

## **APPENDIX 14**

### **Formal Comments and DES Responses**



**Formal Comments Received From:**

- Mr. Paul Chamberlin and Mr. David Cedarholm, UNH/Durham Water System
- Ms. Michelle Daley, NH Water Resources Research Center
- Emery & Garrett Groundwater, Inc.
- Mr. Jamie Fosburgh, National Park Service
- Mr. Sean Greig, Town of Newmarket Department of Public Works
- Mr. James MacCartney, Lamprey River Technical Review Committee
- Mr. Dennis McCartney, Town of Raymond Public Works Department
- Dr. William McDowell, NH Water Resources Research Center
- Dr. Loren Meeker
- Ms. Sharon Meeker, Lamprey River Advisory Committee
- Mr. Carl Spang, Lamprey River Watershed Association



## **Comments Received From:**

Mr. Paul D. Chamberlin, P.E.  
Assistant Vice President  
Energy & Campus Development  
University of New Hampshire

Mr. David Cedarholm, P.E.  
Town Engineer  
Town of Durham

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**Source:** Letter dated Monday March 2, 2009.

## **Comments/Questions**

### **A. Did DES Apply the Correct Factors (IPUOCRs) in Establishing Protected Instream Flows as Required by State Law?**

#### **Comment UDWS-A-1:**

DES did not factor the UDWS needs into its analysis of PISFs. RSA 483:9-c requires that both instream public uses and uses for which the River was designated under the Rivers Management and Protection Act be maintained and protected. We appreciate that it is difficult to reconcile all of the protected uses in establishing PISFs, but the Town and UNH's public water supply is both an instream public use and a key reason why the River was designated in the first instance. However, the Report has not considered the needs of the UDWS at all in establishing protected flows.

#### **Response:**

DES agrees with the UNH/Durham, Newmarket water systems and others that public water supply is to be protected as part of the instream flow rules. DES and public water suppliers (PWS) have an interest in defining a process that will protect the long-term interests of PWS. DES disagrees that that protection should be done by defining a protected flow for PWS. DES must avoid an allocation scenario which goes against riparian rights and the public trust, and that will ultimately not satisfy PWS future demands.

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an IPUOCR (protected entity) list which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration,

this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by UNH/Durham or any other water user) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES Publication WD-09-13). By maintaining the essential characteristics of the natural flow regime, a public water supplier's opportunity to withdraw water is protected. Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

However, consumptive uses, notably public water supply withdrawals, will change the flow regime. This will require flow management to offset the impacts. The greater the consumptive use, the more management will be required.

The management for public water supply protection will be evaluated as part of the second phase of this study in the development of the Lamprey River Water Management Plan. Conservation, water use management and impoundment management are all components of a Water Management Plan that work together to maintain the important characteristics of the natural flow hydrograph while providing coordinated opportunity for water withdrawal among riparian owners. This is the appropriate place for protecting public water supply interests. DES also believes that maintaining the essential characteristics of the natural flow regime will the public water supply's opportunity to withdraw water.

#### **Comment UDWS-A-2:**

Further, the rules that prescribe how DES is to establish PISFs require that DES identify and catalog all outstanding characteristics, all instream public uses, all designated uses under the Federal Clean Water Act, and all resources listed under RSA 483:6, IV(a) for which the River is designated.

Public water supply is an instream public use that must be considered in establishing PISFs. The statutory definition states that instream public uses "shall include the State's interest in surface waters, including, but not limited to, navigation; recreation; fishing; storage; conservation; maintenance and enhancement of aquatic and fish life; fish and wildlife habitat; wildlife; the protection of water quality and public health; pollution; aesthetic beauty; and hydroelectric energy production." See RSA 483:9-c, (I). While this list does not specifically mention public water supply, that is certainly part of the "State's interests in surface waters," and it is also consistent with the protection of "water quality and public health." Moreover, the list is not all inclusive, in any event. Instream public uses include, but are not limited to, the particular list.

Furthermore, the PISFs must protect the uses for which the River was designated. As set forth in both the 1989 River Nominating Form submitted by the Lamprey River Watershed Association (see Attachment 1), and the DES Report to the general court on the Lamprey's designation dated July 1990 (see Attachment 2), the UNH/Durham water supply is an important factor underlying the River's designation.

In Env-Ws 1905.03, DES is also required to use any comments received during the public hearing and comment to review the proposed protected instream flow relative to certain factors, these include outstanding characteristics set forth in RSA 483:1, the factors listed in RSA 483:6, IV (a), instream public uses, resources for which the River is designated, and other information relevant to the proposed protected instream flows. Env-Ws 1905.03(b) (1,2,3,10,14). The comments that the UDWS is providing herewith relate in large part to its public water supply. Those comments must be factored into the PISFs because public water supply is an outstanding characteristic, identified in RSA 483:1, it is a community resource which is listed under RSA 483:6, it is an instream public use, it is a resource for which the River was designated, and, in any event, it is very relevant to the proposed protected instream flows.

Notwithstanding the requirement that public water supply be considered in establishing PISFs, the actual basis -- the “determinant (*sic*) factors” (see page 1 of the Executive Summary) -- for DES’s proposed PISFs disregards the public water supply needs for the UDWS and focuses exclusively on aquatic species.

### **Response:**

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by UNH/Durham or any other water user) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

### **Comment UDWS-A-3:**

It is not clear from the statute or regulations what standard DES must apply in determining the appropriateness of the proposed PISFs. The underlying statutory requirement is clear that instream public uses and designated uses must be protected. Under that broad requirement, the proposed PISFs are insufficient in that they do not protect the UDWS public water supply. Moreover, RSA 483:9-c, III specifically requires that DES assess the effect of protected instream flows on existing water supply. This requirement is carried forward in the regulations as well, in Env-Ws 1905.04(b) (4).

**Response:**

One standard DES uses to define the PISFs is that of biological integrity. Biological integrity is defined in Env-Ws 1700 Surface Water Quality Standards as the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.\* To identify the community of species, DES developed a Target Fish Community for the Lamprey River using a composite of comparable, high quality streams in the region as the index of biological integrity for fish. For recreational use, DES used the current habits and preferences to determine flow levels that will protect recreational interests. For riparian wildlife and vegetation, the standard is maintaining frequency and magnitude of flows sufficient to provide life-cycle needs for their existing locations. There is no similar standard for the increasing demand of public water supply. Any prescribed level of flow protection must continue to migrate with increasing demand or it will not meet UDWS flow needs.

The Instream Flow Program has two components. Currently only the first part has been developed. The protected flows describe the criteria for flows to protect instream uses. These will be protected by implementing management that will be described in the second component. Without implementation under a Water Management Plan there are no impacts to existing uses by establishing the protected flows alone. This is because water use and management is a watershed-wide activity, not relying on the use or management by one facility to define an impairment or to manage for protection. Unless they were the only water user in a watershed, no single water user would be responsible for not meeting the protected flows, and neither will they be solely responsible for management.

\*Biological integrity is a Surface Water Quality Standard required by Env-Wq 1703.01(b) that says that “All surface waters shall be restored . . . to maintain the chemical, physical, and biological integrity of surface waters.” Use of these standards is supported by the intent of the Rivers Management and Protection act stated in RSA 483:2: It is the intent of the legislature that the New Hampshire rivers management and protection program shall complement and reinforce existing state and federal water quality laws.

**B. Are the Technical Aspects of the Report Sound and Does the Report Provide a High Enough Level of Confidence in the Study?****Comment UDWS-B-1:**

The purpose of the PISF Study is to apply the best available science to develop an approach that will protect and maintain existing instream public uses, outstanding characteristics, and resources (IPOUCRs). Yet, in general and despite extensive data gathering, the Study appears to lack focus on the specific goals of the study, focusing more on habitat enhancement research and less on maintaining and protecting existing instream public uses and resources as the statute requires.. The Study concludes that certain aquatic species during critical bio-periods drive minimum flows, and we agree with the goal of assessing reasonable habitat enhancement as part of the instream water flow study. But there is no assessment in the PISF Study of these flows along with corresponding public water supply needs. Since public water supply is both a designated use and an existing public use, the Study is incomplete. The Study at various times includes consideration of the Natural Flow Paradigm, the “naturalized” hydrograph, and “pre-colonial” conditions. Whether and to what extent the goal of the Study is to establish instream flows that

will enhance aquatic habitat in order to support a “naturally-occurring” ecosystem is not at all apparent. Thus, the PISF Report should state what the precise goal of the proposed protected instream flows are, and acknowledge the criteria/limits of the desired enhancements of aquatic and fish life.

**Response:**

The goals of the Instream Flow Program are expressed in Env-Ws 1901.01, which draws on The Rivers Management and Protection Act, RSA 483. The statute describes the criteria under which protected flows must be established.

*“Env-Ws 1901.01 Purpose. The purpose of these rules is to specify standards, criteria, and procedures by which a protected instream flow shall be established and enforced for each designated river segment on the Lamprey River and the Souhegan River in order to maintain water for instream public uses and to protect the resources for which the river or river segment is designated.”*

The program’s goals must also complement and reinforce existing state and federal water quality laws as required by RSA 483:2. This requirement regarding water quality standards, includes Env-Wq 1703.01(b) that surface water be restored to maintain biological integrity. Biological integrity is the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

The comment incorrectly states that the purpose of the study seems to “focus on habitat enhancement research”. Protected flows are the MINIMUM flow requirements for full support of the instream public use. Maintaining biological integrity has other components than flow alone, but this program attempts only to define the flow conditions that will maintain biological integrity. The Instream Flow Program is limited to flow management activities, and no requirements for habitat restoration are part of the protected flows or water management plans. However, even though these protected flows are applied to the existing conditions, the analysis uses baseline conditions in order to define biological integrity goal which must fit the “natural habitats of a region.”

To define the components of Lamprey River biological integrity required identification of the community that should occur in “similar natural habitats of the region.” The existing river community has been and continues to be modified by withdrawals and impoundments, so its existing condition should not be used as the standard for biological integrity. This requires development of the Target Fish Community to define a fish population appropriate to the river. The Target Fish Community is defined using fish from reference (least impacted) rivers with similar in characteristics to the Lamprey. Identification of a target fish community shows how the existing fish community differs. By characterizing these differences, conclusions can be drawn relative to the impacts of habitat or flow modifications. The Lamprey Target Fish Community is similar to the existing Lamprey fish population, but shows shifts in the composition and structure.

Similarly, baseline habitat conditions must be used to define protected flows to meet biological integrity requirements. The existing flow and river structure conditions have been and are modified from the natural condition. Since habitat is made up of both flow conditions and river

structure, the baseline hydrologic and river structure must be used to define biological integrity. This is true regardless of whether this baseline condition no longer exists as on the Lamprey where impoundments now represent a significant portion of the river. The resulting protected flows define the hydrology to support biological integrity. It is not necessary that these impoundments be removed for these protective flows to apply. The protected flows based on the baseline hydrology and river structure will protect biological integrity in the unmodified parts of the river and do no harm to the structurally modified parts. If the dams were removed these same flows would continue to apply.

**Comment UDWS-B-2:**

The Report describes the target fish community (TFC) model and empirical habitat suitability criteria model that were developed for “reference conditions consisting of limited flow disturbance and habitat impairment” -- which are intended to represent an expected “naturalized” river. These conditions differ dramatically from the actual conditions of the river which contains an established water supply reservoir that services the largest community in the watershed. Early sections of the Report state that the reference conditions are based on the “naturalized” river, which was developed using an artificial pre-colonial corrected hydrograph that was intended to include adjustments for water withdrawals and excluded the human made impoundments (Wiswall and Macallen). In later sections of the report, it is difficult to discern whether the results are relative to the actual existing conditions or the simulated expected (“naturalized”) conditions. The methodology describing how the “naturalized” river was developed lacks detail and scientific reference. It also is not clear how the Study accounted for water withdrawn from users in the watershed and Pawtuckaway Lake or for the effect of seasonal water retention in the many impoundments within the watershed. Rather, the Study establishes reference conditions that are dramatically different from current conditions and any conditions that can reasonably be expected to exist in the foreseeable future. How these reference conditions provide a meaningful basis for the Study and its conclusions is not addressed. Additionally, establishing reference conditions that exclude the human made impoundments, particularly the water supply reservoir, sets a standard that may well be unrealistic, artificially conservative, and potentially unachievable. To what extent and how was consideration given during the Study that the baseline conditions may be too unrealistic? What was done to ensure this the pre-colonial/naturalized baseline conditions would not produce overly conservative results?

**Response:**

The baseline conditions modeled during this study are not unrealistic, nor should the results be considered overly conservative for the following reasons. One purpose of the PISF study was to describe the protected flows that will support the biological integrity of the Lamprey River. Biological integrity is not based on the existing community, but on what should be found based on similar natural habitats. The only realistic means of describing conditions for a river’s biological integrity is to use the combination of a Target Fish Community, naturalized river hydrology, and baseline river structure.

The Target Fish Community uses fish collections from rivers similar to the Lamprey\* to represent reference conditions. Even the best of rivers have modifications resulting in loss of habitat. Habitat loss and flow modification have resulted in reduced abundance of flow-dependent species. However, these fish collections are the best available representations of what fish are living in rivers similar to the Lamprey. It is under-conservative in that it is unlikely to

adequately express the numbers and relative abundance of certain anadromous and sensitive species that should be present.

The naturalized flows are not pre-colonial conditions. The correction of flows was limited to removing reported water uses and to offsetting the estimated storage and release quantities (during spring filling and fall drawdown) of the largest dams from the recorded hydrograph. Neither all watershed water use, nor all the impoundment impacts were included, resulting in some component of flow modification remaining in the naturalized hydrograph. Also, no attempt was made to balance the impacts of land use changes, on-and off-stream wetland losses, evaporation from impoundments, and river structure modifications. As such, the naturalized flow corrections under-represent the actual natural flow conditions and the use will result in under-conservative results. Additional information will be added to the report to provide additional details on the naturalized flows beyond the description in the report and in Appendix 13.

The baseline structure that was used included modifications to Wiswall and Macallen Dam to model fish habitat in free-flowing river conditions. To increase the proportion of free-flowing river in the model to represent baseline conditions and define flows that support the fluvial fish species, Wiswall Dam was removed and Macallen Dam was lowered by 2 meters (6.6 ft.). The presence of wood structure was also added to nearly all of the hydromorphologic units along the river to account for the addition of fallen trees in a mature river system. The presence of undercut banks was added to most of the runs and pools and overhanging vegetation was added to most hydromorphologic units to create riverine conditions similar to those existing in the Lamprey Designated River.

Baseline conditions are commonly used as assessment tools and as targets for impacted and modified streams. Baseline conditions for flow, fish targets and river structure are equivalent to EPA's reference condition approach for water quality standards. Further, the result of using the baseline river structure instead of the existing impounded conditions will be more realistic protected flows, since a goal is to define flows that will support the Target Fish Community. Using the existing conditions would attempt to define riverine flows on the physical structure of an impounded river.

The corrections made to these key habitat components in the assessment represent only gross corrections that were made using available and measurable values. Fifteen fish collections from six reference rivers with similar character to the Lamprey were used to define the Lamprey Target Fish Community. The water uses in the naturalized flow record are reported values. The dam operations are recorded, as are the hydrographs covering pre- and post-operations periods. Only these larger impacts were incorporated in deriving the baseline conditions. The baseline river structure uses the known lengths of the impounded sections and sonar measurements of their depths. Estimates of smaller or more historical conditions having diminishing returns or that can't be supported with available data were not used. The components used in the baseline conditions are not overly conservative and the use of baseline conditions is necessary to define the biological integrity.

\* The Lamprey Target Fish Community Report is at [http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/documents/tfc\\_report\\_legros\\_21june2007final.pdf](http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/documents/tfc_report_legros_21june2007final.pdf).

### **Comment UDWS-B-3:**

Basing the PISFs on what could be overly conservative simulated reference conditions that do not reflect the existing hydrologic conditions or habitat and excludes the public water supply reservoir violates the statutory requirements in RSA 483:9-c which states "each protected flow shall be established and enforced to maintain water for instream public uses and to protect the resource for which the river or segment is designated." This statement contains two distinct requirements: (1) maintain water for instream public uses; and (2) protect the resource for which the river or segment is designated.

With respect to the first requirement, the UDWS is an instream public use that was identified as such in the 2005 IPUOCR Report. Based on the statute, each protected flow shall be enforced to "maintain" water for instream public uses including public water supply.

Public water supply is listed in Table 2-1 of the 2006 Final Report on IPUOCRs as a flow-dependant IPUOCR. The analysis of the assessment method for public water supply for all flow-dependant IPUOCRs is set forth on pages 39-40 of the 2006 report. The "proposed assessment for public water supply" initially calls for a record review of public water supply systems to evaluate the timing, magnitude and duration of withdrawals. Yet, in the draft PISF Report, the only analysis of the UDWS is one paragraph on page 18 which references a personal communication with Wesley East and three sentences summarizing the 2000-2005 water user reports submitted by the UDWS. Further, the 2006 IPUOCR Report states that the "impact" of the withdrawal of water from the river by the Town of Durham/UNH will be evaluated (emphasis added). The draft final Report provides no assessment whatsoever of flow requirements for public water supplies. (See p. iii-iv of the Report's Table of Contents)

Thus, DES has not analyzed at all the flows necessary for the public water supply; rather, it has indicated that it will look at the impact of the withdrawal on other aquatic resources. The Report did not consider the flow demands needed to maintain public water supplies and artificially elevated the value of the minimum protect flow requirements estimated for all other instream public uses through an overreaching goal of enhanced baseline conditions. With respect to second requirement of RSA 483:9-c, the UDWS was designated as an important resource which warranted legislation in 1965 identifying the Lamprey River as a public drinking water source for present and future generations of Durham and neighboring Towns. In 1990, the segment of the Lamprey River containing UDWS reservoir and pumping station was designated as a "rural river" under RSA 483:15 due in part to the established economic and social value of the UDWS (see Attachments 1 and 2). The 1990 Rivers Management and Protection Program's Statement of Policy, RSA 483:1, provides in part that "New Hampshire's rivers and streams comprise one of its most important natural resources, historically vital to New Hampshire's commerce, industry, tourism, and the quality of life of New Hampshire people. It is the policy of the state to ensure the continued viability of New Hampshire rivers as valued economic and social assets for the benefit of present and future generations." RSA 483:1 also includes public water supply as an outstanding characteristic to be conserved and protected through the regulation of instream flows. The designation of the same segment of the Lamprey under the National Wild and Scenic Rivers Program was driven in part to protect the water supply from a hydroelectric developer. Its classification as a "recreational" river in the Wild and Scenic Program is based on the existence of the UDWS reservoir and the degree of development on the reach. The other two classifications, "wild" and "scenic" do not allow human-made impoundments.

**Response:**

The modeled natural flow daily hydrograph (naturalized flow) is the reference condition that DES uses to establish protected flows for ALL flow-dependent IPUOCRs. The modeled natural flow daily hydrograph deviates from the recorded daily hydrograph in two quantifiable factors – known water withdrawals reported to DES, and known manipulation of impoundment water levels. This is not “overly conservative.”

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by UNH/Durham or any other water user) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

It is not appropriate for DES to incorporate water demand estimates for public water supply into protected instream flows. Water demand for public water supply is independent of water availability from any particular source. The Instream Protected Flows must assure that public water supplies have adequate opportunity to withdraw water, not that river flows be assured to meet demand. The Natural Flow Paradigm provides a quantitative measure of adequate opportunity. By maintaining flows as close to the natural regime, all non-consumptive IPUOCRs are supported. However, consumptive uses, notably public water supply withdrawals, will change the flow regime. This will require management to offset the impacts. The greater the consumptive use, the more management will be required.

**Comment UDWS-B-4:**

The PISF Study did not consider the public water supply needs of the UDWS and its challenges in meeting existing needs and anticipated future demand during low flow conditions, and the Study inappropriately assumed that system’s needs would be met “through adaptive management practices (artificial recharge, conservation, development of alternative water sources, or off-stream storage, etc.)” (see pages 20 and 21) without considering practical and potential limitations. The established Lamprey River PISFs need to protect the UDWS in accordance with 483:9-c, and for the following reasons:

- The UDWS is a flow dependent instream public use and a resource for which the Lamprey River was designated.

- The potential for water supply demand reduction through water conservation has technologic and social/political limits. Estimating the potential to reduce average water supply demand must be based on an evaluation of realistic water conservation measures, existing and expected future water user trends and demographics, and a realistic assessment of the future potential for water conservation measures. The UDWS is committed to a water conservation program, and since 1999 the UDWS has invested more than \$1M on water conservation efforts associated exclusively with the Lamprey River withdrawal. Considering the success that the UDWS has had with maintaining below average per capita water demands, implementing a more aggressive water conservation program has limitations.

The availability of alternative water sources is also limited, particularly in the Seacoast area. Permitting and constructing the infrastructure for new water sources is extremely costly, and dependent on funding approval through public referendum or vote of elected officials, neither of which can be assured. Thus the degree to which the alternative drinking water sources will contribute to the UDWS's future needs is not fully assessed.

- The population of water users in Durham and UNH is expected to more than double in the foreseeable future (as suggested in the recently updated Draft Water Resource Management Plan). Utilizing the Lamprey River as a water source has been a primary component in the total extended source equation since 1965 (see Attachment 3 - excerpts from the February 1965 Camp, Dresser & McKee, *Durham, New Hampshire, Report on Additional Water Supply*).
- UDWS reliance upon the Oyster River is less dependable than the Lamprey River. Due to the pending nomination of the Oyster River into Rivers Management and Protection Program, it is likely that future established Oyster River PISFs will further limit water availability.
- The §401 Water Quality Certification ("WQC") limits are not well supported by science, and are believed to be overly conservative. It has been the UDWS's understanding, based on the early §401 WQC negotiations, that the §401 WQC established interim conditions that would one day be superseded by the more scientifically-based PISFs and the water management plan. Attachment 4 includes a series of tables that were presented at the January 14, 2009 public hearing. The lower right table in Attachment 4 provides the results from an assessment of the PISFs with respect to the UDWS's §401 WQC conditions over the full record of Lamprey River flow data. This table reveals that §401 WQC conditions were naturally exceeded on a regular basis including during average and wet years, and confirms that the §401 conditions likely come into effect prematurely.
- We believe the UDWS's reliance upon surface water is small relative to the Lamprey's flows even at river flows as low as 4 or 5 cfs (relative to the Packers Fall Gage). Our analysis suggests that the system's average withdrawal has negligible effects on stream flow and water level fluctuations during Lamprey flow as low as 4 or 5 cfs. However, such an analysis is missing from the Study.
- Since the Water Management Plan places the responsibility of preparing water conservation and water use plans for the UDWS on DES (Env-Ws 1906.02 and 1906.03),

it is imperative the a PISF be established that considers the needs of the UDWS prior to development of the Water Management Plan.

**Response:**

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

By maintaining flows close to the natural regime, all non-consumptive IPUOCRs are supported. However, consumptive uses, notably public water supply withdrawals, will change the flow regime. This will require management to offset the impacts. The greater the consumptive use, the more management will be required.

Conservation, water use management and impoundment management are all components of a Water Management Plan that work together to maintain the important characteristics of the natural flow hydrograph while providing coordinated opportunity for water withdrawal. This is the appropriate place for protecting public water supply interests. The conditions of the UDWS 401 Water Quality Certificate will be superseded by the adopted Water Management Plan.

We must rebut the implicit assumption of the comment that it is the responsibility of the Lamprey River to supply the water needed for UDWS now and in the future. It is no more the Lamprey River's responsibility to supply UDWS water needs than it is the Lee Wells' responsibility to supply these needs. UDWS is in fact responsible for total management of the public water system to develop diverse sources and storage facilities, utilize them within natural and regulatory constraints, and encourage wise and conservative water use among its customers.

**Comment UDWS-B-5:**

Table B-1 below tabulates the results of an assessment prepared by the Town of the recommended flow criteria from Table 23 of the Report for the common shiner during the Rearing & Growth (R&G) bioperiod flows as they would potentially have been applied during the eight notable low flow event between 1980 and 2007 based on recession data recorded at the Packers Falls USGS stream gage. During each of these notable low flow events the Packers Falls USGS gage recorded flows of 11 cfs or less. Each column contains the flow relative to the specific year that would have been observed at the end of the allowable durations for the

common, critical and rare PISFs. The allowable duration for the common, critical and rare PISFs are 46 days, 15 days, and 6 days respectively. For example: in 2007 a “rare” flow of 16 cfs was observed on August 21<sup>st</sup>. At the end of the allowable duration of 6 days (August 27<sup>th</sup>) the observed flow was 11 cfs (see shaded cell below). The flows continued to fall to the “lowest flow recorded” for that recession event of 6.6 cfs (in bold) until it rained on September 6<sup>th</sup>. The “Y” signifies that yes the allowable duration was exceeded, or “N” for no it was not exceeded.

**Table B-1**

Observed Flows at End of the Allowable Duration for the Common Shiner R&G PISFs

<b>Common Shiner R&amp;G PISF</b>	<b>1980</b>	<b>1983</b>	<b>1984</b>	<b>1995</b>	<b>1999</b>	<b>2002</b>	<b>2003</b>	<b>2007</b>	<b>Average</b>
<b>COMMON</b> <110 cfs 46 days	20 Y	12 Y	19 Y	4.2 Y	9.3 Y	4.1 Y	NA	8.1 Y	11
<b>CRITICAL</b> <22 cfs 15 days	8.6 Y	7.4 Y	10 Y	2.5 Y	12 Y	5.6 Y	16 Y	6.6 Y	8.6
<b>RARE</b> <16 cfs 6 days	12 Y	9.1 Y	12 Y	7 Y	9.3 Y	6.5 Y	11 N	11 Y	9.7
Lowest Flow Recorded	4	7.4	10	1.6	2.3	1.8	11	<b>6.6</b>	5.8

- Notes: 1. Y indicates that the PISF flow duration was exceeded  
 2. N indicates that the PISF flow duration was not exceeded  
 3. NA indicates that the PISF flow duration was not reached

As noted in Table B-1, the common and rare PISFs in 2003 are the only instances in which the allowable durations were either not reached or not exceeded. These results suggest that the PISFs and/or the allowable durations are overly stringent due to the fact that they are exceeded in seven of the eight years of very low summer flows over the last 28 years. Thus, for this one bio-period alone, there would be violations of the minimum protected flows for about one in four of the years in question, including almost every summer of low flow conditions. This data and analysis also begs the question of what underlying problem with the common shiner has been experienced over this time frame to suggest that higher flows must be maintained in order to accommodate their rearing and growth needs.

**Response:**

This analysis is using only a select sample of years and, as the commenter admits, these were years with very low flows. If the model picks it up, it means only that the sensitivity of the model is correct. Furthermore, only five of these events exceeded a catastrophic duration. Since a catastrophic duration is allowed once in 10 years, **only 3** would trigger management action caused by these durations (1983, 1999, and 2002). Flows lower than 4 cfs occurred only four times: in 1983, 1995, 1999 and 2002. If the management would prevent the catastrophic durations in 2002, no flow augmentation would be necessary in 2007. Hence, the protection of

instream flows would occur in only four instances in almost 30 years. These few cases of water use restrictions should not be considered as overly conservative and confirm that the results are reasonable.

Regarding the question of what is the underlying problem with the common shiner, please refer to the draft report page 113 documenting habitat limitations for this species.

**Comment UDWS-B-6:**

The draft PISF Report states that the “the following discussion summarizes the scientific basis” for the protected flows for the human recreational (boating and swimming) and water supply uses of flow [was] developed using questionnaires and surveys.” (See page xv). Evaluating a flow-dependent public water supply using only questionnaires and surveys is far too simplistic of an approach to be considered a “scientific basis” for the evaluation of a public water supply’s flow needs. The one questionnaire provided to the Town was rejected due to the subjective nature and concerns about their likelihood of producing biased results (see Attachment 5). This concern was communicated by the Town by e-mail to the administrator of the questionnaire Shannon Rogers, and voiced at the subsequent WMPAAC meeting. The Report provides no summary of the information relative to water supply uses gleaned from the questionnaires and surveys. Also, was an additional survey requested? The Town of Durham only received this one questionnaire.

In contrast to the Report’s limited concern for public water supply needs, the Report goes on to say “From long term records of naturalized flows, a daily record of available habitat is established.” (See page xix). The naturalized flows are improperly referred to as being part of a record here and throughout the Report. These references imply that there is a “record” of naturalized flows but there is not. Our understanding is that the term naturalized flows represents flows that were developed from modeling of the river as it may have existed in pre-colonial times by removing surface and groundwater withdrawals, adding return flows from dam operations, and other adjustments to account for apparent human impacts since the Colonial period began. The result is an estimated naturalized flows based on numerous assumptions, which may or may not be valid. Describing the estimated naturalized flows as based on a long term record is misleading and suggests that the naturalized flows represent a record of fact-based observations.

**Response:**

The use of the surveys and questionnaires (see response to Comment UDWS-B-7) was to obtain information from the public water suppliers on their water use and system operation so that they could be described in the report and be used as supporting information for the preparation of the Lamprey River Water Management Plan. The water needs of the public water suppliers will be evaluated in consideration of the protected instream flows defined for the Lamprey Designated River during the Water Management Plan process.

The naturalized flows used in this study of the Lamprey River are not measured values, but estimates based on corrections to the 30-year measured flow record (1976-2005) from the USGS gaging station at Packers Falls near Newmarket. The naturalized flows were calculated by making adjustments to the recorded flows at the Packers Falls gage, accounting for net water use and for dam operations. So although the naturalized flows have not been directly measured or

recorded in the field, they are based on a long term record of flow data recorded by the USGS. But, the naturalized flows are only estimates based on these records. To address this, when first introduced in the Executive Summary and the Report it will be noted that the naturalized flows are estimates based on a long term flow record.

**Comment UDWS-B-7:**

The Study appears to have done a thorough assessment of the recreational flow needs, including an extensive survey of boaters, lengthy discussions about the dozens of interviews with swimmers and boaters. See page 6-18. However, there is no mention in the Report of the extensive interview with Durham Town Engineer David Cedarholm conducted by Shannon Rogers of UNH on June 14, 2006 in which the UDWS's dependence upon the Lamprey River as a drinking water source was discussed in detail. As noted above, the Town did not respond to the questionnaire/survey sent to UDWS because of the subjective nature of the questions.

**Response:**

The interviews and survey performed by Ms. Shannon Rogers were done to collect information from stakeholders in the Lamprey River Water Management Planning Area for consideration in the Water Management Plan phase of the project. A separate questionnaire to collect information on existing water use, water system operations, and any planned modifications to the water system was sent to and completed by Mr. Wesley East of the UNH Water Utilities. Some of this information was incorporated into the description of the UDWS water use and operations presented in the Report (see next comment) and will be referred to during the preparation of the Water Management Plan. We look forward to working together with UDWS during preparation of the Water Management Plan

**Comment UDWS-B-8:**

The discussion about the UDWS is oversimplified and it excludes any discussion about the important role the Lamprey River plays in meeting the overall UDWS's needs during times of peak demands. In particular, there is no discussion about the critical role of the Lamprey River during times when low summer flows in the Oyster River and the Lamprey River correspond with peak demands triggered by the start-up of the UNH fall semester. There is also no mention of the future role that Lamprey River has been expected to play in meeting the Town's population growth since utilizing the Lamprey River as a drinking water source was first conceived and legislated in 1965. See page 18-21.

**Response:**

The purpose of the discussion of the UDWS, in the Report, was to recognize that they are an active water user on the Lamprey Designated River and to generally describe and document its water use, operations and any existing legislative grants or conditions regarding its use. A more detailed discussion of the UDWS, including its water use and water use patterns will be presented in the Water Management Plan to be prepared following the establishment of the Protected Instream Flows.

It is not the responsibility of the Lamprey River to provide water to meet UDWS peak demand. UDWS is in fact responsible for total management of the public water system to develop diverse sources and storage facilities, utilize them to meet peak demand within natural and regulatory constraints, and encourage wise and conservative water use among its customers.

**Comment UDWS-B-9:**

The Report inaccurately states that the UDWS has chosen not to withdraw water when flows fall below 13 cfs “because they have not installed or identified a monitoring system upstream of the (Wiswall) dam”. The UDWS has explored numerous locations upstream of the dam to monitor inflow to the Wiswall Reservoir and has been unsuccessful in identifying an acceptable upstream location due to variety of obstacles (i.e. difficult access, private property issues, poorly defined river channel during low flows, concerns with vandalism, etc.). The UDWS received verbal approval from DES in the fall of 2008 to implement a flow monitoring plan that involves calculating inflow based on measurements of outflow at the Wiswall Dam, rate withdrawal at the pump station, and change in reservoir storage.

**Response:**

DES acknowledges the Draft Lamprey River Flow Monitoring Plan dated August 25, 2008 and the discussion of the monitoring of flows by the Town of Durham will be revised in the Report to reflect this Plan.

**Comment UDWS-B-10:**

The Report indicates that the planned diversion of water from the Lamprey River for artificial recharge near the Spruce Hole Bog would occur during the spring flows. (See page 19). Development of the Spruce Hole aquifer has not been approved by either Durham or the University, and the DES large groundwater withdrawal permit application is still pending. Furthermore, the timing of when the diversion might take place has not been conclusively determined. While the study should include discussion of the potential development by Durham and the University of this water source, it is not appropriate for the Study to include assumptions regarding development of the Spruce Hole aquifer, particularly when the Report implies that the Spruce Hole aquifer may serve as mitigation of withdrawal limitations from the Lamprey that may result from the Study.

**Response:**

The report only states that the development of the Spruce Hole Bog aquifer is under investigation and is being studied. The DES has confirmed that it has only received preliminary hydrogeologic information from the Town’s consultant (Emery & Garrett Groundwater, Inc.) regarding this potential new water supply source. Regarding the potential timing of any planned withdrawals from the river for artificial recharge, the statement that the “diversion of water would occur during the spring when flows are high” was based information provided by Mr. Wesley East of the UNH Water Utility and by Mr. Michael Metcalf the author of the Draft Update to Water Resources Plan prepared for the UDWS. The Draft Plan is currently posted at the Town of Durham’s Department of Public Works Water Division web site. In the Updated Plan the utilization of the Spruce Hole may include the opportunity for artificial recharge, where the Lamprey would be pumped at high flows for later recovery. Relative to the suggestion that

the report implies that Spruce Hole might serve as mitigation of any withdrawal limitations resulting from the PISF study, the intent of the report is only to document the consideration of Spruce Hole as a new source of water for UDWS.

**Comment UDWS-B-11:**

The Report states that instream fauna will govern the proposed PISFs to the exclusion of the UDWS because public water systems have options to reduce water withdrawals through adaptive management practices (artificial recharge, conservation, development of alternative resources, offstream storage, etc.) while the instream fauna and their supporting habitat would not (see page 20-21). This is the essence of DES's rationale for not analyzing the flow needs of the UDWS. As stated above, this assumes wrongly that the public water supplies have all or most of the options listed available to them, or that some or all of the options are without limitation. It also improperly overrides the second sentence in RSA 483:9-c which states "Each protected instream flow shall be established and enforced to maintain water for instream public uses and to protect the resources for which the river or segment is designated." The UDWS is both an instream public use and a resource for which the segment was designated. This requires that a PISF be established and enforced to maintain and protect its water resource. As an instream public use and protected resource the UDWS flow needs must also be thoroughly assessed and included as part of this Report rather than wait for the Water Management Plan phase.

**Response:**

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by UNH/Durham or any other water user) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

By maintaining flows close to the natural regime, all non-consumptive IPUOCRs are supported. However, consumptive uses, notably public water supply withdrawals, will change the flow regime. This will require management to offset the impacts. The greater the consumptive use, the more management will be required.

Conservation, water use management and impoundment management are all components of a Water Management Plan that work together to maintain the important characteristics of the natural flow hydrograph while providing coordinated opportunity for water withdrawal. This is the appropriate place for protecting public water supply interests.

**Comment UDWS-B-12:**

As discussed above, the concept of a TFC model based on a fish community that might be expected to reside in an unimpacted stream without impoundment dismisses the UDWS as an instream public use and protected resource; therefore, violating RSA 483:9-c. This approach is expected to produce unrealistic PISFs for species and habitat that are potentially incompatible with the UDWS and its water supply reservoir.

**Response:**

Defining instream flows that would be protective to the native fish fauna and follow the natural flow paradigm while ignoring other sources of human impact may lead to erroneous results. It is simply impossible to define the protective instream flow for fluvial fish in the impoundment because these species do not use such habitats very commonly. Hence using today's conditions as a baseline in a river that is not impact free, would be a way to create "unrealistic" results. Furthermore, in the long run such a strategy allows for the continuous encroachment of human induced alterations on the ecosystem and does not take their cumulative impact into account.

**Comment UDWS-B-13:**

The discussions on the Target Fish Community (TFC) and the MesoHABSIM modeling frequently reference the choices, decisions, and selections that the consultants made in the process of developing the expected fish and benthic community used in the Study. These and the other analyses (i.e. habitat suitability and flow requirement assessments, flood plain transects, habitat mapping surveys) performed in the Study that are based on professional judgment are all potentially subjective sources of error. When compounded, they contribute to diminishing the overall technical confidence, accuracy, and validity of the results. The Report needs to identify the parameters that potentially contribute to the sources of error and describe the quality assurance and data validation that was used to minimize the potential for compounding error.

**Response:**

Every model requires interpretation that is based on professional judgment. It is an accepted practice that is not specific to models applied in this study. MesoHABSIM is an improvement of widely accepted and USGS approved IFIM methodology, which is frequently used to settle court cases. Compared to the majority of studies conducted using IFIM this study underwent rigorous validation procedures. Additional work for validation that goes beyond what is accepted as a standard has not been contracted and would require additional funding. Further, the study is undergoing professional peer review by qualified experts. This review is in progress and the results will be made public.

See also discussion on MesoHABSIM assessment accuracy added on Page 157 of the draft report.

### **Comment UDWS-B-14:**

The Report indicates that none of the rare, threatened, and endangered (RTE) turtle species (Blandings, spotted, wood turtles) were observed in the designated reach due to impoundments, recreation, and human activity, and lack of suitable nesting sites. The Report states that turtle nesting sites require dry sandy banks, (which are not typically found in the Wiswall area), and that the turtles prefer tributaries rather than the main river channel. Although the Report (see pages 78-80) implies that these species do exist because there may be available turtle habitat, they apparently prefer habitat found in the tributaries of the Lamprey. It is not clear how the PISFs allow for this. Also, we do not see in the Report the data that confirms that TRE turtle habitat exists within the influence of the Wiswall reservoir. The National Wild and Scenic designation reach of the Lamprey River is classified as "recreational" river which includes impoundments which should be noted in the baseline reference conditions. This designated impounded/recreational status has been identified as not compatible with RTE species & habitat; therefore, the PISF should be adjusted accordingly.

The flow requirements for RTE turtles (and other species) are apparently based on flows patterns that include pre-1955 data as examples of problems, and do not account for the impact of recreation and human activity (see page 48). This tends to elevate a protective status of an absent IPOUCR, and it is also indiscriminately applied to the entire designated segment. The result is artificially conservative and potentially an overestimation of the impact of one IPOUCR on another IPOUCR, regardless of whether actual overlap exists between the two. We are concerned that this unfairly influences the future limits that the PISFs will imposed on the UDWS reservoir/withdrawal.

### **Response:**

Wood, spotted and Blanding's turtles are shy and secretive, and not surprisingly, we observed only one wood turtle during our field studies. However, we do not state that the listed turtles were not observed in the designated reach due to lack of habitat or human disturbance, though some areas appear to be unsuitable turtle habitat for these reasons. We cite several previous studies of wood and Blanding's Turtles along the Lamprey River, and note that potential habitat for these and also spotted turtles is present at various places in the Designated Reach.

Statements in the Wild and Scenic documentation that a designated "recreational" river is "not compatible" with RTE species/habitat does not guarantee that protected species are absent, or diminish their protection.

While the designated reach is treated as a single unit for PISF purposes, we recognize that aquatic and riparian entities are not distributed evenly along the designated reach. Our scope and budget does not cover the intensive field effort needed to document presence/absence for each of the listed plants and animals throughout the project area, or nesting and hibernation locations. Plant and animal distributions can also change over time, particularly in dynamic river corridors. We did try to confirm known locations and identify potential habitats all along the designated reach. We omitted specific location information about listed species in our report in accordance with our signed agreement with the Natural Heritage Bureau (as protection of these species is paramount). In the event that desired management activities in one portion of the designated reach may conflict with a PISF, a focused field study might be appropriate to evaluate potential direct impacts.

The determination of protective flows for wood, Blanding's and spotted turtles was based on field observations of water levels (and concurrent flow data) in potential turtle habitats. The USGS flow record was reviewed only to place the observed flows in historical context.

**Comment UDWS-B-15:**

Pre-colonial fourth order rivers throughout New England consisted of abundant beaver habitat with numerous impoundments (Naiman, R.J., C.A. Johnson, and J.C. Kelley. 1988. Alteration of North American Streams by Beaver, *BioScience Vol. 38 No.11*). It is not apparent that this type of habitat was considered in the Report. A naturalized "unimpacted" river based on a free flowing unimpounded river is a biased approach and does not consider the full range of possible habitat that may have occurred during the pre-colonial times. The target fish community (TFC), MesoHABSIM model, habitat suitability exercise, and the representative hydrographs need to be reexamined in light of this information. The expected or TFC in a New Hampshire pre-colonial river with abundant beaver may be more representative of a warm regime and less eurythermal, or cold, and more similar to the existing thermal regime.

The Natural Flow Paradigm concept in this study implies that the principal management objective is to allow streams to flow as close to its natural flow regime as possible. This approach seems predicated on river restoration with dam removal in order to comply with the Protected In-Stream Flows (PISF). There is no stated assumption that these structures will be removed in the foreseeable future, so we question the logic of basing protected flows on conditions that do not, and are not likely to, exist.

The Report states that 45% of the protected section is impoundment (see page 82). The Study models baseline conditions in the designated section by assuming removal of Wiswall dam and reducing MacCallen dam by 2 meters (which approximates removal of this structure and the artificial impoundment.) When so much of the designated section is affected by existing impoundment, we do not understand the relevance of establishing protected flows using these assumptions, unless there is strong potential the dams will be removed and the modeled conditions established. The Report should address this.

**Response:**

Defining instream flows that would be protective to the native fish fauna and follow the natural flow paradigm while ignoring other sources of human impact may lead to erroneous results. It is simply impossible to define the protective instream flow for fluvial fish in the impoundment because these species do not use such habitats very commonly. Hence using today's conditions as a baseline in a river that is not impact free, would be a way to create "unrealistic" results. Furthermore, in the long run such a strategy allows for the continuous encroachment of human induced alterations on the ecosystem and does not take their cumulative impact into account.

Due to their temporary and permeable nature, beaver dams can hardly be compared with man-made constructions like those found on the Lamprey River.

The literature and expert opinion (Gurnell 1998; Beier and Barrett 1987; Allen 1983; Howard 1982; Stephen DeStefano and Kiana Koenen, pers. comm.) suggest that high quality beaver habitat is primarily dependent upon the following:

- Stream gradient: lower-gradient streams provide higher-quality habitat.

- Stream flow rate: streams with high flow rates and those with extreme spring flooding events are not suitable for beavers.
- Valley width: wider valleys are better habitat than narrow streams with high banks.
- Forest type: deciduous trees (especially *Populus* and *Salix* species) provide higher quality habitat than coniferous trees.
- Aquatic vegetation: aquatic vegetation such as *Sagittaria*, *Lemna*, *Potamogeton*, *Elodea*, and especially *Nymphaea* and *Nuphar* provide an important food resource.
- Stream depth: beavers are more likely to build dams in streams where the water depth is less than 1.5 m (4.9 ft).

Currently the impoundments create areas that are much deeper than 1.5 m excluding them from suitable habitat. Removal and lowering of the dams would actually offer much more opportunities for beavers to build shallow impoundments.

Overall, we would say that the Lamprey is not high quality beaver habitat in many places – due to flow, water depth, and gradient – but we have seen good beaver habitat and plenty of beaver signs in several places:

- Backwater swamp north of Glenmere Village – multiple dams, lodge, tracks, etc.
- Moat Island – active lodge on edge of island, trails in backwater coves
- Floodplain above Wiswall Dam – trails, tracks, bank dens, browse
- Tuttle Marsh outlet – multiple small dams

Beaver probably travel up and down most of Lamprey corridor, but dams and dens are most likely in the slower backwaters and along tributaries. The backwaters, shallow pool margins and slow tributaries have plenty of emergent and submergent plants, and hardwoods seem to be plentiful enough for beaver in the Lamprey River valley.

### References:

Allen, A. 1983. Habitat suitability index models: Beaver. Unpublished report. Habitat Evaluation Procedures Group, U.S. Fish and Wildlife Service. Fort Collins, Colorado. 20 p.

Beier, P. and R. Barrett. 1987. Beaver habitat use and impact in Truckee River Basin. California. *Journal of Wildlife Management* **51**: 794-799.

Gurnell, A. 1998. The hydrogeomorphological effects of beaver dam-building activity. *Progress in Physical Geography* **22**: 167-189.

Howard, R. 1982. Beaver habitat classification in Massachusetts. M.S. Thesis. University of Massachusetts, Amherst. 67 p.

**Comment UDWS-B-16:**

The downstream Affected Water Users and Affected Dam Owners cannot meet stream flow management expectations and comply with protected instream flow rules when, as the Report states, “Pawtuckaway Lake is the dominant water body in the system and is in the center of the watershed.” (See page 4). Unless Dolloff Dam and other entities in the watershed that affect stream flow are brought under integrated management plans, UNH and Durham could be in the untenable position of being required to meet downstream flow requirements when the dominate impoundment in the watershed is excluded from the management umbrella. DES assured UDWS officials during the January 14, 2009 public hearing that in implementing the PISF’s, management plans will be required of all entities in the watershed whose activities may influence flow in the river. How are water management plans for the entire watershed integrated as part of this process? What assurance is offered to the various interests affected in the designated section of the river that use restrictions and protective measures will be equally applied throughout the watershed?

The ability of UDWS to comply with PISF rules is of particular concern when the Report establishes expectations that flow will be augmented in rare habitat conditions. Unless the watershed is managed as a whole, one downstream entity cannot be expected to “augment” flows in extreme conditions when upstream activity is exacerbating the problem.

**Response:**

In the second phase of this study, the Lamprey River Water Management Plan (WMP) will focus on both the Affected Water Users (AWU) and Affected Dam Owners (ADO) located within the Lamprey River Water Management Planning Area (WMPA - the tributary drainage area to the designated river, Env-Ws 1902.16). AWUs are defined as those required to be registered and having a withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its tributary drainage area (Env-Ws 1902.03), while ADOs are defined as owners of a dam with an impoundment having a surface area greater than 10 acres in the watershed area of a designated river (Env-Ws 1902.02). So, all of the AWUs and ADOs located within the watershed upstream of the endpoint of the Lamprey Designated River (Durham/Newmarket town line) are included in the WMP process.

The AWUs and ADOs of the Lamprey River WMPA have already been contacted to obtain information on their water use or dam operations. This information will be used to develop a Conservation Plan, Water Use Plan and a Dam Management Plan, which are the principal elements of the Lamprey River WMP. As part of the WMP process, the needs of the water users and dam owners will be evaluated relative to the protected instream flows (PISFs) established for the Lamprey River. Ultimately, the outcome of this process will be the determination of how the established protected instream flows will be maintained through the implementation of appropriate conservation and operational management measures by the AWUs and ADOs.

Water Management Plans will be integrated by the project team and presented in public meetings of the Lamprey River Water Management Planning Area Advisory Committee. The individual components for each Affected Water User and Affected Dam Owner will be worked out with the particular water user or dam owner in advance. Some water users and dam owners will have more or less to do than others because of their positions in the watershed or the effectiveness of their management actions. The Lamprey River Water Management Planning Area Advisory

Committee and the finally the public hearing will be the forum where fairness of the comprehensive Water Management Plan will be evaluated.

**Comment UDWS-B-17:**

Cold water species were noted as being absent in the lower reaches, yet there is no thermal data or thermal analysis. We question whether it is reasonable to assume that cold water species (primarily trout) will hold over during the summer in the lower reaches of the river. The Report cites no evidence that they did historically, or whether their native habitat was historically limited to the upper reaches of the river as is presently the condition.

**Response:**

Please see Appendix 10 for thermal data and analysis. Trout were not included in the habitat model.

**Comment UDWS-B-18:**

The Report implies proactive action in critical low flow period (i.e. flow augmentation for concerns about stressed RTE habitat) without stating what those actions might be. Increased release from the Wiswall Reservoir seems to be the only action available for the lower designated reach. However, an augmented release from the Wiswall Reservoir would not fit within the established framework of the §401 WQC which restricts UDWS's access to the water stored in the impoundment in order to protect shoreline wetlands surrounding the impoundment. Is an augmenting release from the Wiswall Reservoir contemplated, and if so, under what criteria might the UDWS be directed to release water from the Reservoir to augment downstream flows?

**Response:**

Following the establishment of the PISF, a Water Management Plan (WMP) will be prepared for the Lamprey River Water Management Planning Area. The objective of the WMP is to establish how the protected instream flows will be maintained. The WMP includes the development of a Dam Management and Water Use Plan for Wiswall Dam. These plans will take into consideration the current operation of the dam, the potential for water use modification, sharing or both based on water use patterns and needs. Until these Plans are completed any discussion of the potential for and timing of augmentation flows from the Wiswall Dam would be both premature and speculative.

The conditions of the existing 401 WQC will be superseded by the adopted Water Management Plan.

**Comment UDWS-B-19:**

The discussion on hydrology in the Report and in Appendix 13 lacks depth and scientific reference, and includes no explanation of the assumptions applied to the development of the estimated hydrograph based on a reconstruction of "pre-colonial" flow conditions. The hydrology section needs to include the data of the estimated hydrograph (both in tabular form and graphically represented) and a discussion of how it differs from the observed historical record hydrograph. The absence of the data makes it impossible to conduct a thorough review of

the analysis or evaluate the validity of the assumptions and the results. The hydrology discussion does not adequately describe how the influence of Pawtuckaway Lake was considered and does not give details as to how withdrawals, retention, and releases at Pawtuckaway Lake were accounted for in development of the naturalized pre-colonial hydrograph. Based on DES's NH Water Resource Primer Figure 11-5 (See Attachment 6), Pawtuckaway Lake's influence obviously has a huge impact on flows even today.

**Response:**

Daily data are included in the revised version of Appendix 13. Regarding Pawtuckaway Lake, 18 years (1992 to 2007) of daily dam operation records were reviewed to identify median start and end dates and corresponding stage values for the fall dam release and the spring filling event. For these stages, the change in storage was calculated using a depth, area, storage relationship for the lake. The median change in storage was divided by the median duration of the drainage (fill) time. Between periods, Dolloff Dam is not typically actively managed.

**Comment UDWS-B-20:**

The aerial image showing the river depth of the Wiswall Reservoir on page A12-6 of Appendix 12, appears skewed to one side and inconsistent with physical cross-sections developed through this reach. The bright green color in the image, which is intended to represent the deepest portion of the channel, appears to hug the western river bank which is inconsistent with the sinuosity of the river channel in this reach. This suggests that the GPS/depth data used to generate this figure was improperly geo-referenced which raises concern about the overall accuracy of the Study's depth information. Spatial and depth data validation documentation should be provided.

**Response:**

The figure in question was reviewed and it was agreed that improvements were necessary. There was a combination of too much data (points are being drawn on top of each other) and the points were drawn in sequence by their depth category (due to point overlap it appeared as though some depth classes received priority over others). The original figure also had colors in reverse order from what is normally intuitive (i.e. dark blue was shallow instead of deep); this however was correctly indicated by the legend. The color classification scheme was corrected in the newest version.

To solve the problem in terms of data presentation, the point data was converted into a tin surface and a bin scale was developed that follows a more intuitive color scheme. Additionally, bump outs for the dam area and the pump house area in the Wiswall Impoundment were added to show some examples with greater detail.

The Z data or depth field is derived from an Acoustic Doppler Current Profiler which records depth with errors in the cm range. However, the instrument averages data from 3 sensors which results in a smoothed depth value over a 5 second interval. This technique helps to reduce the errors associated with false signals from underwater objects like submerged trees or vegetative mats. The latitude and longitude data was derived from a Trimble XTpro which can have sub-meter positioning accuracy, but between the canopy and not having a base station correction the

expected error is in the meters range. Because of this, it is possible for some data shifts laterally, but these shifts would not influence the decisions made through viewing this data.

The survey was designed to recover information about the potential mesohabitat assemblage currently submerged by the impoundments and was not indented for engineering applications. The TIN shown is developed using triangulation between data points and the acquisition of these points was limited by time, river obstacles and the boat's path. Since the survey was intended to identify general morphology of the original channel at the mesohabitat level, the resolution of the survey more than adequately fits its use in the project. A more detailed survey of the impoundment using sonar and RTK GPS system could have been made, but would come at a higher cost and may not influence the end result. The figure mentioned as well as the corresponding Newmarket impoundment figure has been updated based on this comment and were replaced in Appendix 12.

### **Comment UDWS-B-21:**

Table 6 on Page 22 includes Atlantic Salmon in the existing fish community. According to the NH Fish and Game Department, there currently are no Atlantic Salmon in the Lamprey River system (email with Cheri Patterson) and the only reason Atlantic Salmon were identified during the 2003 baseline fish sampling was that it the sampling occurred during a salmon reintroduction program that has since been terminated primarily due to water quality and thermal regime issues. Fish and Game reported that the Atlantic Salmon have not returned to the Lamprey in a few years and they have no plans to repeat the Salmon reintroduction program. Two of the six bio-periods for which PISFs are established are based at least in part on Atlantic Salmon, yet there is very little habitat for this species expected in the river (see page 112). The Report is silent on why it makes sense to base PISF flows on a species that is not present in the river. If the State has no commitments to reintroduce the Atlantic Salmon to the Lamprey River, why are flows being based on this species?

Even after a fish ladder is constructed at the Wiswall Dam, the chances that a program to re-establish a Atlantic Salmon population in the Lamprey River System will be successful is highly unlikely for numerous reasons that are mostly out of the control of the affected water users: need for a cold water thermal regime, upstream land use impacts, unsuitable choriotope in available breeding areas, water quality issues, etc.

### **Response:**

The Target Fish Community serves in this study as a template guiding the PISF determination that will follow the Natural Flow Paradigm. Hence, the habitat requirements for the Atlantic salmon serve as an indicator for flows that should occur in the river according to the natural flow regime. This analysis neither recommends Atlantic salmon restoration nor takes into account the management plans of federal agencies. This has been explained and justified on page 14 and 92 of the draft report.

The statement that NH Fish and Game is no longer interested in the Atlantic salmon restoration is not only incorrect (conversation with Cheri Patterson), but also irrelevant for the determination of PISF that are based on the Natural Flow Paradigm. Not including the habitat for this species would violate this key principle of the study.

**C. Has the Process Included Sufficient, Meaningful Input from the TRC, Affected Water Users, and Other Interested Parties?**

**Comment UDWS-C-1:**

Even though the January 14, 2009 public hearing was noticed as the joint hearing with the House Resources Committee and the Senate Environment Committee, that hearing did not satisfy the requirements of Ch. 5 of the Laws of 2008. Section 5:3, III (a) which states that DES must conduct the PISF studies and submit a report By April 1, 2009. The next two sentences then state that the department shall hold a public hearing jointly with the Senate and House Committees within sixty days, and that the department consider any public comments received to make revisions to the instream flow levels and water management plans. Holding the required joint hearing prior to the submittal of the final PISF report is inconsistent with the direct requirements of last year's session law. Further, that hearing was conducted by two DES officials, with no Senate Environment Committee in attendance and only one (the chair) member of the House Resources Committee present. We appreciate that DES has provided substantial opportunity for public input in what is a very open process, but it is important to carefully follow the legal requirements that the Legislature has established.

**Response:**

The purpose of the joint hearing is to hear such public comments that may result in changes to the report before it is made final. The hearing was held in accordance with Chapter 5:3III(a)(Laws of 2008).

The draft report was presented during the week before December 14, 2009 and the public hearing was held within 60 days on January, 14, 2009. The public comment period was open until March 2, 2009 allowing additional time beyond the required 30 days for review.

In addition, the draft report was presented for review several months before the hearing at public meetings of the Technical Review Committee. Specific notification and invitations to these meetings are sent to all affected parties, the towns in the watershed, members of the Water Management Planning Area Advisory Committee, and myriad interested parties who have been following the program for years. They are invited so as to be presented with the project progress information and are allowed to offer any comments.

The public hearing was held jointly with the legislative committees, but the Department cannot and does not require the attendance of the legislature.

**References:**

III. The commissioner of the department of environmental services shall:

(a) By April 1, [2007] 2009, conduct protected instream flow studies and submit a report that details the results of science for the pilot program, including the projected impacts of the protected instream flows and water management plans to be implemented on water users, wildlife, recreation, and other interests along the rivers and any recommendations for proposed legislation. The department shall hold a public hearing jointly with the senate environment committee and the house resources, recreation and development committee within 60 days and be open for a public comment period of an additional 30 days. The department shall consider the

public comments received in any revisions to the protected instream flow levels and water management plans for the Lamprey River and the Souhegan River.

**Comment UDWS-C-2:**

Looking further at the procedural requirements of Ch. 5 of the Laws of 2008, the next milestone that DES must achieve is the October 1, 2009 deadline to “adopt and implement the protected instream flows and water management plans”. One year later, yet another public hearing and comment is required and a report must be submitted to the Legislature concerning the pilot program by December 1, 2010. UNH and the Town have serious reservations about whether thorough and fully integrated water management plans can be put in place for all water users in the Lamprey River Watershed, in the few months remaining between April 1 and October 1 of this year. As stated above in our technical comments, there has been no real analysis of water needs of the UDWS, and that is also true for other water users on the Lamprey. To undertake the data gathering and analysis, and prepare the necessary conservation, water use, and dam management plans for all the water users seems extremely optimistic. We strongly urge that DES not curtail the necessary analysis and collaboration which is the hallmark of the water management plan process in order to meet a merely aspirational goal set by the Legislature. A legislative extension of the deadlines may be advisable, though not necessary, but it is very important that DES and all interested parties take the time necessary to produce the right results.

**Response:**

Legislation has been proposed in the spring 2009 session that would extend the duration of the Pilot Program. The Lamprey Water Management Plan process would then be continued through September 2010.

**Comment UDWS-C-3:**

The TRC’s Annual Report provided to the Legislature on November 1, 2008 indicated that on September 22, 2008 the 700+ page draft final Lamprey PISF Report was completed and presented to the TRC for review prior to its meeting on October 23, 2008. The TRC met again on November 13, 2008, only three weeks after receiving the draft, and voted to continue to the public hearing/comment phase, but with reservation. Given the length and complexity of the report, this may have not afforded a reasonable opportunity for thoughtful review of the document by TRC members.

**Response:**

The Lamprey Technical Review Committee’s duty is to advise DES on technical aspects of the study. DES has made the study methods used to define the protected flows part of its continued interaction with the advisory committees (Technical Review Committee and Water Management Planning Area Committee) and with the public. The Department has made numerous presentations describing these methods over the years during both this study and the Souhegan study. The Lamprey study was nearly an identical process to the Souhegan study and several members of the Lamprey Technical Review Committee also served on the Souhegan Technical Review Committee. The results of the Souhegan study were under review for over a year resulting in no comments that changed the method used or the results of the Souhegan protected

flows. The Souhegan Study has been available on the DES website and in libraries in draft form since February 2007 and in final form since March 2008.

DES began presenting the methods and results used in the Lamprey Study to the Lamprey Technical Review Committee beginning initially in April 2007. DES presented the methods and results again to the Lamprey Technical Review Committee at its June 8, 2008 meeting. The draft report document was first presented at the October 23, 2008 meeting. The Committee (and the entire notification list) received web access to the report on October 3 for their review prior to the meeting. The presentation continued at the November 13, 2008 meeting. The November Technical Review Committee meeting was not the end of the review time available to that group. The Technical Review Committee as a group or individually had the opportunity to continue its review and to comment during the over four weeks between their approval of the report to go to the public hearing, or during the subsequent 30-day review period prior to the public hearing, or during the almost seven week comment period following the public hearing. Even counting only from October 3 to the final due date for comments on March 2 allowed over 20 weeks for review and comment.

**Comment UDWS-C-4:**

Based on a comparison between the September 22, 2008 Draft Report and the December 9, 2008 Draft Report, there was significant text added to the Report after the TRC voted to continue to the next phase. Some of the text added to the December 9<sup>th</sup> Draft, including the last paragraph on Page 20 (which was awkwardly placed following the discussion about the Newmarket Water Works) contains absolute and unprecedented policy setting discussion that should have been reviewed by the TRC. This discussion is of such importance as to potentially invalidate the vote of the TRC to continue to the next phase. The attached draft letter from the TRC to the Commissioner of DES (see Attachment 7 - draft letter dated December 1, 2008), which was provided to the Town of Durham for review and comment (and may or may not have been sent), evidenced some TRC members' concerns about continuing to the next phase.

**Response:**

As noted by UDWS the following two paragraphs did not appear in the September 9, 2008 version of the Draft Lamprey River Proposed Protected Instream Flow Report, but were included in the December 9, 2008 version:

“Provisions in the existing 401 Water Quality Certificate for the UNH/Town of Durham water supply inter-basin transfer and the conditions included in the Groundwater Discharge Permit for the Town of Newmarket’s artificial recharge water diversion project establish limitations on either the amount of water that can be withdrawn and/or the timing of withdrawals from the designated segment. The diversion of water by these public water supplies will be further governed by the proposed protected instream flows for instream fauna as discussed later in this report. The rationale for this recommendation is that in order to maintain and enhance aquatic and fish life along with fish and wildlife habitat (Chapter 483:0-c) sufficient flow must be available in the designated segment during specific bioperiods for the identified protected entities. Where the public water systems would have options to reduce water withdrawals through adaptive management practices (artificial recharge, conservation, development of alternative water sources, off-stream storage, etc.) the instream fauna and their supporting habitat would not and would be potentially at risk if water withdrawals resulted in flows below the

proposed PISFs. Water use by these public water supplies and other affected water users in the Water Management Plan Area will be further evaluated in during the development of the Water Management Plan, following the adoption of the proposed PISFs.

In the instance that water withdrawals from the designated segment are needed to alleviate emergency conditions, Chapter 483 (New Hampshire Rivers Management and Protection Program) includes provisions for this emergency use. Specifically, Chapter 483:9-c states that *“the protected instream flow levels established under this section shall be maintained at all times, except when inflow is less than the protected instream flow level as a result of natural causes or when the commissioner determines that a public water supply emergency exists which affects public health and safety.”* Provisions for the emergency use of water by the UNH/Durham water supply system are also included in its existing 401 Water Quality Certificate.”

The proposed PISFs were presented to the Technical Review Committee (TRC) over two meetings, one held on October 23, 2008 and one held on November 13, 2008. At the November meeting, the recommendation that no specific PISF was to be proposed for public water supplies (PWS) was presented along with the goal of minimizing the impact of water supply use on the instream protected entities through the development of the Water Management Plan. Following the discussion in the November 13, 2008 TRC meeting, the decision was made to include the two paragraphs in question to provide clarification of how the proposed PISFs would apply to the PWS located on the designated segment and also to document that any withdrawals in response to a water supply emergency would pre-empt the PISFs, which was not discussed in the previous draft of the report.

Although these two paragraphs were not included in the draft version of the report that the TRC reviewed, the recommendation not to propose a specific PISF for the PWS on the designated segment was presented at the November 13, 2008 TRC meeting, which pre-dates the draft letter from the TRC to the DES Commissioner. The draft report was then released to the public on December 9, 2008, which is the version of the report that the UDWS has provided comment on. As for the decision not to develop and propose a specific PISF for PWS located on the designated segment, that discussion is provided in the response to several other comments in this letter on this specific issue.

#### **Comment UDWS-C-5:**

Although the PISF Report represents conscientious and hard work, the work has been done with limited critical review. Based on (1) the limited questions posed many TRC members, either verbally at meetings or in writing, (2) the confusing and conflicting methodology, the TRC apparently did not – and in fairness could not realistically – perform a thorough review during critical phases. A third party review needs to be conducted by an impartial entity with clear separation and disconnect from the consulting team, fish and wildlife conservationists, and the affected water users. The selection of the Instream Flow Council (IFC) to conduct the 3<sup>rd</sup> party review, as suggested by the program leaders, would lack the critical impartiality.

#### **Response:**

A third party review is being developed with the Instream Flow Council. The critical questions concern statistical analyses, fisheries studies, and incremental flow models. Instream Flow

Council has the expertise to conduct the assessment of these critical questions. Furthermore, the Instream Flow Council has no investment in the results of the Lamprey Study and in fact would be most critical of the study if it contains flaws. The Lamprey Technical Review Committee and US EPA both specifically support the Instream Flow Council conducting this review. DES believes there is no group better suited to provide impartiality and the expertise to judge this study. We request that you bring forward immediately any information that would lead UDWS to conclude that the Instream Flow Council or anyone involved in the third party review has a conflict of interest.

**Comment UDWS-C-6:**

Numerous important references are missing from the list of reference (here are just a few): Poff and Ward, 1990 (Page xviii); Novak and Bode, 1992 (page 22, 23); Bain and Meixler, 2002 (page 21, 22); Richter et al, 1997 (page 92), and Richter et al, 1996 (Appendix 13, Page 2); Bunn and Arthington, 2002 (page 94, 95), Niemi et al, 1990 (page 130). Further, the last paragraph on page 20 contains a reference to a scientific paper that is not in the list of references. The fourth paragraph on page 21 contains multiple references to scientific papers that are not in the list of references, and the second paragraph on page 23 contains a reference to a scientific paper that is not in the list of references. This reference is apparently the source of a key equation explaining Percent Similarity; since the reference is unavailable, please explain the reasoning behind the 0.5 multiplier in the Percent Similarity equation.

**Response:**

Review of the Draft report confirms that several references included in the main report and in one of the Appendices (13) were not included in the reference section of the report. The missing references have been identified and are included in the final version of the report.

The reference for the Percentage Similarity equation is:

Novak, M.A., and R.W. Bode. 1992. Percent model affinity, a new measure of macroinvertebrate community composition. *Journal of the North American Benthological Society* **11** (1): 80-85.

This equation originally appeared in:

Whittaker, R.H. 1952. A study of summer foliage insect communities in the Great Smoky Mountains. *Ecological Monographs* **22** (1): 1-44.

In this paper, Whittaker presents his equation to determine an index of association, which is a measure of percentage similarity:

“When samples are of indefinite area or of different sizes, value of percentage similarity changes with change in relative size of the samples. To provide a standard basis of comparison it is desirable to use samples of equal numbers of individuals or, more simply, to compare the samples in terms of decimal fractions or percentages rather than by numbers of individuals. Using decimal fractions and summing differences without regard to sign gives a measurement ranging from zero to 2.00, one half of which may

serve as an expression of population difference. One minus this last value equals the sum of the smaller fractions and may be used as an index of association of two samples,

$$I_a = 1 - .5 \sum [a - b] = \sum \min (a,b)$$

When  $a$  and  $b$  are decimal fractions of samples A and B.

**Comment UDWS-C-7:**

There is confusing inconsistency between the dates indicated on the Report documents available for review on the DES website and available for download from the DES FTP site. There also two separate links on the DES website where digital Reports are available for download; however, one has a December 9, 2008 date and other has a December 10, 2008 date. Both these documents appear to have 12/9/2008 in the footer of the main body of the Report, but the document available on the FTP site has date of 12/10/08 in the footer. What are the differences between these 3 report documents?

**Response:**

The DES posted two links on its Instream Flow Protection Pilot Program web page that directed persons to the same version of the Draft Lamprey River Protected Instream Flow Report. One link (Lamprey Proposed Protected Instream Flows) appears under Hot Topics and is dated December 9, 2008. The second link appears under Publications (Lamprey Proposed Protected Instream Flow) and is dated December 10, 2008. The version of report posted on the web has a date of December 9, 2008 both on its cover page and in its footer. Unfortunately, the Table of Contents, List of Figures and List of Tables were not paginated correctly.

The FTP site includes a copy of the report, having a footer date of December 10, 2008, but includes corrected pagination for the Table of Contents, List of Figures and List of Tables. The footnote date automatically reset to reflect the day that the pagination changes were made to the report.

So, although there are two different links to the Draft Lamprey River Proposed Protected Instream Flow Report, they direct the viewer to the same report. This version of the Report differs slightly from the version posted by the DES on its FTP site. The version of the Report posted on the FTP site includes the corrected pagination. Other than the corrected pagination and updated footnote, there are no other differences between these two versions of the report.

**Comment UDWS-C-8:**

The table of content and the main body of the report lacks a consistent sequential section/subsection numbering system. Without a section and subsection numbers, which is standard in any scientific report of this significance, it is extremely difficult to understand when section begin and end and keep track of the context of each subsection relative to the main sections or chapters. It also make is difficult to reference, discuss, or comment on particular parts of the report. It is recommended that a sequential outline style section/subsection numbering system be incorporated into the document.

**Response:**

Agreed. This change will be made for the final report.

**D. Conclusion**

**Comment UDWS-D-1:**

The principal "takeaways" thus far for the UNH/Durham Water System are best captured as follows:

-- Further consideration of existing public water supply needs as a flow-dependent instream use and resource is needed. This vital public use must be more fully studied before PISFs are finalized, and not simply deferred until the development of a water management plan for the Lamprey River.

-- The inadequate assessment of public water supply needs is compounded by what may be overly conservative assumptions and methods used to determine flows needed to preserve natural fish and aquatic habitat. The modeled conditions which are based on presumed "pre-colonial" habitat differ dramatically from actual and foreseeable conditions. The rationale, justification for and validity of analyzing fish and aquatic habitat needs from such models is lacking. DES also needs to support the science and the policy judgments that require affected water users to assure flows and limit withdrawals in order to enhance aquatic habitat for selected target species.

-- Considering the overall goal of applying this "pilot study" approach to the remaining rivers in the Rivers Management and Protection Program, the methods, data and analysis from which the conclusions are drawn must be readily and widely accepted. The need for an impartial third party review of the Report is paramount for gaining the confidence and acceptance of the affected water users.

-- Notwithstanding looming Legislative submittal deadlines of April 1, 2009 for the final PISF report and then October 1, 2009 for a water management plan for all affected water users, DES must not rush to conclude this pilot project. Notwithstanding the voluminous amount of data and documentation that has been developed to date, we believe that more time than the mere four weeks remaining is needed to review and consider the PISF Report before it is finalized. And we have serious concerns that a well-considered water management plan can be realistically developed before the October 1 submittal deadline. Either the legislative deadline needs to be extended, or the Legislature will have to forgive DES's taking the time needed to develop it properly.

**Response:**

DES acknowledges your concerns regarding the Draft Proposed Protected Instream Flow Study Report and has provided responses to each of your comments. Regarding your comment on the limited time for the completion of the Water Management Plan, legislation has been proposed in the spring 2009 session that would extend the duration of the Pilot Program. The Lamprey Water Management Plan process would then be continued through September 2010. This extension should provide sufficient time for the completion of a Plan that recognizes the concerns of each of the potentially affected water uses and dam owners located within the Lamprey River Water Management Planning Area.

After careful consideration of RSA 483:9-c and related statutes in the context of UDWS comments, DES has concluded that public water supply, although it is a valuable and very important outstanding characteristic of designated rivers where the use exists, is not a flow-dependent IPUOCR.

## Comments Received From:

Ms. Michelle L. Daley  
Research Scientist  
Associate Director NH Water Resources Research Center  
Department of Natural Resources and the Environment  
University of New Hampshire  
310 Nesmith Hall  
131 Main Street  
Durham, NH 03824-2500

**Source:** email dated Monday, March 02, 2009 11:48 AM

## Comment MD-1:

My largest concerns lie with the MesoHABSIM model used to predict instream flows necessary to support fish and aquatic life since these seem to be the most flow sensitive entities in the Lamprey River based on the report. First, the use of this model seems fundamentally flawed by excluding the dams that are present along the Lamprey River. The Macallam, Wiswall and Folsom Dams will exist into the foreseeable future and will continue to impact the hydrologic regime of the Lamprey. When establishing protected instream flows, it seems necessary to model reality and incorporate the role of these dams into any modeling exercise.

## Response:

You are correct in noting that the baseline river structure no longer exists and that the dams will continue to affect habitat conditions. The purpose of using conditions without dams in the MesoHABSIM modeling was not to recommend that modifications be made, but to establish a baseline for the determination of flows to which the natural fish fauna have adapted. This is an element of the Natural Flow Paradigm, which has been adopted as an underlying principle for this study. This is the only way to define reasonable reference conditions.

The results on protected flows of using both current and baseline conditions are documented in the **Protected Habitat Levels** section of the report. In the modeling, the river is assessed as one by combining the reference reaches. The total amount of habitat is lower under the current conditions than under the baseline conditions, which reflects the existing river conditions having both dams and impoundments and limited woody debris and undercut banks in these sections. Protected flows would have to be higher to maintain habitat levels using current conditions: For example under Rearing and Growth Bioperiod, “At present conditions this habitat level corresponds with flows of **0.95 cfsm (173 cfs)**. The flows corresponding with 11 percent CA (channel area) under baseline conditions are **0.6 cfsm (109 cfs)**.” What would be unreasonable is to try to maintain habitat conditions with flow where the river’s structural conditions do not support that habitat level any longer. The application of the protected flows still applies under the current conditions, but using baseline conditions means that unnatural flow conditions are not necessary to try to make those existing conditions function as if the dams were not present. Therefore, the results of this study represent a reasonable and practical approach, while at the same time still following scientifically sound logic.

**Comment MD-2:**

Second, the ecological variables included in the final MesoHABSIM model for presence/absence should have the same sign in the model for abundance if they are also included in that model. One of the variables was included in both models, but had different signs (positive in one and negative in the other). How can one variable positively influence the presence of fish in one model and then negatively impact the abundance in the other (or vice versa)? These final models should make ecological sense. Finally, the relative importance of the different variables included in the final MesoHABSIM models is not evident and this is an important consideration when interpreting the model results. Examining the relative importance of ecological variables included will help inform the reader/decision maker and this should be examined and included in the next version of the report.

**Response:**

Because of the two different assessments being conducted—presence and abundance—the parameters should not necessarily be expected to be similar. The abundance models that were constructed for this study are contingent on the presence of fish, meaning that they were based only on sites where fish were known to be present. An example of how a parameter may be positively correlated with presence, but negatively correlated with abundance follows for one attribute such as woody substrate. Woody substrate may correlate positively with the presence of a species, pointing towards a greater chance of finding the species where this substrate appears. However, it does not necessarily mean that this is a linear relationship with the number of individuals. It only means that wherever this substrate was present, we only found a few of the animals. The negative coefficient for woody substrate in the abundance model indicates that we can find the species of fish where there is such a substrate, but only few in numbers. Therefore, the occurrence of the same attribute with a different sign (positive or negative) in both models is justified and mathematically correct.

Regarding the relative importance of the ecological variables used in the modeling, their standard errors were included in the coefficient tables which can be found in the revised version of Appendix 6.

**Comment MD-3:**

My other concern is that when it comes time to establish these PISF rules and allocate water use, not all the users who have a hydrologic influence on the designated reach will be part of the allocated water use. Large water users upstream and large groundwater withdrawals that aren't within the water management planning area can certainly still have a hydrologic influence on the designated reach. I'm concerned that even if the most ideal protected instream flows are set, they may not be reached if these other water users are not incorporated into the management plan.

**Response:**

As outlined in Env-Ws 1905.02, the scope of the Protected Instream Flow Study is limited to the outstanding characteristics, instream public uses and resources for the designated river segment only. So water users located either upstream or downstream of the designated river segment were not discussed in the Draft Lamprey River Proposed Protected Instream Flow Report. The Water

Management Planning Area includes essentially all registered water users in the upstream watershed, and all registered dam owners with an impoundment area sufficient to provide any usable storage.

The second phase of the study, the Water Management Plan (WMP), will focus on both the Affected Water Users (AWU) and Affected Dam Owners (ADO) located within the Water Management Planning Area (WMPA - the tributary drainage area to the designated river, Env-Ws 1902.16). AWUs are defined as those required to be registered and having a withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its drainage area (Env-Ws 1902.03), while ADOs are defined as an owner of a dam with an impoundment having a surface area greater than 10 acres in the watershed area of a designated river (Env-Ws 1902.02).

The AWUs and ADOs of the Lamprey River WMPA have already been contacted to obtain information on their water use or dam operations. This information will be used to develop a Conservation Plan, Water Use Plan and a Dam Management Plan, which are the principle elements of the Lamprey River WMP. As part of the WMP process, the needs of the water users and dam owners will be evaluated relative to the protected instream flows (PISFs) established for the Lamprey River. Ultimately, the outcome of this process will be the determination of how the established protected instream flows will be maintained through the implementation of appropriate conservation and operational management measures by the AWUs and ADOs.

**Comment MD-4:**

My final comment is regarding table 1. This table seems to be the heart of the report and is what the established protected instream flows will be. It should be clear to the casual reader of table 1 how these flows were reached (brief/one sentence model description) and how this table will influence our management plan. There are overlapping time periods with different flows...which flow will be managed for? Explaining the table and terms in more detail in the legend would be useful.

**Response:**

Table 1 has been revised to accurately describe the bioperiod durations. Text has been added to define the individual components of Table 1 and to describe how the protected instream flows will be used to identify periods requiring management actions.



**Comments Received From:**

Emery & Garrett Groundwater, Inc.  
56 Main Street  
P.O. Box 1578  
Meredith, New Hampshire 03253

**Source:** Letter dated Friday February 27, 2009

**1. Water Uses Upgradient of the Designated Section of the Lamprey River**

**Comment EGGI-1:**

The only registered water users and public supply wells mentioned in the Report are those of Durham/UNH and Newmarket. Why is there no discussion of other water resources upgradient of the designated portion of the Lamprey River?

**Response:**

As outlined in Env-Ws 1905.02, the scope of the Protected Instream Flow Study is limited to the outstanding characteristics, instream public uses and resources for the designated river segment only. So water users located either upstream or downstream of the designated river segment were not discussed in the Draft Lamprey River Proposed Protected Instream Flow Report.

The second phase of the study, the Water Management Plan (WMP), will focus on both the Affected Water Users (AWU) and Affected Dam Owners (ADO) located within the Water Management Planning Area (the tributary drainage area to the designated river, Env-Ws 1902.16). The water management planning area includes essentially all registered water users in the upstream watershed, and all registered dam owners with an impoundment area sufficient to provide any usable storage. AWUs are defined as those required to be registered and having a withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its drainage area (Env-Ws 1902.03), while ADOs are defined as an owner of a dam with an impoundment having a surface area greater than 10 acres in the watershed area of a designated river (Env-Ws 1902.02).

The AWUs and ADOs of the Lamprey River WMPA have already been contacted to obtain information on their water use or dam operations. This information will be used to develop a Conservation Plan, Water Use Plan and a Dam Management Plan, which are the principle elements of the Lamprey River WMP. As part of the WMP process, the needs of the water users and dam owners will be evaluated relative to the protected instream flows (PISFs) established for the Lamprey River. Ultimately, the outcome of this process will be the determination of how the established protected instream flows will be maintained through the implementation of appropriate conservation and operational management measures by the AWUs and ADOs.

## Comment EGGI-2

Please provide a list of the water supply wells and dams that were included in the evaluation of the naturalized flow.

### Response:

All registered water users were included (see list below) as well as Dolloff Dam on Pawtuckaway Lake in Nottingham, NH.

<b>Name</b>	<b>Water Use ID</b>	<b>Type</b>
SEVERINO TRUCKING COMPANY INC	20751 20751-S03	SW
SCENIC NURSERY INC	20747 20747-S03	SW
SCENIC NURSERY INC	20747 20747-S02	GW
SCENIC NURSERY INC	20747 20747-S01	GW
LEISURE VILLAGE	20783 20783-S01	GW
LEISURE VILLAGE	20784 20783-S01	GW
LEISURE VILLAGE	20785 20783-S02	GW
FERNALD LUMBER INC	20557 20557-S03	SW
FERNALD LUMBER INC	20557 20557-D01	GW
EPPING WWTF	20389 20389-D01	SW
PENNICHUCK WATER WORKS RAYMOND WATER DEPARTMENT	20351 20061-S01	TW
EPPING WATER WORKS	20061 20061-S01	GW
EPPING WATER WORKS	20045 20045-S04	GW
EPPING WATER WORKS	20045 20045-S02	GW
PENNICHUCK WATER WORKS	20018 20018-S01	GW
NEWMARKET WATER WORKS	20057 20057-S02	GW
CHIKALLA GERALD*	20126 20126-S01	SW
UNIVERSITY OF NH	20066 20066-S02	SW
EPPING WATER WORKS	20045 20045-S01	GW
DELUGE INCORPORATED	20679 20679-S01	GW
NEWMARKET WATER WORKS	20057 20057-S05	SW
NEWMARKET WATER WORKS	20057 20057-S04	SW
NEWMARKET WATER WORKS	20057 20057-S03	GW
NEWMARKET WATER WORKS	20057 20057-S01	SW
EPPING WATER WORKS	20045 20045-S03	GW

SW - Surface water

GW - Groundwater

TW - Transfer of water from Raymond to Pennichuck

\* - Nottingham Lake Dam, current contact Larry Costa

**Comment EGGI-3:**

What is the total amount of groundwater withdrawals removed from the measured flow data to determine the naturalized flow?

**Response:**

Surface water and groundwater withdrawals were not aggregated separately. Withdrawals differ by year and month.

Average daily consumptive water loss (cfs) including all water losses in and upstream of the designated reach.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
pre '85	0.080	0.071	0.068	0.068	0.075	0.080	0.075	0.075	0.071	0.066	0.061	0.065
85	0.112	0.102	0.101	0.099	0.109	0.116	0.111	0.110	0.104	0.098	0.094	0.096
86	0.112	0.102	0.101	0.099	0.109	0.116	0.111	0.110	0.104	0.098	0.094	0.096
87	0.112	0.102	0.101	0.099	0.109	0.116	0.111	0.110	0.104	0.098	0.094	0.096
88	0.112	0.102	0.101	0.099	0.109	0.116	0.111	0.110	0.104	0.098	0.094	0.096
89	0.116	0.110	0.102	0.103	0.107	0.126	0.108	0.110	0.112	0.102	0.083	0.085
90	0.109	0.104	0.095	0.098	0.107	0.116	0.105	0.097	0.103	0.098	0.095	0.089
91	0.107	0.109	0.106	0.097	0.106	0.119	0.125	0.126	0.117	0.108	0.095	0.091
92	0.100	0.106	0.111	0.114	0.158	0.144	0.138	0.133	0.133	0.110	0.106	0.113
93	0.112	0.118	0.116	0.113	0.146	0.154	0.370	0.338	0.139	0.115	0.119	0.117
94	0.113	0.125	0.120	0.149	0.150	0.171	0.170	0.158	0.156	0.125	0.125	0.125
95	0.125	0.126	0.124	0.148	0.156	0.167	0.171	0.376	0.778	0.140	0.129	0.126
96	0.118	0.136	0.140	0.161	0.171	0.181	0.146	0.152	0.137	0.147	0.129	0.131
97	0.140	0.157	0.151	0.161	0.158	0.253	0.235	0.473	0.145	0.237	0.177	0.150
98	0.130	0.131	0.125	0.154	0.167	0.169	0.181	0.178	0.166	0.151	0.131	0.118
99	0.151	0.159	0.182	0.193	0.220	0.264	0.259	0.354	0.291	0.138	0.135	0.144
00	0.119	0.132	0.145	0.158	0.203	0.179	0.205	0.184	0.199	0.130	0.112	0.117
01	0.124	0.151	0.150	0.179	0.201	0.472	0.200	0.237	0.264	0.174	0.221	0.163
02	0.208	0.213	0.362	0.363	0.315	0.356	0.614	0.918	1.012	1.614	1.176	0.496
03	0.285	0.306	0.298	0.271	1.177	1.053	1.171	1.158	1.168	1.292	0.882	0.131
04	0.177	0.163	0.240	0.211	0.296	0.290	0.450	0.586	1.217	1.054	0.851	0.528
05	0.157	0.151	0.165	0.159	0.215	0.225	0.273	0.274	0.245	0.183	0.168	0.156

**Comment EGGI-4:**

Have all towns, water supplies, dam operators, and environmental groups upgradient of the designated section been notified of the Lamprey River Instream Flow study, and specifically notified that the results of the study could potentially impact the use of water resources in their communities, from their wells, or within their lakes?

**Response:**

Yes. Each Affected Water User and Affected Dam Owner was notified by certified mail dated November 3, 2005 that protected flows are being developed, that they will be enforceable, and that they are encouraged to participate in the process.

In addition, notification of each Technical Review Committee or Water Management Planning Area Advisory Committee meeting is sent by email or hard copy to: the town selectmen of the watershed, the River Management Advisory Committee, the instream flow working group of the Water Council, the legislative instream flow committee, the Affected Water Users and Affected Dam Owners, the Local River Management Advisory Committee, the chairs of all the Local River Management Advisory Committees, the Water Quality Standards Advisory Committee, and 115 other interested parties who have asked to be notified. Any one may join the mailing list and all interested parties are invited to attend and participate in the meetings. The Water Management Planning Area Advisory Committee representing watershed stakeholders is made up of agricultural water users, business water users, lakes committees, conservation and recreational interests, hydropower interests, members of the legislature serving the watershed towns, government official from watershed towns and other groups.

Additionally, notification of Technical Review Committee and Water Management Planning Area Advisory Committee meetings and agendas are posted on their websites. Public hearings are posted on the website and noticed in newspapers thirty days before the hearing. All meeting documents are presented on the website and the Department has made a point of providing CDs and in many cases hard copies of draft and final documents on request. The website contains explicit documentation of the requirements for protected flows and the mechanisms for implementing the protected flows. Draft and final Protected Instream Flow Reports, and copies on CDs are provided to watershed libraries for review and distribution.

**2. Poor Labeling of Hydrographs and Inconsistent Use of Terminology**

**Comment EGGI-5:**

Appendix A describes a process of creating naturalized flow by removing the impacts of water withdrawals and dam operations from the measured river flow. *However, it is not clear throughout the document when analyses are performed using naturalized flow vs. measured flow.* For example, the graphs in Figures 3 and 9 display mean daily flows (or is this the mean of mean daily flows? They are differently represented on Figures 3 and 9), but there is no indication of whether this is for naturalized or measured flow. (Is this the measured flow for the entire period of record or is it a composite data set of measured flow before 1955 and corrected data post 1955?) *Please provide an explanation.*

**Response:**

Relative to Figure 3, which appears in the discussion of the rare, threatened and endangered: wildlife, vegetation and natural/ecological communities, the flows presented in this figure are the mean of mean daily flows. The means were calculated using the mean daily flow values recorded at the USGS gaging station at Packers Falls, as reported for the period of 1934 to 2006. The vertical axis of this figure will be corrected for the final report. In addition, the assessment

of the rare, threatened and endangered: wildlife, vegetation and natural/ecological communities was based on flows recorded at the USGS Packers Falls gage.

Figure 9, which appears in the discussion of fish bioperiods, is labeled correctly and the hydrograph is based on the mean of the daily mean flow as recorded at the USGS Packers Falls gage for a 72 year period of record. The flows recorded at the USGS Packers Falls gage were used to help delineate the bioperiods for the fish and other aquatic species studied. To further clarify what flow data was used during the MesoHABSIM analysis, please note the following:

<u>Task</u>	<u>Data</u>
Habitat suitability criteria development.	Field measured velocities and recorded flows at USGS Packers Falls gage in 2006 and 2007.
Habitat rating curves for current condition.	Same as above.
Habitat rating curves for baseline condition.	Same as above.
Habitat time series analysis.	Naturalized mean daily flows, past 30 years at USGS Packer Falls gage.
Proposed protected instream flows.	Same as above.

**Comment EGGI-6:**

Under the discussion of hydrographs, several terms were used to describe flow data, including Historic Data, Naturalized Flow, Untransformed Representative Hydrographs, Representative Hydrographs, Selected Hydrographs, Simulated Hydrographs, and Target Hydrographs. *These terms are extremely confusing; please provide an explanation.*

**Response:**

Historic data or records – In Part Two of the main report, reference is made to historic records, which are the historic flow records for the Lamprey River. This reference has been revised to note the source of these records. In Appendix 13 references were made to the historical record of Lamprey River flow as recorded at the USGS Lamprey River gage, historic water withdrawals (based on water use report data) and/or historic dam operations. All these are referenced in context to their source of information.

Naturalized flow or stream flow – this term appears in the main report and refers to the estimated flows when the net water withdrawals are included and corrected for dam operations. Naturalized stream flow is the equivalent of the pre-colonial flow, which is discussed in Appendix 13. For consistency, the references to pre-colonial in Appendix 13 have been changed to naturalized.

Pre-colonial hydrograph – see above.

Representative hydrograph - the term representative hydrograph appears in Part Two of the main report, where the recommended PISFs are compared with the recorded Lamprey River flows for four different flow conditions: three wet years, three dry years, three average years and last five years. So the term representative hydrograph refers to the hydrograph that is representative of these different conditions (wet, dry, average or last five years).

Selected hydrograph - this term appears in the captions for two of the figures (48 and 49) that appear in Part Two of the main report and merely refers to the representative hydrographs shown in the figure. The selected hydrographs being the 30-year record, 3-year average, 3-year low flow, last 5 years and 3 –year high flows.

Simulated hydrograph - The use of the term simulated appears in the discussion of the Habitat Time Series Analysis. The term simulated refers to the naturalized flows or naturalized hydrograph. The term simulated was replaced with the term naturalized for consistency.

Target flow – mentioned in the discussion of the Rating Curves for the Study Area. The targeted flows are those five flow levels ranging from 0.1 cfs to 2.0 cfs, during which the habitat mapping surveys were determined in the field (see Table 16)

Target hydrograph – mentioned in the Representative Hydrograph section in Part Two of the report. Equivalent to the term representative hydrograph (three year wet, dry and average and the last five years).

#### **Comment EGGI-7:**

There seems to be multiple places in Part 2, Section II of the Report where the meaning of the term "met" or "meets" is difficult/impossible to interpret. In some contexts, it appears as though the term "meets the PISF" refers to the instance when a flow value is higher than the PISF and that particular flow is allowable or acceptable. In other cases, it appears that the same term implies that a flow has decreased to the point where it falls below the PISF and it is no longer allowable or acceptable. The document needs to be very clear about this term, so that the tables in Part 2, Section II can be interpreted correctly and consistently. *Please provide an explanation.*

#### **Response:**

The interpretation of the results presented in Part Two, Section II of the Report as stated in the comment is correct. Please note that the captions for the tables presented in this part of the report clearly state if the results of the comparison between the protected instream flows (PISFs) and the flows in the representative hydrograph either meet or don't meet the defined PISF value. The only difference in the presentation of the results is that for the non-fish assessments (Tables 26 and Tables 29 to 43) they are presented for the number of days and percentage of time that the flows of the representative hydrograph are greater than the PISF for the protected entity.

For the assessment of the PISFs for fish, the results (Tables 45 to 48) are clearly presented as the number of times that the PISFs were not met (flow below value) and the number of years in the record in which the PISFs were not met (duration exceeded). The only apparent inconsistency in the presentation format for these tables (45 to 48), is that they note the days and number of years when the representative hydrograph flows are lower than the PISFs, where the tables for recreation and natural communities and rare, threatened and endangered species (non-fish) show

the number of days and percentage of time the flows of the representative hydrograph are greater than the PISFs.

The rationale for the change in presentation style for Tables 45 through 48 was that in general, ultimately it was the Fish PISF that were the critical PISF to meet (meeting these flows meant that most if not all other protected entities needs were met). In this sense then and moving forward towards the management plan, the identification of when the river requires management strategies would be based on when flows are not meeting the PISF rather than when they meet the PISF. That is to say that DES would be tracking the days that the river flow is BELOW (not meeting) the PISF, and when the duration is also then exceeded, management strategies would then be implemented. So in this case, the presentation of the information in Tables 45 through 48) is consistent with the manner in which the system is monitored for management purposes.

### **Comment EGGI-8**

*All graphs, tables, and supporting calculations need to be reviewed and clearly and consistently labeled.*

### **Response:**

Agreed. The document has been reviewed and editorial changes have been made.

### **3. Potential Errors in PISF Analyses**

#### **Comment EGGI-9:**

The foundation of the instream flow values is, in theory, based on determining and maintaining natural streamflow conditions. This includes the evaluation of habitats, fish populations, vegetation, water flows, etc. The evaluation of each of these parameters (dependent or independent) has many errors and unknowns associated with them. Yet there are no error assessments or sensitivity analyses for any of these parameters and their associated potential impacts on the accuracy of this model.

For example, the calculations of the PISFs are dependent upon which flow data set is used (naturalized or measured). Based on the description in Appendix A13, the naturalized flow will be greater in the spring and lower in the fall than the measured flow. Therefore, the PISFs would be higher for the spring and lower in the fall if the naturalized flows are used for the analysis than if the measured flows are used. This will result in a higher number of actual flows that are lower than the PISF for the spring seasons. This will also require the implementation of more frequent watershed management techniques ... such as reducing the water withdrawals or initiating dam releases.

Assuming that the naturalized flow was used in the PISF analyses, then it is important to understand the error associated with the creation of the naturalized flow time series used in the analyses. Unfortunately, the report does not present any assessment of error in the calculation of the naturalized flow. By using the mean daily flow hydrograph presented in the report (Figures 3 and 9), it can be seen that the 20.80 to 33.00 cfs correction used in the February-May period is approximately 3 to 10% of the total flow and the 29.29 cfs correction used in the October-December period is approximately 10 to 30% of the flow (this range represents percentages of the range of flows in each season). *These are very significant adjustments to the measured flow*

*and would result in potentially very significant errors in the hydrograph corrections, and subsequently designated PISFs. For example, the fall corrections of 29.29 cfs are approximately 75% of the critical flow for this time period (i.e. 40 cfs). The fact that the corrections made to the measured data are nearly equal to the critical flow is very troubling.*

In addition, it is necessary to show representative illustrations of how the corrections to the measured flow impacted the hydrographs (i.e., during wet and dry three-year periods). It would also be useful to have some information about the relationship between the magnitude of the corrections and the total flow. What error is associated with this process? This information must be presented to understand whether the corrected hydrographs, and resulting PISFs are reasonable and scientifically credible.

*We request that you provide a full explanation of what the overall potential errors might be in your analyses and how they would impact the accuracy of your designation of PISF values.*

### **Responses:**

Based on comments received during the presentation of the draft findings of the protected instream flow study to the Technical Review Committee, a section (Error and Uncertainty) was included in the draft report that discusses the potential sources of error associated with the development of the naturalized flows. As discussed in this section of the report, potential errors are associated with a number of the datasets used to develop the naturalized flows including: the recorded stream flows at the USGS Packers Falls gage, the water withdrawals and discharges reported to DES by affected water users (AWU) and the historical dam release information on file with the NH Dam Bureau. The calculated naturalized flows were based on the information available and these values reflect any errors associated with the data used to derive these flows. No quantitative error assessment or sensitivity analysis was requested by DES as part of the Request for Proposal (RFP) for this project and, as a result, were not proposed as part of the scope of work.

EGGI correctly describes the effects of the adjustments made to the annual hydrograph to reflect the storage and release of water from Pawtuckaway Lake. Discussion of the seasonal adjustments for the Pawtuckaway Lake dam operations are discussed further in the response to the next comment (EGGI-10). Relative to their effect on the protected instream flows, the naturalized spring flows are higher, while the naturalized fall flows are lower to adjust for the storage and release of water from Pawtuckaway Lake. So the naturalized flows, and their associated protected instream flows will be higher for the spring and lower in the fall, when compared to existing conditions. Since most of the controlling flows are for fish and since the lowest and most ecologically stressful flows are experienced in the late summer and fall, the existing flow values (which will be monitored at the Packers Falls gage) would typically be greater than the naturalized flows and the associated protected instream flows reducing the potential number of management events. This is illustrated by the Critical Flow levels for the summer rearing and growth bioperiod and the Atlantic salmon spawning bioperiod presented in Figure 3 supplied by EGGI in their comment letter. The Rare Flow levels would plot well below the existing mean hydrograph for these two bioperiods.

Regarding Figures 3 and 9 in the report, both of these show the mean of the daily mean flow recorded at the USGS Packers Falls gage over a 73 year period of record and do not represent the naturalized flow. Their purpose was to illustrate the delineation of the bioperiods for wildlife and natural communities (Fig. 3) and for fish (Fig. 9). Relative to the naturalized flow correction

in the spring, the quoted 3 to 10% of total flow falls with the range of the error associated with the gaging of the recorded flows, while the adjustment to the fall flow is indeed significant. This reflects both the low flow magnitude typically experienced during this period of the year and the significance of the alternation of flow by the Pawtuckaway Lake dam operation.

#### **4. Seasonal Adjustments Made to the Hydrographs**

##### **Comment EGGI-10:**

Three seasonal adjustments were made to the hydrographs to compensate for how the post 1955 operation of the Dolloff Dam impacts flow (Appendix A13). These include a 20.80 cfs adjustment for February 21-March 29, a 33 cfs adjustment for March 30 to May 5, and a 29.29 adjustment for October 12 to December 19. Appendix A13 indicates that these correction periods were converted into a daily time series and then added/subtracted to the measured data to create a naturalized flow hydrograph. However, there is no description of how the conversion to a time series was completed. *Was data smoothing used? If so, how was this accomplished and/or applied? How does this smoothing impact the accuracy of the hydrographs for the time periods (spring and fall) that are between the correction periods (summer and winter)? Please explain (or provide the evidence for) why these corrections do not adversely alter the accuracy of the flow duration curves and, subsequently, the selected PISFs.*

##### **Response:**

Obtaining exact flow values for the Pawtuckaway drawdown and filling is challenging. Fortunately, the NH Dam Bureau follows the same routine annually. Using 16 years (1992 to 2007) of dam operation records, we were able to discern that the drawdown and filling dates are nearly identical from year-to-year (typically within one week) to identify median start and end dates and corresponding stage values for the fall dam release and the spring filling event. For these stages, the change in storage was calculated using a depth, area, storage relationship for the lake. The median change in storage was divided by the median duration of the drainage (fill) time. Between periods, Dolloff Dam is not typically actively managed. Inaccuracies in the hydrographs will occur when releases occur during those periods.

In addition, the drawdown is typically quite similar year-to-year with a mean of 5.4 ft (95% confidence interval is 5.0 to 5.7 ft). There is slight more year-to-year variability with the filling due to variations inflow. The March filling period typically raises the reservoir between 2.9 and 4.0 ft (95% confidence interval). The April filling period typically raises the reservoir between 2.2 and 3.0 ft (95% confidence interval). Because records do not exist for the entire 30-yr record, the typical management regime was applied. Years having drought conditions were examined individually. If Dam Bureau records existed, then these were used to estimate drawdown and filling for this period.

#### **5. The “Naturalized Flow” Does Not Reflect Land Use Changes that have Occurred in the Lamprey River Watershed Over the Past Several Decades, which Impairs the Accuracy of the Selected PISFs**

**Comment EGGI-11:**

Although there is some discussion regarding the attempt to make adjustments to the measured daily flow values of the Lamprey River due to water withdrawals and known storage changes in Lake Pawtuckaway, the so-called "naturalized flow" does not reflect the myriad number of land use changes that have occurred in the Lamprey River Watershed over the past several decades. The dramatic changes in land use within the Lamprey River Watershed have gradually caused significant increases in the amount of impermeable surface area. Each land use change in and of itself has created an imperceptible change in the flow duration curve of the Lamprey River, but the cumulative effect of thousands of small changes has undoubtedly changed the character of the flow duration curve over many decades. The cumulative impact of land use changes may well be more significant to the correction of the flow data than the known withdrawals or changes in storage in Lake Pawtuckaway. Therefore, the flow duration curve for today's Lamprey River will differ from that over the period of record. This fact raises substantial uncertainty regarding the ability to predict truly naturalized flow.

If the increase in impermeable surface area creates longer-duration and lower magnitude low-flow events, then today's measurements of low flow are much more likely to be less than the PISFs, which are based upon flow statistics from a relatively long period of record. Therefore, any management scheme for the River that hopes to re-create "pre-colonial" flow conditions will have to overcome the effect of all the land use changes that have occurred in the entire watershed. *We do not consider this as being realistic and request that a full explanation be made that addresses these significant sources of inaccuracy in this analyses.*

**Response:**

No trends were identified in the Indicators of Hydrologic Alteration/Range of Variability Approach (IHA/RVA) statistics except as documented (see discussion in Part Two – Hydrologic Evaluation of Lamprey Protected Flows in Section I. - Representative Hydrographs of the report and Appendix 13 Section 1.2 – Historical Analysis). The proposed and approved hydrologic analysis method did not include land use changes.

**6. Common Flows Exceed Mean Daily Flows – Why?****Comment EGGI-12:**

Based upon EGGI's Figure 3 (attached, EGGI has superimposed the PISFs on Figure 3 for the common and critical periods onto Figure 9 that was presented in the Proposed Protective Instream Flow Report.) presented herein, we ask the question ... *How can Common flows, as defined in the report, exceed the mean of daily mean flows during the low flow conditions of summer? This would seem to invalidate the analyses. Please provide a full explanation.*

**Response:**

This is because the common flow threshold means that flows are generally between the critical and common level for the durations specified in the PISF.

## 7. Comparison of PISFs to historic stream flow

### Comment EGGI-13:

Part 2 – Section II of the Report presents a number of tables showing the number of days (and percent of days) that a particular PISF is met (or exceeded) for representative periods of the hydrograph data. For example, these periods include 1) the Last Five Years of record; 2) Wet Three Years; 3) Average Three Years; and 4) Dry Three Years. Several questions are raised about the analyses from the data presented.

*What PISFs are used in these evaluations? Common, Critical, Rare, or all?*

### Response:

The only entities in which Common, Critical or Rare flow PISFs are proposed are for fish. Non-fish PISF have their own prescribed periods and flows. The PISF for each IPUOCR was first presented, and then the number of time that it was not met or not met was reported for each of the representative hydrographs. The comparison of the hydrographs with the Common, Critical or Rare flow PISFs, as proposed for fish, appears in Table 45 to 48 in which the Common, Critical and Rare flows are clearly labeled. The other comparisons are based on their specific proposed PISF values, which don't include Common, Critical or Rare flows.

### Comment EGGI-14:

Some of the PISFs are met or exceeded nearly all of the time (e.g. Deep and Shallow Marsh or Blandings Turtle/Spotted Turtle) and other PISFs are rarely met or exceeded (e.g. Low Floodplain Forest-Growing Season or High Floodplain Forest and Oxbow/Backwater). It seems reasonable to expect that the amount of time a PISF is met or exceeded during the various bioperiods would be relatively similar. *Why is this not the case? Of what value is it to have PISF that is exceeded by river flows nearly 100% of the time, or almost never, regardless of the time period or seasonal precipitation?*

### Response:

The bioperiods for the diverse riparian flow dependent entities we were required to evaluate generally follow an annual cycle of seasons, and the PISF tables and assessments are set up this way. However as you note, some entities, such as floodplain forests, may require periodic high flows that rarely occur in a given spring, or a given year, or even in a given 3 or 5 year period. Despite the long and variable periods between high flow events, this occasional flooding is critical to maintaining the floodplain community characteristics, as discussed in the text. Some riparian entities have survival strategies not shared by fish that reduce their flow sensitivity (such as mobility, dormancy, leaf drop, delayed reproduction), and therefore their PISF values, durations and/or frequencies are easily met in most years, though still critical for survival. Our charge was to try to determine the PISF values for these riparian entities, regardless of whether or not they could turn out to be the most critical ones for management decisions during any given year.

**Comment EGGI-15:**

Table 44 – All of the bioperiods, except for GRAF Spawning, have longer Catastrophic Durations than Allowable Durations (for each level of flow). *Why is the Catastrophic Duration shorter than the Allowable Duration for the GRAF Spawning critical flow?*

**Response:**

Table 44 had a typographic error that has been corrected.

**Comment EGGI-16:**

Tables 45-48 show the number of times in the hydrograph record that a PISF were not met (i.e. flow was below the PISF). However, one can not tell how many times or how long a water management plan would have been required for each scenario shown on the Tables. This information would serve as important background information for the Water Management Technical Committee, and would also give some perspective on whether the PISFs are set too high to be reasonably met in the future through watershed management. *Please present a table showing the number of times a Management Plan would be required and the duration of the Plan for each scenario presented.*

**Response:**

As requested, please find at the end of this document, four tables that show the number of management events that would occur, by bioperiod, when the PISFs are compared with the representative hydrographs for the last five years (2003 to 2007), the wet three years (2005 to 2007), the average three years (1990 to 1992), the dry three years (1964 to 1966) and for 30 years (1976 to 2005).

**8. How Does MesoHABSIM Compare to Other Methods?**

**Comment EGGI-17:**

The Lamprey River Instream Flow Study is a pilot program to evaluate methods for restoring the Lamprey River to natural conditions. However, there are no discussions of how the MesoHABSIM method compares to other alternatives in effectiveness (except for simply mentioning another method at the beginning of the report). *Why was the MesoHABSIM model selected?*

**Response:**

First it should be noted that the goal of the Lamprey Instream Flow Program is not to restore the Lamprey River to natural conditions. The goal is to define and implement management to maintain instream flows that protect biological integrity and provide water for other valued river resources including recreation, public water supply, and hydropower. MesoHABSIM was selected to evaluate the flow needs of aquatic life species. Other assessment methods were used to define flows protection for other resources.

The MesoHABSIM model is a habitat simulation method conducted that establishes the river-specific relationship between stream flow and habitat availability at a meso-scale. The MesoHABSIM model is an instream flow incremental method that follows the same principles that have been used in the determination of instream flows by US Fish and Wildlife Service and US Geological Survey since the 1970s and vetted in many court cases. MesoHABSIM is an improvement of this method and comparative studies have been performed. This method was first used in the US in Connecticut in the late 1990s. Please see [www.MesoHABSIM.org](http://www.MesoHABSIM.org) for examples of other projects and literature.

The successful project team was selected largely because of the MesoHABSIM method presented in their proposal. The Selection Committee, which included two members of the Lamprey Technical Review Committee, two members of the Lamprey Water Management Planning Area Advisory Committee, elected by their respective committees, and two staff members of DES, unanimously selected the project team based on the project team's 1) specialized experience, 2) project personnel, and 3) project approach. Both The project approach component was weighted as 50 percent of the total score and centered on the MesoHABSIM method. Two project teams proposed PHABSIM and one proposed MesoHABSIM. This method was considered superior to the PHABSIM method proposed by the other project teams.

PHABSIM (Physical habitat simulation) results are part of an Instream Flow Incremental Method approach (IFIM). PHABSIM shows a range of habitat conditions occurring with changing flow. It is a model of stream hydraulics and habitat. It is critical to make sure transects are located in the right spot to cover pools, riffles and runs as the results are extrapolated to the river scale. Investigators survey the transects to describe what the bottom is like, and take depth measurements and measure velocity at intervals to show what this cross section looks like in terms of velocity and depth. Depth, velocity, and substrate are measured again at different flows to calibrate response to flows.

MesoHABSIM (Meso-scale habitat simulation) was selected because it is an improvement on existing physical habitat simulation models such as PHABSIM, which was originally developed for reach-scale applications. MesoHABSIM results are part of an Instream Flow Incremental Method approach. MesoHABSIM shows a range of habitat conditions occurring with changing flow. It is a model of stream hydraulics and habitat. One improvement is that MesoHABSIM modifies the data acquisition technique and analytical approach of earlier physical habitat models by changing the scale of resolution from micro- to meso-scales. Investigators map hydromorphological units (riffles, runs, pools, glides, etc.) because the units are more representative of fish habitat than a transect. Hydromorphological units as well as associated hydrologic and cover characteristics are used to describe mesohabitats. Investigators take measurements of depth and velocity, substrate, and cover (such as logs on bottom, etc.) and remap the hydromorphological unit areas to show what the mesohabitats look like at different flows. Measurements are made in all the hydromorphological units over several river reaches at different flows along extensive sections of a river. More of the river is measured directly, and at a biologically-significant scale, so transposition to river scale is much closer to the direct measurements.

DES made the proposals of the three project teams available to the Lamprey Technical Review and Lamprey Water Management Planning Area Advisory Committees prior to the selection. DES invited the members to attend the Selection Committee meeting at which the proposals were reviewed and to submit comments to the Selection Committee in advance.

Later, before the instream flow study assessments began, the Technical Review Committee again was presented with the assessment methods for their approval. The MesoHABSIM method was presented as one of the planned assessments and a draft report memorializing the plan to use the MesoHABSIM method was circulated and reviewed by the Committee at its meetings on February 13, 2005. The report was approved in final form a year later in March 7, 2006.

MesoHABSIM was chosen as an incremental flow method implemented at a biologically significant scale. The assessment of hydromorphological units as habitat units is most applicable to the scale actually used by fish. This characteristic allows it to avoid the criticisms of other incremental methods that apply micro-scale assessments extrapolated to river reach scale. MesoHABSIM applies more habitat parameters to determine habitat use than most incremental methods resulting in better model results.

#### **Comment EGGI-18:**

It is important to know where this method has been applied previously, and whether it has been successful in restoring other rivers/streams to the desired conditions. It would also be useful to compare this complicated method to other simpler methods based on hydrograph analyses. For example, how do the PISFs defined compare to seasonal Q80 values of stream flow. Based on a quick analysis by EGGI, and statistical data provided by the NHDES, it appears that the seasonal Q80 values are similar to the PISFs defined for the various seasons (certainly within the error of the Instream Flow and NHDES statistical analyses). The largest misfit was in the fall PISF and Q80 values. As noted above, the fall season is actually where the corrections to the hydrographs were the largest relative to the measured flow.

Please provide evidence as to why the MesoHABSIM method is considered accurate and more reliable than other methods. Has the MesoHABSIM method been vetted by other industry experts?

#### **Response:**

Please see [www.MesoHABSIM.org](http://www.MesoHABSIM.org) for project examples and literature. In addition, please refer to the Task 4 report and model selection procedure. Furthermore, the MesoHABSIM model follows the same principles as widely recognized Instream Flow Incremental Methodology, which has been used in the determination of instream flows by US F&WS and USGS since the nineteen seventies and vetted in many court cases. MesoHABSIM is an improvement of this method and comparative studies have been performed.

### **9. Natural Fish Species versus Target Fish Species**

#### **Comment EGGI-19:**

The target fish communities for the Lamprey River are derived from “near-pristine rivers with similar characteristics to the Lamprey.” We see no description of 1) which rivers were used as proxies for the Lamprey River; 2) a description of how these rivers are considered similar to the Lamprey River; 3) a discussion of how the fish species in each proxy river have been determined and 4) if the fish species in each proxy river are natural (i.e., there was no introduction of fish species by humans). All this information would be needed/helpful so that readers can assess if the rivers are similar...and if the target fish communities are reasonable.

Furthermore, did these investigations perform historical research to find out what species were present in the Lamprey under natural, pre-human impacts? It is entirely reasonable to expect that the “pre-colonial” Lamprey River (as referred to in the report) was not an exact physical replica of today’s river. For example: 1) there may have been differences in historical stream flow and precipitation; 2) the morphology of the river was likely different due to meandering and changes in deposition and erosion through the years; 3) there may have been more beaver dams and impoundments behind the dams, etc. (Such things would have had water flow and chemistry impacts on the habitats and biota of the river ... and would potentially result in natural fish species that were not the same as the target fish communities used in this study.) For example, beaver and human dams have two related effects on water quality that are somewhat independent of flow, namely that the water tends to be warmer behind a dam and also lower in dissolved oxygen. Water temperature and dissolved oxygen concentrations are likely to have a greater impact on fish species than what was considered in this Report.

*Please address the questions above and provide evidence that the target fish community originally selected is an appropriate starting point for this Instream Flow Analyses.*

**Response:**

All requested information on the process of Target Fish Community development is presented in detail in the Lamprey Target Fish Community Report created as a part of Task 4

[http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/documents/tfc\\_report\\_legros\\_21june2007final.pdf](http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/documents/tfc_report_legros_21june2007final.pdf)

and

[http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/documents/tfc\\_report\\_appendix\\_final.pdf](http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/documents/tfc_report_appendix_final.pdf).

It was not the purpose of the development of Target Fish Community to provide detail on “pre-colonial conditions”. The goal of this model is to develop a list and dominance structure of native fish community that would utilize the river under today’s conditions, without major human interferences. It is a management target not historical community. Therefore, the model is based on current fish data from rivers that are low impact rivers. It sets the benchmark of what should be expected in river like Lamprey without major human impacts.

The approach and the model have been reviewed and approved in 2007 by the Technical Review Committee.

**10. Lack of Protection for Public Water Supplies**

**Comment EGGI-20:**

There is a distinct lack of reference and/or guidance in this Report that serves to protect existing and/or future public water supplies that derive their drinking water from the Lamprey River Watershed. Public water sources must be considered as an Instream Public Use. RSA 483 defines flow-dependent entities as fish, riparian wildlife, vegetation, and human uses. The use of water for public water supply from the Lamprey River Watershed within the designated reach (and outside of this specific designated reach) is all flow-dependent and therefore flow must be maintained to meet both existing and future water supply needs.

*Please explain why the protection of public water supplies is not included as part of this Report.*

**Response:**

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by water users including public water suppliers) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

By maintaining flows close to the natural regime, all non-consumptive IPUOCRs are supported. However, consumptive uses, notably public water supply withdrawals, will change the flow regime. This will require management to offset the impacts. The greater the consumptive use, the more management will be required.

**Comment EGGI-21:**

These comments reflect only a small number of our questions, but for the sake of reasonableness we have limited this to just those presented above. We remain concerned about the methods used and the subsequent consequences of implementing the suggested PISF values as the basis for establishing a Management Plan. Furthermore, we have concerns about the resultant possible impacts to communities that depend upon the Lamprey River Watershed for existing and future public and private water supplies. Lastly, we remain concerned about the limited amount of time that has been set for establishing a Management Plan (October 1, 2009). We believe that this date is premature given that this Report has not yet been completed and that sufficient consensus has not been secured to provide confidence to the watershed community as a whole that these proposed Instream Flow Rates are scientifically defensible.

**Response:**

DES acknowledges the concerns raised by Emery & Garrett Groundwater, Inc. (EGGI). We hope the responses that have been provided in this document have addressed your technical questions on the PISF study. Regarding your concerns about the impact that the implementation of the PISFs may have on water supplies, one purpose of the NH Instream Flow Program is to provide for the existing and future water supplies of the state. Without management, water supply will go only to the highest priority water users as consumptive uses increase. Only with

management can these supplies be secure. Lastly, regarding your concerns about the limited amount of time available for the completion of the Water Management Plan process, legislation has been proposed that would extend the duration of the Pilot Program. The Water Management Plan process would then be continued through much of 2010.

**Following tables provided in response to comment EGGI-16**



Assessment of Lamprey PISF

Representative Year Sets

Management Events and Durations

Last 5 years		Management Events						Duration						
Year	Bioperiod	Sum of Persistent Common event starts	Sum of Persistent Critical event starts	Sum of Persistent Rare event starts	Sum of Catastrophic Common event starts	Sum of Catastrophic Critical event starts	Sum of Catastrophic Rare event starts	Max of Catastrophic Common Count	Max of Catastrophic Critical Count	Max of Catastrophic Rare Count	Max of Persistent Common Count	Max of Persistent Critical Count	Max of Persistent Rare Count	
2003	1	1	0	0	0	0	0	0	0	0	24	0	0	
	2	2	0	0	0	0	0	0	0	0	6	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	0	0	0	0	0	0	0	0	0	0	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
2004	1	1	1	0	0	0	0	0	0	0	31	26	0	
	2	1	1	0	0	0	0	0	0	0	17	2	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	0	0	0	0	0	0	0	0	0	0	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
2005	1	0	0	0	0	0	0	0	0	0	0	0	0	
	2	1	0	0	0	0	0	0	0	0	14	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	1	0	2	0	0	0	0	0	0	31	0	4	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
2006	1	0	0	0	0	0	0	0	0	0	0	0	0	
	2	1	3	2	1	0	0	21	0	0	27	5	2	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	0	0	0	0	0	0	0	0	0	0	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
2007	1	2	1	0	0	0	0	0	0	0	14	11	0	
	2	1	0	0	0	0	0	0	0	0	8	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	1	2	2	0	0	2	0	0	6	28	7	9	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
Sum =		12	8	6	1	0	2	21	0	6	31	26	9	=MAX

Wet three years		Management Events						Duration						
Year	Bioperiod	Sum of Persistent Common event starts	Sum of Persistent Critical event starts	Sum of Persistent Rare event starts	Sum of Catastrophic Common event starts	Sum of Catastrophic Critical event starts	Sum of Catastrophic Rare event starts	Max of Catastrophic Common Count	Max of Catastrophic Critical Count	Max of Catastrophic Rare Count	Max of Persistent Common Count	Max of Persistent Critical Count	Max of Persistent Rare Count	
2005	1	0	0	0	0	0	0	0	0	0	0	0	0	
	2	1	0	0	0	0	0	0	0	0	14	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	1	0	2	0	0	0	0	0	0	31	0	4	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
2006	1	0	0	0	0	0	0	0	0	0	0	0	0	
	2	1	3	2	1	0	0	21	0	0	27	5	2	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	0	0	0	0	0	0	0	0	0	0	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
2007	1	2	1	0	0	0	0	0	0	0	14	11	0	
	2	1	0	0	0	0	0	0	0	0	8	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	1	2	2	0	0	2	0	0	6	28	7	9	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
Sum =		7	6	6	1	0	2	21	0	6	31	11	9	=MAX

Assessment of Lamprey PISF

Representative Year Sets

Management Events and Durations

Average 3 years		Management Events						Duration						
Year	Bioperiod	Sum of Persistent Common event starts	Sum of Persistent Critical event starts	Sum of Persistent Rare event starts	Sum of Catastrophic Common event starts	Sum of Catastrophic Critical event starts	Sum of Catastrophic Rare event starts	Max of Catastrophic Common Count	Max of Catastrophic Critical Count	Max of Catastrophic Rare Count	Max of Persistent Common Count	Max of Persistent Critical Count	Max of Persistent Rare Count	
1990	1	0	0	0	0	0	0	0	0	0	29	0	0	
	2	1	0	0	0	0	0	0	0	0	3	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	0	0	0	0	0	0	0	0	0	0	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
1991	1	0	0	0	0	0	0	0	0	0	0	0	0	
	2	1	1	0	0	0	0	0	0	0	27	3	0	
	3	1	0	0	0	0	0	0	0	0	14	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	1	0	0	0	0	0	0	0	0	4	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
1992	1	0	0	0	0	0	0	0	0	0	0	0	0	
	2	2	0	1	0	0	0	0	0	0	19	0	3	
	3	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	0	0	0	0	0	0	0	0	0	0	0	0	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Sum =</b>		5	1	2	0	0	0	0	0	0	29	3	4	=MAX

Dry 3 years		Management Events						Duration						
Year	Bioperiod	Sum of Persistent Common event starts	Sum of Persistent Critical event starts	Sum of Persistent Rare event starts	Sum of Catastrophic Common event starts	Sum of Catastrophic Critical event starts	Sum of Catastrophic Rare event starts	Max of Catastrophic Common Count	Max of Catastrophic Critical Count	Max of Catastrophic Rare Count	Max of Persistent Common Count	Max of Persistent Critical Count	Max of Persistent Rare Count	
1964	1	1	1	1	0	0	0	0	0	0	12	8	3	
	2	1	0	0	0	0	0	0	0	0	1	0	0	
	3	1	1	1	0	1	1	0	8	9	14	7	5	
	4	0	1	0	0	0	1	0	0	6	0	4	0	
	5	1	2	2	1	1	2	13	10	26	34	16	9	
	6	1	1	1	0	0	0	0	0	0	11	6	4	
1965	1	2	2	2	0	0	0	0	0	0	19	14	10	
	2	2	1	0	0	1	0	0	4	0	23	8	0	
	3	1	0	0	0	0	0	0	0	0	8	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	1	1	1	0	1	1	0	21	38	33	16	9	
	6	1	1	0	0	0	0	0	0	0	35	3	0	
1966	1	0	0	1	1	1	0	10	28	0	36	26	7	
	2	1	0	0	0	0	0	0	0	0	21	0	0	
	3	1	0	0	0	0	0	0	0	0	6	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	
	5	1	1	4	1	1	1	13	1	16	34	16	9	
	6	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Sum =</b>		15	12	13	3	6	6	13	28	38	36	26	10	=MAX

Assessment of Lamprey PISF

Representative Year Sets

Management Events and Durations

30 years

Year	Management Events						Duration						
	Sum of Persistent Common event starts	Sum of Persistent Critical event starts	Sum of Persistent Rare event starts	Sum of Catastrophic Common event starts	Sum of Catastrophic Critical event starts	Sum of Catastrophic Rare event starts	Max of Catastrophic Common Count	Max of Catastrophic Critical Count	Max of Catastrophic Rare Count	Max of Persistent Common Count	Max of Persistent Critical Count	Max of Persistent Rare Count	
1976	5	3	3	1	0	1	13	0	8	34	13	10	
1977	2	1	1	1	1	1	23	38	42	36	26	22	
1978	5	3	4	1	1	1	13	19	17	34	16	9	
1979	2	0	0	0	0	0	0	0	0	10	13	0	
1980	7	3	3	1	1	2	2	5	14	36	26	22	
1981	3	1	1	2	0	0	15	0	0	36	22	20	
1982	3	1	0	0	0	0	0	0	0	5	3	0	
1983	2	2	2	1	0	1	13	0	16	34	16	9	
1984	2	1	1	0	0	0	0	0	0	29	7	8	
1985	4	4	4	2	2	2	11	7	12	27	23	9	
1986	2	2	0	0	0	0	0	0	0	22	2	0	
1987	6	0	0	0	0	0	0	0	0	19	0	0	
1988	2	0	0	0	0	0	0	0	0	36	0	0	
1989	3	2	1	1	0	1	12	0	5	36	5	5	
1990	1	0	0	0	0	0	0	0	0	29	0	0	
1991	2	1	1	0	0	0	0	0	0	27	3	4	
1992	2	0	1	0	0	0	0	0	0	19	0	3	
1993	4	3	4	2	2	2	13	12	17	34	16	9	
1994	5	1	1	0	0	0	0	0	0	34	4	4	
1995	4	4	6	1	1	1	13	20	36	34	16	9	
1996	4	1	1	0	0	1	0	0	2	31	4	9	
1997	5	2	3	1	0	1	13	0	7	34	8	9	
1998	4	3	4	1	0	1	3	0	7	34	13	9	
1999	4	4	3	0	3	4	0	31	46	27	16	11	
2000	2	0	0	0	0	0	0	0	0	7	0	0	
2001	6	4	7	4	0	2	13	0	9	37	13	9	
2002	3	3	3	3	3	2	25	40	54	36	26	22	
2003	3	0	0	0	0	0	0	0	0	24	0	0	
2004	2	2	0	0	0	0	0	0	0	31	26	0	
2005	2	0	2	0	0	0	0	0	0	31	0	4	
<b>Sum =</b>	101	51	56	22	14	23	25	40	54	37	26	22	=MAX



**Comments Received From:**

Mr. Jamie Fosburgh  
River Programs Manager  
National Park Service  
Northeast Region Office  
15 State Street  
Boston, Massachusetts 02109-3572

**Source:** Letter dated Wednesday February 25, 2009

**Comment NPS-1:**

On Page xxix of the Executive Summary the report states: “The lowest naturalized flow recorded in the last 30 years was 3.7 cfs at the Packers Falls.” NPS is unclear as to whether this value is the lowest flow actually measured at the Packers Falls gage, or if it is a value generated by the hydrologic analysis designed to “naturalize” the hydrograph by removing the influence of impoundments and withdrawals. We request clarification regarding the source of this value.

**Response:**

For clarification of the source and use of this number, 4 cfs flow represents the lowest flow (3.7 cfs was rounded up to 4) occurring in the 30-year naturalized flow record. Stream flow gages, such as the Packers Falls gage, record the net stream flow of all the upstream activities as affected by upstream water use and impoundment management so they present actual stream flow. Flows less than 4 cfs have been recorded at the Packers Falls gage because those records include withdrawals and returns. 4 cfs is the lowest flow recorded after corrections to offset water usage and impoundment management conditions were made to naturalize the flow. These corrections were calculated using the registered water use records and the storage and release records for Lake Pawtuckaway. Not all impacts on flow were part of the corrections to naturalize stream flow. Further corrections for storage and release from other dams and for other impacts on flow (development, land use changes, unregistered withdrawals, etc.) were not made because of the lack of quantifiable data.

It should also be noted that the recommendation that “flows never be allowed to fall below 4 cfs” has been withdrawn from the report. It is believed that the remaining flow protections, when implemented under the Water Management Plans, will prevent abnormally low flow conditions. If flows were to reach these levels because of natural conditions, it is likely that emergency status would be declared by the Commissioner under RSA 483:9-c.IV.

**Comment NPS-2:**

We were unable to find a discussion or presentation of the methodology used to generate the “naturalized” flow and the resulting data in the *Draft Lamprey River Proposed Protected Instream Flow Report* or the published reports generated under Tasks 1 through 4 of the Lamprey River Flow studies. We request that this information be added as an appendix to the report.

**Response:**

Please refer to Appendix 13 (Hydrology) in the *Draft Lamprey River Proposed Protected Instream Flow Report* which includes a discussion of the development of the naturalized flows.

**Comment NPS-3:**

Will the proposed protection scheme (not just the 4 cfs) replace the conditions in Durham's existing §401 certificate, or will it be overlaid on them?

**Response:**

The conditions in the 401 will be replaced by, not incorporated into the Water Management Plan. The 401 conditions will be replaced by the water use plan for the UNH/Durham public water supply under the Water Management Plan to be adopted by the DES' commissioner. A condition of adoption under Env-Ws 1906.07(b)(3) is that "Implementation of the water management plan will result in maintenance of the established protected instream flows;"

**Comment NPS-4:**

It is our reading that the recommendation on Page xxix of the Executive Summary that "...flows should never be allowed to fall below 4 cfs..." can be interpreted to mean that the PISF Report is recommending that 1) no duration below this value is allowable, and 2) that water management actions be implemented to prevent flow from dropping below 4.0 cfs. We request confirmation as to the correctness of our interpretation and ask that the report be clarified for the benefit of all readers regarding this matter. Assuming that our interpretation is correct, this raises the question of whether flows will be tracked in real-time as they approach the various target flows e.g. 4.0 cfs, and how the affected water users (will be notified regarding the required management actions?

**Response:**

The recommendation for a minimum flow of 4 cfs has been removed from the report. It is believed that the remaining flow protections, when implemented under the Water Management Plans, will prevent abnormally low flow conditions. If flows were to reach these levels because of natural conditions, it is likely that emergency status would be declared by the Commissioner under RSA 483:9-c.IV.

Conceptually, flows on the Lamprey River will be monitored on a real-time basis using the USGS gage at Packers Falls, which may be supplemented by the new USGS gage at Langford Road in Raymond. Real-time flow values along with historical flow frequency data will be compared with the proposed protected instream flow levels to determine if management actions are required. The details of the flow monitoring program, water management actions and water management action notification will be evaluated in the next phase of this project, the Water Management Plan.

## **Comment NPS-5:**

We wish to echo the comments of the LRAC regarding the critical need for accurate flow measurement during low flow periods. It will be especially critical to have accurate measurements and calibrations in the 1 to 100 cfs range, and the need to augment the USGS Packers Falls gage with additional upstream gages should be seriously considered.

## **Response:**

Regarding concerns of measured low flow accuracy: the USGS regularly monitors site conditions and measures discharge at each of their river gages to determine the accuracy of the reported stage-discharge relationship. The qualitative rating system used by the USGS to assess the independent discharge measurements shows that at the Packers Falls gage, from 1985-2009, more than 80% of flow measurements taken at flows below 100 cfs were determined to be within 8% of the “true” discharge. Additionally, only 2 of the 14 total observations made at flows less than 4 cfs were determined to be more than 8% off from the “true” discharge. Mr. Richard Kiah of the USGS New Hampshire/Vermont Water Science Center in Pembroke, New Hampshire, when asked about the accuracy of flow measurements at the Packers Falls gage, stated that since water year 2000 (when the current rating curve was established for the Packers Falls gage) eight measurements have been used to check the stage-discharge rating curve between 1-100 cfs and have ranged from -2.4% to +4.7% of the expected flows. A quantitative assessment of flow measurement techniques shows that at most sites most discharge measurements fall within 3-6% of “true” discharge and rarely exceed 20% error even under very poor conditions (Sauer and Meyer, 1992, Determination of error in individual discharge measurements, *USGS Open File Report 92-144*, p. 17).

One factor that can affect flow measurements at the Packers Falls gage, particularly under low-flow conditions, is backwater from beaver dams and algae growth on ledges (which can slightly raise water levels). Backwater raises water levels in the vicinity of the gage which affects the stage-discharge relationship. Mr. Kiah noted that of the 31 measurements made at flows of 1-100 cfs (since 2000) 21 have been affected by backwater. Under those conditions a flow measurement is made and then the obstruction causing the backwater is removed. The river stage is then monitored following removal of the obstruction to assess the stage-discharge relationship and ensure that the river stage returns to the expected level for the measured discharge. The stage and discharge data during backwater conditions are quality controlled by the USGS by either applying a correction to the data or by producing an estimate of flows if the backwater is severe.

Because the measured discharge from the USGS is typically within +/- 8% of “true” flows and quality controls are used to correct data which has been compromised by backwater conditions, we have determined that the margins of error are acceptably small to consider the reported flow values at Packers Falls to be representative of river conditions.

With regard to the installation of additional gaging stations, on July 1, 2008 the USGS began operation of a new gaging station (USGS 01073319) on the Lamprey River at Langford Road in Raymond, New Hampshire. Real time gage height and discharge data can be obtained for this site online at the USGS website ([waterdata.usgs.gov/nh/nwis/](http://waterdata.usgs.gov/nh/nwis/)). The discharge data obtained from this station along with the Packers Falls gage will be utilized in the monitoring and management of the Protected Instream Flows under the Water Management Plan.

**Reference:**

Sauer, V.B. and R.W. Meyer. 1992. Determination of Error in Individual Discharge Measurements. U.S. Geological Survey Open-File Report 92-144. Norcross, Georgia. 21 p.

**Comment NPS-6:**

Aesthetic beauty/scenic is listed in Table 2.1 (Matrix of IPUOCR's) of the Task 4 report titled "*Instream Public Uses, Outstanding Characteristics, and Resources of the Lamprey River and Proposed Protective Flow Measures for Flow Dependent Resources*" (Normandeau Associates, Inc. and others. November 2006), due to the Lamprey River's Wild and Scenic River status. The table contains a column listing whether or not a given category is flow dependent. "No" appears in this column for the category Aesthetic beauty/scenic. We believe this to be an incorrect determination. Flow levels are very much related to scenic and aesthetic qualities of the river. Many instream flow studies conducted for other projects (e.g. hydroelectric licensing/relicensing) routinely evaluate the aesthetic impact of varying flow levels. This might appropriately be included as an aspect of recreational flow needs. Such a consideration would have particular importance in relation to impounded areas, including the area behind Wiswall Dam, which is heavily used for recreation and is very much impacted by flow/impoundment levels.

**Response:**

In the definition of Instream Public Uses, Outstanding Characteristics, and Resources included in the DES Lamprey Request for Proposals (dated February 9, 2005) the Instream Public Use of aesthetic beauty has its Outstanding Characteristic and Resource listed as being aesthetic and scenic, where "scenic sites shall include, but not be limited to, designated viewing areas, scenic vistas, and overlooks". Based on this definition and a review of existing information on the Lamprey River a preliminary draft of the "*List of Instream Public Uses, Outstanding Characteristics, and Resources*" was prepared (August 2005). The characteristics of the aesthetic beauty/scenic entity for the Lamprey River included the large proportion of undeveloped land which contributes to its scenic nature, three scenic waterfalls (Wadleigh Falls, Wiswall Falls and Packers Falls) and river views from the bridges on Wadleigh Falls Road, Lee Hook Road, Wiswall Road and Packer's Falls Road. Based on a review of the existing information, this entity was identified as being non-flow dependent in the preliminary draft listing.

The preliminary draft listing was the basis for the field survey performed August 25-26, 2005 to verify the existence and occurrence of the identified entities. The preliminary draft entity list and the identified flow-dependent resources were presented to the WMPAAC on October 7 2005 and following this meeting the final entities list (October 28, 2005) was prepared. This information was also presented at a meeting of the Technical Review Committee on February 13, 2006. Using the final list along with the results of the on-stream survey the Task 4 (*Instream Public Uses, Outstanding Characteristics, and Resources of the Lamprey River and Proposed Protective Flow Measures for Flow Dependent Resources Draft and Final Report*) were prepared. During the review of either the flow dependent resource listing or the draft or final Task 4 we received no comments regarding the designation of the aesthetic beauty/scenic entity as being non-flow dependent. It should be noted that the Task 4 report (Section 3.2.8) did recommend that "the prescribed flow, which will include sufficient flow in the river to maintain the aquatic environment, will be sufficient to preserve the scenic value of the river." Meaning,

that although a specific protective flow value was not proposed for aesthetic and scenic beauty, the proposed PISFs are expected to be protective of this instream public use, outstanding characteristic and resource of the Lamprey River.

As a result of this comment and others, DES has drafted guidance which identify aesthetic beauty as flow-dependent. In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

**Comment NPS-7:**

Public water supply is listed as an outstanding characteristic under RSA 483:1. It is also listed in Table 2.1 (Matrix of IPUOCR's) of the Task 4 report titled "*Instream Public Uses, Outstanding Characteristics, and Resources of the Lamprey River and Proposed Protective Flow Measures for Flow Dependent Resources*" (Normandeau Associates, Inc. and others. November 2006), due to the Durham – UNH water withdrawal. We note that this water withdrawal is downstream of several AWUs, including impoundments. Please elaborate as to why the consultants elected not to propose a protected instream flow for public water supply. While it may be difficult to develop a scientifically defensible value for this IPUOCR, there may be other approaches based on practical criteria, existing capacities, and other factors. The failure to identify a protected flow for this protected entity could have the effect of compromising the 4 cfs minimum flow level and other aspects of the protected flow scheme.

**Response:**

Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by UNH/Durham or any other water user) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

**Comment NPS-8:**

Table 15 of the report - *Flow-Dependent RTE wildlife, RTE vegetation, and natural/ecological communities* recommends “No PISF” for a number of protected entities several of which the table footnote reports may: “...be vulnerable to rapid or prolonged changes in water levels associated with dam management. This recommendation appears inconsistent with the discussion on Page 76 of the report which states that when the Wiswall Dam gates were opened on the morning of April 10<sup>th</sup>: “...water appeared to be approximately six to 12 inches below the dam spillway, shallow marsh communities were already drained, and only narrow channels of water remained in the deep marsh channel...fish and amphibians were stranded in mud by the rapid drop of the water surface...[and]...Mussels were present on the exposed river shoreline, and beaver and muskrat bank burrow entrance holes were exposed. Please reconcile this apparent inconsistency. Clearly, adverse impacts were documented far before the 18 inch drawdown threshold which appears to be selected as a protected impoundment level. Similarly, the no impoundment drawdown > six inches for more than seven consecutive days from March 15-July 31 appears to have limited correlation to data in the larger report, possibly ignoring other types of impacts, and impacts that would occur after July 31.

**Response:**

For riparian entities, landscape position and water levels are the most critical elements of the protective flow evaluation. Within larger impoundments, water levels do not have the same correlation with flow as in free-flowing reaches, and so establishing a protected flow for the few riparian entities that are found primarily near the impoundments was not as meaningful as having a protective water level. The 6 inch and 18 inch water levels cited in the PISF report reflect seasonal differences in sensitivity to water levels for marsh plants and animals (primarily invertebrates and breeding/larval amphibians). This comment may refer to past discussions among DES, UNH/Durham, and the Lamprey River Local Advisory Committee on the appropriate limits for managed water level fluctuations in Wiswall Reservoir, in the context of UNH/Durham’s 401 WQ certificate. Those discussions are not a consideration in this study.

We chose to observe the Wiswall Dam inspection drawdown to try to learn from it and apply our observations to the PISF study. However, we did not intend to provide rules, standards, or guidelines for the extreme water level reductions associated with dam inspections, where “rate of change” of water levels may far exceed those normally associated with natural events. Much of the observed adverse impact on aquatic life during the observed drawdown was due to the season (spring), and the rapid rate of water level decline. A slow drawdown might allow many mobile aquatic animals to temporarily relocate or cling successfully to their habitats. We did not attempt to specify an allowable “rate of change” for such activities, as our data are not sufficient to propose one, but as we state in the text, rate is an important dimension to consider for drawdown events. This study does not address rate of change of impoundment water levels due to dam management activities.

**Comment NPS-9:**

Mussels are mentioned several times in the IP(U)OCR Report 2006 (Pages 20, 23, and 39). The reference on Page 39 states that Brook Floater mussels: “...are extremely vulnerable to inadequate flow conditions...” However, there is conspicuously little discussion about mussels in

the *Draft Lamprey River Proposed Protected Instream Flow Report*, and the manner in which the target flows address their flow needs is not presented. Please illuminate this disparity.

**Response:**

Although we identified fresh water mussels in the PISF report, developing the habitat model for this animal group was abandoned based on the findings of the Souhegan study. The Souhegan model demonstrated no habitat change with flow conditions within investigated range. This is in part due to a broad range of habitat used by mussel species, which may be fast or slow flowing. A generic model for mussels is not sensitive enough to capture the habitat changes for individual species. As our observations of the drawdown of the Wiswall Impoundment documented, mussels seem to be more vulnerable to rapid change of depth.

Therefore, protection for mussels is maintained by three factors: maintaining fish species upon which the mussel larvae are dependent, keeping shear stresses within ranges that allow juvenile mussel settlement, and avoiding dewatering of habitat at rates that would strand mussels. Maintaining fish species will be supported by protected instream flows that support the Target Fish Community described in the protected flows in Table 1. Shear stresses are maintained by avoiding dam management activities resulting in hydraulic conditions that substantially increase flow velocities. This will be incorporated in the Water Management Plan by ensuring the rate of change of flows released from impoundments is within the range of natural flows. Dewatering may occur naturally or under the combined effects of water withdrawals and natural conditions. Dewatering, if it occurs, needs to occur at natural rates that allow mussels to relocate. Rate of change is a component of the Natural Flow Paradigm, but it is not described as part of the protected instream flows because it is a function of the water use and dam management activities. Rate of change considerations will be part of the management alternatives described within the Water Management Plan.



## **Comments Received From:**

Mr. Sean Greig  
Superintendent of Public Water & Sewer  
Department of Public Works  
Town Hall  
186 Main Street  
Newmarket, New Hampshire 03857

**Source:** Letter dated Friday February 27, 2009

### **1. Lack of Protection for Public Water Supplies**

#### **Comment NM-1:**

*We find no reference or guidance in the report that serves to protect Newmarket's need and statutory requirement to provide a safe, reliable public water supply. Public water supplies must be considered an Instream Public Use. Protected in-stream flows are defined in the study for flow-dependent protected entities listed in RSA 483. These potential entities were grouped as fish, riparian wildlife, vegetation and human uses. The use of the Lamprey River as a public water supply source must be considered as flow dependent and therefore sufficient flow must be made available to meet public water supply needs. Please explain why public water supplies are not fully considered for protection in this Report.*

#### **Response:**

A careful reading of RSA 483 reveals that public water supply is not an Instream Public Use (RSA 483:4.XI) but an Outstanding Characteristic (RSA 483:1). Early in the pilot project, DES published an [IPUOCR \(protected entity\) list](#) which was available for public comment in 2004. In a 2006 report defining the flow-dependent IPUOCRs, UNH/Durham Water System was revised to be a flow-dependent IPUOCR because it had a Clean Water Act Section 401 Water Quality Certification (# 2001-001) with conditions tied to flow in the river. Upon further consideration, this flow-dependency of the withdrawal is an artificial construct generated for the 401 WQC. Other than the management conditions defined in the 401 WQC, there is no relationship between water withdrawals (by Newmarket or any other water user) and a protected instream flow.

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

It is not appropriate for DES to incorporate water demand for public water supply into protected instream flows. Water demand for public water supply is independent of water availability from any particular source. The Instream Protected Flows must assure that public water supplies have

adequate opportunity to withdraw water, not that river flows be assured to meet demand. The Natural Flow Paradigm provides a quantitative measure of adequate opportunity. By maintaining flows close to the natural regime, all non-consumptive IPUOCRs are supported. However, consumptive uses, notably public water supply withdrawals, will change the flow regime. This will require management to offset the impacts. The greater the consumptive use, the more management will be required.

## **2. Scientific Credibility of the Study**

### **Comment NM-2:**

Having attended several public hearings regarding the proposed Instream Flow Report, I was informed that the Technical Review Committee (TRC) had numerous reservations regarding this document. In fact, it was my understanding that a draft letter had been prepared and submitted to the NHDES Commissioner that served to express their concerns. This letter should be made available to the public for review. Please provide me with a copy of this letter.

### **Response:**

A copy of the Lamprey River Technical Review Committee letter is posted on the DES website: [http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/pisf\\_comments.htm](http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/lamprey/pisf_comments.htm) along with all of the other comment letters, which are available to the public.

### **Comment NM-3:**

This study is complex and very difficult for any layman to understand or comprehend. However, I have a very difficult time believing that the substantial number of subjective judgments made in the statistically based MES(O)HABSI(M) model allow for any accurate assessment that is sufficient to set specific PISFs. There was no error assessment for any of the parameters used in the model and no discussion of potential errors and their potential impacts to the conclusions of the model. Also, why was there no sensitivity analysis performed in this analyses?...even though the report author claimed in the Raymond Hearing (January 8, 2009) that such a sensitivity analysis could be performed. We ask that you provide a specific discussion and explanation of what the potential errors might be in your analyses and how they would impact your designation of PISF values.

### **Response:**

Yes, the Instream Flow Report is complicated. There are simpler methods and equally complicated methods available. The selected method was chosen because it meets the requirements of RSA 483 and Chapter 278 (Laws of 2002). These requirements specify river-specific studies to protect the variety of entities described in statute. Included in these entities are parts of the ecosystem relying on the presence and variability of river flows. Describing these protective river flows is a complex task because the relationship between stream flow and the ecosystem is intricate and varied including periods of growth and contraction occurring simultaneously for different species. Simpler methods afford less flexibility for water use and ultimately do not result in protections for the instream uses.

Since the beginning of this project in 2005, the DES has made available to stakeholders and the general public the scope and methodology to be used as part of the Lamprey River protected instream flow study. The DES and its contractors (Normandeau Associates, Inc., the Rushing Rivers Institute and the University of New Hampshire) attended several meetings with the Water Management Planning Area Advisory Committee and the Lamprey Technical Review Committee to present and discuss the proposed methods for this project. During these meetings the technical aspects of the proposed project were discussed in detail and questions regarding the proposed study were addressed.

Regarding the issue of the subjective judgments made during the MesoHABSIM modeling work during this study. The professionals involved with this project made every effort to minimize subjective judgments by relying on data derived from objective measurements and observations. Still, every model requires some underlying assumptions and interpretation that is based on professional judgment. This is an accepted practice that is not specific to the models used in this study.

During the presentation of the results of the Draft Report to the Lamprey Review Committee the issue of whether any error assessments or sensitivity analyses were performed as part of the MesoHABSIM modeling was raised. As you've noted, this issue was also raised during the presentation of the study results at the meeting of the Water Management Planning Area Advisory Committee. Additional comments regarding this issue were made at the Public Hearing and in several of the comment letters received by DES. As discussed in the Draft Report (see Error and Uncertainty Section – MesoHABSIM Assessment), some components of the MesoHABSIM modeling process were validated as part of the study and the results were included in Appendix 6 (Habitat Suitability).

In response to comments received by Dr. Loren Meeker on the statistical methods used in developing the MesoHABSIM models additional analysis was performed. The specific issue was the lack of an analysis of variance for the statistical models used and the inclusion of “large coefficients” in the original analysis. The models for the Rearing and Growth Bioperiod were rerun without these coefficients and the results of this reanalysis resulted in a change to the proposed common and critical flows and the allowable and catastrophic durations for the rare flow. These changes will be included in the final report. Also, the standard errors associated with the habitat suitability models were added to the tables found in Appendix 6.

**Comment NM-4:**

Furthermore, I would like to know why there has been no objective third-party review of this study. Also, has the MES(O)HABSI(M) model been thoroughly vetted in the industry? If so please explain and provide examples where this model has been used successfully in other similar applications.

**Response:**

The DES has contracted with the Instream Flow Council (IFC) to provide a third party review of the Final Souhegan River Protected Instream Flow Report and the Draft Lamprey River Proposed Protected Instream Flow Report. The reports and their supporting material have been provided to representatives of the IFC. The work will be done this spring and summer and

completed this fall. This was not a part of the work scope of the protected instream flow study, nor is it normally done as part of this type of study.

As for other examples of where MesoHABSIM has been applied, see [www.MesoHABSIM.org](http://www.MesoHABSIM.org) for project examples and literature. In addition, please refer to the Task 4 report and model selection procedure (available on the website.) Furthermore, the MesoHABSIM model follows the same principles as the widely recognized Instream Flow Incremental Methodology (IFIM), which has been used in the determination of instream flows by US Fish and Wildlife Service and US Geological Survey since the 1970s and vetted in many court cases. MesoHABSIM is an improvement of this method and comparative studies have been performed.

**Comment NM-5:**

We remain concerned regarding the accuracy of this report and the resultant possible impacts this could have on maintaining the delivery of our existing public drinking water supplies and with our on going capital investments associated with developing additional water needed to meet our future water supply requirements. Furthermore, the limited time that has been set for developing a subsequent Management Plan by October 1, 2009 seems extremely premature given that this PISF report has not yet been completed and that sufficient consensus has not been developed to provide a reasonable level of stakeholder confidence that these Potential Instream Flow Rules are scientifically meaningful.

**Response:**

DES acknowledges the concerns raised by the Town of Newmarket's Department of Public Works. Regarding your comment on the limited time for the completion of the Water Management Plan, legislation has been proposed in the 2009 session that would extend the duration of the Pilot Program. The Lamprey Water Management Plan process would then be continued through September 2010. This extension should provide sufficient time for the completion of a Plan that recognizes the concerns of each of the potentially affected water uses and dam owners located within the Lamprey River Water Management Planning Area.

**Comments Received From:**

Lamprey River Technical Review Committee

**Source:** Letter dated Friday February 27, 2009

**Comment TRC-1:**

First, the method (MesoHabSim) used to determine the instream flow needs for fish is very complicated for even instream flow experts to conduct their own review. Additionally, it appears that some of the MesoHabSim results indicate that higher flows provide no increased benefit to stream-dwelling fish which is contrary to general expectations about the ecology and habitat requirements for certain fish species. These results may be correct, but the apparent discrepancy between the results and our working understanding of fish habitat does raise questions about the methodology. Absent a statistical analysis of the results of habitat-based assessments, it is difficult to gauge the accuracy of the protected flows.

**Response:**

A complex model is required to analyze the 4-dimensional nature of ecological processes and biological interactions. With increasing knowledge of fish community response to habitat along with improved regional fish community databases, the habitat modeling effort may be simplified for future instream flow studies.

It is our experience, from other projects, that the better-structured riverbed creates a more stable habitat that is less variable with flow. Although the expectations of dramatic habitat increase with flow for all stream species is based on the experience with earlier models and intuitive observations, this conclusion may be lacking the insight into habitat complexity created by stream morphology. Not all of the fluvial species may be focused on hydraulic conditions as much as on availability of refuge and foraging habitat.

The development of flow recommendations based on habitat models using different species would not lead to a significant change in conclusions, as presented in Table 24 of the report. Also, although not presented in this report, the predicted habitat availability generated by the model was compared with the distribution of fish species reported in the Lamprey River Baseline Fish Sampling Report. The results of this comparison supported the validity of the model assumptions.

**Comment TRC-2:**

Second, the datasets used to determine the instream flows contain variability, and an analysis of this variability has not been conducted. Specifically, the dataset used to construct the “Target Fish Community”, the fish community that one would expect in the Designated Sections of the Lamprey River, contained data from several reference streams, some of which had large proportions of certain species, while others did not contain those same fish species. This was not explained in the analysis of these datasets. Furthermore, there was no statistical procedure used to determine if a fish species was truly over- or underrepresented in the existing Lamprey River

fish community. A value that may be considered arbitrary was used to determine if a fish species was over- or underrepresented. This value may not reflect the variability within the datasets. The TRC (Technical Review Committee) would like to see an analysis of the variability of the “Target Fish Community” and a narrative of conclusions drawn from this analysis. This should be a simple task, and will provide important information to (the) TRC in our review of the results of the entire study.

**Response:**

The variation in species composition in different rivers is a consequence of natural and spatial variability. The Target Fish Community (TFC) is a model, an approximation of the expected community, and its certainty is only as good as the input data. Several steps were taken to offset the variability in fish collections and make sure that the TFC represented the Lamprey River. First, was the number and quality of the fish collections used. To reduce the influence of variability, fifteen fish collections from six rivers were used and only if they met specific criteria for comprehensiveness in the numbers of fish collected. Next, the fish collection locations selected had to match Lamprey River characteristics. Then, the formula used to develop the TFC uses ranking procedures to determine expected proportions of individual species. Ranking of the greatest sum of relative abundances means that a species that occurs most commonly in the data set has a rank of one and less frequently occurring species rank lower down the species list. Therefore, the method is not sensitive to small fluctuations in species composition. Finally, to test the results, the TFC was evaluated by fisheries experts serving on the Technical Review Committee who agreed with the final list of selected species and their relative abundances.

As described at the TRC meetings in February and March 2007, the standard for evaluating over-represented or under-represented species is in fact an arbitrary value. The selected bounds were set for existing fish species that were 50% over or under the Target Fish Community. Inspecting the pollution and thermal tolerances and other characteristics of species listed as either over- or under-represented indicates whether there are other problems than habitat limitations due to flow. This information is not part of the protected instream flow calculations, but is really a check on other factors that might be affecting fish distribution. The TRC reviewed and approved the Lamprey TFC report in 2007 and DES continued the instream flow assessment based on that approval.

The comparison of the TFC to the existing community to determine if a fish species was truly over- or underrepresented is used to approximate the current status of the fish fauna and to identify factors other than flow that may cause changes in the fish community. Statistical analysis of the appropriate factor to be used was not performed, because the comparison serves only as a check in the process of determining the protected instream flows. It is not required for the determination of indicator species and has no influence on the final result.

**Comment TRC-3:**

It is our understanding that the Instream Flow Council (IFC), made up of dozens of members of instream flow experts through the United States and Canada, has agreed to conduct an independent third party review of this method and of the proposed Lamprey River protected instream flows. Goal II of the IFC is to “Promote sound instream flow science”. We look forward to this review, and realize that to meet statutory deadlines it must be conducted after the Lamprey instream flow study has been completed. The TRC wants to recognize that the third

party review was a concept developed and initiated by DES, which speaks to the Department's commitment to validating the science applied to the instream flow projects.

**Response:**

DES proposed a third-party review as a means of providing an answer to the questions raised by members of the Technical Review Committee concerning the methods and results of the Souhegan and Lamprey River protected instream flow studies. The Instream Flow Council was recently contracted by DES to perform the third-party review. DES has identified the critical review priorities as being in the fields of fish studies, statistics, and incremental flow models.

Originally, it was the intention of DES to conduct this review using the final versions of the Souhegan and Lamprey River Protected Instream Flow reports. However, to complete the third-party review process earlier, in order to be completed within the grant cycle and to meet program deadlines, the review will look at the Lamprey Proposed Protected Instream Flow Report instead of the final report. The review will be conducted this year with a completion date of September 30, 2009.



**Comments Received From:**

Mr. Dennis G. McCarthy  
Public Works Director  
Town of Raymond  
Public Works Department  
Town Offices  
4 Epping Street  
Raymond, NH 03077

**Source:** Letter dated Friday February 27, 2009

While I certainly support efforts to protect the states water resources, I am uncomfortable with the information being developed by this report. As a layman, it is difficult for me to provide comment upon this technical report. However my discomfort is based upon a number of general factors such as:

**Comment RAY-1:**

The report's technical review committee does not appear to be satisfied with the study's methodology.

**Response:**

The Lamprey Technical Review Committee's duty is to advise DES on technical aspects of the study. The committee voted at their November 13, 2008 meeting to present the Lamprey Proposed Protected Instream Flows for a public hearing. At the meeting some members raised issues that they would like to see further investigated. The committee presented these issues to DES for further assessment. DES is evaluating the committee's comments and responding.

One of the issues being evaluated is the study methodology for protected flows for fish. To date the committee has not identified any technical problems with the methodology. The Technical Review Committee was presented with the assessment methods for their approval before the study began. This methodology was presented and a report describing the assessment methods was circulated and reviewed by the Committee at its meetings on February 13, 2005 and again in final form a year later on March 7, 2006. In fact, the project team was originally selected in large part because of this method presented in their proposal. The selection committee, which included two members of the Lamprey Technical Review Committee, unanimously selected the project team based on their 1) specialized experience, 2) project personnel, and 3) project approach, with the 50 percent of the score weighted on the project approach.

DES was satisfied with the committee members' recommendations of the methodology during the selection process and its confirmation again before the studies were begun. However, DES is going further to evaluate committee members' concern by presenting the Souhegan and Lamprey studies to the Instream Flow Council, recognized by the Lamprey Technical Review Committee as being made up of instream flow experts throughout the United States and Canada, for their independent review and evaluation of the methods used and the results.

**Comment RAY-2:**

The concerns voiced by a number of the professional engineers and hydrogeologists in the audience questioning the report's methodology and validity of results.

**Response:**

DES presented the Proposed Protected Instream Flow Report in order to hear any concerns. DES has prepared a detailed response to all comments received and will address any specific omissions or errors.

**Comment RAY-3:**

A number of anomalies within the study which must be overlooked to support the analysis. For example, the driest time of the year analysis is supported by flow rates which are greater than the wettest time of the year data.

**Response:**

[Note: discussion with the commenter identified that the anomaly referred to was related to a question raised during the January 8, 2009 WMPAAC meeting and related to the analysis of the protected flows during representative sets of years for dry, wet and average periods.]

The presentation slides have been reviewed for errors and the values presented are all correct so this comment concerning the question raised appears unfounded. Values that might appear anomalous are presented on the slide showing the UNH/Durham 401 Water Quality Certification conditions. This slide documents the number of days that flow is within certain ranges of flow during the dry, wet and average representative years. During the representative average 3-year period, flows within a certain range were less common than during either the representative wet or dry 3-year periods. That is as should be expected for that range of flows.

The representative years were selected based on their mean annual flow. The result is that some wet years have drier periods and some dry years have wetter periods. The hydrographs in Figures 47 and 48, in the report, show this clearly. This distribution of certain selected flow ranges described in the presentation is not a mistake even though it does not follow intuition.

**Comment RAY-4:**

The size of the report consisting of 223 pages, with a 19 page summary, and approximately 600 pages of appendices, The sheer preponderance of information brings to mind the saying "if you can't dazzle them with brilliance you should baffle them with ....."

**Response:**

The project team acknowledges that the report is lengthy and technically complex. The length of the report and the technical nature of the discussion in the report reflect the amount of information gathered through the study's investigations and the level of technical analysis required for the assessment of the proposed protected instream flows. The purpose of including all of the appendices was to present the background information and data that were collected as

part of the study and to provide additional documentation supporting the results presented in the main body of the report. Several of the appendices were specifically added at the request of the Souhegan Technical Review Committee during the review of the Souhegan River Protected Instream Flow Study Report.

It was not the intent of the project team to make the information presented in the report inherently difficult to comprehend, but it reflects the technical nature of the work performed. If anything, the project team attempted to provide sufficient detail of the methods used, the results obtained and the conclusions drawn, so that they could be reviewed and commented by the public and other stakeholders engaged in the process.

The legislature, in the legislation requiring pilot studies (chapter 278, laws of 2002), specifically envisioned a detailed, river-specific study to establish protected instream flows. Legislative action followed at least two failed attempts by DES to adopt regulations based on simplified methods. These methods were unacceptable to stakeholders. It would appear that the desires of stakeholders, previously expressed in deliberations that are documented on the DES website, and the explicit action of the legislature have resulted in a study which, by design, is complex and takes many pages to communicate adequately.

**Comment RAY-5:**

Many of the reports definitions and explanations defy understanding or even common sense. The following is an example:

*“The **common flow** is the flow corresponding to the highest habitat magnitude above which the frequency of occurrence begins to decline significantly with incremental increase in habitat magnitude.”*

This definition is apparently important in regard to recommend protected instream flows for fish, but its meaning is incomprehensible both to me and our engineering and hydrogeological consultants.

**Response:**

This definition has been presented in many public meetings over the previous four years. It should be read in the context of the preceding passages, in the report, describing the protected flow assessment method.

**Comment RAY-6:**

Since all of the Town’s existing and potential groundwater sources are within the drainage basin of the Lamprey River or its tributaries, and will therefore be impacted by the eventual water management plan; I believe it is very important that any report, plan, or legislation regarding the river be approached accurately and scientifically.

As such, based upon only my layman’s impression of the report, I must go on record as opposing the conclusions of the report and any water management plan promulgated from or by its conclusions. Further, I have recommended the Town’s Board of Selectmen and legislative representatives (I.E. Barnes, Bishop, Kepplar, and Hoezel) be put on notice that this report and

any legislation coming from it may not be based upon sound science and/or engineering, nor be in the best of interest of the Town of Raymond.

**Response:**

Thank you for your comment.

## Comments Received From:

Dr. William H. McDowell  
Professor of Water Resources Management  
Department of Natural Resources and the Environment  
Presidential Chair  
Director, NH Water Resources Research Center  
238 Spaulding Life Sciences Building  
38 Academic Way  
University of New Hampshire  
Durham, NH 03824

**Dated:** Monday, March 02, 2009 5:38 AM by email

## Comment McD-1:

My biggest concern is the treatment of impoundments in the modeling exercise. As I raised at the public meeting, it seems that the final runs of the MesoHABSIM model used to derive protected instream flows for fish were conducted as if the river did not have any dams. This is obviously untrue, and throws doubt on the validity of the entire exercise. If MesoHABSIM is used to describe habitat conditions upon which regulations will be based, then dams must be included. They have altered river flow for many decades, and are likely to continue to do so. The Macallam and Wiswall Dams certainly change the nature of low flows in the Lamprey River, and must be included in any plan to develop protected instream flow rules.

## Response:

You are correct in noting that the baseline river structure no longer exists and that the dams will continue to affect habitat conditions. The purpose of using conditions without dams in the MesoHABSIM modeling was not to recommend that modifications be made, but to establish a baseline for the determination of flows to which the natural fish fauna have adapted. This is an element of the Natural Flow Paradigm, which has been adopted as an underlying principle for this study. This is the only way to define reasonable reference conditions.

The results on protected flows of using both current and baseline conditions are documented in the **Protected Habitat Levels** section of the report. In the modeling, the river is assessed as one by combining the reference reaches. The total amount of habitat is lower under the current conditions than under the baseline conditions, which reflects the existing river conditions having both dams and impoundments and limited woody debris and undercut banks in these sections. Protected flows would have to be higher to maintain habitat levels using current conditions: For example under Rearing and Growth Bioperiod, “At present conditions this habitat level corresponds with flows of **0.95 cfsm (173 cfs)**. The flows corresponding with 11 percent CA (channel area) under baseline conditions are **0.6 cfsm (109 cfs)**.” What would be unreasonable is to try to maintain habitat conditions with flow where the river’s structural conditions do not support that habitat level any longer. The application of the protected flows still applies under the current conditions, but using baseline conditions means that unnatural flow conditions are not necessary to try to make those existing conditions function as if the dams were not present.

Therefore, the results of this study represent a reasonable and practical approach, while at the same time still following scientifically sound logic.

**Comment McD-2:**

Another concern is that not all users of the river will be part of the allocated water use. Large water users upstream and large groundwater withdrawals that aren't within the water management planning are likely to have a hydrologic influence on the designated reach, but their effects are not likely to be accounted for. They must be for the plan to be meaningful and fully protective.

**Response:**

As outlined in Env-Ws 1905.02, the scope of the Protected Instream Flow Study is limited to the outstanding characteristics, instream public uses and resources for the designated river segment only. So water users located either upstream or downstream of the designated river segment were not discussed in the Draft Lamprey River Proposed Protected Instream Flow Report. The Water Management Planning Area includes essentially all registered water users in the upstream watershed, and all registered dam owners with an impoundment area sufficient to provide any usable storage.

The second phase of the study, the Water Management Plan (WMP), will focus on both the Affected Water Users (AWU) and Affected Dam Owners (ADO) located within the Water Management Planning Area (WMPA - the tributary drainage area to the designated river, Env-Ws 1902.16). AWUs are defined as those required to be registered and having a withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its drainage area (Env-Ws 1902.03), while ADOs are defined as an owner of a dam with an impoundment having a surface area greater than 10 acres in the watershed area of a designated river (Env-Ws 1902.02).

The AWUs and ADOs of the Lamprey River WMPA have already been contacted to obtain information on their water use or dam operations. This information will be used to develop a Conservation Plan, Water Use Plan and a Dam Management Plan, which are the principle elements of the Lamprey River WMP. As part of the WMP process, the needs of the water users and dam owners will be evaluated relative to the protected instream flows (PISFs) established for the Lamprey River. Ultimately, the outcome of this process will be the determination of how the established protected instream flows will be maintained through the implementation of appropriate conservation and operational management measures by the AWUs and ADOs.

**Comment McD-3:**

The consideration given to the effects of water regime on endangered plants is admirable. But some thought should also be given to the effects of water withdrawals on invasives such as zebra mussels and Didymo.

**Response:**

Invasive species are not a public use or outstanding characteristic or resource (IPUOCR), and therefore we did not target them for evaluation. Didymo and zebra mussels are not known to

inhabit the Lamprey River, and water management alone will not prevent or encourage invasion by these species, so they were not addressed in this study. Nonetheless, we recognize that invasive species can be a threat to IPUOCRs and may also be flow dependent. Therefore, we included a discussion of the potential effects of stream flow on invasive species observed or known to be within the riparian corridor (Assessment of Flows, Section B. 3).

**Comment McD-4:**

I strongly urge DES to make all the raw habitat data collected for this project available on the web. It is a valuable resource.

**Response:**

DES is planning to receive data collected in the study by the project team and make that data available. Eventually, DES would like to make this data available through the Department's Environmental Monitoring Database, which is web-accessible.



## Comments Received From:

Dr. Loren D. Meeker  
Professor Emeritus of Mathematics  
UNH

**Source:** Letter dated Monday, January 26, 2009

In general, when using the AIC procedure with a great many variables the values to be minimized can be v(e)ry close together with many model values, each model with different independent variables, differing by only small and, probably, insignificant amounts. The AIC process is intended for comparing model constructions and does not, necessarily, identify the most understandable and explanatory model. This becomes very apparent when one tries to understand what the presented models are actually indicating. For example, the first “presences” model summary of the report shows two coefficients of -234 and 20 while the remaining variable coefficients are all less than 3 in absolute value. The variable with the 20 coefficient becomes the largest in the “abundance” model but changes sign now indicating a negative influence on abundance rather than its positive influence on presence. These differences may be justified but from the information presented in the report that can not be determined and so may be a (possibly misleading) statistical artifact.

The standard way of addressing the problem just described is by providing an analysis of variance table showing the percent of variance explained by each of the explanatory variables and/or estimated standard deviations of the coefficients. With that information one can assess the importance of each variable in understanding the system under study. In this situation one does not even know how many of the 20 preliminary variable sets contained each of the final variables. There is a comment in the report that some of the “large coefficients” are statistical artifacts arising from single observations. If that is indeed the case, those coefficients should not be included in the final report as they are very misleading. How large are “large coefficients”? I think a standard logistic regression modeling effort should be conducted using the variables identified and used in each “final” model. With the results of that analysis one would have a much better idea of the important explanatory parts of the study.

When a model contains many variables which explain very small and statistically insignificant amounts of variance the coefficients of the truly important explanatory variables can be considerably different when the extraneous variables are omitted. In the models reported here we have no way of judging the validity of the estimated coefficients. They may, or may not, deserve the importance placed on them in the habitat suitability estimates for which they are used. Without some estimate of significance we can not be confident in the results.

These concerns are important as the estimated coefficients are used to assess habitat suitability for the Lamprey River sections and, in turn, are used in defining the PISF. Unless confidence can be placed on the validity of the model coefficients there can be considerable doubt as to the value of the final product.

In summary, it is my opinion that the models were developed in a semi-automatic way using the AIC process which requires little supervision. While that process is an excellent way of developing preliminary models, it is, in my opinion, not automatically acceptable in generating

models which succinctly summarize and provide understanding of the process under study. I believe it is the latter that is needed for this study as its final conclusions, the PISF, seem to rely strongly on the model results.

**Response:**

The model building process that was used for the Rearing and Growth Bioperiod is based on the Akaike Information Criterion (AIC). This approach provides an objective measure of the quality of a model, while striking a compromise between the models fit and model parsimony. We are hesitant to drop parameters from these final models based on other criteria (parameter P values, or standard errors) as the AIC score is a reflection of the entire model and the final model has a better AIC score than any model in which a parameter is dropped. That said, we acknowledge the importance of including confidence intervals on the estimated parameters and how this could be misleading in interpretation.

Therefore, in response to these comments the standard errors have been included in the coefficient tables that appear in Appendix 6. Also, in response to these comments, the Rearing and Growth Bioperiod was rerun without the variables having large coefficients. This resulted in changes to the common flow (110 cfs to 104 cfs) value, its catastrophic duration (81 to 82 days) along with the allowable duration (6 to 5 days) and catastrophic duration (28 to 15 days) for the rare flow. These changes have been incorporated into the recommended PISF table. Also, it should be noted that the habitat levels for common shiner (Rearing and Growth Bioperiod) were not affected with the exception of the duration of rare conditions.

The abundance models that were constructed as part of the modeling are contingent on presence; they are based only on sites where the fish were known to be present. Thus, we do not necessarily expect the parameters to be similar. For example, it could be that, given the entire range of current velocities in a river, a species is present only within areas of relatively low velocities, but within the inhabited range of currents that species is more abundant in higher velocities conditions. This would yield different magnitudes of coefficients between the two different models, each of which may be valid and meaningful. In another scenario, one attribute such as xylal (representing substrate dominated by tree trunks, branches or roots) may correlate positively with the presence of a species, but only in low numbers. The negative correlation between attribute and high abundance in the second model describes exactly that. Therefore, the occurrence of the same attribute with a different sign (positive or negative) in both models is justified and mathematically correct.

**Comments Received From:**

Ms. Sharon Meeker, Chair  
Lamprey River Advisory Committee

**Source:** Letter dated Friday February 27, 2009

**Comment LRAC-1:**

This report summarizes activities conducted to establish minimum flow rates in the Lamprey River that are needed to ensure the identified instream public uses, outstanding characteristics and resources (IPUOCRs) are not adversely impacted by insufficient river flows. This report is the culmination of more than four years of study and will be the foundation for the eventual Water Management Plan (WMP). The WMP will dictate how dam owners and water withdrawers are to coordinate water management activities to ensure minimum flows are met. Therefore it is critically important the study methods and results be presented in a clear, concise and readily understood manner so that all Lamprey River stakeholders are able to obtain a solid grasp on what the minimum flows are and how they were established.

**Response:**

Agreed. DES and the project team are revising the report, especially the Executive Summary, in response to specific and general comments in this regard. In addition, as with the Souhegan protected flows, the Lamprey Establishment Declaration will be a succinct description of the scientific basis for the flows.

**Comment LRAC-2:**

LRAC found the Executive Summary confusing and lacking fundamental information. We suggest the Executive Summary be expended in manner so that it is a “stand alone”, all encompassing review of all the Lamprey River Flow studies conducted to date. For many stakeholders and elected officials, the subject report is likely the only report they will read therefore it should include a timeline, legislative authority, and results of Tasks 1 through 4 of the Lamprey River Flow studies.

**Response:**

The purpose of the Executive Summary is to provide a stand-alone document that briefly discusses the key elements and findings of the main report.

The structure and content of the Lamprey Executive Summary was modeled after the Executive Summary of the Souhegan River Report. Changes to reduce this section of the draft Souhegan Report were made in response to comments that were received during that review which considered the Souhegan Executive Summary too lengthy and complex. Despite being a summary, the Executive Summary still contains considerable foundational and technical content.

Additional information has been added to the Lamprey Executive Summary including the legislative authority, definitions, reference to previous supporting reports, and details describing

the protected flow tables and how they are applied to define a management event under the Water Management Plan. Clarifications have been made where commenters pointed out parts that they did not understand.

**Comment LRAC-3:**

Table 1 in the report “Protected Instream Flow Criteria for Fish in the Lamprey Designated River” presents the minimum flow rates on the Lamprey River for various times of the year (bioperiods), for different fish, for different minimum durations and different frequencies. We understand the minimum flows in this table will be the controlling flows for the water management plan. This table needs to be simplified and made much easier to understand. We request this table be made into a graph(s) that has time of year on the x-axis and flow rate on the y-axis. The controlling minimum flow should then be plotted on the graph for the various times of the year. We note the Executive Summary for the Souhegan River Instream Flow Study included graphs and in general was more comprehensive.

**Response:**

Based on comments raising concerns with these graphs when presented in the Souhegan Report, DES decided not to include a similar graph showing the individual protected flow thresholds in the bioperiods because it can be misleading. The graph would not show the flow duration criteria of these thresholds that are critical components to the flow protections.

**Comment LRAC-4:**

The report appears to suggest the USGS river gage at Packers Falls will be the only gage used to monitor compliance with the minimum flows throughout the designated reach of the Lamprey River. LRAC believes one gage is inadequate to monitor flows for the WMP and requests the report include an analysis/discussion on the number and location of river flow gages needed to adequately monitor flow.

**Response:**

The Lamprey River currently has two USGS continuous record gages. USGS 01073500 LAMPREY RIVER NEAR NEWMARKET, NH, also known as the Packers Falls gage, is in the Designated River segment, located near the lower end of the river, which measures 183 square miles of watershed. This gage has flow records going back to 1934. Last summer a new gage, USGS 01073319 LAMPREY RIVER AT LANGFORD ROAD, AT RAYMOND, NH, was installed under a cooperative program between DES and USGS. This gage began operating July 1, 2008. This gage is located near the middle of the watershed and measures 55.7 square miles.

The gage at Packers Falls is adequate to define flow conditions for the 12 miles of the Designated River. The lowest protected flow magnitude criterion is 16 cfs (measured at the Packers Falls gage). The low flows measured at the two Lamprey gages show a high degree of correlation, in particular for flows between 18 and 350 cfs at the Packers Falls gage (equivalent to flows between 4 and 80 cfs at the gage in Raymond.) Because of the short record at the Raymond gage, no lower flow comparisons can be made yet. The new Raymond gage will measure a portion of the watershed containing fewer and smaller dams. The new gage may be

used as a check on data at the Packers Falls gage, but the Water Management Plan is expected to rely on the Packers Falls gage as the index gage.

Note also that a proposal for placing and funding an additional gage has been made by the Lamprey River Watershed Association. This gage as proposed would be located near Lee Hook Road and may provide inflow data for the river just upstream of the UNH/Durham water withdrawal. The proposed gage would also provide data downstream of one of Newmarket Public Works' proposed water withdrawal locations. To date, a suitable location for a permanent gage has not been identified in this vicinity.

#### **Comment LRAC-5:**

Because the most critical time to have accurate measurement of flows is during low flow periods, the USGS Packers Falls gage and future additional gages should be calibrated to read accurately in the 1 to 100 cfs range.

#### **Response:**

The USGS regularly monitors site conditions and measures discharge at each of their river gages to determine the accuracy of the stage-discharge data. The qualitative rating system used by the USGS to assess the independent discharge measurements shows that at the Packers Falls gage, from 1985-2009, more than 80% of flow measurements taken at flows below 100 cfs were determined to be within 8% of the "true" discharge. Additionally, only 2 of the 14 total observations made at flows less than 4 cfs were determined to be more than 8% off from the "true" discharge. Mr. Richard Kiah of the USGS New Hampshire/Vermont Water Science Center in Pembroke, New Hampshire, when asked about the accuracy of flow measurements at the Packers Falls gage, stated that since water year 2000 (when the current rating curve was established for the Packers Falls gage) eight measurements have been used to check the stage-discharge rating curve between 1-100 cfs. These measurements have ranged from -2.4% to +4.7% of the expected flows. A quantitative assessment of flow measurement techniques shows that at most sites most discharge measurements fall within 3-6% of "true" discharge and rarely exceed 20% error even under very poor conditions (Sauer and Meyer, 1992, Determination of error in individual discharge measurements, *USGS Open File Report 92-144*, p. 17).

One factor that can affect flow measurements at the Packers Falls gage, particularly under low-flow conditions, is backwater from beaver dams and algae growth on ledges (which can slightly raise water levels). Backwater raises water levels in the vicinity of the gage which affects the stage-discharge relationship. Mr. Kiah noted that of the 31 measurements made at flows of 1-100 cfs (since 2000) 21 have been affected by backwater. Under those conditions a flow measurement is made and then the obstruction causing the backwater is removed. The river stage is then monitored following removal of the obstruction to assess the stage-discharge relationship and ensure that the river stage returns to the expected level for the measured discharge. The stage and discharge data during backwater conditions are quality controlled by the USGS by either applying a correction to the data or by producing an estimate of flows if the backwater is severe.

Because the measured discharge from the USGS is typically within +/- 8% of "true" flows and quality controls are used to correct data which has been compromised by backwater conditions,

we have determine that the margins of error are acceptably small to consider the reported flow values at Packers Falls to be representative of river conditions.

**Reference:**

Sauer, V.B. and R.W. Meyer. 1992. Determination of Error in Individual Discharge Measurements. U.S. Geological Survey Open-File Report 92-144. Norcross, Georgia. 21 p.

**Comment LRAC-6:**

Page xxx of the Executive Summary states the lowest recorded Lamprey River flow in the last 30 years was 3.7 cfs. As the lowest recorded flow, it goes to recommend that Lamprey River flow be managed so that flows never go below this value. This statement appears to suggest this flow will be the controlling, default minimum flow for all bioperiods, frequencies and durations. Please elaborate on how this 3.7 cfs flow is to be used in the eventual water management plan.

**Response:**

The recommendation of a minimum flow of 4 cfs has been removed from the report. We believe the remaining flow protections when implemented under the Water Management Plans will prevent abnormally low flow conditions. If flows were to reach these levels because of natural conditions, it is likely that emergency status would be declared by the Commissioner under RSA 483:9-c.IV.

**Comment LRAC-7:**

We understand the minimum flows were established using the Natural Flow Paradigm. This paradigm assumes there are no natural or manmade made impoundments on the river. Please elaborate on how minimum flows developed assuming there are no impoundments are to be applied in the WMP to a river that has impoundments.

**Response:**

The Natural Flow Paradigm states that fish are best supported by the flow regime under which they have adapted. It does not assume the absence of impoundments. To meet biological integrity goals, approximating natural flows is the target condition. Identifying those flows then is the job of this study. The description of the stream flow under the Natural Flow Paradigm requires inclusion of components of not only magnitude, but also timing, duration, frequency and rate of change. It is accepted that simply providing a single minimum flow will not adequately support fish habitat. The protected flows use these Natural Flow Paradigm components. There is no assumption relating to natural or manmade impoundments in the Natural Flow Paradigm, only recognition that that the natural flows with their variability are best suited to supporting aquatic species like fish: The Lamprey protected flows were developed and described with these concepts.

Protected flows must be the combination of flow components that will support biological integrity. Since biological integrity is best supported by the conditions under which fish have adapted – the baseline conditions. These conditions of flow and river structure, which are the

basic components of fish habitat, have been used to identify the flows that support fish species under conditions of biological integrity.

The presence of man-made impoundments limits the amount of free-flowing, riverine habitat available in the assessment. Thus, the protected flows are defined using the baseline river structure which includes estimates of pre-impoundment free-flowing, riverine habitat. This results in an assessment of the flow in the river that would support the fish community in the baseline river structure, or in other words, that meet the definition of biological integrity. Defining the protected flow for the original river structure does not mean that the impoundments must be removed. It only means the identified protected flows will support the community of fish species that would naturally occur in the unimpounded river segments.

**Comment LRAC-8:**

New Hampshire law RSA 483:9-C, Establishment of Protected Instream Flows paragraph III states in part “*The procedure adopted under this section shall include an assessment of the effect of a protected instream flow upon existing hydroelectric power generation, water supply, flood control, and other riparian users...*” Please state how this requirement, exclusive of hydroelectric power, was addressed in the report.

**Response:**

The following discussion concerning the required assessments will be added to the report.

“RSA 483:9-C requires an assessment of the effect of a protected instream flow upon certain water users. The protected flows have no effect on existing water use by water supply, flood control, and other riparian users. The effect of the protected instream flow on water uses results only from the implementation of management alternatives under the Water Management Plan that will be put into practice to meet the protected flows. The Water Management Plan will include conservation, water use changes and impoundment management by Affected Water Users and Affected Dam Owners in the watershed. The Water Management Plan has not been developed. Until the plan is developed, which will be done with the input and guidance from these water users and dam owners, the effects of its implementation remain unknown. The assessment required by RSA 483:9-C will be completed as part of the review process for the draft Water Management Plan.”

**Comment LRAC-9:**

Page Roman numeral xxx (xxix on some reports) states “*The lowest naturalized flow recorded in the last 30 years was 3.7 cfs at the Packers Falls gage*”. Please clarify if this flow rate is from actual data from the flow gage or a synthesized flow rate from a hydraulic model?

**Response:**

The recommendation that “flows never be allowed to fall below 4 cfs” has been withdrawn from the report. It is believed that the remaining flow protections, when implemented under the Water Management Plans, will prevent abnormally low flow conditions. If flows were to reach these levels because of natural conditions, it is likely that emergency status would be declared by the Commissioner under RSA 483:9-c.IV. For clarification of the source and use of this number, 4

cfs flow represents the lowest flow (3.7 cfs was rounded up to 4) occurring in the 30-year naturalized flow record. Stream flow gages, such as the Packers Falls gage, record the net stream flow resulting from all the upstream activities as affected by upstream water use and impoundment management. Because those records include withdrawals and returns, flows less than 4 cfs have been recorded at the Packers Falls gage.

4 cfs is the lowest flow recorded after corrections to offset water usage and impoundment management conditions were made to naturalize the flow. These corrections were calculated using the registered water use records and the storage and release records for Lake Pawtuckaway. Only quantifiable corrections were made: not all of the impacts on flow were part of the corrections to naturalize stream flow. Corrections for storage and release from other dams in the watershed and for other impacts on flow (development, land use changes, unregistered withdrawals, etc.) were not made because of the lack of quantifiable data.

**Comment LRAC-10:**

Page xxix states a comprehensive analysis was conducted to determine the flows necessary to support the needs of fish, riparian vegetation, wildlife and human uses. This analysis concluded the protected entity with the highest flow need, (therefore the controlling flow) were various types of fish. Table 1 summaries the minimum flow needs for various fish species. Earlier studies concluded both fish and mussels are a primary indicator of ecological integrity. The 2006 IP(U)OCR Final Report notes that the brook floater mussel is extremely vulnerable to inadequate flow conditions and would be evaluated using MesoHABSIM. Please elaborate on how the flow needs of mussels will be satisfied with the flows outlined in Table 1.

**Response:**

Although we indentified fresh water mussels in the PISF report, developing the habitat model for this animal group was abandoned based on the findings of the Souhegan study. The Souhegan model demonstrated no habitat change with flow conditions within investigated range. This is in part due to a broad range of habitat used by mussel species, which may be fast or slow flowing. A generic model for mussels is not sensitive enough to capture the habitat changes for individual species. As our observations of the release of Wiswall Impoundment documented, mussels seem to be more vulnerable to rapid instantaneous change of depth.

Therefore, protection for mussels is maintained under this program by three factors: maintaining fish species upon which the mussel larvae are dependent, keeping shear stresses within ranges that allow juvenile mussel settlement, and avoiding dewatering of habitat at rates that will strand mussels. Maintaining fish species will be supported by protecting fish flows that support the Target Fish Community described in the protected flows in Table 1. Shear stresses will be maintained by avoiding management activities resulting in hydraulic conditions that substantial increase flow velocities. Meeting this criterion will be incorporated in the Water Management Plan by ensuring the rate of change from relief flows released from impoundments is within the range of natural flows. Dewatering may occur naturally or under the combined effects of water withdrawals and natural conditions. Dewatering, if it occurs, needs to occur at natural rates that allow mussels to relocate. Rate of change is a component of the Natural Flow Paradigm, but it is not described as part of the protected instream flows because it is a function of the use and management activities. Rate of change considerations will be part of the management alternatives described within the Water Management Plan.

**Comment LRAC-11:**

It was not clear how the synthesized flows developed for the Natural Flow Paradigm were developed. The report should include a description of the hydraulic model and the methodology used to establish these flow rates.

**Response:**

Naturalized flows were developed to model protected flows for fish. The method used to develop the naturalized flow hydrograph is discussed in Appendix 13 of the report. A section expanding the discussion of the development of these flows and their use will be added to the main report.



**Comments Received From:**

Mr. Carl F. Spang  
President  
Lamprey River Watershed Association  
43 North River Road  
Lee, New Hampshire 03861

**Source:** Letter dated Monday March 2, 2009

**Comment LRWA-1:**

The report seems to say that the river will be managed for an absolute minimum low flow at either 16 cfs or 4 cfs either of which seems entirely too low. As noted in the report, the 4 cfs level is nearly at the lowest recorded flow level in 30 years. Why would we allow the river to get this low under managed conditions? Locals know that when the flow gets to 20 cfs you can walk across the river even near Wiswall dam.

**Response:**

The recommendation of a 4 cfs minimum flow has been removed from the report. It's believed that the remaining flow protections, when implemented under the Water Management Plans, will prevent abnormally low flow conditions. If flows were to reach these levels because of natural conditions, it is likely that emergency status would be declared by the Commissioner under RSA 483:9-c.IV.

The lowest proposed protected instream flow of 16 cfs (fish rearing & growth bioperiod) is based on the results of the detailed evaluations of the hydrology of the Designated River and the instream aquatic resources of the river, as documented in the draft report. When the Rare Flow value for the rearing and growth bioperiod is compared with the flows recorded during the 3-year average flow period (1990 to 1992), flows fell below the proposed rearing and growth protected instream flow (PISF) 70 out of 282 days or roughly 25 percent of the time. So, although a flow of 16 cfs may appear to be too low, flows of this magnitude do occur during average flow conditions about 25 percent of the time. The goal of the implementation of the proposed PISF is to limit the number of occurrences of flows below these levels and their duration.

**Comment LRWA-2:**

If table 1 is the chart to be followed, it was not adequately explained. A better explanation of this table should be prepared and what it means for future management of the river. This should be done PRIOR to the development of the Management Plan.

**Response:**

Table 1 has been revised to accurately describe the bioperiod durations. Text has been added to define the individual components of Table 1 and to describe how the protected instream flows will be used to identify periods requiring management actions.

### **Comment LRWA-3:**

We have several concerns regarding the MesoHABSIM model used to predict in-stream flow necessary to support fish and aquatic life. First, the use of this model seems fundamentally flawed by excluding the dams that are present along the Lamprey River. The MaCallam, Wiswall and Folsom Dams will exist into the foreseeable future and will continue to impact the hydrologic regime of the Lamprey. When establishing protected in-stream flows, it seems necessary to model reality and incorporate the role of these dams into any modeling exercise.

### **Response:**

Several similar comments were received regarding the presence of the dams in the Designated River and how the MesoHABSIM modeling addressed these. The purpose of using conditions without dams in the MesoHABSIM modeling was not to recommend that modifications be made, but to establish a baseline for the determination of flows to which the natural fish fauna have adapted. This is an element of the Natural Flow Paradigm, which has been adopted as an underlying principle for this study. This is the only way to define reasonable reference conditions.

The results on protected flows of using both current and baseline conditions are documented in the **Protected Habitat Levels** section of the report. In the modeling, the river is assessed as one by combining the reference reaches. The total amount of habitat is lower under the current conditions than under the baseline conditions, which reflects the existing river conditions having both dams and impoundments and limited woody debris and undercut banks in these sections. Protected flows would have to be higher to maintain habitat levels using current conditions: For example under Rearing and Growth Bioperiod, “At present conditions this habitat level corresponds with flows of **0.95 cfsm (173 cfs)**. The flows corresponding with 11 percent CA (channel area) under baseline conditions are **0.6 cfsm (109 cfs)**.” What would be unreasonable is to try to maintain habitat conditions with flow where the river’s structural conditions do not support that habitat level any longer. The application of the protected flows still applies under the current conditions, but using baseline conditions means that unnatural flow conditions are not necessary to try to make those existing conditions function as if the dams were not present. Therefore, the results of this study represent a reasonable and practical approach, while at the same time still following scientifically sound logic.

### **Comment LRWA-4:**

Second, the ecological variables included in the final MesoHABSIM model for presence/absence should have the same sign in the model for abundance if they are also included in that model. One of the variables was included in both models, but had different signs (positive in one and negative in the other). How can one variable positively influence the presence of fish in one model and then negatively impact the abundance in the other (or vice versa)? These final models should make ecological sense.

### **Response:**

Because of the two different assessments being conducted—presence and abundance—the parameters should not necessarily be expected to be similar. The abundance models that were constructed for this study are contingent on the presence of fish, meaning that they were based

only on sites where fish were known to be present. An example of how a parameter may be positively correlated with presence, but negatively correlated with abundance follows for one attribute such as woody substrate. Woody substrate may correlate positively with the presence of a species, pointing towards a greater chance of finding the species where this substrate appears. However, it does not necessarily mean that this is a linear relationship with the number of individuals. It only means that wherever this substrate was present, we only found a few of the animals. The negative coefficient for woody substrate in the abundance model indicates that we can find the species of fish where there is such a substrate, but only few in numbers. Therefore, the occurrence of the same attribute with a different sign (positive or negative) in both models is justified and mathematically correct.

**Comment LRWA-5:**

Finally, the relative importance of the different variables included in the final MesoHABSIM models is not evident and this is an important consideration when interpreting the model results. The next version of the report should include the relative importance of variables included in final models.

**Response:**

Regarding the relative importance of the ecological variables used in the modeling, their standard errors were included in the coefficient tables, which can be found in the revised version of Appendix 6. In this appendix, the attributes identified as having a correlation with the presence and abundance of the fish species and insect families studied as part of this project are also presented.

**Comment LRWA-6:**

The assessment of recreational needs was poorly done. The survey method was limited in location, number of participants, and recreational type. The recommended minimum flow levels are totally inadequate to meet recreational needs on the river. The logic that led to conclusions such as “swimming is opportunistic” and therefore ineligible for In-stream Flow protection is indefensible.

**Response:**

As proposed in the Task 4 Report (DES 2006), the assessment of boating flows was to be evaluated qualitatively through a combination of field observations and interviews of boaters on the river during various river stages including low summer flows and high spring flows. The Lamprey River was visited seven times from the spring of 2006 to the spring of 2007 to distribute surveys and observe boating conditions over a range of flows from 64 cfs to 353 cfs. Additional information regarding boating conditions and flow preferences was obtained during the interview of swimmers performed on July 29 and August 5, 2006 when flows were 235 and 173 cfs, respectively. This information was supplemented by the field observations of the Rushing Rivers Institute field crew who were on the river during the spring, summer and fall of 2006 and the summer of 2007 over a range of flows 14 to 366 cfs.

In addition to the survey results and the field observations obtained, web-based information and reports on paddling conditions were reviewed and local individuals knowledgeable about boating

on the Lamprey were contacted. Based on the information obtained from all of these sources, a protected instream flow of 275 cfs was proposed for boating on the designated portion of the Lamprey River. It should be noted that this value is greater than the minimum flow (of 200 cfs) recommended in the Appalachian Mountain Club's guide to paddling the Lamprey River (Monkman and Monkman 2002) and should support boating on both the impounded and free flowing sections of the river.

The development of a protected instream flow for swimming recreation was to be based on the findings obtained from interviews of swimmers at designated beaches (DES 2006) during the summer. Field interviews were performed at the four designated beaches recognized by the DES on the designated portion of the Lamprey River: Wadleigh Falls Campground, Glenmere Village, Wellington Camping Park and Ferndale Acres Campground. These interviews were performed on July 29 and August 5, 2006. Based on the results of the interviews performed at the campgrounds, two swimming holes were identified as popular swimming locations and were visited on August 5 2006 to interview additional swimmers.

The responses of the individuals interviewed suggested that the decision to swim in the river is based upon its availability (close to where they are staying or are from) warm weather and water temperature as opposed to flow. Although, respondents did indicate too high a flow poses a safety hazard and at too low a flow the water may become too warm and murky for swimming. The areas where swimming is most popular are those sections of the river that are impounded, including the sections where the three campgrounds are located. Due to the backwater conditions on these sections of the river, they are less flow dependent than the free flowing sections of the river to support a sufficient depth of water for swimming and wading. Based on these findings, no specific protected instream flow was proposed for swimming on the designated portion of the Lamprey River.

The qualitative evaluation of both boating and swimming recreation were based on surveys, interviews and field observations which are common methods for assessing flow and recreation (Whittaker and others, 2005).

In response to comments related to protected flows for swimming, boating, public water supply, and aesthetics, DES proposes to apply the Natural Flow Paradigm to protected flows for these IPUOCRs, as explained in a separate guidance document (Application of the Natural Flow Paradigm to Protected Instream Flows – DES publication WD-09-13). Maintenance of a daily hydrograph close to the estimated natural hydrograph will result in the same opportunity for swimming, boating, public water supply use, and experience of aesthetic beauty as would be obtained in the absence of modifications due to human activity.

### **References:**

Department of Environmental Services (DES). 2006. Instream Public Uses, Outstanding Characteristics, and Resources of the Lamprey River and Proposed Protective Flow Measures for Flow Dependent Resources Final Report. NHDES-R-WD-06-49. Prepared by Normandeau Associates, Inc., the University of Massachusetts and the University of New Hampshire. 54 p.

Monkman, J. and M. Monkman. 2002. Discover Southern New Hampshire: AMC Guide to the Best Hiking, Biking and Paddling. AMC, Boston, MA. 288 p.

Whittaker, D., B. Shelby and J. Gangemi. 2005. Flows and Recreation: A Guide to Studies for River Professionals. Hydropower Reform Coalition, Washington, D.C. 44 p.

**Comment LRWA-7:**

The executive summary is not adequate for describing the background as to the reason for this study and does not do a good job of spelling out the results and ramifications of the decisions. Laypersons must be able to understand this summary and it needs to be better written to convey the principles and findings of the study.

**Response:**

Based on the comments received from several parties, the Executive Summary has been edited and revised in an attempt to address these concerns.

**Comment LRWA-8:**

When will a third party review be completed on this draft report?

**Response:**

It was the intention of DES to conduct this review looking at the final Protected Instream Flow reports for both the Lamprey and Souhegan studies. These final reports would incorporate comments and suggestions raised by the Technical Review Committees and by the public. However, to complete the third-party review process earlier, the review will look at the Lamprey Proposed Protected Instream Flow Report instead of the final report. The review will be conducted this year with a completion date of September 30, 2009.

**Comment LRWA-9:**

Who will decide if the minimum flows are being met?

**Response:**

DES will be responsible for tracking and publicizing the flow conditions relative to the protected flows. DES intends to post this information to the DES website on a continuous basis along with the management status for implementing management actions under the Water Management Plans. Affected Water Users and Affected Dam Owners will be expected to track their management status and implement their part of the Water Management Plan when flow conditions published by DES indicate management action. DES expects to audit the response of affected water users and affected dam owners to management conditions..

**Comment LRWA-10:**

Will the person/organization who determines that the minimum flow is not being met have the authority to require the release of water to assure minimum flow?

**Response:**

DES will be monitoring the stream flow relative to the protected flow conditions and the Water Management Plan components are enforceable. In some cases, the flow releases will be coming from DES-operated impoundments. Where there is other ownership, the Department will be auditing compliance. Not complying with the Water Management Plan would result in a violation of Water Quality Standards. Water will be released by the Affected Dam Owners, who have the authority to store and release water for this purpose.

Changes in land owner agreements may be required in order to store water in flood control dams for longer periods of time. Part of the Water Management Plan will be defining or developing these kinds of requirements. There may also be a need to change state law authorizing dam management under the instream flow program. This change would result in language similar to RSA 482:13, which preauthorizes the fall drawdown in lakes removing the requirement for public hearings prior to each fall drawdown.

**Comment LRWA-11:**

Now that there are two USGS gaging stations on the Lamprey, will both stations be used to implement the management plan?

**Response:**

As you have noted in your comment, the Lamprey River currently has two USGS continuous record gages. USGS 01073500 LAMPREY RIVER NEAR NEWMARKET, NH, also known as the Packers Falls gage, is in the Designated River segment, located near the lower end of the river, which measures 183 square miles of watershed. This gage has flow records going back to 1934. Last summer a new gage, USGS 01073319 LAMPREY RIVER AT LANGFORD ROAD, AT RAYMOND, NH, was installed under a cooperative program between DES and USGS. This gage began operating July 1, 2008. This gage is located near the middle of the watershed and measures 55.7 square miles.

The gage at Packers Falls is adequate to define flow conditions for the 12 miles of the Designated River. The lowest protected flow criterion is 16 cfs (measured at the Packers Falls gage). The low flows measured at the two Lamprey gages show a high degree of correlation, in particular for flows between 18 and 350 cfs at the Packers Falls gage (equivalent to flows between 4 and 80 cfs at the gage in Raymond.) Because of the short record as the Raymond gage, no lower comparisons can be made yet. The new Raymond gage will measure a portion of the watershed containing fewer and smaller dams. The new gage may be used as a check on data at the Packers Falls gage, but the Water Management Plan is expected to rely on the Packers Falls gage as the index gage.

DES is aware that the Lamprey River Watershed Association has proposed the installation of a new gage located near Lee Hook Road, which may provide inflow data for the river just upstream of the UNH/Durham water withdrawal. The proposed gage would also provide data downstream of one of Newmarket Public Works' proposed water withdrawal location. To date, a suitable location for a permanent gage has not been identified in this vicinity.

**Comment LRWA-12:**

If there are flaws in the model, does it change what the flow should be? After this comment period, if these are changes to the model and subsequent changes to the cfs, will a change be made to the recommended minimum low flow?

**Response:**

Yes, changes can be made in the protected flows if new information is identified or if an error is found. The process is described in Section Env-Ws 1905.05 Petition for Change of an Established Protected Instream Flow. If there are errors or flaws that are identified after the flows are established, there is a process for having the protected flows changed. The process is described in the rules and hinges on providing information on some data or process that was used incorrectly or was unknown at the time of the Protected Instream Flow Study. Not liking the results is not sufficient for challenging the protected flows.

**Comment LRWA-13:**

The report appears to say that low flows will be tracked but not until the third season will management intervention occur. Why allow these low-flow occurrences to happen given what is already known about the detrimental effects of low flow?

**Response:**

Low flows are naturally occurring events that should continue to occur. Native species are adapted to survive low-flow conditions: some species thrive on low flows. This balance of conditions for all species is important for protecting the ecosystem. The concern is with extended durations or increased frequency of low flows. These circumstances unbalance the ecosystem, allowing some species to thrive overmuch and causing others to decline dangerously.

The protected flows assessment incorporates the Natural Flow Paradigm's acceptance of occasional occurrences of even very low flows to define durations. The protected flows are defined with three flow magnitudes, each with two durations: a persistent duration and a catastrophic duration. Low flows exceeding the persistent durations should be expected to occur every two to three years. The allowable durations for the identified flow magnitudes were defined on this basis. The assessment used three consecutive events below a flow magnitude which occur for longer than the persistent duration to define when management should occur. Similarly, low flows exceeding the catastrophic durations should occur no more than once in ten years. The assessment evaluated durations of catastrophic events to define the catastrophic durations as events that should not happen more often than once in ten years. Two events below a flow magnitude that occur for longer than the catastrophic duration within ten years define a catastrophic condition requiring management. These criteria allow the appropriate low flows to continue to occur, but not overly frequently.

**Comment LRWA-14:**

Will public water supply needs come before the needs of the river and its inhabitants?

**Response:**

No, there is no hierarchy of needs under the Instream Flow Program. All flow-dependent IPUOCRS are to be protected. The balance between competing needs will be maintained by management under the Water Management Plan, which will define how to support public water supply's needs as a valued river resource while maintaining the protected flows for all IPUOCRS under the Natural Flow Paradigm.

The Natural Flow Paradigm is a foundational element of the instream flows. This concept recognizes that instream water needs are supported by maintaining stream flows close to the natural flows. Fish are adapted to these flows and the recreational and hydropower users, and waste treatment facilities operate under their expectations of continuance of these flows. The protected flows support maintenance of the natural flow regime: The Water Management Plan components must implement it.

By maintaining flows as close to the natural regime, all non-consumptive uses are supported. However, consumptive uses will change the flow regime. This requires management to offset the impacts. The larger the consumptive use impact, the more management will be required.

**Comment LRWA-15:**

What are the towns supposed to do about the results of this study? Will it be clear to the towns what their role will be in the maintenance of river flows?

**Response:**

Unless the towns are either an Affected Water User or an Affected Dam Owner, they have no responsibility under the protected flows. Once the flows are established as water quality standards by the commissioner, no permits can be approved that do not comply with the protected flows. All responsibilities for flow maintenance actions are described in the Water Management Plan. As an Affected Water User or an Affected Dam Owner, a town would comply with its portion of the Water Management Plan, which it was involved in developing, and so its role should be clear to the town.

**Comment LRWA-16:**

What will the legal recourses be if the plan is not followed?

**Response:**

DES has statutory authority to enforce Water Quality Standards under RSA 485-A:12. Every Affected Water User and Affected Dam Owner has been notified that the Water Management Plan is enforceable. The Water Management Plans implement the protected flows, which are established by the Commissioner as Water Quality Standards. Anyone not following their Water Management Plan is in violation of Water Quality Standards.

**Comment LRWA-17:**

Unfortunately, the results of the study need to be better communicated. The report is complicated and not easy for laypersons to understand. (In fact, professionals are having trouble deciphering it.) Many, many people could potentially be affected by the flow levels being proposed for protection. If public participation is to be an important part of this process, each section must be summarized in a simplified manner.

**Response:**

The project team acknowledges that the report is lengthy, and technically complex. The length of the report and the technical nature of the discussion in the report reflect the amount of information gathered through the study's investigations and the level of technical analysis required for the assessment of the proposed protected instream flows.

It was not the intent of the project team to make the information presented in the report inherently difficult to comprehend. The project team attempted to provide sufficient detail of the methods used, the results obtained and the conclusions drawn, so that they could be reviewed and commented by the public and other stakeholders engaged in the process.

The purpose of including much of the data in appendices was to present the background information and additional documentation supporting the results outside the main body of the report to preserve its continuity. An executive summary is part of the report to provide a simplified summary. This has been revised in order to make it more readable.