

DAM MANAGEMENT PLAN

Wiswall Dam (State Dam ID #071.04)



Figure 1 – Wiswall Dam, photo taken April 19, 2008.

Introduction

Wiswall Dam (lat. 43° 06' 14", long. -70° 57' 48") is located on the Lamprey River, immediately downstream of the Wiswall Road bridge crossing in Durham, New Hampshire. The dam is located on the Lamprey Designated River and is approximately three miles upstream of the end of the Designated River. This dam is owned by the Town of Durham (see contact information), is active, its primary use is ~~identified as recreation and the to impoundment~~ the Wiswall Reservoir, which is one of the water supplies for the University of New Hampshire/and-Town of Durham wWater sSystem (UDWS). The reservoir also, and it provides recreation for local residents.

Dam Design

The dam was constructed in 1911. The dam consists of a concrete structure, and has a gated spillway, which can be manually used to regulate water levels in the ~~impoundment reservoir~~ (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 describing the characteristics of the dam is summarized in Table 1.

Minimum Flow, Flowage Rights or Contractual Obligations

In 2001, estimated minimum flow requirements for Wiswall Dam were defined in "Section 401 Water Quality Certificate for Town of Durham withdrawal at Lamprey River, Durham, New Hampshire, Water Quality Certificate File #2001-001." The

conditions of the certificate were amended in 2009~~10~~. However, this Dam Management Plan in concert with the Water Use Plan and Conservation Plan for the UDWS withdrawal (#20066-S02) supersedes the conditions of the Section 401 Water Quality Certificate #2001-001.

Under the Water Quality Certificate conditions, at river flows between 45 and 21 cfs (measured at the United States Geological Survey gaging station at Packers Falls), UDWS can divert water from storage or inflow such that outflow is equal to inflow less 1.8 cfs. When flow at the gage reads between 21 and 13 cfs, UDWS can divert water from storage or inflow such that outflow is equal to inflow less 0.4 cfs. When flow is less than 13 cfs, outflow from the dam must equal its inflow, so any withdrawal would have to be from the volume of water stored in the impoundmentreservoir. Operation of the dam to release flow would be required when pumping and flow is less than 13 cfs or when the water level in the impoundmentreservoir is below the spillway. The maximum rate of drawdown within the Wiswall Reservoir is one inch per day, with a maximum drawdown of 18 inches.

A specific right to the use of waters from the Lamprey River was granted to the Town of Durham and the University of New Hampshire by the New Hampshire legislature in Chapter 332 of the Laws of 1965. Under this law Durham and UNH ~~waswere~~ granted the right to divert waters from the Lamprey River and it has flowage rights in the Town of Lee to maintain the dam at Wiswall Falls.

Comment [DC1]: The introductory paragraph of Chapter 332 from 1965 referenced both the Town of Durham and UNH.

The Town of Durham has identified the Wiswall Reservoir (impoundmentreservoir) as the UDWS's primary water source and has used it as such beginning in 2009. Plans have been presented by UDWS to DES Watershed Management Bureau to install a water level gage in the Wiswall Reservoir and a flow measurement station 250 feet downstream of the dam. These measures are to support calculations for managing outflow from the impoundmentreservoir under the conditions of the Water Quality Certification. The plan includes future upgrades to these measurement points by installing instrumented water level transducers to record real-time stage elevation and transmit real-time data to the UDWS Water Treatment Plant operator. Improvements to the Wiswall Dam are proposed as part of the Wiswall Dam Repair & Fish Ladder Project, which will include an outflow weir for down stream fish migration and the ability to more accurately estimate outflow during low flow. As a result, the flow measurement station 250 feet downstream from the Dam will not be required.

Comment [DC2]: Check to see if this actually took place in 2008.....

Riparian Property Obligations or Agreements

Chapter 332 of the Laws of 1965 dictates that the use of water by the Town of Durham cannot lower the water level upstream from the so-called Hook Island Falls in Lee or result in the breaching of the Hook Island Falls.

Comment [DC3]: I think this interpretation is wrong – isn't it about disallowing flashboards and flooding hook Island falls?

Water Quality Requirements or Limits

Water quality requirements associated with Wiswall Dam are included in its Section 401 Water Quality Certificate (#2001-001). Principally, the water quality requirements included in the certificate are the minimum flow and storage change conditions discussed in the "Minimum Flow, Flowage Rights or Contractual Obligations" section of this Plan.

Comment [DC4]: What is the purpose of all the reference to the 401 cert if it is to be superseded by the DMP?

As noted, these requirements will be superseded by the adoption of the Water Management Plan.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Wiswall Dam is 500 acre-foot (ac-ft), while its permanent storage volume is 360 ac-ft. Durham Public Works

estimated the volume in gallons in the top 18 inches of the impoundmentreservoir as:

0 to 6" -	7,137,266 gallons	=	954,052 cubic feet	=	21.9 acre-ft
0 to 12" -	11,421,704 gallons	=	1,526,762 cubic feet	=	35.0 acre-ft
0 to 18" -	17,037,153 gallons	=	2,277,390 cubic feet	=	52.3 acre-ft

The drainage area upstream of the dam is 183 square miles, which provides considerable runoff potential for refilling the impoundmentreservoir. When compared with the other dams in this Water Management Planning Area, the storage volume and relatively large contributing drainage area for Wiswall Dam result in a high potential for water management use based on water availability.

Comment [DC5]: Update these numbers with the values in the refined chart and include a reference.

Potential Impacts of Storage and Relief Flows

The primary use of Wiswall Dam is as an impoundment for drinking water storage/recreational (NH Dams Data Sheet 071.04). Boating, fishing and swimming are also commonly observed recreational activities in the impoundmentreservoir although there are no maintained public access points. The lowering of the impoundmentreservoir water level in response to a flow management event should have little impact on the recreational activities in the impoundmentreservoir, unless the water level is lowered by several feet.

Comment [DC6]: This data sheet obviously needs updating. Based on the results of the 2003 Wiswall Dam Removal Study done by Dufresne-Henry, it is likely the only reason the Dam was not removed is because it impounds a water supply reservoir.

There are mapped wetlands within the impoundmentreservoir and they could be impacted by either rapid declines in water levels or by prolonged periods of below normal water levels.

As previously mentioned, ~~t~~The Wiswall Reservoir is used as a water supply by UDWS. Releasing water from this dam would affect the storage available to the UDWS. As a result, this Dam Management Plan must be coordinated with the Water Use Plan developed for the UDWS withdrawal from the impoundmentreservoir (#20066-S02). Alternatively, water withdrawal may lower water levels in the impoundmentreservoir below the spillway, thereby requiring operation of the dam to maintain downstream flows.

Comment [DC7]: What point is this sentence attempting to make?

Potential for Dam Management to Meet Instream Flow Requirements

The overall potential for this dam for flow management of the Lamprey Designated River is considered to be low due to its location, which affects only the last three miles of the Designated River, and due to the loss of storage that water releases would cause affecting its use as a water supply source for UDWS. Releases from the dam for the protection of instream flows would reduce the water available for use as ~~a~~ source of water for UDWS without improving flow conditions in the upper nine miles of the Designated River.

Comment [PC8]: Dave, If I understand correctly, it is an even shorter distance to the upper end of the McCallaen impoundment??

Wiswall Dam has a role in maintaining protected flows by passing water needed to maintain stream flow downstream. The large volume of the impoundment creates a potential for attenuation of a relief flow release originating higher up in the watershed such that the target flow may not be met. Depending on the magnitude of the relief flow, the dam should may need to be operated under this Dam Management Plan to pass the relief flow to minimize attenuation.

Dam Management Activity **Proposed**

The main components of the Wiswall Dam Management Plan are listed below and described further where necessary in the paragraphs below:

- The Affected Dam Owner will ensure that relief flows resulting from releases under dam management actions upstream of Wiswall Dam are conveyed through the Wiswall Reservoir during the relief flow release.
- Maximum impoundment reservoir drawdown is 18 inches below the spillway.
- Maximum water level change is one inch of drawdown per day.
- The Affected Dam Owner will maintain the dam's water release mechanism(s) to allow controlled releases of water.
- The Affected Dam Owner will monitor and record flow and dam conditions and take actions to ensure that flow conditions are met continuously.

Dam management activities are expected to occur on a frequency from as little as none per year to one or more events per bioperiod in five of the six bioperiods. The Spring Flood bioperiod will not be managed under the Lamprey Dam Management Plan.

1. At all times except during relief flow releases under the Lamprey Dam Management Plan, the Affected Dam Owner will operate the dam to ensure that downstream flow is maintained at a discharge equal to inflow or equal to inflow minus the UDWS withdrawal (20066-S02), whichever is less.
2. When a relief flow release event is scheduled, DES will notify the Affected Dam Owner contact identified in this document. The Affected Dam Owner will provide an alternate or emergency contact person to the DES Instream Flow Program upon adoption of this plan. DES's notification will be by phone or email, or both, at least 24 hours in advance of the intended relief flow release. The Affected Dam Owner will confirm receipt of this notification by phone or email within 24 hours.
3. For the duration of the relief flow pulse beginning at the release start time and continuing until the two-day pulse has passed Wiswall Dam, the Affected Dam Owner will maintain outflow below Wiswall Dam at least equal to inflow on an instantaneous basis. The arrival of the relief flow at Wiswall Dam has a lag time of approximately 23 hours behind the start time when water is released from the upstream dams. No actions will be taken during the two-day period of the pulse to increase Wiswall Reservoir storage resulting in the diminution of the flow downstream of the dam or attenuation of the relief flow pulse as it passes through the Wiswall Reservoir.

Comment [DC9]: The volume of the Wiswall Reservoir is not "large", and for this reason it does not provide a significant potential to attenuate the relief flow. The soon to be installed outflow notch/weir will be self regulating which will help to reduce the potential for attenuation. In addition, for the reason stated in the previous paragraph it does not provide a great potential to provide significant relief flow for the mostly impounded downstream reach.

Comment [PC10]: Agree that DES is imposing requirements based on assumed behavior the system. They also have a practical problem in that no one knows or can measure how much attenuation occurs between the Patuckaway dams and our reservoir since the upstream gage is on a side branch of the Lamprey. It would seem just as good an assumption that there is some, but how much?

Comment [DC11]: Without conducting some actual relief flow tests that would provide the UDWS with some real data of what flows to expect and when, and to what degree the new notch/weir of the dam might actually have on flow attenuation, it is unreasonable to insist that the UDWS come up with a plan to "ensure the relief flows are conveyed" without some amount of attenuation. Pulling stop logs in anticipation of an untested relief flow increases the UDWS's liability of losing drinking water storage during a potentially critical period of demand. Depending on when it happens, it could result in prematurely declaring Stage 4 (Water Emergency).

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Comment [PC12]: Undefined requirement. What is "controlled release" We've proposed the accuracy as being what can be obtained by pulling a 4" stop log which DES has apparently rejected. What degree of control is expected?

Comment [PC13]: I would add that this is a natural system with natural variability. The degree of precision implied is inconsistent with the system being controlled.

Comment [DC14]: As stated in the previous comment, this is all based on untested hypothetical information. The precision of dam outflow controls will not existing to manage small changes in pool elevation. There needs to be acceptable range pool elevation increase by which the UDWS will be required to operate the dam.

Comment [DC15]: Is there an intentional connection between this paragraph and the following bullet list?

Comment [DC16]: What is this number? And, what is meant by "whatever is less"?

Comment [DC17]: This schedule is unrealistic for a municipality where the responsible staff members may not be available under such short notice. The planning involved in a relief flow release would happen at least a week before the actual release, and as such it seems reasonable that an "Affected" dam owner could be given more than 48 to 72 hrs notice.

Comment [DC18]: Maintaining inflow equal to inflow on an "instantaneous" basis would require a staff person to continually reside at the dam... Where is DES coming from here?

4. The Affected Dam Owner will maintain the dam's water release mechanism(s) to allow controlled releases of water in the flow ranges of the proposed relief pulses. Variability in stream flow discharge is expected during the release event. If during the relief flow release the water level of the Wiswall Reservoir is below the spillway, operation of the dam outlet will be required and variable rates of discharge may be required to maintain outflow equal to inflow. Consequently, operability of some mechanism for flow release must be assured during all but the Spring Flood bioperiod.

Comment [DC19]: The outflow weir will be self-regulating, and if the UDWs is not withdrawing then we do not plan to pull additional stop logs.

5. The Affected Dam Owner will not at any time except relating to maintenance operations or in the case of a water emergency cause the impoundment reservoir water level to fall below 18 inches below the spillway crest, nor to cause the water level to drop at a rate higher than one inch per day.

Comment [PC20]: Does this mean stopping outflow to hold the reservoir level constant?

6. The Affected Dam Owner will monitor and record flow and dam operational conditions during the relief flow release from four hours before the time of arrival at Wiswall Dam of the release until at least four hours after the two-day pulse has passed Wiswall Dam: therefore from 19 hours after the upstream dam release(s) through the two-day pulse and the four hours following. Measurement intervals will be at a minimum of every four hours: automated measurements should be conducted at 15-minute intervals, which is the desired frequency. The Affected Dam Owner will record the dam's current flow structure conditions (gate position or other criteria defining the outflow) and the height of the water level relative to the spillway, the flow immediately downstream of the dam outlet and any other information necessary to determine that outflow is equal to inflow. If the results of these measurements show that outflow does not equal inflow, the Affected Dam Owner will take immediate action to adjust the outflow towards that end. These measurements will continue on a frequency of at least once every four hours. Measurements and results of calculations and daily UDWS water withdrawal volumes will be provided to DES following each release event.

Comment [DC21]: Again, this level of monitoring will require a staff person to reside contuously at the dam.

Comment [DC22]: Automated measurements will consist of pool elevation at the Pump Station and flow at the Packers Fall USGS gage.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice upon adoption of the Lamprey Water Management Plan.

DES expects that changes to the outlet structure of Wiswall Dam will be made to better manage water releases. Recent discussion with the Town have included their plan to install a stoplog bay which can be used as a weir to manage flow releases at the dam or a fish passage structure. Plans for management of flow releases from whatever contingency will be completed by September 30, 2012.

Comment [PC23]: This seems to endorse the idea that our degree of control will be based on the stop logs (4" increments) and the inherent release control of a weir. That would be OK but isn't what the preceding material says.

Estimated Cost of the Implementation of the Dam Management Plan

The actions associated with the implementation of the Dam Management Plan for Wiswall Dam include operation of the dam's outlet structure, monitoring, recording and reporting of water levels, dam release configuration and flow measurements. These actions will be performed by Town personnel. The estimated costs associated with this work will be dependent upon the number of personnel involved, and either the degree of

automation of the system or the number of site visits required to perform the necessary flow management actions and the travel time and mileage.

As discussed in the Water Use Plan the estimated cost of the installation of the gages for water level and flow monitoring may range from \$10,000 to \$30,000 depending upon the equipment used and the type of installation. The establishment and operation of these gages is already required as part of a flow monitoring plan under the existing 401 Water Quality Certificate. The labor involved in monitoring for relief flows will be dependent upon the number of relief flow events. Assuming a minimum of one relief flow event a year, the estimated cost for monitoring, recording and reporting of water levels, dam release configuration and flow measurements could range from \$2,000 to \$4,000 depending on labor rate and labor hours expended.

Comment [DC24]: Paul Chamberlin should be able to provide more accurate costs relative to the automated water level monitoring structure and instrumentation.

Comment [DC25]: What is the basis of this cost?

Dam Owner and Contact Information

Owner: Town of Durham
Address: Public Works Department, 100 Stone Quarry Drive, Durham, NH 03824
Contact: Mr. David Cedarholm, P.E.
Phone: 603-868-5578
Email: dcedarholm@ci.durham.nh.us

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

References:

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Email from David Cedarholm, Town Engineer, Durham to Wayne Ives, NH Instream Flow Specialist, June 29, 2010.

Preliminary Dam Engineering Report, Wiswall Dam, Durham, New Hampshire.
Prepared for Department of Public Works, Town of Durham. Prepared by Stephens Associates Consulting Engineers, LLC. Dated December 1, 2006.

Table 1 – Wiswall Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	56.5*
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	56*
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	41*
Height of the dam (ft) from toe to the highest point on the dam	18
Freeboard (ft)	5
Type of spillway controls or outlet works	2 Gates
Dimensions of spillway controls or outlet works	5 ft x 6 ft*
Surface area (ac) of <u>impoundment reservoir</u> at maximum impoundment	30
Drainage area (sq. miles)	183
Maximum storage (ac-ft)	500
Normal or permanent storage (ac-ft)	360
Total discharge capacity (cfs)	6238
Maximum unoperated discharge (cfs)	5216
Design storm discharge (cfs)	8210
Estimated 50-year flood flow (cfs)	NA
Estimated 100-year flood flow (cfs)	8210

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #071.04.

*- Information from Stephens and Associates (2006)

Note: NA – not available from NH Dams Data Sheet.