EXHIBIT– 2

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VIA FEDERAL EXPRESS AND E-MAIL
Lisa Jackson, Administrator
Arthur A. Elkins, Jr., Inspector General
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

RE: Great Bay Nutrient Criteria and Permit Development - Documentation of Apparent Scientific Misconduct and Agency Bias; Request for Transfer of Matter to Independent Panel of Experts for Review

Dear Administrator Jackson and Inspector General Elkins:

This correspondence is submitted on behalf of the Great Bay Municipal Coalition, which is comprised of the cities of Dover, Exeter, Newmarket, Portsmouth, and Rochester, NH. In recent months, EPA Region I has issued three draft NPDES permits for Exeter, Newmarket, and Dover that seek to impose a 3 mg/l total nitrogen (TN) effluent limit based on a draft numeric TN water quality criterion of 0.3 mg/l that has never been formally adopted by the state of New Hampshire or approved by EPA. These severe effluent limits and related stormwater reduction requirements are expected to cost the regulated communities in the watershed more than *one billion dollars* in additional capital and operating costs. The affected communities have repeatedly provided Region I with detailed analyses of the relevant Great Bay water quality data and studies conducted by independent researchers that show there are fundamental errors underlying the Region's mandates. The same concerns regarding oversimplified "stressor-response" analyses were highlighted by EPA's Science Advisory Board (SAB) in April 2010 and by an internal EPA Region I assessment in September 2010. Moreover, an independent, federally funded Technical Advisory Committee (TAC) for the Great Bay Estuary had also identified many of the same errors and deficiencies in 2008. Nonetheless, Region I has ignored all of these findings.

It is now apparent that serious regulatory violations, bias, and scientific misconduct underlie the Region's actions. The history regarding this matter is summarized on the attached timeline (Attachment A) and discussed in greater detail below for your consideration. For the reasons detailed herein, in accordance with the *EPA Scientific Integrity Policy* and the *Federal Policy on Research Misconduct*, the Coalition requests that (1) the review of Great Bay water quality criteria compliance and permitting be withdrawn from EPA Region I and transferred to an independent panel of experts who can assess the scientific basis of the Region's position and that (2) the Region's actions leading to this request be investigated by the Office of Inspector General.

Background on Great Bay Estuary Impairment Evaluation

The following provides a brief synopsis of key scientific and regulatory issues affecting Region I's decision to impose "limits of technology" TN regulation mandates on municipal dischargers to Great Bay.

1. Technical Advisory Committee (2005 – 2008) Concludes TN/Transparency is Not the Cause of Eelgrass Declines in the Great Bay Estuary

The New Hampshire Estuaries Project (NHEP) (a federally-funded state project) formed a Technical Advisory Committee (TAC) in September 2005 to address the development of appropriate numeric water quality standards for the Estuary. The TAC members included EPA Region I, New Hampshire Department of Environmental Services (DES), University of New Hampshire (UNH) professors, municipal representatives, the Conservation Law Foundation (CLF), and a number of environmental consultants. Detailed site-specific research was conducted on the factors influencing the ecology of the Estuary and in particular the effect of nutrient concentrations on both the tidal rivers and Great Bay. Over the course of several meetings from 2006 to 2008, the TAC evaluated the results of these detailed studies, reaching the following scientific consensus:

(1) The classic model of eelgrass loss due to TN-induced transparency decrease is inapplicable to Great Bay because transparency reduction was not the cause of the eelgrass losses and there is minimal phytoplankton growth in Bay and Piscataqua River due to physical characteristics of those waters;

(2) Increasing total inorganic nitrogen (TIN) levels since the 1980s did not significantly increase algal blooms;

(3) The main factor controlling transparency in Great Bay [and tidal rivers] is color and turbidity from the tidal rivers (algal levels in the Bay are low and only account for 8% of the light extinction in Bay waters);

(4) Using data from other estuaries (i.e., Chesapeake Bay) to set Great Bay standards is not appropriate due to significant physical differences (eelgrass in Great Bay apparently tolerate higher TN loadings than other estuaries due to short retention times);

(5) It should not be presumed that TN is the cause of eelgrass losses; analyses that combine data from different areas of the Estuary to justify a TN/transparency connection do not prove causation and may be misleading; and

(6) DES should not claim eelgrass impairments exist in the tidal rivers (e.g., Squamscott River) if the area in question is no longer suitable for eelgrass growth [several tidal rivers exhibit naturally low transparency].

See Ex. 1 – TAC Meeting minutes, at Meeting Minutes dated June 10, 2008, and November 17, 2008.

Subsequent to the TAC findings, DES prepared its Methodology and Assessment Results related to Eelgrass and Nitrogen in the Great Bay Estuary for Compliance with Water Quality Standards for the New Hampshire 2008 Section 303(d) List (August 11, 2008). *See* Ex. 2 - Methodology and Assessment Results related to Eelgrass and Nitrogen in the Great Bay Estuary for Compliance with Water Quality Standards for the New Hampshire 2008 Section 303(d) List (August 11, 2008). That document provides a detailed history of eelgrass declines unrelated to nutrient levels occurring in the Estuary. The main factor causing periodic eelgrass losses was noted to be a "wasting disease" that has decimated eelgrass populations around the globe. Consistent with the TAC findings, the Section 303(d) assessment concluded that eelgrass-related impairment listings for nutrients was not justified in Great Bay, Little Bay, the Upper and Lower Piscataqua River, or in Portsmouth Harbor and Little Harbor.

2. Region I Initiative to Develop TN Criteria and Generate TN-induced Eelgrass Impairment Designations (October 2008 – 2010)

In October 2008, subsequent to the TAC findings and DES completion of the 2008 impairment listings, CLF wrote a letter to Region I insisting that more restrictive impairment designations were needed for the Estuary. CLF claimed that TN should be designated the cause of eelgrass loss throughout the Estuary because TN *can* cause loss in *some* situations and, therefore, must be regulated. *See* Ex. 3 – October 6, 2008, CLF letter to EPA Region I. This position was contrary to the TAC technical conclusions and was not based on any new data or revised scientific analysis of the available information. Region I staff favored CLF's position and pressured DES to further change impairment designations and conclusions to reflect this position. *See* Ex. 4 – L. Hamjian, EPA Region I, letter to H. Stewart, NHDES, dated September 30, 2009, at 3. Region I's internal correspondence in November 2008 confirms that the Region knew that no cause and effect relationship between TN and eelgrass loss existed but, despite this knowledge, still pursued the development of stringent TN criteria for Great Bay to "restore" eelgrass populations. *See* Ex. 5 – M. Liebman, EPA Region I, email dated November 21, 2008. Federally-funded studies contemporaneously completed by Dr. Fred Short,[1] a local eelgrass expert, confirmed that eelgrass losses were occurring in areas with both elevated and low TN and transparency levels.[2] Moreover, Great Bay, which had the highest eelgrass populations, had much higher TN levels and lower transparency than Little Bay and the Piscataqua River, where eelgrass failed to recover after the last bout of wasting disease in 1988. Plainly, from these studies, there was no indication that TN or transparency levels were controlling eelgrass recovery anywhere in the Great Bay system.

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[1] Dr. Short is a UNH professor whose supposed research Region I is relying upon to support the need for TN criteria to protect eelgrass in Great Bay.

[2] *See* Beem, N. T., and F. T. Short 2009, Subtidal eelgrass declines in the Great Bay Estuary, New Hampshire and Maine, USA. Estuaries and Coasts, 32: 202-205.

Nonetheless, from November 2008 through June 2009, EPA Region I supported the development of a new TN criteria approach based on transparency impacts (*the precise impact the TAC concluded did not exist*). By June 2009, the state began to implement Region I's recommended approach by developing draft TN numeric criteria for the Great Bay Estuary[3] and revising the impairment assessment for Great Bay using the June 2009 Criteria.[4] The Coalition Members did not find out about the revised impairment designations until after DES in August 2009 submitted a radically revised, final document to Region I, who promptly approved it in September 2009.[5] *See* Ex. 4 – L. Hamjian, EPA Region I, letter to H. Stewart, NHDES, dated September 30, 2009. A review of the impairment listing methodology and the draft criterion indicated that the foregoing represented a 180 degree shift from the TAC findings and the prior publically-released documents. All subsequent attempts by the regulated community to have an independent review of the revised scientific positions have been ignored by the regulatory authorities. Region I subsequently informed DES that it "must" apply the new draft TN criteria wherever eelgrass historically existed. *See* Ex. 6 – S. Perkins, EPA Region I, letter to H. Stewart, NHDES, dated December 9, 2009. By February 2010, Region I had begun internal discussions on the effluent limitation potentially applicable to Great Bay communities. *See* Ex. 7 – S. Silva, EPA Region I, email to C. Deloi, EPA Region I, dated Feb. 11, 2010. Region I acknowledged that a 5 mg/l TN limitation would be acceptable, <u>but</u> the Region would only propose this limitation "with CLF's agreement not to appeal." *Id.* at 1. Absent this agreement, Region I would impose a 3 mg/l TN limitation. *Id.* at 1.

In March 2010, without notice to the public, Region I initiated an internal "peer review" of the 2009 numeric criteria under EPA's N-STEPS program to deflect mounting criticism. *See* Ex. 8 – E. Tupper Kinder letters to EPA Region I dated April 9, 2010, and May 12, 2010 (with attached report). However, repeated Coalition requests to have public involvement in that process and a detailed scientific inquiry were rejected by the Region. The comments submitted by the Coalition to DES were never submitted to the peer reviewers for their consideration. Region I then issued its "peer review" document in June 2010, claiming that the review supported the revised June 2009 Criteria, despite the fact that critical issues raised by the Coalition were never evaluated. At nearly the same time, EPA's Science Advisory Board (SAB) was peer reviewing a draft guidance document on the use of "stressor-response" analysis to derive numeric nutrient criteria for EPA Headquarters. The SAB released its final report in April 2010, and EPA finalized

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[3] *See* Numeric Nutrient Criteria for the Great Bay Estuary, NHDES June 2009 (hereinafter "June 2009 Criteria") (which claimed that the numeric water quality criteria for TN in the Great Bay Estuary should be set at 0.3 mg/l to improve transparency and restore eelgrass populations).

[4] *See* revised 303(d) listing for Great Bay – 2009.

[5] The Region's approval letter noted that the Region had worked closely with DES in developing the eelgrass/transparency-based TN numeric criteria that were used to declare Bay and tidal river areas as eelgrass impaired due to nutrients.

its guidance in November 2010.[6] The SAB report and the EPA guidance document are relevant to this matter because the draft numeric TN criteria presented in the June 2009 Criteria were based on a similar stressor-response analysis. Both the SAB Report and the final Guidance confirm that the use of stressor-response analyses are only scientifically defensible when cause and effect has been demonstrated and significant confounding factors influencing the stressor-response relationship have been accounted for in the analysis. *Id.* at 6. The June 2009 Criteria did not address either of these fundamental considerations, and contemporaneous EPA Region I emails derided the need to make such a demonstration. *See* Ex. 9 – EPA Region I emails regarding cause and effect, dated July-August 2010. Unbeknownst to the Coalition, Region I subsequently conducted a review of the 2009 criteria document in light of the Coalition's technical comments and EPA's SAB Report. *See* Ex. 10 - M. Liebman, EPA Region I, document titled "Review of: Numeric Nutrient Criteria for the Great Bay Estuary, in light of comments made by John C. Hall and Thomas Gallagher (2010)" dated September 1, 2010.[7] This internal analysis confirmed the Coalition's observation that numerous scientific deficiencies underlie the June 2009 Criteria document, including the following:

> **<u>Conceptual models</u>**
>
> "They rely on literature and only sparingly rely on established results from the estuary itself. It would be better to document some of the connections within the estuary itself." [Ex. 10 at 2.]
>
> *Algal blooms*
>
> "The correlations between total nitrogen and 90th percentile chlorophyll *a* levels by assessment unit or by trend monitoring station are strong, but does this discount other factors, such as salinity and wind, or stratification? … Is there supporting information to suggest that the chlorophyll *a* levels observed in the estuary are consistent with a response from the measured or estimated nutrient loading to the estuary?" [Ex. 10 at 2.]
>
> *Macroalgae*
>
> "The conceptual model is that as TN increases, eelgrass is replaced by macroalgae, but the actual mechanism is not sufficiently explained. Are macroalgae better able to utilize nutrients in enriched conditions and thus outcompete eelgrass? Are there any literature or mesocosm experiments in Great Bay that document this? There is literature from Waquoit Bay, but is this area similar enough to Great Bay to explain the process?" [Ex. 10 at 3.]
>
> "Although there does seem to be supporting evidence of this replacement based on one aerial surveys, there is insufficient documentation of the loss of eelgrass and coincident replacement by macroalgae." [Ex. 10 at 3.]

[6] *See* "Using Stressor-response Relationships to Derive Numeric Nutrient Criteria." USEPA, EPA-820-S-10-001, November 2010.

[7] This document was provided to the Coalition by Region I in response to FOIA Request No. 01-FOI-00148-11.

Light extinction

"On page 15, the authors state that eelgrass is sensitive to water clarity without citing the specific experimental evidence in the Great Bay estuary. … For example, do the mesocosm experiments show the effects of increasing nitrogen enrichment on eelgrass in terms of light attenuation, or lengthening of blades, or loss of carbohydrate stores, or epiphytic growth? Are these loadings similar to loadings into Great Bay and are the responses in Great Bay expected based on the mesocosm experiments?" [Ex. 10 at 3.]

Confounding factors

Chlorophyll a

"The authors did not sufficiently evaluate whether salinity is more important than nitrogen in controlling phytoplankton abundance. … Does chlorophyll *a* track salinity as well? … This would provide supporting material to document that the chlorophyll *a* response is controlled primarily by nutrients, rather than habitat changes (i.e. low salinity vs. higher salinity zones)." [Ex. 10 at 3-4.]

Benthic indicators

"The authors state (on page 40) that organic matter comes from primary producers, but they don't evaluate the effect of organic matter from terrestrial sources, especially in the upper parts of the estuary. On page 41, they state that the regressions prove that total organic carbon in sediments is associated with nitrogen and chlorophyll *a* concentrations in the water column, but they don't say that they are caused by them. I suspect that terrestrial sources from nonpoint and sewage treatment effluent are more important than autotrophic sources of organic matter." [Ex. 10 at 4.]

Dissolved oxygen

"The dissolved oxygen section on page 45 presents an incomplete conceptual model, because they do not address other sources of organic matter, including sewage treatment effluent, and terrestrial runoff. … In addition, the relationships could be confounded by salinity stratification, or flushing, rather than nitrogen. The sonde data sources for low dissolved oxygen are all in the tributaries, which are really different than the Great Bay areas, and therefore the low dissolved oxygen could be partly related to poor circulation and salinity wedges and other sources of organic matter (e.g. terrestrial organic matter). Additional information should be presented to discount these other factors." [Ex. 10 at 4.]

Light extinction

"On page 63 and in Figure 34 the authors suggest that the particulate organic matter in the water column expressed as turbidity is caused by nitrogen and that this particulate matter is autochthonous (i.e. derived from phytoplankton). But, there should be supplemental evidence that discounts the possibility that this organic matter is related to the salinity gradient and is from upstream sources of terrestrial runoff." [Ex. 10 at 5.]

Despite the obvious, significant technical deficiencies and failure to provide analyses consistent with the SAB recommendations, Region I continued to claim that the June 2009 Criteria were scientifically defensible.

3. Coalition Members Meet with DES to Review Applicable Scientific Information and Develop a Memorandum of Agreement (2011)

Once the Coalition communities obtained the amended 303(d) listing and learned of Region I's decision to limit the "peer review" of the June 2009 Criteria analysis, they prepared and submitted site-specific data and analyses showing that elevated levels of TN could not possibly have caused eelgrass losses in the Estuary as a result of phytoplankton-induced light extinction and that the water quality criteria of 0.3 mg/l TN was unsupported by any of the site-specific data. In particular, the Coalition documented that there was no information showing that either transparency had significantly *decreased* or algal growth had significantly *increased* in the Estuary from 1990 to 2009. Therefore, it was indefensible to assert TN-induced transparency changes caused the eelgrass losses.

Several meetings were held with DES technical staff to review the information. By April 2011, in response to the presentation of these site-specific data analyses, DES agreed that there remained a significant degree of uncertainty with regard to the draft numeric TN standards and signed a Memorandum of Agreement (MOA) with the Coalition communities designed to investigate and resolve key technical issues. *See* Ex. 11 - MOA. The parties to the MOA agreed that appropriate TN criteria for the Estuary would need to be set for each tidal river on a site-specific basis. Under the MOA, open technical meetings were held with UNH researchers, DES and Region I. Those meetings culminated in a consensus that the impairment mechanism attributed to the loss of eelgrass in the June 2009 Criteria – loss of light transparency due to increased phytoplankton growth – *did not occur and was not the cause of eelgrass changes* in Great Bay. *See* Ex. 12 – MOA Meeting Minutes.

4. EPA Region I Ignores Terms of MOA and Drafts NPDES Permits with Stringent TN Limits (2011)

Throughout 2011 and 2012, the communities repeatedly presented data and analyses to Region I confirming that transparency reductions associated with TN *cannot* be the cause of the eelgrass declines and that TN-induced impacts on transparency (i.e., increased algal growth) are documented to be negligible. *See, e.g.,* Exs. 13, 14, and 15 – Transparency-phytoplankton relationship charts for the Squamscott, Lamprey, and Piscataqua Rivers. The Coalition also reconfirmed that the transparency in the tidal rivers was quite low due to natural factors (color, turbidity, etc.) and, due to these factors, apparently could no longer support eelgrass growth based on the degree of light penetration presumed by DES to be necessary to support such growth. *See id.* Despite the numerous, unrefuted studies confirming there is no "eelgrass-TN-transparency" paradigm controlling eelgrass populations in Great Bay or the tidal rivers, Region I continued to ignore the information submitted by the Coalition communities, without comment, and proceeded to issue three draft NPDES permits (Exeter, Newmarket, and Dover) that established limits-of-technology TN requirements based on the draft TN criteria of 0.3 mg/l from the discredited June 2009 Criteria. In response to comments made on the draft permits, Region I subsequently claimed that its TN-transparency-eelgrass loss position was based on the scientific findings of Dr. Fred Short. *See* EPA Region I Response to FOIA Request No. 01-FOI-00053-12.[8] Because of Region I's reliance on Dr. Short's research claims, the Coalition requested that Dr. Short produce the research he claimed demonstrated that TN levels caused increased algal growth, reduced transparency, and the loss of eelgrass populations throughout the Estuary. *See* Ex. 17 – F. Short email to EPA Region I dated December 22, 2011; Ex. 18 – Correspondence from Coalition to F. Short, dated January 23, 2012, and February 9, 2012. To date, Dr. Short has been unable to produce any such information, and the Region has also failed to produce any such information.

5. Historical Summary

Based on these interactions and documented events it is apparent that Region I has purposefully ignored the valid scientific findings of the TAC and has taken, without support, a position that stringent TN limitations are required to improve transparency and restore eelgrass populations in Great Bay. Furthermore, although critical scientific deficiencies were confirmed by Region I, the Region has undertaken repeated efforts to thwart a comprehensive evaluation of the underlying science and has rendered its decision to impose stringent TN limitations based on administrative fiat, which it has no intention of altering regardless of whatever information is presented.

Basis for Requesting Inspector General Scientific Misconduct and/or Lack of Impartiality Investigation and Transfer of Matter from EPA Region I Due to Documented Bias

EPA's *Scientific Integrity Policy* and the *Federal Policy on Research Misconduct* specify the requirements for appropriate scientific and research conduct and specify the elements that constitute scientific misconduct. As further discussed below, Region I (1) based its regulatory assertions on the manipulation or misuse of data and analyses to support its desired outcome, as opposed to sound science; (2) refused and/or was unable to produce valid documentation to support its position; (3) prevented public involvement in its peer review process; and (4) has consistently demonstrated a lack of impartiality regarding the matter. The Region I's actions plainly violate these policies that are intended to ensure that sound science is used in the regulatory decision-making process. As such, these violations justify withdrawal of the matter from Region I and further investigation.

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[8] As part of the publication of the draft NPDES permits, the Region also issued multipage "fact sheets" to support the application of stringent TN limitations for Coalition members. In order to obtain the underlying basis and support for Region I's various scientific assertions, the Coalition submitted a series of Freedom of Information Act (FOIA) requests to Region I. Upon review, Region I's FOIA responses confirmed that Region I's basis for imposing the new TN restrictions relied heavily on the claims of Dr. Fred Short. *See* Ex. 16 – EPA Region I Phone Logs of Conversations with F. Short, dated November 14, 2011, and November 18, 2011. The Region also made numerous other unsupported claims (i.e., organic nitrogen is rapidly converted to inorganic nitrogen within Great Bay justifying TN control; excessive nitrate levels are harming eelgrass, eelgrass restoration in the tidal rivers is dependent on TN reduction). The FOIA responses further confirmed that Region I did not have any other Great Bay studies or analyses supporting these claims.

1. **EPA Region I's Stance is Based on the Improper Use of Data and Analyses to Support a Desired Outcome and is Not Grounded in Sound Science**

Based on these interactions and documented events, it is apparent that EPA Region I has (1) purposefully ignored the valid scientific findings of the TAC that a "cause and effect" relationship between eelgrass loss, transparency, and TN did not exist, (2) ignored its own analyses identifying numerous significant scientific deficiencies regarding the June 2009 Criteria, and (3) adopted a contrary position that stringent TN limitations are required to improve transparency and thereby restore eelgrass populations in Great Bay. Additionally Region I has intentionally, knowingly, or recklessly adopted the scientific claims of a UNH researcher that it knows are factually unsupported, in order to justify the adoption of stringent TN criteria for the Great Bay Estuary. Individually and collectively, these actions constitute research misconduct. The *Federal Policy on Research Misconduct* states:

> "[r]esearch misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing or reviewing research, or in reporting research results [65 Fed. Reg. 76262 at I], or ordering, advising or suggesting that subordinates engage in research misconduct." 65 Fed. Reg. 76262 at I n.2. "Fabrication is making up data or results and recording or reporting them." 65 Fed. Reg. 76262 at I. "Falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record." 65 Fed. Reg. 76262 at I. The federal policy further states that a finding of research misconduct requires that "[t]here be a significant departure from accepted practice of the relevant research community;" "[t]he misconduct be committed intentionally, or knowingly, or recklessly;" and "[t]he allegation be proven by a preponderance of evidence." 65 Fed. Reg. 76262 at II.

In this case, "[t]he significant departure from accepted practice of the relevant research community" began with the lack of any objective data regarding TN levels causing adverse transparency impacts on eelgrass in the Estuary and developed into the manipulation of real data to produce a false conclusion. Neither Region I, Dr. Short, nor DES can claim ignorance of the lack of scientific justification for the proposed transparency-based TN restrictions, as they were present at the TAC meetings wherein it was expressly concluded that increased TN concentrations *had not caused increased algal growth causing significantly lower transparency levels*. In contradiction to their later research claims, the federal research reviewed by the TAC expressly determined that a significant relationship between TN and transparency did not exist. The TAC minutes confirmed that the changing physical factors unrelated to TN (color, dilution (salinity), and turbidity) actually controlled the transparency existing at those different sites. *See* Ex. 1 – TAC Meeting Minutes, at Meeting Minutes dated December 7, 2007.

When this legitimate research (the conclusions of which were expressly agreed upon in formal State/Federal TAC meetings) produced findings that did not justify an imposition of stringent TN criteria, Region I requested that DES create alternative findings (numeric water quality criteria) specifically to back up their desire for stringent TN regulation and to supplant the properly documented research conclusions reached by the TAC. DES employee Philip Trowbridge (also a TAC member) then created a new "stressor-response" analysis designed to support the falsified claim that TN had induced algal growth increases causing major changes in transparency in both the Bay and tidal rivers.[9] When these new DES analyses (later comprising the June 2009 Criteria) were presented to the TAC in June and November 2008, the TAC advised that the approach did not demonstrate cause and effect and should receive an independent peer review because of the unconventional methods employed. *See id.*, at Meeting Minutes dated June 10, 2008, and November 17, 2008. This independent peer review never occurred. Likewise, Region I internal correspondence demonstrates that it knew these analyses did not represent a "cause and effect" relationship, but nonetheless promoted the methods as scientifically defensible. *See* Ex. 9 – EPA Region I emails regarding cause and effect, dated July-August 2010. As such, the entire TN/transparency analysis used to justify the stringent TN criteria was a gross scientific misrepresentation.

Moreover, the Coalition noted that the simplified "stressor-response" procedures used to develop the draft TN criteria had been specifically rejected by EPA's Science Advisory Board as not scientifically defensible in April 2010.[10] In evaluating the Coalition's comments, Region I itself noted numerous "confounding variables" were not addressed in the development of the June 2009 Criteria. *See* Ex. 10 - M. Liebman, EPA Region I, document titled "Review of: Numeric Nutrient Criteria for the Great Bay Estuary, in light of comments made by John C. Hall and Thomas Gallagher (2010)" dated September 1, 2010. In particular, the Region noted a failure to confirm that salinity or upstream runoff did not control transparency/dissolved oxygen (DO) and a failure to confirm that algal growth actually increased due to higher TN loadings. *Id.* at 3-5. Nonetheless, Region I continued to assert that the June 2009 Criteria may be used to justify the application of stringent TN water quality criteria requiring effluent limits of 3 mg/l TN asserting that the "weight of evidence" justifies such findings.

Finally, all of these issues and fundamental scientific errors were again brought to the Region's attention at the Exeter, NH, NPDES draft permit modification hearing (NPDES Permit No. NH0100871) in June 2011. As demonstrated in the Coalition's reports,[11] which were submitted to Region I and Dr. Short, and the Coalition's response to Region I's request for comments regarding the Exeter draft permit modification, the development of the June 2009 Criteria by DES analysis violated fundamental scientific principles

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[9] This analysis plotted data from dramatically different physical settings (river, bay, ocean) to conclude that TN "caused" the changes in transparency at these different locations, when in fact the data simply showed the inherent principle that TN levels decrease and transparency levels increase from the head of the Estuary to its mouth. *See* Ex. 19 - Relationship between Light Attenuation Coefficient and TN at Trend Stations (NHDES 2009).

[10] In 2010, EPA published guidance on the use of empirical approaches such as stressor response analysis to develop numeric nutrient criteria. (*See* EPA-820-S-10-001.) This guidance was subject to Science Advisory Board review prior to publication. The guidance affirms that stressor response analysis is a valid method *only after a cause-and-effect relationship has been established and confounding factors have been accounted for*. The June 2009 Criteria analysis did not consider either of these critical factors.

[11] Ex. 18 at Attachments to January 23, 2012, Coalition Correspondence to F. Short: HydroQual Reports dated June 14, 2010, and January 10, 2011.

governing water quality impact assessment and was specifically at odds with the TAC-reviewed site-specific information collected for Great Bay. Most notably, the Coalition pointed out that data were combined from dramatically different hydrologic and physical settings to mask the effect of other controlling parameters (e.g., turbidity, dilution (salinity), and color) and to claim that changing TN levels were the sole cause of changing transparency levels. *See id.* The Coalition also provided data plots for the Squamscott River confirming that algal growth was *not* the cause of low transparency in the tidal river. *See* Ex. 13 – Transparency-phytoplankton relationship chart for the Squamscott River. This information was ignored as well, and the Region continued to issue draft permits with identical TN effluent limitations under the claim that the June 2009 Criteria were properly conducted and determined by Region I to be "scientifically defensible."

To bolster its untenable position, Region I later claimed that Dr. Short had completed research for the Estuary that confirmed reduced transparency caused system-wide eelgrass losses. *See* EPA Region I Response to FOIA Request No. 01-FOI-00053-12.[12] That assertion was yet another serious misrepresentation. In fact, the prior TAC meetings that evaluated the proper water quality requirements for Great Bay *expressly concluded that this transparency mechanism for eelgrass loss DID NOT occur in Great Bay*. *See* Ex. 1 – TAC Meeting Minutes, at Meeting Minutes dated December 7, 2007. Federally-funded research completed by Dr. J. Ru Morrison (UNH Professor) had confirmed that transparency in Great Bay was negligibly impacted by algal growth and that color (originating naturally from the tidal rivers) controlled light penetration in those waters.[13] If Dr. Short actually had completed research relevant to that issue, it would have been presented to the TAC, of which he was a member. In reality, Dr. Short's research never looked at whether light transmission in the water column in the Estuary had changed over time due to increased TN and algal growth.

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[12] Region I's FOIA responses confirmed that Region I was relying on the claims of Dr. Fred Short. *See* Ex. 16 – EPA Region I Phone Logs of Conversations with F. Short, dated November 14, 2011, and November 18, 2011. We understand that Dr. Short received extensive federal funding for eelgrass research in Great Bay and the Piscataqua River. Based on this federally-funded research that was supposedly conducted in the Estuary, Dr. Short made a number of very specific scientific claims regarding the factors that caused eelgrass losses in the Bay and tidal rivers. These unsupported claims were used by the Region and DES as the primary basis to link TN to eelgrass loss and to support imposition of a 0.3 mg/l TN water quality standard to improve transparency in the tidal waters of the Bay and to further impose 3 mg/l TN effluent limits to achieve that standard. Specifically, Dr. Short asserted that his research confirmed that increasing TN levels caused increased algal growth, significantly reducing water column transparency causing the demise of eelgrass throughout the system. However, the available records show that he never conducted research that was designed to demonstrate that TN-induced transparency reduction caused the eelgrass losses in Great Bay.

[13] *See* Morrison, J. Ru, et al. *Using Moored Arrays and Hyperspectral Aerial Imaging to Develop Nutrient Criteria for New Hampshire's Estuaries – A Final Report to The New Hampshire Estuaries Project* (September 30, 2008). Available at:
http://ccom.unh.edu/sites/default/files/publications/Morrison_2010_Report_Using_Moored_Arrays_and_Hyperspecral_Areial_Imagery_to_Develop_Nutrient_Criteria_NH_Estuaries.pdf.

Despite repeated requests, no research or studies supporting Dr. Short's claims have been provided to the Coalition. *See* Ex. 18 – Correspondence from Coalition to F. Short, dated January 23, 2012, and February 9, 2012. Region I's continuing efforts to rely on a position it knows, or should know, is unsupported also violates EPA's Research Misconduct guidelines. Based on all of the records and documentation available to the Coalition, it is clear that the technical basis used to create the TN standard was, at best, recklessly prepared or, at worst, intentionally falsified. As the Region was directly involved in promoting these analyses based on research claims regarding Great Bay data it knew were unsupported, Region I has committed science misconduct.

2. Refusal to Allow an Independent Peer Review and Public Involvement in the Process

Region I has undertaken repeated efforts to prevent public input into an objective investigation of the underlying science. These activities confirm that EPA Region I has rendered its biased decision to impose stringent TN limitations based on administrative fiat, which it has no intention of altering regardless of whatever information is presented. Despite the TAC's open evaluation, with the participation of all interested stakeholders, of the detailed studies conducted on Great Bay and its subsequent conclusion that TN should not be designated the cause of eelgrass loss, CLF wrote a letter to Region I in October 2008 claiming that TN should be designated the cause of eelgrass loss in the Bay because TN *can* cause loss in *some* situations and, therefore, must be regulated. *See* Ex. 3 – October 6, 2008, CLF letter to EPA Region I. Following the CLF letter, Region I embarked on a mission to induce DES to change impairment designations and conclusions to reflect that TN was the cause of eelgrass loss. *See* Ex. 5 – M. Liebman, EPA Region I, email dated November 21, 2008. Region I's internal correspondence in November 2008 confirms that that no cause and effect relationship between TN and eelgrass loss existed in Great Bay but, despite this knowledge, Region I still pursued the development of stringent TN criteria for Great Bay. *See id.* Region I's letter approving the radically revised impairment listings for the Estuary acknowledged Region I's major role in developing the new TN criteria and in altering the original DES position that presented to the public. Ex. 4 – L. Hamjian, EPA Region I, letter to H. Stewart, NHDES, dated September 30, 2009.

By June 2009, the state had begun to implement Region I's recommended approach by finalizing the TN criteria and revising the impairment assessments for Great Bay. Region I promoted the state's immediate use of the unadopted numeric criteria, by now calling them a "narrative criteria interpretation."[14] Without further public review, DES submitted the radically revised impairment listings (based on the new, unadopted numeric TN criteria) in August 2009. Region I promptly approved the revised listings and impairment causes in September 2009. Both Region I and DES ignored all attempts by

[14] It should be noted that EPA itself, under the direction of the 11th Circuit Court of Appeals in *Florida Public Interest Group v. EPA*, 386 F.3d 1070 (11th Cir. 2004), developed the controlling analysis of what factors determine when new water quality standards have been developed. The June 2009 Criteria are clearly new water quality standards under this test. New water quality standards can only be adopted through formal rulemaking, which has never been conducted.

the regulated community to have an independent review of the revised scientific positions. *See* Ex. 8 – E. Tupper Kinder letters to EPA Region I dated April 9, 2010, and May 12, 2010 (with attached report). To provide some semblance of reliability and to deflect mounting criticism, the Region set up an extremely limited internal peer review in March 2010 with selected EPA contractors. All Coalition requests to have public involvement in that process and to ensure that appropriate technical questions prepared by the Coalition were addressed through the peer review process were rejected by the Region. The questions posed to the experts selected by Region I were designed to avoid any serious investigation into the lack of demonstrated cause and effect relationships. None of the earlier TAC recommendations or analyses was provided to the peer reviewers. The Coalition members strongly protested the scope of the questions presented and asked for a more public process to occur. *See* Ex. 8 – E. Tupper Kinder letters to EPA Region I dated April 9, 2010, and May 12, 2010 (with attached report). Region I refused to allow the peer review to address the scientific questions raised by the Coalition – in particular whether the analysis framework was consistent with EPA's Science Advisory Board recommendations on use of simplified regressions to establish "stressor-response" nutrient criteria for complex waters. No public input on this "peer review" was allowed.

Consequently, Region I's "independent peer review" document, issued in June 2010, amounted to little more than a contrived approval derived by withholding relevant scientific information and public input from the experts selected by Region I for the review. Subsequent responses to FOIA requests and permit "fact sheets" asserted that this "peer review" justified the Region's conclusion that the new restrictive TN criteria were "scientifically defensible." As noted earlier, all subsequent data and analyses submitted by the Coalition and its experts, confirming the TN-transparency connection did not exist, were ignored by Region I. This occurred even though the Region knew that the Coalition's objections were well-founded. *See* Ex. 10 - M. Liebman, EPA Region I, document titled "Review of: Numeric Nutrient Criteria for the Great Bay Estuary, in light of comments made by John C. Hall and Thomas Gallagher (2010)" dated September 1, 2010. As such, Region I's refusal to allow public participation in the internal "peer review," was plainly an attempt to conceal the Region's internal evaluation identifying critical deficiencies and to prevent an objective scientific assessment. In addition to violating EPA's policies against research misconduct, these actions plainly violate EPA's Scientific Integrity policy that "prohibits all EPA employees, including scientists, managers, and other Agency leadership, from suppressing, altering, or otherwise impeding the timely release of scientific findings or conclusions." EPA Scientific Integrity Policy at IV, Section A, Part 1.

Conclusion and Request for Action

The *Federal Policy on Research Misconduct* states, "[i]n deciding what administrative actions are appropriate, the Agency should consider the seriousness of the misconduct, including, but not limited to, 1) the degree to which the misconduct was knowing, intentional, or reckless; 2) was an isolated event or part of a pattern; and 3) had significant impact on the research record, research subjects, other researchers, entities, or the public welfare." 65 Fed. Reg. 76264 at V. The record is clear that Region I was determined to implement stringent transparency-based TN criteria and designate TN as the cause of eelgrass loss in the Bay. However, no objective scientific information from the Great Bay Estuary supported either action. Moreover, the Region's decision to impose the June 2009 Criteria even after internally identifying major scientific deficiencies with the numeric criteria confirms that the Region has no intention of conducting a competent and impartial scientific assessment for Great Bay. The Region's actions demonstrate that it is biased toward and intent on implementing a predefined regulatory agenda.

This misconduct is not an isolated event, as Region I has intentionally, knowingly, or recklessly committed violations of the *Federal Policy on Research Misconduct* and the *EPA Scientific Integrity Policy* in every step of these proceedings, including the following:

- Ignoring TAC conclusions based on federally-funded Great Bay research which confirmed that TN-induced transparency decreases did not cause the eelgrass losses;

- Promoting stringent transparency-based TN criteria, knowing that algal growth and transparency did not change over time due to TN load increases;

- Purposefully excluding the public from the peer review process and limiting the information provided to the peer reviewers;

- Continuing to support the June 2009 Criteria after internally identifying major scientific deficiencies and significant conflicts with the SAB recommendations on acceptable stressor-response-based criteria;

- Relying on the undocumented claims of a UNH researcher that the Region knew or should have known were unsupported; and

- Continuing to issue stringent NPDES permits, despite available data confirming the basis for these actions is clearly in error.

These actions have great potential to cause harm to the public welfare, as the watershed-wide costs of compliance with the excessive restrictions, if imposed, could easily exceed $1 billion. Consequently, in accordance with applicable policies intended to ensure the integrity of scientific decision making, the Coalition requests EPA Headquarters take the following actions:

1. Due to the severity and quantity of violations, we request that (1) a meeting be arranged with the Administrator's office to discuss the matter and (2) further review of Great Bay Estuary matters be withdrawn from Region I and transferred to an independent panel of experts who can evaluate the scientific information that is the foundation of the Region's position.

2. We further request that Region I's actions be reviewed by the Office of Inspector General.

We look forward to the Agency's swift resolution of this matter and the approval of scientifically defensible approaches to protect the resources of Great Bay.

Sincerely,

John C. Hall

Enclosures

cc: Coalition Members
Curt Spaulding, Administrator of EPA Region I
Thomas Burack, Commissioner of NH DES
Gov. John Lynch
Rep. Frank Guinta
Sen. Jeanne Shaheen
Sen. Kelly Ayotte
Rep. Bob Gibbs
White House Council on Environmental Quality

Attachment A

Timeline for Nitrogen Criteria Development in Great Bay Estuary

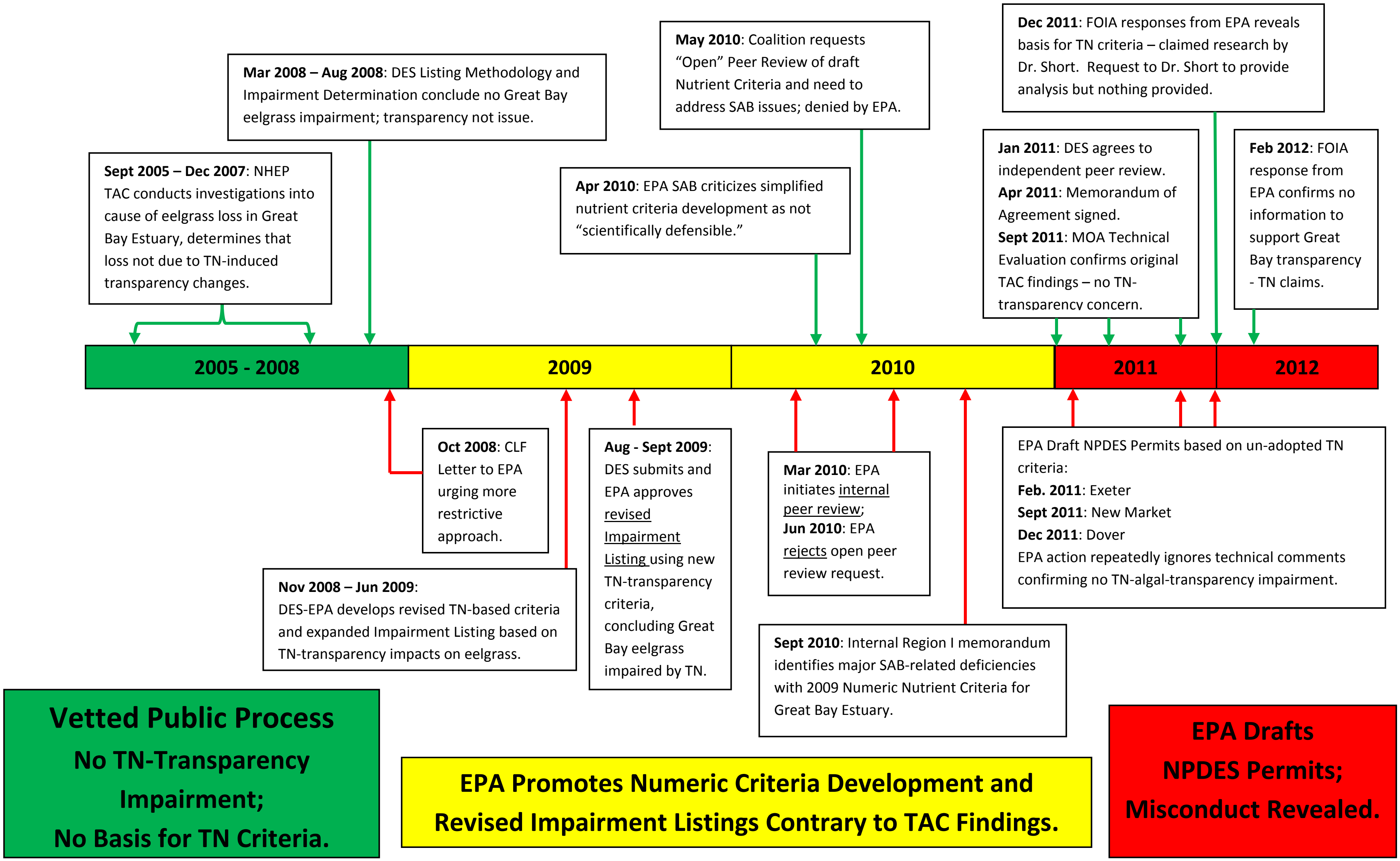

Exhibit 1

Minutes

Technical Advisory Committee

Friday, September 30, 2005 2 PM to 4 PM

NH Department of Environmental Services Coastal Office
50 International Drive
Pease Tradeport
Portsmouth, NH

Meeting Topic: Developing Nutrient Criteria for New Hampshire's Estuaries

Attendees

Phil Trowbridge, NH DES/NHEP
Jean Brochi, EPA
Jim Latimer, EPA
Brian Smith, NHF&G / GBNERR
Don Kretchmer, Normandeau Associates
Pete Ingraham, Forest Society
Jim Reynolds, US FWS
Kelley Thomas, UNH/HCGS
Eyualem Abebe, UNH/HCGS
Tom Irwin, Conservation Law Foundation
Jenn Greene, UNH
Ray Grizzle, UNH
Ann Reid, Great Bay Coast Watch
Rich Langan, UNH
Jay Odell, The Nature Conservancy
Jonathan Pennock, UNH
William McDowell, UNH
Fred Short, UNH
Matthew Liebman, EPA
Jennifer Hunter, NHEP
Art Mathieson, UNH
Steve Jones, UNH

1. Introductions and review of the agenda

Phil Trowbridge opened the meeting at 2:05 pm with the meeting objectives.

2. EPA's perspective and requirements for estuarine nutrient criteria

Matt Liebman of US EPA Region 1 presented the federal mandate for developing nutrient criteria for estuaries and examples of methods that have been used in other New England states. Matt's presentation is available at: http://www.nhep.unh.edu/programs/nutrient.htm

EPA guidance for establishing nutrient criteria for estuaries is available at: http://www.epa.gov/waterscience/criteria/nutrient/guidance/marine/index.html

3. Experiences with nutrient management in Long Island Sound
Paul Stacey of Connecticut Department of Environmental Protection presented information about the nutrient criteria used for Long Island Sound. Paul' presentation is available at :
http://www.nhep.unh.edu/programs/nutrient.htm

More information about the Long Island Sound Study is available at:
http://www.longislandsoundstudy.net/
http://www.epa.gov/region01/eco/lis/epane.html

3. Status and trends of nutrient and eutrophication parameters in Great Bay
Phil Trowbridge of NH DES presented an overview of current NH water quality standards for nutrients, and nutrient status and trends in Great Bay. Phil's presentation is available at:
http://www.nhep.unh.edu/programs/nutrient.htm

4. Brainstorming session.
Following the three introductory presentations, the group brainstormed ideas for developing nutrient criteria for NH's estuaries. The ideas have been grouped according to each discussion topic on the attached sheet, although the discussion did not occur in that order. No decisions were made, and some of the statements are contradictory.

Reference Condition

- We have enough data on nitrogen concentrations in the estuaries so we should at least try EPA's reference condition approach to see what it tells us.
- We may want to use a reference time, instead of a reference condition or location.

Designated Uses

- It does not make much sense to split up the bay into different zones with different designated uses. Setting criteria for the tidal rivers will protect the larger bay.
- The Great Bay should be considered part of a nested set of systems: the coastal watershed, the Great Bay estuary, and the Gulf of Maine.

Indicators

- We need to analyze bioindicators, not just water quality, to determine what condition is acceptable. Ideas for biological indicators are: benthic macroinvertebrates, eelgrass, benthic macroalgae, and oysters. A variety of these bioindicators should be combined into an index of biological integrity.
- Eelgrass is probably the most sensitive biological indicator. We have 20 years of data for Great Bay. These data should be mined.
- Normandeau Associates and NHF&G have old reports with baseline biological information about the Bay. These reports should be mined for changes relative to current conditions.
- The nitrogen concentration of rockweed and eelgrass could be used as an indicator. Art has information on nitrogen content of rockweed. Fred has information on the nitrogen content of eelgrass (the Nutrient Pollution Index).

- Ulva (a macroalgae) is light limited. It needs both high nitrogen and high light to exist. Blooms could be prevented by turbidity.
- Data on macroalgae is only anecdotal. We need a mesoscale remote sensing survey with ground truthing to quantify biomass. Perhaps eelgrass aerial photographs could be used. EPA (Latimer) is able to distinguish between eelgrass and macroalgae from aerial imagery.
- Groundwater loads of nitrogen are a significant datagap. Most of the new development in the watershed uses septic systems. We do not know when the nitrogen loads from these systems will hit the estuary and what they will mean. Studies by Ballestero and Roseen may provide some insight into this issue.
- While biological indicators should be used to determine the acceptable nitrogen loading, we will need a more stable indicator such as nitrogen concentrations or nitrogen loads to determine compliance with the new nutrient criteria.
- Total nitrogen load is a better indicator than total nitrogen concentration. The most current information on point and non-point source loading is in the NHEP Technical Characterization Report (http://www.nhep.unh.edu/resources/pdf/atechnicalcharacterization-nhep-00.pdf). The NHEP will update the loading estimate this fall.

Species Requirements for Water Quality

- EPA completed a study of the effects of low dissolved oxygen on various species for the Virginian Province. DES should review this study to determine if the results can be applied to Great Bay.
- The "right DO" for the water body is inevitably the dissolved oxygen that occurred pre-development. Therefore, if you aim to achieve the perfect DO for the estuary, you will end up requiring a pre-development nitrogen load. A compromise target is needed.

Other

- New limits on nutrient loads from WWTFs that discharge to rivers in the coastal watershed may have an impact on the estuary before estuarine nutrient criteria are set. However, some studies show that reducing phosphorus in WWTF effluent actually hurts estuaries because less nitrogen is taken up by phytoplankton in the rivers. Proposed limits for river discharges should be researched.
- It is best to take an adaptive management strategy. Make the best decision based on the available information at the time and then revisit later.
- The current impairments for DO are in small tributaries with WWTF outfalls. These impairments may not be indicative of general eutrophication, but rather poor infrastructure placement.

5. Adjourn

The meeting was adjourned at 4:10 pm. Phil Trowbridge will do some research on the data sources and issues identified in the meeting and then organize a second meeting. The next meeting will not be held before early 2006 by which time the NHEP Water Quality Indicator Report, which has nutrient status and trend indicators, will have been updated.

Minutes

Technical Advisory Committee

Thursday, June 15, 2006 1 PM to 3 PM

NH Department of Environmental Services
Portsmouth Regional Office
50 International Drive
Pease Tradeport
Portsmouth, NH

Meeting Topic: Developing Nutrient Criteria for New Hampshire's Estuaries

Attendees

Phil Trowbridge, NHEP/DES
Jim Fitch, Woodard & Curran
Jim Latimer, EPA
Robert Roseen, UNH
Jennifer Hunter, NHEP
Diane Gould, EPA
Jeannie Brochi, EPA
Mike Metcalf, Underwood Engineers
Kathleen Legere, UNH
Bill McDowell, UNH
Gregg Comstock, DES
Paul Currier, DES
Fred Short, UNH
Tom Irwin, CLF
Cayce Dalton, Wells NERR
Fred Dillon, FB Environmental

1:00 – 1:05 Introductions and review of the agenda

Phil Trowbridge reviewed the agenda and led a round of introductions.

1:05 – 1:30 NOAA's Assessment of Estuarine Trophic Status (ASSETS) Program

Cayce Dalton, Wells NERR, gave a presentation on the ASSETS program, including the draft results for Great Bay. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 6/15/06 meeting). General information about the ASSETS program is available at: www.eutro.org and http://ian.umces.edu/neea.

Comments on the draft assessment of Great Bay will be accepted until 8/1/06. Send comments to cayce@wellsnerr.org.

1:30 – 2:00 NHEP indicators on nitrogen concentration trends, eelgrass trends, and nitrogen budget for Great Bay

Phil Trowbridge presented the data from NHEP indicators on nitrogen trends, eelgrass trends and nitrogen loads for Great Bay. The presentation is available on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 6/15/06 meeting).

2:00 – 3:00 Discussion of conceptual model

The group discussed the data from the two presentations and the draft conceptual model. The following points were noted:

Targets for numeric criteria

- Because chlorophyll-a and DO are not showing apparent problems but eelgrass is, then eelgrass (water clarity) is the most sensitive target. Another target should be benthic macroalgae (a negative indicator). A DO standard should be protective of other targets: macroinfauna, fish, and shellfish.
- TN and TP concentrations in the water should not have quantitative criteria. Nitrogen loads would be a better indicator.
- Winter DIN concentrations could be used to 'back calculate' nitrogen loads to the Bay over time. DIN concentrations in the winter should be correlated with nitrogen loads because there is no biological activity during that season. However, if loads change seasonally, then winter DIN might not be relevant to load seen by estuary during biologically active seasons. The seasonal pattern of nitrogen loads should be reviewed.

Linkage between eelgrass decline and nitrogen

- The data presented show increasing nitrogen concentrations and decreasing eelgrass but do not show a strong linkage between increasing nitrogen and decreasing water clarity. If eelgrass is going to be a target for nutrient criteria, this linkage needs to be established.
- What is the correlation coefficient between TSS and DIN over the 25 year dataset?
- Look for correlations between TSS and development in the watershed.
- How much of the TSS is inorganic? If the TSS is mostly inorganic, then nutrients cannot be the cause of declining water clarity. Review the percent organic values from the 1991-2001 dataset and the particulate carbon values from 2002-2005.
- Analyze data on TSS, turbidity and PAR from grab samples and sondes to determine if there are correlations.
- What is the TSS load from tributaries and WWTFs?
- How does Great Bay compare to other estuaries in terms of water clarity and POM?
- Review data on the nitrogen pollution indicator for eelgrass. Are there correlations between nitrogen exposure, water clarity and eelgrass vitality?

Next Steps

- Phil Trowbridge will work with Fred Short on an eelgrass-water clarity model.
- Jim Fitch with gather information about the DO standard process in Maine and share it with the group.
- Phil Trowbridge, Jim Latimer and Fred Short will complete the analyses related to water clarity and eelgrass. The biggest issue is clarifying whether nitrogen is responsible for water clarity changes in Great Bay.

3:00 The meeting was adjourned.

Conceptual Model for Developing Nutrient Criteria for New Hampshire's Estuaries

June 15, 2006

Goal

Maintain water quality sufficient for the Aquatic Life Use Support designated use. The definition of the designated use is: "Waters that provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms."

Spatial or Temporal Variability

The water quality criteria will apply to all areas of the estuary at all times.

Indicators

Pressure-State-Response Conceptual Model

Pressure	State	Primary Response	Secondary Response
Nitrogen load Phosphorus load	**TN concentrations** **TP concentrations** (probably an annual average and an index season average)	**Water clarity** **Dissolved oxygen**	Eelgrass Benthic macroalgae Benthic macroinfauna Shellfish Finfish

↔ Water Quality Model

↔ Empirical Relationships or Models

↔ Empirical Relationships or Toxicology

Proposal: Develop or update numeric nutrient criteria for the indicators in **bold**. Numeric limits on nitrogen and phosphorus loads would be developed as part of a TMDL process if the nutrient criteria in the estuary are not met.

Proposed Next Steps

Dissolved Oxygen

- Review EPA criteria for salt water for the Virginian Province for applicability to NH's estuaries. In particular, determine whether the criteria would be protective of benthic infauna, finfish and shellfish in NH's estuaries. The criteria must be protective of the most sensitive species.
- Review the results of Maine's attempt to revise its marine dissolved oxygen standard.
- Determine "naturally occurring" dissolved oxygen in bays and tributaries.
- Develop a recommendation to the Water Quality Standards Advisory Committee for a more appropriate dissolved oxygen standard for tidal waters in New Hampshire.

Water Clarity Indicators

- Conduct a literature review of relationships between light attenuation, turbidity, TSS, chlorophyll-a, and eelgrass.
- Develop empirical relationships between measured light attenuation, turbidity, TSS, chlorophyll-a, and eelgrass in NH's estuaries.
- Determine "naturally occurring" water clarity in bays and tributaries.
- Determine how the effects of benthic macroalgae on eelgrass should be factored into the nutrient criteria to be protective of eelgrass.
- Develop a recommendation to the Water Quality Standards Advisory Committee for appropriate water clarity criteria that adequately protects eelgrass in NH's estuaries.

Total Nitrogen and Total Phosphorus Concentrations

- Conduct a literature review of TN and TP criteria in other states.
- Generate statistics for TN and TP concentrations in areas of NH's estuaries with and without nutrient-related impairments to understand the range of possible criteria values.
- Test for empirical relationships between TN and TP and the dissolved oxygen and water clarity criteria.
- Research water quality models which would predict dissolved oxygen and water clarity based on TN and TP concentrations in the estuary. (This step might be combined with the first bullet of the next section.)
- Develop a recommendation for appropriate TN and TP criteria that result in attainment of the dissolved oxygen and water clarity criteria.

Relationships between TN and TP Loads to TN and TP Concentrations

- Calibrate the analytical model from Dettmann (2001) to predict TN and TP concentrations in the estuary based on measured TN and TP loads. If this approach is not successful, research water quality models which would predict TN and TP in the estuary based on watershed loads.
- Use the SPARROW model to determine the contributors of nitrogen and phosphorus from each watershed.

Minutes

Technical Advisory Committee

Tuesday, February 20, 2007 10:00 AM to 12:00 PM

NH Department of Environmental Services
Portsmouth Regional Office
50 International Drive
Pease Tradeport
Portsmouth, NH

Meeting Topic: Developing Nutrient Criteria for New Hampshire's Estuaries

Attendees

Ed Dettmann, EPA
Phil Trowbridge, NHEP/DES
Jim Fitch, Woodard & Curran
Paul Rodriguez, Woodard & Curran
Eiileen Miller, NHACC
Jennifer Hunter, NHEP
Diane Gould, EPA
Jeannie Brochi, EPA
Paul Currier, DES
Tom Irwin, CLF
Steve Jones, UNH
Rich Langan, UNH
Natalie Landry, DES
Jonathan Pennock, UNH
Ray Koniski, TNC

1. Introductions and review of the agenda

Phil Trowbridge reviewed the agenda and led a round of introductions.

2. Outcome of the attempt to change the marine dissolved oxygen standard for the State of Maine

Jim Fitch recounted his experiences with a task force that recommended changing the marine dissolved oxygen (DO) standard for the State of Maine. The Maine DO standards for marine waters are "as naturally occurs" for SA waters, 85% saturation for SB waters, and 70% saturation for SC waters. The standards apply to instantaneous readings. The application of these standards resulted in many water quality violations in undeveloped estuaries. A task force of MEDEP, NGOs, EPA, MEDMR and WWTF operators was convened to study alternative DO standards. The task force researched the standards being used by other states and EPA research on DO requirements for indigenous organisms (fish, lobster, crustaceans). The task force concluded that 6.5 mg/L would be a more appropriate standard for DO in marine waters. Representing DO in percent saturation units was rejected because of the high error associated with combining measurements of DO, temperature and salinity. The task force presented its proposal to the Maine legislature. The proposal was opposed because it was viewed as a weakening of the standard.

Following Jim's presentation, the group discussed the marine DO standards for New Hampshire. The standards are 5 mg/L (instantaneous) and 75% saturation as a daily average. The group was not in favor of changing the standards but would like a management structure that allows for better interpretation of violations. Datasondes deployed in the estuary collect thousands of DO measurements each year. The occasional violation of the 5 mg/L instantaneous standard should be interpreted in context of all the other measurements.

3. Summary of light availability and light attenuation factors for the Great Bay Estuary

Phil Trowbridge gave a presentation on light availability for eelgrass in Great Bay. In summary, the data analysis showed that measured light attenuation factors accurately predicted where eelgrass was present and absent. However, there were no valid relationships between the light attenuation factors and water quality parameters, such as chlorophyll-a and suspended solids. Approximately half of the variability in the light attenuation factors was explained by changes in salinity, which is inversely proportional to colored dissolved organic matter. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 2/20/07 meeting).

The group made the following comments during the presentation:

- Add instrumentation to the Great Bay buoy to measure light attenuation along with turbidity, chlorophyll-a and CDOM. Use the large dataset to refine the regression relationships.
- Redo analysis of turbidity vs wind speed and precipitation. Resuspension of particle depends on wind speed, wind direction and tide stage.
- Compile the coefficients of the light attenuation factor for TSS, chlorophyll-a and CDOM from other systems. Use these relationships to predict light attenuation in Great Bay based on measured water quality.
- Need to look into surface area of particles as opposed to their weight (as measured by TSS). Organic flock might cause a lot of shading but only account for a fraction of the TSS. Check on relationships between TSS and turbidity as measured by the sondes and grab samples.
- Redo limiting nutrient analysis to only look at times when either nitrogen or phosphorus is completely used up. Neither nutrient is limiting when both are still present.
- Try to find older silica data. Silica limitation only affects diatoms. Research whether the phytoplankton species in Great Bay has changed over time.
- Check nitrogen species in the WWTF outfall for Rochester. Compare the total effluent flow from Rochester WWTF to the plants that discharge on the Salmon Falls River. Do these WWTFs nitrify? Check the data from Cocheco River for outliers in nitrate concentrations.
- Measure light attenuation on filtered and whole water samples from the estuary to determine the relative effects of dissolved vs. particulate components.
- Measure CDOM in grab samples from the estuary.
- The justification for using eelgrass as a water quality target needs to be strengthened. Review the 2005 eelgrass coverage when it is available. Compare current distribution of eelgrass to the historic distribution from the Great Bay Estuary Restoration Compendium. Compare the water quality and water clarity in Great Bay to other systems with eelgrass loss.

4. Analytic mass balance model for nitrogen concentrations in Great Bay

Ed Dettmann gave a presentation on a mass balance model that predicts total nitrogen concentrations in estuaries based on nitrogen loads and hydrodynamics. In summary, the model was able to predict the total nitrogen concentration in Great Bay within 8% of the measured value. Approximately half of the nitrogen entering the Great Bay comes from the Gulf of Maine.

Therefore, a 25% change in land based nitrogen loads will only result in a 12% change in nitrogen concentrations in the estuary. The model has been successfully applied to Narragansett Bay and Boston Harbor. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 2/20/07 meeting).

The group suggested that the model should be applied to smaller segments of the estuary (e.g., Great Bay, Lamprey River) and during specific seasons of the year. The freshwater replacement value is important to the model so more time should be spent verifying that that the value used is accurate.

5. Proposal for classifying Great Bay as a "Tier I" water

Paul Currier gave a presentation on using the antidegradation part of the water quality standards to manage nutrients in the Great Bay watershed. In summary, waters in which at least 90% of the assimilative capacity for a parameter has been used up are considered Tier 1 waters. DES can require no additional loading of the parameter to Tier I waters. A weight of evidence approach can be used to classify a waterbody as Tier I. Therefore, if the TAC determines that at least 90% of the Great Bay's assimilative capacity for nitrogen has been used up, then the water quality standards would give DES the authority to not allow additional nitrogen loads to the bay. The requirement would apply to both point sources and non-point sources. Rulemaking would not be needed to classify a water body as Tier I. Alternatively, the Bay could be classified as Tier II in which additional loads would only be permitted after a formal hearing to determine the social and economic costs and benefits. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 2/20/07 meeting).

The group discussed the proposal. There were concerns about allowing water quality to decrease to within 10% of the standard before taking action. There were also concerns about choosing the correct parameter and accurately determining the assimilative capacity for the bay. Finally, the group discussed enforcement and how the burden of not increasing nitrogen loads would be shared between point sources and non-point sources.

6. Plan next steps

Submit abstracts of nutrient criteria research to the ERF 2007 conference.
Follow up on action items in minutes.
Develop framework for Tier I or Tier II classification of Great Bay.

7. Adjourn

The meeting was adjourned at 12:30 pm.

Minutes

Technical Advisory Committee

Friday, December 7, 2007 9:30 AM to 12:30 PM

Newington Town Hall
205 Nimble Hill Road
Newington, NH 03801

Meeting Topic: Developing Nutrient Criteria for New Hampshire's Estuaries

Attendees

Phil Trowbridge, NHEP/DES
Jennifer Hunter, NHEP
Ed Dettmann, EPA
Jeannie Brochi, EPA
Jim Latimer, EPA
Phil Colarusso, EPA
Matt Liebman, EPA
Paul Currier, DES
Ted Diers, DES
Kevin Lucey, DES
Kathy Mills, GBNERR
Eileen Miller, NHACC
Tom Irwin, CLF
Ray Konisky, TNC
Steve Jones, UNH
Rich Langan, UNH
Jonathan Pennock, UNH
Fred Short, UNH
Bill McDowell, UNH
Art Mathieson, UNH
Valerie Giguere, Underwood Eng.
Peter Rice, City of Portsmouth
David Cedarholm, Town of Durham

1. Introductions and review of the agenda
Phil Trowbridge reviewed the agenda and led a round of introductions.

2. Preliminary results from light attenuation sensors on the Great Bay buoy and hyper-spectral imagery of Great Bay
Ru Morrison gave a presentation on the relationship between light attenuation and water quality measured by the Great Bay buoy in 2007. In summary, the data analysis showed that light attenuation is largely controlled by turbidity and CDOM. Chlorophyll-a only accounts for 8% of the overall light attenuation. Turbidity in the estuary can be predicted from stream flow and wind speed. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

The group made the following comments during the presentation:

- The light availability for eelgrass survival may be 22% but more light is needed for plants to "thrive" (34%) and to protect all stages of the life cycle (>50%).
- Turbidity measured by the buoy is best described as "non algal particles". Phytoplankton measured via the chlorophyll-a sensor are subtracted from the turbidity results. Zooplankton typically do not have an optical shading effect.

- While the results do not show a relationship between chlorophyll-a and light attenuation, it cannot be concluded that nitrogen does not have an effect on eelgrass. Rather, this study showed that the classic model of eelgrass shading by phytoplankton blooms does not describe the Great Bay Estuary. Other factors, such as proliferation of nuisance macroalgae and epiphytic shading, could still relate nitrogen loads to eelgrass loss. Some members also cited direct toxicity of ambient nitrate concentrations to eelgrass.
- The relationship between Kd, chlorophyll-a, turbidity, and CDOM in the middle of Great Bay could be used in another location in the estuary if the particle distributions were the same. However, the relationship should not be applied to other estuaries.

3. Nitrate concentration trends in the Lamprey River watershed
Bill McDowell gave a presentation on nitrogen geochemistry in the Lamprey River watershed. In summary, the data analysis showed that nitrate concentrations at the Packers Falls dam have a statistically significant, increasing trend between 2000 and 2007. The nitrate export from watersheds is best explained by human activity (e.g. population density, developed lands). However, the largest source of nitrogen to the watershed is regional atmospheric deposition. Ninety-four percent of the dissolved inorganic nitrogen that enters the watershed is retained or released to the atmosphere via denitrification. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

The group made the following comments during the presentation:

- Atmospheric deposition of nitrogen is not changing in the region. Therefore, human influence in the watershed is somehow increasing the delivery of nitrogen from the watershed. Increasing impervious surfaces speed up delivery of stormwater to river systems.
- The total nitrogen flux out of the watershed in 2006 was 3.25 kg/ha/year. This value is similar to the total nitrogen flux from the Great Bay watershed in 2002-2004 (3.9 kg/ha/yr).
- Mass balance is based on dissolved inorganic nitrogen. It would be interesting to compile a total nitrogen mass balance.

4. Antidegradation policies which could be used to limit nitrogen loading
Paul Currier gave a presentation on the antidegradation provisions of the Clean Water Act. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

5. (1) Nitrogen loading rates for Great Bay compared to other estuaries; (2) Estuarine nutrient criteria in other states, and (3) Deadline for establishing nutrient criteria for NH's estuaries
Phil Trowbridge gave a presentation on various topics. The nitrogen loading rates for the Great Bay Estuary are higher than would be expected for the amount of eelgrass still present. Four reference estuaries in the Gulf of Maine were identified based on EPA classifications and the Level III Ecoregions. Nitrogen yields from the watersheds draining to these estuaries decreased from south to north. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

The group made the following comments during the presentation:

- Comparisons of nitrogen yield from estuarine drainage areas are not appropriate because they do not normalize for the hydrology of the estuary.
- Reference estuaries in the Gulf of Maine are too different from Great Bay to be useful.
- Estuaries with colder temperatures are less susceptible to eutrophication, so comparisons to estuaries north of Great Bay would not be protective.

6. Develop group consensus on how to proceed in order to meet the deadline
The group discussed the best way to develop nutrient criteria by December 2008. Five options were considered. The pros and cons for each option were summarized in a handout (attached).

- Option 1: Develop a long-term trend of nitrogen and sediment loads to the estuary and compare to historic eelgrass distribution
- Option 2: Develop different nutrient criteria for different segments of the estuary
- Option 3: Designate the Great Bay Estuary as a Tier I waterbody for nitrogen and sediment
- Option 4: Reference concentration approach within Great Bay
- Option 5: Reference approach for other estuaries in the ecoregion

The group discussed the various options. There was not consensus on the way forward or even on using eelgrass as the indicator for nutrient criteria. In general, the group did not feel that options 3 and 5 would be effective. Research should continue on Options 1, 2, and 4. Major points from the discussion are summarized below.

- Are nitrogen loads now much higher than in the 1950s when raw sewage was dumped into the bay? Need to do Option 1 to figure this out. Get historical modeling methods from the Long Island Sound Study.
- Focus on subtidal eelgrass beds to determine the effect of water clarity/water quality changes on eelgrass. If subtidal eelgrass is being lost due to decreased clarity, determine whether nitrogen is the cause of the decline. Use deep edge research at subtidal beds.
- Investigate relationships between DOC delivery from watersheds and CDOM in the estuary.
- Do not spend time researching other estuaries for Option 5. The reference estuaries are too different from Great Bay to be useful. Use the available time and resources to study the Great Bay Estuary.
- Is there a way to combine the cumulative effects of multiple stressors on eelgrass: hydrology, nutrients, CDOM, sediments, sea level rise?
- The imagery for the 1981 eelgrass maps should be reviewed to determine the quality of the 1981 eelgrass distribution maps.
- Comparison of nitrogen yield between watersheds ignores differences in estuarine flushing. This approach will not be productive.
- The Great Bay-Little Bay part of the estuary is very different from the Piscataqua River-Portsmouth Harbor part of the estuary. The former is dominated by intertidal areas. The latter mostly has subtidal habitats. These two parts of the estuary should be studied separately. Different nutrient criteria (especially for water clarity) may be needed for each section.
- Research the direct effects of nitrogen on eelgrass. Journal articles are available from Burkholder (1992, 1994), van Katwijk et al. (1997, Mar. Ecol. Prog. Ser., Vol.157: 159-173), and Touchette (2002, Botanica Marina, Vol. 45: 23-34).

Phil Trowbridge requested that people send additional ideas for analysis or process to him after the meeting.

7. Proposal for updating the environmental indicator reports in 2008-2009 with limited staff time
This agenda item was not discussed due to time constraints. The NHEP will distribute a proposal to the TAC via email to get feedback on this topic.

8. Adjourn
The meeting was adjourned at 12:30 pm.

Minutes

Technical Advisory Committee

June 10, 2008 1:00 – 3:00 pm
Urban Forestry Center, Portsmouth, NH

Attendees

Philip Trowbridge, NHDES/NHEP
Gregg Comstock, NHDES
Phil Colarusso, EPA
Jim Latimer, EPA
Jonathan Pennock, UNH
Ted Diers, NHCP
Jean Brochi, EPA
Paul Currier, NHDES
Steve Jones, UNH
Ed Dettmann, EPA
Elisabeth Pulvermann, CLF
Jennifer Hunter, NHEP
Derek Sowers, NHEP
Richard Langan, UNH
David Hughes, Woodard and Curran
Tom Irwin, CLF
Ru Morrison, UNH
Fred Short, UNH
Peter Rice, City of Portsmouth
Steve Clifton, Underwood Engineers

1. Introductions and review of the agenda

Steve Jones opened the meeting at 1:05 with a round of introductions and a review of the agenda.

2. Discuss and approve proposed changes to NHEP indicators

Phil Trowbridge presented proposed changes to the NHEP Monitoring Plan. The Monitoring Plan needs to be revised by June 30, 2008. Indicators that require significant staff time but are not being used for management decision-making will be deleted. Methodologies for some indicators will be changed to reflect actual practices from the 2006 State of the Estuaries report cycle. A few indicators and supporting variables will be added.

The proposed changes were distributed to the group before the meeting (see handout on "Proposed Changes to the NHEP Monitoring Plan Indicators"). Phil discussed each of the changes with the group. Fred Short commented that HAB12 (Eelgrass biomass) should be an indicator, not a supporting variable. A decision on that indicator was tabled pending discussion of eelgrass indicators later in the meeting. Fred Short suggested keeping HAB7 (Abundance of juvenile finfish) if the data processing could be made more efficient. Phil agreed to contact NHF&G to see if easier data formats were available for this dataset. All of the other changes were accepted.

3. Modeling historic nitrogen loads from the Great Bay watershed
Jim Latimer made a presentation on the work he is doing to model the nitrogen loads to Great Bay from the watershed during different time periods. The presentation is attached. The modeling will be completed by December 31, 2008.

4. Relationships between total nitrogen and water clarity in the Great Bay Estuary
Phil Trowbridge made a presentation on the relationships between light attenuation and water quality parameters using aggregate statistics for different segments of the estuary. The presentation is attached. General comments on the presentation were that causation needs to proven better and that lumping data from all seasons and tides may mask cause and effect.

5. Review and comment on proposed methodology for assessing eelgrass habitat for the State of NH Surface Water Quality Assessments
Phil Trowbridge presented a draft methodology for assessing eelgrass data to determine water quality impairments. A methodology for determining nitrogen impairments using the narrative standard was also presented. The presentation is attached. A document describing the methodologies was circulated before the meeting.

Phil solicited feedback from the group on the assessment methodology. The comments from the group are summarized below. Comments that were repeated by several people are only listed once.

Eelgrass Cover Indicator
- The historic maps of eelgrass cover in the estuary may not be accurate. Therefore, the percent loss calculations relative to historic distributions are uncertain. In some of the tidal tributaries, there has not been any eelgrass mapped in recent years. The whole assessment is based on the presumed presence of eelgrass in these tributaries based on historic maps that were made using unknown methods.
- It may not be appropriate to compare historic eelgrass data with current data since different methods were used for the mapping.
- Using >40% loss from historic distributions is too conservative. This threshold is used by MADEP for eelgrass beds on the order of tens of acres, not something the size of Great Bay. Consider using a lower threshold (e.g., 15-25%).

Eelgrass Biomass Indicator
- Eelgrass biomass is a better indicator of eelgrass ecological services than eelgrass cover.
- Eelgrass biomass reflects changes in the habitat that would be missed by eelgrass cover. For example, the expansion of eelgrass cover in 2005 was due to expansion of new shoots, which have low biomass.
- The error in the biomass indicator estimates should be quantified and the method should be published.

Data Used for Assessments
- Data from 2006 indicate a decline of eelgrass cover and biomass relative to 2005; however the 2006 data were not available for this analysis. NHDES is using data available as of October 2007.

Causes of Eelgrass Loss

- Eelgrass loss due to physical impacts (dredging, moorings, floods, or storms) should be identified to determine if they are the cause of the eelgrass loss.
- Eelgrass loss due to permitted dredge and fill actions should be quantified for each of the segments of the estuary.
- How will a one-year extreme event be treated in this methodology (i.e., catastrophic flood or wasting disease infestation)?
- The causes of eelgrass loss in segments of the estuary are not clearly demonstrated.
- Do not assume nitrogen to be the cause of eelgrass decline if no other causes are evident.

Nitrogen Impairment Determinations

- It is a high standard to require dissolved oxygen, chlorophyll-a, and eelgrass impairments before considering an assessment unit to be impaired for nitrogen. It would be more reasonable to consider an assessment unit to be impaired for nitrogen if there is a chlorophyll-a impairment and some other impairment related to nutrients.
- The methodology for assessing nitrogen impairments needs to be expanded to deal with situations where eelgrass was never present.
- Dissolved oxygen and chlorophyll-a impairments would not be expected from excessive nutrients in Great Bay. The response in Great Bay would likely be macroalgae growth.
- The chlorophyll-a impairment in the Salmon Falls River may be due to phytoplankton blooms in the freshwater reservoirs which are carried into the estuary.
- Macroalgae should be further considered in this analysis.
- Need to also address phytoplankton issues as a possible response.

Other

- What is the management implication for an area that is impaired for eelgrass but not nitrogen? Would mooring fields and docks be restricted in these areas or managed differently?
- Why are other states in New England not using eelgrass for 305(b) assessments? Do they lack data or do they feel that it is not appropriate?
- The Great Bay Estuarine Restoration Compendium lists the Squamscott River as unsuitable for eelgrass restoration. Need to make sure eelgrass can be restored in places that are listed as impaired for eelgrass.
- It is critical to continue to develop numeric criteria for nitrogen for the estuary. The eelgrass assessment process should not replace the numeric nutrient criteria process.
- The proposed approach is very defensible to communities which will have to allocate significant resources to nitrogen reduction.

Editorial Changes

- The summary table should make it clear that no data were collected between 1982 and 1985.
- The text of the document should be less “CLF centric”. The text should just present the methodology.
- The text should clarify what happens if the two methods for assessing eelgrass disagree (e.g., historic loss, current trends).

The feedback will be used to edit the assessment methodology before it is sent out to a regional audience for peer-review.

6. Adjourn
The meeting was adjourned at 3:30 pm.

NewHampshire EstuariesProject

Minutes

Technical Advisory Committee

November 17, 2008 1:00 – 3:00 pm
DES Pease Office, Portsmouth, NH

Attendees

Philip Trowbridge, NHEP/DES
Bill McDowell, UNH
Phil Colarusso, EPA
Ted Diers, NHCP
Jean Brochi, EPA
Paul Currier, NHDES
Steve Jones, UNH
Ed Dettmann, EPA
Jennifer Hunter, NHEP
Tom Irwin, CLF
Ru Morrison, UNH
Fred Short, UNH
Peter Rice, City of Portsmouth
Steve Clifton, Underwood Engineers
Bill Brown, Wright-Pierce
Linda Kalnejais, UNH
Peter Atherton, Wright-Pierce
Matt Liebman, EPA
Jim Fitch, Woodard and Curran
Tom Ballestero, UNH
Chris Nash, DES
Mike Kappler, General Court
Peter Goodwin, Weston & Sampson
Ken Edwardson, DES
Mark Allenwood, Brown & Caldwell
Dean Peschel, City of Dover
Shachak Pe'eri, UNH

1. Introductions and review of the agenda

Steve Jones opened the meeting at 1:00 with a round of introductions and a review of the agenda.

2. Analysis of hyperspectral imagery for light attenuation

Ru Morrison presented the results from research using hyperspectral imagery to map light attenuation in the Great Bay Estuary (see presentation slides).

3. Analysis of hyperspectral imagery for macroalgae and eelgrass mapping

Shachak Pe'eri presented the results from research using hyperspectral imagery to map macroalgae and eelgrass in the Great Bay Estuary (see presentation slides).

4. Proposed nutrient criteria for NH's estuaries

Phil Trowbridge presented propose numeric criteria for nitrogen and other eutrophication parameters for the Great Bay Estuary (see presentation slides and draft document). The comments received at the meeting and via email shortly after the meeting are listed below:

Aggregate Statistics of Water Quality in Assessment Zones

- Using aggregate statistics by zone can mask spatial heterogeneity in each zone. For example, the TN data from the lower Piscataqua zone may be diluted by measurements near Portsmouth Harbor.
- One measure of central tendency should be used throughout. The combination of means and medians for different parameters is confusing.
- Discuss whether removing non-detects will bias statistics high. What percent of results are below method detection levels?

Nutrient Concentrations

- TN includes non-reactive particulate nitrogen. Is TN the best variable for regressions?
- The N:P ratios actually suggest that N and P co-limit in the saline portions of the estuary. Include other information to demonstrate why N is the limiting nutrient.

Relationship between Chlorophyll-a and Nitrogen

- Living phytoplankton contain nitrogen. Demonstrate that the particulate nitrogen in phytoplankton is negligible compared to total nitrogen.
- The text should explain the derivation of the existing threshold for chlorophyll-a from the CALM (20 ug/L for annual 90^{th} percentile). Explain why DES uses a different threshold for chlorophyll-a in fresh waters (15 ug/L).
- The text should explain how 90^{th} percentile concentrations for chlorophyll-a in the summer were converted to annual concentrations. Is it appropriate to use the conversion factor for the Squamscott River for all locations?

Relationship between Total Organic Carbon and Nitrogen

- Include a figure of TN vs salinity to show how these parameters are inversely related.
- Most of the organic carbon is respired in the water column. The accumulation of organic carbon in sediments represents “net” production.

Relationship between Dissolved Oxygen and Nitrogen

- The nitrogen threshold for the maintenance of DO should be lower than 0.50 mg N/L. At the Lamprey River datasonde, where violations of the DO standard have been observed, the median TN concentration was 0.45 mg N/L. This concentration is close to the point where macroalgae proliferation is apparently a problem (0.42 mg N/L).
- The nitrogen threshold for the maintenance of DO was based on a weight of evidence while other thresholds were set using regression equations. Inconsistent.
- Include information on the depth of dataloggers.
- Include information on the range of DO values at each station.
- Was sediment oxygen demand considered?

Relationship between Water Clarity and Nitrogen

- On Figure 15, use the eelgrass coverage mapped by Fred Short in1996 and 2007 to keep methods consistent. The macroalgae coverage in this figure should be updated with the latest information.

- More details about the analysis and ground-truthing of the hyperspectral imagery should be included.
- Define the tidal condition (tide height) on dates of hyperspectral imagery.
- 22% is the minimum level for eelgrass survival – not the level at which eelgrass can reproduce.
- It is not clear why eelgrass is being mapped in the intertidal zone based on NOAA charts. Doesn't this contradict Zmin assumptions?
- There are other factors that affect eelgrass besides nitrogen. Are we confident that eelgrass will be restored if nitrogen concentrations are reduced to the thresholds.
- The relationship between nitrogen and turbidity is a correlation. Causation has not been proven. Nitrogen is a component of organic matter which is responsible for most turbidity. Therefore, it is expected that nitrogen would be correlated with turbidity.

Editorial
- Change title to be "Nutrient Criteria for the Great Bay Estuary". The analysis did not cover other estuaries in NH.
- Add a section at the beginning that more clearly explains the approach taken.
- Include more information on the importance of macroalgae in affecting aquatic life.
- Edit page 8, 1st paragraph, last sentence.
- Explain the level of quality control that the water quality data have undergone.
- Put criteria in terms of Clean Water Act water quality standards: magnitude, duration, and frequency. Frequency is missing.
- Clarify that additional research on Zmax means measurements of actual deep edge depths.

Peer Review
- Linear regressions should be peer-reviewed.
- Has the hyperspectral imagery analysis been peer reviewed?

Regulatory Implications
- Add a section on implications.
- Compare current concentrations to the proposed levels for different sections of the estuary to illustrate implications.
- Will a TMDL be completed to determine the relative contributions of PS and NPS and set allocations?
- Has Maine offered concurrence on this proposal? Will WWTFs in Maine face limits for nitrogen?
- The costs for nitrogen removal should be estimated.
- Will a factor of safety be added?
- The criteria should have a margin of safety to account for exacerbated effects from climate change.
- Criteria should be set for phosphorus in the estuary.

Other Datasets and Information to Include

- Were data from the Lamprey River watershed (WQAL and VRAP) used?
- Consider other models of eutrophication besides the one from NOAA.
- Hyperspectral imagery should be collected again in a few years to confirm the 2007 results and show trends.

5. Adjourn

The meeting was adjourned at 3:30 pm.

Exhibit 2

WD Doc R-WD-08-18

Methodology and Assessment Results related to Eelgrass and Nitrogen in the Great Bay Estuary for Compliance with Water Quality Standards for the New Hampshire 2008 Section 303(d) List

STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
29 HAZEN DRIVE
CONCORD, NEW HAMPSHIRE 03301

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COMMISSIONER

HARRY T. STEWART, P.E.
DIRECTOR
WATER DIVISION

PREPARED BY
PHILIP TROWBRIDGE, P.E.
WATERSHED MANAGEMENT BUREAU

August 11, 2008

NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

Executive Summary

The New Hampshire Department of Environmental Services (DES) developed an assessment methodology for determining compliance with water quality standards for biological integrity (Env-Ws 1703.19) using eelgrass (*Zostera marina*) cover in the Great Bay Estuary as an indicator. DES reviewed eelgrass cover data from 1948 to 2005. Eight regions of the estuary were found to have significant eelgrass loss based upon the degree of historic loss or recent declining trends accounting for natural variability. One region, Great Bay, was found to be threatened for significant eelgrass loss. Impairments for biological integrity (Env-Ws 1703.19) will be added to the State of New Hampshire 2008 Section 303(d) List for these regions. For four tributaries, DES determined that there should also be impairments for nitrogen per the narrative standard, Env-Ws 1703.14. In these four assessment units, there were impairments for chlorophyll-a, which is a primary symptom of excessive nitrogen in estuarine waters. The assessment methodology and results were peer-reviewed by national and regional experts in this field.

Introduction

On March 24, 2008, the Department of Environmental Services (DES) received comments from the Conservation Law Foundation (CLF) on the State of New Hampshire's Draft 2008 Section 303(d) List. CLF's comments included the following:

(a) Significant eelgrass declines in the Piscataqua River and Little Bay demonstrate that these waters are impaired (or threatened).

(b) Eelgrass declines within Great Bay, particularly in light of system-wide eelgrass declines and nitrogen loading trends, demonstrate that Great Bay is an impaired (or threatened) water body.

(c) Eelgrass declines within the Squamscott, Lamprey, and Oyster Rivers, particularly in light of system-wide eelgrass declines and nitrogen loading trends, demonstrate that these waters are impaired (or threatened).

CLF contends that the loss of eelgrass constitutes a violation of Env-Ws 1703.19 (Biological and Aquatic Community Integrity) and that the major cause of impairment should be identified as excessive nitrogen loading and that, as such, these assessment units should also be listed as impaired for Env-Ws 1703.14 (narrative nutrient criteria). CLF further requests that because of potential light attenuation impacts, DES should also consider identifying suspended solids as an additional potential cause.

CLF provided a number of sources of data on eelgrass and estuarine water quality to support their comments. The primary data source was the State of the Estuaries Report (NHEP, 2006) from the New Hampshire Estuaries Project (NHEP). CLF also cited reports from Dr. Fred Short from the University of New Hampshire (UNH).

The eelgrass data were not included in the Draft Section 303(d) List because DES had not established a methodology with numeric thresholds for determining attainment of the aquatic life use based on changes in eelgrass habitat. In response to the comments from CLF, DES has researched this question, focusing on four main points.

- The regulatory authority under New Hampshire law by which DES can consider eelgrass habitat loss to be a water quality standard violation.
- Precedents by other states for placing estuaries on 303(d) lists based on eelgrass loss.
- An assessment methodology for eelgrass habitat data that is based on sound scientific principles and is transferable to other biological data.
- A methodology for using the narrative nutrient standard (Env-Ws 1703.14) to determine nitrogen impairments in tidal waters.

Regulatory Authority

Regulatory authority to consider eelgrass habitat loss to be a water quality violation would be governed by the narrative water quality standard for biological and aquatic community integrity, Env-Ws 1703.19. This regulation states:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
> (b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Eelgrass (*Zostera marina*) is the base of the estuarine food web in the Great Bay Estuary. Healthy eelgrass beds filter water and stabilize sediments (Short and Short, 1984) and provide habitat for fish and shellfish (Duarte, 2001; Heck et al., 2003). While eelgrass is only one species in the estuarine community, the presence of eelgrass is critical for the survival of many species. Maintenance of eelgrass habitat should be considered critical in order to "maintain a balanced, integrated, and adaptive community of organisms". Loss of eelgrass habitat would change the species composition of the estuary resulting in a detrimental difference in community structure and function. In particular, if eelgrass habitat is lost, the estuary will likely be colonized by macroalgae species which do not provide the same habitat functions as eelgrass (Short et al., 1995; Hauxwell et al., 2003; McGlathery et al, 2007). Therefore, DES believes that significant losses of eelgrass habitat would not meet the narrative standard of Env-Ws 1703.19 and create a water quality standard violation for biological integrity.

Eelgrass is sensitive to water clarity (Short et al., 1995). Cultural eutrophication from excess nitrogen, and suspended sediments in estuaries cause phytoplankton blooms, periphyton growth on eelgrass leaves, and light attenuation from non-algal particles (Short et al., 1995; Hauxwell et al., 2003; McGlathery et al, 2007). DES has not developed numeric criteria for the protection of eelgrass for nitrogen or suspended solids. For nitrogen, DES can use the narrative standard for nutrients, Env-Ws 1703.14, to evaluate impairments. The narrative standard for estuarine waters, which are Class B, states:

> (b) Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring.

Until numeric criteria are available, DES must interpret the narrative standard using a weight-of-evidence approach. DES does not have water quality criteria for suspended solids. Therefore, development of impairment assessment methodology for this parameter was not pursued.

The NHEP Technical Advisory Committee is leading an effort to develop numeric nutrient criteria for nitrogen and suspended solids for the protection of eelgrass as the main indicator of aquatic life health in the Great Bay Estuary. The committee hopes to produce recommendations by the end of 2008.

Precedents from Other States

DES contacted the other coastal states in New England for their policies on assessing eelgrass loss in terms of water quality standards. One New England state has made impairment decisions for estuaries based on eelgrass habitat loss. The Massachusetts Department of Environmental Protection (MA DEP) considers an estuary to be impaired if there has been a significant eelgrass loss based on the best professional judgment of the assessor (MA DEP, 2007). MA DEP has not established numeric thresholds for significant eelgrass loss. In the Massachusetts approach, eelgrass habitat maps from as far back as 1951 are compared to more recent maps. If the eelgrass habitat loss is easily noticeable to the assessor, MA DEP will consider that estuary to be impaired for eelgrass loss. MA DEP began this practice for the 2006 assessment cycle. Eelgrass assessments are made for estuaries being studied by the Massachusetts Estuaries Project for which there are numeric nutrient criteria as well as for other estuaries for which both historic and current eelgrass data are available but numeric nutrient criteria have not been established. If there is a pattern of loss and there is a weight of evidence that the loss is due to nutrients, the water body segment is listed as impaired by excess nutrients. The weight of evidence approach includes additional data indicating low dissolved oxygen, high phytoplankton chlorophyll *a*, high nitrogen concentrations, and/or organically enriched benthic habitat. If there are no additional data or information available for the "weight of evidence" approach, the assessment staff determine that the water body segment impairment is habitat alteration. Therefore, there is a precedent within New England for states to add assessment units to their 303(d) lists for significant eelgrass loss and to consider the cause of the impairment to be nitrogen without having numeric nutrient criteria.

New Hampshire Assessment Methodology

DES uses a standardized approach to assessments to ensure that impairment decisions are made with credible indicators and use support criteria. This standardized approach is described in the DES Comprehensive Assessment and Listing Methodology or CALM (NH DES, 2008). The CALM for the 2008 303(d) list does not contain indicators or use support criteria for eelgrass. Therefore, DES developed a peer-reviewed methodology to use indicators and use support criteria for eelgrass, which is based on sound scientific principles and is equally credible to the indicators already in the CALM.

Eelgrass Indicator

There are three indicators of eelgrass habitat in the Great Bay Estuary:

(1) Synoptic surveys of eelgrass cover using aerial imagery. Dr. Fred Short at UNH has completed these surveys for at least portions of the Great Bay Estuary every year from 1986 to 2005. The eelgrass cover maps are ground truthed by annual boat visits to sites in the estuary. The advantage of this data source is that it is collected using standardized procedures that are published in the scientific literature (Short and Burdick, 1996) and an approved Quality Assurance Project Plan. The current survey results can be readily

compared to historic information on eelgrass presence between 1948 and 1981 which was compiled by The Nature Conservancy for the Great Bay Estuarine Restoration Compendium (Odell et al., 2006). The NHEP uses this information as an environmental indicator in its State of the Estuaries Report. The deadline for data submittals for the 2008 Section 303(d) List was December 2007. The most recent data on eelgrass in the Great Bay Estuary that were submitted by the deadline are from 2005. Maps of eelgrass cover in 2006 and 2007 have been or will be generated in 2008. These data will be considered for the 2010 Section 303(d) List.

(2) Estimates of eelgrass biomass throughout the Great Bay Estuary. These estimates are made from the synoptic survey data for cover and estimates of eelgrass density. The advantage of this data source is that it provides information on changes between healthy "dense" eelgrass beds and less healthy "sparse" beds. The disadvantage of this data source is that the error in the biomass estimates is larger than for the eelgrass cover indicator. The magnitude of this error has not yet been quantified. The NHEP uses this information as a supporting variable in its State of the Estuaries Report.

(3) Time series studies of eelgrass cover, biomass, and other metrics at specific locations over multiple years. Dr. Fred Short maintains research sites in the Lower Piscataqua River and Little Bay where he has monitored eelgrass habitat intensively over multiple years. The advantage of this data source is that more detailed and accurate information is available for the sites being studied. The disadvantage of this data source is that the results may only be representative of the areas being studied, not the whole estuary.

Based on the advantages and disadvantages of the various data sources above, DES feels that eelgrass cover (1) is an appropriate indicator for water quality impairment determinations. This indicator is collected using accepted and standardized protocols and is ground truthed annually. Current eelgrass cover data can also be compared to maps of historic eelgrass cover (compiled from various sources from 1948 to 1981) to determine long-term habitat losses. MA DEP has set a precedent for making 303(d) impairments using loss of eelgrass cover. While eelgrass biomass estimates (2) are useful as a supporting variable, DES, at this time, believes that this data source is too uncertain to be appropriate as a water quality criterion. DES has requested information from UNH to determine the magnitude of error associated with the biomass calculations. Should the error be less than expected, DES will reconsider its position on the use of biomass as an indicator in the future. Similarly, the time series studies (3) provide useful information but do not represent a large enough area to be used as a water quality criterion. Loss of eelgrass at one location may be offset by gains in some other location. Therefore, it is more appropriate to use total eelgrass cover as the indicator for the assessment.

Use Support Criteria for Eelgrass Indicator

When setting use support criteria in the CALM, DES aims to satisfy several goals: consistency with water quality standards; adherence to sound scientific and statistical principles; and consistency between different indicators and water body types. After a review of the available data and the manner in which it is being assessed by MA DEP, DES considers two methods to be appropriate for assessing eelgrass cover data.

(1) If there are reliable historic and current maps of eelgrass cover for an area, DES will use the percent decline from the historic level to determine impairments. A region will be considered to have significant eelgrass loss if the change from historic levels is >20%. This threshold value was determined from natural variability observed in recent eelgrass cover in Great Bay, which will be discussed in the following section. A higher threshold is not needed to account for error in the maps of historic eelgrass populations, because these maps likely underestimate eelgrass coverage during pristine conditions (see chronology of eelgrass changes in the Results and Discussion section). To avoid spurious impairments from one year of data, the median eelgrass cover from the last three years of data (in this case, 2003-2005) will be compared to the historic eelgrass cover. The historic eelgrass cover will be the maximum cover observed in the assessment zone from any one of the historic maps of eelgrass distribution.

(2) If sufficient data from annual surveys are available, DES will evaluate recent trends in the eelgrass cover indicator. Trends will be evaluated using linear regression of eelgrass cover in a zone versus year. The assessment zone will be considered to have significant eelgrass loss if there is a statistically significant ($p<0.05$), decreasing trend that shows a loss of 20% of the resource with 95% confidence (i.e., the 95^{th} percentile upper confidence limit of the regression for the most recent date is less than 20% of the maximum value of the cover over the time series). Statistical procedures for estimating prediction intervals for individual estimates from Helsel and Hirsh (1992) will be used. DES selected 20% as the threshold for "significant loss" based on the natural variability in eelgrass cover that has been observed in Great Bay. For the period between 1990 and 1999, eelgrass cover in Great Bay was relatively healthy and stable. The relative standard deviation of the eelgrass cover during this period was 6.5%. Assuming that the variability in eelgrass cover in Great Bay is representative of other locations, DES chose three relative standard deviations (3 x 6.5 = 20%) as an appropriate threshold for non-random change from reference conditions.

DES will consider a zone to be impaired if either of the two methods indicates significant eelgrass loss. In the EPA Assessment Database, impairments due to significant eelgrass loss will be coded as "Estuarine Bioassessments". For assessment zones with significant eelgrass loss, DES will review available records for dredging and mooring fields to identify potential impacts to eelgrass from these activities.

Use Support Criteria for Nutrients

The estuarine eutrophication model used by the National Oceanic and Atmospheric Administration relates external nutrient inputs to primary and secondary symptoms of eutrophication (Bricker et al., 2007). Elevated chlorophyll-a concentrations and proliferation of macroalgae are primary symptoms of eutrophication, while low dissolved oxygen, loss of submerged aquatic vegetation (e.g., eelgrass), and harmful algal blooms are secondary symptoms. This approach is consistent with the conceptual model of coastal eutrophication presented by Cloern (2001). Therefore, the most direct link between nutrient inputs to an estuary and eutrophic effects is for chlorophyll-a concentrations in the water and macroalgae growth.

DES evaluates chlorophyll-a concentrations in the estuary to determine support of the primary contact recreation designated use. More than 1,800 chlorophyll-a results from tidal waters were evaluated for the 2008 Section 303(d) List. Assessment units were considered to be impaired if more than ten percent of the chlorophyll-a samples in the assessment unit had concentrations higher than 20 ug/L, or if any two readings within an assessment unit exceeded 40 ug/L (NH DES, 2008). The tidal portions of four tributaries to the Great Bay Estuary were listed as impaired for chlorophyll-a in the draft 2008 Section 303(d) List for New Hampshire: the Squamscott River, Lamprey River, Oyster River, and the Salmon Falls River.

Several studies of macroalgae were completed in the Great Bay Estuary in the 1980s. Mathieson and Hehre (1986) documented the distribution of different macroalgae species throughout the tidal shoreline of New Hampshire, including the Isles of Shoals. Chock and Mathieson (1983) and Hardwick-Witman and Mathieson (1983) studied the species composition at particular locations in the estuary. These studies provide a baseline macroalgae species in the estuary. There have been reports of increases in the abundance of different species of nuisance macroalgae by researchers at UNH, but the studies from the 1980s have not been repeated to document the changes. It is not possible to determine impairments of designated uses or water quality standards based on the available data. In 2008, the NHEP received a grant from EPA to use hyperspectral imagery to quantify nuisance macroalgal cover (multiple *Ulva* species, *Gracilaria* [e.g. *G. tikvahiae*], epiphytic red algae [e.g., ceramialean red algae] and detached/entangled *Chaetomorpha* populations) using a standard, synoptic method. Once this study is completed, it may be possible to determine trends in macroalgae and to use this as an indicator of impairment in future assessments.

The primary symptoms of eutrophication are useful as a means to detect eutrophication before secondary symptoms develop. Phytoplankton blooms (as measured by chlorophyll-a concentrations) subsequently lead to low dissolved oxygen due to respiration of organic matter (Cloern, 2001). Cultural eutrophication from increased nitrogen loads to estuaries has been shown to be a major cause of seagrass disappearance worldwide (Burkholder et al., 2007; Short and Wyliie-Escheverria, 1996). Excess nitrogen contributes to eelgrass loss by promoting the proliferation of epiphytes and ephemeral macroalgal species on and around seagrasses and by increasing phytoplankton blooms which decrease water clarity (Short et al., 1995; Hauxwell et al., 2001; Hauxwell et al., 2003). However, eelgrass can be lost due to other factors such as disease (Muehlstein et al., 1991), sedimentation, and construction of boat moorings, docks or other structures.

Therefore, for the 2008 Section 303(d) List, DES will consider estuarine assessment units to be impaired for nutrients per Env-Ws 1703.14 if there is an impairment for one of the primary symptoms of eutrophication. A quantitative assessment methodology is only available for chlorophyll-a concentrations in water. The impairments will be specifically for nitrogen because nitrogen is the limiting nutrient in estuaries (Howarth and Marino, 2006).

Results and Discussion

DES applied the assessment methodology to the eelgrass cover data for all sections of the Great Bay Estuary. Historical eelgrass cover maps were available from the Great Bay Estuarine Restoration Compendium (Odell et al., 2006) for all areas except the upper reaches of the Piscataqua River, Portsmouth Harbor and Little Harbor. Recent eelgrass cover maps are available for all areas between 1996 and 2005. For the Great Bay, Lamprey River, Squamscott River, and Winnicut River, eelgrass cover has been mapped annually since 1986. Eelgrass is not known to have been present in the Cocheco or Salmon Falls Rivers. These tidal tributaries were only evaluated for nitrogen impairments.

DES has 43 assessment units to cover the Great Bay Estuary that are coincident with the National Shellfish Sanitation Program growing areas. Great Bay itself consists of five different assessment units. In terms of eelgrass habitat it makes sense to evaluate eelgrass cover on aggregates of assessment units covering contiguous areas in order to reduce variability from small shifts in the locations of eelgrass beds. Therefore, DES aggregated the eelgrass cover data into thirteen areas: Winnicut River, Squamscott River, Lamprey River, Oyster River, Bellamy River, Cocheco River, Salmon Falls River, Great Bay, Little Bay, Upper Piscataqua River, Lower Piscataqua River, Portsmouth Harbor/Little Harbor, and Sagamore Creek. The assessment units associated with each of these areas are shown in Table 1. For the Piscataqua River and Portsmouth Harbor zones, the eelgrass cover on both the New Hampshire and Maine sides of the river were included in the totals. Eelgrass in the tidal creeks along the Maine side of the Piscataqua River was not included in the totals. The boundaries of each of the aggregated assessment zones are shown in Figure 1.

Information on the historic distribution of eelgrass cover is available from local maps and the scientific literature. Each of the data sources for the historic distribution of eelgrass are discussed in the following approximate chronology.

> The **pre-colonial distribution** of eelgrass cover in the Great Bay Estuary is unknown. In Buzzards Bay, the coverage of eelgrass in 1600 was estimated to be at least two times greater than the coverage in 1985 (Costa, 2003).
>
> In **1931-1932**, there was a massive die off of eelgrass in both North America and Europe due to 'wasting disease' caused by an infestation of the slime mold, *Labryinthula zostera* (Godet et al., 2008). Nearly all of the eelgrass beds along the east coast of the United States were lost during this outbreak. Beds in low salinity areas (e.g., tributaries) survived and helped to repopulate the coasts (Short et al., 1986). Jackson (1944) reported that the loss of eelgrass in the Great Bay

Estuary released large quantities of silt into the water and affected shellfish, fish, and waterfowl populations.

In **1948**, S. Bradley Krochmal completed a survey of eelgrass in the Great Bay Estuary and its tributaries for a University of New Hampshire M. Sc. thesis on smelt populations (Krochmal, 1949). Aerial photography was not used to map the eelgrass beds. The thesis does not explicitly state the methods used but it is presumed that shore and boat surveys were employed based upon the text.

In 1948, eelgrass populations were just beginning to recover from the 1931 wasting disease outbreak. Costa (2003) reported that the greatest rates of eelgrass recovery in Buzzards Bay occurred in the 1950s and 1960s. Eelgrass beds in France had hardly recovered by the 1950s (Godet et al., 2008). Therefore, the distribution of eelgrass in the Great Bay Estuary in 1948 represents a population in recovery. Much of the eelgrass was concentrated in the low salinity areas in the tidal tributaries, which is expected because the beds in low salinity areas survived the wasting disease. Regarding eelgrass in Great Bay, Krochmal (1949) states, "*Zostera* can be found only on the side sheltered from the prevailing northwesterly winds. The best development is found at the mouths of the Exeter, Lamprey, and Oyster Rivers."

The thesis contains a carefully drawn 1:64,000 scale map of eelgrass presence. Eelgrass presence on the map is denoted by three different density symbols, "P", "S", and "C". The density code "P" is for "isolated patches" of eelgrass. Eelgrass densities of "S" ("scattered") and "C"("common") refer to eelgrass cover greater than or equal to 25 percent of the substrate. The lowest density of eelgrass that is mapped with current methods using aerial photography is 10 to 30 percent cover of substrate. Therefore, to be reasonably consistent with current methods, only the eelgrass beds mapped in the "scattered" or "common" density codes will be used for comparisons to current data.

The boundaries of the eelgrass beds were digitized by The Nature Conservancy by creating polygons that surround groups of the same density symbols on the map. Because the bed boundaries were not actually shown on the map, the polygons created through the digitizing process should be considered approximate. Moreover, with a 1:64,000 map, the width of a line on the page covers approximately 100 feet of actual land surface. Digitizing this scale map introduces additional uncertainty in the area estimates for typical eelgrass beds on the order of 10 to 20 percent.

The map shows the complete extent of eelgrass in the Winnicut, Squamscott, Lamprey, Oyster Rivers, Great Bay and Little Bay. The map also covers the lower part of the Bellamy River and the lower part of the Upper Piscataqua River. In addition to the map, the thesis contains narrative summaries of conditions in the Cocheco River, Salmon Falls River, and Piscataqua River. The author makes frequent references to discharges of raw sewage and industrial wastes to the rivers. Therefore, conditions during this mapping period were far from pristine.

In **1962**, the Maine Geologic Survey mapped eelgrass beds on the Maine side of the Piscataqua River as part of the Coastal Maine Geologic Environment survey (ME DEP, 1962). The beds were mapped from aerial photography and checked by field visits to some sites. This survey covered a relatively small portion of the Great Bay Estuary. However, the eelgrass beds on the Maine side of the river were not mapped by any other sources until 1996. Therefore, this historic dataset provides useful information.

In **1980-1981**, the New Hampshire Fish and Game Department completed an inventory of natural resources in the Great Bay Estuary (NH FGD, 1981). Eelgrass populations in the Great Bay, Little Bay, and portions of the Piscataqua River were assessed using boat and diver surveys. The surveys did not cover any of the tidal tributaries to Great Bay or Little Bay.

The inventory was completed in response to the "T/V New Concord" oil spill in 1979 which released 25,000 gallons of No.6 fuel oil into the estuary. In Buzzards Bay, the eelgrass populations completed their recovery from the 1931 wasting disease outbreak in the 1980s (Costa, 2003). If the trajectory of recovery in Great Bay was similar, the distribution of eelgrass in 1980-1981 is useful for documenting the recolonization of eelgrass in Great Bay, Little Bay, and the Piscataqua River. Eelgrass was largely absent from these areas in the 1948 survey.

The boundaries of the eelgrass beds were drawn on NOAA charts and then represented on a small scale map in the report (1:64,000). As with the 1948 dataset, digitizing from a map of this scale introduces error on the scale of 10-20% in area estimates for typical size eelgrass beds. The uncertainty from transferring eelgrass bed boundaries from the NOAA charts to the report map is unknown.

In **1984**, there was a recurrence of wasting disease in the Great Bay Estuary. The disease virtually eliminated the eelgrass beds in Little Bay and the Piscataqua River (Short et al., 1986). Paradoxically, the distribution of eelgrass in Great Bay increased in 1984 relative to 1981. The 1984 map was created from aerial photography and ground truth surveys by the University of New Hampshire. This map has not been digitized and, therefore, could not be used in this analysis.

In **1988-1989**, eelgrass populations in the Great Bay Estuary were again decimated due to an infestation of wasting disease (Muehlstein et al., 1991). The coverage of eelgrass in the Great Bay fell to 15 percent of normal levels (NHEP, 2006). By 1990, the eelgrass cover in Great Bay had rebounded to pre-infestation levels.

In **1995**, a small wasting disease outbreak decreased the biomass of eelgrass in the Great Bay (NHEP, 2006).

The datasets from 1948, 1962, and 1980-1981 were collected before the current monitoring program using aerial photography began in 1986. Therefore, these datasets are considered to be "historic". However, the preceding chronology shows that none of the historic data sources represent pristine, pre-colonial distribution of eelgrass in the Great Bay Estuary. The eelgrass populations in the estuary have been nearly wiped out by wasting disease on several occasions, most notably in 1931. The historic maps from 1948, 1962, and 1980-1981 illustrate the eelgrass cover in various stages of recovery from the 1931 wasting disease pandemic and impacts due to discharges of untreated sewage, industrial waste, and oil. Therefore, the three maps of historic eelgrass beds should be considered to represent the minimal extent of eelgrass historically.

Figure 2 shows the eelgrass beds mapped by each of the historical data sources. Figure 3 shows the presence of eelgrass from the most recent (2005) survey. The acreage of eelgrass cover in each zone over time is summarized in Table 2. The results for each zone are discussed below.

Winnicut River

The historic maps of eelgrass do not show eelgrass cover in the Winnicut River. Linear regression of eelgrass cover from 1990 to 2005 detected a significant decreasing trend at the 0.05 significance level (Figure 4). The trend indicates that at least 48% of the eelgrass cover in this assessment unit was lost as of 2005. The trend was evaluated for the 1990-2005 period because the eelgrass populations in the whole estuary were devastated in 1988-1989 due to an infestation of the slime mold, *Labryinthula zostera*, commonly called "wasting disease" (Muehlstein et al., 1991). Including data from before 1990 would have prevented detection of any trends since the wasting disease episode. Per the assessment methodology, the Winnicut River should be considered impaired for significant eelgrass loss. The cause of the eelgrass loss is unknown. Dredging is not a possible cause as there are no records of major dredging operations in Winnicut River (USACE, 2005). There are no major mooring fields in this assessment zone. There were insufficient data to determine if there were any chlorophyll-a violations in this zone. Since there are no known chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Squamscott River

The historic maps of eelgrass in the Squamscott River show 42.1 acres of habitat in 1948. Median eelgrass cover for the 2003-2005 period was 0 acres. Therefore, 100% of the eelgrass cover in this area has been lost. The cause of the eelgrass loss is unknown. Dredging is not a possible cause as the last channel dredge occurred in 1911 (USACE, 2005). There are no major mooring fields in this assessment zone. The Squamscott River is also impaired for chlorophyll-a. Seven of the 91 chlorophyll-a samples in this assessment zone were greater than the water quality criterion for primary contact recreation (20 ug/L). Three of these samples had a chlorophyll-a concentration greater than 40 ug/L (Magnitude of Exceedence criterion). Per the assessment methodology, the Squamscott River should be considered impaired for significant eelgrass loss and nutrients (nitrogen).

Lamprey River

The historic maps of eelgrass in the Lamprey River show 53.4 acres of habitat in 1948. Median eelgrass cover for the 2003-2005 period was 0 acres. Therefore, 100% of the eelgrass cover in this area has been lost. The cause of the eelgrass loss is unknown. Dredging is not a possible cause as the last channel dredge occurred in 1903 (USACE, 2005). There are no major mooring fields in this assessment zone. The Lamprey River is also impaired for chlorophyll-a. Three of the 110 chlorophyll-a samples in this assessment zone were greater than the water quality criterion for primary contact recreation (20 ug/L). Two of these samples had a chlorophyll-a concentration greater than 40 ug/L (Magnitude of Exceedence criterion). Per the assessment methodology, the Lamprey River should be considered impaired for significant eelgrass loss and nutrients (nitrogen).

Oyster River

The historic maps of eelgrass in the Oyster River show 182.5 acres of habitat in 1948. Median eelgrass cover for the 2003-2005 period was 0 acres. Therefore, 100% of the eelgrass cover in this area has been lost. The cause of the eelgrass loss is unknown. Dredging is not a possible cause as the channel has not been dredged (PDA, 2006). There are only a few small mooring fields in this assessment zone. There is also a chlorophyll-a impairment in the Oyster River. Nine of the 98 chlorophyll-a samples in this assessment zone were greater than the water quality criterion for primary contact recreation (20 ug/L). Six of these samples had a chlorophyll-a concentration greater than 40 ug/L (Magnitude of Exceedence criterion). Per the assessment methodology, this assessment unit should be considered impaired for significant eelgrass loss and nutrients (nitrogen).

Bellamy River

The historic maps of eelgrass in the Bellamy River show 66.9 acres of habitat in 1948 and 36.0 acres in 1980-1981. Median eelgrass cover for the 2003-2005 period was 0 acres. Therefore, 100% of the eelgrass cover in this area has been lost. The cause of the eelgrass loss is unknown. Dredging is not a possible cause as the last channel dredge occurred in 1896 (USACE, 2005). There are only a few small mooring fields in this assessment zone. Per the assessment methodology, the Bellamy River should be considered impaired for significant eelgrass loss. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion in this zone. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Great Bay

The historic maps of eelgrass in the Great Bay show 263.9 acres of habitat in 1948 and 1217.4 acres in 1980-1981. Median eelgrass cover for the 2003-2005 period was 2,043.3 acres. Therefore, the eelgrass cover in this area has expanded relative to the historic data sources; the change relative to the pre-colonial distribution of eelgrass is unknown. Linear regression of eelgrass cover from 1990 to 2005 did not detect a significant trend at the 0.05 significance level. The trend was evaluated for the 1990-2005 period because the eelgrass populations in the whole estuary were devastated in 1988-1989 due to an infestation of the slime mold, *Labryinthula zostera*, commonly called "wasting disease" (Muehlstein et al., 1991). Therefore, per the assessment methodology, Great Bay should not be considered impaired for significant eelgrass loss. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion in this zone. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

The Clean Water Act allows for water bodies to be listed as "threatened," which generally means that the listing agency has cause to believe that the water body may well be impaired by the next listing cycle. Preliminary data for eelgrass in 2006 and 2007 in this assessment zone indicate a downward trend since 2005. This trend may be sufficient to result in significant eelgrass loss for the 2010 303(d) List. Therefore, the Great Bay should be listed as "threatened" on the 2008 303(d) List. An additional reason to consider the eelgrass habitat in the Great Bay to be threatened is the absence of eelgrass from the tributaries which served as refuges during past wasting disease outbreaks.

Little Bay

The historic maps of eelgrass in the Little Bay show 76.5 acres of habitat in 1948 and 408.7 acres in 1980-1981. Median eelgrass cover for the 2003-2005 period was 14.2 acres. Therefore, 97% of the eelgrass cover from 1980-1981 in this area has been lost. The cause of the eelgrass loss is unknown. Short et al. (1986) attributed the loss of eelgrass in Little Bay between 1981 and 1984 to a wasting disease outbreak. Dredging is not a possible cause as major dredging has not occurred in this assessment zone (USACE, 2005). There are several large mooring fields in this assessment zone. The mooring fields near Dover Point and the Bellamy River seem to overlap with potential and current eelgrass habitat. Per the assessment methodology, Little Bay should be considered impaired for significant eelgrass loss. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion in this zone. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Upper Piscataqua River

The historic maps of eelgrass in the Upper Piscataqua River show 62.0 acres of habitat on the New Hampshire side of the river in 1948, 17.7 acres on the Maine side of the river in 1962, and 42.2 acres on the New Hampshire side in 1980-1981. Combining the acreages from the New Hampshire and Maine sides of the river in 1948 and 1962, respectively, the historic coverage of eelgrass in this zone was 79.7 acres. Median eelgrass cover for the 2003-2005 period was 0.7 acres. Therefore, 99% of the eelgrass cover in this area has been lost. The cause of the eelgrass loss is unknown. Short et al. (1986) attributed the loss of eelgrass in the Piscataqua River between 1981 and 1984 to a wasting disease outbreak. Dredging is not a possible cause as major dredging has not occurred in this assessment zone (USACE, 2005). There are several large mooring fields in this assessment zone that seem to overlap with potential eelgrass habitat. Per the assessment methodology, the Upper Piscataqua River should be considered impaired for significant eelgrass loss. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Lower Piscataqua River

The historic maps of eelgrass in the Lower Piscataqua River show 41.9 acres of habitat on the Maine side of the river in 1962 and 86.6 acres of habitat on the New Hampshire side in 1980-1981. Combining the acreages from the Maine and New Hampshire sides of the river in 1962 and 1980-1981, respectively, the historic coverage of eelgrass in this zone was 128.4 acres. Median eelgrass cover for the 2003-2005 period was 24.2 acres. Therefore, 81% of the eelgrass cover in this area has been lost. The cause of the eelgrass loss is unknown. Short et al. (1986) attributed the loss of eelgrass in the Piscataqua River between 1981 and 1984 to a wasting disease outbreak. Significant dredging operations have occurred in this assessment zone between 1956 and 2000 (USACE, 2005). This assessment zone is used frequently by large ships. There are several large mooring fields in this assessment zone that seem to overlap with potential and current eelgrass habitat. Per the assessment methodology, the Lower Piscataqua River should be considered impaired for significant eelgrass loss. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Portsmouth Harbor and Little Harbor

The historic maps of eelgrass do not cover Portsmouth Harbor and Little Harbor. Comparisons between historic and current eelgrass cover were not possible. Linear regression of eelgrass cover from 1996 to 2005 did not detect a significant decreasing trend at the 0.05 significance level. Per the assessment methodology, this assessment unit should not be considered impaired for significant eelgrass loss. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Sagamore Creek

The historic maps of eelgrass do not cover Sagamore Creek. Comparisons between historic and current eelgrass cover were not possible. Linear regression of eelgrass cover from 1996 to 2005 did not detect a significant decreasing trend at the 0.05 significance level. Per the assessment methodology, this assessment unit should not be considered impaired for significant eelgrass loss. There are insufficient data to determine if there are any chlorophyll-a violations in this zone. Since there are no known chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Cocheco River

Eelgrass is not known to have been present in the Cocheco River. The historic sources did not map and current eelgrass maps do not show eelgrass in this zone. Available chlorophyll-a data indicate compliance with the chlorophyll-a criterion. Since there are no chlorophyll-a impairments in this zone, an impairment for nutrients per Env 1703.14 is not justified.

Salmon Falls River

Eelgrass is not known to have been present in the Salmon Falls River. The historic sources did not map and current eelgrass maps do not show eelgrass in this zone. However, the Salmon Falls River is impaired for chlorophyll-a. Six of the 52 chlorophyll-a samples in this assessment zone were greater than the water quality criterion for primary contact recreation (20 ug/L). None of the samples had chlorophyll-a concentrations greater than 40 ug/L (Magnitude of Exceedence criterion). Per the assessment methodology, the Salmon Falls River should be considered impaired for nutrients (nitrogen).

Peer Review of Methodology

Description of the Peer Review Process

DES organized a two step scientific peer review to validate the science and data used in this assessment methodology. First, on May 30, 2008, DES distributed a draft of the methodology to the Technical Advisory Committee for the New Hampshire Estuaries Project. This group met on June 10, 2008, to discuss the draft methodology (minutes available). DES revised the methodology based on comments received at that meeting. Second, on June 20, 2008, DES distributed the revised methodology to local and regional experts. The peer-review panel consisted of the NHEP Technical Advisory Committee, EPA, NOAA, state governments in New England, National Estuary Programs in New England, National Estuarine Research Reserves in New England, potentially affected municipalities in New Hampshire and Maine, and interested non-governmental organizations. Comments were requested by July 11, 2008. On July 2, 2008, DES staff met with representatives from potentially affected municipalities to review the proposal and answer questions.

Peer Review Comments and DES Responses

DES received comments from the following organizations or individuals:

1. Joe Costa, Buzzards Bay National Estuary Program
2. Steve Halterman, Massachusetts Department of Environmental Protection
3. Kathy Mills, Great Bay National Estuarine Research Reserve
4. Jim Latimer, U.S. Environmental Protection Agency
5. Phil Colarusso, U.S. Environmental Protection Agency
6. Pete Richardson, Watershed resident
7. Dave Cedarholm, Town of Durham
8. Tom Irwin, Conservation Law Foundation

9. Russell Dean and Jennifer Perry, Town of Exeter
10. Ray Konisky, The Nature Conservancy
11. Chris Nash, DES Shellfish Program
12. John Bohenko, City of Portsmouth
13. Tim Visel, Sound School Regional Vocational Aquaculture Center

DES paraphrased the comments *that suggested changes to the methodology* from each letter, grouped the comments by subject area, and provided responses in the paragraphs below. Numbers at the end of each comment correspond to the list of people above and denote which person provided the comment. Comments that supported the proposed methodology or suggested editorial changes have not been summarized, although these comments were reviewed and considered by DES staff.

Massachusetts DEP Methodology

- The MA DEP approach to assessing eelgrass loss was incorrectly represented. If there is a pattern of loss and there is a weight of evidence that the loss is due to nutrients, the water body segment is listed as impaired by excess nutrients. The weight of evidence approach includes additional data indicating low dissolved oxygen, high phytoplankton chlorophyll *a,* high nitrogen concentrations, and/or organically enriched benthic habitat. If there are no additional data/information available for the "weight of evidence" approach, the assessment staff determine that the water body segment impairment is habitat alteration. MA DEP has not yet had to set a minimum "significant" loss "threshold" for this impairment category. (2, 8, 10)

Response: The citation to MA DEP method was changed.

Eelgrass Biomass Indicator

- The methodology should include eelgrass biomass declines as an indicator of impairment. The density of eelgrass is a significant factor in determining the health and viability of eelgrass. (5, 8)
- The variability in the eelgrass biomass indicator should be quantified. (5)

Response: DES believes that there is much more variability in the eelgrass biomass indicator than the eelgrass cover indicator. On June 20, 2008, DES requested data from UNH on variability and quality assurance protocols related to this indicator. UNH has not yet provided sufficient data to complete an assessment of the uncertainty for the biomass indicator. If the uncertainty in this indicator is acceptably low, DES will consider this indicator for the assessment methodology for the 2010 303(d) list.

Threshold for Significant Eelgrass Loss

- The 40% threshold for significant eelgrass loss (relative to historical eelgrass coverage) is too high. (4, 5, 8, 10)
- The threshold should be changed to 10% (8) or 20% (5, 10).
- The same threshold for eelgrass cover loss should be used whether the loss is measured relative to historic maps or relative to recent trends. (5, 8)

Response: The threshold for historical losses was changed to 20% assuming that the historical data can be validated. The threshold for significant loss relative to recent trends remained at 20% to be consistent.

Averaging Period/Anomalous Years

- DES should exclude from trend analyses any eelgrass data for years during which there is significant eelgrass loss due to events not associated with water quality conditions (e.g., wasting disease, dredging, storms). (3)
- DES should not to average eelgrass cover data for the most recent four years as a measure of "current conditions". This practice has the potential to mask significant trends, as well as to delay needed action. (8, 10)

Response: For assessing changes from historical datasets to current conditions, the averaging period was shortened to three years. The median value was used instead of the average to discount an anomalous year. For assessing trends using the current monitoring data, the data from all years were weighted equally.

Ruppia

- DES should remove *Ruppia maritima* from its calculations of eelgrass cover and biomass. *Ruppia* (widgeon grass) is an annual plant that may colonize areas of eelgrass loss; counting it as healthy eelgrass habitat is not an appropriate method. (8, 10)

Response: *Ruppia* coverage was removed from all calculations.

Eelgrass Trend Methods

- DES should focus on eelgrass trends and, when a downward trend beyond the natural variation is observed, list the assessment unit as impaired. (8)
- DES should use Great Bay eelgrass cover data for 1996 – the year with the greatest recorded acreage of cover – as the reference point for assessing more recent annual data and trends. (8)

Response: The methodology for assessing current eelgrass data already uses trends with thresholds for impairment set at levels beyond the range of natural variation. The methodology already uses the maximum eelgrass coverage within the period for trend analysis to calculate percent loss.

Data for Report

- DES should include the draft 2006 eelgrass cover data in the analysis for the 2008 303(d) list. (8)

Response: UNH has not provided a final report for the 2006 eelgrass mapping survey. DES has received raw data from 2006. However, there were questions about the polygon attributes which UNH has not answered. DES has quality assurance requirements for data used for 305(b) assessments. Given that the 2006 data would best be characterized as "draft", they do not meet these quality assurance requirements. DES will use eelgrass data from 2006 and subsequent years that are final by December 31, 2009, for the 2010 303(d) List.

Indicators for Nitrogen Impairments

- Nitrogen impairments should be assigned to an assessment unit if any of the primary or secondary eutrophication symptoms are present (e.g., low dissolved oxygen, algal blooms, increasing nitrogen concentrations, and eelgrass loss not explained by other causes). (5, 8)

Response: DES will propose numeric water quality criteria for nutrients in estuarine assessment units by December 31, 2008. This proposal will include a methodology for determining impairments when various primary or secondary symptoms of eutrophication occur. DES expects significant input from the NHEP Technical Advisory Committee and other stakeholders on this proposal. DES believes that determining nitrogen impairments based on phytoplankton blooms (chlorophyll-a) for the 2008 303(d) List is an appropriate first step in this process. The new criteria will be used for the 2010 303(d) List.

Historical Eelgrass Coverage Datasets

- Source citations for historical eelgrass maps should be added. (3, 11)
- The historical eelgrass maps should not have been aggregated. The results from each survey should be presented individually. (9, 12)
- In the summaries for each river, state a time frame for the historic maps to give readers a sense of how far back in time the comparison extends. (3)

Response: The historical maps from 1948, 1962, and 1980 have been presented separately on figures and tables. The methods and applicable area for each historical survey have been described.

"Threatened" Listing for Great Bay

- The Clean Water Act allows for water bodies to be listed as "threatened," which generally means that the listing agency has cause to believe that the water body may well be impaired by the next listing cycle. Given the preliminary eelgrass data for 2006 and 2007, DES should list the Great Bay as threatened for significant eelgrass loss on the 2008 303(d) list. (5, 8)

Response: Preliminary data for eelgrass in 2006 and 2007 indicate a downward trend since 2005. This trend may be sufficient to result in significant eelgrass loss for the 2010 303(d) List. Therefore, DES agrees that Great Bay should be listed as "threatened" on the 2008 303(d) List for Aquatic Life Use Support.

Eelgrass Loss Due to Storms or Dredging or Other Causes

- In areas where significant eelgrass loss has been observed, DES should research non-water quality factors which have the potential to destroy eelgrass beds, such as storms, dredging, erosion, docks, grazing, ice scour, wasting disease, and boat moorings. These factors may account for part or all of eelgrass loss in certain areas of the Great Bay Estuary. (7, 9, 11, 12)

Response: DES has not attributed causes for any of the impairments for significant eelgrass loss. The impairment is merely a reflection that historical eelgrass beds are no longer present or current eelgrass beds are declining faster than natural variability. DES agrees that all relevant factors should be investigated in areas with significant eelgrass loss. DES does not currently have the resources to complete these investigations but can contribute relevant data. Information on dredging and mooring fields has been added to this report to assist with the investigations.

Nitrogen Effects on Eelgrass

- Heck and Valentine (2007) argue that cascading trophic effects from the loss of predator species are equally important to nutrient inputs. (9)
- The cause and effect link between nitrogen concentrations and eelgrass has not clearly been established. (12)

Response: Eelgrass loss is not presumed to be related to nitrogen. Nitrogen impairments for the 2008 cycle are based exclusively on elevated chlorophyll-a concentrations, a primary symptom of cultural eutrophication. DES may develop a relationship between nitrogen and eelgrass as part of the numeric water quality criteria for nutrients in estuarine assessment units.

Chlorophyll-a Impairments

- Details on the chlorophyll-a concentrations in the Squamscott River, Lamprey River, Oyster River, and the Salmon Falls River should be included in the report. (7)

Response: This information has been added to the summaries for each assessment area.

Additional Research

- DES should investigate historical changes in nitrogen loading and eelgrass loss using ^{210}Pb-dated sediment cores using USGS methods (see http://sofia.usgs.gov/workshops/waterquality/ligninphenol/). (9)

Response: It is not possible complete this research in time for the 2008 303(d) List deadline but DES will consider this idea for future studies.

Conclusions and Recommendations

1. There has been significant eelgrass loss in several sections of the Great Bay Estuary. Due to the importance of eelgrass for the ecosystem of the estuary, the loss of this habitat constitutes a water quality impairment under Env-Ws1703.19. The specific zones and assessment units that will be considered impaired for Aquatic Life Use Support due to "Estuarine Bioassessments" in the 2008 Section 303(d) List are as follows (Figure 5):

Assessment Zone	DES Assessment Unit ID
WINNICUT RIVER	NHEST600030904-01
SQUAMSCOTT RIVER	NHEST600030806-01
OYSTER RIVER	NHEST600030902-01-01
	NHEST600030902-01-02
	NHEST600030902-01-03
	NHEST600030904-06-17
BELLAMY RIVER	NHEST600030903-01-01
	NHEST600030903-01-02
LAMPREY RIVER	NHEST600030709-01
LITTLE BAY	NHEST600030904-06-10
	NHEST600030904-06-11
	NHEST600030904-06-12
	NHEST600030904-06-13
	NHEST600030904-06-14
	NHEST600030904-06-15
	NHEST600030904-06-16
UPPER PISCATAQUA RIVER	NHEST600031001-01-01
	NHEST600031001-01-02
	NHEST600031001-01-03
LOWER PISCATAQUA RIVER	NHEST600031001-02

2. The Great Bay should be listed as threatened for significant eelgrass loss. Preliminary data for eelgrass in 2006 and 2007 in this assessment zone indicate a downward trend since 2005. This trend may be sufficient to result in significant eelgrass loss for the 2010 303(d) List. The specific zones and assessment units that will be considered threatened for Aquatic Life Use Support due to "Estuarine Bioassessments" in the 2008 Section 303(d) List are as follows (Figure 5):

Assessment Zone	DES Assessment Unit ID
GREAT BAY	NHEST600030904-02
	NHEST600030904-03
	NHEST600030904-04-02
	NHEST600030904-04-03
	NHEST600030904-04-04
	NHEST600030904-04-05
	NHEST600030904-04-06

3. Violations of the narrative standard for nutrients, Env-Ws 1703.14, were evident in four assessment units. In these four assessment units, there were impairments for chlorophyll-a, which is a primary symptom of excessive nitrogen in estuarine waters. The specific assessment units that will be considered impaired for Primary Contact Recreation due to nutrients (specifically nitrogen) in the 2008 Section 303(d) List are as follows (Figure 6):

Assessment Zone	**DES Assessment Unit ID**
LAMPREY RIVER	NHEST600030709-01
SQUAMSCOTT RIVER	NHEST600030806-01
OYSTER RIVER	NHEST600030902-01-03
SALMON FALLS RIVER	NHEST600030406-01

4. UNH should provide DES with the requested information to determine the magnitude of error associated with the biomass calculations.

5. Aerial imagery for future eelgrass cover assessments should be georectified. The older imagery should be archived at NH GRANIT to document the source of the 1986 to 2005 eelgrass cover maps.

6. Metadata records for the historic maps of eelgrass cover should be created and these data sources should be archived at NH GRANIT.

7. The NHEP Technical Advisory Committee should continue to develop numeric nutrient criteria for the Great Bay Estuary.

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Tables

Table 1: Assessment units in each zone of the estuary

GROUP NAME	AUID	DESCRIPTION
BELLAMY RIVER	NHEST600030903-01-01	BELLAMY RIVER NORTH
	NHEST600030903-01-02	BELLAMY RIVER SOUTH
COCHECO RIVER	NHEST600030608-01	COCHECO RIVER
GREAT BAY	NHEST600030904-02	GREAT BAY PROHIB SZ1
	NHEST600030904-03	GREAT BAY PROHIB SZ2
	NHEST600030904-04-02	CROMMENT CREEK
	NHEST600030904-04-03	PICKERING BROOK
	NHEST600030904-04-04	FABYAN POINT
	NHEST600030904-04-05	GREAT BAY
	NHEST600030904-04-06	ADAMS POINT SOUTH
LAMPREY RIVER	NHEST600030709-01	LAMPREY RIVER
LITTLE BAY	NHEST600030904-06-10	ADAMS POINT MOORING FIELD SZ
	NHEST600030904-06-11	ADAMS POINT TRIB
	NHEST600030904-06-12	U LITTLE BAY (SOUTH)
	NHEST600030904-06-13	LOWER LITTLE BAY
	NHEST600030904-06-14	LOWER LITTLE BAY MARINA SZ
	NHEST600030904-06-15	LOWER LITTLE BAY GENERAL SULLIVAN BRIDGE
	NHEST600030904-06-16	ULITTLE BAY (NORTH)
LOWER PISCATAQUA RIVER	MEEST600031001-02	LOWER PISCATAQUA RIVER
	NHEST600031001-02	LOWER PISCATAQUA RIVER
OYSTER RIVER	NHEST600030902-01-01	OYSTER RIVER (JOHNSON CR)
	NHEST600030902-01-02	OYSTER RIVER (BUNKER CR)
	NHEST600030902-01-03	OYSTER RIVER
	NHEST600030904-06-17	OYSTER RIVER MOUTH
PORTSMOUTH HARBOR AND LITTLE HARBOR	MEEST600031001-11	UPPER PORTSMOUTH HARBOR-ME
	MEOCN000000000-02-18	ATLANTIC OCEAN
	NHEST600031001-05	BACK CHANNEL
	NHEST600031001-08	WENTWORTH-BY-THE-SEA
	NHEST600031001-11	UPPER PORTSMOUTH HARBOR-NH
	NHEST600031002-02	LITTLE HARBOR
	NHOCN000000000-02-18	ATLANTIC OCEAN
SAGAMORE CREEK	NHEST600031001-03	UPPER SAGAMORE CREEK
	NHEST600031001-04	LOWER SAGAMORE CREEK
SALMON FALLS RIVER	MEEST600030406-01	SALMON FALLS RIVER
	NHEST600030406-01	SALMON FALLS RIVER
SQUAMSCOTT RIVER	NHEST600030806-01	SQUAMSCOTT RIVER
UPPER PISCATAQUA RIVER	MEEST600031001-01-01	UPPER PISCATAQUA RIVER
	MEEST600031001-01-02	UPPER PISCATAQUA RIVER
	MEEST600031001-01-03	UPPER PISCATAQUA RIVER-SOUTH-ME
	NHEST600031001-01-01	UPPER PISCATAQUA RIVER-NORTH
	NHEST600031001-01-02	DOVER WWTF SZ
	NHEST600031001-01-03	UPPER PISCATAQUA RIVER-SOUTH
WINNICUT RIVER	NHEST600030904-01	WINNICUT RIVER

Table 2: Eelgrass cover in different zones of the Great Bay Estuary (acres)

Year	Winnicut River	Squamscott River	Lamprey River	Oyster River	Bellamy River	Great Bay	Little Bay	Upper Piscataqua River*	Lower Piscataqua River*	Portsmouth Harbor and Little Hbr*	Sagamore Creek
Pre-Colonial	??	??	??	??	??	??	??	??	??	??	??
1931-1932	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0	Approx. 0
1948	0.0	42.1	53.4	182.5	66.9	263.9	76.5	62.0	a	a	a
1962	a	a	a	a	a	a	a	17.7	41.9	a	a
1980-1981	a	a	a	a	36.0	1217.4	408.7	42.2	86.6	a	a
1986	2.2	0.0	0.0	a	a	2015.2	a	a	a	a	a
1987	2.2	0.0	0.0	a	a	1685.7	a	a	a	a	a
1988	0.0	0.0	0.0	a	a	1187.5	a	a	a	a	a
1989	0.0	0.0	0.0	a	a	312.6	a	a	a	a	a
1990	15.9	0.0	0.0	a	a	2024.2	a	a	a	a	a
1991	23.4	0.0	0.0	a	a	2255.8	a	a	a	a	a
1992	7.3	0.0	0.0	a	a	2334.4	a	a	a	a	a
1993	6.9	0.0	0.0	a	a	2444.9	a	a	a	a	a
1994	13.8	0.0	0.0	a	a	2434.3	a	a	a	a	a
1995	7.8	0.0	0.0	a	a	2224.9	a	a	a	a	a
1996	7.6	0.0	0.0	14.0	0.0	2495.4	32.7	1.6	31.2	315.7	1.8
1997	7.5	0.0	0.0	a	a	2297.8	a	a	a	a	a
1998	10.0	0.0	0.0	a	a	2387.8	a	a	a	a	a
1999	10.2	0.0	0.0	0.0	0.0	2119.5	26.2	0.5	11.4	294.1	3.0
2000	0.0	0.0	0.0	0.0	0.0	1944.5	7.5	1.6	11.4	321.3	0.9
2001	4.1	0.0	0.0	0.0	0.0	2388.2	10.9	2.0	20.4	319.5	2.2
2002	3.5	0.0	0.0	0.0	0.0	1791.8	4.3	0.5	17.2	332.0	2.3
2003	3.5	0.0	2.2	0.0	0.0	1620.9	14.2	2.9	32.1	324.8	2.2
2004	4.2	0.0	0.0	0.0	0.8	2043.3	12.8	0.7	20.1	291.1	2.5
2005	9.2	0.0	0.0	0.0	0.0	2201.2	25.8	0.4	24.2	283.3	6.1
2003-2005 median	4.2	0.0	0.0	0.0	0.0	2043.3	14.2	0.7	24.2	291.1	2.5
Percent Change: Historic to '03-'05 Med	NA	-100%	-100%	-100%	-100%	68%	-97%	-99%	-81%	NA	NA
Significant Decrease Since 1990	Yes (-48%)	NA	NA	NA	NA	No	NA	NA	NA	No	No
Listing	Impaired	Impaired	Impaired	Impaired	Impaired	None	Impaired	Impaired	Impaired	None	None

a = not mapped NA = not analyzed * The 1948 and 1980-1981 surveys only covered the NH side of the river. The 1962 survey only covered the ME side.

* The acreages for 1996-2005 include beds from both the NH and ME sides of the river but not the tidal creeks along the Maine shore.

Figures

Figure 1: Eelgrass assessment zones

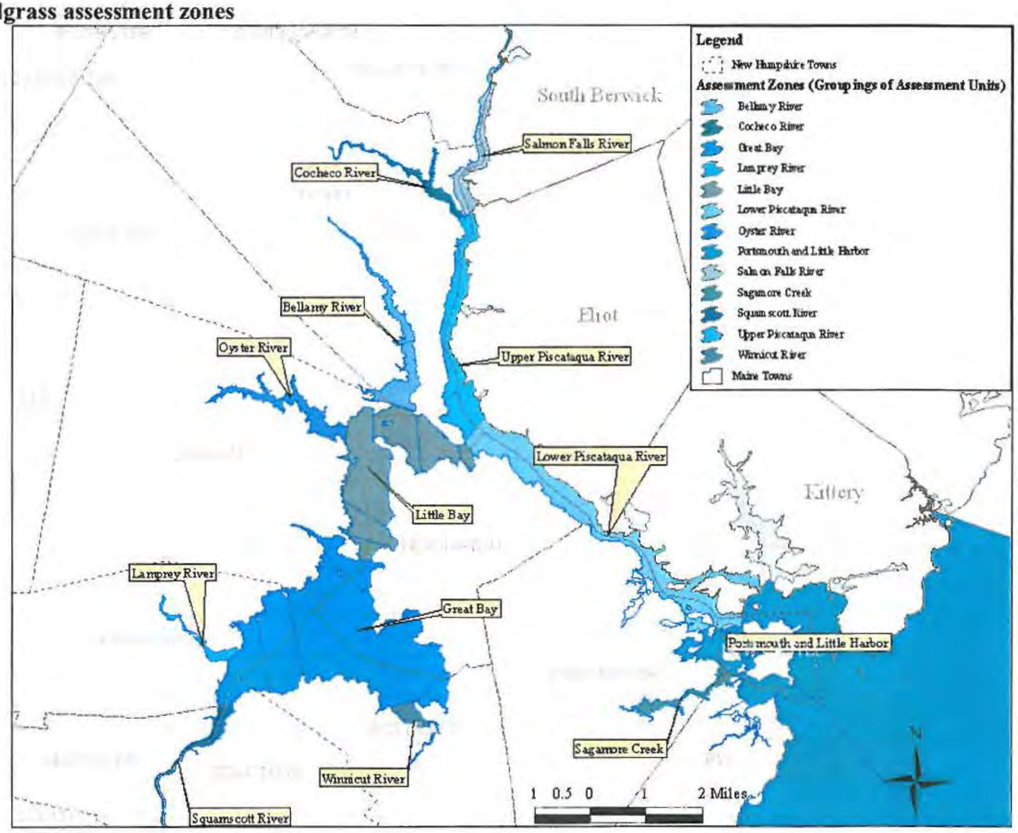

Figure 2: Historic eelgrass cover from surveys completed between 1948 and 1981

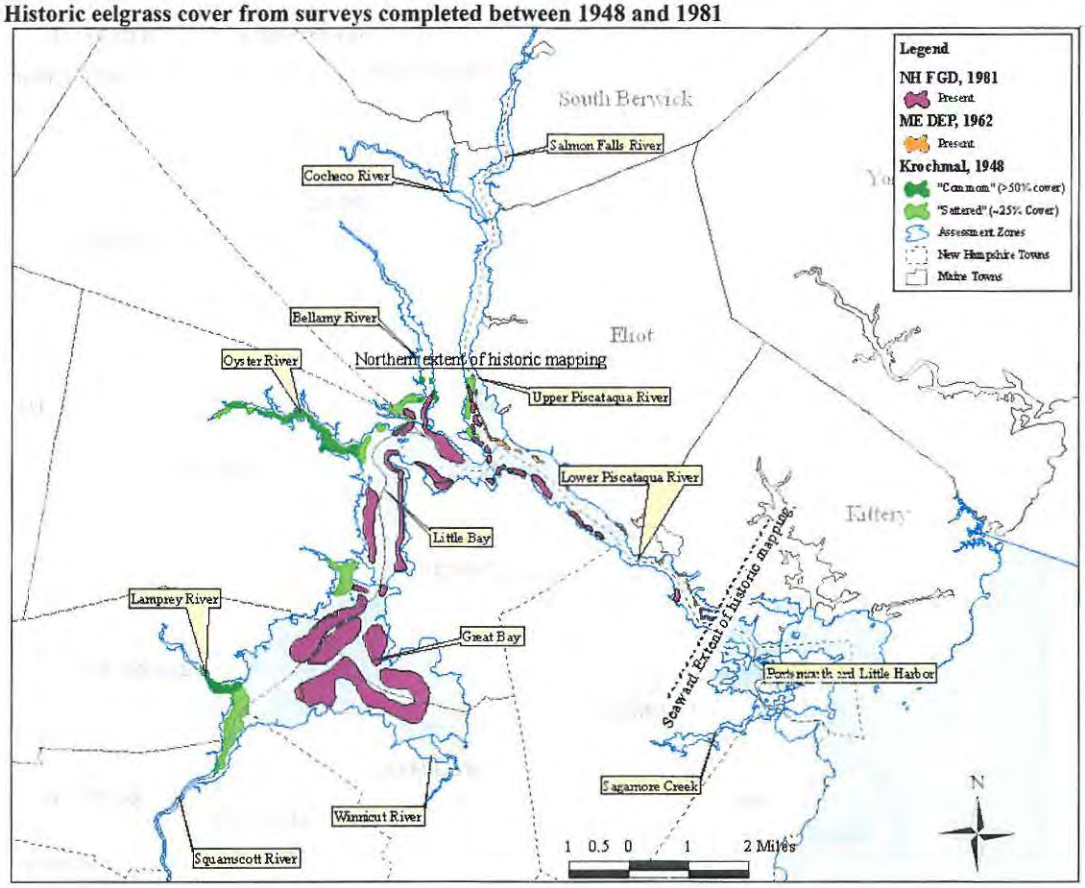

Figure 3: Eelgrass cover in 2005

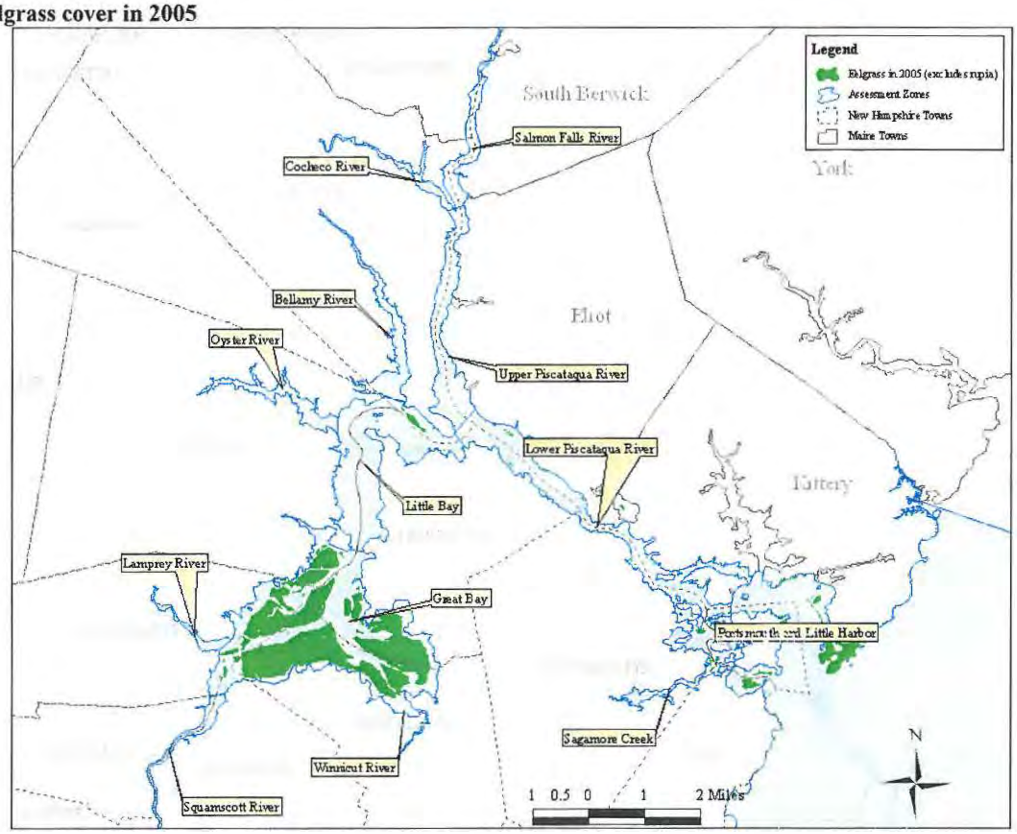

Figure 4: Trend in eelgrass cover in the Winnicut River

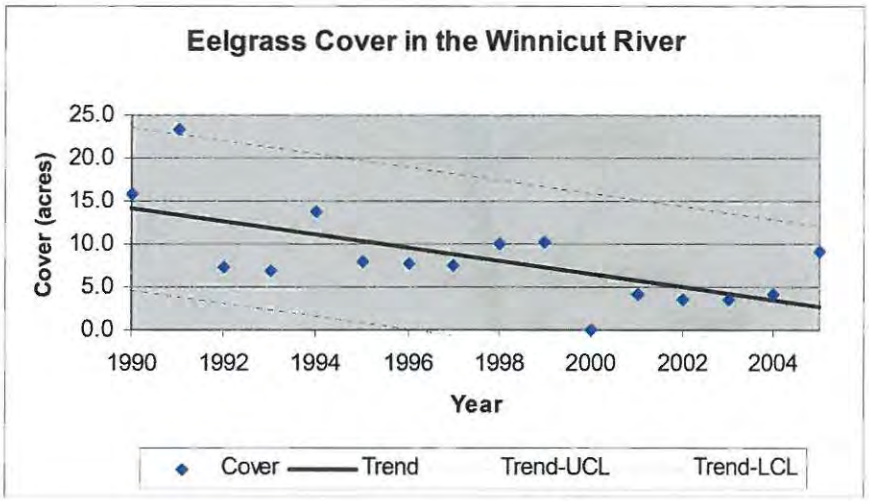

Figure 5: Final eelgrass assessment for significant eelgrass loss

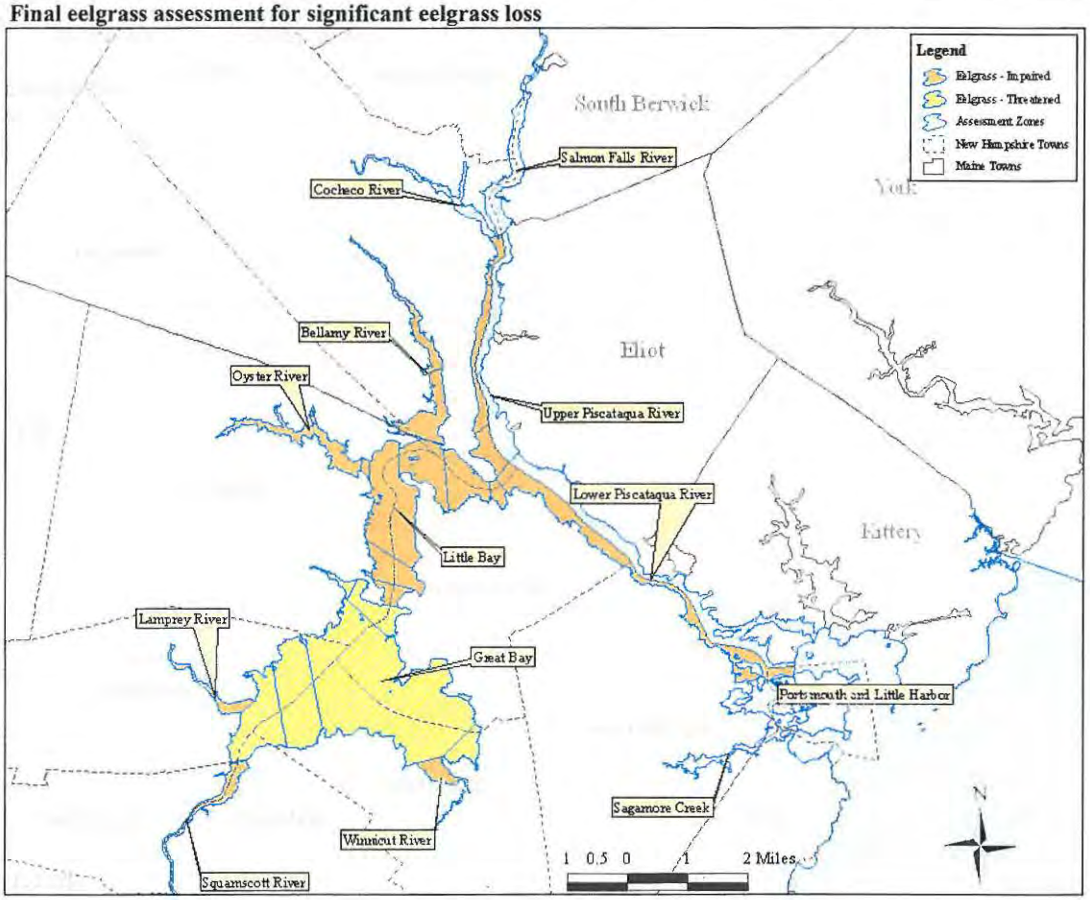

Figure 6: Impairments for nitrogen

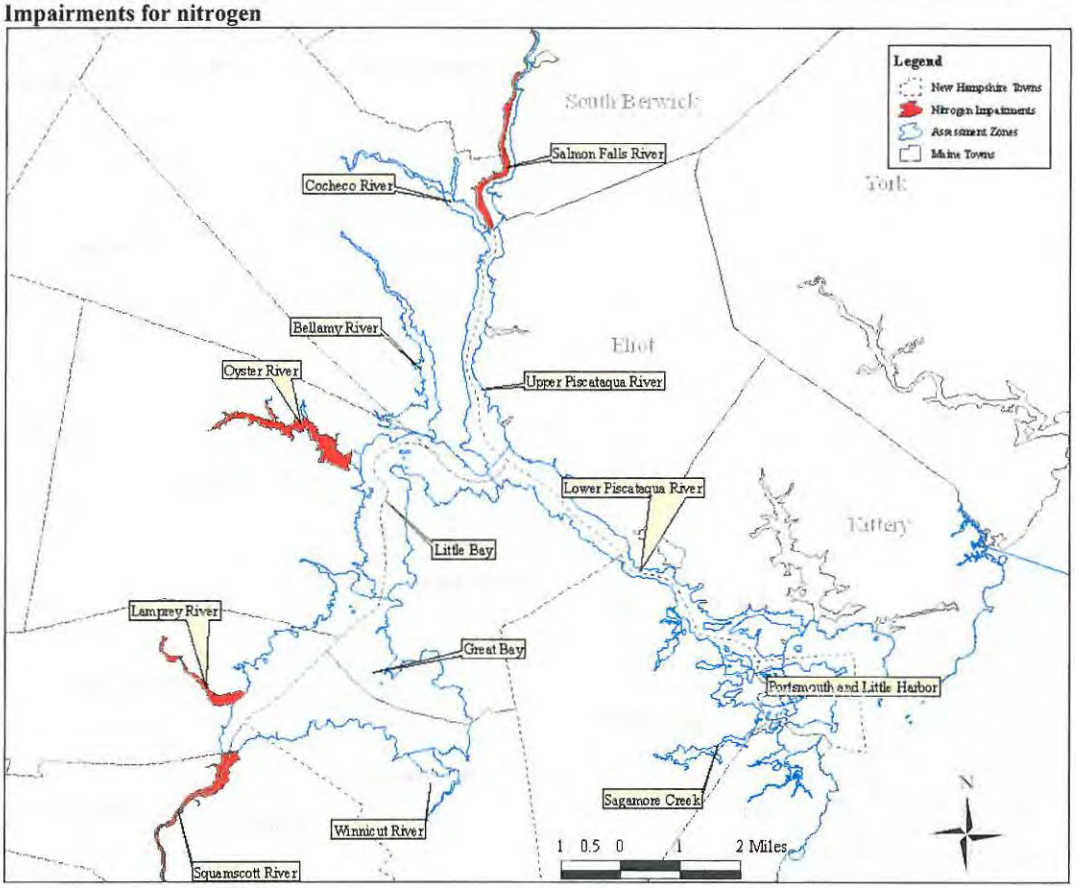

Exhibit 3

TN < 0.39 mg/l (MADEP)
DIN < 0.15 mg/l (Ches. Bay) } eelgrass/SAV   Chloro a 3.5

CONSERVATION LAW FOUNDATION

October 6, 2008

0.39 upper threshold for eelgrass
< 0.30 better

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Mr. Alfred Basile
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Re: State of New Hampshire 2008 Section 303(d) List

Dear Messrs. Silva and Basile:

As you know, the N.H. Department of Environmental Services (NHDES) recently submitted its final 2008 Section 303(d) List for the Environmental Protection Agency's (EPA) review and approval. I am writing to provide the Conservation Law Foundation's (CLF) concerns with certain aspects of the proposed List as it pertains to assessment units that are part of the Great Bay estuary, which have been identified as violating state water quality standards as a result of eelgrass declines and/or excessive nitrogen.

I. Background

Great Bay estuarine waters are experiencing significant declines in eelgrass – a cornerstone of the estuary's ecology – and rising nitrogen concentrations. CLF raised concerns with NHDES's omission of these problems from its initial, draft Section 303(d) List. We communicated those concerns to both EPA and NHDES through formal comments. As you know, NHDES responded by developing a draft, and then final, methodology for assessing these issues in New Hampshire's estuarine waters. Although CLF does not agree with all aspects of the methodology, we were pleased by the attention NHDES devoted to this issue, as well as its determinations that (1) a number of estuarine waters are violating state water quality standards as a result of eelgrass loss, and (2) four estuarine tributaries are violating state water quality standards relative to nitrogen. As a result of these determinations, the final 2008 List, as compared to the draft 2008 List, contains new impairment listings related to eelgrass loss and violation of narrative

chapt 4 - Appendix G   5/21/08 email to Phil nutrients standards.[1] For each of the newly added estuarine impairments pertaining to eelgrass loss and nitrogen, NHDES has assigned a "TMDL priority" of "LOW," and a "TMDL schedule" of 2021.

II. TMDL Priority and Schedule

CLF is greatly concerned with the priority and TMDL schedule assigned to the above impairment listings. The priority assignment of "LOW" and the 2021 TMDL schedule are grossly inconsistent with the value of Great Bay estuary and the severity of the threats facing it. Indeed, NHDES' methodology itself acknowledges the critical nature of problems facing the estuary, and the essential role of eelgrass within the estuary, stating:

> Eelgrass (*Zostera marina*) is the base of the estuarine food web in the Great Bay estuary. Healthy eelgrass beds filter water and stabilize sediments (Short and Short, 1984) and provide habitat for fish and shellfish (Duarte, 2001; Heck et al., 2003).. While eelgrass is only one species in the estuarine community, the presence of eelgrass is critical for the survival of many species. Maintenance of eelgrass habitat should be considered critical in order to "maintain a balanced, integrated, and adaptive community of organisms." Loss of eelgrass habitat would change the species composition of the estuary resulting in a detrimental difference in community structure and function. In particular, if eelgrass habitat is lost, the estuary will likely be colonized by macroalgae species which do not provide the same habitat functions as eelgrass (Short et al., 1995; Hauxwell et al., 2003; McGlathery et al., 2007).

NHDES, Methodology and Assessment Results Related to Eelgrass and Nitrogen in the Great Bay Estuary for Compliance with Water Quality Standards for the New Hampshire 2008 Section 303(d) List (Aug. 11, 2008) (hereinafter "Final Methodology") at 3. The Final Methodology describes massive losses of eelgrass throughout the estuary (*see id.*, generally) and acknowledges the sensitivity of eelgrass to water clarity, including cultural eutrophication from excess nitrogen. *Id.* at 3.

The significant eelgrass losses, and rising nitrogen concentrations, have raised great concern, including the concern that the Great Bay estuary could be approaching a tipping

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[1] Specifically, the List recently submitted by NHDES identifies the following named estuarine assessment units as being impaired for aquatic life uses as a result of eelgrass declines ("Estuarine Bioassessments"): Lamprey River, Squamscott River, Oyster River, Bellamy River North, Bellamy River South, Winnicut River, Adams Point Mooring Field SZ, Adams Point Trib, Lower Little Bay, Lower Little Bay Marina SZ, Lower Little Bay General Sullivan Bridge, Little Bay (North), Oyster River Mouth, Upper Piscataqua River – North, Dover WWTF SZ, Upper Piscataqua River – South, and Lower Piscataqua River. It identifies the following named estuarine assessment units as being impaired for primary contact recreation uses as a result of "Nitrogen (Total)": Salmon Falls River, Lamprey River, Squamscott River, and Oyster River. In addition to the above impairments, the List also identifies the following named estuarine assessment units as threatened, as a result of eelgrass declines ("Estuarine Bioassessments"): Great Bay Prohib SZ1, Great Bay Prohib SZ2, Crommet Creek, Pickering Brook, Fabyan Point, Great Bay Conditionally Approved, and Adams Point South. It also identifies the following named estuarine assessment units as being threatened as a result of eelgrass loss ("Estuarine Bioassessments"): Great Bay Prohib SZ1, Great Bay Prohib SZ2, Crommet Creek, Pickering Brook, Fabyan Point, and Great Bay Conditionally Approved.

point, and could experience the sort of catastrophic changes that have been experienced elsewhere, such as in the Chesapeake Bay. *See* June 3, 2008 Portsmouth Herald Opinion Piece submitted by Drs. David Burdick, Arthur Mathieson, Gregg Moore and Fred Short of the Jackson Estuarine Laboratory (attached). *See also* CLF Comments on State of NH Draft 2008 Section 303(d) List (March 24, 2008), Attachments D, F.

The above estuarine impairments are symptomatic of an ecological crisis which warrant immediate attention, before the situation worsens, and to avoid the threat of significant and widespread changes to the health of the Great Bay estuary. Accordingly, New Hampshire's Section 303(d) List must be amended to assign "High" priority, and an aggressive schedule (no longer than two years) for the development of TMDLs to address these impairments. CLF respectfully requests that EPA require these amendments prior to approving New Hampshire's 2008 Section 303(d) List.

III. Sources of Impairments

NHDES's Final Methodology assesses whether the significant eelgrass losses in Great Bay estuarine waters can be attributed to dredging or mooring fields. It concludes that eelgrass declines in the Winnicut River, Squamscott River, Lamprey River, Oyster River, Bellamy River, Little Bay and Piscataqua River (Upper and Lower) cannot be attributed to dredging activities; that there are only a few minor mooring fields in the Oyster and Bellamy Rivers; that certain mooring fields in Little Bay, and several large mooring fields in the Lower Piscataqua River "seem to overlap with potential and current eelgrass habitat"; and that "there are several large mooring fields [in the Upper Piscataqua River assessment zone] that seem to overlap with potential eelgrass habitat." Final Methodology at 11-14.

For each of the eelgrass-loss and nitrogen impairments described in footnote 1, above, the final 2008 List submitted by NHDES describes the source of impairment as "Source Unknown." Because dredging and mooring activities have not been identified as the sole culprit of eelgrass declines in a single assessment unit, because nitrogen concentrations and total suspended solids (TSS) are both increasing in the estuary, and because nitrogen and TSS both can contribute to eelgrass losses, we urge EPA to require the 2008 List to be amended to include nitrogen and TSS and, where applicable, mooring fields, as sources of eelgrass-loss impairments. We further urge EPA to require the 2008 List to be amended to identify relevant wastewater treatment facilities, and wet weather stormwater discharges, as sources of the nitrogen impairments. *See* CLF Comments on Draft Section 303(d) List (March 24, 2008), Attachment D, p. 13 (identifying wastewater treatment facilities (34 percent), and non-point sources draining to tributaries and directly to the estuary (61 percent collectively) as the primary sources of nitrogen). Absent these amendments, the final 2008 List submitted for EPA's review is simply not complete.

IV. Uses Affected by Nitrogen Impairment

The proposed final 2008 List identifies "Nitrogen (Total)" as impairing Primary Contact Recreation uses in the Squamscott, Lamprey, Oyster and Salmon Falls Rivers. It also identifies the Squamscott, Lamprey and Oyster Rivers as being impaired as a result of eelgrass loss ("Estuarine Bioassessments"). In light of these latter impairment listings (i.e., because these waters have experienced significant eelgrass losses), and because nitrogen levels, and associated chlorophyll-a concentrations and other effects, can contribute to eelgrass losses, we urge EPA to require amendment of the final List to also identify "Nitrogen (Total)" as impairing the Aquatic Life uses of the Squamscott, Lamprey and Oyster Rivers.

V. <u>"Estuarine Bioassessments" Terminology</u>

The final List submitted by NHDES uses the term "Estuarine Bioassessments" to describe impairments associated with eelgrass loss. This terminology provides insufficient information for persons reading the List to understand the nature of this impairment. Accordingly, we request that EPA require the List to be amended to identify impairments associated with eelgrass losses as follows: "Estuarine Bioassessments – eelgrass declines." This change will obviate the need to locate and review NHDES's separate listing methodology to understand the meaning of the vague and generic term "Estuarine Bioassessments," thereby making it more user-friendly.

*   *   *   *

As always, CLF appreciates the opportunity to comment on this matter. Thank you for your ongoing attention to these important issues facing the Great Bay estuary. Should you have any questions about these comments, please do not hesitate to contact me.

Very truly yours,

Thomas F. Irwin,
Senior Attorney

Encl.

cc: Mr. Robert Varney, Regional Adminstrator, EPA-New England
Mr. Harry Stewart, Director, Water Division, NHDES
Mr. Ken Edwardson, NHDES

Exhibit 4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

September 30, 2009

Harry T. Stewart, P.E., Director
New Hampshire Department of Environmental Services
Water Division
6 Hazen Drive, Box 95
Concord, New Hampshire 03302-0095

Re: 2008 Section 303(d) List

Dear Mr. Stewart:

Thank you for submitting New Hampshire's 2008 §303(d) list of water quality limited segments. In accordance with §303(d) of the Clean Water Act (CWA) and 40 CFR §130.7, the U.S. Environmental Protection Agency (EPA) has conducted a complete review of the State's list, including all supporting documentation. Based on this review, EPA has determined that New Hampshire's 2008 §303(d) list meets the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations. Therefore, by this order, EPA hereby approves the State's list, submitted electronically on September 10, 2008, and amended on August 14, 2009 to include listing a number of water body segments in the Great Bay estuary for nitrogen, and amended on September 29, 2009 to retain one water body on the list that had initially been removed from the list.

Thank you for your hard work in developing the 2008 §303(d) list. My staff and I look forward to continuing our work with NHDES to implement the requirements under §303(d) of the CWA. If you have any questions or need additional information please contact Steve Silva at 617-918-1561 or Al Basile at 617-918-1599.

Sincerely,

Lynne A. Hamjian

Lynne Hamjian, Acting Director
Office of Ecosystem Protection

Enclosure

cc: NH DES: Paul Currier, Gregg Comstock, Ken Edwardson
EPA: Steve Silva, Ann Williams, Al Basile, Beth Edwards

EPA Review of New Hampshire's 2008 Section 303(d) List

I. INTRODUCTION

EPA has conducted a complete review of New Hampshire's 2008 Section 303(d) list and supporting documentation. Based on this review, EPA has determined that New Hampshire's list of water quality limited segments (WQLSs) still requiring TMDLs, meets the requirements of Section 303(d) of the Clean Water Act ("CWA" or "the Act") and EPA's implementing regulations. Therefore, by this order, EPA hereby approves New Hampshire's 2008 Section 303(d) list. The statutory and regulatory requirements, and EPA's review of New Hampshire's compliance with each requirement, are described in detail below.

II. STATUTORY AND REGULATORY BACKGROUND

Identification of Water Quality Limited Segments for Inclusion on the 303(d) List

Section 303(d)(1) of the Act directs States to identify those waters within its jurisdiction for which effluent limitations required by Section 301(b)(1)(A) and (B) are not stringent enough to implement any applicable water quality standard, and to establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters. The Section 303(d) listing requirement applies to waters impaired by point and/or nonpoint sources, pursuant to EPA's long-standing interpretation of Section 303(d).

EPA regulations provide that States do not need to list waters where the following controls are adequate to implement applicable standards: (1) technology-based effluent limitations required by the Act, (2) more stringent effluent limitations required by State or local authority, and (3) other pollution control requirements required by State, local, or federal authority. See 40 CFR Section 130.7(b)(1).

Consideration of Existing and Readily Available Water Quality-Related Data and Information

In developing Section 303(d) lists, States are required to assemble and evaluate all existing and readily available water quality-related data and information, including, at a minimum, consideration of existing and readily available data and information about the following categories of waters: (1) waters identified as partially meeting or not meeting designated uses, or as threatened, in the State's most recent Section 305(b) report; (2) waters for which dilution calculations or predictive modeling indicate non-attainment of applicable standards; (3) waters for which water quality problems have been reported by governmental agencies, members of the public, or academic institutions; and (4) waters identified as impaired or threatened in any Section 319 nonpoint assessment submitted to EPA. See 40 CFR §130.7(b)(5). In addition to these minimum categories, States are required to consider any other data and information that is existing and readily available. EPA's 2006 Integrated Report Guidance describes categories of water quality-related data and information that may be existing and readily available. See EPA's October 12, 2006 memorandum on *Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions* which recommended that the 2008 integrated water quality reports follow the *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* (2006 Integrated Report Guidance (IRG)) issued July 29, 2005 (available at http://www.epa.gov/owow/tmdl/2006IRG/) as supplemented by the October 12, 2006 memo and attachments. While States are required to evaluate all existing and readily available water quality-related data and information, States may decide to rely or not rely on particular data or information in determining whether to list particular waters.

In addition to requiring States to assemble and evaluate all existing and readily available water quality-related data and information, EPA regulations at 40 CFR §130.7(b)(6) require States to include as part of their submissions to EPA, documentation to support decisions to rely or not rely on particular data and information and decisions to list or not list waters. Such documentation needs to include, at a minimum, the following information: (1) a description of the methodology used to develop the list; (2) a description of the data and information used to identify waters; and (3) any other reasonable information requested by the Region.

Priority Ranking

EPA regulations also codify and interpret the requirement in Section 303(d)(1)(A) of the Act that States establish a priority ranking for listed waters. The regulations at 40 CFR §130.7(b)(4) require States to prioritize waters on their Section 303(d) lists for TMDL development, and also to identify those WQLSs targeted for TMDL development in the next two years. In prioritizing and targeting waters, States must, at a minimum, take into account the severity of the pollution and the uses to be made of such waters. See Section 303(d)(1)(A). As long as these factors are taken into account, the Act provides that States establish priorities. States may consider other factors relevant to prioritizing waters for TMDL development, including immediate programmatic needs, vulnerability of particular waters as aquatic habitats, recreational, economic, and aesthetic importance of particular waters, degree of public interest and support, and State or national policies and priorities. See 57 FR 33040, 33045 (July 24, 1992), and EPA's 2006 Integrated Report Guidance.

III. ANALYSIS OF NEW HAMPSHIRE'S SUBMISSION

EPA has reviewed the State's submission. The initial submittal was sent electronically on September 10, 2008 (items 1-4). An amendment to the § 2008 303(d) list and associated documents (items 5-7), were sent electronically on Aug 14, 2009. The State sent a further amendment by email on September 29, 2009. The complete submittal package includes the following components:

1. State of New Hampshire 2008 Section 303(d) List;
2. List of waters/impairments being removed from New Hampshire's 2006 303(d) List;
3. New Hampshire's 2008 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM);

4. Response to Public Comments dated September 9, 2008;
5. Amendment to the § 2008 303(d) list, dated August 6, 2009, which adds a number of waterbody segments in the Great Bay estuary to New Hampshire's 2008 303(d) list;
6. Amendment to the § 2008 303(d) list, dated September 29, 2009, which retains Wright Pond on the list as impaired for aluminum.
7. Final report entitled "Numeric Nutrient Criteria for the Great Bay Estuary (June 2009)." The report documents the derivation of numeric targets that will be used to interpret the State's existing narrative nutrient criterion and narrative criteria for biological and aquatic community integrity; and
8. Response to public comments, dated June 10, 2009.

Public Participation

New Hampshire conducted a public participation process in which it provided the public the opportunity to review and comment on the 2008 draft Section 303(d) list. A public comment period was opened upon the release of the draft list on February 22, 2008 and was closed on March 24, 2008. The NHDES posted the draft list on the Department's website and mailed notices to approximately 30 organizations/agencies.

The City of Keene and Conservation Law Foundation (CLF) were the only commenters. The City requested NHDES to remove from the § 303(d) list the segment of the Ashuelot River downstream of the City's wastewater treatment plant discharge. EPA believes NHDES's decision to retain this segment on the § 303(d) list was reasonable because of multiple instream exceedences of the dissolved oxygen criteria since 2001 and the low dilution factor (2:1) associated with the wastewater treatment facility.

CLF raised several concerns about NHDES's failure to list a number of waterbody segments in the Great Bay estuary for impairments due to nitrogen. EPA agreed that the information provided by CLF warranted further evaluation, and EPA encouraged the State to rapidly move forward with the development of numeric nutrient targets for the Great Bay estuary.

On June 10, 2009, the NHDES completed the development of numeric thresholds for nitrogen concentrations, chlorophyll-a and light attenuation for the Great Bay estuary which will be used to translate, or interpret, the State's existing narrative criteria for nutrients and biological and aquatic community integrity, to protect the designated uses of primary contact recreation and aquatic life use support. EPA was heavily engaged throughout the development of the numeric targets, providing both technical assistance and submittal of two rounds of comments, one of which was during the public comment period.

The State plans to formally adopt the numeric targets as water quality criteria and to submit the water quality standards revisions to EPA for approval. In the meantime, as discussed further below, EPA believes that the targets represent a reasonable interpretation of the State's narrative criteria and form an appropriate basis for determining whether additional waters in the Great Bay estuary should be listed on the §303(d) list based on nonattainment with the narrative criteria.

The State conducted a public comment period from December 30, 2008 through March 20, 2009 to solicit comments on: 1) The appropriateness of the numeric targets as an interpretation of the State's narrative nutrient standard, and 2) The proposed listing of additional water body segments in the Great Bay estuary as a result of the newly derived numeric nutrient targets. Over one hundred comments were submitted by twelve entities; all of the comments related to the proposed numeric targets. There were no comments on the additional waters that the State would add to the § 303(d) list on the basis of the proposed numeric targets.

EPA concludes that New Hampshire's public participation process was consistent with its Continuing Planning Process (CPP), and that New Hampshire provided sufficient public notice and opportunities for public involvement and response.

Identification of Waters and Consideration of Existing and Readily Available Water Quality-Related Data and Information

EPA has reviewed the State's submission, and has concluded that the State developed its Section 303(d) list in compliance with Section 303(d) of the Act and 40 CFR § 130.7. EPA's review is based on its analysis of whether the State reasonably considered existing and readily available water quality-related data and information and reasonably identified waters required to be listed.

New Hampshire used the NHDES assessment database to develop its 2008 § 303(d) list. The same database was used to assist in the preparation of the biennial § 305(b) report. Both the § 303(d) and § 305(b) reports were submitted to EPA as an integrated report for 2008. The NHDES provides on-going notice on its website to request data from outside sources. Information received from outside sources was assessed in accordance with the State's assessment methodology. In the development of the 2008 § 303(d) list, New Hampshire began with its existing EPA approved 2006 § 303(d) list and relied on new water quality assessments (i.e., post-2006) to update the list accordingly. New Hampshire believes that information pertaining to impairment status must be well substantiated, preferably with actual monitoring data, for it to be used in § 303(d) listing.

As noted above, the State added additional waters to the § 303(d) list in response to CLF's comments on the draft list and further evaluation of nitrogen-related impairments in the Great bay estuary. As a result of that additional evaluation, which included the development of numeric targets to interpret existing narrative criteria, NHDES added a number of waters to the list. EPA has reviewed the Sate's analysis on which the numeric targets are based, and agrees that the targets reflect a reasonable interpretation of the State's existing narrative criteria. This determination is based on the fact that the State's analysis to derive nutrient targets was very transparent, included significant scientific and stakeholder input, and resulted in targets that were generated from very robust data sets using multiple lines of evidence.

EPA also believes that NHDES made reasonable decisions to include the additional waters in light of the numeric targets. The State reassessed all waters in the Great Bay estuary, appropriately applied the newly derived nutrient targets, and added those assessment units that exceeded the new targets to the 2008 § 303(d) list.

The State provided a rationale for not relying on particular and readily available water quality-related data and information as a basis for listing waters. Beginning with the 1998 list and continuing through the 2008 listing process, New Hampshire chose not to list waters where the only information regarding water quality was unsubstantiated anecdotal information (e.g., citizen complaint). New Hampshire analyzed relevant data and information for each water body in the State in deciding whether there was sufficient, reliable data to support listing. The regulations require states to "assemble and evaluate" all relevant water quality related data and information, and New Hampshire did so for each of its waterbodies. The regulations permit states to decide not to use any particular data and information as a basis for listing, provided they have a reasonable rationale in doing so. New Hampshire's decision not to use unsubstantiated anecdotal information is reasonable in light of the uncertainty about the reliability of such information. Moreover, it is reasonable for New Hampshire to decide to focus its listing and TMDL development resources on waters where water quality impairments are well-documented, rather than on waters with only unreliable water quality information. As additional waters are assessed, EPA expects New Hampshire would add waters to its list where such assessments show water quality standards are not being met.

In certain cases, New Hampshire included waters on the 2008 303(d) list based solely on evaluative information when it had confidence that an impairment exists. In developing the 2008 303(d) list, New Hampshire used data older than five years of age if waters had previously been listed as threatened or impaired, even though data older than five years is considered "evaluative" information under EPA's Section 305(b) guidance. For waters not previously listed, New Hampshire considered only data that were five years old or less for rivers, streams impoundments, estuaries, and ocean waters, and 10 years old or less for lakes and ponds.

The State concluded that the use of data older than five years for waters previously listed (provided that it met all other data requirements stipulated in the assessment methodology) is reasonable in order to prevent removal of waters from a threatened or impaired category. In addition, NHDES has found that the water quality of many lakes and ponds does not change dramatically with time due to their large volume and longer retention times (on the order of years); therefore, use of 10-year-old data is believed to provide a reasonably accurate assessment of water quality conditions for these waterbodies. EPA believes this conclusion is reasonable, and it is consistent with EPA regulations for States to decide to list waters based on data older than five years. The regulations require States to consider all available data, and to use it unless they provide a reasonable rationale for not doing so.

Waters were not added to the 2008 § 303(d) list where limited information might indicate a possible impairment but it was determined to be insufficient (usually not well documented) for the purpose of listing on the § 303(d) list. For each assessment unit not listed, where information indicated that an impairment due to a pollutant may exist, but available information was determined to be insufficient to support a § 303(d) listing, the waterbodies were not included on the § 303(d) list. Instead, they were included in a separate category on the Integrated Report for waters in need of further assessment.

In summary, the NHDES considered the most recent §305(b) assessments, as required by EPA's regulations, and used information obtained primarily through monitoring as the basis for adding water quality impairments to the 2008 §303(d) list. EPA concludes that the State properly assembled and evaluated all existing and readily available data and information, including data and information relating to the categories of waters specified in 40 CFR § 130.7(b)(5).

Priority Ranking

As described in its methodology, New Hampshire established a priority ranking for listed waters by considering: 1) the presence of public health issues, 2) natural/outstanding resource waters, 3) threat to federally threatened or endangered species, 4) public interest, 5) available resources, 6) administrative or legal factors (i.e., NPDES program support or court order), and 7) the likelihood of implementation after the TMDL has been completed.

Individual priority rankings for listed waters are presented as the date shown on the 303(d) list which indicates when the TMDL is expected to be completed. EPA finds that the waterbody prioritization and targeting method used by New Hampshire is reasonable and sufficient for purposes of Section 303(d). The State properly took into account the severity of pollution and the uses to be made of listed waters, as well as other relevant factors described above.

Waters which are not listed on New Hampshire's 2008 § 303(d) List

EPA requested that the State provide a rationale for its decision not to include previously listed waters. As discussed below, the State has demonstrated, to EPA's satisfaction, good cause for not listing these waters, as provided in 40 CFR § 130.7(b)(6)(iv):

1. The NHDES moved 5,123 AU's that were impaired for mercury to Category 4a. EPA concurs with this action as a Statewide mercury TMDL has been approved by EPA. All freshwaters in the State of New Hampshire were previously listed for mercury because of a Statewide fish consumption advisory. To keep the size of this document manageable, individual mercury delistings for fish consumption are not shown.

2. Since the approval of the 2006 303(d) List, the NHDES established 61 new freshwater AU's. The NHDES has placed these new AU's into Category 4a for mercury. EPA agrees that since the coverage of the approved mercury TMDL includes all freshwaters of the State, it is appropriate to place these new AU's into Category 4a and not into Category 5.

AUID	AUID NAME
NHIMP600030701-02	THURSTON POND DAM, DEERFIELD
NHIMP600031004-07	MARY'S POND DAM, SEABROOK
NHIMP700010802-01	SALMON BROOK II DAM

NHLAK600020604-03-02	MOORES POND SKI AND BEACH
NHLAK600020604-03-03	MOORES POND - ASSOCIATION BEACH
NHLAK600030607-05	SCRUTON POND, BARRINGTON
NHLAK700010205-01-01	MIRROR LAKE - MIRROR LAKE BEACH
NHLAK700010601-01-02	SPECTACLE POND - GROTON TOWN BEACH
NHLAK700010603-02-14	NEWFOUND LAKE - HEBRON TOWN BEACH
NHLAK700020110-02-37	LAKE WINNIPESAUKEE WAWBEEK CONDO ASSOC BEACH
NHLAK700030108-03	CAMPBELL POND, ANTRIM, CLS-A
NHLAK700030302-02-02	BLAISDELL LAKE - CAMP WABASSO BEACH
NHLAK700030505-04-01	ROLF POND - SANDY BEACH CAMPGROUND BEACH
NHLAK700060301-05	WHITTIER POND
NHLAK700060302-15	HORSESHOE POND, CANTERBURY
NHLAK700060601-01-02	DEERING RESERVOIR - DEERING LAKE BEACH
NHLAK700060601-01-03	DEERING RESERVOIR - HOPKINTON INDEPENDENT SCHOOL BEACH
NHLAK700060906-03	DREAM LAKE, AMHERST
NHLAK700061001-11	PENNICHUCK POND, HOLLIS
NHLAK700061102-14	WILSON POND, SALEM
NHLAK700061203-05-02	RAINBOW LAKE - KAREN-GENA BEACH
NHLAK700061403-13	CEDAR SWAMP POND, KINGSTON
NHLAK801060105-04-04	MASCOMA LAKE - DARTMOUTH COLLEGE BEACH
NHRIV600020105-09	ICE POND BROOK
NHRIV600020802-07	WEETAMOE BROOK
NHRIV600030603-11	HURD BROOK
NHRIV600030608-16	JACKSON BROOK
NHRIV600030902-15	CHASE BROOK
NHRIV600030903-13	GARRISON BROOK
NHRIV600030904-13	SHAW BROOK
NHRIV600030904-14	BRACKETT BROOK
NHRIV600030904-15	UNNAMED BROOK UNDER BAYSIDE ROAD
NHRIV600030904-16	WILLEY CREEK
NHRIV600030904-17	UNNAMED BROOK
NHRIV600030904-18	UNNAMED BROOK
NHRIV600030904-19	WILLEY CREEK
NHRIV600030904-20	UNNAMED BROOK
NHRIV600030904-21	UNNAMED BROOK
NHRIV600031001-11	UNNAMED STREAM BEHIND CHURCH
NHRIV600031004-17	MARY'S BROOK
NHRIV700010802-10	SALMON BROOK, CWF
NHRIV700020101-22	NORTH INLET TO RUST POND
NHRIV700020103-13	UNNAMED BROOKS TO DINSMORE POND
NHRIV700020108-06	UNNAMED BROOK - HAWKINS POND OUTLET
NHRIV700020201-21	DURKEE BROOK
NHRIV700020202-11	UNNAMED BROOKS TO SAWYER LAKE
NHRIV700030501-16	BEAVER GLEN BROOK
NHRIV700030504-14	UNNAMED BROOK TO FRENCH POND (ALONG FRENCH RD)
NHRIV700060401-12	UNNAMED BROOK TO CRYSTAL LAKE
NHRIV700060703-10	UNNAMED BROOK FROM CRYSTAL LAKE TO COHAS BROOK

NHRIV700061203-25	HOWARD BROOK
NHRIV700061203-26	LAUNCH BROOK
NHRIV801010902-04	INDIAN BROOK
NHRIV801060401-25	ANDERSON POND BROOK
NHRIV801060401-26	STROING BROOK
NHRIV801060405-30	UNNAMED TRIB - TO PERKINS POND
NHRIV801060405-31	UNNAMED TRIB - TO PERKINS POND
NHRIV801060405-32	UNNAMED TRIB - TO PERKINS POND
NHRIV801070203-13	SPRUCE RIVER
NHRIV802010101-19	UNNAMED BROOK - TO SAND POND
NHRIV802010101-20	UNNAMED BROOK - TO SAND POND

3. The NHDES moved 284 AU's that were impaired for pH to Category 4a. EPA concurs with this action, as pH TMDL's have been developed and approved for each of the 284 AU's.

AUID	AU NAME	PRIMARY TOWN	FFY of APPROVAL	TMDL ID
NHLAK600020302-01-02	ECHO LAKE - STATE PARK BEACH	CONWAY	2008	33879
NHLAK600020303-03-02	IONA LAKE - CAMP ALBANY BEACH	ALBANY	2008	33879
NHLAK600020303-07-02	PEQUAKET POND - REC DEPARTMENT BEACH	CONWAY	2008	33879
NHLAK600020701-02-02	LOWER BEECH POND - WILLIAM LAWRENCE CAMP BEACH	TUFTONBORO	2008	33879
NHLAK600020702-01-02	DAN HOLE POND - CAMP MERROVISTA BEACH	TUFTONBORO	2008	33879
NHLAK600020702-01-03	DAN HOLE POND - CAMP SENTINEL BAPTIST BEACH	TUFTONBORO	2008	33879
NHLAK600020801-06-02	SILVER LAKE - MONUMENT BEACH	MADISON	2008	33879
NHLAK600020801-06-03	SILVER LAKE - FOOT OF THE LAKE BEACH	MADISON	2008	33879
NHLAK600020801-06-04	SILVER LAKE - NICHOLS BEACH	MADISON	2008	33879
NHLAK600020801-06-05	SILVER LAKE - KENNETT PARK BEACH	MADISON	2008	33879
NHLAK600020802-04-02	OSSIPEE LAKE - CAMP CALUMET BEACH	OSSIPEE	2008	33879
NHLAK600020802-04-03	OSSIPEE LAKE - DEER COVE PB BEACH	OSSIPEE	2008	33879
NHLAK600020802-04-04	OSSIPEE LAKE - CAMP CODY FOR BOYS BEACH	FREEDOM	2008	33879
NHLAK600020803-08-02	SHAW POND - CAMP WAKUTA BEACH	FREEDOM	2008	33879
NHLAK600020804-01-04	LEAVITT BAY - CAMP MARIST BEACH	EFFINGHAM	2008	33879
NHLAK600020804-01-05	BROAD BAY - CAMP HUCKINS BEACH	FREEDOM	2008	33879
NHLAK600020804-01-06	BROAD BAY - CAMP ROBIN HOOD BEACH	FREEDOM	2008	33879
NHLAK600030601-05-02	SUNRISE LAKE - TOWN BEACH	MIDDLETON	2008	33879
NHLAK600030704-02-02	PAWTUCKAWAY LAKE - PAWTUCKAWAY STATE PARK BEACH	NOTTINGHAM	2008	33879
NHLAK600030704-02-03	PAWTUCKAWAY LAKE - TOWN BEACH	NOTTINGHAM	2008	33879
NHLAK700010802-03-02	HERMIT LAKE - TOWN BEACH	SANBORNTON	2008	33879
NHLAK700010804-01-02	HIGHLAND LAKE - TOWN BEACH	ANDOVER	2008	33879

AUID	AU NAME	PRIMARY TOWN	FFY of APPROVAL	TMDL ID
NHLAK700010804-02-02	WEBSTER LAKE - GRIFFIN TOWN BEACH	FRANKLIN	2008	33879
NHLAK700010804-02-03	WEBSTER LAKE - LEGACE TOWN BEACH	FRANKLIN	2008	33879
NHLAK700020101-05-02	LAKE WENTWORTH - ALBEE BEACH	WOLFEBORO	2008	33879
NHLAK700020101-05-03	LAKE WENTWORTH - WENTWORTH STATE PARK BEACH	WOLFEBORO	2008	33879
NHLAK700020101-05-04	LAKE WENTWORTH - PUBLIC BEACH	WOLFEBORO	2008	33879
NHLAK700020101-05-05	LAKE WENTWORTH - CAMP BERNADETTE BEACH	WOLFEBORO	2008	33879
NHLAK700020101-05-06	LAKE WENTWORTH - CAMP PLEASANT VALLEY BEACH	WOLFEBORO	2008	33879
NHLAK700020101-05-07	LAKE WENTWORTH - PIERCE CAMP BIRCHMONT BEACH	WOLFEBORO	2008	33879
NHLAK700020101-07-02	RUST POND - WOLFEBORO CAMP SCHOOL BEACH	WOLFEBORO	2008	33879
NHLAK700020108-02-03	LAKE WAUKEWAN - TOWN BEACH	MEREDITH	2008	33879
NHLAK700020110-02-04	LAKE WINNIPESAUKEE - MELVIN VILLAGE LAKE TOWN BEACH	TUFTONBORO	2008	33879
NHLAK700020110-02-05	LAKE WINNIPESAUKEE - MOULTONBOROUGH TOWN BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-07	LAKE WINNIPESAUKEE - PUBLIC BEACH	TUFTONBORO	2008	33879
NHLAK700020110-02-08	LAKE WINNIPESAUKEE - CARRY BEACH	WOLFEBORO	2008	33879
NHLAK700020110-02-09	LAKE WINNIPESAUKEE - BREWSTER BEACH	WOLFEBORO	2008	33879
NHLAK700020110-02-10	LAKE WINNIPESAUKEE - ALTON BAY TOWN BEACH	ALTON	2008	33879
NHLAK700020110-02-11	LAKE WINNIPESAUKEE - PUBLIC DOCK TOWN BEACH	ALTON	2008	33879
NHLAK700020110-02-12	LAKE WINNIPESAUKEE - ELACOYA STATE PARK BEACH	GILFORD	2008	33879
NHLAK700020110-02-13	LAKE WINNIPESAUKEE - GILFORD TOWN BEACH	GILFORD	2008	33879
NHLAK700020110-02-14	LAKE WINNIPESAUKEE - ENDICOTT PARK WEIRS BEACH	LACONIA	2008	33879
NHLAK700020110-02-15	LAKE WINNIPESAUKEE - LEAVITT PARK BEACH	MEREDITH	2008	33879
NHLAK700020110-02-16	LAKE WINNIPESAUKEE - TOWN BEACH (CENTER HARBOR)	CENTER HARBOR	2008	33879
NHLAK700020110-02-17	LAKE WINNIPESAUKEE - STATES LANDING TOWN BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-20	LAKE WINNIPESAUKEE - CAMP ALTON BEACH	ALTON	2008	33879
NHLAK700020110-02-21	LAKE WINNIPESAUKEE - BROOKWOOD/DEER RUN BEACH	ALTON	2008	33879
NHLAK700020110-02-22	LAKE WINNIPESAUKEE - CAMP KABEYUN BEACH	ALTON	2008	33879
NHLAK700020110-02-23	LAKE WINNIPESAUKEE - CAMP LAWRENCE BEACH	MEREDITH	2008	33879
NHLAK700020110-02-24	LAKE WINNIPESAUKEE - CAMP	MEREDITH	2008	33879

AUID	AU NAME	PRIMARY TOWN	FFY of APPROVAL	TMDL ID
	MENOTOMY BEACH			
NHLAK700020110-02-25	LAKE WINNIPESAUKEE - CAMP NOKOMIS BEACH	MEREDITH	2008	33879
NHLAK700020110-02-26	LAKE WINNIPESAUKEE - GENEVA POINT CENTER BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-27	LAKE WINNIPESAUKEE - WINAUKEE ISLAND CAMP BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-28	LAKE WINNIPESAUKEE - CAMP ROBINDEL FOR GIRLS BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-29	LAKE WINNIPESAUKEE - CAMP TECUMSEH BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-30	LAKE WINNIPESAUKEE - CAMP WINAUKEE BEACH	MOULTONBOROUGH	2008	33879
NHLAK700020110-02-31	LAKE WINNIPESAUKEE - CAMP BELKNAP BEACH	TUFTONBORO	2008	33879
NHLAK700020110-02-32	LAKE WINNIPESAUKEE - CAMP NORTH WOODS BEACH	TUFTONBORO	2008	33879
NHLAK700020110-02-33	LAKE WINNIPESAUKEE - CAMP SANDY ISLAND BEACH	TUFTONBORO	2008	33879
NHLAK700020110-02-34	LAKE WINNIPESAUKEE - CAMP DEWITT BEACH	ALTON	2008	33879
NHLAK700020110-02-35	LAKE WINNIPESAUKEE - WANAKEE METHODIST CHURCH BEACH	MEREDITH	2008	33879
NHLAK700020201-05-02	LAKE WINNISQUAM - TOWN BEACH	SANBORNTON	2008	33879
NHLAK700020201-05-03	LAKE WINNISQUAM - BARTLETTS BEACH	LACONIA	2008	33879
NHLAK700020201-05-04	LAKE WINNISQUAM - BELMONT TOWN BEACH	BELMONT	2008	33879
NHLAK700020201-05-05	LAKE WINNISQUAM - AHERN STATE PARK	LACONIA	2008	33879
NHLAK700030105-01-02	ZEPHYR LAKE - TOWN BEACH	GREENFIELD	2008	33879
NHLAK700030105-02-03	OTTER LAKE - GREENFIELD SP PICNIC BEACH	GREENFIELD	2008	33879
NHLAK700030105-02-04	OTTER LAKE - GREENFIELD SP MIDDLE BEACH	GREENFIELD	2008	33879
NHLAK700030105-02-05	OTTER LAKE - GREENFIELD SP CAMPING BEACH	GREENFIELD	2008	33879
NHLAK700030105-02-06	OTTER LAKE - CAMP UNION BEACH	GREENFIELD	2008	33879
NHLAK700030105-02-07	OTTER LAKE - GREENFIELD SP BEACH	GREENFIELD	2008	33879
NHLAK700030105-03-02	SUNSET LAKE - TOWN BEACH	GREENFIELD	2008	33879
NHLAK700030105-03-03	SUNSET LAKE - NASHUA FRESH AIR CAMP BEACH	GREENFIELD	2008	33879
NHLAK700030402-02-02	PLEASANT LAKE - ELKINS BEACH	NEW LONDON	2008	33879
NHLAK700030505-01-02	CLEMENT POND - CAMP MERRIMAC BEACH	HOPKINTON	2008	33879
NHLAK700040401-01-02	MELENDY POND - TOWN BEACH	BROOKLINE	2008	33879
NHLAK700040401-02-02	LAKE POTANIPO - TOWN BEACH	BROOKLINE	2008	33879
NHLAK700040401-02-03	POTANIPO POND - CAMP TEVYA BEACH	BROOKLINE	2008	33879
NHLAK700060101-02-02	SONDOGARDY POND - GLINES PARK BEACH	NORTHFIELD	2008	33879

AUID	AU NAME	PRIMARY TOWN	FFY of APPROVAL	TMDL ID
NHLAK700060201-01-02	LOON LAKE - LOON LAKE BEACH	GILMANTON	2008	33879
NHLAK700060202-03-02	CLOUGH POND - TOWN BEACH	LOUDON	2008	33879
NHLAK700060401-02-02	CRYSTAL LAKE-TOWN BEACH	GILMANTON	2008	33879
NHLAK700060401-06-02	MANNING LAKE - CAMP BELL BEACH	GILMANTON	2008	33879
NHLAK700060402-03-02	HALFMOON LAKE - CAMP MI-TE-NA BEACH	ALTON	2008	33879
NHLAK700060403-01-02	BIG WILLEY POND - CAMP FOSS BEACH	STRAFFORD	2008	33879
NHLAK700060403-01-03	BIG WILLEY POND - PARKER MTN BEACH	STRAFFORD	2008	33879
NHLAK700060501-03-02	WILD GOOSE POND - WILD GOOSE POND BEACH	PITTSFIELD	2008	33879
NHLAK700060501-03-03	WILD GOOSE POND - WILD GOOSE CAMP BEACH	PITTSFIELD	2008	33879
NHLAK700060503-01-02	BEAR HILL POND - BEAR HILL POND BEACH	ALLENSTOWN	2008	33879
NHLAK700060601-03-02	PLEASANT LAKE - PUBLIC ACCESS BEACH	HENNIKER	2008	33879
NHLAK700061203-06-02	ROBINSON POND - TOWN BEACH	HUDSON	2008	33879
NHLAK700061203-06-03	UNKNOWN POND - CAMP WINAHUPE BEACH	HUDSON	2008	33879
NHLAK700061204-02-02	LITTLE ISLAND POND - CAMP RUNELS BEACH	PELHAM	2008	33879
NHLAK801010707-01-02	CHRISTINE LAKE - TB BEACH	STARK	2008	33879
NHLAK801040201-03-02	LAKE TARLETON - KINGSWOOD CAMP BEACH	PIERMONT	2008	33879
NHLAK801040203-01-02	POST POND - CHASE TOWN BEACH	LYME	2008	33879
NHLAK801060401-08-02	KOLEMOOK LAKE - TOWN BEACH	SPRINGFIELD	2008	33879
NHLAK801060402-04-02	LITTLE SUNAPEE LAKE - BUCKLIN TOWN BEACH	NEW LONDON	2008	33879
NHLAK801060402-04-03	LITTLE LAKE SUNAPEE - COLBY LODGE BEACH	NEW LONDON	2008	33879
NHLAK801060402-05-02	SUNAPEE LAKE - GEORGES MILL TOWN BEACH	SUNAPEE	2008	33879
NHLAK801060402-05-03	SUNAPEE LAKE - DEWEY (TOWN) BEACH	SUNAPEE	2008	33879
NHLAK801060402-05-04	SUNAPEE LAKE - BLODGETT'S LANDING BEACH	NEWBURY	2008	33879
NHLAK801060402-05-05	SUNAPEE LAKE - SUNAPEE STATE PARK BEACH	NEWBURY	2008	33879
NHLAK801060402-05-06	SUNAPEE LAKE - DEPOT BEACH	NEWBURY	2008	33879
NHLAK801060402-12-02	OTTER POND - MORGAN BEACH	NEW LONDON	2008	33879
NHLAK801060403-04-02	RAND POND - PUBLIC WAY BEACH	GOSHEN	2008	33879
NHLAK801070503-01-02	SPOFFORD LAKE - ACCESS RD TOWN BEACH	CHESTERFIELD	2008	33879
NHLAK801070503-01-03	SPOFFORD LAKE - N SHORE RD TOWN BEACH	CHESTERFIELD	2008	33879
NHLAK801070503-01-04	SPOFFORD LAKE - WARES GROVE TOWN BEACH	CHESTERFIELD	2008	33879
NHLAK801070503-01-05	SPOFFORD LAKE - CAMP SPOFFORD	CHESTERFIELD	2008	33879

AUID	AU NAME	PRIMARY TOWN	FFY of APPROVAL	TMDL ID
	BEACH			
NHLAK801070503-01-06	SPOFFORD LAKE - ROADS END FARM BEACH	CHESTERFIELD	2008	33879
NHLAK802010202-07-02	RUSSEL RESERVOIR - CHESHAM BEACH	HARRISVILLE	2008	33879
NHLAK802010302-01-02	SWANZEY LAKE - RICHARDSON PARK TOWN BEACH	SWANZEY	2008	33879
NHLAK802010302-01-03	SWANZEY LAKE - CAMP SQUANTO BEACH	SWANZEY	2008	33879
NHIMP700060302-02	HAYWARD BROOK/MORRILL POND	CANTERBURY	2007	33878
NHIMP700060502-01	DURGIN POND OUTLET	NORTHWOOD	2007	33878
NHIMP700061403-04	POWWOW POND	KINGSTON	2007	33878
NHLAK600020202-01	FALLS POND	ALBANY	2007	33878
NHLAK600020302-01-01	ECHO LAKE	CONWAY	2007	33878
NHLAK600020303-03	IONA LAKE	ALBANY	2007	33878
NHLAK600020303-05	BIG PEA PORRIDGE POND	MADISON	2007	33878
NHLAK600020303-06	MIDDLE PEA PORRIDGE POND	MADISON	2007	33878
NHLAK600020303-07-01	PEQUAWKET POND	CONWAY	2007	33878
NHLAK600020303-09	WHITTON POND	ALBANY	2007	33878
NHLAK600020604-03	MOORES POND	TAMWORTH	2007	33878
NHLAK600020701-02	LOWER BEECH POND	TUFTONBORO	2007	33878
NHLAK600020701-04	UPPER BEECH POND	WOLFEBORO	2007	33878
NHLAK600020702-01	DAN HOLE POND	TUFTONBORO	2007	33878
NHLAK600020703-03	PINE RIVER POND	WAKEFIELD	2007	33878
NHLAK600020703-04	WHITE POND	OSSIPEE	2007	33878
NHLAK600020801-01	BLUE POND	MADISON	2007	33878
NHLAK600020801-05	MACK POND	MADISON	2007	33878
NHLAK600020801-06-01	SILVER LAKE	MADISON	2007	33878
NHLAK600020802-04-01	OSSIPEE LAKE	OSSIPEE	2007	33878
NHLAK600020803-01-01	LOWER DANFORTH POND	FREEDOM	2007	33878
NHLAK600020803-01-02	MIDDLE DANFORTH POND	FREEDOM	2007	33878
NHLAK600020803-03	UPPER DANFORTH POND	FREEDOM	2007	33878
NHLAK600020803-08	SHAW POND	FREEDOM	2007	33878
NHLAK600020804-01-01	BERRY BAY	FREEDOM	2007	33878
NHLAK600020804-01-02	LEAVITT BAY	OSSIPEE	2007	33878
NHLAK600020804-01-03	BROAD BAY	FREEDOM	2007	33878
NHLAK600020902-01	PROVINCE LAKE	EFFINGHAM	2007	33878
NHLAK600021001-01	BALCH POND	WAKEFIELD	2007	33878
NHLAK600030403-02	HORN POND	WAKEFIELD	2007	33878
NHLAK600030601-05-01	SUNRISE LAKE	MIDDLETON	2007	33878
NHLAK600030602-03	ROCHESTER RESERVOIR	ROCHESTER	2007	33878
NHLAK600030605-01	NIPPO POND	BARRINGTON	2007	33878
NHLAK600030704-02-01	PAWTUCKAWAY LAKE	NOTTINGHAM	2007	33878
NHLAK600030802-01	HUNT POND	SANDOWN	2007	33878

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NHLAK700010104-02	LOON POND	LINCOLN	2007	33878
NHLAK700010205-01	MIRROR LAKE	WOODSTOCK	2007	33878
NHLAK700010304-04	MCCUTCHEON POND	DORCHESTER	2007	33878
NHLAK700010304-05	POUT POND	DORCHESTER	2007	33878
NHLAK700010401-03	CONE POND	THORNTON	2007	33878
NHLAK700010402-03	LOWER HALL POND	SANDWICH	2007	33878
NHLAK700010402-05	UPPER HALL POND	SANDWICH	2007	33878
NHLAK700010402-08	LITTLE PERCH POND	CAMPTON	2007	33878
NHLAK700010501-01	BARVILLE POND	SANDWICH	2007	33878
NHLAK700010501-02	INTERVALE POND	SANDWICH	2007	33878
NHLAK700010501-03	KUSUMPE POND	SANDWICH	2007	33878
NHLAK700010502-04	SKY POND	NEW HAMPTON	2007	33878
NHLAK700010701-03	ORANGE POND	ORANGE	2007	33878
NHLAK700010701-05	WAUKEENA LAKE	DANBURY	2007	33878
NHLAK700010702-02	SCHOOL POND	DANBURY	2007	33878
NHLAK700010802-03-01	HERMIT LAKE	SANBORNTON	2007	33878
NHLAK700010802-04	RANDLETT POND	MEREDITH	2007	33878
NHLAK700010802-05	MOUNTAIN POND	SANBORNTON	2007	33878
NHLAK700010804-01-01	HIGHLAND LAKE	ANDOVER	2007	33878
NHLAK700010804-02-01	WEBSTER LAKE	FRANKLIN	2007	33878
NHLAK700020101-05-01	LAKE WENTWORTH	WOLFEBORO	2007	33878
NHLAK700020101-07-01	RUST POND	WOLFEBORO	2007	33878
NHLAK700020108-02-01	LAKE WAUKEWAN	MEREDITH	2007	33878
NHLAK700020108-02-02	LAKE WINONA	NEW HAMPTON	2007	33878
NHLAK700020108-04	HAWKINS POND	CENTER HARBOR	2007	33878
NHLAK700020110-02-01	PAUGUS BAY	LACONIA	2007	33878
NHLAK700020110-02-19	LAKE WINNIPESAUKEE	ALTON	2007	33878
NHLAK700020110-05	SALTMARSH POND	GILFORD	2007	33878
NHLAK700020201-05-01	LAKE WINNISQUAM	LACONIA	2007	33878
NHLAK700020202-03	POUT POND	BELMONT	2007	33878
NHLAK700020202-04	SARGENT LAKE	BELMONT	2007	33878
NHLAK700030101-08	GRASSY POND	RINDGE	2007	33878
NHLAK700030101-12	POOL POND	RINDGE	2007	33878
NHLAK700030101-13	BULLET POND	RINDGE	2007	33878
NHLAK700030103-02	TOLMAN POND	NELSON	2007	33878
NHLAK700030103-03	JUGGERNAUT POND	HANCOCK	2007	33878
NHLAK700030103-09	SPOONWOOD LAKE	NELSON	2007	33878
NHLAK700030103-10	DINSMORE POND	HARRISVILLE	2007	33878
NHLAK700030105-01-01	ZEPHYR LAKE	GREENFIELD	2007	33878
NHLAK700030105-02-01	OTTER LAKE	GREENFIELD	2007	33878
NHLAK700030105-03-01	SUNSET LAKE	GREENFIELD	2007	33878
NHLAK700030107-01	WILLARD POND	ANTRIM	2007	33878
NHLAK700030202-06	BAGLEY POND	WINDSOR	2007	33878

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NHLAK700030203-02	SMITH POND	WASHINGTON	2007	33878
NHLAK700030203-03	TROUT POND	STODDARD	2007	33878
NHLAK700030204-04	LOON POND	HILLSBOROUGH	2007	33878
NHLAK700030302-02	BLAISDELL LAKE	SUTTON	2007	33878
NHLAK700030302-04-01	LAKE MASSASECUM	BRADFORD	2007	33878
NHLAK700030304-05	TOM POND	WARNER	2007	33878
NHLAK700030304-07	TUCKER POND	SALISBURY	2007	33878
NHLAK700030304-08	LAKE WINNEPOCKET	WEBSTER	2007	33878
NHLAK700030401-02	BUTTERFIELD POND	WILMOT	2007	33878
NHLAK700030402-01	CHASE POND	WILMOT	2007	33878
NHLAK700030402-02-01	PLEASANT LAKE	NEW LONDON	2007	33878
NHLAK700030403-05	HORSESHOE POND	ANDOVER	2007	33878
NHLAK700030502-03	BEAR POND	WARNER	2007	33878
NHLAK700030505-01	CLEMENT POND	HOPKINTON	2007	33878
NHLAK700040401-01-01	MELENDY POND	BROOKLINE	2007	33878
NHLAK700040401-02-01	POTANIPO POND	BROOKLINE	2007	33878
NHLAK700060101-01	SHAW POND	FRANKLIN	2007	33878
NHLAK700060101-02-01	SONDOGARDY POND	NORTHFIELD	2007	33878
NHLAK700060201-01-01	LOON POND	GILMANTON	2007	33878
NHLAK700060201-03	NEW POND	CANTERBURY	2007	33878
NHLAK700060202-03-01	CLOUGH POND	LOUDON	2007	33878
NHLAK700060202-04	CROOKED POND	LOUDON	2007	33878
NHLAK700060401-02-01	CRYSTAL LAKE	GILMANTON	2007	33878
NHLAK700060401-06	MANNING LAKE	GILMANTON	2007	33878
NHLAK700060401-12	SUNSET LAKE	ALTON	2007	33878
NHLAK700060402-03	HALFMOON LAKE	ALTON	2007	33878
NHLAK700060402-05	HUNTRESS POND	BARNSTEAD	2007	33878
NHLAK700060403-01	BIG WILLEY POND	STRAFFORD	2007	33878
NHLAK700060403-02	LITTLE WILLEY POND	STRAFFORD	2007	33878
NHLAK700060501-03	WILD GOOSE POND	PITTSFIELD	2007	33878
NHLAK700060501-08	BERRY POND	PITTSFIELD	2007	33878
NHLAK700060502-03	CHESTNUT POND	EPSOM	2007	33878
NHLAK700060503-01	BEAR HILL POND	ALLENSTOWN	2007	33878
NHLAK700060601-01	DEERING RESERVOIR	DEERING	2007	33878
NHLAK700060601-02	DUDLEY POND	DEERING	2007	33878
NHLAK700060601-03-01	PLEASANT POND	HENNIKER	2007	33878
NHLAK700060602-02	MOUNT WILLIAM POND	WEARE	2007	33878
NHLAK700060604-01	PLEASANT POND	FRANCESTOWN	2007	33878
NHLAK700060607-03	LONG POND	DUNBARTON	2007	33878
NHLAK700060702-03	MASSABESIC LAKE	AUBURN	2007	33878
NHLAK700060802-02	LAKINS POND	HOOKSETT	2007	33878
NHLAK700060802-03	PINNACLE POND	HOOKSETT	2007	33878
NHLAK700060803-02	STEVENS POND	MANCHESTER	2007	33878

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NHLAK700061002-03	HORSESHOE POND	MERRIMACK	2007	33878
NHLAK700061101-01-01	ISLAND POND	HAMPSTEAD	2007	33878
NHLAK700061203-06-01	ROBINSON POND	HUDSON	2007	33878
NHLAK700061204-02	LITTLE ISLAND POND	PELHAM	2007	33878
NHLAK700061204-03	ROCK POND	WINDHAM	2007	33878
NHLAK700061205-01	GUMPAS POND	PELHAM	2007	33878
NHLAK801010102-03	ROUND POND	PITTSBURG	2007	33878
NHLAK801010707-01-01	CHRISTINE LAKE	STARK	2007	33878
NHLAK801040201-03	LAKE TARLETON	PIERMONT	2007	33878
NHLAK801040203-01-01	POST POND	LYME	2007	33878
NHLAK801060101-03	CUMMINS POND	DORCHESTER	2007	33878
NHLAK801060101-05	RESERVOIR POND	DORCHESTER	2007	33878
NHLAK801060103-02	LITTLE GOOSE POND	CANAAN	2007	33878
NHLAK801060104-02	GRAFTON POND	GRAFTON	2007	33878
NHLAK801060401-06	EASTMAN POND	GRANTHAM	2007	33878
NHLAK801060401-08-01	KOLELEMOOK LAKE	SPRINGFIELD	2007	33878
NHLAK801060402-04-01	LITTLE SUNAPEE LAKE	NEW LONDON	2007	33878
NHLAK801060402-05-01	SUNAPEE LAKE	SUNAPEE	2007	33878
NHLAK801060402-11	MOUNTAINVIEW LAKE	SUNAPEE	2007	33878
NHLAK801060402-12-01	OTTER POND	SUNAPEE	2007	33878
NHLAK801060403-01	GILMAN POND	UNITY	2007	33878
NHLAK801060403-04-01	RAND POND	GOSHEN	2007	33878
NHLAK801060404-01	ROCKYBOUND POND	CROYDON	2007	33878
NHLAK801070201-01	CRESCENT LAKE	CRESCENT LAKE	2007	33878
NHLAK801070503-01-01	SPOFFORD LAKE	CHESTERFIELD	2007	33878
NHLAK802010102-05	BARRETT POND	WASHINGTON	2007	33878
NHLAK802010104-01	CALDWELL POND	ALSTEAD	2007	33878
NHLAK802010104-03	CRANBERRY POND	ALSTEAD	2007	33878
NHLAK802010202-02	CHILDS BOG	HARRISVILLE	2007	33878
NHLAK802010202-07	RUSSELL RESERVOIR	HARRISVILLE	2007	33878
NHLAK802010202-14	BABBIDGE RESERVOIR	ROXBURY	2007	33878
NHLAK802010302-01-01	SWANZEY LAKE	SWANZEY	2007	33878
NHLAK802010303-02	MEETINGHOUSE POND	MARLBOROUGH	2007	33878
NHLAK802010303-07	SAND POND	TROY	2007	33878
NHLAK802010303-10	WILSON POND	SWANZEY	2007	33878
NHLAK802020103-04	EMERSON POND	RINDGE	2007	33878
NHLAK802020202-01	COLLINS POND	FITZWILLIAM	2007	33878
NHLAK600030604-01-02	BOW LAKE - TOWN BEACH	STRAFFORD	2006	32408
NHLAK600030604-01-03	BOW LAKE – MARY WALDRON BEACH	STRAFFORD	2006	32409
NHLAK600030604-01-04	BOW LAKE – BENNETT BRIDGE BEACH	STRAFFORD	2006	32410
NHLAK700030102-01-02	THORNDIKE POND – TOWN BEACH	JAFFREY	2006	30636
NHLAK700030103-05-02	HARRISVILLE POND – SUNSET TOWN BEACH	HARRISVILLE	2006	30661

AUID	AU NAME	PRIMARY TOWN	FFY of APPROVAL	TMDL ID
NHLAK700030108-02-02	GREGG LAKE – TOWN BEACH	ANTRIM	2006	30637
NHLAK700060502-08-02	NORTHWOOD LAKE – TOWN BEACH	NORTHWOOD	2006	30638
NHLAK700060502-09-02	PLEASANT LAKE – VEASEY PARK BEACH	DEERFIELD	2006	30639
NHLAK700061002-01-02	DARRAH POND – TOWN BEACH	LITCHFIELD	2006	30662
NHLAK801030302-01-02	ECHO LAKE – FRANCONIA STATE PARK BEACH	FRANCONIA	2006	30640
NHLAK802010303-05-02	STONE POND – TOWN BEACH	MARLBOROUGH	2006	30641
NHLAK802020101-01-02	CAMP TOAH NIPI BEACH ON PECKER POND	RINDGE	2006	22528

4. Since the approval of the 2006 § 303(d) List, the NHDES has established eight new beach AU's on ponds that already have approved TMDL's for pH impairments. EPA concurs that it is appropriate to list the eight AU's in Category 4a for pH, as the TMDL's developed for the parent lakes will also address impairments at the beach AU's.

AUID	AU NAME	New AUID as of	Parent Lake TMDL ID
NHLAK600020604-03-02	MOORES POND SKI AND BEACH (NH635571)	07/05/2006	33878
NHLAK600020604-03-03	MOORES POND - ASSOCIATION BEACH (NH173393)-	07/05/2006	33878
NHLAK700020110-02-37	LAKE WINNIPESAUKEE WAWBEEK CONDO ASSOC BEACH (NH283207)	07/05/2006	33878
NHLAK700010601-01-02	SPECTACLE POND - GROTON TOWN BEACH (NH883841)	07/05/2006	11453
NHLAK700030302-02-02	CAMP WABASSO BEACH (NH770125) ON BLAISDELL LAKE	04/20/2007	33878
NHLAK700060601-01-02	DEERING LAKE BEACH (NH476110) ON DEERING RESERVOIR	04/20/2007	33878
NHLAK700060601-01-03	HOPKINTON INDEPENDENT SCHOOL BEACH (NH770215) ON DEERING RESERVOIR	04/20/2007	33878
NHLAK700010205-01-01	MIRROR LAKE BEACH (NH224709) ON MIRROR LAKE	04/20/2007	33878

5. The NHDES moved 21 AU's that were impaired for aluminum to Category 4a. EPA agrees that this action is appropriate because the aluminum impairments will be addressed by the already approved TMDL's for low pH. Low pH can mobilize aluminum from soil and rock, thus resulting in exceedence of water quality standards. According to NHDES, there are no known sources of aluminum in the 21 AU's other than leaching resulting from low pH.[1]

1. NHDES had also initially moved Wright Pond (NHLAK801010103-03), which had previously been listed for impairment due to aluminum, to Category 2 (fully supporting), based on a determination that the aluminum levels were due solely to naturally low pH, which causes aluminum to be mobilized from soil/rock. After discussions with EPA, NHDES added Wright Pond back onto the § 303(d) list, because acid rain, not just naturally low levels of pH,

AUID	AUID Name
NHLAK400010502-02	CORSER POND, ERROL
NHLAK400010502-05	SWEAT POND, ERROL
NHLAK600020102-02	SAWYER POND, LITTLE, LIVERMORE
NHLAK600020602-02	FLAT MOUNTAIN POND (1&2), WATERVILLE VALLEY
NHLAK700010104-01	BLACK POND, LINCOLN
NHLAK700010201-03	LONESOME LAKE, LINCOLN
NHLAK700010203-02	RUSSELL POND, WOODSTOCK, W/CWF
NHLAK700010204-01	EAST POND, LIVERMORE
NHLAK700010205-02	PEAKED HILL POND, THORNTON, CWF
NHLAK700010304-02	DERBY POND, ORANGE
NHLAK700010307-01	LOON LAKE, PLYMOUTH, WWF
NHLAK700010401-04	GREELEY POND (UPPER), LIVERMORE
NHLAK700010402-04	HALL POND, MIDDLE, SANDWICH, CWF
NHLAK700030301-01	SOLITUDE, LAKE, NEWBURY
NHLAK801010706-01	BOG POND, LITTLE, ODELL
NHLAK801030302-01-01	ECHO LAKE, FRANCONIA
NHLAK801030302-01-02	FRANCONIA STATE PARK ECHO LAKE
NHLAK801030701-01	CONSTANCE LAKE, PIERMONT
NHLAK801060401-07	HALFMILE POND, ENFIELD
NHLAK802010101-04	LONG POND, LEMPSTER
NHLAK802010101-06-01	MILLEN POND, WASHINGTON

6. The NHDES moved one AU that was impaired for shellfishing and primary contact recreation to Category 4a. EPA concurs with this decision, as this AU has an EPA approved TMDL that addresses both uses.

AUID	AU Name
NHEST600031002-02	Little Harbor, C-Ap, 197.98, Ac

7. The NHDES moved one AU that was impaired for primary contact recreation to Category 2 (fully supporting for this use). EPA agrees that this action is appropriate as the source of the impairment, a failed septic system, has been removed and sampling data has demonstrated attainment of water quality criteria. Follow-up water quality monitoring has included analysis of 40 samples.

AUID	AU Name
NHEST600031001-05	Back Channel, P/SZ, 421.64, Ac

contributes to aluminum leaching into the water body. Unlike the other lakes and ponds with high aluminum levels due to acid rain, Wright Pond is not addressed by any of the pH TMDLs that have been approved.

8. The NHDES moved two AU's that were impaired for primary contact recreation to Category 4a. The EPA concurs with this decision, as both AU's have an approved TMDL.

AUID	AU Name
NHIMP802010303-04-02	SAND DAM VILLAGE POND-TOWN BEACH
NHIMP700030204-05-02	MILL POND-TOWN BEACH

9. The NHDES moved one AU that was impaired for primary contact recreation to Category 2 (fully supporting for this use). The EPA agrees that this action is appropriate because more recent sampling conducted in 2002, 2003, 2004, 2005, 2006 and 2007 have revealed that water quality criteria for primary contact recreation are in full support. The original listing was based upon sampling conducted on a single day in 2001.

AUID	AU Name
NHRIV700010303-09-02	LOWER BAKER RIVER-TOWN BEACH

10. The NHDES moved seven AU's that were impaired for lead (Pb) to Category 3 (Insufficient Information). The NHDES has reported that the original listing was in error, as all collected samples were below the analytical detection limit. EPA concurs with the State's decision to move these waters to Category 3.

AUID	AU Name	Number of Lead Samples	Number of lead samples below the analytical detection limit
NHRIV600020305-02	Saco River	9	9
NHRIV600020106-08	Saco River	2	2
NHRIV600020202-05-01	Swift River	2	2
NHRIV600020202-05-02	ROCKY GORGE-SWIFT RIVER	2	2
NHRIV600020202-05-03	LOWER FALLS-SWIFT RIVER	2	2
NHRIV600020203-01	Swift River	2	2
NHRIV600020302-05-02	Kearsarge Brook	2	2

12. The NHDES moved 36 AU's that were listed as impaired for fish consumption due to PCB's to Category 3 (Insufficient Information). NHDES explained that it believed that the reason for listing in previous cycles was because PCB's have been detected in the tissue of fish taken from the Connecticut River. However, the concentrations were below the threshold that would trigger a fish consumption advisory, according to both NHDES and the NH Environmental Health Program (NHEHP). NHDES interprets its designated use of "fish consumption" to be in attainment if there are no "restricted consumption" or "no consumption" fish advisories in effect. Given that the levels

of PCB's in the tissue of fish from the Connecticut River are below levels that would trigger a consumption advisory, EPA believes that NHDES's decision to move these AU's to Category 3 is reasonable.

AUID	AU Name
NHIMP801010305-01	CONNECTICUT RIVER - CANAAN HYDRO
NHIMP801030201-01	CONNECTICUT RIVER - GILMAN DAM POND
NHIMP801030203-01	CONNECTICUT RIVER - COMERFORD STORAGE DAM
NHIMP801030205-02	CONNECTICUT RIVER - MCINDOES RESERVOIR
NHIMP801030206-01-01	CONNECTICUT RIVER - DODGE FALLS (TAILRACE OF MCINDOES DAM)
NHIMP801030206-01-02	CONNECTICUT RIVER - DODGE FALLS
NHIMP801060703-05	CONNECTICUT RIVER - BELLOWS FALLS
NHIMP801070507-01	CONNECTICUT RIVER - VERNON DAM
NHLAK801030202-01	MOORE RESERVOIR
NHLAK801040402-03	WILDER LAKE
NHRIV801010203-04	CONNECTICUT RIVER
NHRIV801010203-07	CONNECTICUT RIVER
NHRIV801010305-01	CONNECTICUT RIVER
NHRIV801010305-02	CONNECTICUT RIVER
NHRIV801010404-02	CONNECTICUT RIVER
NHRIV801010405-03	CONNECTICUT RIVER
NHRIV801010603-05	CONNECTICUT RIVER
NHRIV801010902-02	CONNECTICUT RIVER
NHRIV801010902-03	CONNECTICUT RIVER
NHRIV801010903-02	CONNECTICUT RIVER
NHRIV801030201-02	CONNECTICUT RIVER
NHRIV801030203-01	CONNECTICUT RIVER
NHRIV801030205-02	CONNECTICUT RIVER
NHRIV801030206-03	CONNECTICUT RIVER
NHRIV801030703-04	CONNECTICUT RIVER
NHRIV801040205-06	CONNECTICUT RIVER
NHRIV801040402-13	CONNECTICUT RIVER
NHRIV801060302-01	CONNECTICUT RIVER
NHRIV801060302-05	CONNECTICUT RIVER
NHRIV801060305-12	CONNECTICUT RIVER
NHRIV801060702-12	CONNECTICUT RIVER
NHRIV801070501-10-01	CONNECTICUT RIVER - BYPASSED RIVER REACH BELOW BELLOWS FALLS DAM
NHRIV801070501-10-02	CONNECTICUT RIVER
NHRIV801070502-06	CONNECTICUT RIVER
NHRIV801070505-10	CONNECTICUT RIVER
NHRIV802010501-05	CONNECTICUT RIVER

13. The NHDES moved two AU's to Category 2 (Fully Supporting) for both primary and secondary contact recreation (sedimentation/siltation). The original impairments and subsequent listings were the result of direct stormwater discharges. Sediment deltas formed in the lake below each of the