

Appendix I

Responses to Comments on the DRAFT Water Management Plan

Lamprey River Water Management Plan

August 2013

This appendix summarizes the comments received on the Draft Lamprey River Water Management Plan Report (11 April 2011). Due to the large number of comments and questions received, they were summarized and grouped into categories. The major categories of comments pertain to: Pawtuckaway Lake; Mendums Pond; the Lamprey River; the University of New Hampshire/Town of Durham Water System (UDWS); the overall Plan, and, public policy and other. Several of the categories are further subdivided into specific issues that received repeated comments. Each comment summary includes a response. Copies of the original comments (emails or documents sent by mail or email) are also included in this Appendix.

In order to minimize the length of this response Appendix, when commenters pointed out simple requests for punctuation, grammar, or spelling modifications, by and large the appropriate edits were made but are not documented here.

Comments were received from the following individuals, federal or state agencies, educational institutions, groups, local and state government representatives:

- Ralph Abele, United States Environmental Protection Agency (EPA)
- Lee Bartlett
- Doug Bechtel, The Nature Conservancy
- Claire Boudreau
- James Breen
- Dennis Byrne, Campus Recreation, University of New Hampshire
- Sara Callaghan, Lamprey River Advisory Committee (LRAC)
- Frank G. Case, NH State Representative (Candia, Deerfield, Northwood and Nottingham)
- David Cedarholm, P.E. and Paul Chamberlin, P.E., UNH/Durham Water System
- Lauren E. Chaurette
- John Cooley, Jr., Loon Preservation Committee
- Gary and Lynn Cox
- Eleanor Crow
- Michele L. Daley, NH Water Resources Research Center
- Donna Danis
- Eric Danis
- John Decker
- Tom Duffy, Pawtuckaway Lake Improvement Association (PLIA)
- John K. Edwards
- Jamie Fosburgh, National Park Service (NPS)
- David Galpin
- Jim Hadley, Neighborhood Guardians
- Paul Herald
- Kevin Jordan
- James Patrick Kelly
- Pamela D. Kelly
- Donna King
- Edward T. Kotowski
- Elizabeth S. Kotowski

- Andrea LaMoreaux, NH Lakes Association
- Andrea Lawson
- Victor Maslov
- Glenn Normandeau, New Hampshire Fish and Game Department (NHF&GD)
- Town of Nottingham Selectmen: Gary A. Anderson, Mary L. Bonser and Hal W. Rafter
- Jim Rohrer
- James Rosborough
- Thad Russell
- Rydeen
- Stephen Soreff, MD
- Carl F. Spang, Lamprey River Watershed Association (LRWA)
- Dennis Stephens, PE
- Therese Thompson
- Marguerite Tucker
- Duane and Pam Walker

1. Pawtuckaway Lake: Specific Comments and Questions

The vast majority of the comments and questions on the Draft Lamprey River Water Management Plan Report were associated with Pawtuckaway Lake. Commenters expressed concern regarding the scope and validity of the Plan and the consideration and evaluation of the impact of the proposed Plan actions on Pawtuckaway Lake. Because many of the comments and concerns related similar perspectives, they were grouped into categories for response. Major concerns included:

- The perceived precedence of the Lamprey River over Pawtuckaway Lake and its use as a storage impoundment
- The impacts of the proposed management strategies on fall drawdown and winter water levels
- The frequency and maximum amount of summer drawdowns and the impact of reduced water levels in Pawtuckaway Lake on fish, wildlife, recreation, property values and the local economy
- Water quality and cyanobacteria
- Reference to and use of the survey results presented in the Notice of Decision on Determination of Lake Level dated December 19, 2000 to support proposed lake level changes in the Plan
- The notification of property owners of any water releases
- Property rights and property values
- Impacts of recent Legislative designation of additional portions of the Lamprey River under the Rivers Management and Protection Program
- Recommendations and requests for further study
- Public input and outreach

Precedence of Lamprey River over Pawtuckaway Lake and its use as a Storage Impoundment

Issue: Several comments received asked why the health and the protected entities of the lower Lamprey River take precedence over Pawtuckaway Lake and why DES would consider using Pawtuckaway Lake as a storage impoundment.

Response: The Lamprey River WMP strives to balance the values of Pawtuckaway Lake and the health of the Lamprey River. Water is held back in Pawtuckaway Lake for recreational purposes. During low-flow summer days, flow to the rivers from Pawtuckaway Lake (if any) is much less than inflow. Small releases of the water held in lakes to protect the ecosystem health of the river downstream have little impact on the lake and large benefits for the river. The summertime water level changes in the lakes being managed under this plan are within the natural variation for lakes and well within the range of existing human influences. A two day pulse of stored water that may be released reestablishes the natural pattern of stream flows for the river downstream without depleting the lake or compromising its recreational uses.

In the development of strategies to create relief flows to support the protected instream flows on the Lamprey Designated River (Lee-Durham segment), DES assessed all Affected Dams and their associated impoundments in the Lamprey River Water Management Planning Area. However, when considering the distance of each dam to the Lamprey Designated River, their operational capabilities, watershed areas and storage volumes, the list of 19 potential sites was quickly winnowed to Pawtuckaway Lake and Mendums Pond.

First and foremost in the overall concept of the water management plan development for the Lamprey Designated River is that the needs of all water users along the river and its tributaries are intended to be met as best as possible. Because there are competing uses when water availability is low, sometimes choices have to be made: sometimes preference is given to meet human uses and at other times ecosystem needs are given preference. The relief flows are part of this strategy to protect ecosystem needs.

Historical and current operations change stream flow patterns affecting river health. The Water Management Plan adds changes to the current management approach to better support river health. Pawtuckaway Lake was developed as a water storage reservoir in 1842 and continues to be a managed water body. Pawtuckaway Lake began as a natural lake that was further impounded to serve the mills in Newmarket and the original dam was upgraded in 1972. In 1955, the State of New Hampshire began operating the impoundment for recreation: saving water in the spring, holding water over the summer, and releasing water in the fall.

Figure I.1 shows the median monthly river flow of the Lamprey River at the USGS gaging station on the river near Newmarket, NH. What the figure clearly shows is how the June through September river flows have been maintained much lower since 1955 (to almost one third of the pre-1955 data) as well as the increase in flows in October and November. Changes in the management of Pawtuckaway Lake are not the sole cause of reduced Lamprey River summer stream flow but these are among the most significant. (Note: The volumes of each impoundment in and upstream of the Lamprey Designated River, Lee-Durham segment, are

presented in Table 6 in the Report. Pools with the largest surface area have the largest volume per unit depth at the surface.)

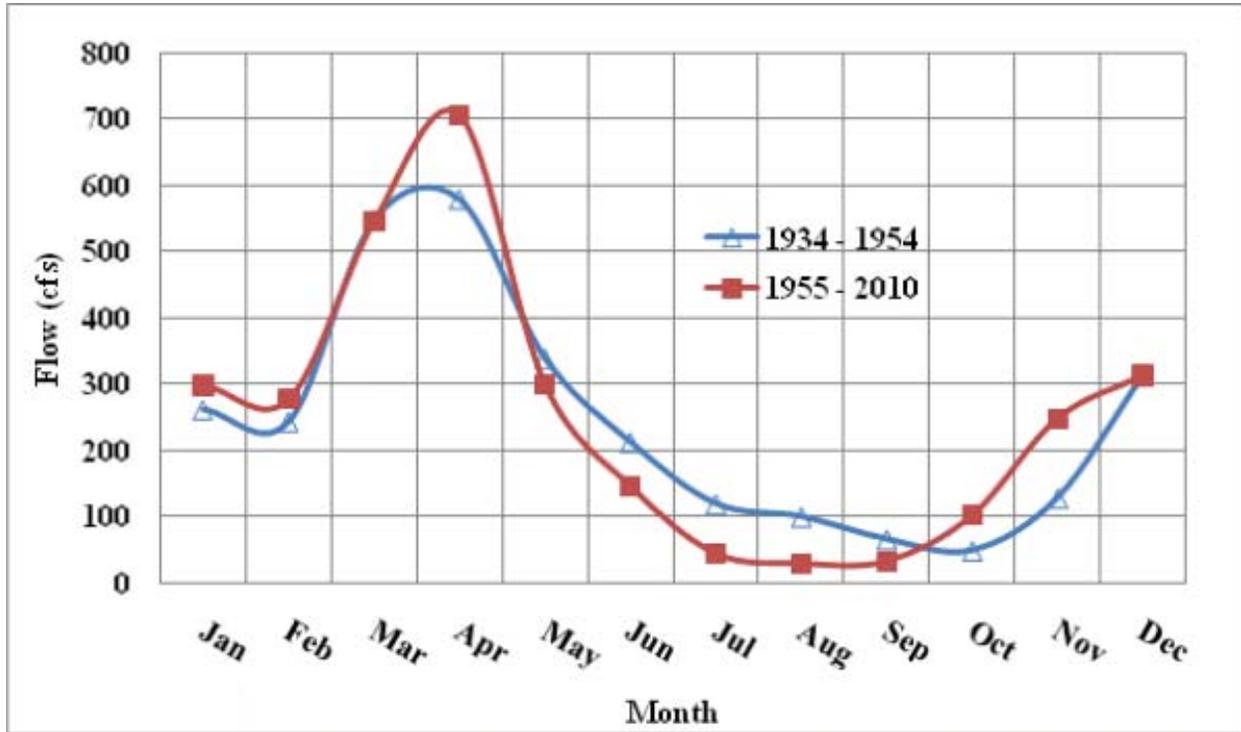


Figure I.1. Median monthly Lamprey River flows at the USGS gage near Newmarket, NH pre- and post-dam operation management change in 1955.

Figure I.2 displays the standard deviation for the same median monthly river flows. This figure demonstrates how operations at Pawtuckaway Lake and other impoundments help to reduce the summer variability of flows. Combined, Figures I.1 and I.2 show that with the current management of watershed impoundments for recreation, flows in the Lamprey River are lower in the summer and have less variability. While daily summer flows would naturally reach low values, these low flow periods would be broken up more frequently in the natural state (higher standard deviation) compared to the present state in which low flows persist for long durations. These conditions affect all instream uses and resources downstream.

The management of the Lamprey River in the past 50 years placed recreation and flood control as the highest objectives. Recreational use in particular has resulted in holding water in Pawtuckaway Lake to the detriment of the downstream river reaches. The Lamprey River Water Management Plan concludes that infrequently, when low flows persist excessively, a small amount of water stored in these same impoundments should be released in order to relieve the stress on the downstream aquatic flora and fauna.

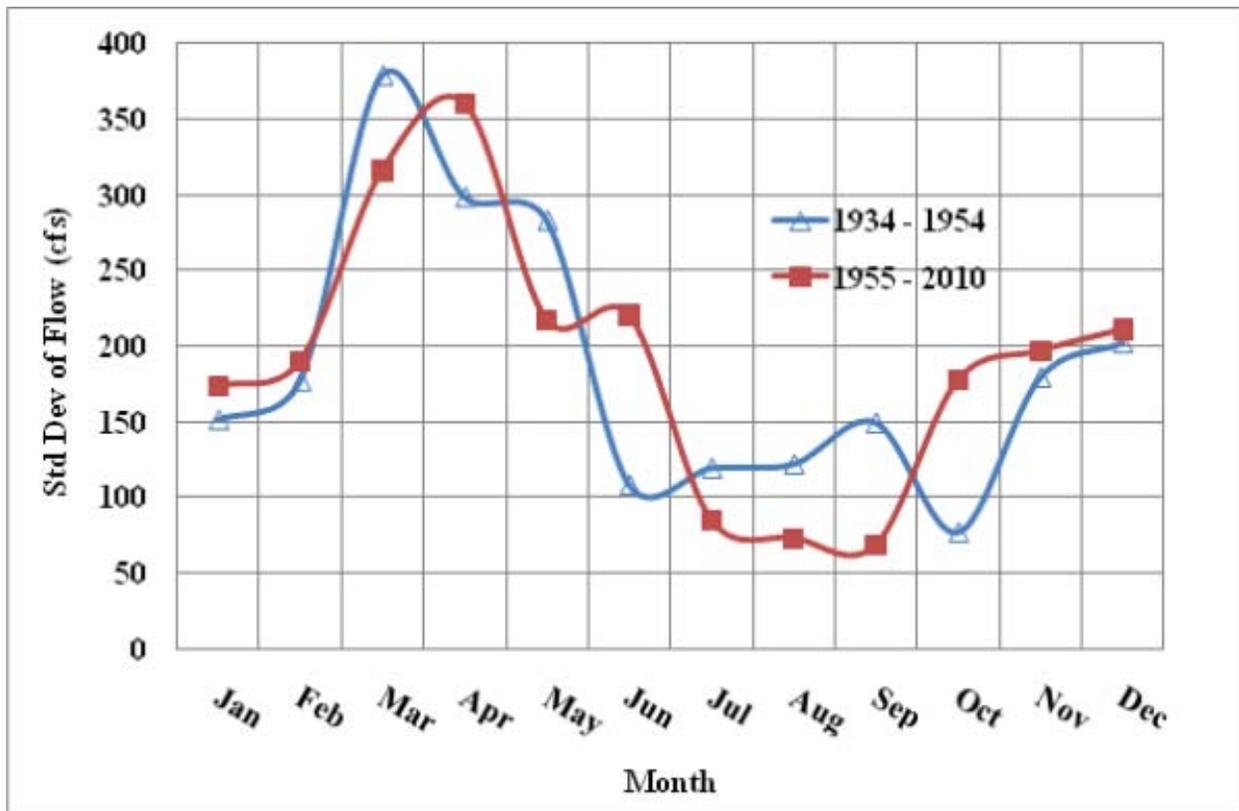


Figure I.2. Standard deviation (variability) of median monthly Lamprey River flows at the USGS gage near Newmarket, NH pre and post dam operation management change in 1955.

Change in Fall Drawdown and Winter Water Levels

Issue: Numerous comments were received regarding the proposed reduction in the fall drawdown and the resulting higher lake levels during the winter. The majority of the commenters did not support reducing the lake drawdown during the fall and maintaining higher lake levels during the winter. The primary concerns noted in the comments were: potential changes to docks resulting from higher winter lake levels; reduced opportunities for dock and shoreline maintenance during the winter months; less destruction of aquatic invasive weeds along the shoreline; and, reduced potential for flood storage.

Response: The Lamprey River Water Management Plan reduces the annual fall drawdown of the lake level from 7 feet to 4.8 feet to accommodate storage for the Overwintering bioperiod. The change in winter lake level also will improve water quality in Pawtuckaway Lake by providing more habitat for fish, better habitat for hibernating frogs and turtles, and greater removal of phosphorus.

DES has evaluated the fall drawdown relative to the lake's water quality and ecosystem health. The effects of changing the fall drawdown were the subject of a 2012-13 Lake Level

Investigation, which included the results of two winter release tests at different lake levels, a survey of dock conditions at the new winter lake level and an extension of the measurement of phosphorus levels from October through April. DES has concluded that the deeper (i.e., 7 foot) drawdown negatively impacts the lake and that the 4.8 foot drawdown will reduce these impacts.

In addition, if a relief flow release is needed to support Lamprey River winter flows, then one relief flow release event can be accommodated. Using part of the water retained, there is sufficient volume and water level to conduct a single release starting from the 4.8 foot drawdown level, but not enough starting at a lower lake level because outflow rates drop as the lake level falls. DES determined from two release tests conducted in December 2012 and January 2013 that a deeper drawdown would not allow for sufficient release flow rates. At 4.8 feet, an effective release averaging 65 cfs can be maintained for 2 days, thereby meeting the winter relief flow goal. At a deeper drawdown of 5.5 feet, the effective release was less than 36 cfs.

DES determined from sampling and analysis of phosphorus samples and from lake outlet flow conditions, that the deeper drawdown is causing phosphorus to stay in the lake, and that a shallower drawdown is likely to reduce concentrations of phosphorus, especially in the northern section. Less water is released from the northern section when there is a deeper drawdown and, at the same time, most of the phosphorus load enters the northern section of the lake.

The DES Dam Bureau routinely manages impoundments based on its assessments of snowpack and ice conditions. In order to fill the lake by summer, the DES Dam Bureau must begin refilling Pawtuckaway Lake in late January to early February even though ice is still present on the lake. The DES Dam Bureau will continue to manage spring snowmelt to balance the desire for summer full pool Mendums Pond and Pawtuckaway Lake with the demand to avoid flooding. The DES Dam Bureau has assessed the flood hazard resulting from the changed winter water level. Because of the small volume difference between the old and new winter lake levels, there is very little change in storage conditions. The storage at the new winter lake level attains the safety requirements for passing storm flows. If ice is still present at the end of March, DES can delay filling the last three feet of the pond. The DES Dam Bureau will determine storage needs and manage the dams by storing and releasing water to fill or drain these waterbodies. If an Overwintering release is not needed for stream flow management, the DES Dam Bureau may delay refilling or may conduct a release to increase available lake volume for the storage of spring runoff. As seen with Hurricane Irene, the DES Dam Bureau can operate the storage to provide for flood storage. The DES will retain its prerogative to manage the lake for human health and safety.

With the reduction of the fall drawdown by about one and one-half feet, some shorefront owners' access to the lake bottom and to their docks may change. The fall drawdown will generally reach the new winter lake level at the end of November. Management of lake levels to accommodate shorefront owners' access to deeper waters for maintaining their docks and water fronts will be addressed on an individual basis.

A field survey of dock depths was performed relative to winter ice affecting docks. UNH measured water depth at 42 docks in the southern lake area on July 2, 2011.¹ Figure I.3 displays these data which show that 59% of docks are located in a water depth of 4.8 feet or shallower. These docks will not be affected by the suggested winter drawdown of 4.8 feet. A Pawtuckaway Lake resident toured parts of the lake over New Year's Day 2012 and measured the amount of exposed lake bottom at various locations and photographed these conditions at full drawdown. DES conducted a trial of the new winter lake level beginning November 26, 2012. During the week that the lake level was held at 4.8 feet of drawdown, DES and shorefront owners examined and photographed dock conditions around the whole lake area. An estimated 25% of the docks around Pawtuckaway were in the water at this drawdown, although many of these docks were in less than a few inches of water. The Lake Level Investigation proposed to mitigate potential impacts on these docks by phasing in the new drawdown depth over a period of 4 years. This will allow affected dock owners time to assess and make changes as necessary. All seasonal docks are required by rule to be removed for five months every year at the end of boating season.

A baseline aquatic plant survey has been proposed for October 2013 to evaluate long-term changes in the distribution and composition of lake plant life. Studies have shown that winter drawdowns have mixed results in reducing undesirable plant growth. DES has conducted a study at Ashuelot Pond that indicates that species tolerant of winter freezing may replace those native species killed by this management technique. Other studies have shown that the drawdown method of aquatic plant management leaves openings for exotic and invasive species to colonize. The presence of invasive species historically requiring removal at Pawtuckaway Lake indicates that the drawdowns are at most partially successful in controlling invasive vegetation.

Change made as a result of comments: The change in the winter drawdown is described in an August 2013 Notice of Decision on Determination of Lake Level for Pawtuckaway Lake. According to the decision, the change in winter drawdown will be phased in over a four year period. DES will make no winter relief pulses during that time. A new baseline plant survey will be conducted in the fall of 2013.

¹ Pawtuckaway Lake was at 250.5 feet (0.1 ft higher than normal full pool elevation)

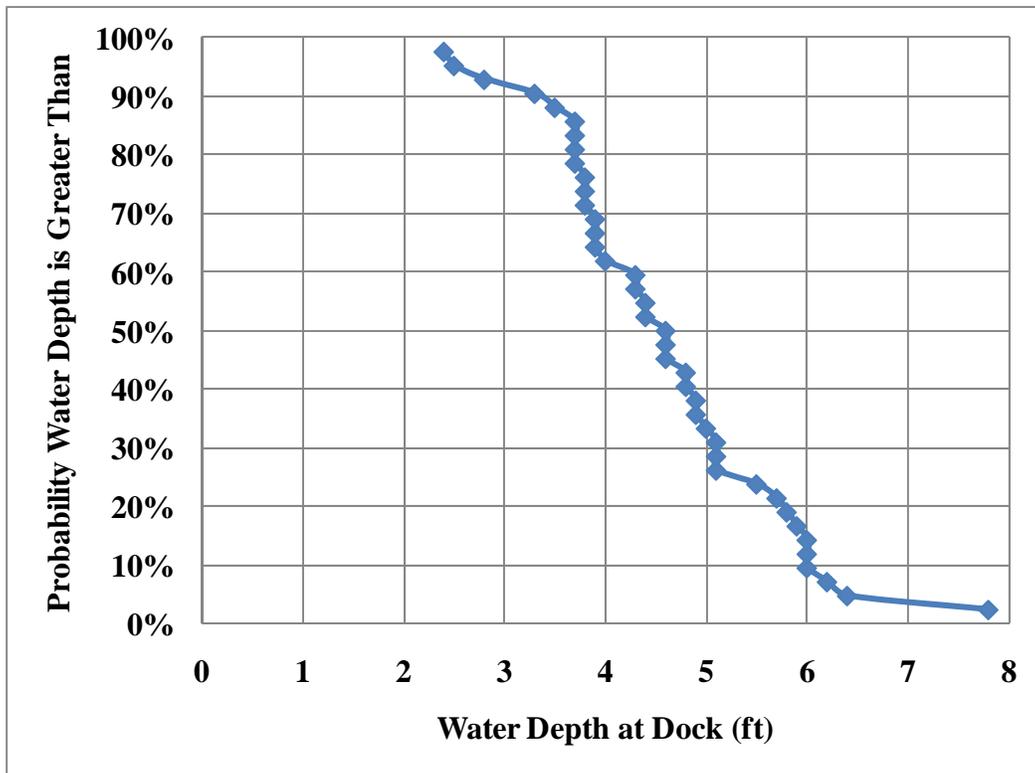


Figure I.3 Cumulative probability distribution of water depths at Pawtuckaway Lake docks on 2 July 2011.

Summer Relief Flow Releases and Lake Level Changes

Issue: Of significant concern to the commenters is the proposal to create relief flows for the Lamprey Designated River, which would result in lower water levels in Pawtuckaway Lake during the summer. The main concerns expressed in the comments are the potential effects of lower lake levels on fish, wildlife and recreation.

Response: A relief flow is additional water to raise the flow in the river for two days to a level above a particular bioperiod’s instream flow target. The relief flows in the three bioperiods from May 5 to October 6 (see Table I.1) will be created by releasing stored water from both Mendums Pond and Pawtuckaway Lake. Table I.1 also shows the anticipated water level declines as a result of relief flows. The size of the relief flows were developed by comparing the targeted instream flows² to the Lamprey River flows over a 30-year period. The relief flow volume is calculated to make up for a deficit between stream flow and the targeted instream flow in 90% of the deficit events.³

² Refer to Table 1 in the Water Management Plan.

³ A failure rate of one year in ten is considered acceptable and desirable to maintain the natural flow variability. A 20% buffer was added to offset losses from the relief pulse due to such factors as bank storage, wetlands, and attenuation by distance.

Many of the stated concerns appear to be a consequence of the perception that lake levels will change frequently or by large amounts as a result of relief flows. DES's assessment of historical stream flow conditions indicate that the occurrence of summer relief flows will be rare and will be less than 4 inches due to management.

The magnitude and frequency of changes to lake levels due to hypothetical relief flows have been estimated for a 56 year period from 1956 through 2011 (see Figure I.4.). In the 56 years, there were 33 years when no relief pulses would have occurred and thirteen more years when one relief pulse each year would have occurred. During two years, six relief flows would have been applied. The change in water level from management in these worst two years was four inches.⁴ This review shows that even in the driest years, water level changes due to management would have been within the range of natural lake level fluctuations.

Natural lake levels in New Hampshire vary between one and two feet. During the summer, Pawtuckaway Lake, even without outflow, commonly falls 6 to 8 inches. Mendums Pond may commonly fall 3 inches during the summer, but during a dry summer may fall 7 inches. DES has determined that no relief flow releases will be initiated if the combined effect of management and natural decline have or will result in a water level 18 inches below the Dolloff Dam spillway (elevation 250.4 feet) or the Mendums Pond Dam spillway (elevation 224.5 feet.) These conditions are described in the Dam Management Plans for Mendums Pond, and the Drowns and Dolloff Dams developed for this Water Management Plan.

The effects of the relief flows on fish and wildlife in Pawtuckaway Lake were discussed with representatives of the New Hampshire Fish and Game Department (NHF&GD) and their concerns were summarized in their comment letter (dated June 16, 2011). The principal concern raised by NHF&GD was the potential effect of a flow release on diadromous fish and on loons. The NHF&GD noted that the release of water from the Pawtuckaway Lake dams during the summer to generate the relief flows may initiate the downstream migration of diadromous fish, specifically alewives. Stop logs would be removed from the dam outlet structures at times during the summer to produce the relief flows. This action has the potential to provide attraction flow to juvenile alewives at a time (summer) when inhospitable conditions would exist in the Lamprey River. NHF&GD notes in their comment letter (included in this appendix) that they would not want the alewives to swim downstream into the Lamprey River until they are either mature enough or flow conditions are optimal for them to migrate directly to the ocean. The management objective for the alewives is to keep them in Pawtuckaway Lake and have them continue to grow until October, at which time they normally migrate downstream into the Gulf of Maine. Based on discussions between NHF&GD and DES, a flow-through barrier will be placed on the upstream side of the dam outlets to prevent juvenile alewives from leaving Pawtuckaway Lake during a summertime flow release.

Regarding loons, NHF&GD has documented one loon nest in the northern part of Pawtuckaway Lake and one in the southern part of Pawtuckaway Lake. DES discussed protections for loon

⁴ These water level decline estimates assume that the impoundments started at full normal pool. Should starting water levels be lower than this full pool, the water level decline would be less than 13 percent greater. Should wet weather follow a relief flow event, the water level in these lakes may be raised.

nesting with NHF&GD and The Loon Preservation Committee. The lowering of water levels more than six inches during the nesting period could prevent the loons from being able to return to their nests as they can only slide their bodies across the ground. Raising water levels during the nesting period may flood nests. As a result, NHF&GD requested that significant lowering of water levels should not occur between May 15 and July 15. This period coincides with the Clupeid and the GRAF Spawning and early Rearing and Growth bioperiods, during which time relief flow releases could potentially occur. DES has changed the Pawtuckaway Lake and Mendums Pond dam management plans to protect loon nesting during this period.

Prior to conducting any relief flows deemed necessary between May 15 and July 15, DES will request an evaluation of loon nesting conditions from NHF&GD, in coordination with The Loon Preservation Committee (<http://www.loon.org/>) and with Pawtuckaway Lake Improvement Association. Relief flow releases that would result in a cumulative reduction in water level greater than six inches will be avoided during this period if successful nesting is occurring. The Loon Preservation Committee has agreed to work on evaluations of loon nesting during the May 15-July 15 period for Mendums Pond and Pawtuckaway Lake.

NHF&GD stated that drawdowns to offset low water conditions before May 15 and after July 15 should have minimal or no effect on the loons. NHF&GD also requested that winter drawdowns not commence until after October 15 to allow loon chicks to fledge. Generally, the fall drawdown begins at about this time. Protected instream flows during this bioperiod will be maintained by the annual fall drawdown.

NHF&GD also noted that DES had not analyzed conditions of cumulative lowering of water levels from multiple relief flow releases and their effects on fish and wildlife. DES later evaluated the cumulative lake level decline during years when multiple relief flows would have been applied. From 1956 through 2011, 82% of the years had one or zero management events to which this concern would not apply. The remaining nineteen percent of the years had between two and six events. The two worst years that had six relief flows had cumulative lake level declines from management of four inches. Under those circumstances management would have been within the range of natural lake fluctuation; however, DES and NHF&GD will continue to work cooperatively to further address this concern.

The anticipated effects of the water level changes on summer recreation in Pawtuckaway Lake were considered not to be significant because the summer pool is generally managed within a one foot range around the full lake level mark. The lake generally is filled above the full pool level by Memorial Day and then may drop six to nine inches over the summer. The lake level typically declines from evaporative losses and from the small amount of leakage at the dams by as much as would occur as a result of the relief flows.

Table I.1 Relief flow releases by bioperiod from Mendums and Pawtuckaway to meet flow deficits and the calculated changes in water level from full pool.

Bioperiod	Period	Volume needed to meet 90% of historical deficits (ac-ft)	Volume needed to meet 90% of historical deficits with 20% buffer (ac-ft)	Equivalent two-day flow release (cfs)*	Change in water level from full pool using releases that meet 90% of historical deficits w/ 20% buffer (feet)	Water source
Overwintering	Dec 9 – Feb 28	216	259	65	0.65 feet – not from full pool	Mendums Pond not used. Pawtuckaway Lake release from the 4.8 foot level.
Spring Flood	Mar 1 – May 4	-	-	-	-	No active management planned
Clupeid Spawning	May 5 – Jun 19	118	142	36	0.14	from storage and drawdown
GRAF Spawning	Jun 20 – Jul 4	20	24	6	0.02	from storage and drawdown
Rearing & Growth	Jul 5 – Oct 6	47	56	14	0.05	from storage and drawdown
Salmon Spawning	Oct 7 – Dec 8	75	90	23	4.82 at Pawtuckaway and ~7 feet at Mendums	Annual fall drawdown
Mendums		265 Acres at full recreational pool				
Pawtuckaway		783 Acres at full recreational pool				
*Division of the releases between Mendums and Pawtuckaway at the ratio of 265:783 or about 1:3.						

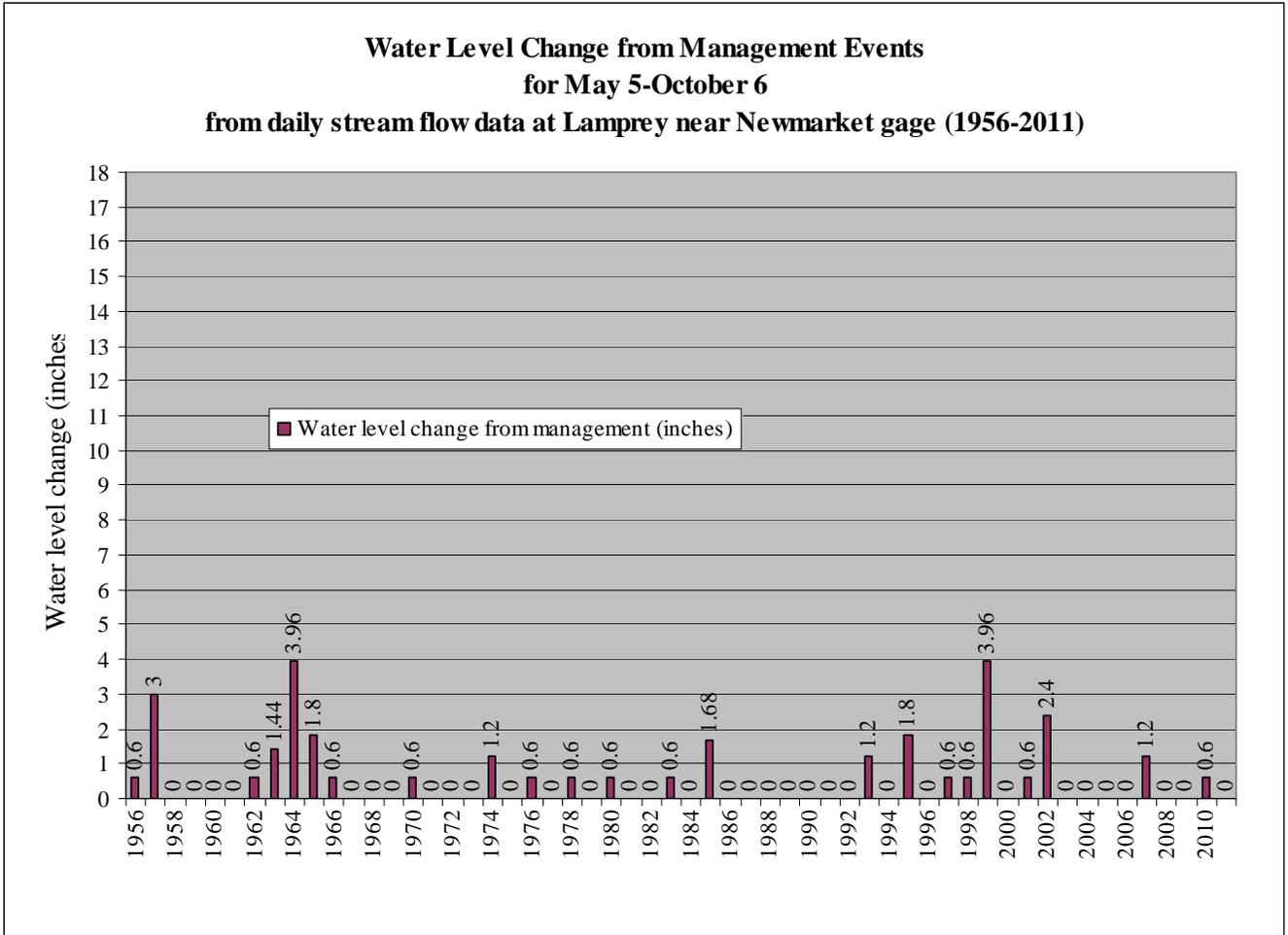
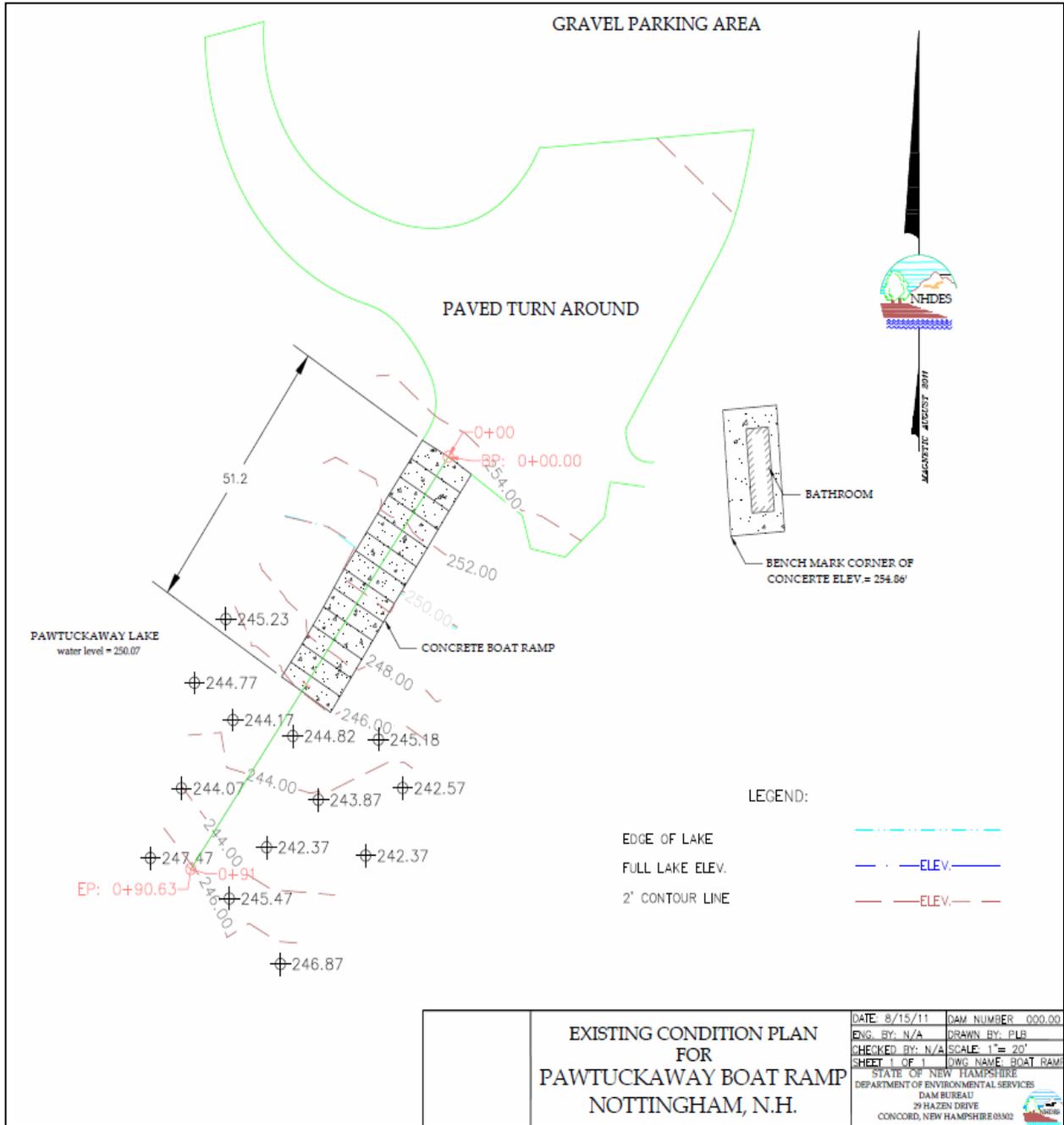


Figure I.4 Historical assessment of lake level change as a result of relief flows

Several commenters, including NHF&GD, noted that Fundy Cove is a shallow area where the lowering of water levels could be an issue to fish and wildlife residing there and could also limit the utilization of the NHF&GD’s existing public boat ramp. As described in the previous paragraph, changes in water level from management are likely to be rare and of a sufficiently small amount as to be unlikely to affect fish or wildlife. At the best of times, Fundy boat ramp is a difficult access point. DES surveyed the boat ramp at Fundy Cove to evaluate its use from a waterbody management perspective and in terms of routine lake decline effects. Figure I.5 and Figure I.6 show the results of this survey in plan view and as a cross-section of the boat ramp. A reduction in the depth and length available for boat launching would occur if the water level is lowered 18 inches, but sufficient water depth remains for use of the boat launch—approximately 40 feet of the boat launch would be in depths of at least 2 ½ feet, and most of that distance would be over 3 ½ feet deep. This would be an extremely rare occurrence.

Figure I.5 2011 Survey data and plan view at the Fundy Cove Boat Ramp.



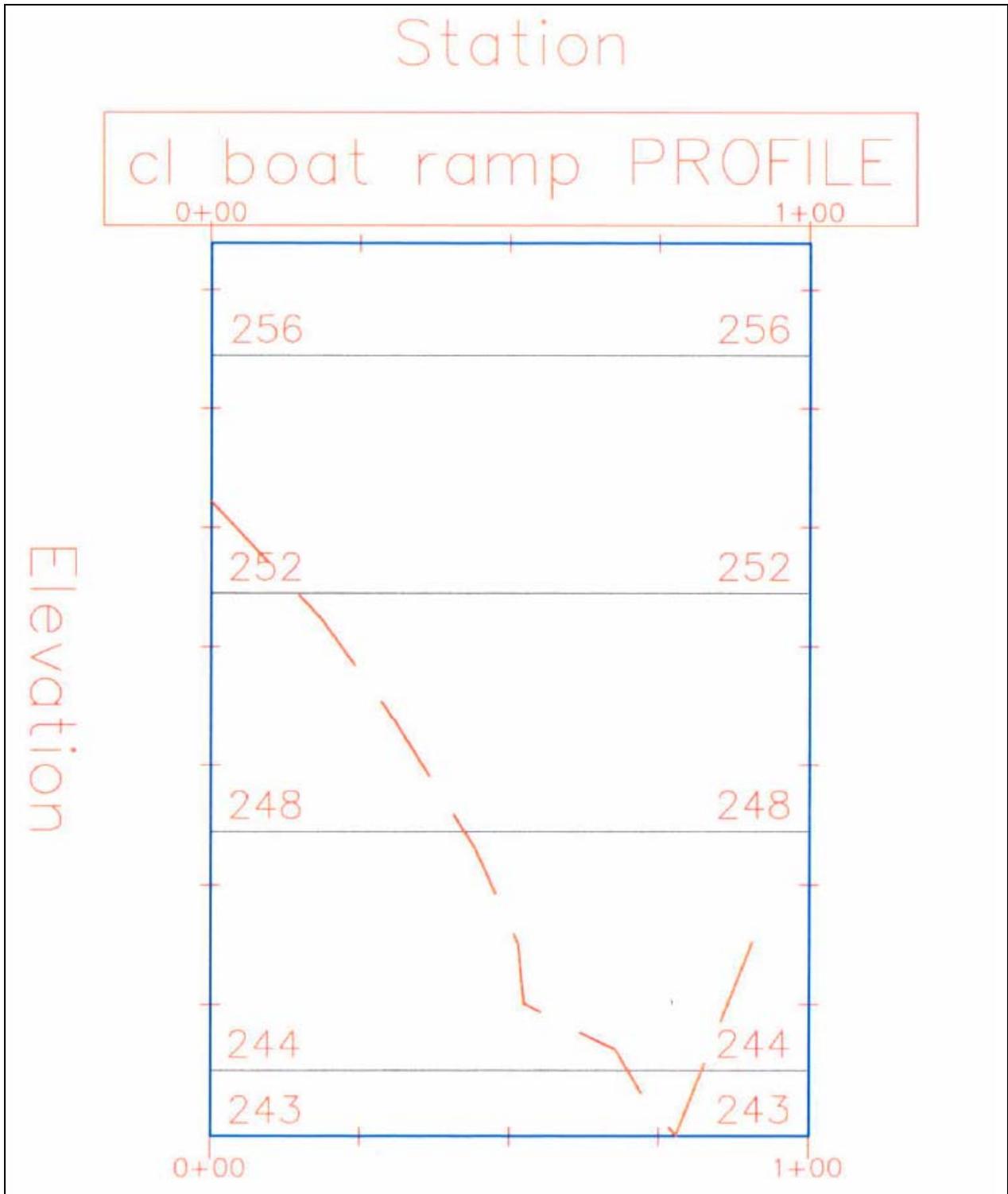


Figure I.6. Profile along the Fundy Cove Boat Ramp. Normal pool level is 250.4 feet.

In summary, the summertime relief flows that may result in up to a few inches of drawdown in Pawtuckaway Lake in addition to the routine lake level declines can be accommodated and still allow for recreational use and aquatic life support in Pawtuckaway Lake. The effects of the

relief flows on loons are manageable. Barriers can be employed to address untimely downstream alewife migration. If necessary, NHF&GD will advise DES through the adaptive management process on revisions to the Lamprey River Water Management Plan to limit negative effects on fish and wildlife. Use of the Fundy boat ramp is not likely to be compromised. The Water Management Plan acknowledges that there may be times when the relief flows are not viable, and it is the intent of the Plan to achieve the best possible outcome for lake interests and instream flow protection.

Changes made as a result of comments: Limits have been added to the amount of change in water level in order to protect recreational uses and habitat needs. Summertime (May 5 through October 6) water level changes will be limited to less than 18 inches below the full lake level. Water levels between May 15 and July 15 during successful loon nesting will not, as a result of management, be lowered by greater than six inches. DES and NHF&GD will develop a process and implement barriers for preventing alewife from outmigration during relief flow releases.

Water Quality and Cyanobacteria

Issue: Numerous comments were received regarding the effect of the proposed water level changes on the water quality of the lake, particularly water temperature, dissolved oxygen and cyanobacteria. Concerns were that lowering water levels in the summer would make the lake shallower and increase water temperature, which would, in turn, lower dissolved oxygen levels and increase the frequency of cyanobacteria blooms. Commenters expressed concern over the potential effect of an increased frequency of such blooms on recreation in the lake and at beaches located on the lake.

Response: The plan's effects on water levels are within the natural variability of lake levels. Separating the effects of management from existing water quality issues within the slight variations of water level from management will require years of water quality data, and may never be possible. However, the relief flow strategy will be reviewed in light of water quality data to determine if the Pawtuckaway Lake water levels that result from relief flows are associated with water quality degradation.

While increased water temperature during the summer was not studied in detail, the increased lake level elevation in the winter in part offsets this concern: more water in the impoundment in the winter maintains more cold thermal mass to absorb summer temperature increases. The winter water level is recommended for every year, whereas the relief flows are not. In addition, since the relief flows result in water level declines within the normal range for the lake, summer water temperature should remain within its normal range. Relief flow releases will have little effect on temperature. Similarly, dissolved oxygen conditions are affected by other factors such as thermal stratification and photosynthesis to a larger degree than by temperature.

NHF&GD expressed concerns regarding the effect that the release of water from Pawtuckaway Lake would have on water temperatures downstream and on aquatic fauna there and requested in their comments that continuous (hourly) water temperature data be collected in summer 2011 in order to make informed decisions about the effect of the water level changes on water temperature and aquatic fauna. Temperature recorders were installed in 2010 through 2013.

Long term monitoring of water temperature may be implemented to address and evaluate this concern. Temperature measurements were collected during the release test conducted in September of 2012. These measurements showed that stream flow below Dolloff Dam increased as a result of adding flow from the lake since there was very little flow prior to the release. Temperature changes in the river were compared with a tributary flowing into the lake and were within the range of diurnal fluctuations found there. Temperature effects downstream of the release disappeared within a short distance below Dolloff Dam.

There is no evidence to suggest that the changes in water level from relief flow releases will aggravate algal blooms. DES advisories for cyanobacteria in Pawtuckaway Lake have been issued during two recent years, most recently on May 27, 2011. This advisory came during a cold, rainy period in the spring of that year. Since cyanobacteria blooms are occurring now, they are obviously not caused by the proposed management plan and the existing causes are in need of attention. Cyanobacteria blooms result from a complex set of conditions that include nutrient availability and depletion, light, temperature, percent oxygen saturation, wind patterns, internal lake mixing, growth stage, and zooplankton predation. However, the chief cause is continued inflow of phosphorus to the lake.

Change made as a result of comments: DES will continue to monitor temperature during the evaluation period.

Notification of Water Releases and Water Level Changes

Issue: Several commenters asked about plans to notify property owners before any water release and requested that abutters to the Lake be notified of any water releases or water level changes in writing.

Response: DES will post a notification 48 hours in advance of planned water releases on its web site. The DES tool that tracks Lamprey River flow conditions relative to the protected flow criteria is available on the DES Instream Flow Program website. This tool uses tables and graphic forms of data to show flow conditions relative to protected flows. The tool identifies when conditions that will require flow management are imminent. DES will email notification to the Towns of Nottingham and Barrington and to the leadership of the Pawtuckaway Lake Improvement Association of an impending relief flow release.

Change made as a result of comments: The notification process is described.

Use of Survey Results in Notice of Decision on Determination of Lake Level for Pawtuckaway Lake dated December 19, 2000 to Support Water Management Plan.

Issue: Some commenters noted that they had not participated in any survey performed as part of the study done for the 2000 Notice of Decision (NOD) or for the Draft Lamprey River Water Management Plan Report. Many felt the descriptions of the NOD survey results were misleading because they were outdated, they did not represent the conditions being proposed or were misinterpreted.

Response: The NOD described the survey results. At that time there was a distribution of interests ranging from zero feet through seven feet for the fall drawdown.⁵ Most people surveyed at that time preferred a lesser drawdown. DES documented this information in the Draft Water Management Plan. A survey of current landowners was not performed as part of this project but based on the comments received on the Water Management Plan the majority of the commenters did not support the proposed water level changes.

Change made as a result of comments: Reference to the survey results from the 2000 NOD has been removed from the Water Management Plan.

Impact of Recent River Designations in the Lamprey River Water Management Planning Area on the Draft Water Management Plan and Pawtuckaway Lake

Issue: Several comments were received questioning the impact of the 2011 designation of the remaining portion of the Lamprey River and its major tributaries⁶ on the Water Management Plan and its proposed actions on Pawtuckaway Lake.

Response: The Lamprey River Protected Instream Flows and the Lamprey River Water Management Plan apply only to the Lee-Durham segment of the Lamprey River. The Water Management Planning Area begins at the Durham/Newmarket Town line as established when it was designated in 1990. The enacting legislation (House Bill 1449-A) described only this river segment for a pilot program to study and establish protected instream flows and water management plans on the Lamprey River. As a result, the additional assessment of the effect of the recent river designations is beyond the scope of the current study.

The current instream flow program, which applies to the 1990 designated portion of the Lamprey River, is a pilot program that will be evaluated and perhaps revised by the legislature and DES. The effects on Pawtuckaway Lake of the future application of the instream flow program to the upper portions of the Lamprey River cannot be defined at this time.

Changes made as a result of comments: No change.

Public Comment Recommendations and Requests for Further Study

Issue: Many of the comments received included recommendations of actions that should be taken to improve the Lamprey River Water Management Plan and studies that should be performed to further evaluate potential effects on Pawtuckaway Lake. These included:

- Developing a monitoring plan to assess overall effects due to relief flow releases;
- Developing a mechanism for feedback from lake residents and users after programs are implemented to document any observed effects;
- Consider first 24 months after Plan implemented as a trial period or pilot project during which careful assessment of effects be conducted;

⁵ Undocumented in the draft Water Management Plan was the 1992 request from Pawtuckaway residents and fishermen to reduce or do away with the seven foot drawdown as harmful to the fish.

⁶ Little River, North Branch River, North River, Pawtuckaway River and Piscassic River

- Conduct studies of weed and algae growth and drift, loon habitat, water quality and fish populations;
- Information gathered from monitoring and studies be analyzed and used to weigh the cost to Pawtuckaway Lake of implementing the Plan, which should then be revised accordingly;
- Involve the UNH Lamprey River Hydrologic Observatory, the UNH Stormwater Center and the Piscataqua Estuaries Regional Partnership in additional studies;
- Keep the Pawtuckaway Lake Improvement Association informed of activities that affect Pawtuckaway Lake and seek feedback from its members;
- Conduct additional studies to assess effects that proposed drawdowns would have on the quality, enjoyment and economic value of Pawtuckaway Lake;
- Complete an environmental impact study of the Pawtuckaway River Watershed before any changes in the management of water levels in Pawtuckaway Lake are approved or reallocation of water resources occurs; and
- Conduct an environmental impact study that considers economic impacts of the Plan, including the potential effects on visitation to Pawtuckaway State Park and the likely effects to real estate from diminished property values.

Response: DES acknowledges that monitoring is warranted to address the issues raised concerning the Lamprey River Water Management Plan. DES notes that the two-year period through September 2015 will be an evaluation period of the Plan, at the end of which a legislative review of the pilot program will occur that will include the opportunity for additional public input. As discussed in the summary section of the Plan, monitoring is recommended to determine if the desired outcomes are being achieved and, if not, how the management actions can be revised to better meet the objectives of maintaining protected instream flows and minimizing impacts.

DES will work cooperatively with stakeholders to develop targeted studies and monitoring plans to identify any impacts or unintended consequences associated with the implementation of the Plan. DES and the Pawtuckaway Lake Improvement Association conducted a test relief flow release in September 2012 at the suggestion of the Pawtuckaway Lake Improvement Association. DES also conducted two winter time release tests suggested by the Pawtuckaway Lake Improvement Association, and conducted monitoring through the fall, winter and spring of 2012 and 2013, continuing the lake water quality measurements carried out during the summer by the Pawtuckaway Lake Volunteer Lake Assessment Program. DES has scheduled an update of previous aquatic plant surveys for October 2013. DES will continue to assist local property owners, lake associations, river and watershed associations as well as regional planning and scientific research groups to develop work plans and pursue grants to fund these studies and monitoring plans.

DES has met several times with the Pawtuckaway Lake Improvement Association leaders, Nottingham selectmen and the public to present information and continue the dialogue about stakeholders' interests in lake management.

Changes made as a result of comments: DES will continue to keep the public informed about the Lamprey River Water Management Plan activities and will maintain a website to distribute

project information. DES intends to continue to discuss the implementation with the Lamprey Water Management Planning Area Advisory Committee and other interested parties during the evaluation period. Public response to conditions and effects may continue to reach DES.

In the short term, DES will develop a report on the 2013-2015 implementation period of the Water Management Plan to evaluate its effects. At the end of this period, there will be a public hearing and a legislative review of the results to date, including economic effects if any, that will be used by the legislature to determine the future application of instream flow protection measures.

Public Input and Outreach

Issue: Issues raised in the comments received on public input and outreach included various opinions: that the Plan was prepared with limited input from the affected community, other state agencies or other regional planning efforts; that the public hearing was not well advertised and many stakeholders were unaware of the management changes proposed for Pawtuckaway Lake; that the composition of the advisory committee leaned toward water suppliers and Durham town officials; and concerns that a survey of Pawtuckaway Lake residents on the lake was not conducted.

Response: Pursuant to the Instream Flow Rules (Env-Wq 1900), DES issued a public notice 30 days prior to the public hearing held in Durham on May 11, 2011. This notice was distributed to Affected Dam Owners, Affected Water Users, members of the Lamprey River Water Management Planning Area Advisory Committee and Lamprey River Technical Review Committee, Lakes Management Advisory Committee, Rivers Management Advisory Committee, the Towns of Lee and Durham and each of the other watershed towns, the Water Quality Standards Advisory Committee, chairs of the Local River Management Advisory Committees, the Senate Bill 330 Study Committee, persons who requested notification of Instream Flow Program activities along with the other parties identified in Env-Wq 1906.06 Hearing and Opportunity for Public Comment on Water Management Plans. As required under the Instream Flow Rules, DES issued a notice of the public hearing in Foster's Daily Democrat. Notice of the public hearing was posted on the DES website calendar and the Instream Flow Program's webpage.

DES and the project team met in public meetings with the Lamprey River Water Management Planning Area Advisory Committee five times during the development of the Lamprey River Water Management Plan, beginning in January 2009. The Lamprey River Water Management Planning Area Advisory Committee consists of members representing a broad range of stakeholders including: Local River Management Advisory Committee representatives; Affected business Water Users; a conservation commission member; local government officials; recreational interests; a community citizen representative; conservation interests; business interests; a state senator; a state representative; a lake association representative; public water supplier; Affected Dam Owner; and an Affected agricultural Water User. Meetings were held on July 9, 2010, February 11, 2011, May 6, 2011 and May 20, 2011 that specifically focused on the draft sub-plans and the Draft Lamprey River Water Management Plan.

DES met with members of other State of New Hampshire agencies (the DES Dam Bureau, the NHF&GD, the NH Department of Resources and Economic Development, and the Pawtuckaway State Park Manager) on March 18, 2011 to discuss the Draft Lamprey River Water Management Plan. DES met again with NHF&GD on June 1, 2011 and continued those discussions in response to the comments received on the Plan.

DES also met with the Pawtuckaway Lake Improvement Association (PLIA) after receiving comments from many of their members at the Water Management Plans public hearing. DES presented the plan at the PLIA annual meeting on June 11, 2011 and delayed the end of the comment period as requested by the PLIA. DES also suspended completion of the plan to continue dialogue with Nottingham and the Pawtuckaway Lake Improvement Association and to conduct various studies. DES conducted a public hearing as part of the Pawtuckaway Lake Level Investigation in May 2012, met with Pawtuckaway Lake Improvement Association leadership in August 2012 and in February and May of 2013, and also conducted many discussions and answered questions by email and phone. DES held a Science Round table on September 28, 2012. And DES provided an update and discussion followed by a public information meeting to answer questions on October 30, 2012.

DES also met with a subcommittee of the Lakes Management Advisory Committee and the Rivers Management Advisory Committee to address their concerns about conflicts between lakes and rivers resulting from the need to manage water resources. The Committees jointly developed and recommended a set of guiding principles for comprehensive management of lakes and rivers.⁷

Changes made as a result of comments: No changes.

2. Mendums Pond: Specific Comments or Questions

Issue: Comments specific to Mendums Pond in general mirrored those for Pawtuckaway Lake and, therefore, much of the Pawtuckaway Lake response (above) is relevant to Mendums Pond. UNH Campus Recreation commented that while their use is now from March through November, they are intending on expanding their use to up to 10 months per year. UNH commented that the effect of the current management (annual 7-foot fall drawdown) represents a safety issue in the fall and early spring. The commenter sees the management for protected flows as representing a reduction or elimination of recreational opportunities. Mendums Pond was identified as a loon nesting area.

Response: The Plan does not include any recommended changes to the fall drawdown and winter pond level for Mendums Pond, so management would not affect changes planned by UNH Campus Recreation from October 7 through May 4. DES has not yet addressed the large, 7 foot annual drawdown at Mendums Pond. Mendums Pond will be used to support relief flows only outside that period. The pond level decline due to relief flow releases is on the order of a

⁷ The document containing the guiding principles for comprehensive water resource management is available on the Rivers Management Advisory Committee blog at <http://xml2.des.state.nh.us/blogs/rmac/> and on the Lakes Management Advisory Committee blog at <http://xml2.des.state.nh.us/blogs/lmac/>.

few inches, which should not significantly impact recreation on Mendums Pond. DES has apportioned the release volumes to result in equal water level changes in each lake from a relief flow pulse. The frequencies and extent of relief flow releases are as rare and limited as described above for Pawtuckaway Lake. As described above with respect to Pawtuckaway Lake, should wet weather ultimately follow a relief flow, the Mendums Pond water level may be restored to the pre-relief flow level. Management for loons will be conducted in the same fashion as that being applied at Pawtuckaway Lake including limits on management between May 15 and July 15 during nesting, and coordinated evaluations of conditions and effects of management with NHF&GD. DES will notify the town of Barrington when a relief flow release is imminent.

Changes made as a result of comments: Limits have been added to the amount of change in water level in order to protect recreational uses and habitat needs. Summertime (May 5 through October 6) water level changes will be limited to less than 18 inches below the full lake level. Water levels between May 15 and July 15 during successful loon nesting will not, as a result of management, be lowered by greater than six inches.

3. Lamprey River Specific Comments or Questions

There were a number of comments specific to the Lamprey River focused on 1) why a minimum flow was not proposed, and 2) the basis for the proposed two-day relief flows. The comments are summarized below and responses are provided.

Minimum Flow

Issue: Several commenters noted that a minimum flow of 4 cfs was mentioned in the Draft Lamprey River Protected Instream Flow Report (dated 12/09/2008), but was not included in the final version of that report issued on July 13, 2009 or in the Draft Lamprey River Water Management Plan Report. Comments requested an explanation as to why a 4 cfs minimum flow was not included in the Draft Lamprey River Water Management Plan Report and for its reconsideration as part of the Lamprey River Water Management Plan.

Response: In the Draft Lamprey River Protected Instream Flow Report, a minimum flow value of 4 cfs was suggested, but this recommendation was not included in the final version of the report dated July 13, 2009 and was not included in the Draft Lamprey River Water Management Plan Report. The reason for dropping the consideration of a 4 cfs minimum flow was explained in the response to the comments received on the Final Lamprey River Protected Instream Flow Report:

A flow of 4 cfs was proposed as a minimum flow because it was the lowest flow observed in the river. The description of the lowest flow was a new concept in the pilot program that had not been used in the Souhegan study. The naturalized flows for the period 1976 through 2005 were observed to contain no flows lower than 3.7 cfs. The 3.7 cfs value was the lowest measured flow after correction for human effects of water withdrawals and management of Lake Pawtuckaway. The conclusion was that stream flow in

the Lamprey should not be lower than these historical naturalized flows. The 3.7 cfs value was rounded up to 4 cfs.

Management issues were not investigated in the (Protected Instream Flow) study and would have been defined for this condition in the water management plan, but the decision was made that the 4 cfs criteria were redundant under the flow protections and that flow conditions below 4 cfs would likely result in emergency conditions being declared by the commissioner. The use of a 4 cfs minimum flow as a stream flow criterion has been dropped from the protected flow recommendations.

Relief Flow

Issue: Commenters noted that the concept of relief flows was not evaluated by the Technical Review Committee and was not included in the Lamprey River Protected Instream Flow study reports. The biological rationale and efficacy of this approach was questioned along with the possible effects on Pawtuckaway Lake and Mendums Pond. It was posited that the relief flows are conceptual and untested and may be counter to the Natural Flow Paradigm. An alternative approach was also proposed, whereby the human-caused impacts on extreme low flows are quantified so that dam releases offsetting these impacts be conducted as opposed to the two-day relief flows.

Response: The relief flow concept was not presented to the Technical Review Committee as part of the Lamprey River Protected Instream Flow study because it was not part of the technical content developed during that phase of the project. The role of the Technical Review Committee was to evaluate the results of the Protected Instream Flow study and did not continue into the development of the Water Management Plan. The concepts presented in the Draft Lamprey River Water Management Plan Report were presented to and discussed with the Lamprey River Water Management Planning Area Advisory Committee (WMPAAC), which provided critical comment and recommendations.

Recreating the patterns of stream flow conditions is a major focus of protecting rivers worldwide. The duration of the relief flow was developed by studying the characteristics of the monitored river hydrograph. Figure I.7 displays the cumulative probability distribution of the duration of natural relief periods from June 20 to October 6 each year. In this figure, it can be seen that one third of the natural relief flow events last one or two days. Two days is the duration of summertime stream flow responses to small rainfall events that result in flows above the protected flow magnitudes. Longer relief flow periods might be better at supporting flow-dependent fish and other aquatic species, but doing so may unnecessarily remove water from storage.

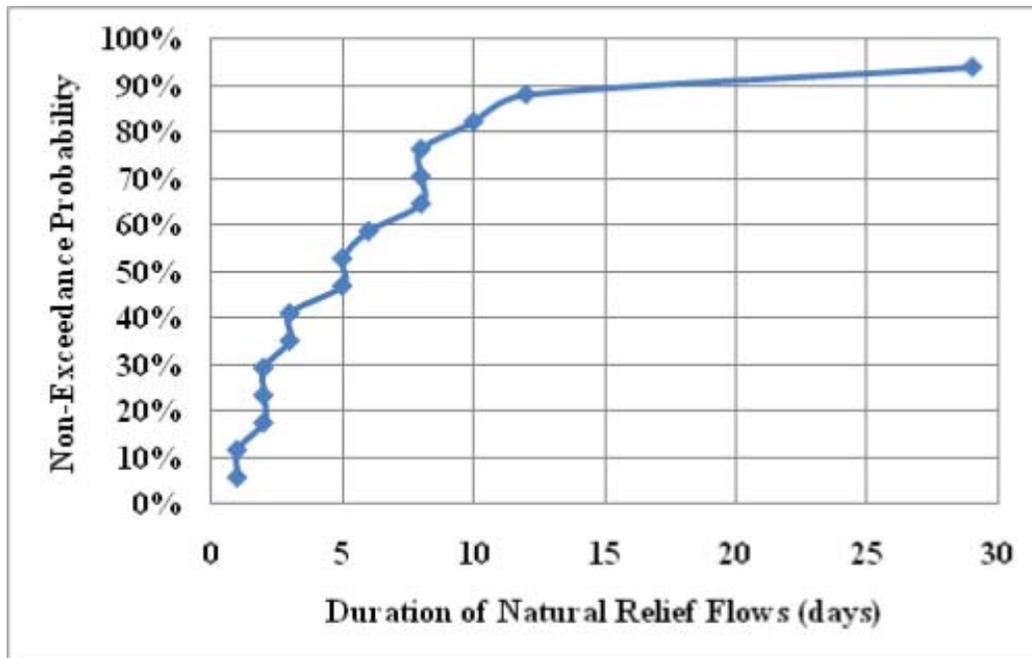


Figure I.7. Lamprey River Natural Relief Flow Durations 2000 – 2010.

Table I.2 displays other rivers where re-creating hydrologic variability is presently occurring across the United States. As the Water Management Plan is implemented, metrics such as fish numbers may support the two day relief flow, or indicate that it should last longer.

The proposed alternative of quantifying the human-caused impacts on extreme low flows and then off-setting only these impacts with dam releases is interesting, but could be more complicated and problematic. A major issue would arise in the determination of the magnitude of human impacts that are not related to direct and indirect water groundwater or surface water withdrawals. Examples of these impacts are impervious surfaces, land use changes, displacement of water by sewer systems and other actions which change stream hydrology but are difficult to quantify.

Changes made as a result of comments: No change required.

Table I.2: Summary of recent projects where flow regimes have been "naturalized"
 (from Poff et al.: *The natural flow regime: a paradigm for river conservation and restoration*; BioScience 1998)

Location	Flow Components Mimicked	Ecological Purpose	Reference
Trinity River, CA	timing and magnitude of peak flow	rejuvenate gravel habitats, provide flows for out-migrating salmonid smolts	Barinaga 1996, Trinity River Report 1997
Truckee River, CA	timing, magnitude, duration of peak flow, rate of change during recession	restore riparian trees	Christensen 1996
Owens River, CA	increase base flows, partially restore overbank flows	restore riparian vegetation and habitat for brown trout and native fish	Hill and Platts 1997
Rush Creek, CA and other tributaries to Mono Lake	increase minimum flows	restore riparian vegetation and habitat for waterfowl and non-native fish	Los Angeles DWP
Oldman River and tributaries, southern Alberta	increase summer flows, reduce rates of post-flood stage decline	restore riparian vegetation (cottonwoods) and cold water fisheries (trout)	Rood et al. 1995
Green River, CO	timing and duration of peak flow; duration and timing of non-peak flows; reduce rapid baseflow fluctuations from hydropower generation	recovery of endangered fish species; enhance other native fishes	Stanford 1994
Gunnison River, CO	timing and duration of peak flow; duration and timing of non-peak flows; reduce rapid baseflow fluctuations from hydropower generation	recovery of endangered fish species	Pfeiffer et al. 1996
Rio Grande, NM	timing, duration of floodplain inundation	ecosystem processes (e.g., nitrogen flux, microbial activity, litter decomposition)	Molles et al. 1995
Pecos River, NM	magnitude, frequency, timing	spawning signal for endangered fish	Hoagstrom et al. 1994

Colorado River, AZ	magnitude, timing	restore habitat for endangered fish	Collier et al. 1997
Bill Williams River, AZ (proposed)	mimic natural flood peak timing and duration	promote establishment of native trees	US Army Corps of Engineers 1996
Pemigewasset River, NH	do not exceed natural frequency of high flows during summer low flow season; reduced rate of change during hydropower generation	enhance native Atlantic Salmon recovery	Federal Energy Regulatory Commission 1995
Roanoke River, VA	restore more natural patterning of monthly flows in spring; reduce rate of hydrograph rise/fall	increased reproduction of striped bass	Rulifson and Manooch 1993
Kissimmee River, FL	magnitude, duration, rate of change	restore floodplain inundation to recover wetland functions and native species	Toth 1995

4. University of New Hampshire/Town of Durham Water System and Wiswall Dam

Issue: Several comments were received regarding the University of New Hampshire/Town of Durham Water System (UDWS) and Wiswall Dam. The comments focused on UDWS's Water Use Plan, its use of the Lamprey Designated River as a water supply source, its increasing dependence on the river as its water supply, the lack of discussion in the Water Management Plan of its development of an alternative water supply source and management of Wiswall Dam. One commenter questioned why UDWS was given an additional 10 days (15 day catastrophic duration plus 10 days) before having to implement a Stage 4 Alert when compared with other Affected Water Users and noted that there didn't appear to be any difference in the water conservation actions taken in the Stage 3 and Stage 4 Alerts.

Response: DES recognizes that UDWS does not fit into the standard water use patterns and conditions of many other public water suppliers. This stems from both the sources of supply outside the Lamprey River watershed and the characteristics of the water demand. Water use varies dramatically because of the student population, and UDWS has sources of water that do not impact the Lamprey River flow. UDWS has a unique water use pattern that includes peak use during September and October as opposed to the common pattern of peak use during July and August. The UDWS water use plan and conservation plan include actions affecting their water sources outside of the Lamprey River watershed. Use of these sources does not affect Lamprey River stream flow. These considerations were taken into account while developing UDWS's Conservation sub-plan and Water Use sub-plan.

UDWS changed its reliance on the Lamprey Designated River from its past use as an emergency source to use as the system's primary source beginning in late 2008. As a result, UDWS has increased its total withdrawals from the Lamprey River over the last several years. This change in use has the advantage of protecting water quality and quantity in the Oyster River. Under the Water Management Plan, UDWS will be managing its withdrawals from the Lamprey during periods of low flow.

During the development of the draft Water Use Plan, UDWS specifically requested that system capacity be considered in addition to flow in the Lamprey Designated River for triggering water use management actions. The reasoning was that the other sources (Lee Well and the Oyster River Reservoir) outside of the Lamprey River watershed are available.

Because of the availability of other sources outside the Lamprey watershed, UDWS also requested that the catastrophic duration for the Stage 4 Alert for implementing outside water use reductions be increased by 10 days. UDWS has demonstrated during the period from 2009 through to the present that they use other sources more heavily during Lamprey River low flow periods.

Stages 3 and 4 of the UDWS conservation plan are different. The major difference in the water conservation actions to be taken between the Stage 3 and 4 is that all outdoor watering is banned in Stage 4, while some limited outdoor use is allowed in Stage 3. It is worth mentioning that UDWS has never reached Stage 3 or 4 conditions.

The UDWS Conservation sub-plan notes that UDWS has developed a new water supply in the Spruce Hole Aquifer. This supply is expected to reduce its dependence on the Lamprey River, particularly during periods of low stream flow. The project has none of the supporting infrastructure in place and the well is not operational. As a result, the operation of this well was not discussed or incorporated into the UDWS Water Use Plan. UDWS's Water Use Plan may need to be revised and the Lamprey River Water Management Plan amended to reflect this new water source in the future.

UDWS, as with all the other Affected Water Users in the Lamprey River Water Management Planning Area, will be required to maintain the protected instream flows. The Town of Durham will be required to pass any relief flows released from Pawtuckaway Lake or Mendums Pond through Wiswall Dam.

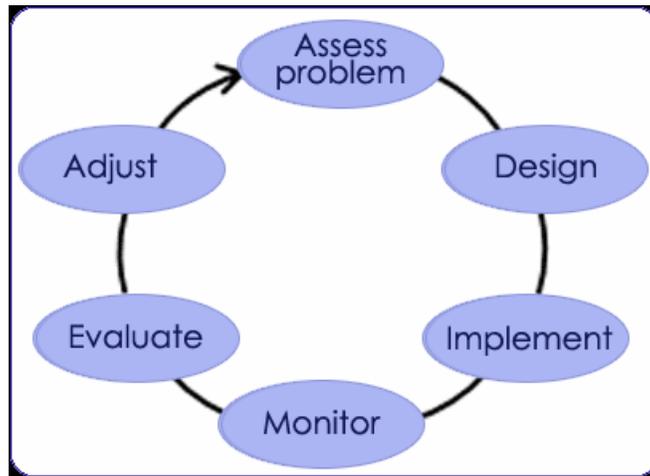
5. Public Policy Comments or Questions

Issue: Several comments were received regarding public policy issues and the Water Management Plan. Comments mentioned: a lack in confidence in the DES to manage the controlled water releases based on past experience; concern that triggers for management and decisions to pursue management actions would be automatic, with little human involvement; the desire for more local contact and input on management actions, dependence on adaptive management instead of defining solutions ahead of time; and; that the Water Management Plan is not consistent with the DES Commissioner's 2010-2015 Strategic Plan.

Response: The DES Dam Bureau has significant experience in dam and impoundment management operations and is confident that the dams on Pawtuckaway Lake and Mendums Pond can be managed to meet the requirements of the Lamprey River Water Management Plan. The DES Dam Bureau demonstrated a successful relief flow release from Dolloff Dam in September 2012 and later held the lake at the new winter lake level from November 26 through December 2 prior to another successful release test in December 2012.

Relief flow releases will be evaluated by DES prior to initiation and will not be applied without review. The public and the downstream Affected Water Users and Affected Dam Owners will have advance warnings leading up to relief flow releases. DES's decision to release water will be based on the flows recorded by the USGS gage at Packers Falls compared with the protected instream flow levels. The lake level conditions and biological concerns at the time in Mendums Pond and Pawtuckaway Lake will be factored into any decision to initiate a relief flow. A decision to create a relief flow pulse will be reviewed by the DES River Management Protected Program and the DES Dam Bureau staff prior to a management action. DES will notify the Towns of Nottingham and Barrington and the Pawtuckaway Lake Improvement Association leadership when a relief flow release is imminent. DES will be in consultation with others such as NHF&GD and The Loon Preservation Committee prior to making a release decision.

Since the Protected Instream Flows and the Water Management Plan are part of a pilot program and represent a new approach to water resource management in New Hampshire, adaptive management is an integral component. The adaptive management process, illustrated in Figure I.8, will help DES maintain flexibility in its decision making, improve its understanding of the Lamprey Designated River and guide the actions to be taken to meet the goals of the Instream Flow Program. Because of the large variability in the hydrology and site conditions, it is impossible to predict every aspect of instream flow in the watershed, no matter how long studies might last. DES is confident that the issues have been vetted enough to begin management activities. Learning from applying the management is the only way that deficiencies can be identified and corrected.



Source: U.S. Department of Interior

Figure I.8. The Adaptive Management Process.

Furthermore, the Protected Instream Flow Rules (Env-Wq 1900) provide Affected Dam Owners or Affected Water Users a petition process to make changes in the Water Management Plan (Env-Wq 1906.08) and the opportunity to request a waiver (Env-Wq 1908.01) of specific rules. DES expects to continue working with the stakeholders in the Lamprey River Water Management Planning Area during the two-year implementation period to further refine the Water Management Plan using the experience gained during implementation. In addition, the legislature will conduct a program review in 2015.

DES notes that the Lamprey River Water Management Plan is consistent with the vision of the DES 2010-2015 Strategic Plan (November 2010). The development of the Lamprey River Protected Instream Flows and the Water Management Plan are part of the overall efforts being taken by DES, as noted in Commissioner Burack’s introduction, “ensuring high levels of water quality for water supplies, ecological balance, and swimming, fishing, and boating...and managing water resources for future generations.” The development of these protections and management plans are part of the broader range of initiatives being pursued by DES to meet the challenge of Goal 2 of the 2010-2015 Strategic Plan to “effectively protect New Hampshire’s natural resources and high quality of life as the state grows.” Both the protected instream flows and the management plans provide meaningful measures to protect the natural resources of the Lamprey Designated River today and into the future.

Changes made as a result of comments: No changes required.

6. Overall Plan Comments or Questions

A broad range of comments were received on the Plan including those focused on: editorial changes or errors; support or opposition to the Plan as proposed; the deadline in the instream flow legislative statute; the extent of the study within the watershed and its level of detail; the plan’s overall credibility; the structure of individual plans; the lack of evaluation of watershed scale measures; the reallocation of water resources from the lakes to the Lamprey River; and, the plans inability to protect resources of the Lamprey Designated River.

Comments regarding specific editorial changes were reviewed and, where appropriate, were incorporated into the Final Lamprey River Water Management Plan. The Executive Summary was replaced and several other sections were revised and re-organized to improve the readability of the Plan.

Many comments were from individuals, groups or local governments associated with Pawtuckaway Lake who opposed the plan. Their opposition to the Plan was focused on the potential impact of water level changes on: docks; property values; recreation (boating and fishing); water quality; and, wildlife (fish and loons) in the Lake. Opponents of the Plan also stated it is “full of inaccuracies, undocumented and unstudied assumptions and dangerous conclusions,” is limited in scope, and will not protect the Lamprey Designated River. Most of these comments have been addressed in the 2013 Pawtuckaway Lake Level investigation and in other sections of this appendix. Comments and responses thereto, on the Lamprey River Water Management Plan not previously addressed are presented in the following paragraphs.

Several comments stated that the Water Management Plan should be scrapped or considered null and void since it had not been approved or adopted by its legislated deadline of September 30, 2010. The basis for this comment is incorrect. House Bill 588, passed by the House and the Senate and signed by the Governor in 2013, extended the instream pilot program deadlines. With this extension, the Lamprey River Water Management Plan must be adopted and implemented by September 1, 2013 and a final report documenting the results of the pilot program be submitted to the legislature by December 1, 2015. The program was extended to allow for the completion of the Plan and provide sufficient time for public review and comment, with the goal of establishing an acceptable Plan for the protection of instream flows on the Lamprey Designated River. DES notes that no one has been harmed by any delay in implementing the Plan and, therefore, the plan will be implemented when prepared. Likewise, no documentation of harm has been brought forth by the public.

Commenters noted that the scope of the Plan was limited, did not address watershed scale issues (impervious cover, future development, etc.), did not include an assessment of all water use in the Water Management Planning Area or did not consider the recent expansion of the designated reach. DES recognizes that many of these issues are important, but their consideration and analysis are beyond the scope of the Instream Flow Program statute and the required components of a Water Management Plan as defined by the Instream Flow Rules.

Several comments expressed the opinion that the Report was unrealistic, that the effects on other resources in the watershed were not fully considered, that it promotes the reallocation of resources, relies too much on adaptive management and may lead to additional management requirements in the future. DES notes that the Lamprey River Water Management Plan and its sub-plans (Conservation, Dam Management and Water Use Plans) incorporate the information as required by statute and by the Instream Flow Rules and that additional assessments were conducted that were not prescribed in order to evaluate effects of management. The Plan establishes a management plan to protect the flow-dependent entities on the Lamprey Designated River as required by statute. The Plan also has evaluated conditions on the lakes that are affected by the management plan to ensure persistence of valued characteristics and continued enjoyment of these lakes. The Plan incorporates adaptive management as a means of providing flexibility in the application of the Plan and to reflect the dynamic nature of water resource management.

One of the comments acknowledged that “a lot of work and data collection went into this analysis and it would be useful to have this raw data publicly available on the internet and presented in tables or spreadsheets (instead of PDFs) so that it can be easily used in other capacities.” DES will attempt to

make this information available via the OneStop Program on DES's website:

<http://des.nh.gov/onestop/index.htm>.

Lastly, along with providing comments and recommendations on the Lamprey River Water Management Plan, several agencies and groups noted their support of the Instream Flow Program and its goal of establishing and maintaining protective instream flows for the Lamprey Designated River.

These included:

- Lamprey River Advisory Committee
- Lamprey River Watershed Association
- National Park Service
- New Hampshire Fish and Game Department
- New Hampshire Lakes
- The Nature Conservancy

Changes made as a result of comments: No changes required.

7.0 Comments from UDWS and Responses

Comments

The University of New Hampshire and the Town of Durham sent a lengthy set of comments which is repeated here in its entirety (italics).

The following are general comments:

1. Originally, drafts of the proposed UDWS Water Use Plan, the Wiswall Dam Management Plan and the UDWS Water Conservation Plan were provided in MS Word format for UNH's and the Town of Durham's comments and as mentioned above we have been in discussion with NHDES for some time now regarding specific language. In April 2011, the bulk of the three draft plans were then incorporated into the body of the Draft Lamprey River Water Management Plan, which was provided in PDF format only, and the individual draft Plans were included in separate appendices in the PDF. This has unnecessarily complicated the comment process since now the same information exists in essentially three places with potentially three different versions making proofing of the final information very difficult. Hence, the reason most of the below comments contain three references. Does NHDES plan to maintain the format of having the bulk of the information from the three plans in the body of the Water Management Plan and entirety of the individual plans included in separate appendices? The UDWS does not feel this makes practical sense since it will make revising the information moving forward even more complicated than it already is. It is our recommendation that the body of the Water Management Plan not contain so much redundant information and instead refers to the individual plans which would be contained entirely in their own appendices.

2. The title of Table 3 on page 19 is "Affected Dam Owners", however it is a list dams not the actual owners. A column should be added that list the owner of the respective dams."

3. The discussion about manageability of instream flows and the need for it is based on a comparison of statistical analyses that were used developed the flow duration curve of the Lamprey River, projections of population increase and assumptions about water demand. It is important to bear in mind that neither regional population projections nor per capita water use can be expected to follow current trends with a

great deal of confidence. Per capita water use has been in decline since the 1970s, which is why the UDWS's water demand is only at 25% of what was projected in 1970.

4. Page 25, first paragraph in the PDF. This paragraph exaggerates the per capita use of users in the watershed (150 gallons per person per day is about 50-100% greater than the per capita use in most area Towns) and therefore exaggerates its impact on the Lamprey River. There is lack of source references to support this discussion. In addition, the last sentence states: "So on average, there is plenty of water, however often demand exceeds supply". The use of the word "often" in this statement is contrary to the lengthy preceding discussion which makes the case that demand exceeds supply infrequently.

5. Page 26, 2nd paragraph in the PDF incorrectly refers to a Newmarket gage. There is no stream gage in Newmarket. The Packers Falls gage is located in the Town of Durham, however for some reason the USGS refers to it as "near" Newmarket.

6. Page 39, 3rd paragraph in the PDF states "prior to obtaining approval for the proposed new source, but no later than June 1, 2012, UDWS will finalize its proposed Water Conservation Plan in accordance with Env-Wq 2101". A deadline of June 1, 2012 may be unrealistic; however, UDWS will commit to making a reasonable effort to finalize the proposed Water Conservation Plan prior to this deadline.

*The following comments are provided primarily to prevent an unreasonable burden from being placed on the operations of the UDWS, and to ensure that basic operational constraints do not result in an accidental violation of the **UDWS Water Use Plan**. The first page reference refers to the MS Word document of UDWS Water Use Plan (see attachment) followed by the page reference(s) in the complete PDF Water Management Plan document.*

7. Page 6, paragraph following bullet list (pages 54 and 224 in the PDF): The ability to base the 1 inch per day drawdown on a weekly average is needed in order to manage the reservoir outflow by removing 1 stop log at a time which would result in a release of "slugs" of water much like a relief pulse. This is also essential if for some reason outflow is managed with a low level gate in which case it is extremely tricky to maintain a steady drop in pool elevations.

8. Page 6, last paragraph (Page 55, 2nd paragraph and page 225, 3rd paragraph in the PDF): The notification requiring the UDWS to acknowledge within 24 hours is workable, unless the notification is received on a Friday or a weekend in which case acknowledgment will be provided on the following Monday.

9. Page 7, 1st paragraph (page 55, 2nd paragraph and page 225, 3rd paragraph in the PDF): All the language regarding DES plan to create relief flows, the estimated timing of the pulse arrive, and the estimated volume of the flow expected to arrive at the Wiswall Dam are only estimates since the operation of creating a relief flow on the Lamprey River is completely untested the UDWS is extremely uncomfortable with the prescriptive requirements prior to actual trials being conducted. The language suggests that the owner of the Wiswall Dam could create a relief flow "equal to the current bioperiod's 90th percentile event volume, but without the volume of the 20% buffer released to compensate for losses" has great potential failing and cause the UDWS to violate the conditions if the volume that arrives at the Wiswall Reservoir is inadequate. Because the concept of creating a relief flow is untested, the UDWS has little confidence that the 20% buffer released from the upstream sources will provide enough of a buffer to allow the UDWS to maintain compliance without losing a significant amount of stored water that would otherwise be available to meet public drinking water requirements. It may also require the

Wiswall Reservoir be drawn down more than 18 inches total. The following language should be inserted: “Provided that an adequate volume of water is released from upstream sources arrives at the Wiswall Dam, UDWS will make a reasonable effort to create a relief flow that is equal to the current bioperiod’s 90thile event volume, but without the volume of the 20 percent buffer released to compensate for losses”.

10. Page 7, 2nd paragraph (page 55, 3rd paragraph and page 225, 4th paragraph in the PDF): The text currently states: “When stream flows in the Lamprey are below 18 cfs, the system’s water sources will comprise the Lee Well, the Oyster River surface water withdrawal and the remaining storage within the drawdown limits of Wiswall Reservoir”. This apparently implies UDWS will be required to maintain inflow equal to outflow at Wiswall, however the designated critical flow of 18 cfs has an associated allowable duration of 15 day. UDWS proposes to use this 15 day allowable duration to begin scaling down the operations at the UNH Water Treatment Plant, and requests the ability to withdraw 0.8 cfs from the Lamprey River instream flow when flows fall below 18 cfs for a period of plus 7 days, and the ability to withdraw 0.4 cfs from 7 days to 15 days. This is necessary for the UNH Water Treatment Plant to more reasonably transition from a high to lower operational level, and to preserve the capacity in the Lee Well until absolutely necessary as prescribed on page 9, 4th paragraph (page 57, 5th paragraph and 227, 6th paragraph of the PDF).

11. Page 9, 1st paragraph (page 57, 2nd paragraph and 227, 3rd paragraph in the PDF): In order for the UDWS to impose mandatory water use restrictions, the Durham Town Council would need to adopt an ordinance to require such actions and impose penalties. UDWS shall work with the Town and UNH to establish procedures to implement mandatory water use restrictions and water conservation measures consistent with this water use plan. Discuss procedure and schedule for adopting water use restrictions as part of a new or updated Town Water Ordinance.

12. Page 9: Cost considerations (page 57 and 228 of the PDF): The following language more accurately reflect the UDWS’s true costs and should be inserted: “The management activities would be performed by UNH and Town staff and/or a consultant and the annual costs to implement and maintain the water use plan is expected to range from \$10,000 to \$30,000. The reduced water withdrawal capacity imposed by the protected instream flow program may trigger the permitting, engineering, and installation of associated infrastructure for a new water source and ranges from \$4 million to \$6 million”.

*The following comments are provided primarily to prevent an unreasonable burden from being placed on the operations of the UDWS and the Town of Durham, and to ensure that basic operational constraints do not result in an accidental violation of the **Wiswall Dam Management Plan**. The first page reference refers to the MS Word document of Wiswall Dam Management Plan (see attachment) followed by the page reference(s) in the complete PDF Water Management Plan document.*

13. Page 2, 3rd paragraph (page 46, introductory paragraph and page 191 of the PDF): Chapter 332 from 1965 referenced both the Town of Durham and UNH.

14. Page 3, 3rd paragraph (page 192 in the PDF) – The estimated volume of the impoundment of the top 12” is 12,142,211 gal or 1,623,290 CF or, 37.3 ac-ft per 8-25-10 email correspondence with Wayne Ives.

15. Page 3, 5th paragraph (page 193 in the PDF) – The primary purpose for reservoir is clearly for water supply storage and recreation is secondary. This was the conclusion of the 2003 Dufresne-Henry

study. The NH Dams Data Sheet 071.04 referenced in the paragraph needs to indicate “water supply storage” as the primary purpose. The UDWS requests that NHDES revise NH Dams Data Sheet 071.04 accordingly.

16. Page 3, 3rd to last paragraph (page 193 in the PDF) – The last sentence of this paragraph is confusing.

17. Page 3, 2nd to last paragraph (page 193 in the PDF) – There may be approximately 3 miles of river downstream of Wiswall Dam, but the vast majority of this stretch of river is impounded. This should be acknowledged here.

18. Page 3, last Paragraph – (page 46 last paragraph and page 194, 1st paragraph in the PDF): As evident in Table 6, the volume of the Wiswall Reservoir is not “large” as stated in this paragraph, 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. DES is imposing requirements based on assumed behavior the system. They also have practical problems in that no one knows or can measure how much attenuation occurs between the Pawtuckaway dams and our reservoir since the upstream gage is on a side branch of the Lamprey. It is reasonable to assume that some degree of attenuation will occur upstream of the Wiswall Reservoir, but how much? The statewide drawdown in 2009, which was used to assess the relief flow volume needed, was conducted in mid October. The antecedent moisture conditions during this time would typically have been very different from what would be expected during a drought when an actual relief flow would be considered.

19. Page 4, starting with the 3rd Paragraph (pages 47 and 194 in the PDF) – Regarding relief flows: Without conducting some actual relief flow tests that would provide NHDES and 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). What is a “controlled release”? The UDWS has proposed the accuracy as being what can be obtained by pulling a 4” stop log. What degree of control is expected? This is a natural system with natural variability. The degree of precision implied is inconsistent with the system being controlled, and this is all based on untested hypothetical information. The high degree precision of dam outflow controls will not exist to manage small changes in pool elevation. There needs to be a reasonable range of pool elevation variability by which the UDWS will be required to operate the dam.

20. Page 4 (Page 194 in the PDF): Delete the first bullet list. It is redundant with the following bullet list.

21. Page 4, bullet Item #1 (page 47 and 194, 1st bullet item in the PDF): This paragraph is confusing and it is not clear what the final phrase “whichever is less” is referring to.

22. Page 4, bullet Item #2 (page 47 and 194, 2nd bullet item in the PDF): The requirement to confirm receipt of DES’s notification within 24 hours is unrealistic for a municipality where the responsible staff may not be available, particularly if the notification arrives on a Friday or weekend. 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.

23. Page 4, bullet Item #3 (pages 47 and 194, 3rd bullet item in the PDF): Maintaining inflow equal to inflow on an “instantaneous” basis would require a staff person to continually reside at the dam and is simply unrealistic. The alternative approach proposed in the Water Use plan, and as suggested above, the following language should be considered here: “Provided that an adequate volume of water is released from upstream sources arrives at the Wiswall Dam, UDWS will make a reasonable effort to create a relief flow that is equal to the current bioperiod’s 90%ile event volume, but without the volume of the 20 percent buffer released to compensate for losses.” However, UDWS would prefer to simply agree to cooperate with NHDES to develop reasonable relief flow protocols based on experience from actual relief flow trials.

24. Page 5, bullet Item #4 (pages 47 and 195, 4th bullet item in the PDF): The outflow weir will be self-regulating, and if the UDWS is not withdrawing then we do not plan to pull additional stop logs.

25. Page 5, bullet Item #5 (pages 47 and 195, 4th bullet item in the PDF): The water level drop is proposed to be based on a 7 day average of 1 inch per day.

26. Page 6, bullet Item #6 (pages 47 and 195, 5th bullet item in the PDF): Again, this level of monitoring will require a staff person to reside continuously at the dam. Automated measurements will consist of pool elevation at the Pump Station and flow at the Packers Fall USGS gage.

27. Page 6, 2nd paragraph (page 48 and 196 in the PDF): The paragraph regarding cost needs to be revised to more accurately reflect the Town of Durham’s true cost with the following language “The estimated annual 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, and is expected to range from \$200,000 to \$400,000 in infrastructure improvements (dam outflow controls) and \$10,000 to \$100,000 for operation and maintenance”. NHDES recently informed the UDWS that they have changed its plan to nullify or supersede Durham’s §401 Water Quality Certificate upon adoption of the Lamprey River Water Management Plan, and instead has suggested that they would prefer to modify to the Certificate’s language to simply refer to the Lamprey River Water Management Plan. As recently as October 2010, the Administrator of the Watershed Bureau, Paul Currier, informed the Durham Town Council that the §401 Water Quality Certificate would become null and void upon adoption of the Lamprey River Water Management Plan. The basis of nullifying the Certificate is because ALL the conditions included in the current Certificate will be updated and incorporated into the Water Management Plan. Once the Water Management Plan is adopted, the Certificate will serve no practical purpose and would only perpetuate unnecessary bureaucracy and redundancy regulatory oversight if maintained in some modified form. The UDWS insists that NHDES proceed with nullifying Durham’s §401 Water Quality Certificate upon adoption of the Lamprey River Water Management Plan as was promised to the Durham Town Council.

Responses

The UDWS comments were categorized into groups referring to the Water Management Plan in general, and to the UDWS Water Use Plan and the Wiswall Dam Management Plan. DES replied separately to some of UDWS’s comments in a letter on August 26, 2011. The discussion below and the DES letter summarize DES’s responses to these comments.

Water Management Plan Comments with responses

DES and UDWS have had continued dialogue which has resolved the comments received concerning their Water Use Plan. DES has made substantial changes to the form and content of the Water Management Plan in response to UDWS's comments.

1. UDWS suggests that the report should not summarize the plan information in the body of the text.

DES response: This approach allows a comprehensive overview of the parts and will be retained.

2. UDWS suggests the addition of owners names to a list of dams.

DES response: Owner's names will be added.

3. UDWS states that water use projections suggesting the need for management are not certain.

DES response: Regardless of the figures used, management is needed to meet the protected flows under existing use and watershed conditions.

4. UDWS objects to certain details of per capita water use in the discussion of water demand impacts on the Lamprey and to the characterization as "often" of the occurrences of water demand exceeding flow based on the earlier discussion. (1st P. on p. 25)

DES response: The per capita values are conservative estimates of water use and do not affect the implementation of the Water Management Plan. The value of 150 gallons is frequently used to estimate required flows for new developments.

The point is being made that low flows that exceed water demand are common enough to be of concern. This text has been revised.

5. UDWS objects to referring to the Lamprey River near Newmarket gage as the Newmarket gage

DES response: Text has been changed to say "near" Newmarket.

6. UDWS characterizes the deadline for the Conservation Plan by June 1, 2012, as possibly unrealistic, but will make a reasonable effort to complete it by that date.

DES response: DES appreciates the continued effort to develop a UDWS Conservation Plan and will continue to provide whatever support is appropriate.

UDWS Water Use Plan

7. UDWS states they need the impoundment drawdown rate extended from a daily to a weekly average because management by gates and stoplogs is too coarse. (p.6, draft WUP).

DES response: When management is needed there are three mechanisms at Wiswall Dam that may be used singly or in combination to manage outlet flows: an outlet notch, the Denil fish ladder gate, and two low-level outlet gates.

DES recognizes that UDWS has had little experience with management of these dam outlet controls constructed in July 2011 and that a test period is warranted to try various configurations to meet outflow requirements. DES expects that management actions will not meet the management goals continuously. However, relaxing management actions will not result in meeting management goals.

The ideal management would maintain only as much outflow as is needed to match inflow. Using stoplogs in the outflow weir may make it difficult to maintain a steady drop in pool elevations. Releases by stoplog removal are likely to be represented as a increase in flow followed by a gradual decline as water level behind the dam drops.

DES agreed to a drawdown rate of 1 inch per day after discussions with UDWS. Several years ago during a rapid drawdown for repairs, Normandeau Associates noted that rapid drawdown between 12 inches and 18 inches had stranded aquatic species above the water line and flushed other aquatic species out of their wetlands habitat. UDWS has proposed a 1 inch per day drawdown averaged over a week, recognizing potential difficulties in creating the ideal management conditions. The worst case scenario under this proposal would be a large release and withdrawal resulting in up to a 7 inch drawdown in less than a day. This would be followed by a week of flow equal to inflow less UDWS's withdrawal, and the cycle would be repeated the following week. DES's goal is to match outflow with inflow more closely than a seven day average would allow.

The goal of one inch per day will be retained while allowing for a period of testing various configurations of the outlet structures to meet outflow goals. UDWS will operate the withdrawal and Durham will operate the dam to maintain outflow such that Wiswall Reservoir levels are commensurate with inflow. Adaptive management will be applied using experience gained through testing the operations of the outlet structures. DES and UDWS will arrive at a final rate of change goal for managing Wiswall Reservoir based on testing existing and alternative outflow configurations and their effects on aquatic life and habitat.

8. UDWS staffing hours during the work week means that acknowledgement of DES release plan notifications within 24 hours only works Monday through Thursday.

DES response: DES will issue a preliminary notification 72 hours in advance of an anticipated relief flow pulse, which will allow UDWS to schedule appropriate personnel.

9. UDWS states a lack of confidence in the arrival of sufficient relief flow volume and is concerned that they will be responsible for providing the difference. UDWS suggests the option of making a "reasonable effort" to pass the relief flows below Wiswall provided that an adequate volume is released.

DES response: UDWS need only pass the relief flow that arrives at the Wiswall Dam. UDWS is not responsible for making up any deficit in relief flow volume. Language to this effect will be added to the Water Use Plan.

DES's goal is to release from upstream and then pass through Wiswall Dam a pulse of water that exceeds the protected flow magnitude for two days following a catastrophic condition. These pulses are called relief flows.

DES determined the relief flow volumes that will be released so as to meet or exceed the requirements of the protected flows at the USGS gage downstream of Wiswall Reservoir. It will be up to DES to release sufficient flow such that an adequate volume arrives at Wiswall Reservoir.

UDWS must pass only inflow as it arrives from relief pulses until it exceeds the protected flow. If insufficient flow arrives at Wiswall, no water from storage must be passed to make up for any deficits in relief flows.

UDWS's Lamprey Flow Monitoring Plan states that they can calculate inflow based on change in impoundment level, the USGS gage flow rate and the UDWS withdrawal pumping rate. UDWS may withdraw water from Wiswall storage at any time. UDWS may take water from Wiswall storage during a relief pulse provided it can quantify and release the relief pulse inflow that arrives at Wiswall Reservoir.

UDWS does not need to operate Wiswall Dam to release the relief pulse if outflow is maintained to equal the inflow (i.e., the water level does not increase.) A relief pulse that is attenuated by the outlet structures at Wiswall Dam will require UDWS to operate those structures to pass the pulse within the two day period. If water is already passing over the spillway, this requires no further action. However, if UDWS is withdrawing water or water is not above the spillway, the relief flow would be partially or completely captured and the gates or stoplogs should be operated to release the relief flow.

Tests under actual low flow conditions were conducted by DES. Testing was necessary to confirm the time lag between release and arrival at Wiswall Dam. The time between the release and arrival at the USGS gage three miles downstream was measured at 23 hours in 2009. During tests in 2012 and 2013, pulses arrived 17 to 18.5 hours after the release. UDWS participated by evaluating Wiswall Reservoir water levels during these tests.

10. UDWS requests a 0.8 cfs allocation for 7 days after other water users are out of the river at 18 cfs and 0.4 cfs allocation for the next 8 days instead of using Oyster River Reservoir or Wiswall Reservoir storage.

DES response: Based upon further discussion with UDWS this will not be part of the UDWS WUP.

11. UDWS agrees to work with the Town Council and UNH to put summer time water use reduction into their ordinances.

DES response: Thank you. DES appreciates the work of UDWS to achieve these reductions and will be glad to provide assistance to UDWS and the Durham Town Council.

12. UDWS describes the costs of this part of the Water Management Plan to reflect permitting, infrastructure, and engineering costs for a new water source valued at \$4 million to \$6 million.

DES response: UDWS explained that this is the cost of developing and permitting the Spruce Hole well. Applying these costs to the Water Management Plan assumes that the additional water source is needed only because of the ISF program. DES believes instead that UDWS is anticipating increased water demands and acknowledging the desire for diversification of sources to reduce risk.

Currently, the Lamprey River Water Quality Certification #2001-001 regulates withdrawals from the Lamprey River when stream flows are below 45 cfs. The adopted Water Management Plan will expand the availability of water by increasing the volume of water available at lower flows, and by increasing the useable storage in Wiswall Reservoir. Management activities by UDWS during water withdrawals under the Water Management Plan will be less frequent than those required under the Water Quality Certification because they apply only under more rarely occurring conditions.

Wiswall Dam Management Plan

13. UDWS wants to include UNH into the list of entities granted water in the 1965 legislation.

DES response: The statute (Laws of 1965, Chapter 65) includes only the towns as authorized to use water from the Lamprey River, not the University. UNH's status under this legislation does not affect the Water Management Plan components for UDWS or Wiswall Dam.

14. UDWS revises the estimated Wiswall storage between 6 inches and 12 inches upward by 6% from initial estimates, citing documentation in a subsequent email of August 25, 2010.

DES response: The revised value has been used in the Water Management Plan.

15. UDWS requests that the primary purpose of Wiswall impoundment be changed from recreation to water supply.

DES response: DES described the procedure for changing the primary purpose to UDWS at the April 6, 2011 meeting. This request must be sent to the DES Dam Bureau. The Dam Bureau has stated that they would approve such a request. The Water Management Plan will retain the current information until an official change is made.

16. Confusing last sentence on p. 193, third to last paragraph. “Alternatively, water withdrawal may lower water levels in the impoundment below the spillway, thereby requiring operation of the dam to maintain downstream flows.”

DES response: This section has been revised.

17. UDWS wants the report to note that the larger part of the three river miles below Wiswall is impounded.

DES response: Implied in this request is that flow downstream of Wiswall Dam is not very important. Water quality standards apply to all surface waters. This comment has no bearing on the Dam Management Plan.

18. UDWS disputes that Wiswall impoundment is large enough to attenuate the relief flows. UDWS then points out that DES assumes that the water released from upstream dams will be passed downstream to Wiswall.

DES response: Attenuation of the relief flows into longer and lower volume pulses will occur when a relief flow does not have access to the spillway or another outlet capable of passing these flows due to low water levels in Wiswall Reservoir. The volumes of two bioperiods’ relief flow pulses could be stored in Wiswall Reservoir if the starting Wiswall water level is at 18 inches below the dam crest. These relief flows would be essentially captured under these conditions if an appropriate outflow is not maintained.

Larger relief flow pulses will occur during the Clupeid Spawning, the Overwintering and the Salmon Spawning bioperiods. Passage of these larger pulses will also be significantly attenuated if required to pass through the outlet notch without adjusting the stoplog level to maintain Wiswall Reservoir outflow equal to inflow.

Attenuation of the relief flow before it arrives at Wiswall Reservoir is possible and DES has accounted for some attenuation between the points of release and Wiswall Dam. The volume released reflects a buffer estimated to offset this attenuation. Testing of the relief flow effectiveness was conducted in September and December 2012 and January 2013. Testing was not under low flow conditions. Under these conditions, DES observed the flow releases passed through Wiswall Reservoir with minimal attenuation. Further testing under low flow conditions will be needed and will be conducted on those occasions. Adaptive management will be applied if release volumes or timing need to be adjusted based on the results of these tests.

DES does not expect UDWS to use any stored water to create the relief pulse, only to pass the pulse that arrives at the Wiswall Reservoir.

19. UDWS states that DES is unreasonable to expect UDWS to pass the relief flows since UDWS cannot manage outflows accurately.

DES response: DES believes that UDWS, with the additional structures related to the fish ladder construction, has the ability to pass the relief flow pulses and manage flows to

offset the effects of pumping withdrawals when expected. The July 2011 construction of an outlet notch with stoplogs, a Denil fish ladder with a gate, and the replacement of the two existing lower level gates create mechanisms for managing outflow that were not available in the September 2010 trials using only the older lower level gates, which were then in disrepair.

20. UDWS suggests deletion of a list as redundant to another list on Page 4 (Page 194 in the PDF).

DES response: The first list is a summary. The following text expands on that outline. No change will be made.

21. UDWS does not understand the text saying, “whichever is less” in the first management condition applying to passing flow on Page 4, bullet Item #1 (page 47 and 194, 1st bullet item in the PDF.)

DES response: The text has been revised.

22. UDWS staff is not available to confirm receipt of notification within 24 hours on Fridays or weekends. UDWS wants 48 to 72 hours advanced notice.

DES response: DES will issue a preliminary notification 72 hours in advance of an anticipated relief flow pulse.

23. UDWS does not want to commit to passing the relief flows. UDWS would prefer to agree to cooperate with NHDES to develop reasonable relief flow protocols based on experience from actual relief flow trials.

DES response: UDWS will attempt to pass the increase in flows arriving at Wiswall impoundment. Adaptive management will be applied if initial attempts fail. Adaptive management is part of the Water Management Plan provisions as are trials of the volumes and the timing of relief pulse flows arriving at Wiswall Reservoir.

UDWS will base trial releases on measurements of inflow based on the process described in the Lamprey Flow Monitoring Plan developed to meet conditions of the Lamprey Water Quality Certification. DES will work with UDWS to evaluate and adjust release conditions based on trial runs.

24. UDWS does not plan to manage the stoplogs if they are not pumping because the outflow weir will be self-regulating.

DES response: It is not clear how UDWS will cause the outflow weir to be self-regulating. If the outflow weir constricts inflow from passing downstream, management will be needed. If not, then no management will be required.

When the water level is over the spillway, additional flow resulting from a relief flow pulse would not be delayed and no management would be required. Whether currently pumping or not, water levels below the spillway will require flow to pass through the outflow weir that was constructed in July 2011. As long as outflow equals inflow, no stoplog management will be needed. Larger volumes of flow change attempting to pass through the outflow weir may be constricted. To pass some of the relief flow pulses, management of the stoplogs to meet the relief flow conditions may be necessary.

25. UDWS proposes the rate of water level decline of 1 inch per day be averaged over 7 days.

DES response: The rate of decline will be 1 inch per day during a period of adaptive management to test the effectiveness of the management processes. See response to Comment 7 also for more discussion.

26. UDWS states that limiting the drawdown to 18 inches overall and 1 inch per day would require extensive staff time. UDWS states that automated measurements will consist of pool elevation at the Pump Station and flow at the USGS gage.

DES response: UDWS later notified DES that a water level recorder has been installed at the UDWS withdrawal point on the river. This is a component of UDWS's Lamprey Flow Management Plan to measure inflow under their Water Quality Certification # 2001-001.

UDWS has not yet provided DES with results from calculating inflow under UDWS's Lamprey Flow Management Plan and reserves the need to make changes based on demonstrated results. DES has calculated withdrawal rates equivalent to 1 inch of drawdown per day and these calculations can be used by UDWS. By managing pumping and dam operations to match these rates, staff time will be minimized. UDWS will be developing an Standard Operating Procedures (SOP) document for determining inflow to Wiswall Reservoir and for determining the necessary outflow configurations of the dam to match inflow.

27. UDWS attributes the costs of the Water Management Plan to include the cost of infrastructure improvements for the dam outflow controls at costs from \$200,000 to \$400,000 and \$10,000 to \$100,000 for O&M.

DES response: UDWS indicated at subsequent meetings that these changes are the costs for installation of the Wiswall Dam fish ladder, outlet notch and low flow gates. These values of \$200,000 to \$400,000 should not be attributed solely to the Instream Flow program. The fish passage construction was necessitated by other state and federal requirements and was largely paid for with federal funding (including a significant local match).

The management plan will require additional time for UDWS employees to operate the dam outlet structures during a flow relief pulse since these pulses are new conditions, so there is an increased cost. However, these conditions requiring management are rarely encountered. In addition, the fish passage system will also require management.

Without further input from UDWS, DES's original estimates will continue to be used in the plan.

28. Lamprey 401 Water Quality Certification #2001-001 – UDWS insisted on not having a 401 Water Quality Certificate.

DES response: Text referring to the status and application of the 401 Water Quality Certification (WQC) relative to the Water Management Plan has been struck from the WMP; statements that the 401 WQC applies still remain in the historical documentation.

Issuance of the WMP does not relieve UDWS from its federal 401 WQC requirements. However, the 401 WQC will be revised to say that, after its adoption, the Water Management Plan will become the effective description of water use management applicable under the 401 WQC.

DES additional comments:

29. DES is concerned with the use of demand/capacity ratios that UDWS has added to the plan to determine outside water use stages

DES developed plans for outside water use reductions tied to Lamprey River stream flow stages to reduced demand. Outside water use reductions are in effect from May 5 through October 6 when limited source water availability corresponds with low river flow periods according to criteria described in the Durham UNH Conservation Plan.

Earlier in the development of the Water Use Plan, UDWS suggested adding demand/capacity ratios as additional criteria for determining the stage conditions when the outside water use conservation would begin. DES believed the additional criteria were justified because UDWS has water sources outside of the Lamprey watershed not affecting flow in the Lamprey and because UDWS has a unique seasonal water use pattern whereby the highest demand occurs in September and October.

However, these additional criteria add unneeded complexity to evaluating conditions for reducing outside water use reductions. DES suggests the removal of these criteria.

If retained, the application of demand/capacity criteria to this plan needs to be further evaluated as to the values used and how the ratios are to be assessed. DES reserves the right to re-evaluate these criteria with UDWS as UDWS continues to develop this process. Development, with DES involvement, of the demand/capacity ratio algorithm is a requirement under UDWS's Water Use Plan.

8.0 Received Written Comments

All received written comments may be found Appendix J.