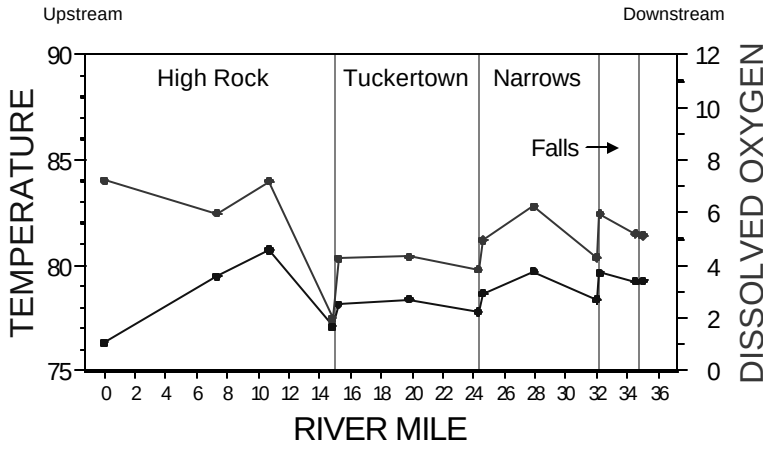
August 14-15, 2001
Temperature (°F) and DO (mg/L) by River Mile



August 20-21, 2002
Temperature (°F) and DO (mg/L) by River Mile



August 19-20, 2003
Temperature (°F) and DO (mg/L) by River Mile



Longitudinal Variability

- Time of travel through system makes synoptic data difficult to interpret.
- The interaction between each reservoir and tailwater may be a better way to look at upstream/downstream relationships.

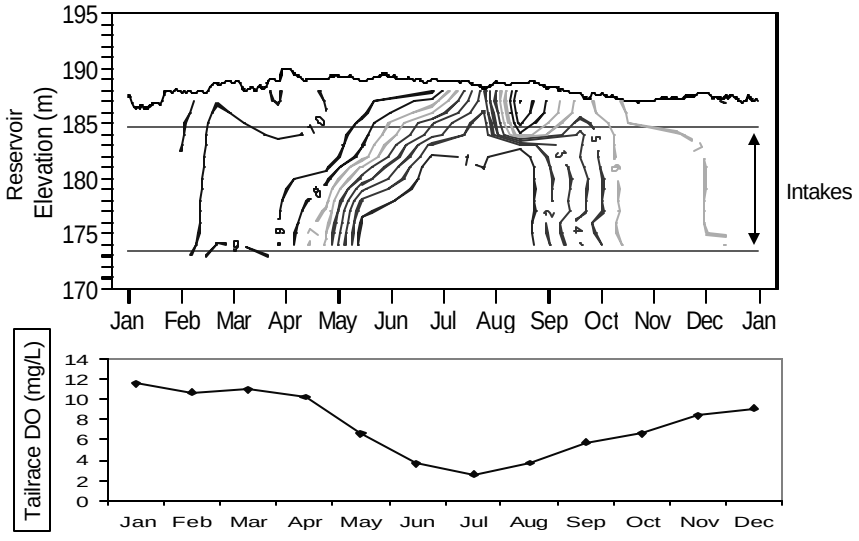
Today's Discussion

- Quick review of continuous tailwater data
- Longitudonal look at DO from High Rock through Falls
- Relationship between water level, reservoir DO and tailwater DO at High Rock and Narrows
- Effect of generating units on tailwater dissolved oxygen concentrations
- Recommendations for testing

Question: What is the relationship between water level, reservoir and tailwater dissolved oxygen?

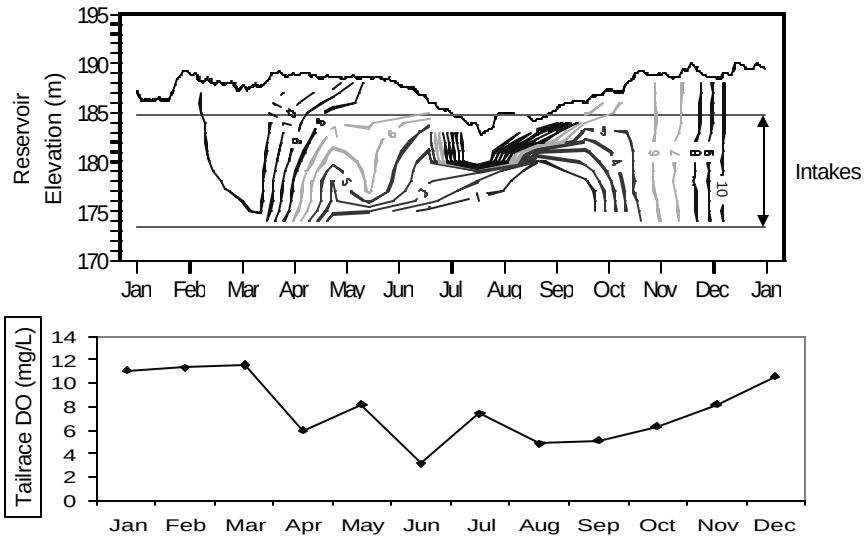
- High Rock monthly tailrace data for 2001 and 2002, continuous data for 2003
- Narrows, continuous data for 2001, 2002 and 2003.

High Rock – Dissolved Oxygen in 2001



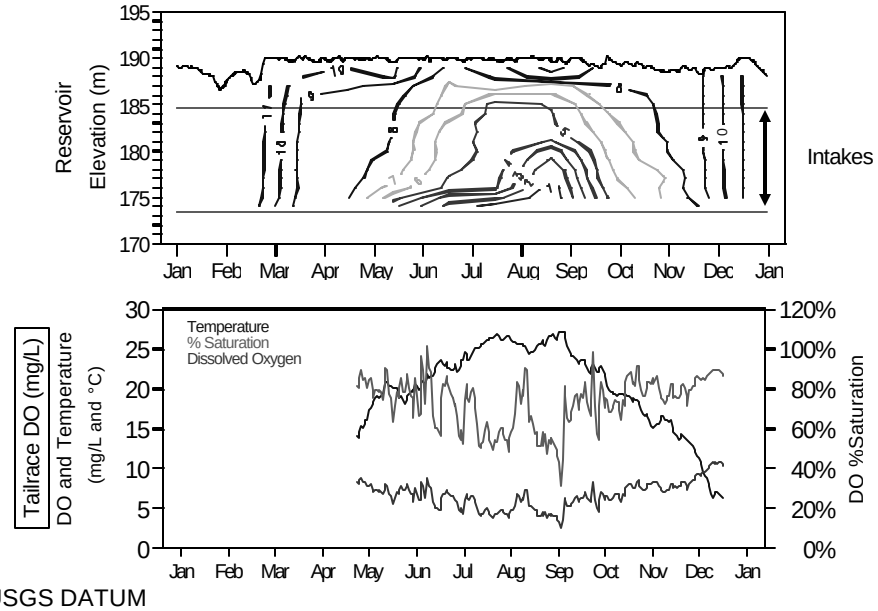
USGS DATUM

High Rock – Dissolved Oxygen in 2002



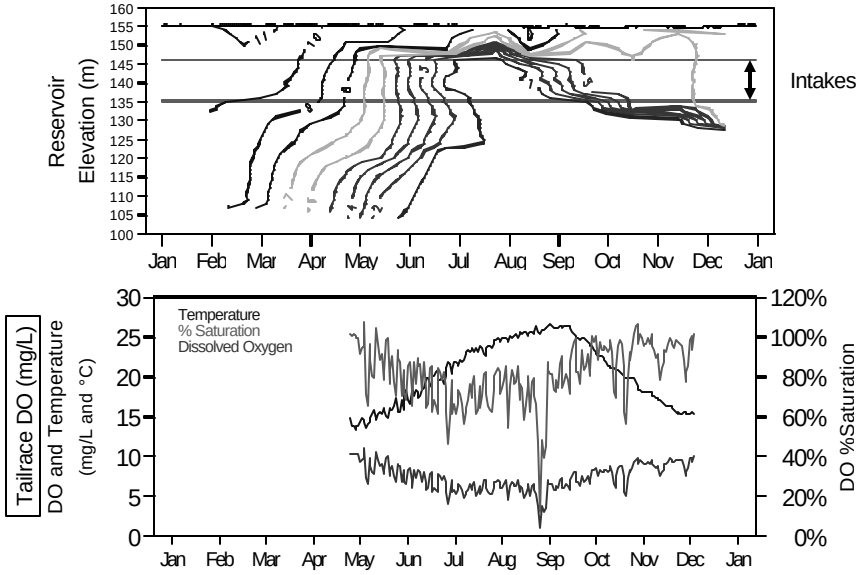
USGS DATUM

High Rock – Dissolved Oxygen in 2003



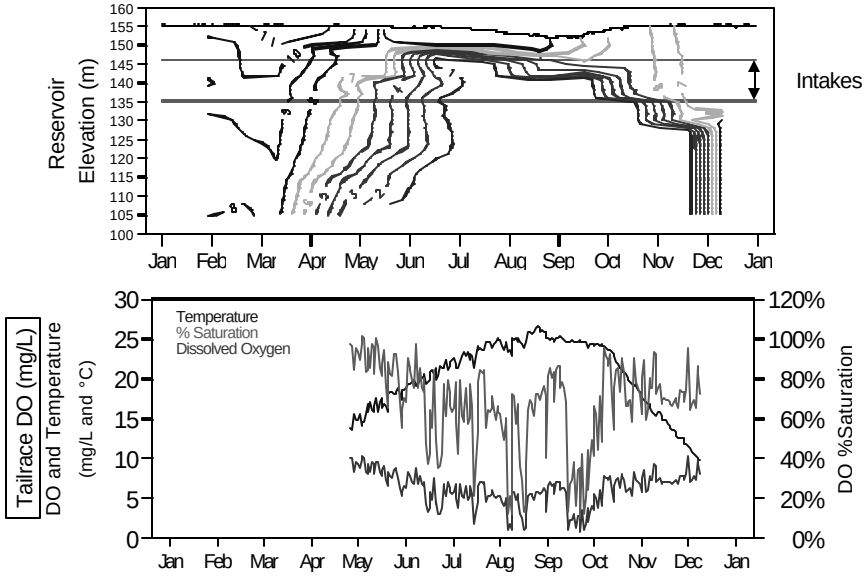
USGS DATUM

Narrows – Dissolved Oxygen in 2001



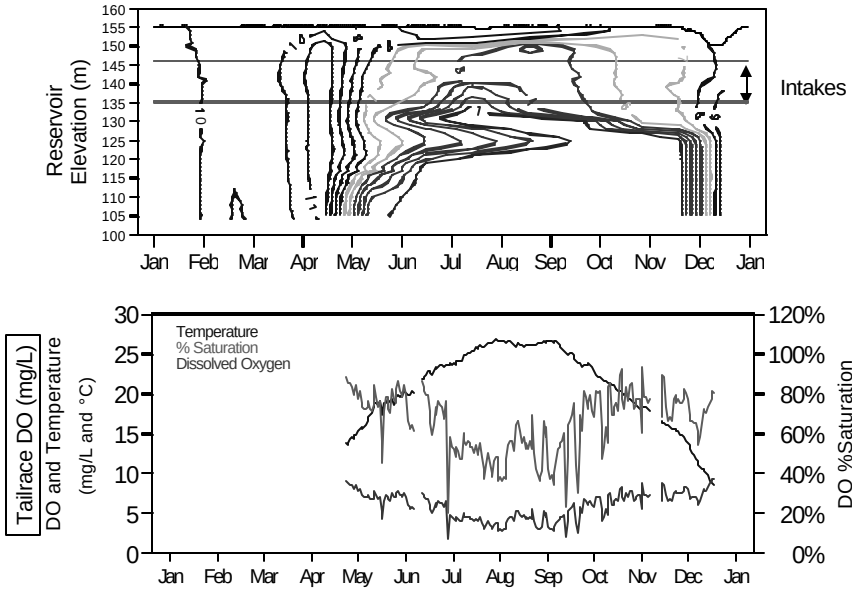
USGS DATUM

Narrows – Dissolved Oxygen in 2002



USGS DATUM

Narrows – Dissolved Oxygen in 2003



USGS DATUM

Relationship between reservoirs and tailraces

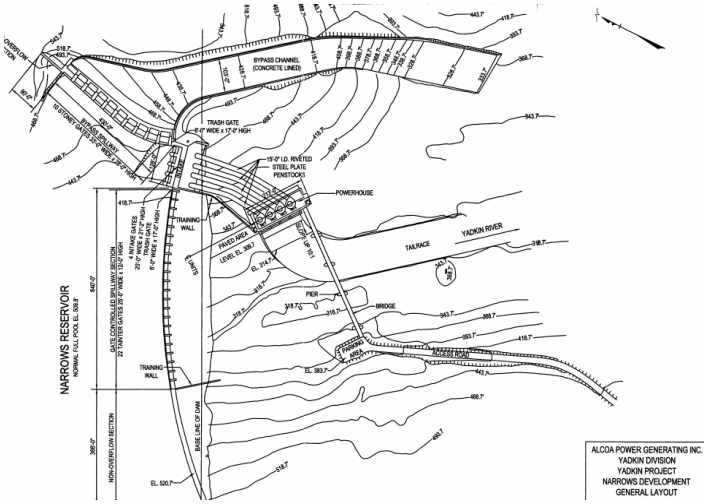
- At full pond, during summer, intakes may entrain cooler water with low dissolved oxygen content
- At lower water levels, intakes may entrain warmer water with somewhat higher dissolved oxygen content

Today's Discussion

- Quick review of continuous tailwater data
- Longitudinal look at DO from High Rock through Falls
- Relationship between water level, reservoir DO and tailwater DO at High Rock and Narrows
- Effect of generating units on tailwater dissolved oxygen concentrations
- Recommendations for testing

Question: How do generation and air injection into Unit 4 affect tailwater dissolved oxygen at Narrows?

Narrows Project



Why evaluate Narrows?

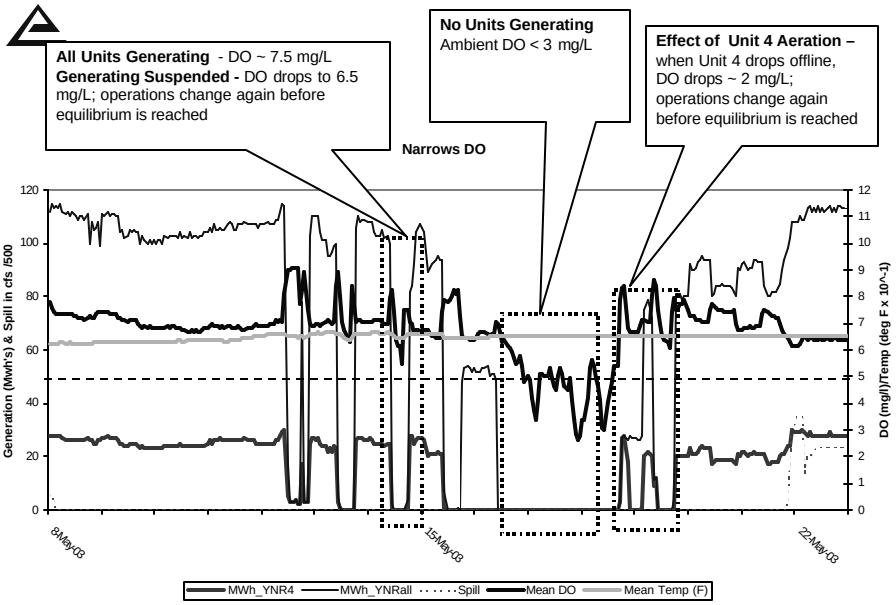
- Air injection only at Narrows
- Narrows is deepest impoundment and has the greatest dissolved oxygen deficit

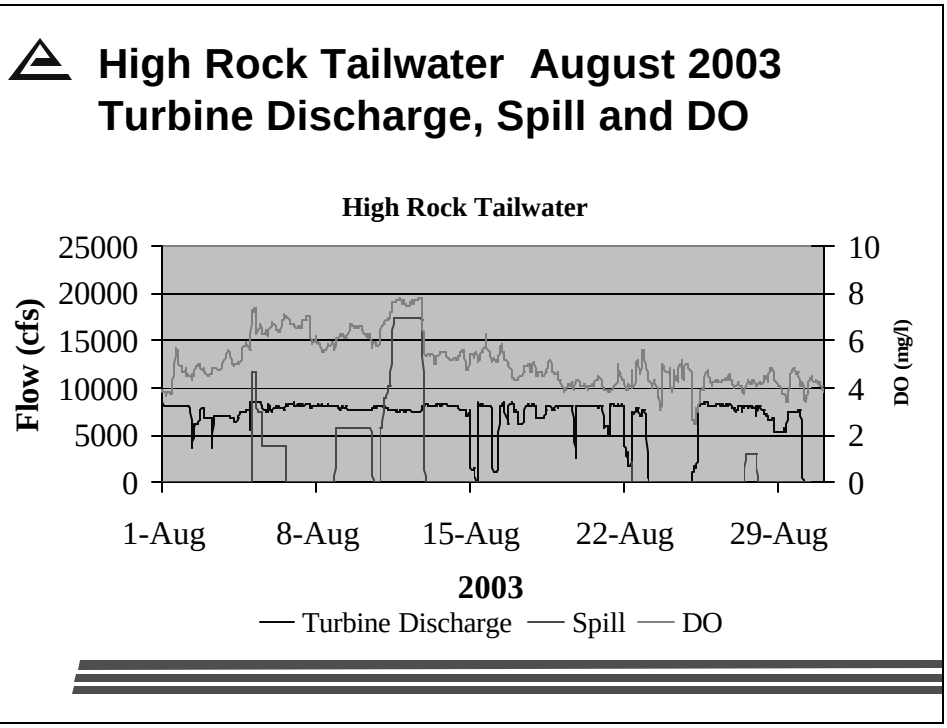
Schedule of Runner Test at Narrows, August 2001

- Survey 1 – Unit 4 no aeration
- Survey 2 – Unit 4 one valve open
- Survey 3 – Unit 4 two valves open
- Survey 4 – no units running
- Survey 5 – All units running, no aeration
- Two units running
- Survey 6 - Flow through all units no gen, no air
- All units running
- Survey 7 - All units running, two valves open

Runner Test results 2001, DO (mg/l) (change from previous setting in brackets)

Status	No air	1 valve	2 valves
No units	6.6-4.6		
Unit 4	7.6-2.6	2.5-5.5	5.5-6.0
All units	5.6-3.0		4.7-6.2


All Units Generating - DO ~ 7.5 mg/L
Generating Suspended - DO drops to 6.5 mg/L; operations change again before equilibrium is reached
No Units Generating
Ambient DO < 3 mg/L
Effect of Unit 4 Aeration – when Unit 4 drops offline, DO drops ~ 2 mg/L; operations change again before equilibrium is reached
Narrows DO
Generation (Mwh's) & Spill in cfs /500
DO (mg/l)/Temp (deg F x 10^-1)
8May-03
15May-03
22May-03
MWh_YNR4
MWh_YNRall
Spill
Mean DO
Mean Temp (F)


High Rock Tailwater August 2003
Turbine Discharge, Spill and DO
High Rock Tailwater
Flow (cfs)
DO (mg/l)
1-Aug
8-Aug
15-Aug
22-Aug
29-Aug
2003
Turbine Discharge
Spill
DO

Operation Analysis Conclusions

- **When no units are operated, DO decreases significantly**
- **When one or more units are operated, DO increases**
- **When Unit 4 air valves are open, DO increases 2-3 mg/l**
- **There is a time lag before operational changes alter water quality in the tailrace and the DO reaches equilibrium**
- **This time lag can obscure effects of the operational change unless adequate time is allowed to reach equilibrium**

Today's Discussion

- Quick review of continuous tailwater data
- Longitudinal look at DO from High Rock through Falls
- Relationship between water level, reservoir DO and tailwater DO at High Rock and Narrows
- Effect of generating units on tailwater dissolved oxygen concentrations
- Recommendations for testing

Candidate scenarios for further testing at Narrows and High Rock

- Units running in various combinations and at various power levels
- Multiple units at full power and one or more units at lower power levels with and without air injection
- Run tests longer to allow more equilibration particularly at low flows

Attachment 4 – NCDWQ Presentation

(Currently Not Available – Will be Attached to Final Meeting Summary)

Attachment 5 - “Systematic Planning and High Rock Lake TMDLs”

Systematic Planning and High Rock Lake TMDLs

NC Division of Water Quality

Section 303(d) of the federal Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. High Rock Lake has been placed on the 303(d) list of impaired waters in North Carolina (Draft 2004 Integrated Report). The upper portion is impaired for chlorophyll *a* (i.e., algal blooms), low dissolved oxygen, and turbidity. The lower portion is impaired for turbidity.

Water bodies designated as impaired require the development of total maximum daily loads (TMDL) approved by the EPA. A TMDL is a written, quantitative plan for attaining and maintaining water quality standards for a specific waterbody and pollutant. The TMDL plan for High Rock Lake will identify reduction goals for the pollutants causing impairment.

The TMDL must relate the pollutant sources to water quality targets, the applicable water quality standards. The resulting cause-and-effect relationships are then used to establish the capacity of the water body to assimilate loads in order to establish the maximum allowable pollutant load. Loading or assimilative capacity reflects the maximum amount of a pollutant that may be delivered to the water body and still achieve water quality standards.

Typically, predictive water quality models are used to develop the linkages between pollutant sources and water quality targets. Models are simplified representations of environmental processes, often in mathematical terms, used to understand natural systems and to predict the impact of management alternatives.

The Division of Water Quality plans to use a systematic planning framework described by the Data Quality Objectives (DQO) process to initiate TMDL development for High Rock Lake (scheduled to begin mid to late 2004). The DQO process will be used to guide scientific data collection and model development to ensure that the level of detail in planning is commensurate with the importance and intended use of the work to be performed and available resources.

DATA QUALITY OBJECTIVES (DQO) PROCESS

The DQO process helps to answer the following basic questions:

- Why do we need the data?
- What must the data represent?
- How will we use the data?
- How much uncertainty is acceptable?

The goal is to ensure that the data collected or generated by models for decision making are of the right type, quantity, and quality. The planning process will help identify the technical goals and data requirements (both existing and newly collected) of the modeling project as well as approximate costs and a schedule. In addition, the DQO process

- Ensures that limited resources are spent on collecting only those data that will support defensible decisions.

- Fosters communication among all participants and directs efforts to achieving consensus between decision makers, stakeholders, and regulators.
- Provides an effective structure to document activities and decisions, and to communicate the data collection design and modeling approach to others.
- Makes Quality Assurance Project Plans (QAPPs) easier to prepare and more technically focused on issues that have the greatest impact on decisions.

The DQO process as it applies to TMDL projects consists of 5 basic steps:

1. State the problem
2. Identify the decision
3. Identify inputs to the decision
4. Define the study boundaries
5. Develop a decision rule

STEP 1 defines the problem that initiated the study. This step allows the decision-making team to recognize multiple facets of the problem and consider the perspectives of key stakeholders to ensure all issues are addressed properly and adequately.

STEP 2 defines the decision statement or problem that the study will attempt to resolve.

STEP 3 identifies the different types of information needed to resolve the problem.

STEP 4 defines the spatial and temporal boundaries of the problem.

STEP 5 summarizes the attributes of the problem and how the information collected will guide decision makers to choose a course of action to solve the problem.

For more information, consult EPA's *Guidance for the Data Quality Objectives Process* (QA/G-4) and *Guidance for Quality Assurance Project Plans for Modeling* (QA/G-5M) at http://www.epa.gov/quality.

CONTACT INFORMATION:

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http://h2o.enr.state.nc.us/tmdl/

Attachment 6 – May 3, 2004 Memo from John Dorney RE: 401 Water Quality Certification Issues

Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P. E. Director
Division of Water Quality
Coleen H. Sullins, Deputy Director
Division of Water Quality

May 3, 2004

MEMO

TO: Water Quality Issue Advisory Group
FERC permit for Yadkin Project (FERC No. 2197)

FROM: John Dorney

RE: 401 Water Quality Certification Issues: A Summary

Various generic questions have been raised concerning the 401 Certification process and FERC relicensing. The following summary describes the major water quality-related issues for FERC licenses and how they relate to the 401 Water Quality Certification process in NC.

What is a 401 Water Quality Certification?

Section 401 of the Clean Water Act requires states to issue certifications for federally permits and licenses in order to ensure that water quality standards are met by the project. Most 401 Certifications are issued by the NC Division of Water Quality for Section 404 Permits from the US Army Corps of Engineers (wetland fill permits). However, FERC licenses also require 401 Certifications. The review of projects for 401 Certification is outlined in 15A NCAC 2H .0500.

Like all state actions, the 401 Certification can be appealed through the NC Office of Administrative Hearings and the state court system. The conditions of the Certification are binding on the applicant and enforcement can be either through the FERC Permit or done separately by the Division of Water Quality as part of our standard compliance/enforcement process.

What are the major issues with respect to FERC Permits and 401 Certification?

In North Carolina, the Division of Water Quality will focus on the effect of the **operation** of the dam on water quality standards rather than the **physical existence** of the dam when reviewing applications for 401 Certifications for FERC licenses. Other water quality issues may need to be addressed in the overall settlement agreement if they are not appropriate to address in the 401 Certification. Reopener clauses are standard in 401 Certifications in order to ensure continued compliance. Modeling, upgrade schedules and monitoring can also be conditions of 401 Certifications for FERC permits when they relate to dam operation.

Which issues will DWQ handle in the 401 Certification for the APGI permit?

The following are several major water quality-related issues that have been raised for this project. The 401 Certification will address the first two issues. Any other water quality-related issues can be addressed in the settlement process.

1. Low flow and bypass reaches
2. Low dissolved oxygen
3. Eutrophication in High Rock Lake
4. Sedimentation in High Rock Lake
5. Interbasin transfer of water
6. Pollutant (Total Maximum Daily Load – TMDL) allocation for High Rock Lake

I can be reached at 919-733-9646 if you have any questions.