

Action : Fish Instream Flow Study

Prerequisite Actions: N/A

Action Description:

Conduct new streamflow studies in three specific reaches: (Tennessee Creek bypass, Nantahala River downstream of the Powerhouse and Tuckasegee River downstream of Caney Fork Creek). Rerun streamflow analyses for: the East Fork (Wolf Creek bypass and East Fork between Cedar Cliff Powerhouse and West Fork confluence), West Fork (Thorpe bypass, West Fork between Tuckasegee Powerhouse and confluence with East Fork and West Fork/ East Fork confluence to Caney Fork Creek) and Nantahala River bypass (Nantahala Dam to Dicks Creek confluence, Dicks Creek confluence to Whiteoak Creek confluence, Whiteoak Creek diversion dam to confluence with Nantahala bypass and Whiteoak Creek confluence to Nantahala Powerhouse).

Applicable Hydro Projects/Developments:

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

I. Objective(s)

- (1) To quantify and evaluate the relationship between flow rate and habitat for aquatic biological communities in stream reaches affected by the projects.
- (2) To provide a basis for reaching agreement on site-specific, habitat-based, seasonal instream flow requirements.
- (3) To identify and evaluate a range of specific flow management options and alternatives that will be analyzed.
- (4) Address flow needs for critical biological periods, such as spawning and rearing periods, which may be particularly susceptible to the effects of fluctuating flows.

II. Basis

The bases for this study are contained in 18CFR4.51 and 18CFR4.61 under basic information filing requirements relative to descriptions of project-related water quality and quantity issues. Additionally, flow-related issues are covered under the Fish and Wildlife Coordination Act, the Clean Water Act, Section 401 and the North Carolina General Statute Chapter 113, Article 1 (powers and duties of the DENR).

III. Geographic and Temporal Scope

The specific study reaches will be determined for each of the projects designated in the action description above, during ongoing study plan consultation and site visits. Alternative flows negotiated under this action will be implemented for the new license period.

IV. Approach and Analysis

During consultations relative to instream flow issues, all parties agreed that the issue would be best addressed by a holistic approach that considered all flow-related stakeholders. Since the utilization of water resources of the Little Tennessee Basin involve multiple, competitive interests,

the consideration of streamflow issues for the NPL projects and any resulting studies must integrate that wide range of interest and utilization. Accordingly, this study plan incorporates a global approach to evaluating the various flow issues for NPL projects and collecting the necessary information to make sound, reasonable streamflow decisions that balance the various competing user interests. The evaluation of instream flows will also draw upon the results of other studies that address physical parameters, such as temperature and flow time of travel, and biological studies that describe the aquatic biological communities.

In evaluating NPL instream flow issues, two categories of studies were identified: (1) studies involving bypass reaches and (2) studies involving mainstem reaches subject to peaking operations. This study plan outlines the various proposed studies within each category, on a site by site basis. Generally, the approach for both bypass and peaking reaches will consist of describing or quantifying the aquatic biota associated with that site, conducting habitat surveys, and modeling habitat responses to changes in flow. A review of historical resource data and re-analyses of historical streamflow studies will also be used where these data are available. In terms of the general approach for flow studies, habitat analyses may utilize a guild approach, or generalized habitat criteria in addition to single or multiple target species approach, for evaluating habitat suitability.

Due to the complexity of the flow issue and the resulting studies, only broad strategic approaches and strategies have been developed at this time. Most of the study details are yet to be determined. Such details as study reaches/transects, the timeline for conducting field studies and the analytical approach for evaluating instream habitat are still being determined. Accordingly, this plan is a work in progress and the Technical Leadership Team will continue to work together to make decisions regarding detailed study design, implementation, analyses, and recommendations.

A preliminary review of aerial photography of the Tuckasegee River from the East Fork/West Fork confluence to the Oconaluftee River confluence was used to confirm the need for four separate study reaches for the Tuckasegee River study. Although useful for study reach identification, the aerial photography was not detailed enough for habitat mapping. Accordingly, additional field habitat mapping of some study reaches will be necessary, prior to the selection of study transects.

The record of historical, unregulated flows for the Tuckasegee River will be developed for calculation of maximum and minimum monthly, median flows. These flows will be used to determine the three calibration flows to be used for field data collection for each of the four study reaches.

The timing of the studies under this action plan will be coordinated with other studies at the same site(s) that also involve flow issues and hydro operations coordination (i.e., Recreational Instream Flow Study, Impacts of Water Releases on Recreation Evaluation, Evaluation of High Water Availability for Recreation Releases, Sediment Management Plan, Aesthetics Evaluation and Zone of Peaking Influence Study).

Alternative approaches for field studies (e.g., expert panel) and analytical alternatives for flow analyses (e.g., two flow analysis, dual flow analysis, utilization of generalized habitat criteria, etc.) may be considered where the utilization of these techniques will enhance the interpretation of study results and/or facilitate alternatives analyses. These analytical approaches may be useful for both peaking and bypass reaches and for previously conducted studies, as well.

Bypass Studies – East Fork

Wolf Creek

Duke Power and the agencies agree that the physical habitat model previously developed for the reach of Wolf Creek upstream of Wolf Creek Reservoir is adequate to evaluate the instream flow needs of the Wolf Creek bypass between the Wolf Creek Dam and Powerhouse. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) and generalized habitat criteria (e.g., shallow slow, shallow fast, etc.). Site specific fisheries and macroinvertebrate data assembled under the Fish and Macroinvertebrate Surveys, respectively, will be used to assist in the analysis of flows for this bypass reach. Additionally, mesohabitat mapping will be conducted in the bypass to describe and quantify the various mesohabitats present. This mapping may be accomplished by analyzing existing aerial photography of the area and/or analyzing aerial photography generated for the current GIS Database study. If this approach does not provide the necessary data, based on field validation of a representative section of the reach, then field mapping of the entire study reach will be conducted. The habitat data will be used in the streamflow re-analysis.

Tennessee Creek

A new instream flow study will be conducted in the Bonas Defeat bypass reach. This study will be limited to the lower accessible sections of the bypass. The study will employ the IFIM methodology, and may utilize curves for specific macroinvertebrate groups and generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) and generalized habitat criteria (e.g., shallow slow, shallow fast, etc.), as mentioned for the Wolf Creek bypass study. Site specific fisheries and macroinvertebrate data assembled under the Fish and Macroinvertebrate Surveys, respectively, will be used to assist in the analysis of flows for this bypass reach. Additionally, mesohabitat mapping will be conducted in the bypass to describe and quantify the various mesohabitats present. This mapping may be accomplished by analyzing existing aerial photography of the area and/or analyzing aerial photography generated for the current GIS Database study. If this approach does not provide the necessary data, based on field validation of a representative section of the reach, then field mapping of the entire study reach will be conducted. The habitat data will be used in the streamflow analysis.

Bear Creek

No specific field instream flow study will be conducted in the short reach between the Bear Creek Dam and Powerhouse. Alternatively, general fisheries and macroinvertebrate data assembled under the Fish and Macroinvertebrate Surveys, respectively, will be used to evaluate this reach. To assist in this evaluation, mesohabitat mapping will also be conducted in the reach to describe and quantify the various mesohabitats present. This mapping may be accomplished by analyzing existing aerial photography of the area and/or analyzing aerial photography generated for the current GIS Database study. If this approach does not provide the necessary data, then field mapping of mesohabitats will be conducted.

Cedar Cliff

No specific field instream flow study will be conducted in the short reach between the Cedar Cliff Dam and Powerhouse. Alternatively, general fisheries and macroinvertebrate data assembled under the Fish and Macroinvertebrate Surveys, respectively, will be used to evaluate this reach. To assist in this evaluation, mesohabitat mapping will also be conducted in the reach to describe and quantify the various mesohabitats present. This mapping may be accomplished by analyzing existing aerial photography of the area and/or analyzing aerial photography generated for the current GIS Database study. If this approach does not provide the necessary data, then field mapping of mesohabitats will be conducted.

Bypass Studies – West Fork**Thorpe**

Data from the previous instream flow study conducted for the Thorpe bypass will be used for a re-analysis of bypass flows. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc). General fisheries and macroinvertebrate data assembled under the Fish and Macroinvertebrate Surveys, respectively, will also be used in the re-analysis of bypass flows.

Bypass Studies – Nantahala**Nantahala Dam to Dicks Creek**

Data from the previous instream flow study conducted for this bypass reach will be used for a re-analysis of bypass flows. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc). Population estimates from previous depletion studies in this reach will also be used to assist in the analysis of flows.

Dicks Creek to Whiteoak Creek

Data from the previous instream flow study conducted for this bypass reach will be used for a re-analysis of bypass flows. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc). Population estimates from previous depletion studies in this reach will also be used to assist in the analysis of flows.

Whiteoak Creek Diversion Dam to Nantahala Bypass

Data from the previous instream flow study conducted for this reach of Whiteoak Creek will be used for a re-analysis of flows. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic

riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc). Population estimates from previous depletion studies in Whiteoak Creek will also be used to assist in the analysis of flows.

Whiteoak Creek Confluence to Nantahala Powerhouse

Data from the previous instream flow study conducted for this bypass reach will be used for a re-analysis of bypass flows. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc). Population estimates from previous depletion studies in this reach will also be used to assist in the analysis of flows.

Peaking Reach Study – East Fork

Cedar Cliff Powerhouse to West Fork Confluence

Data from the previous instream flow study conducted in this reach of the East Fork Tuckasegee River will be used for a re-analysis of flows. The re-analysis will be conducted utilizing additional preference curves (e.g., mottled sculpin) and others to be determined; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc).

Peaking Reach Study – West Fork

Tuckasegee Powerhouse to East Fork Confluence

Data from the previous instream flow study conducted in this reach of the West Fork Tuckasegee River will be used for a re-analysis of flows. The selection of species to model and associated preference curves will depend upon the results of the Fish and Macroinvertebrate Surveys. The curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc).

Peaking Reach Study – Tuckasegee

East Fork/West Fork Confluence to Caney Fork Creek

Data from the previous instream flow study conducted in this reach of the mainstem Tuckasegee River will be used for a re-analysis of flows. The selection of species to model and associated preference curves will depend upon the results of the Fish and Macroinvertebrate Surveys; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc).

Caney Fork Creek to Bryson City USGS Gage

A new instream flow study using IFIM will be conducted in this portion of the Tuckasegee River. Study details have not been defined at this time, however, the general scope of the study will be as follows:

Four tentative study reaches have been identified: (R1) Caney Fork Creek to Scotts Creek, (R2) Scotts Creek to Barkers Creek, (R3) Barkers Creek to the Oconaluftee River and (R4) the Oconaluftee River to the Bryson City USGS gage. The study reach from the East Fork/West Fork confluence to Caney Fork Creek analyzed in a previous instream flow study may be combined with study reach 1 described above. Additionally, the section of study reach R3 from Shoal Creek Road to the confluence of the Oconaluftee River will be hydrologically analyzed with study reach R4, due to similarities in habitat. The number and location of data collection transects within each study reach will be jointly determined by resource agencies and Duke Power personnel during May/June 2001 site visits. All remaining field habitat mapping will also be conducted at this time. Aerial photography generated for the current GIS Database study will be used to assist in habitat mapping and transects placement.

The preference curves to be used in this study have not been determined. The selection of species to model and associated preference curves will depend upon the results of the Fish and Macroinvertebrate Surveys; however, the curves will probably include curves for specific macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc).

The Division of Water Resources and Duke Power are jointly developing the flow history for the Tuckasegee River. Once these data have been developed and analyzed, three data collection flow targets (low, medium and high) for each of the four study reaches will be determined. The flow targets will be selected to permit model simulation over the range of historical flows.

Peaking Reach Study – Nantahala

Nantahala Powerhouse to NOC Bridge

A new instream flow study using IFIM will be conducted in this portion of the Nantahala River. Study details have not been defined at this time, however, the general scope of the study will be as follows:

It was determined that one study reach would be sufficient to evaluate instream flows for the Nantahala River downstream of the Nantahala Powerhouse. The proposed study reach extends from the Nantahala Powerhouse to the concrete bridge at the Nantahala Outdoor Center. The final study reach and the number and location of transects will be jointly determined by resource agencies and Duke Power personnel during a site visit. Field habitat mapping will also be conducted at this time. Aerial photography generated for the current GIS Database study will be used to assist in habitat mapping and transects placement. The site visit will be conducted during non-generation to permit the observation of instream habitat and transects location.

The preference curves to be used in this study have not been determined. The selection of species to model and associated preference curves will depend upon the results of the Fish and Macroinvertebrate Surveys; however, the curves will probably include curves for specific

macroinvertebrate groups, generic functional fish guilds (e.g., generic riffle dweller, generic pool dweller, etc.) or generalized habitat criteria (e.g., shallow slow, shallow fast, etc).

The Division of Water Resources and Duke Power will jointly develop the flow history for the Nantahala River. Once these data have been developed and analyzed, three data collection flow targets (low, medium and high) for each of the four study reaches will be determined.

The flow targets will be selected to permit model simulation over the range of historical flows.

Run-of-River Projects

The resource agencies have expressed concerns over instream flows downstream of the run-of-river projects during reservoir refilling, subsequent to maintenance drawdowns. During refilling, the projects are not able to operate in a run-of-river mode. To address these concerns, the resource agencies and Duke Power will work cooperatively to develop procedures to ensure adequate downstream flows during the refilling period. These procedures will be jointly developed by the Technical Leadership Teams for the Fish Instream Flow and Run-of-River Operation studies.

V. Schedules and Required Conditions

The timing of the studies under this action plan will need to be coordinated with other studies at the same site(s) that also involve flow issues and hydro operations coordination (i.e., Recreational Instream Flow Study, Impacts of Water Releases on Recreation Evaluation, Aesthetics Evaluation, and Zone of Peaking Influence Study). Respective project operations will be coordinated to ensure the appropriate timing and magnitude of flows required for field data collection. Presently, the new instream flow studies are scheduled to begin in the Spring 2001. The collection of all field data should be completed by early fall 2001. Model simulations, analyses of study results and final reports should be completed by mid 2002. Field data will be jointly collected by resource agencies personnel, Duke Power personnel and a mutually agreed upon consultant, under the direction and oversight of the NPL project manager.

VI. Results

The results of the streamflow studies will be used to evaluate the instream flows at referenced projects to address protection of instream biological resources, recreational activities and maintenance of viable project economics. These studies will also provide the needed data to assist in the potential development of flow-related settlement agreements.

VII. Participants

	Organization	Name	Phone #	E-Mail
Duke Power Lead	Duke Power	Duane Harrell	(704) 875-5453	rdharrel@duke-energy.com

Agency Contacts	NC Wildlife Resources Commission	Chris Goudreau	(828) 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	Donley Hill	(828) 257-4212	donleyhill@fs.fed.us
	US Forest Service	Ray Johns	(828) 257-4859	rayjohns@fs.fed.us
	NC Department of Environment and Nat. Res.- Division of Water Resources	Steve Reed	(919) 715-5424	steven.reed@ncmail.net
		Jim Mead	(919) 715-5428	jim.mead@ncmail.net
Duke Supporting Consultant	Duke Engineering & Services, Inc.	Michael Barclay	(360) 671-1150	
Other Participants	N/A			

VIII. Expected Benefits

The expected benefits of these streamflow studies will be the adoption of instream flows for NPL projects that will adequately address the protection of instream biological resources, recreational activities and maintenance of viable project economics. These studies may also lead to the adoption of mutually beneficial settlement agreements for NPL flow-related issues.

IX. List of Attachments

N/A

X. List of References

N/A