Chapter 7
Water Quantity and Water Quality

Understanding Stream Flow

Stream flow is monitored by USGS gaging stations and the 7-day 10-year low flow (7Q10) statistic is calculated to determine minimum flow requirements appropriate for water use activities. Examples of these activities include: point source discharge effluent assimilation; water withdrawals; protection of aquatic life; navigation; wetland maintenance; recreation; hydropower and TMDL development. Flows less than the 7Q10 may be the result of drought, but also can be caused by water withdrawals or impoundments. When stream flow falls below the 7Q10, water quality violations may occur. Flow requirements are often thought of as minimum flows or releases, but they can also include maximum flow limits for peaking hydropower dams, seasonal releases for fish spawning, or weekend releases for recreation. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs).

Managing Flow from Impoundments

Minimum Release Requirements

The Dam Safety Law is to ensure maintenance of minimum stream flows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water downstream of the impoundment. The ***Division of Water Resources*** (DWR), in conjunction with the ***Wildlife Resources Commission*** (WRC), recommends conditions related to release of flows to satisfy minimum instream flow requirements. The ***Division of Land Resources*** (DLR) issues the permits and is responsible for enforcement. The Federal Energy Regulatory Commission (FERC) licenses most dams associated with hydropower. Flow requirements may also be established for non-dam projects that require a *Finding of No Significant Impact* to satisfy a State or Federal environmental review or as a condition of a permit required by the Clean Water Act.

Calculated minimum stream flows for impoundments in the French Broad River Basin are listed in Table 7-1. If the inflow is less than the minimum release the minimum release becomes that inflow rate.

Table 7-1: Minimum Releases from Impoundments in the French Broad Basin

Name of Dam	Waterbody	Drainage Area	Minimum Release
Craggy*	French Broad River	965.0 mi^2	460 - 860 cfs
Capitola*	French Broad River	1,338.0 mi^2	N/A "run-of-river"
Redmon (Marshall)*	French Broad River	1.343.0 mi^2	N/A "run-of-river"
Ivy*	Ivy Creek (River)	156.0 mi^2	16 cfs
Walters*	Pigeon River	455.0 mi^2	100 cfs
Waynesville Water Supply	Allen Creek	12.9 mi^2	3.5 cfs
Long Valley Lake	Long Valley Branch	1.9 mi^2	0.36 cfs
Eagle Lake	Phillips Creek	0.7 mi^2	0.5 cfs
Cove	UT to Swannanoa River	1.3 mi^2	0.2 cfs
Palas Trout Farm	Shope Creek	2.2 mi^2	0.28 cfs
Hendersonville	North Fork Mills River	10.5 mi^2	8.0 cfs
Hendersonville	Bradley Creek	10.3 mi^2	8.0 cfs

Cliffs of High Carolina	Rocky Fork Creek	0.9 mi^2	0.2 cfs
Diamond Lake	UT to North Toe River	0.8 mi^2	0.25 cfs
WRC Pisgah Fish Hatchery	Davidson River	13.8 mi^2	**
WRC Pisgah Fish Hatchery	Ceder Rock Creek	2.5 mi^2	**

Note: Although every attempt has been made to include all flow requirements in the basin, omission from the list does not negate those with flow requirements from fulfilling their obligations.
*Denotes a hydroelectric dam
**Minimum release varies based on current flow and time of year.

Hydroelectric Dams

There are five operational dams in the French Broad River basin, including three on the French Broad River, one on Ivy Creek, and one on the Pigeon River.

Craggy Dam (FERC Project No. P-3457) is located on the French Broad River downstream of the State Road 1002 Bridge at river mile 142 near Woodfin. The dam is required by its FERC license to provide a tiered release of 460 cfs from July January, and 860 cfs the remainder of the year. This dam must also operate in a run-of-river (non-peaking) mode. The powerhouse bypasses 3,200 feet of river channel. The facility is owned and operated by Buncombe County Metropolitan Sewer District.

Capitola Dam (FERC Project No. P-3457) is located on the French Broad River upstream of the State Road 1001 Bridge at river mile 125.5 in Marshall. The dam has no minimum release requirement; however, the dam must operate in a run-of-river (non-peaking) mode. The powerhouse bypasses 1,000 feet of river channel. The facility is owned and operated by the French Broad Electric Membership Corporation.

Marshall (Redmon) Dam (FERC Project No. P-3457) is located on the French Broad River upstream of the State Road 1136 Bridge at river mile 123 downstream of Marshall. The dam has no minimum release requirement; however, the dam must operate in a run-of-river (non-peaking) mode. The facility is owned and operated by Progress Energy.

Ivy River (Creek) Dam (FERC Project No. P-7509) is located 2.2 miles upstream of the mouth of Ivy Creek. The dam is required by its FERC license to provide a 7Q10 flow of 16 cfs. A calibrated gage is required to monitor downstream flows. This dam must also operate in a run-of-river (non-peaking) mode. The facility and is owned by Madison Hydro Partners, LP.

The Walters Hydroelectric Project (FERC Project No. P-432) is operated by Progress Energy. The Walters Dam and Reservoir (Waterville Lake) are located at river mile 38 at the Pigeon River confluence with Cataloochee Creek. The project powerhouse is located at river mile 26 at the Pigeon River confluence with Big Creek on the North Carolina-Tennessee border. The pipe from the dam to the powerhouse bypasses 12 miles of the Pigeon River.

No minimum release is required in the bypassed Pigeon River channel below the dam until water quality and biological criteria are met. In lieu of a minimum flow, the utility will contribute funds to the Pigeon River Fund (www.pigeonriverfund.org) that will be administered by the Pigeon River Committee. In exchange for contributions to the fund, DENR will not seek a minimum release from the dam for ten years. When water quality and biological criteria are met, the established minimum release into the bypassed channel will be 30 cfs during May and June, and 20 cfs during the remainder of the year.

This facility is also required by its FERC license to provide a minimum flow of 100 cfs one mile below the powerhouse at Brown's Bridge in Tennessee. A gage is required at Brown's Bridge to monitor flows.

Scheduled recreational releases are also required downstream of the project's powerhouse. The Schedule One recreational release is 1,200 cfs from 1:00 pm to 6:00 pm on two weekdays during each week, and 12:00 pm to 6:00 pm on Saturdays between the Saturday of the Memorial Day weekend and the Saturday of the Labor Day weekend. The Schedule Two recreational release is 1,200 cfs from 2:00 pm to 6:00 pm and will be maintained for the four weeks prior to Memorial Day weekend through the scheduled Saturday release on Labor Day weekend. The release schedule may be modified based on recreational use and may be curtailed during drought conditions. Progress Energy provides a toll-free phone number (1-800-899-4435) to provide information on the recreational flow releases.

Water Supply Impoundments, Withdrawals and/or Miscellaneous Dams

There are additional non-hydroelectric dams with flow requirements in the basin associated with public water supply or recreation. In addition, there are run-of-river water withdrawals not associated with dams that have flow-by requirements.

The Cascade Dam is a retired hydroelectric facility on the Little River [AU# 6-38-(1)]. During operation, the facility was required to provide a 7Q10 flow of 23 cfs below the dam. A calibrated gage was established to monitor the flow requirement. The project bypassed 1,016 feet of the Little River when in operation.

Lake Junaluska Dam, located on Richland Creek [AU# 5-16-(16)], is a retired hydroelectric facility. The Lake Junaluska Assembly is required to release water from the dam in a run-of-river mode. The Assembly agreed to a lake management plan with WRC that allows the lake to be drawn down beginning on November 15 to a level not to exceed 2,448 feet mean sea level and return to full pool by April 15. A 7Q10 flow of 27.7 cfs or inflow, whichever is less, is to be maintained below the dam during refill.

NCWRC operates the Pisgah Forest State Fish Hatchery under a special use agreement between the WRC and the U.S. Forest Service. Davidson River [AU# 6-34-(1)] and Grogan Creek (AU# 6-34-9-1) are the primary sources of water for the hatchery. DWR participated in a stream flow study to examine impacts to streams from hatchery operations and possible modifications to hatchery operations to reduce impacts to aquatic habitat. NCWRC has installed gages at the intakes and will modify withdrawals based on four flow windows and will shift from Grogan Creek to Davidson River during the low-flow window. A minimum flow of 0.05 cfs will be maintained in the bypassed river reach of Davidson River adjacent to the hatchery.

Maggie Valley Sanitary District's water treatment plant has a permitted capacity of 3.0 mgd and uses Jonathan(s) Creek [AU# 5-26-(5.5) and -(7)] and Campbell Creek [AU# 5-26-8-(2.5)]. There is an 8 cfs flow-by requirement below the Jonathan(s) Creek intake when withdrawals are in excess of 1.5 mgd. Withdrawals up to 1.5 mgd from Campbell Creek may be used to supplant withdrawals less than 3.0 mgd from Jonathan(s) Creek. The installation of a calibrated gage is required to monitor flows.

The Town of Waynesville's water supply reservoir is located on Allen Creek [AU# 5-16-7-(8.5)]. The dam has a 7Q10 release requirement of 3.5 cfs. A calibrated flume is used to make the release.

On the Little East Fork Pigeon River [AU# 5-2-12-(5.5)] a trout hatchery is permitted to withdraw water only when 6.5 cfs is maintained downstream of the point of withdrawal. A calibrated gage is required to monitor flows.

A trout hatchery diversion on Shope Creek (AU# 6-78-3) was permitted with an installed orifice sized for a 7Q10 release of 0.28 cfs.

Long Valley Lake on Long Valley Branch (AU# 6-75) has a flow requirement of 0.36 cfs.

Eagle Lake Dam on Phillips Creek (AU# 6-26-1) has a flow requirement of 0.5 cfs.

Cove Dam on an unnamed tributary of the Swannanoa River (AU# 6-78) near Oteen has a flow requirement of 0.2 cfs.

Diamond Lake Dam at the Communities of Penland is located on a tributary to the North Toe River [AU# 7-2-(27.7)]. The required minimum release from the dam is 0.25 cfs.

The City of Hendersonville presently has a permitted capacity of 12 mgd at its water treatment plant and relies upon the Mills River [AU# 6-54-(4.5) and -(5)], the North Fork Mills River [AU# 6-54-2-(1)] and Bradley Creek [AU# 6-54-3-17-(0.5)] as water supply sources. The North Fork Mills River and Bradley Creek impoundments are located on FSederal property. There is an 8 cfs release requirement below each of these two impoundments and gages are required to monitor the releases. Hendersonville is presently pursuing a water treatment plant expansion to 18 mgd and an emergency intake on the French Broad River downstream of the Mills River confluence.

The city can withdraw 12 mgd from the Mills River without restriction. The city can withdraw up to 18 mgd without restrictions January - June, with an 8 cfs release from the upstream impoundments on North Fork Mills River and Bradley Creek. With no withdrawals from the upstream impoundments, then up to 14.2 mgd could be withdrawn from the Mills River July -December without restrictions. From July - December, withdrawals up to 18 mgd are permissible if North Fork Mills River and Bradley Creek run free, and the following targets are met below the Mills River intake: 30 cfs (July and December); 40 cfs (August, October and November); and 42 cfs (September). The City must establish a gage downstream of its intake to monitor flows when its maximum daily withdrawal equals or exceeds 14 mgd.

Instream Flow Studies

DWR participated in an instream flow study with the City of Asheville on Beetree Creek [AU# 6-78-15-(6)] and the North Fork Swannanoa River [AU# 6-78-11-(13)]. The City maintains two water supply impoundments: Beetree and Burnett Reservoirs. This study was in conjunction with dam repairs and long-term water supply planning. The results of the study as they relate to flow requirements from the two reservoirs are pending.

Water Withdrawals

North Carolina General Statute G.S. 143-215.22H, originally passed in 1991, requires surface water and ground water withdrawals that meet certain conditions established by the General Assembly to register their water withdrawals and surface water transfers with the State and update those registrations at least every five years. Agricultural water users that withdraw one million gallons of water a day or more and non-agricultural water users that withdraw one hundred thousand gallons of water a day are required to register. Administrative rules that became effective in March 2007 (15A NCAC 02E.0600) stipulate that registrants must also report their water usage annually to the Department of Environment and Natural Resources. In its 2008 session, the General Assembly established civil penalties for failure to comply with these requirements.

Units of local government that supply or plan to supply water to the public are required to prepare a Local Water Supply Plan (LWSP). Like the withdrawal registrations, a LWSP must be updated at least every five years and systems required to prepare a LWSP must also report water usage annually to the Division of Water Resources. Preparing a LWSP and keeping it updated meets a local government's obligation to register their water withdrawals under General Statute 143-215.22H.

In the basin there are 11 registered users that withdraw surface water (Table 7-2).

Table 7-2: Current Surface Water Withdrawals by Local Water Supply Systems

County	Water System	Source	Withdrawal	HUC
Haywood	Town of Waynesville	Allen Creek	3.654 MGD Avg.	06010106
Buncombe	City of Asheville	Mills River Burnette Reservoir Bee Tree Reservoir	3.900 MGD Avg. 17.700 MGD Avg. None MGD Avg.	06010108
Buncombe	Woodfin Sanitary Water and Sewer	Sugarcamp Fork Laurel Fork	0.739 MGD Avg. None	06010105
Buncombe	Town of Weaverville	Ivy River	0.548 MGD Avg.	06010105
Haywood	Town of Canton	Pigeon River	1.347 MGD Avg.	06010106
Haywood	Maggie Valley Sanitary District	Campbells Creek Jonathans Creek	0.830 MGD Avg. None	06010106
Henderson	City of Hendersonville	Mills River Bradley Creek North Fork Mills River	5.433 MGD Avg. 1.312 MGD Avg. 1.312 MGD Avg.	06010105
Madison	Town of Mars Hill	Poplar Cove Reservoir Carter Cove Reservoir	0.227 MGD Avg. None	06010105
Madison	Town of Hot Springs	Cascade Branch	MGD Avg.	06010105
Mitchell Avery	Town of Spruce Pine	North Toe River Beaver Creek Graveyard Creek	0.010 MGD Avg. 0.900 MGD Avg. None	06010108
Transylvania	City of Brevard	Catheys Creek	1.040 MGD Avg.	06010105

Interbasin Transfers

Water users in North Carolina are also required to register surface water transfers with the DWR if the amount is 100,000 gallons per day (GPD) or more. In addition, persons wishing to transfer two million gallons per day (MGD) or more or increase an existing transfer by 25 percent or more must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled Major River Basins and Sub-Basins in North Carolina, on file in the Office of the Secretary of State. These boundaries differ from the 17 major river basins delineated by DWQ. Table 7-3 summarizes interbasin transfers within the basin.

Table 7-3: Estimated Interbasin Transfers from the French Broad Basin

Supplying System	Receiving System	Source	Destination	Est. Transfer (MGD)
Hendersonville	Hendersonville	French Broad River	Broad River	< 0.1
Hendersonville	Saluda	French Broad River	Broad River	0.151

In determining whether a certificate should be issued, the State must determine that the overall benefits of a transfer outweigh the potential adverse impacts. Factors used to determine whether a certificate should be issued include: • The necessity, reasonableness and beneficial effects of the transfer;
• The detrimental effects on the source and receiving basins, including: effects on water supply needs; wastewater assimilation; water quality; fish and wildlife habitat; hydroelectric power generation; navigation and recreation;
• The cumulative effect of existing transfers or water uses in the source basin;
• Reasonable alternatives to the proposed transfer; and
• Any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an Environmental Assessment or Environmental Impact Statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition. For more information on interbasin transfers, visit the website at http://www.ncwater.org or call DWR at (919) 733-4064.

Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of pollutants such as metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. DO is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and stream flows are reduced. In a long-term drought, these problems can be greatly exacerbated, and the potential for water quality problems to become catastrophic is increased.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface can be quickly delivered to streams unless appropriate management and stormwater BMPs are in place to slow runoff and allow infiltration. When stream flows are well below normal, polluted runoff becomes a larger percentage of the water flowing in the stream.

Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During droughts, these wastewater discharges may make up a larger percentage of the water flowing in a stream than during normal climatic and stream flow conditions. These discharges may also contribute to lowered DO concentrations and increased levels of other pollutants during drought conditions.

As stream flows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower DO levels, and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These are also areas where longer retention times due to decreased flows allow algae to take full advantage of the nutrients present resulting in algal blooms. During daylight hours, algae greatly increase the amount of DO in the water, but at night algal respiration and die off can cause DO to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause difficulty in water treatment, resulting in taste and odor problems in finished drinking water.