

**Action:** Temperature and Dissolved Oxygen Survey **Prerequisite Actions:** N/A

**Action Description:**

Monitor and characterize the water temperature and dissolved oxygen upstream, in the tail-race, downstream and in applicable bypasses.

**Applicable Hydro Projects/Developments:**

Nantahala (2692), Thorpe (Glennville-2686), Tuckasegee (Little Glennville-2686), Cedar Cliff (2698), Tennessee Creek (2698), and Wolf Creek (2698), Bryson (2601), Dillsboro (2602), Franklin (2603), and Mission (2619).

**I. Objective**

Characterize the water temperature and dissolved oxygen regimes upstream of the impoundment, in the immediate tailwater, downstream of the impoundment, and in applicable bypasses.

**II. Basis**

Even though the North Carolina Division of Water Quality has reported that the water quality in the Nantahala, Little Tennessee, and Tuckasegee Rivers has supported the designated use of the water body, the measurement of water quality is a portion of the basic information requirement of 18CFR4.51 and 18CFR4.61. Pursuant to obtaining a FERC license, a 401 certification (maintenance of water quality standards associated with project) is necessary for the project(s). Temperature and dissolved oxygen are the primary water quality parameters used to assess the habitability and suitability for many aquatic organisms.

**III. Geographic and Temporal Scope**

Historical data (collected by NC DENR and Fish and Wildlife Associates, Inc.) will be used to characterize the distribution and variability of temperature and dissolved oxygen within the various impoundments.

Temperature and dissolved oxygen measurements for the East Fork, West Fork, Dillsboro, and Bryson projects will extend from the Tuckasegee powerhouse on the West Fork River and the Cedar Cliff powerhouse on the East Fork River beyond the Dillsboro project to just upstream of the headwaters of Fontana Lake. Temperature measurements will also be conducted in the Wolf Creek and Bonas Defeat bypasses on the East Fork Tuckasegee River and the Thorpe bypass on the West Fork Tuckasegee River.

Temperature measurements associated with the Nantahala project will be made in the Nantahala bypass and will extend downstream of the Nantahala powerhouse to the headwaters of Fontana Lake. Dissolved oxygen will be measured periodically (May – November) in the powerhouse discharge.

Temperature measurements associated with the Franklin project will be taken in the Little Tennessee River and the Cullasaja Rivers immediately upstream of the project and in the Little Tennessee River immediately downstream of Lake Emory Dam. Dissolved oxygen will be monitored in the Little Tennessee River immediately downstream of the Franklin powerhouse.

Temperature measurements will be taken from spring 2001 until spring 2002, while dissolved oxygen measurements will be taken during the summer / fall 2001.

Temperature and dissolved oxygen measurements in the Hiwassee River will be collected upstream and downstream of the Mission Project during the summer / fall 2001. The temperature and dissolved oxygen measurements will be used to calibrate the water quality portion of the tail-water mathematical model used by TVA to assess Chatuge downstream releases.

#### **IV. Approach and Analysis**

Recording thermistors (StowAway®Tidbit®, Onset Computer Corp.) will be programmed to record temperature at 15-minute intervals (corresponding with USGS flow measurements). The Tidbits will be deployed as early as practical in the spring of 2001. The temperature recordings will be taken for a period of one year at the various locations.

Dissolved oxygen measurements (as well as conductivity, temperature, depth, and pH) in the Tuckasegee and Little Tennessee Rivers will be collected with programmable Hydrolab Data-Sondes®. The DataSondes will be placed in the rivers for a 4-day period in August, 2001, and a 4-day period in September, 2001. The Hydrolabs will be programmed to record data at 5 minute intervals during these tests. These tests will be conducted during periods of low flow (minimum rainfall) and normal project operation during low flow conditions.

The same equipment and techniques will be employed to measure water quality in the Hiwassee River above and below the Mission project. However, the timing and exact locations of the Hydrolab deployments will be a function of the conditions required by the mathematical model employed by TVA.

Spot checks of dissolved oxygen measurements (as well as conductivity, temperature, and pH) will be made monthly (May – November) in the Nantahala and Franklin powerhouse discharges. These measurements will be made while the projects are generating power.

Even though the North Carolina Certified Laboratory Procedures only require calibration of Hydrolabs according to the manufacturer's recommendation, additional quality control procedures designed to measure the accuracy and precision of the instruments will be employed prior to and after the river deployments. Additionally, the temperature loggers will be placed in a controlled temperature bath prior to and after river deployments for the determination of accuracy and precision.

The water quality sampling locations (and comparison with zone of peaking influence study) are presented in the following table. In addition, the locations for the measurement of temperature and dissolved oxygen correspond to the appropriate locations used for fish and macroinvertebrate surveys. The recording devices that will be placed immediately downstream of a project will be placed in the channel that receives the water discharged through the turbines (indicated by an asterisk in the following table).

**Water Quality Sampling Locations and Comparison with Zone of Peaking  
Influence Study**

River System		Water Quality		Zone of Peaking
Project	Location Description	River Mile	Parameter(s)	Influence
<b>Hiwassee River</b>				
<b>Mission</b>	2 locations upstream, 2 locations downstream of Mission dam*	-	Temp / DO	N/A
<b>Little Tennessee River</b>				
<b>Franklin</b>	Little Tennessee River immediately downstream of Franklin Dam	113.0	Temp / DO	N/A
	Little Tennessee River Immediately upstream of confluence with Cullasaja River	117.6	Temp	N/A
	Cullasaja River, upstream of Porter Cove	1.2	Temp	N/A
<b>Nantahala River</b>				
<b>Nantahala</b>	Nantahala Bypass, immediately upstream of confluence with Dicks Creek	-	Temp	N/A
	Nantahala Bypass, immediately upstream of confluence with White Oak Creek	-	Temp	N/A
	White Oak Creek, immediately upstream of confluence with Nantahala Bypass	-	Temp	N/A
	Nantahala Bypass, immediately upstream of powerhouse	14.5	Temp	N/A
	Nantahala River, powerhouse Discharge*	13.6	Temp / DO	N/A
	Nantahala River, upstream of Queens Creek and Winding Stair Rd.	12.2	Temp	Level Logger
	Nantahala River, at USGS gauge	10.7	N/A	Level Logger

	Nantahala River, downstream of Blowing Spring	8.0	N/A	Level Logger
	Nantahala River, upstream of NPDES Discharge in Vicinity of NOC	5.2	Temp	Level Logger
<hr/>				
<b>East Fork Tuckasegee River</b>				
<b>Tennessee Creek</b>	Bonas Defeat Bypass Immediately upstream of powerhouse	-	Temp	N/A
	Wolf Creek Bypass Immediately upstream of powerhouse	-	Temp	N/A
<b>Cedar Cliff</b>	Immediately downstream of Powerhouse*, upstream of confluence with West Fork	50.2	Temp / DO	N/A
<hr/>				
<b>West Fork Tuckasegee River</b>				
<b>Thorpe</b>	West Fork Bypass, immediately upstream of powerhouse	3.8	Temp	N/A
<b>Tuckasegee</b>	West Fork River, immediately downstream of powerhouse*	1.1	Temp / DO	N/A
<hr/>				
<b>Tuckasegee River</b>				
	Tuckasegee River, immediately upstream of Caney Fork	47.1	Temp / DO	Level Logger
<b>Dillsboro</b>	Tuckasegee River, above Sylva waste treatment plant	36.2	Temp / DO	Level Logger
	Tuckasegee River, immediately below Dillsboro Dam*, upstream of Scots Creek and USGS gauge	31.7	Temp / DO	Level Logger
	Tuckasegee River, immediately upstream of Barkers Creek	27.4	N/A	Level Logger
	Tuckasegee River, immediately upstream of Camp Creek and downstream of Bumgarner Branch	23.0	N/A	Level Logger
<b>Bryson</b>	Tuckasegee River, immediately upstream of confluence with Oconaluftee River	18.7	Temp / DO	Level Logger
	Oconaluftee River, upstream of Bryson Dam at USGS gauge	3.2	Temp / DO	N/A
	Oconaluftee River, immediately downstream of Bryson Dam*	0.3	Temp / DO	N/A

Tuckasegee River, downstream of  
Ferguson Fields, at USGS gauge in  
Bryson City

12.7

Temp / DO

Level Logger

## V. Schedules and Required Conditions

The field measurements for temperature will begin as early as possible in 2001 to enable a one-year period of data collection. Dissolved oxygen measurements will be conducted during August and September, 2001, under periods of low flow (to be determined by DPC Hydro Central). Prior to the deployment of the instruments, field reconnaissance visits to the various locations will take place to select the proper specific placement of the temperature loggers. Considerations for specific placement include recordings under lowest flow conditions, vandalism, and safety.

Data from the continuous recording devices will be analyzed and reported prior December, 2002. Study plans will incorporate mutually agreed upon consultant services, as necessary, under the direction and oversight of NPL project managers.

## VI. Results

Temperature and dissolved oxygen regimes will be used to assess adherence to state water quality standards and will be correlated with the abundance and distribution of fish and macroinvertebrates. The period of data collection will be compared to historic records of flow. Observations from the study will be discussed in context with the historical flow record.

## VII. Participants

	<b>Organization</b>	<b>Name</b>	<b>Phone #</b>	<b>E-Mail</b>
<b>Duke Power Lead</b>	Duke Power	Jon Knight	(704) 875-5417	jcknight@duke-energy.com
<b>Agency Contacts</b>	NC Wildlife Resources Commission	Chris Goudreau	(919) 652-4360	goudrecj@wnclink.com
	US Fish and Wildlife Service	Mark Cantrell	(828) 258-3939 Ext. 227	mark_a_cantrell@fws.gov
	US Forest Service	Richard Burns	(828) 257-4212	rgburns@fs.fed.us
	Nat. Res. - Division of Water Quality	Kevin Barnett	(828) 251-6208	kevin.barnett@ncmail.net
<b>Duke Supporting Consultant</b>	TBD			

<b>Other Participants</b>	Eastern Band of Cherokee Indians	Mike Bolt	(828) 497-6824	Chermapl@ hotmail.com
	Little Tennessee Watershed Assoc.	James Johnson	(828) 349-9338	nbumppo@dnet.net
	Friends of Lake Glenville	Doug Odell	(865) 690-1865	dodell@juno.com