RESPONSE TO PUBLIC COMMENTS

From June 22, 2006 to August 25, 2006, the United States Environmental Protection Agency ("EPA" or "Region") solicited public comments on a draft National Pollutant Discharge Elimination System ("NPDES") permit, developed pursuant to an application from the City of Keene, New Hampshire ("City" or "Permittee") for its wastewater treatment plant, located in Swanzey, New Hampshire. The Keene Wastewater Treatment Facility ("Keene WWTF") discharges to the Ashuelot River, which has been designated as a Class B water under New Hampshire Surface Water Quality Regulations. A public hearing was held on July 27, 2006 at the Keene Public Library.

Extensive comments were received from the City and its consultant, Camp, Dresser and McKee, during the pubic comment period. Additional comments were received from the following parties:

Town of Swanzey Sewer Commission
Ms. Barbara Skuly, Chairman, Ashuelot River Local Advisory Committee

After a review of the comments received, EPA and NHDES have made a final decision to issue this permit authorizing this discharge. Although EPA's decision-making process has benefited from the various comments and additional information submitted during the public comment period, the information and arguments presented did not raise any substantial new questions concerning the permit. EPA did, however, improve certain analyses and make certain clarifications in response to comments. These improvements and changes are detailed in this document and reflected in the final permit. A summary of the changes made in the final permit are listed in Section F below. The analyses underlying these changes are explained in the responses to individual comments that follow. The following responses include responses to the written comments received during the public comment period, which also encompass the issues raised in the oral comments made at the public hearing.

A copy of the final permit may be obtained by sending a written request to the following address:

United States Environmental Protection Agency, Region 1
Attn: Jeanne Voorhees
1 Congress Street, Suite 1100 (CWP)
Boston, Massachusetts 02114-2023

Copies of the permit may also be obtained by calling or emailing Ms. Voorhees, who can be reached at (617) 918-1686 or voorhees.jeanne@epa.gov. Copies can also be obtained from http://www.epa.gov/region1/npdes/index.html.

A. Comments Submitted by Mr. John A. MacLean, City Manager, City of Keene, New Hampshire

NON-PHOSPHORUS ISSUES

Comment A1: The City requests that EPA eliminate the maximum daily limit for total recoverable lead (29.1 ug/l) on the grounds that there is no reasonable potential for a violation of this water quality standard. Attached hereto as Attachment 1 is a spreadsheet showing the City's influent lead concentration since January 1995. The City's influent lead has exceeded the effluent maximum daily limit only 14 times since January 1995, or in 3.4 percent of the samples collected. The average influent lead concentration during this time was 9.3 ug/l.

Attached hereto as Attachment 2 is a spreadsheet showing the percent removal of lead through wastewater treatment facility operations during the same time frame. Using only sample pairs that are offset to represent the detention time through the WWTF, and ½ of the detection limit for results that were not detected, the average percent removal of lead through the WWTF is 86.2 percent. Using this percent removal, even the highest detected influent lead concentration would have been reduced to well below the maximum daily limit. In light of this data, there is no reasonable potential for the City to violate the acute in-stream lead criteria, and accordingly this maximum daily limit should be eliminated from the permit.

Response A1: The Region concurs with the conclusion that there is no reasonable potential for the Permittee's effluent discharges to cause or contribute to violations of the acute lead criterion and has therefore eliminated the requirement of a maximum daily limit for total recoverable lead. However, the Region arrived at this conclusion using a different methodology than the one employed above. Simply comparing percent lead removal between influent and effluent does not fully address the specific requirement under New Hampshire's Surface Water Quality Regulations ("NH Standards") that water quality criteria be met under critical low flow conditions (*i.e.* 7Q10). *See* Env-Ws 1705.02. When conducting its reasonable potential analysis, the Region also uses this hydrologic condition.

As explained in the Fact Sheet, the Region must impose water quality-based effluent limits if it determines that the discharge causes, or has a reasonable potential to cause, or contribute to an excursion of numeric or narrative water quality criteria. *See* 40 CFR § 122.44(d)(1)(i)-(iii). *See* Fact Sheet at 5. When determining reasonable potential, the Region must consider: (1) existing controls on point and nonpoint sources of pollution; (2) pollutant concentration and variability in the effluent and receiving water as determined from the permit application, monthly discharge monitoring reports (DMRs), and State and Federal water quality reports; (3) sensitivity of relevant species to toxicity testing; and, (4) where appropriate, dilution of the effluent in the receiving water. *See* 40 CFR § 122.44(d)(1)(ii). The Region also utilizes statistical approaches outlined in the Technical Support Document for Water Quality-based Toxics Controls ("TSD") (EPA 1991) to characterize the effects of effluent variability and reduce uncertainty in

determining whether an effluent limitation is required. Finally, the Region considers available data and information pertaining to the discharger, such as compliance history and in-stream survey data.

Consistent with EPA technical guidance and regulations, the Region calculates the projected in-stream concentration of a pollutant by using the maximum observed effluent concentration of a pollutant, assuming both 7Q10 conditions and maximum flows from the treatment plant (*i.e.*, design flow). Under NH Standards, 7Q10, or available dilution for rivers and streams, is based on a known or estimated value of the lowest average flow which occurs for seven (7) consecutive days with a recurrence interval of once in ten (10) years for aquatic life and human health criteria for non-carcinogens, or the long-term harmonic mean flow for human health (carcinogens only) in the receiving water at the point just upstream of the outfall. *See* Env-Ws 1702.44 and 1705.02. Furthermore, 10% of the receiving water's assimilative capacity must be held in reserve for future needs. *See* Env-Ws 1705.01.

Thus, the analysis of the projected in-stream lead concentrations that will result from the Permittee's effluent discharge is as follows:

Given,

C_d = Maximum effluent lead concentration = 4.90 ug/l
Q_d = Plant Design Flow = 9.3 cfs
Q_s = 7Q10 = 12.19 cfs
C_r = Receiving water lead concentration during critical conditions
0.9=Factor to reserve 10 percent of assimilative capacity per Env-Ws 1705.01

$$C_r = \frac{(C_d)(Q_d)}{0.9(Q_s + Q_d)}$$

Assuming a hardness of 25 mg/l, the resulting receiving water lead concentration is 2.36 ug/l.[1] This result is well below the acute criterion for total recoverable lead, 14 ug/l.[2] *See* Env-Ws 1703.21. Therefore, there is no reasonable potential for effluent lead concentrations to cause or contribute to an excursion of the acute criterion. The acute lead limit has accordingly been deleted from the final permit. The permit still requires the facility to report the maximum daily lead result for each month to confirm that concentrations of lead in the facility's effluent remain low. Such a reporting requirement will allow EPA to quickly ascertain whether there have been changes in lead levels which might impact sensitive aquatic species, including the endangered dwarf wedge mussel, and therefore require reopening of the permit. This reporting requirement is not burdensome in that it requires no additional testing of the discharge.

[1] The rationale for adopting an assumed hardness value of 25 mg/l is addressed in Response A3 below.
[2] The acute criterion appearing in the Fact Sheet (13.88 ug/l) differs from the acute criterion above (14 ug/l) because it is expressed in terms of the dissolved fraction of lead, and not total recoverable lead.

Comment A2: The City requests that EPA remove from its permit both average monthly and maximum daily limits for total recoverable copper on the grounds that data provided by the City establishes that there is no reasonable potential for violating the State's water quality standard for copper. The basis for the City's position is explained in detail in the City's January 27, 2000 letter to EPA, a copy of which is attached hereto as Attachment 3 (with attachments). The data submitted with that report establishes that the City's discharge of copper was not violating, or demonstrating a reasonable potential to violate, State water quality standards for copper.

While the details supporting the City's position are outlined in Attachment 3, the results can be summarized as follows: with respect to the data supplied with that submittal, on no occasion did the calculated in-stream concentration of copper come close to violating State water quality standards. On only three dates did the calculated copper concentration exceed 2.0 ug/l, and on no occasion did it exceed 3.0 ug/l. Moreover, the calculated in-stream concentration *never* exceeded the New Hampshire chronic water quality standard of 2.7 ug/l. We would note as well that the EPA never responded to or took issue with either the data or the conclusions set forth in our January 27, 2000 submittal.

We have included as Attachment 4 similar copper and flow data for the timeframe since the City's January 2000 submittal, for the period 1999 to 2005. That data similarly confirms that the City is not regularly violating either the acute or chronic water quality standards for copper. On only six of approximately 280 days did the data indicate a violation of water quality standards. Because the City's data establishes that it is neither violating nor exhibiting a reasonable potential to violate the in-stream water quality standard for copper, there is no statutory or regulatory basis for EPA to include such limits in the City's permit.

Response A2: The projected in-stream copper values presented by the Permittee in the referenced attachments do not reflect critical low flow conditions, which EPA assumes when determining whether a discharge has a reasonable potential to violate standards. *See* Response A1 above. Instead of assuming low flow conditions, the City calculates ambient copper concentrations by using daily stream flow data from a US Geological Survey gage station (01160350) located in West Swanzey, New Hampshire and the effluent copper concentrations collected on corresponding days. Had the City properly assumed the more conservative 7Q10 conditions, there would have been yet additional excursions above ambient criteria beyond the six excursions that the City has already acknowledged. The agencies also note that six violations in 280 days already exceeds the one excursion every three years on average return frequency described in the TSD. *See* TSD at D-4 to D-5.

Reviewing data in Attachment 4, the maximum effluent copper concentration occurred on May 5, 1999. In the equation below, this maximum copper concentration and 7Q10 flow (12.19 cfs) are applied to determine whether a reasonable potential exists for copper concentrations in the discharge to cause or contribute to an excursion of water quality criteria. Assuming there is no background concentration of copper, and

Given:

C_d = Maximum effluent copper concentration = 49 ug/l [highest value reported (sampled on 5/5/99) out of approximately 280 total samples in Attachment 4]
Q_d = Plant Design Flow = 9.3 cfs
Q_s = 7Q10 = 12.19 cfs
C_r = Receiving water copper concentration during critical conditions
0.9=Factor to reserve 10 percent of assimilative capacity per Env-Ws 1705.01

$$C_r = \frac{(C_d)(Q_d)}{0.90(Q_s + Q_d)}$$

The receiving water copper concentration under critical conditions and using a hardness of 25 mg/l is 23.56 ug/l, which exceeds the total recoverable acute and chronic criteria for copper, 3.79 ug/l and 2.85 ug/l, respectively.[3] *See* Env-Ws 1703.21. Therefore, a reasonable potential exists for effluent copper concentrations to cause or contribute to an excursion of these criteria, and both the monthly average and maximum daily limits will remain in the permit in accordance 40 CFR § 122.44(d)(1)(iii).

The Permittee is currently under an administrative order, issued on September 27, 2004, for, among other things, discharging wastewater in violation of the effluent limitation for copper contained in the permit. This administrative order will remain in effect through permit renewal process. A new administrative order will be issued following issuance of the final permit. The Permittee should contact Joy Hilton (617.918.1877) of EPA's Office of Environmental Stewardship with any questions.

Comment A2(a): Even if a permit limit for copper were appropriate, the limit contained in the draft permit is overly protective of the receiving stream. The permit limit was developed by simple application of the State's water quality standard multiplied by the dilution of the receiving water, assuming a hardness of 25 mg/l. However, this simple calculation fails to take into account the fact that copper in municipal wastewater treatment facility effluents is not toxic. Specifically, laboratory and field studies overwhelmingly support the conclusion that copper in biologically treated effluents exists in organo-complexes and is not bio available. Accordingly, numeric copper criteria are inappropriate for biologically treated effluents. Literature and studies supporting this conclusion are included in Attachment 5.

Response A2(a): The Permittee should be aware that NH Standards mandate procedures for the development of alternative site specific criteria, including for instances "where site specific information is available which substantiates the use of different criteria." Env-Ws 1704.01; *see also*, Env-Ws 1704.02 (Procedures) and Env-Ws 1704.03 (Modification). In the absence of such an analysis by the Permittee and a determination

[3] The acute and chronic criteria appearing in the Fact Sheet (3.64 ug/l and 2.74 ug/l, respectively) differ from the acute criterion above because they are expressed in terms of the dissolved fraction of copper, and not total recoverable copper.

by NHDES and EPA that site specific criteria would protect existing and designated uses, the Region is obligated to impose a copper limit that will ensure compliance with currently applicable numeric water quality standards, in this case Env-Ws 1703.21 (Water Quality Criteria for Toxic Substances). The Permittee should also be aware that while copper in biologically treated effluent may be bound in organo-complexes, the chemistry of the receiving water (*i.e.* pH, alkalinity) can alter the complex, thus making copper available. *See, e.g., Ambient Water Quality Criteria for Copper*, USEPA 1980 and *Draft Update of Ambient Water Quality Criteria for Copper*, USEPA 2003. The extent to which such alteration will occur is uncertain. Therefore, site specific analyses are necessary to determine the extent to which copper is available in-stream. When that analysis becomes available, the Permittee can request that the permit be modified.

Comment A2(b): We have also included as Attachment 6 a Memorandum dated November 15, 2004 prepared by the City's consultants, Camp, Dresser and McKee (CDM) analyzing the applicability of the Biotic Ligand Model (BLM) as present in EPA's 2003 "Draft Update of Ambient Water Quality Criteria for Copper" (also included in Attachment 6) for developing ambient water quality criteria in the Ashuelot River. In this update, EPA writes that, "These criteria are based on the latest available scientific information and supercede EPA's previously published recommendations for copper."

Through the incorporation of water hardness in the copper limit calculation, NHDES/EPA recognizes that other factors influence copper toxicity. Using the BLM carries this practice to its next logical step and further refines the calculations. The model yields a limit that is more accurately predictive of an effluent's biotoxicity by addressing additional variables that can affect the bioavailability of metals, including copper. In its Guidance, EPA writes, "Because of the influence of water quality parameters such as pH, alkalinity, and organic matter on the formation of compounds that affect the amount of cupric ion present, not all of the copper in the water column contributes directly to toxicity." EPA then concludes that the concept of the total concentration of any metal is "not a good predictor of toxicity."

The CDM Memorandum confirms that, because of metal speciation, the same "total" metal concentration can cause variable degrees of toxicity because of differences in the distribution of the metal among different chemical forms. Preliminary application of the BLM model, with limited available data, to copper in the Ashuelot River establishes that accurate water quality criteria, fully protective of the aquatic environment, are 9-13 times higher than the corresponding criteria reflected in the State water quality standards. This is further support for the City's position that the limit for copper contained in the draft permit is significantly overprotective of the aquatic environment and inconsistent with the best available science.

Response A2(b): EPA has issued revised national recommended freshwater aquatic life criteria for copper that utilizes the BLM model (*Aquatic Life Ambient Freshwater Quality Criteria—Copper 2007 Revision*). *See* 72 FR 7983 (February 22, 2007). EPA recommended criteria recommendations are intended to assist states and authorized tribes in the development of state and tribal water quality standards. An EPA recommended

water quality criterion does not substitute for requirements of the CWA or EPA regulations, nor is an EPA criteria recommendation itself a water quality regulation or standard. It does not impose legally binding requirements on the EPA, states, authorized tribes or the regulated community. State and tribal decision makers retain the discretion to adopt approaches that differ from EPA's water quality criteria recommendations on a case-by-case basis.

Under CWA § 301(b)(1)(C) and NPDES regulations, EPA is obligated to impose limits and conditions that will ensure compliance with the state water quality standards in effect at the time of permit issuance, which the Region has done in this case. The existing copper criteria in NH Standards do not provide a mechanism to incorporate BLM. The New Hampshire Standards do allow for adjustments to criteria based on the water effects ratios (WER), which is computed as a specific pollutant's acute or chronic toxicity values measured in water from the site, divided by the respective acute or chronic toxicity value in laboratory dilution water. No water effects ratio has been calculated for this discharge. Accordingly, the Region will continue to apply the current copper criteria.

Comment A3: The City requests that EPA recalculate the permit's metals limits using a hardness value of 48 mg/l. State Water Quality Standards for metals are based on an assumed hardness of 25 mg/l as CaCO3. It appears that EPA developed the draft permit's proposed metals limits using the basic water quality standards found in State regulations, without an adjustment for hardness. State regulations appropriately allow an adjustment of these water quality standards where hardness varies from this 25 mg/l standard. Enclosed as Attachment 7 are copies of other permits for municipal wastewater treatment facilities when the permitting authority used hardness values other than 25 mg/l.

Attached hereto as Attachment 8 is hardness data for both the wastewater treatment facility effluent and the Ashuelot River upstream of the wastewater treatment facility. Attached hereto as Attachment 9 is a report prepared by the City's consultant's Camp, Dresser & McKee (CDM) analyzing hardness and river flow records, and concluding that estimated total river hardness in the receiving water is 48 mg/l. Accordingly, the City's metals limits should be determined using an assumed hardness of 48 mg/l. The City requests that EPA recalculate the City's metals limit using actual hardness data.

Response A3: CDM correlated instream hardness with receiving water flow as measured at the upstream Surrey Mountain flow gage. The data shows a negative correlation (*i.e.*, hardness increases as flow decreases). The four lowest recorded flows were 18, 29, 21, and 21 cfs, and the corresponding hardness values were 27.6, 36.9, 36.9, and 45.1 mg/l. The average of these values is 36 mg/l, which CDM rounded to 35. CDM then calculated a downstream hardness assuming an effluent hardness of 65 mg/l, a receiving water flow of 12.19cfs (7Q10) and a plant discharge flow of 9.3 cfs (design flow) to yield a calculated hardness of 48 mg/l. Chronic and acute total recoverable copper criteria calculated at a hardness of 48 mg/l are 4.98 and 7.01 respectively, compared to chronic and acute criteria of 2.85 and 3.79, calculated at a hardness of 25 mg/l.

While this analysis would normally be a reasonable approach for approximating hardness immediately downstream of a facility's discharge under 7Q10 conditions and is similar to the analyses performed in the Massachusetts NPDES permits ,[4] it is not appropriate in this case, where actual in-stream hardness data collected downstream of the Keene discharge consistently show much lower hardness values than the CDM calculation. Data collected between stations 02-Ash and 16-Ash show the highest downstream value to be 33.3 mg/l, and the average to be 17.32 mg/l (n = 78). *Id. See* Email and data, dated September 12, 2006, from Dan Dudley (NHDES) to Jeanne Voorhees (EPA). The difference between the calculated value and the observed downstream values are most likely due to the influence of the South Branch of the Ashuelot River, one-half mile downstream of the treatment plant discharge and upstream of sampling station Ash-16, and other tributaries entering the main stem.

Without good information on the hardness, flow, and background copper concentration in the South Branch of the Ashuelot River and the other tributaries, it is difficult to determine if the less stringent copper limits resulting from the CDM calculation would be sufficiently protective of water quality. Given the potential for copper toxicity on aquatic species in the receiving water, EPA believes a reasonably conservative approach is warranted and has concluded that a change to the presumed hardness would be inappropriate at this time based on the current information in the record.

EPA imposes permit limits based on the specific facts and circumstances of individual discharges and receiving waters. The use of a particular hardness value (or approach to calculating such a value) may differ from permit to permit.

Comment A4: The City requests that EPA recalculate the summer ammonia limit using the accepted river 7Q10. The draft permit contains both summer and winter limits for ammonia nitrogen. In its Fact Sheet, EPA explains that, "Neither the revised water quality criteria nor updated 7Q10 flow were used in the development of the summer ammonia limits, because elevating the levels of ammonia during the summer months would contribute to the additional depletion of in-stream oxygen levels through the nitrification of ammonia to nitrate. The Ashuelot River is already impaired by low dissolved oxygen, and thus does not have capacity to assimilate increased loadings of potentially oxygen depleting pollutants such as ammonia."

One problem with this conclusion is that it is based on stale data. As discussed in greater detail in the City's comments on phosphorus, several discharges that would influence the amount of dissolved oxygen in the river have been removed since the data relied upon by EPA was obtained, making it likely that data is no longer accurate. In fact, there may no longer be a dissolved oxygen deficit. In addition, the City is currently removing significantly more phosphorous than it was at the time that data was obtained. Furthermore, if the permit contains *any* phosphorous limit, that will result in a further reduction in impacts to dissolved oxygen levels. Together, these reasons show that more

[4] Portions of the fact sheets for three Massachusetts POTWs and the SUEZ Energy Power Plant permit in Bethlehem, NH were attached to the comment. The SUEZ Energy Fact Sheet is not discussed in our response since the default hardness of 25 mg/l was used to calculate the copper limit.

current data needs to be obtained to support any conclusion regarding a lower ammonia limit than the appropriate calculations would indicate. There is no current data to support the conclusion that ammonia during the summer months is contributing to dissolved oxygen depletion.

More fundamentally, EPA has utterly failed to quantify how the presence of ammonia may be impacting dissolved oxygen levels, so as to justify a permit limit more stringent than that determined by use of an appropriate dilution factor. The permit's summer ammonia limits should be based on the State water quality standard, multiplied by the dilution factor, as is the case with all other toxic parameters in the City's permit.

Response A4: As described in the fact sheet, the summer ammonia limits in the 1994 permit were based on toxicity, and the numeric water quality criteria for ammonia toxicity have since been relaxed. If ammonia toxicity were the only characteristic of ammonia at issue, EPA would consider a relaxation of the effluent limits.[5] As discussed in the fact sheet, the receiving water is listed on the New Hampshire 303(d) list as impaired for dissolved oxygen saturation. Continuous monitoring data collected for the TMDL which is under development shows that violations of this criterion occurred both upstream and downstream of the treatment plant at stations 16D-Ash and 16B-Ash and also shows that the 5 mg/l criterion was nearly violated at station 16D-Ash (a low value of 5.07 was recorded on 8/17/2001). The nitrification of ammonia to nitrate and nitrites consumes dissolved oxygen from the receiving water. Although EPA acknowledges that it cannot precisely quantify the impact, it is clear that an increase in the discharge of ammonia would further depress the dissolved oxygen in the receiving water. EPA and NHDES have concluded that application of the new, less stringent standard is prohibited under the anti-backsliding provisions of the CWA. CWA Sections 402(o)(1) and 303(d)(4) allow backsliding in non-attainment waters only if consistent with a wasteload allocation in an approved TMDL or if the standards have been lowered based on a use attainability analysis, neither of which has occurred in this case, or if one of the other exceptions to anti-backsliding in Section 402(o)(2) is met.

The Permittee argues that the violations referenced above are based on "stale data" and has submitted Volunteer River Assessment Program (VRAP) monitoring data which were collected since the TMDL sampling was performed in 2001 and 2002. The Permittee further asserts that the VRAP data do not show violations of the 5 mg/l water quality criterion downstream of the treatment plant since 2002. EPA has reviewed the Volunteer Monitoring data submitted by the Permittee. The data are collected as part of a routine monitoring program conducted from May through September; however, neither the sampling locations nor the sampling conditions are designed to show the impacts of point source discharges on water quality in the Ashuelot River. For example, the TMDL sampling was done under low flow, high temperature receiving water conditions in

[5] In consultation with USFWS, EPA would however approach this question cautiously given the presence of the endangered dwarf wedge mussel in the receiving waters. *See 1999 Update of Ambient Water Quality Criteria for Ammonia* (EPA 1999); *see also, Freshwater Mussel Survey Near a Municipal Wastewater Treatment Outfall in the Ashuelot River (Keene, New Hampshire)* at 2 (citing concern over the effect of ammonia nitrogen in the effluent on the dwarf wedge mussel).

August and included intensive sampling immediately upstream and downstream of the Keene discharge. The nearest VRAP station downstream of the Keene discharge is Ash-16, located one half mile downstream, and below the confluence with the South Branch of the Ashuelot River. The nearest upstream station is Ash-18, located about 2.5 miles away, and upstream of the confluence of Ash Swamp Brook and the Branch. There is usually only one August sample per year and it is not taken to correspond with low flow conditions. A table summarizing the July and August VRAP dissolved oxygen and phosphorus data for Ash-18, Ash-16, and Ash- 15 is shown below:

Station	Date	Time	Flow* (cfs)	Flow** (cfs)	Water Temp (° C)	DO (mg/l)	DO % saturation	Total P (mg/l)
Ash-18	7/14/01	08:07	31	116	19.5	8		0.012
	7/31/01	11:29	16	74	21.4	8.2		
	8/18/01	09:07	7.3	40	22.2	6.15	70.7	0.012
	7/20/02	09:30	27	66	22	6.34	71.8	
	8/17/02	09:20	4.6	37	24	3.9	45.7	
	7/26/03	08:04	15	134	19.6	8.8	96.8	0.007
	8/16/03	08:25	740	1030	23.9	7.22	85.3	0.01
	7/17/04	07:56	24	93	19.6	7.46	80.9	0.007
	8/21/04	08:15	70	342	21.7	6.87	78.8	0.006
	7/23/05	09:15	55	232	23.7	8.21	80.1	0.018
	8/20/05	09:15	31	129	21.0	6.14	79.5	0.012
Ash-16	7/14/01	09:06	31	116	18.2	8.4		0.08
	7/31/01	11:52	16	74	21.6	9.2		
	8/18/01	09:42	7.3	40	21.5	6.21	70.8	0.154
	7/20/02	10:26	27	66	21.3	6.32	71.8	
	8/17/02	10:05	4.6	37	24	4.99	58.8	
	7/26/03	10:00	15	134	22.1	6.7	75.5	0.097
	8/16/03	10:04	740	1030	22.7	7.6	89.5	0.031
	7/17/04	09:30	24	93	20.1	7.43	81.3	0.083
	8/21/04	09:35	70	342	21.1	7.26	81.6	0.063
	7/23/05	10:10	55	232	22	7.17	78.8	0.061
	8/20/05	10:15	31	129	19.9	7.2	78.3	0.046
Ash-15	7/14/01	11:40	31	116	19.8	8.3		0.89
	7/31/01	12:11	16	74	23.7	11.5		
	8/18/01	10:25	7.3	40	22	8.1		0.162
	7/20/02	10:40	27	66	23	8.96	103.8	
	8/17/02	10:25	4.6	37	25.96	9.25	113.6	
	7/26/03	10:52	15	134	23.4	6.91	82.2	0.092
	8/16/03	10:24	740	1030	23.8	7.4	87.2	0.038
	7/17/04	10:00	24	93	21.6	6.68	73.7	0.077
	8/21/04	10:10	70	342	22.1	7.02	80.2	0.069

	7/23/05	10:50	55	232	23.6	8.18	80.1	0.067
	8/20/05	10:21	31	129	20.6	6.11	83.6	0.046

*Flow at Surry Mountain gage shown for comparative purposes, flow at Keene outfall is greater. 7Q10 at the Surry Mountain gage is 2.6 cfs.
**Flow at West Swanzey gage shown for comparative purposes, flow at Keene outfall is less. 7Q10 at the West Swanzey gage is 20.1 cfs.

As can be seen in the table, the VRAP sampling done in 2001 and 2002 was done at the closest to critical low flow conditions and shows the lowest dissolved oxygen concentration and saturation values downstream of Keene, including a concentration violation of 4.99 mg/l at Ash-16. The more recent data was collected at higher receiving water flows and so would not be expected to reflect critical conditions. Also, the continuous DO data collected for the TMDL shows that the low point in the diurnal curve usually occurs prior to 09:00 hours. The VRAP sampling generally occurs later in the morning. (Also, the VRAP grab sample data is clearly inadequate to draw any firm conclusion regarding compliance with DO saturation criterion because the criterion is based on a daily average.) Based on the current information in the record, EPA does not believe there is sufficient evidence to conclude that the receiving water is no longer DO impaired or at significant risk for such impairment. This conclusion is consistent with the NHDES CALM at p. 3-43, note 1, which requires newer data underlying a "fully supporting" water quality assessment to include "samples collected in the same general area and under similar conditions (i.e., wet weather, dry weather, season, etc) as when the older exceedances occurred" to allow for meaningful comparison with the older data.

EPA also evaluated effluent data for other oxygen demanding pollutants and noted that the Permittee has consistently achieved effluent concentrations well below its effluent limits for CBOD and ammonia.[6] There has been no appreciable improvement in the discharge of these pollutants since 2001, mainly because the effluent concentrations were low in 2001, reflecting a consistently well-treated effluent. Even with this superior level of performance with respect to oxygen demanding pollutants, the receiving waters are still exhibiting DO impairments. Viewed from this perspective it is important that the Keene treatment facility continue to provide this high level of treatment to ensure that downstream water quality is not further degraded. If a final, EPA approved TMDL indicates that low effluent limitations for ammonia during the summer months are not necessary to achieve downstream DO criteria under critical low flow conditions, the Permittee may consider seeking a modification of the Permit.

Comment A5: The City requests that EPA recalculate the winter ammonia limits using the pH range of 5.2 to 6.8 standard units as indicated by river sampling data. In developing the permit's winter ammonia limit, EPA assumed a river pH of 7. (See page

[6] EPA also evaluated the Permittee's effluent data to determine whether the treatment plant is removing "significantly more phosphorus" than when the TMDL data was collected. The monitoring data shows that the average effluent total phosphorus concentration discharged during the growing season of April through October since 2001 did not go down significantly until 2006.

13 of Fact Sheet.) The City's pH data, attached hereto as Attachment 10, establishes that the river pH is significantly lower than this. Specifically, the enclosed data establishes that the winter range of pH upstream of the WWTF is 5.2-6.8 standard units. The model calculations should be re-examined using this pH range.

Response A5: According to NH Standards, the pH of Class B waters such as the Ashuelot River shall range between 6.5 to 8.0 standard units (su), unless due to natural causes.[7] *See* Env-Ws 1703.18(b). The receiving water is listed on the 303(d) list for pH, indicating that NHDES does not believe that the low pH is due to natural causes. Therefore, calculating a winter ammonia permit limit based on a pH value less than the water quality criterion of 6.5 su as proposed by the commenter would not be permissible.

Based on a review of the winter data submitted by the commenter, the pH range is 5.2 su to 7.7 su. EPA acknowledges that there are several possible values between 6.5 su and the maximum observed pH of 7.7 su that could be selected that would be consistent with pH criterion.[8] EPA does not believe that the selection of a pH on the extreme low end of the permissible range, which would lead to higher ammonia limits, would be appropriate in this case. EPA believes a reasonably conservative approach is justified given current national criteria guidance for ammonia, which emphasizes the toxicity of ammonia during the colder periods of the year, and the presence of an endangered species (dwarf wedge mussel) in the receiving waters.[9] *See 1999 Update of Ambient Water Quality Criteria for Ammonia* (EPA 1999); *see also, Freshwater Mussel Survey Near a Municipal Wastewater Treatment Outfall in the Ashuelot River (Keene, New Hampshire)* at 2 (citing concern over the effect of ammonia nitrogen in the effluent on the dwarf wedge mussel). Using an assumed pH of 7.7 would be the most conservative approach given that ammonia toxicity increases with increasing pH. However, EPA and NHDES have agreed that using a neutral pH of 7 is sufficiently protective considering that the permit already incorporates a layer of conservatism by calculating the effluent limit using the 7Q10 dilution factor, whereas actual dilution will be higher than 7Q10 during the winter months. The Region also notes that this is only slightly higher than the upper end of the acceptable range proposed by the commenter.

Comment A6: EPA's draft permit contains the following requirement: "The permittee's treatment facility shall maintain a minimum of 85 percent removal of both $CBOD_5$ and TSS." The City requests that its measurement of percent removal of $CBOD_5$ be based

[7] The Ashuelot River is included on New Hampshire's 2004 303(d) list as impaired for low pH both upstream and downstream of the discharge. The suspected cause or source of the impairment is unknown. The Region is not aware of any information that would suggest that this condition is due to natural causes.
[8] EPA's 1999 Update of Ambient Water Quality Criteria for Ammonia states, at 7, "The state of knowledge for the pH dependence is incomplete in terms of understanding specific mechanisms, variation among species, and interactions with various physiochemical processes. Lacking a definitive, thorough theoretical approach for describing pH effects, the most reasonable approach is to adopt the best empirical description that can be obtained from available data."
[9] EPA is re-evaluating the current aquatic life criteria for ammonia in response to recent studies suggesting that some freshwater mussel species may be more sensitive to ammonia exposure than the aquatic organisms considered in deriving the current ammonia criteria. *See* 69 FR 41262 (July 8, 2004).

upon influent BOD_5 and effluent $CBOD_5$. Alternatively, the City requests an exemption from this requirement when the influent $CBOD_5$ is below 100 mg/l.

The laboratory results for influent $CBOD_5$ and BOD_5 can be very different. Since 1995, the average percent difference between influent BOD_5 and $CBOD_5$ has been 28, with a standard deviation of 16.4 mg/l, with $CBOD_5$ almost always higher than BOD_5.

In *Third Century of Biochemical Oxygen Demand*, Rodger B. Baird and Roy-Keithe Smith write, "Traditionally, it has been believed that raw and primary wastewater contain too few viable nitrifying organisms, and that nitrification is therefore not a concern in the BOD_5 test. Based on interpretations of method 5210, however, the US Environmental Protection Agency and some states began to require inhibition of nitrification on raw and primary influents. *This practice results in underestimation of the strength of these wastes, and perhaps, underestimation of treatment plant design or removal efficiency.* (Albertson, 1995)". *See* Attachment 11.

Data collected by the City supports this conclusion. Attachment 12 shows influent $CBOD_5$, influent BOD_5 and effluent $CBOD_5$ for the City from 1996 to 2005. The data establishes influent $CBOD_5$ and influent BOD_5 varies widely on a given date. Thus, $CBOD_5$ is not a good measure of oxygen demand in treatment plant influent. The problem is particularly acute at low concentrations. Note, for example, that on May 16, 2001, the influent BOD_5 was nearly three times the influent $CBOD_5$, and the percentage removed was radically different depending on whether the removal percentage was calculated using one or the other. Under those circumstances, the City is already removing the vast majority of oxygen-demanding organisms but, if influent $CBOD_5$ is used, its percentage removal appears artificially low. For these reasons, EPA should modify the permit to provide that the percentage removal should be calculated using influent BOD_5 and effluent $CBOD_5$, at least when influent $CBOD_5$ is less than 100 mg/l.

Response A6: The monitoring data submitted by the City shows that the influent BOD_5 concentrations are generally higher than the influent $CBOD_5$ concentrations[10], which is expected given that in the $CBOD_5$ test, nitrification, a process which utilizes dissolved oxygen is inhibited. The pages from the text of the *Third Century of Biochemical Oxygen Demand* submitted with the comment (pages 143 and 144) do not include the language cited in the comment so EPA cannot put the quoted language in context, but the quoted language appears to be concerned with the underestimation of influent strength for purposes of treatment plant design if only $CBOD_5$ (and not BOD_5) is considered, and does not appear to address the issue of whether use of influent and effluent $CBOD_5$ results in an underestimation of the treatment plant removal rate. The pages submitted include a discussion of underestimation of influent $CBOD_5$, evaluate whether the chemical used to inhibit nitrification is toxic to carbonaceous organisms, conclude that it is not, and advise that the cause of lower-than-expected $CBOD_5$ results is likely due to improper test set-up and insufficient seed amounts.

[10] Although the City stated the opposite in its comments, EPA assumes that this was a typographical error since $CBOD_5$ is a component of BOD_5.

Our review of the influent BOD_5 and $CBOD_5$ and effluent $CBOD_5$ data submitted by City shows that the City's calculations of the long term average difference between influent BOD_5 and $CBOD_5$ concentrations of about 28 percent are accurate. This percentage is slightly greater than the percent difference assumed in the secondary treatment regulations for effluent limits based on BOD_5 versus $CBOD_5$ (30 mg/l versus 25 mg/l or 17 percent.) The differences between percent removals based on BOD versus CBOD would therefore not be that great. For example, an influent BOD_5 concentration of 200 mg/l and an effluent concentration of 30 mg/l yields a percent removal of 85 percent. If the observed relationship between influent BOD_5/COD_5 and the relationship contemplated by the secondary regulation between effluent BOD_5 and $CBOD_5$ are applied, the influent concentration of $CBOD_5$ would be 144 mg/l, the effluent would be 25 mg/l, and the percent removal would be 83 percent. Looking at the two most recent months of data submitted with the comments (November, 2005 and December 2005), shows that the difference to be even less.

	Influent BOD_5	Influent $CBOD_5$	Effluent $CBOD_5$	Effluent BOD_5 *	% Rem $CBOD_5$	% Rem $BOD_5/CBOD_5$	% Rem BOD_5
Nov 2005	144	128	4.45	5.4	96.5	96.9	96.2
Dec 2005	174	144	3.5	4.2	97.6	98.0	97.5

* calculated based on a 17 % difference between effluent BOD_5 and $CBOD_5$

NPDES regulations at 40 CFR §§ 133.102(a)(3) and 133.102(a)(4)(iii) address percent removal requirements for BOD_5 and $CBOD_5$. Each provision requires that the 30-day average percent removal between influent and effluent concentrations of BOD_5 and $CBOD_5$, respectively, shall not be less than 85%. An exemption from this secondary treatment requirement in the form suggested by the commenter is not contemplated by and would not be appropriate under applicable regulations. *See* 40 CFR §§ 133.102, 103 and 105. Thus, the secondary treatment requirements allows effluent limitations and percent removals to be calculated in terms of BOD_5 *or*, at the discretion of EPA, $CBOD_5$, but do not contemplate mixing and matching the two parameters to calculate percent removal values. This stands to reason, because the two parameters provide different measures of oxygen demand. *See* US EPA NPDES Permit Writers' Manual (1996) at 77-78. Accordingly, EPA has retained the percent removal condition as is, which requires the use of $CBOD_5$ influent and effluent for measurement purposes.[11] If, however, the permittee wishes to have a percent removal limit based on BOD_5 and is willing to perform the required sampling, EPA would consider a permit modification to substitute BOD_5 percent removal limits.

[11] Considering that the Keene WWTF has consistently met the 85% $CBOD_5$ requirement, it is unclear why the City has made the requested change. As documented in the Fact Sheet, there were no permit violations for the percent removal of $CBOD_5$ during the review period (January 2004 to July 2005). Additionally, the percent removal $CBOD_5$ averaged 93%, which is well above the requirement of 85% removal.

Comment A7: The City requests that EPA eliminate the requirement that the City "provide an adequate staff to carry out the operation, maintenance, repair and testing functions required to ensure compliance with the terms and conditions of this permit." This provision is unduly vague and no statutory or regulatory authority is cited for this requirement. The City is aware that the terms and conditions of the permit are enforceable, and that it has an obligation under law to comply therewith. The separate requirement that the City "provide an adequate staff" if unduly vague and unenforceable since it does not purport to determine what is "adequate" for these purposes. In the absence of specific statutory or regulatory authority for the inclusion of this requirement, this requirement should be eliminated.

Response A7: CWA § 402(a)(1) authorizes EPA to impose conditions in an NPDES permit so long as there is a reasonable connection between the condition and the achievement of effluent limitations or fulfillment of the purposes of the Act. This authority would include reasonable conditions necessary to assure compliance with pollution discharge limits required by an NPDES permit. For example, EPA has authority to impose a permit condition that requires proper operator qualifications given the reasonable relationship between the condition and the plant's attainment of effluent limitations. *See* Decision of the General Counsel No. 19 (June 27, 1975). Similarly, federal regulations require each NPDES permittee to "at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee" to comply with permit limits. 40 CFR § 122.41(e) (Conditions applicable to all permits; Proper operation and maintenance). Implicit in the duty to properly operate and maintain a treatment facility is the existence of personnel to perform such functions. The adequate staffing condition follows rationally from this existing regulation and is an appropriate exercise of EPA's authority under section 402(a)(1). The Region recognizes that the requisite number of staff will vary from facility to facility and thus uses a flexible term ("adequate staff") in defining the means by which to comply with a clear, unambiguous end, which is compliance with permit limits. The permit clearly prescribes conduct on the part of the Permittee and a standard for evaluating the successful completion of the conduct. The condition is sufficiently clear to apprise persons of ordinary intelligence of required conduct, does not encourage arbitrary or discriminatory enforcement by the agency and therefore is not in the Region's view vague.

Comment A8: The City requests that EPA remove from the draft permit the requirements relative to submission of a final local limits report or, alternatively, extend the deadline for submission of said report to 161 days after sampling commences. The required submission of the City's local limits report is addressed in the current Administrative Order, Docket No. 04- 47 and should not be reiterated in this permit. Moreover, the City has requested an extension of the November 1, 2006 deadline for the submission of its final Local Limits Report. According to the January 2006 sample plan that was submitted to EPA, sample collection and analysis must have been completed by the end of July for the City to meet the November 1, 2006 deadline. Due to unusually high levels of infiltration, those samples have not yet been collected.

The City has forwarded EPA the correspondence attached hereto as Attachment 14 which establishes that, due to extreme high flows in the receiving stream, the City is unable to complete the sampling necessary to the Local Limits Reports that would allow it to meet the November l deadline. The City first alerted EPA to this possibility in the undated letter (sent in January 2006) which noted (at page 2) that the completion of this report was dependent on when sampling could be conducted which itself depended on when the river returned to normal (low) summer flows. This issue was raised again in our letter of April 18, 2006 (see page 3), our letter of July 10, 2006 and most recently in our letter of August 9, 2006.

As discussed in the enclosed submissions, due to weather conditions, the WWTF's flow has not yet reached its 2006 dry weather flow levels. Although the City has contracted with a consultant to perform the data analysis, has identified and put on notice a laboratory to perform the required analysis, has received the sample bottles, and has determined a sampling plan, no samples have been collected.

As directed by email communication from Jay Pimpare, Region 1 EPA, the City discussed the WWTF flow data with its consultant, Robert Cote of Teton Environmental. Mr. Cote indicated that because of the continuing infiltration in the historic domestic sample sites it is preferable to collect samples for determining local limits when the WWTF flows are in the dry weather range of 2.5-2.9 MGD. He believed that the final limit calculation would be impacted if samples are collected while signification infiltration is still occurring. Mr. Cote added that because infiltration and elevated POTW flow correlate closely to Ashuelot River flows, see graph and table below, it appears likely that sampling will be able to be scheduled during September or October 2006, provided a return to average river flow conditions occurs.

[Graph and Table Not Reproduced]

Attachment 15 is the data from the United States Geological Survey that was used in the graph and table above. The use of alternate sample sites was considered and rejected because the City's two historic domestic sample sites were selected to represent the City's two major water supplies, well water and surface water. Mr. Cote noted that retaining these sampling locations will also facilitate comparisons of new information to historical results, which will be valuable for assessing if changes are observed in POTW headworks loadings. Although the water supplies are combined in the distribution system, the surface water is generally found in the older sections of Keene, where the sewer mains are much older and infiltration is more prevalent. The City has committed to aggressive sewer infrastructure rehabilitation work as detailed in its 2005 Structural Integrity Plan. The first phase of this work will be complete in November 2006, but the projects will continue over at least the next six years. The oldest sections are being replaced first.

Because EPA requires the City to collect new data on domestic wastewater characteristics to use in the local limits calculations, the City will not be able to meet the November 1,

2006 deadline as referenced both in the draft permit and the Administrative Order. Its July and August letters contained a request for extension which request remains pending.

Response A8: The local limits report was received by EPA on January 31, 2007. The schedule has therefore been removed from the permit.

Comment A9: The City requests that EPA reduce the requirement of Whole Effluent Toxicity testing for both chronic and acute effects for both fathead minnows and ceriodaphnia to once a year. The draft permit contains requirements for Whole Effluent Toxicity testing. EPA has discretion to waive these tests where the municipality has established a solid record of compliance with such tests. Attached hereto as Attachment 13 is a summary of the City's performance on its Whole Effluent Toxicity testing. Of the 50 tests performed between June 20, 1994 and December 2005, only 3 did not pass. Between April 1998 and May 2005, there were 30 tests with passing results, most with 100% effluent. EPA's Fact Sheet states: "After a minimum of four complete and consecutive WET tests, all of which must be valid and demonstrate compliance with the permit limits for whole effluent toxicity, the Permittee may submit a written request to the EPA seeking a review of the toxicity test results." The City's history of passing WET test results, as set forth in Attachment 13, demonstrates a much longer period of compliance. Accordingly, there is no reason why EPA should not now reduce the requirement for Whole Effluent Toxicity testing for both chronic and acute effects for both fathead minnows and ceriodaphnia to once a year.

Response A9: As noted in the Fact Sheet (at 21), the results of 20 WET tests between May 2001 and October 2005 exhibited toxicity during only one quarter, May 2002, with the remaining tests all equal to or greater than 100%. Based on these results and the results presented by the commenter (see above), the frequency of the WET testing for Fathead Minnows (*Pimephales promelas*) and Daphnids (*Ceriodaphnia dubia*) have been reduced to once per year, during the quarter ending September 30th.

B. Comments Submitted by the City of Keene on the Proposed Phosphorus Limit

Comment B1: As EPA is aware, the State has no numeric water quality standard for phosphorus. EPA has presented insufficient information to establish even a potential violation of the narrative limit contained in State water quality standards. Given the extreme cost of implementing phosphorus removal necessary to achieve EPA's proposed limit, it is imperative that any such limit be technically defensible and necessary to achieve water quality standards. For the following reasons, EPA's proposed limit is neither technically defensible nor necessary to achieve water quality standards.

As noted in EPA's draft Fact Sheet, the State of New Hampshire has two narrative criteria which potentially relate to the discharge of phosphorus. Regulation Env-Ws 1703.14(b) provides that, "Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring." Env-Ws 1703.14(c) provides that, "Existing discharges containing either phosphorus or nitrogen which encourage cultural eutrophication shall be treated to

remove phosphorus or nitrogen *to ensure attainment and maintenance of water quality standards*." However, the only relevant "water quality standard" is that set forth in § 1703.14(b), namely, that there be no impairment of existing or designated uses. Accordingly, the presence of phosphorus in a receiving water violates State water quality standards *only* when it impairs designated uses, in this case Class B standards.

Response B1: The Region disagrees with the commenter's interpretation of the State's nutrient criterion. Nothing in the text of Env-Ws 1703.14(c) suggests that the reference to "water quality standards" is limited to mean the single water quality criterion set forth at Env-Ws 1703.14(b). To the contrary, "water quality standards" is a defined term under the NH Standards and means "the combination of designated uses of surface waters and the water quality criteria for such surface waters based upon such uses." *See* Env-Ws 1702.52. Similarly, Env-Ws 1703.01(b) (Water Use Classifications) provides, "All surface waters shall be restored to meet the water quality criteria for their designated classifications including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface waters." Thus, while the reference to "water quality standards" in Env-Ws 1703.14(c) includes the criterion set forth at Env-Ws 1703.14(b), it is certainly not limited to that single provision.[12] Instead, it refers more generally to the uses and criteria applicable to Class B waters (*i.e.*, aesthetics; recreation; turbidity; slicks, odors and surface floating solids; minimum DO, *etc.*). NHDES also interprets its nutrient criterion in this manner. As detailed in the Fact Sheet and in Response B3 below, the administrative record for the permit demonstrates that phosphorus effluent discharges from the Keene WWTF adversely impact numerous uses and State water quality criteria.

This reading of New Hampshire's water quality standards is consistent with the statutory and regulatory framework governing water quality standards and with the relationship of those standards to the NPDES permitting process. State water quality standards are comprised of three essential parts: (1) one or more "designated uses" (*e.g.*, fish habitat, recreation, public water supply) for each water body or water body segment in the state; (2) water quality "criteria" expressed in numeric concentration levels for short ("acute") or longer ("chronic") exposure times and/or narrative statements specifying the amounts of various pollutants that may be present in each water body without impairing the designated uses of that water body; and (3) an antidegradation provision, which prohibits discharges that would degrade water quality below that necessary to maintain the "existing uses" of a water body. *See* CWA § 303(c)(2)(A), 33 U.S.C. § 1313(c)(2)(A); 40 C.F.R. §§ 131.10-.12. While distinct, these components reinforce one another. So long as criteria are met, water quality will generally be sufficiently high to protect the designated use. *See* 40 CFR § 131.3. By that same token, violations of criteria can be evidence of use impairment. Water quality-based effluent limits imposed through NPDES permits are designed to ensure that all components of water quality standards are

[12] Env-Ws 1703.14(b) and Env-Ws 1703.14(c) serve different, though related, purposes. Subsection (b) is an in-stream standard that prohibits nutrients in concentrations that impair existing or designated uses, while subsection (c) is a treatment standard that is triggered by discharges that "encourage cultural eutrophication." As a practical matter, use impairments resulting from excess nutrients, such as nuisance aquatic plant growth, often stem from cultural eutrophication.

achieved. *See* CWA § 301(b)(1)(C); 40 C.F.R. § 122.44(d)(1) (requiring limits on pollutants that have "a reasonable potential to cause or contribute to an excursion above *any State water quality standard, including State narrative criteria for water quality.*" (emphasis added) To determine whether a phosphorus limit is necessary, it would make little sense for the Region to focus solely on designated use provisions, while ignoring underlying water quality criteria designed to implement such uses. Thus, when imposing permit limits, EPA considers both designated uses and the underlying criteria.

Comment B2: EPA suggests that (1) the numeric values cited in its Fact Sheet are criteria (which must therefore be met in the receiving waters), and (2) elevated levels of chlorophyll *a* by itself constitutes cultural eutrophication, prohibited by the NH water quality standards. Neither of these suggestions is accurate. Rather, the only relevant State water quality standard potentially implicated by a discharge of phosphorus is protection of aquatic life, which may be compromised by dissolved oxygen (DO) impairment. There is no identified level of phosphorus or chlorophyll *a* which, in and of itself, is violative of this water quality standard.

Response B2: (1) The commenter suggests that the Region has equated the *Quality Criteria for Water 1986* ("Gold Book") value of 0.1 mg/l with the state water quality criterion for nutrients. It has not. In the course of determining the trophic status of the receiving waters and deriving a protective phosphorus effluent limit that would meet the narrative phosphorus criterion, the Region looked to a variety of sources, including the Gold Book, the *Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria* ("Ecoregional Nutrient Criteria") and the *Nutrient Criteria Technical Guidance Manual: Rivers and Streams* (EPA 2000) ("Nutrient Criteria Technical Guidance Manual"). These constitute information published under CWA § 304(a). The Region explained in the Fact Sheet that it used Section 304(a) information and recommended criteria as *guidance* to interpret the State's narrative criterion for nutrients and not as substitutes for state water quality criteria. The Region's use of the Gold Book and other relevant materials published under Section 304(a) to develop a numeric phosphorus limit sufficiently stringent to achieve the narrative nutrient criterion is consistent with applicable NPDES regulations. When deriving a numeric limit to implement a narrative water quality criterion, EPA is authorized to:

> Establish effluent limits on a case-by-case basis, using EPA's water quality criteria, published under Section 304(a) of the CWA, supplemented where necessary by other relevant information.

40 CFR § 122.44(d)(1)(vi)(B). While the various recommended values for phosphorus contained in the materials cited above—*e.g.* 0.01 mg/l (*Ecoregional Nutrient Criteria*) to 0.1 mg/l (*Gold Book*)—were not specifically designed to meet New Hampshire's water quality standards in particular, these values do reflect a range of ambient phosphorus concentrations that are sufficiently low to prevent cultural eutrophication.[13] The

[13] For example, the Gold Book states:

Region's decision to opt for an in-stream phosphorus target approximating the Gold Book value rather than the ecoregional criterion is discussed in Response E5 below.

(2) By using ambient phosphorus and chlorophyll *a* concentrations as primary causal and response indicators, respectively, for eutrophication, the Region followed the approach recommended by EPA's *Nutrient Criteria Technical Guidance Manual*. The Region weighed this in-stream phosphorus and chlorophyll *a* evidence, along with DO data and other relevant information, in order to establish the existence of cultural eutrophication in the Ashuelot River and derive a protective effluent limit. The Region does not suggest that elevated chlorophyll *a* levels alone constitute cultural eutrophication or that they alone violate water quality standards. Rather, elevated chlorophyll *a* levels can be used as one response variable among several associated with eutrophication. As stated in EPA's *Nutrient Criteria Technical Guidance Manual*:

> Algae is either the direct or indirect cause of most problems related to excessive nutrients, *e.g.* algae are directly responsible for excessive, unsightly periphyton mats or surface plankton scums, and may cause high turbidity, and algae are indirectly responsible for diurnal changes in DO and pH.

Id. at 31. Measures of chlorophyll *a* in surface waters are correlated with the amount of suspended algae, or phytoplankton. Use of chlorophyll *a* to measure receiving water response to nutrient loading is appropriate because it is a sensitive primary response indicator of phosphorus enrichment/eutrophication.

Too narrow a focus on low DO to determine the existence and impacts of eutrophication would be inappropriate. Certain types of algal biomass above nuisance levels can produce large diurnal fluctuations in DO. *Id.* at 35. However, the extent of the diurnal swings in DO depends on a variety of factors, including turbulence, light, temperature, buffering capacity and the amount and health of algal and/or macrophyte biomass. *Id.* The influence of these factors on DO concentrations "reduce the specificity and potentially reduce the reliability of [DO] to indicate response from nutrient enrichment," as opposed to direct measures of algal biomass such as chlorophyll *a*. *Id.*

Comment B3:

In light of the foregoing, in order to justify a proposed phosphorus limit, EPA must find, and the City of Keene (and potentially the Environmental Appeals Board or Federal Court) must be convinced of several things:

> Algal growths impart undesirable tastes and odors to water, interfere with water treatment, become aesthetically unpleasant, and alter the chemistry of the water supply. They contribute to the phenomenon of cultural eutrophication.
>
> To prevent the development of biological nuisances and to control accelerated or cultural eutrophication, total phosphates as phosphorus (P) should not exceed 50 ug/l in any stream at the point where it enters any lake or reservoir, nor 25 ug/l within any lake or reservoir. A desired goal for the prevention of plant nuisances in streams or other flowing waters not discharging directly to lakes or impoundments is 100 ug/l total P. (Mackenthun, 1973) (p. 240).

1. that the relevant segment of the Ashuelot River is not meeting a narrative water quality standard (in this case, impairment of aquatic life) due to dissolved oxygen impairment;

2. that the presence of phosphorus in the relevant segment of the Ashuelot River is a major contributing factor to this dissolved oxygen impairment;

3. that the presence of phosphorus in the City's effluent is contributing to elevated phosphorus levels that are causing the dissolved oxygen impairment; and

4. that EPA's mandated in-stream criteria of 0.1 mg/1 (which is not based on any State water quality standard) is the appropriate level to protect against any dissolved oxygen impairment that impacts aquatic life.

Response B3:

(1) The commenter misstates the legal threshold that the Region must meet in order to impose a phosphorus effluent limit in the permit. Prior to imposing a water-quality based effluent limitation, the Region must at a minimum demonstrate that the discharge of pollutants has a *reasonable potential* to cause or contribute to a violation of applicable in-stream water quality standards. If phosphorus effluent discharges from the Keene WWTF cause, contribute, or have a reasonable potential to cause or contribute to violations of any applicable standards, then EPA is obligated to impose a limit in the permit under the Clean Water Act and applicable regulations. *See* CWA § 301(b)(1)(C); 40 CFR §§ 122.4,122.44(d)(1)(i), (iii)-(vi).

Contrary to the commenter's assertion, the Region's reasonable potential inquiry associated with phosphorus effluent discharges from the Keene WWTF is not limited to dissolved oxygen impacts on aquatic life protection. Rather, under NH Standards, the protection of aquatic life uses is one among several applicable designated uses and criteria that the Region must consider when implementing the narrative nutrient criterion.[14]

Under NH Standards, surface waters are divided into water "use" classifications: Class A and B. *See* RSA 485-A: 8; Env-Ws 1702.11. The Ashuelot River has been classified by the State as a Class B water. Each of these classes is subject to class-specific criteria. *See* Env-Ws 1703.01 and 1703.04. Class B waters are designated as a habitat for fish, other aquatic life and wildlife and for primary (*e.g.* swimming) and secondary contact (*e.g.* fishing and boating) recreation. RSA 485-A: 8, II. Waters in this classification "shall have no objectionable physical characteristics." *Id.* NH Standards also provide

[14] NH Standards define cultural eutrophication in terms of excessive plant growth *and/or* dissolved oxygen. *See* Env-Ws 1702.15. There is also nothing to suggest that aquatic life use impairment must necessarily involve dissolved oxygen impairment. Such impairments can be caused by a range of adverse chemical, biological and physical processes, for instance, physical alteration of benthic habitat due to settling of organic debris.

that the discharge of sewage or waste "shall not be inimical to aquatic life or to the maintenance of aquatic life in said waters." *Id.*

These designated uses are protected by class-specific minimum narrative and/or numeric water quality "criteria." With respect to nutrients, Env-Ws 1703.14(b) sets forth a class-specific criterion that prohibits in-stream concentrations of phosphorus in Class B waters that would impair any existing or designated uses. Meanwhile, Env-Ws 1703.14(c) establishes a minimum level of treatment for phosphorus discharges that "encourage cultural eutrophication." Cultural eutrophication is, in turn, defined as "human-induced addition of wastes containing nutrients to surface waters which result in excessive plant growth and/or a decrease in dissolved oxygen." *See* Env-Ws 1702.15. Such discharges must be treated to remove phosphorus to the extent required to ensure and maintain water quality standards. *See* Env-Ws 1703.14(c).

Unless naturally occurring, Class B waters are also prohibited from containing benthic deposits that have a detrimental effect on the benthic community (Env-Ws 1703.08), as well as from having slicks, odors, or surface floating solids (Env-Ws 1703.12) or color in concentrations (Env-Ws 1703.10) that will impair any existing or designated uses. Class B waters also shall not contain turbidity more than 10 NTUs (nephelometric turbidity units) above naturally occurring conditions. *See* Env-Ws 1703.11. Class B waters, in addition, have a minimum dissolved oxygen saturation requirement of 75% (daily average), and an instantaneous minimum concentration requirement of at least 5 mg/l. *See* Env-Ws 1703.07(b).

Regardless of classification, NH Standards furthermore require that all surface waters meet certain general water quality criteria. *See* Env-Ws 1703.03 and 1703.04. All surface waters must be "free of substances in kind or quantity" that:

a. Settle to form harmful deposits;
b. Float as foam, debris, scum, or other visible substances;
c. Produce odor, color, taste or turbidity which is not naturally occurring and would render it unsuitable for designated uses;
d. Result in dominance of nuisance species; or
e. Interfere with recreational activities.

Env-Ws 1703.03(c)(1)(a)-(e). In the Region's view, the range of designated uses and general and class specific criteria described above more accurately reflects the water quality standards applicable to the discharges of treated sewage from the Keene WWTF into the Ashuelot River.

In its analysis of whether the Permittee's phosphorus effluent discharges have a reasonable potential to cause or contribute to violations of water quality standards, the Region evaluated the sources of phosphorus loading into the Ashuelot River, as well as relevant physical, chemical and biological impacts of such loading in the receiving water. Consistent with the approach taken in EPA's *Nutrient Criteria Technical*

Guidance Manual, the Region looked to total phosphorus as the primary causal variable and chlorophyll *a* as the primary response variable.

Under undisturbed natural conditions, phosphorus concentrations are very low in most aquatic ecosystems. Typically, elevated levels of nutrients such as phosphorus will cause excessive algal and/or plant growth resulting in reduced water clarity and poor aesthetic quality. Phosphorous and other nutrients (*i.e.*, nitrogen) promote the growth of nuisance levels of algae, such as phytoplankton (free floating algae) and periphyton (attached algae), filamentous algae such as moss and pond scum, and rooted aquatic plants, referred to generally as macrophytes. Through respiration, and the decomposition of dead plant matter, excessive algae and plant growth can reduce in-stream dissolved oxygen concentrations to levels that could negatively impact aquatic life and/or produce unpleasant sights and strong odors, negatively impacting recreational and aesthetic uses.

EPA nutrient criteria technical guidance states that water column concentrations of total phosphorus, algal biomass as chlorophyll *a*, turbidity and transparency and flow and velocity are the primary nutrient parameters to consider when selecting water quality variables to evaluate or predict of the condition or degree of eutrophication in a water body. *See Nutrient Criteria Technical Guidance* at 29-38. Phosphorous is often used as a causal indicator of eutrophication because its presence results in plant growth, while chlorophyll *a* "is considered the most important biological response variable for nutrient-related problems." *Id.* at 31; *see also*, Chapra (1997) and Thomann & Mueller (1987). Chlorophyll *a* is a sensitive indicator of algal biomass. Excessive algae is directly responsible for unsightly periphyton mats or surface plankton scum.[15]

As mentioned above, in the absence of a numeric criterion for phosphorus, the Region in part looks to nationally recommended criteria and other technical documents for guidance. *See* 40 CFR § 122.44(d)(1)(vi)(B). EPA has recommended total phosphorous concentrations for receiving waters in various technical guidance materials. The *Gold Book* recommends in-stream phosphorous concentrations of 0.1 mg/l for any stream not discharging directly to lakes or impoundments to control the effects of cultural eutrophication. Meanwhile, the *Nutrient Criteria Technical Guidance Manual* cites a range from 10-90 ug/l to control periphyton and from 35 to 70 ug/l to control plankton (see Table 4 on page 101). Finally, EPA's Ecoregional Nutrient Criteria outlines so-called "reference" conditions in waters within specific ecoregions across the country which are minimally impacted by human activities; and thus are representative of waters without cultural eutrophication. Keene is within Ecoregion VIII, *Nutrient Poor Largely Glaciated Upper Midwest and Northeast*. Recommended criteria for this ecoregion is a total phosphorous criterion of 10 ug/l (0.010 mg/l) and chlorophyll *a* criterion of 0.63 ug/l (0.0063 mg/l).

In the Region's view, the weight of the evidence demonstrates that the Ashuelot River is eutrophic. In-stream sampling data indicate that both total phosphorus, the primary causal variable, and chlorophyll *a*, the chief response variable, are present in

[15] Secondary response variables include dissolved oxygen, pH, primary productivity and presence of macrophytes. *See* Nutrient Criteria Technical Guidance Manual at 35-45.

concentrations consistent with those found in eutrophic waters. As set forth in the Fact Sheet, during the summers of 2001 and 2002, the NHDES sampled the Ashuelot River to collect data for a TMDL. The river was sampled on August 16, 23 and 29, 2001 and on August 28, 2002. A summary of pertinent data obtained during the sampling is presented below in Table One. The data represents effluent samples taken from the two WWTFs in the study area, Keene and Swanzey, and from the Ashuelot River upstream and downstream of these facilities. A map showing the location of the WWTFs and the location of the Ashuelot River sampling sites is attached as *Exhibit A*. The sampling stations are numbered in descending order from upstream to downstream, with the upstream stations having the higher numbers. Station 2-Sba is a sampling station on the South Branch of the Ashuelot River, which discharges to the main branch just downstream of Station16B-Ash.[16]

Table One

Station	Ortho Phosphorous (mg/l)				Total Phosphorous (mg/l)				Chlorophyll *a* (ug/l)			
	2001			2002	2001			2002	2001			2002
	8/16	8/23	8/29	8/28	8/16	8/23	8/29	8/28	8/16	8/23	8/29	8/28
16D-Ash	0.031	<0.005	<0.005	<0.01	0.018	0.014	0.016	0.022	1.97	2.16	3.44	1.91
[redacted]												
16B-Ash	0.638	0.102	0.898	1.06	0.644	0.125	0.955	1.132	2.3	2.89	3.65	2.97
2-Sba	0.047	0.005	0.005	<0.01	0.023	0.017	0.02	0.015	3.23	2.13	2.73	2.2
16-Ash	0.145	0.241	0.246	0.245	0.16	0.271	0.287	0.268	3.44	1.8	3.84	NA
15E-Ash	0.187	0.231	0.257	0.196	0.203	0.265	0.31	0.235	4.72	10.3	6.04	3.97
15-Ash	0.179	0.169	0.206	0.209	0.197	0.197	0.265	0.263	7.09	11.4	10.43	4.93
14T-Ash	0.181	0.161	0.201	0.21	0.193	0.192	0.244	0.29	4.31	5.83	6.92	6.23
[redacted]												
14-Ash	0.12	0.117	0.136	0.141	0.158	0.18	0.277	0.213	7.83	16.3	69.64	13.64
12-Ash	0.112	0.085	0.116	0.097	0.123	0.123	0.191	0.143	5.76	3.82	23.77	19.02

Except at stations located above the Keene WWTF and on the South Branch of the Ashuelot River (Stations 16D-Ash and 2-Sba, respectively), the data in Table One illustrate that total phosphorous concentrations at all sampling stations on the mainstem exceed the Gold Book value (0.10 mg/l), the values cited in the *Nutrient Criteria*

[16] Sampling data collected by the New Hampshire Volunteer Assessment Program similarly shows sharply elevated ambient phosphorus concentrations a short distance downstream of the Keene WWTF discharge (Station 16-Ash). *See* 2002 Ashuelot River Water Quality Report, Figure 5-7; 2003 Ashuelot River Water Quality Report, Figure 5-6; 2004 Ashuelot River Water Quality Report, Figure 5-6; 2004 Ashuelot River Water Quality Report, Figure 7.

Technical Guidance Manual (.01 to .09 mg/l to control periphyton and from .035 to .07 mg/l to control plankton) and the recommended Ecoregion criterion (0.010 mg/l).[17]

Chlorophyll *a* data also provides insight into the trophic status of the Ashuelot River, although the available chlorophyll *a* data set for the Ashuelot River is limited by the number of sampling events. The range of recommended chlorophyll *a* concentration limits to prevent nuisance conditions and water quality degradation in streams range from 8 ug/l to 15 ug/l. *See Nutrient Criteria Technical Guidance Manual*, Table Four at 101-102. As mentioned, the recommended ecoregional chlorophyll *a* criterion is .63 ug/l. As illustrated in Table One, chlorophyll *a* data exceed the recommended ecoregional chlorophyll *a* criterion at all stations and *Nutrient Criteria Technical Guidance Manual* values at certain stations. The range of in-stream chlorophyll *a* is 1.97 ug/l to 69.64 ug/l. Although the data for chlorophyll *a* measures in the Ashuelot River are based on single samples, a comparison of these values with those in EPA guidance documents and the scientific literature indicates nutrient impairment in the Ashuelot River, in particular downstream of the West Swanzey WWTF.[18]

The primary causal and response indicator data support the conclusion that phosphorus effluent discharges from the Keene WWTF "encourages cultural eutrophication" within the meaning of Env-Ws 1703.14(c) and Env-Ws 1702.15. This is evidenced in the first instance by excessive levels of algal biomass as chlorophyll *a* in the water column downstream of the facility's discharge. Based on these elevated in-stream measures of the primary and response variables for eutrophication and relevant EPA technical guidance, EPA believes that it is reasonable to conclude that discharges from the Keene WWTF (the dominant source of bioavailable phosphorus loading to the Ashuelot River under critical low flow conditions) are encouraging cultural eutrophication in the receiving waters.[19]

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[17] The phosphorus concentrations will also exceed a New England-wide recommended value (0.020 mg/l - 0.022 mg/l) as reflected in a paper being developed by EPA, the New England Interstate Water Pollution Control Commission and the environmental consulting firm ENSR. *See Riffles vs. Reservoirs – Nutrient Criteria and Downstream Effects* (Mitchell, Liebman, Ramseyer, and Card, 2004). The paper was still in draft form as of the date of final permit issuance.

[18] Table Two in the *Nutrient Criteria Technical Guidance Manual* (at 27) suggests boundaries for trophic classification of streams as characterized by mean chlorophyll *a*. Based on the values presented, the Ashuelot River would be considered, at a minimum, mesotrophic and, thus at risk for eutrophication.

[19] The Region believes that a protective approach that imposes nutrient limits *prior* to the appearance of severe impairments is reasonable. This is consistent with the memorandum accompanying the *Nutrient Criteria Technical Guidance Manual* (Memo: Development and Adoption of Nutrient Criteria into Water Quality Standards (November 14, 2001)), which notes, at 19:

> Decisions to list waters as impaired under Clean Water Act section 303(d) should ideally occur prior to highly visible responses such as algal blooms to facilitate a more proactive approach to management. One approach is to consider excessive levels of nitrogen and phosphorus as a basis for listing regardless of the status of early response variables such as chlorophyll *a* or turbidity.

With this said, the administrative record for the permit includes evidence that significant impairments of the receiving waters due to phosphorus-driven eutrophication have already occurred, as discussed elsewhere in Response B3.

Consistent with the Region's conclusion is ample record evidence of visible occurrences of nuisance aquatic plant growth downstream of the discharge.[20] A survey conducted for the US Fish and Wildlife Service notes that, "Aquatic macrophytes & filamentous algae were common downstream of the effluent, perhaps due to nutrient enrichment but also because riparian canopy was sparse and the stream received much sunlight." *Freshwater Mussels of the Ashuelot River, Keene to Hinsdale* (Biodrawversity, 2003) at Appendix 1 (Mussel Data Form for Site 9). The Region believes a more accurate interpretation of the facts would be that the elevated in-stream phosphorus concentrations *combined with* sparse riparian canopy are resulting in excessive plant growth. This inference is reasonable given that the canopy was also observed to be sparse 600 yards above the facility's outfall without any indication of nuisance plant growth. *Id.* (Mussel Data Form for Site 7).[21] Further downstream, the survey again notes "abundant aquatic macrophytes along the edge" of the river. *Id.* (Mussel Data Form for Site 11). Yet further, where the flow rate is observed to be "very slow – not even noticeable," the survey observed, "lots of emergent macrophytes along the banks, and also lots of duckweed 'rafts' floating by." *Id.* (Mussel Data Form for Site 14). Over the next 150 yards, the survey notes, "quite a lot of algae on all submerged surfaces making it difficult to see mussels in some places, and also large 'rafts' of duckweed[,]" as well as some submerged macrophytes. *Id.* (Mussel Data Form for Site 15). Again, a particularly slow flow rate was noted. *Id. See also*, Mussel Data Form for Site 15(2)) ("Flow rate was very slow. There was quite a lot of algae on all submerged surfaces making it difficult to see mussels in some places."); Mussel Data Form for Site 16(1) ("Lots of algae & other slimy stuff on submerged surfaces...Water quality here was not great. Nutrients seemed to be the main problem – there was lots of algal growth and the water was quite turbid."); Mussel Data Form for Site 16(2) (observing "some macrophytes"); Mussel Data Form for Site 16(3) ("...rocks were often covered with a dense filamentous algae. Macrophytes were not that common."); Mussel Data Form for Site 17 ("some macrophytes").

The impairments described above all occurred *upstream* of the Swanzey WWTF, which is located close to Site 17. The descriptions of the sites below Site 17 indicate increased flow velocities in many areas, and riffles and eddies become more common. There is little evidence of visual impairment in this stretch of the river. However, in areas where the river slows significantly impairment is noted, for instance at Site 18, and Site 23, where "[m]any of the rocks were covered with thick filamentous algae" and some macrophytes were present. As to this latter area, the surveyor further states, "I had visited this area a few years but did not survey here, and at the time there were obvious signs of eutrophication (excessive algal growth, turbidity). This will probably happen later this summer." Similarly, at Site 24, where flow velocity was minimal, the cobble

[20] Attached as *Exhibit B* are pictures provided by Barbara Skuly Ashuelot River Local Advisory Committee, showing conditions in the Ashuelot River both upstream and downstream of the Denman Thompson Bridge in West Swanzey. This location is upstream of the West Swanzey WWTF.

[21] "Some patches of aquatic macrophytes" are observed at site 8, which is 10 to 200 yards upstream of the effluent. The light profile of this segment shifts from very little canopy and full sunlight upstream to afternoon shade further downstream. The survey notes, "[s]ome patches of aquatic macrophytes" at site 8. However, it is unclear from the survey data form exactly where along this stretch the plant growth occurred (*i.e.* proximity to the outfall and attendant elevated in-stream phosphorus concentrations).

and boulders on the river's bottom "were mostly covered with dense filamentous algae and some type of macrophyte."[22]

In July 2003, surveys conducted for the US Fish and Wildlife Service also noted strong odors in the area immediately downstream of the Keene WWTF discharge:

> There was a very strong sulfur smell bubbling out of the sediment along the right bank, indicating anaerobic decomposition of the sediments. There was also a fairly strong "sewer smell" down stream of the effluent.

Freshwater Mussels of the Ashuelot River, Appendix 1, Mussel Survey Data Form from Site 9 (Biodrawversity 2003). These odors were not indicated in the 1000 yard stretch above the point of discharge. The outfall pipe is located on the right bank. Given their nature and proximity to the outfall, the anaerobic benthic conditions and strong odors appear to be attributable to the effluent discharge from Keene WWTF and are in violation of Env-Ws 1703.03(c), and the anaerobic benthic conditions indicate probable low D.O. at the bottom of the water column. (NHDES field notes from the TMDL sampling on August 28, 2002 also note odor from the WWTF, although there no indication of the strength).

These observations correspond with the NHDES field data collected in the course of developing the TMDL. These data indicate evidence of eutrophic conditions over the entire course of the Ashuelot River, including immediately downstream of the Keene WWTF.[23] For example, beginning upstream of the Keene WWTF at Stations 21-Ash, 20A-Ash, 19-Ash 17-Ash, 16M-Ash, and 16D-Ash, the percent cover information collected on August 16, 23, and 29, 2001 and August 28, 2002 for macrophytes ranged between 0 % to 80 %-90% cover, phytoplankton ranged between 0 % to 33% cover, and periphyton ranged between 0 % to 100 % cover. In the segment of the Ashuelot River downstream of the Keene WWTF, and upstream of the Swanzey WWTF, the percent cover of macrophytes ranged between 0% and 33%, phytoplankton ranged between 0% and 34%-66%, and periphyton ranged between 0% and 75%. Downstream of the Swanzey WWTF, at Stations 14-Ash and 12-Ash, the percent cover for macrophytes ranged between 0% and 33%, phytoplankton ranged between 0-5% and 67-100%, and periphyton ranged between 0-33% and 80%. NHDES field notes from August 29, 2001 indicate "some duckweed along bank" at Station 16-Ash, "some duckweed in patches" at Stations 15E and 14T, and a "solid duckweed mat" at Station 12 that was "stinky."

The excessive plant growth described above violates water quality standards. Noxious plant growth of this kind and extent clearly impairs designated uses, as provided by RSA 485-A: 8, II, which require the receiving water to be free of objectionable characteristics and to be suitable for swimming and other recreational purposes.

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[22] The area covered by survey sites 8-24 roughly corresponds to sampling stations represented in Table 1. Although a precise comparison cannot be made because the individual sampling locations between the two data sets differ, it is worth noting the general correspondence between the spike in in-stream phosphorus and chlorophyll *a* concentrations in this area and the instances of nuisance of plant growth.

[23] These reports were submitted to EPA by its consultant, CDM, on behalf of the Permitteee.

Such excess plant productivity also violates numerous class-specific and minimum water quality criteria. Floating duckweed growth violates the Class B criterion prohibiting slicks, odors, and surface solids that impair designated uses, in this case recreational and aesthetic. *See* Env-Ws 1703.12. This growth also contravenes minimum criteria set forth at Env-Ws 1703.03, which prohibits substances in kind or quantity that (a) settle to form harmful deposits, (b) float as debris, scum, or other visible substances), (c) produce odor rendering the receiving water unsuitable for designated uses, and (e) interfere with recreational activities. The odors and changes to the benthos resulting from the anaerobic decomposition violate both Env-Ws 1703.12 (odors) and Env-Ws 1703.08 (Benthic Deposits).

The foregoing phosphorus-driven use impairments, to which the Keene discharge is contributing, clearly violate Env-Ws 1703.14(b). The phosphorus discharges from the Keene WWTF require a level of treatment necessary to ensure attainment and maintenance of water quality standards in accordance with the nutrient standard required by Env-Ws 1703.14(c).

(2) Contrary to the commenter's understanding, EPA does not have to demonstrate that Keene is the "major contributing factor" of dissolved oxygen impairment in order to impose the phosphorus limit, but only that phosphorus effluent discharges from the facility have, at a minimum, the reasonable potential to cause or contribute to a violation of applicable water quality standards.[24] Even so, the record demonstrates that effluent discharges from the Keene WWTF do in fact constitute the majority of phosphorus loading to the Ashuelot River. *See Total Phosphorus Loading Analysis for the Ashuelot River TMDL* (NHDES). There is no continuous point source discharge of phosphorus upstream of the Keene facility. The upstream phosphorus load is approximately 1.2 lbs under 7Q10 flow conditions and using upstream phosphorus concentrations. Under 7Q10 conditions, and assuming a summer period effluent flow of 3 MGD, it is estimated that the Keene WWTF contributes approximately 86 lbs/day of phosphorus. By contrast, the Swanzey WWTF contributes approximately 3.4 lbs/day of phosphorus under current effluent discharge levels (0.08 MGD assumed) at critical low flow.[25] As to the relative contribution of point and nonpoint sources, NHDES determined that under current conditions (*i.e.*, Keene WWTF flows), the Keene facility represents approximately 72.3% of the annual total phosphorus loading and nonpoint sources represent approximately 27.7%.[26] Furthermore, a greater disparity would exist between point and nonpoint sources under 7Q10 conditions, when contributions from stormwater are relatively

[24] It is worthwhile recalling that test for triggering phosphorus removal standard at Env-Ws 1703.14(c) is whether the discharge "encourages cultural eutrophication," not whether the discharge is primary cause of the impairment.

[25] Under current conditions, annual total phosphorus loading from the Keene WWTF is 30,588.6 lbs/year. The Swanzey WWTF contributes 1,092.5 lbs/year. *See* Total Phosphorus Loading Analysis for the Ashuelot River TMDL, Table 2.

[26] Under future conditions, the combined point source loading from the Keene and Swanzey WWTF will dominate when both the Keene and Swanzey WWTFs are at full design flow capacity, the Keene WWTF will represent 84.4% of the total loading and nonpoint sources will represent approximately 15.6% of the annual TP load at Station 16B.

negligible. Although results of this analysis are presented on an annual average basis, they demonstrate the relative contribution of the Keene WWTF as compared to non-point sources.

(3)(4) Pursuant to Env-Ws 1703.14(c), discharges that encourage eutrophication require treatment necessary to ensure compliance with water quality standards. As explained above, the Region does not believe that its reasonable potential inquiry need be limited to aquatic use impairments attributable to low DO. It should be further noted that NH Standards define cultural eutrophication in terms of excessive plant growth *and/or* dissolved oxygen. *See* NHDES Env-Ws 1702.15. Thus, a water body can be use impaired as a result of cultural eutrophication even without dissolved oxygen violations. As described above, excessive plant growth has a direct adverse impact on both aquatic life habitat and recreational uses.

As noted in the Fact Sheet and above, a target ambient phosphorus concentration of 0.1 mg/l is within the range of recommended phosphorus concentrations (0.010 mg/l to 0.10 mg/l) contained in the record and thought to be sufficiently stringent to prevent cultural eutrophication. The Region opted for a limit that would achieve the Gold Book recommended concentration of 0.1 mg/l rather than the more stringent effects-based values (0.03 mg/t to 0.09 mg/l) and reference-based values (0.01 mg/l) cited in the record for the reasons discussed in the Fact Sheet (at pp. 19-20) and Response E5 below.

Comment B4: As is recognized in EPA's Fact Sheet, the State of New Hampshire will be conducting a total maximum daily load ("TMDL") study of the relevant segments of the Ashuelot River. The TMDL Program is described in the New Hampshire Department of Environmental Services' (DES) web site as follows: "The term 'total maximum daily load' (TMDL) refers to the calculation of the maximum amount of a pollutant that a waterbody can receive, and attain or maintain water quality standards for its designated use." *See* Attachment 1. DES further describes the TMDL process as follows: "In the broader sense of the term, a TMDL refers to a detailed plan that identifies the pollutant reductions a waterbody needs to meet New Hampshire's water quality standards and develops a strategy to implement those reductions ..." *Id.* Because a TMDL has not yet been conducted for the Ashuelot River, neither EPA nor DES have (1) "identified the pollutant reductions [required] to meet . . . water quality standards" or (2) develop[d] a strategy to implement those reductions."

Once the TMDL study is completed, EPA and the City will have answers to the foregoing questions and will be in a position to determine if a phosphorus limit is necessary to achieve water quality standards and, if so, what that limit should be. Specifically, the TMDL, scheduled for 2009, will determine whether the attainment of Class B standards is being impaired due to the presence of nutrients, what level of nutrients are acceptable to maintain designated uses, what sources are contributing to the introduction of nutrients into the relevant segments of the Ashuelot, and what level of restrictions, if any, should be imposed on those sources in order to achieve water quality standards. However, at this point in time, none of the foregoing has been done.

Response B4: States are required to prepare Total Maximum Daily Load (TMDL) analyses for receiving waters listed on the 303(d) list. A TMDL is a planning tool that identifies the amount of a pollutant from point, nonpoint and background sources that may be discharged to a water quality-limited segment. A TMDL, if available, complements the permitting process by providing EPA with additional information about the maximum capacity of the receiving water to assimilate pollutants from multiple categories of sources and still meet standards. The State of New Hampshire's 2004 303(d) list of impaired waters identifies surface waters which do not currently meet state water quality standards (NHDES 2004). Segments of the Ashuelot River have been identified as violating water quality standards for percent Dissolved Oxygen (DO) saturation, aluminum, pH and *Escherichia coli*.

NHDES has performed sampling necessary to perform a TMDL for dissolved oxygen impairments on the segment of the Ashuelot River from the Keene WWTF to the West Swanzey Wastewater Treatment Plant, but does not anticipate completing the TMDL until 2009. Although it is EPA's understanding that the TMDL will contain an allocation for phosphorus, EPA believes that it is reasonable to move forward with a water quality-based phosphorus effluent limitation in light of the existing nutrient impairment of the receiving water combined with numerous past delays associated with completion of the TMDL. *See* Response B3 above.

Neither the CWA nor EPA regulations require that a TMDL be completed before a water quality-based limit may be included in a permit. Rather, water quality-based effluent limitations in NPDES permits must be "consistent with the assumptions and requirements of any *available* [emphasis added] wasteload allocation." 40 C.F.R. § 122.44(d)(1)(vii)(B). Thus, an approved TMDL is not a precondition to the issuance of an NPDES permit for discharges to an impaired segment. Following development of the TMDL and approval by EPA, the wasteload, or point source, allocations will be used as a basis for the phosphorus effluent limitation in any subsequently issued NPDES permit. Until then, however, EPA will base effluent limits for phosphorus on its interpretation of the narrative criteria in the currently approved water quality standards. Indeed, the purpose of water quality standards is not only to "establish the water quality goals for a specific water body" but also to "serv[e] as the regulatory basis for establishment of water quality-based treatment controls and strategies beyond the technology-based level of treatment required by section 301(b) and 306 of the Act." 40 CFR § 130.3.

As discussed in the Fact Sheet (3-7), when reissuing an NPDES permit, EPA is obligated as a matter of statute and regulation to include any water quality-based effluent limitations necessary to ensure compliance with applicable water quality standards. *See* CWA § 301(b)(1)(C); 40 CFR § 122.44(d)(1), (5) (requiring EPA to incorporate "any more stringent limitation, treatment standards, or schedule of compliance requirements established under Federal or State law or regulations in accordance with" Section 301(b)(1)(C)); 40 CFR § 122.4(d) (prohibiting permit issuance where "the imposition of conditions cannot ensure compliance with water quality requirements of all affected states"). Thus, upon establishing that there was a reasonable potential for phosphorus concentrations in the Keene WWTF's effluent to cause or contribute to a violation of

water quality criteria, EPA was compelled to include a phosphorus effluent limit sufficiently stringent to ensure compliance with standards. *See* 40 CFR § 122.44(d)(1)(iii).

EPA is required to use relevant available information to establish water quality limits when issuing NPDES permits to impaired waters. EPA has used the data collected by NHDES for the TMDL, and has established water quality-based limits for total phosphorous using this data, applicable narrative state water quality standards, federal water quality criteria guidance and other relevant information discussed in the "Nutrients" section of the Fact Sheet. The EPA believes that the proposed limits represent a level of control necessary to achieve water quality standards.[27]

Comment B5: The City's Permit expired in April 1999 and, accordingly, EPA and the New Hampshire Department of Environmental Services (DES) have had more then seven years to develop the data necessary to provide answers to the foregoing questions. The fact that the State has not yet completed its TMDL is an issue over which the City had and has no control. The City is aware that the Ashuelot River has been placed upon the State of New Hampshire's Section 303(d) list for impairment due to dissolved oxygen. However, the Fact Sheet provides no discussion regarding how this determination was made. The data discussed below suggests that dissolved oxygen levels in the Ashuelot River are well within the State's saturation criteria.

Moreover, even if the River *were* DO-impaired, in order to understand the reasons for any such impairment, a TMDL study must be completed to address the entire spectrum of DO-demanding pollutants: TSS, BOD, ammonia, phosphorus (due to its algae-encouraging tendencies) and chlorophyll a (as an algae indicator). The study must rely on representative data for each of these parameters throughout the relevant stretch of the river. In this manner, a TMDL study will provide a complete picture/assessment of the ability of the river to accept nutrients. To date, EPA and the State have identified only a limited number of sampling locations where it is alleged that the river is impaired due to dissolved oxygen deficits. As discussed further below, such data is significantly outdated, and does not even attempt to assess the impact of other point and non-point sources of phosphorus.

Once a TMDL has been performed, all parties will understand the total pounds of a pollutant that can be discharged into a water body, from all sources, and still meet water quality standards. Then, a calculated loading (based on the total amount allowed and including a safety factor) may be identified for each of the identified pollutants. The resulting computer model can be varied to show the effect of less BOD, more phosphorus; less phosphorus, more TSS; etc., until a balance of treatment affordability and water quality can be reached.

Once the TMDL is completed, the entire picture of oxygen-demanding pollutants will be

[27] The Region's response to the comment above is equally applicable to the comments made by numerous participants at the public hearing urging a delay in imposing a phosphorus effluent limit until completion of the TMDL.

better understood, and a variety of different limits for BOD, TSS, ammonia and phosphorus could potentially be calculated which would achieve the same goal of reducing oxygen-demanding substances present in the water. Those limits will directly impact the kind of treatment that the City must provide, not just for phosphorus but other pollutants as well.

Response B5: The 303(d) listing for DO was based on in-stream sampling that revealed numerous violations of minimum instantaneous and percent saturation DO levels in 2001 and 2002. EPA agrees that a TMDL completed with the assistance of a dynamic hydrological model can be a very useful planning tool to assist EPA in setting appropriate permit limits. However, as discussed in Response B4, it is not a necessary predicate to NPDES permitting, and EPA is not required to await completion of a TMDL for DO, or any other parameter, prior to imposing a phosphorus effluent limitation in the reissued permit.

EPA acknowledges that the recent data provided by the Permittee does not indicate violations of the minimum DO saturation criterion. As noted previously, these more recent data were not obtained under low flow summer conditions and would not be expected to reflect DO under summer 7Q10 conditions. These recent data do not impact EPA's fundamental conclusion that imposing a phosphorus effluent limit on the Keene WWTF is necessary to ensure compliance with water quality standards, as discussed above.

Comment B6: As an example of the kind of analysis that is necessary to develop a technically-defensible nutrient limit, the City directs EPA's attention to the TMDL completed for the Contoocook River *prior* to EPA's imposition of a phosphorus limit for the Town of Peterborough. *See* Attachment 2. In sum, in the absence of a completed TMDL, EPA has not provided a technically-defensible permit limit.

Response B6: The commenter should note that the Contoocook River TMDL is not complete and focuses on minimum DO criteria. Numerous issues have been raised on the draft TMDL and no completion date has been established. The available data and modeling completed to date are not sufficient for developing a TMDL for phosphorus. Please see Responses B2 and B3 above with respect to the basis of the phosphorus limit.

Comment B7: EPA's attempt to impose a permit limit for phosphorus prior to the completion of a TMDL has another significant adverse practical impact. If the City were forced to meet EPA's proposed permit limit for phosphorus *now*, prior to completion of that TMDL, the City may be constructing expensive treatment technology that will either be unnecessary to achieve water quality standards or, at the other end of the spectrum, be inadequate to achieve such standards and, thus, obsolete within a few years.

We have attached hereto as Attachment 3 a report prepared by the City's consultants Stantec, which sets forth estimated construction and operation costs associated with various treatment technologies which could potentially meet EPA's proposed phosphorus limit of 0.2 mg/l. Construction costs alone will run into the millions of dollars.

Specifically, Stantec determined that the City should use enhanced biological phosphorus removal combined with either tertiary clarification with two stage filtration or tertiary ballasted floc removal. The 2006 estimated construction costs for these options range from $9.03 to 9.955 million. These numbers do not include engineering and contingency costs, nor an adjustment for inflation.

If the City were to construct a treatment system to meet a 0.2 ug/l standard and it was subsequently determined, after completion of the TMDL, that the City must meet a significantly more stringent standard, it is possible that the City would need to construct an entirely different treatment technology and the technology previously constructed would be obsolete and worthless. On the other hand, if it were determined after the TMDL that the City must meet a less stringent standard than 0.2 mg/1, the City would have over-constructed expensive treatment technology that is *not* necessary to achieve water quality standards. Either scenario is problematic.

Response B7: To the extent that a more stringent limit is imposed in the future, it is likely to that the Permittee will be able to modify or supplement any technology it has adopted rather than replace it entirely. Given the nature of technologies available to treat phosphorus, and the ability to combine them in a number of different ways that achieve a wide range of phosphorus reductions, it is very unlikely that the City would be left in a position of having over-engineered its upgrade. EPA encourages the City to consult with its engineering consultants as it plans and designs the upgrade to ensure that the technology it adopts will be compatible with meeting more stringent limits.

The Region believes that it is unlikely that a TMDL will result in a phosphorus effluent limit less stringent than 0.2 mg/l, based in part on the fact that the Keene WWTF is the dominant source of bioavailable phosphorus loading to the Ashuelot River. In the event that a TMDL translates into a phosphorus effluent limit less stringent than 0.2 mg/l, EPA notes that the Town of Swanzey, a downstream discharger, has raised the possibility of implementing a water quality trading scheme. In the future, there may be an opportunity for the Permittee to trade credits generated from utilizing excess performance capacity with the Town of Swanzey. *See EPA Water Quality Trading Policy* (January 13, 2003).

Comment B8: The financial impact to the City in having to meet the permit's proposed phosphorus limits is significant. Attached hereto as Attachment 4 is an analysis of that impact prepared by the City's Assistant Public Works Director and Laboratory Manager Donna Hanscom. The attachment establishes that the City's sewer rates have increased approximately 30 percent in 2005, and currently planned projects (not including anything related to the proposed phosphorus limit) are expected to cause additional rate increases of approximately 8 percent per year. The cost of implementing a phosphorus removal project necessary to meet the permit's proposed limit would cost an estimated $16.2 to $17.8 million, including 23 percent for engineering, a 30 percent contingency and adjusted for 4 percent annual inflation. *See* Attachment 4. Such costs would increase the sewer charge for its largest users *an additional* 60 percent over the existing projected increases. To require the City to incur this enormous cost in order to meet a permit limit

which is not mandated by State water quality standards and which EPA and the State have not yet developed the necessary data to support, would be arbitrary and capricious.

Response B8: As described above, NH Standards do contain a narrative nutrient water quality criteria, which the Region has interpreted in accordance with federal regulations and available guidance to develop a numeric permit limit. In general, the commenter should note that cost considerations or technological feasibility are *not* permissible factors in setting water quality based effluent limits. *United States Steel Corp. v. Train*, 556 F.2d 822, 838 (7th Cir. 1977); *see also, In re City of Moscow*, 10 E.A.D. 135, 168 (EAB 2001). Thus, water quality standards and the permit limits based on them may be set so as to force technological advances and environmental progress. The Permittee can, however, conduct an analysis of affordability issues for the purposes of determining whether a designated use cannot be obtained or for obtaining a variance. In determining affordability, EPA uses *Interim Economic Guidance for Water Quality Standards*. (March 1995).[28]

Comment B9: As set forth above, the presence of phosphorus in receiving water violates State water quality standards only if it impairs designated uses, in this case Class B standards.

EPA's November 2001 Nutrient Policy Document directed states to develop nutrient criteria plans using one of three approaches: (1) develop nutrient criteria that reflect localized conditions and protect specific designated uses using the process outlined in technical guidance manuals; (2) adopt EPA's recommended numeric criteria or (3) use other scientifically-defensible methods to develop criteria protective of designated uses. *See* Policy Document, attached hereto as Attachment 5, at p. 2. At various points in the document, EPA underscored that the fundamental purpose of nutrient criteria is to protect designated uses. *See* Policy Document at p. 4 ("EPA expects states . . . to describe a systematic approach . . . to assess the .. . need for nutrient criteria to protect designated uses."); Policy Document at p. 5 ("States .. . establish criteria for the specific purpose of protecting the designated uses of their waters."). In fact, EPA recognized that its "Gold Book" recommendation constituted an "attempt to characterize reference conditions on a broad ecoregion or sub-ecoregion scale *irrespective of designated uses* . . . or levels of refinement within the same type of designated use ...." *Id.* at p. 5. Thus, EPA's Gold Book criteria, upon which EPA ultimately based its proposed permit limit, is not related to the protection of designated uses in New Hampshire Class B streams.

Shortly after EPA published its nutrient policy document, the State of New Hampshire issued its "Plan for Adoption of Nutrient Water Quality Criteria," attached hereto as Attachment 6. New Hampshire elected to "develop its own scientifically-defensible approach", stating that EPA's recommended statistical approach did not "relate directly to use support." Significantly, New Hampshire's policy states that, "based on . . . reports and professional experience, we believe that there are not many New Hampshire waterbodies for which water quality does not support designated or existing uses

[28] The Region's response to the comment above is equally applicable to the objections made by numerous participants at the public hearing regarding the cost of complying with the phosphorus limit.

(primarily aquatic life and swimming) due to cultural nutrient enrichment." *See* New Hampshire Plan at p. 1. New Hampshire "proposed to set numeric limits by waterbody type only for chlorophyll a because that is the parameter that (in almost all cases) actually results in non-attainment of a designated use due to cultural nutrient enrichment, either aquatic life use support or recreation." *See* New Hampshire Plan at p. 2.

Response B9: As explained in the Fact Sheet, the Region opted to base the phosphorus limit on the Gold Book approach rather than the reference condition-based ecoregional approach. *See* Fact Sheet at 19-20. The Permittee's quotation from the EPA's 2001 Nutrient Criteria Document relates to the reference conditions-based approach, not the approach that the Region actually took in establishing the phosphorus limit. With that said, the elided quote from EPA's 2001 Memorandum has been stripped of its proper context. The sentence from the memorandum following the one quoted by the commenter clarifies:

> EPA considers these 304(a) criteria recommendations to be protective against the adverse effects of excessive nutrient enrichment in these ecoregions for *all assigned designated uses* [emphasis added], in the absence of information to the contrary... If reference conditions accurately reflect minimally disturbed conditions, then all attainable uses should be protected if water quality is equal to or better than the reference conditions.

EPA Nutrient Criteria Memorandum at 4. The reference condition approach would be expected to protect New Hampshire's designated uses, which is a variant on the commonly used fishable/swimmable formulation and certainly within the range of uses addressed by ecoregional guidance ("The waters of this classification shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies."). Likewise, the Gold Book approach, which recommends a value of .1 mg/l, is designed "to prevent the development of biological nuisances and to control accelerated or cultural eutrophication[.]"

All states, including New Hampshire, are in the process of developing numeric nutrient criteria that, at a minimum, will protect all designated uses. As noted, NHDES has not adopted numeric nutrient criteria. Its Nutrient Policy Document remains in draft form and has not been approved by EPA. Water column chlorophyll *a* levels are an indicator of phytoplankton biomass, which would be expected to be higher in stream segments with low current velocity, long detention time, low turbidity/color, open canopy, greater depth, and greater depth to width ratio. *Nutrient Criteria Technical Guidance Manual*, Table 1, at 21. However, it is not adequate as the *only* indicator of eutrophication to document the full extent of nutrient related impacts in most rivers/streams, because stream segments with high current velocity, low turdidity/color, open canopy, shallow stream depth, minimal scouring, limited macroinvertebrate grazing, gravel or larger substrata, and smaller depth to width ratio would be expected to have a high periphyton biomass, which is not measured by water column chlorophyll *a*. For instance, in river reaches where macrophytes and/or periphyton dominate, these indicators of

eutrophication also need to be considered in the development of numeric criteria. Also, any criteria that is based on a response variable such as chlorophyll *a* must also include a mechanism for establishing limits on the causal variable (*i.e.* phosphorus) that will result in attainment of the criteria.

NHDES has been using a chlorophyll *a* value of 15 ug/L as a threshold value for 303(d) listing determinations related to nutrient impacts to a single designated use, primary contact recreation. *See* Consolidated Assessment and Listing Methodology at 3-33. Again, this number has not been adopted by NHDES as a water quality criterion, nor is it used by the Department to address nutrient related impacts on other designated uses, such as aquatic life. Even if the chlorophyll *a* value of 15 ug/l were to be used, the data documented in the Fact Sheet and in Response B3 above demonstrate that it is being exceeded in the receiving waters. Moreover, available technical literature and EPA guidance suggests that water column chlorophyll *a* criteria will likely need to be significantly less than 15 ug/l in order to be sufficiently protective of standards.

Comment B10: Accordingly, EPA must do more than conclude that phosphorus constitutes a "threat" of cultural eutrophication before imposing a phosphorus limit. Rather, EPA must point to specific data establishing that Class B uses are not being met in the Ashuelot River due to the presence of phosphorus. As is made clear in the discussion below and supporting documents, this EPA has not done. The State of New Hampshire has made clear that it believes that few New Hampshire waterbodies are not meeting designated or existing uses due to cultural nutrient enrichment. EPA has neither rebutted this statement nor made a case that such uses are not being met in the Ashuelot River due to the presence of nutrients. The discussion contained in EPA's Fact Sheet simply establishes that phosphorus may be present in the Ashuelot River at concentrations higher than certain values referenced in EPA's "Gold Book." It contains no discussion as to whether or not Class B uses are being met due to the presence of phosphorus.

Response B10: The Region believes that the record adequately demonstrates that the receiving waters are eutrophic due in part to the substantial phosphorus effluent discharges from the Keene facility and that Keene's phosphorus effluent discharges have contributed to violations of water quality standards (*e.g.*, impairment of primary and secondary contact recreational uses such as swimming and boating, as well as aesthetic uses, due to excessive plant growth, surface scum, floating solids; impairment of aquatic life uses due to low dissolved oxygen). *See* Responses B2 and B3 above.

The Region does not need to rebut the NHDES's view in its draft policy concerning the overall number of nutrient impaired waters prior to imposing a phosphorus limit. Even if the Region agreed with NHDES's assessment, the question would still remain whether the Ashuelot River is among those few impaired waterbodies. As discussed in Responses B2 and B3 above, EPA believes that it is.

Comment B11: Submitted herewith under separate cover is a technical support document prepared by the City's consultants, Camp, Dresser and McKee (CDM) which addresses

EPA's argument, set forth in the permit's Fact Sheet, in support of the proposed phosphorus limit. In order to aid in following the discussion in the CDM report, we have included as Attachment 7 a map of the relevant stretch of the Ashuelot River, showing tributaries and sampling stations. The CDM report identifies the following deficiencies in EPA's analysis which renders the permit's proposed phosphorus limit arbitrary and capricious:

Comment B11(a): EPA erroneously characterizes the information on phosphorus contained in its Gold Book. *See* CDM Report at Sec. I. The Gold Book clearly indicates that there is no national criterion for phosphorus which is the reason EPA has moved forward on the development of regional ecosystem guidance, and has required individual states to develop strategies for the development of nutrient water quality criteria.

Response B11(a): Please see Response C1.

Comment B11(b): EPA erroneously characterizes New Hampshire's 0.05 mg/L total phosphorus "level of concern." *See* CDM Report at Sec. II. The State has specifically disavowed this as a criterion, noting that there is no surface water quality standard for phosphorus "due to the high degree of natural variability and the difficulty of pinpointing the exact source."

Response B11(b): Please see Response C2.

Comment B11(c): EPA's Fact Sheet ignores New Hampshire's nutrient management strategy. *See* CDM Report at Sec. III. That strategy specifically disavowed EPA's "recommended statistical approach" in favor of a chlorophyll-*a* based approach to nutrient regulation. EPA has implicitly approved this approach.

Response B11(c): As explained in the Fact Sheet, the Region looked at a variety of causal and response variables in deriving a protective phosphorus effluent limit, and considered these data in light of EPA recommended criteria and information published under CWA § 304 (*i.e.*, *Gold Book*, the *Ecoregional Nutrient Criteria, Nutrient Criteria Technical Guidance Manual*) and other relevant, peer reviewed technical literature. Additionally, the Region's approach is consistent with federal regulations governing the development of a numeric permit limit to implement a narrative criterion. The Region opted to apply a limit consistent with the effects-based Gold Book approach for phosphorus rather than the reference condition-based ecoregional criterion. *See* Fact Sheet at 19-20.

Please see Responses B2 and B3 above with respect to the chlorophyll *a*-based approach and the risks of over-reliance on a single response variable. Please also see Response C3.

Comment B11(d): EPA's analysis of chlorophyll-a data is erroneous. *See* CDM Report at Sec. IV. The available data supports the conclusion that the relevant segment of the Ashuelot River is oligotrophic, not eutrophic.

Response B11(d): Water column chlorophyll *a* data cited by the commenter (in Section IV of the CDM comments) is not sufficient to characterize the Ashuelot River's trophic status. First, two of the stations cited in the comments (10-Ash and 2-Ash) are far downstream of the Keene and Swanzey (POTW) discharges and were not even sampled during the TMDL sampling in 2001 and 2002. The data from all three stations summarizes New Hampshire Ambient River Monitoring data, which was not necessarily collected under critical low flow. The data shown for Station 16-Ash does not include the data collected for the TMDL during 2001 and 2002, which was collected under low flow conditions. Finally, for Station 16-Ash, the chlorophyll data collected during the TMDL sampling shows that this site is not a station where phytoplankton (*i.e.* water column chlorophyll *a*) is the dominant growth form and, therefore, it is expected that water column chlorophyll *a* values would be lower. For example, on August 29, 2001, when the highest levels of chlorophyll *a* were recorded at Stations 12-Ash and 14-Ash, along with significant amounts of duckweed as noted in the field notes provided by the Permittee, Station 16-Ash had low chlorophyll *a* levels. Thus, Station 16-Ash should not be considered a critical Station for chlorophyll *a*. *See* Fact Sheet at 17 (Table Three). Additionally, the survey conducted on August 16, 2001 recorded observations of periphyton (75% coverage) and scattered/common macrophyte coverage at Station 16-Ash. This demonstrates that nuisance plant growth resulting from cultural eutrophication conditions can prevail even where chlorophyll *a* levels are relatively low (3.44 ug/l).

The data indicates that conditions exist at these stations 12-Ash, 14-Ash, and 16-Ash which are favorable to aquatic plant growth. The presence of duckweed and high chlorophyll *a* at 12-Ash and 14-Ash is a further indication that these are slower moving reaches where it would be expected that floating biomass (duckweed) and water column biomass would dominate (versus other stations, such as 16-Ash where periphyton would dominate and lower water column chlorophyll *a* values would be expected. Therefore, in EPA's view, 12 Ash and 14-Ash are key stations to be included in any accurate overall assessment of water column chlorophyll *a* and floating biomass. Again, the reliance upon only one indicator of eutrophication can be misleading, which is why EPA employs a multi-factorial approach. *See* Responses B2 and B3 above.

Comment B11(e): EPA's analysis of dissolved oxygen is flawed. *See* CDM Report at Sec. V. The data discussed in the CDM report establishes the most recent data (ignored in EPA's Fact Sheet) indicates more favorable dissolved oxygen results than reflected in the earlier sampling relied upon by EPA. Contrary to the information set forth in EPA's Fact Sheet, dissolved oxygen levels in the Ashuelot River are well within the State's saturation criteria and, most significantly, the *highest* levels of DO saturation occur *upstream* of the City's wastewater treatment facility.

Response B11(e): Please see Response C5.

Comment B11(f): EPA has failed to consider recent and ongoing changes relative to phosphorus loading which renders the data on which it has relied obsolete. *See* CDM Report at Sec. VI. Relative to the latter issue, since the data on which EPA relies was

obtained, the following has occurred or will be occurring in the near future, all of which significantly impact water quality in the Ashuelot River:

(1) Numerous nutrient discharges to the Ashuelot River have been eliminated. Attached hereto as Attachment 8 is the Affidavit of Eric Swope and related correspondence which outlines the number of nutrient-containing discharges to the Ashuelot River which have been eliminated in recent years.

(2) As discussed further in the CDM report, the Homestead Mill Dam in West Swanzey is scheduled to be removed in the near future, which should result in substantial water quality benefits.

(3) The City has been consistently reducing its effluent phosphorus concentrations, as reflected in the phosphorus data included in Attachment 9.

(4) If EPA proposes an interim phosphorus limit as part of an administrative order (which the City is willing to consider pending completion of a TMDL), this will further reduce the amount of phosphorus in the City's effluent and, accordingly, in the Ashuelot River.

In light of the aforementioned changes both in nutrient loading in the Ashuelot River and the morphology of the river itself, more recent data is necessary to develop any reasonable conclusions regarding dissolved oxygen and chlorophyll-a levels in the Ashuelot River.

Response B11(f): Please see Response C6.

Comment B11(g): Even if the data established that a permit limit for phosphorus were appropriate (which it does not), EPA's proposed limit is based on an incorrect calculation of the required level of treatment. *See* CDM report at Sec. VII. The Agency has arbitrarily required the City to meet the 0.2 mg/l limit throughout the period April through October, when the data clearly show that such a limit is not necessary in the spring when factors such as water temperature, available light and high stream flows indicate that the higher levels of discharge would not adversely impact the River.

Response B11(g): While limits are established based on meeting ambient targets during 7Q10 flow conditions, it is critical to control phosphorus inputs during the entire growing season. This reasonably conservative approach is important in aquatic systems where the cycle of cultural eutrophication is already underway, as is the case in the Ashuelot River. In order for the river to be restored to health, this cycle must be broken by limiting the amount of excessive phosphorus available for uptake by aquatic plants.[29] Excessive

[29] EPA's adoption of a conservative approach regarding the length of the growing season and the period during which to impose the warm weather seasonal phosphorus limit is justified. Here, EPA applied its technical expertise to consider the scientific literature and the available data in the record, but was left with

phosphorus discharged during the growing season accumulates in plant biomass and can often be retained in the system through settling in slow moving/impoundment sections of the river. Phosphorus can then recycle into the water column, exacerbating eutrophic conditions during critical periods. In EPA's experience, aquatic plant growth begins in April and continues through October in New England rivers. EPA's *Rates, Constants and Kinetics Formulations in Surface Water Quality Modeling (Second Edition)* includes an envelope curve of algal growth rate versus temperature that shows that growth rates begin to increase at temperatures above 0 degrees Celsius (see Figure 6-2 on page 298).

C. Comments Submitted by Mr. John J. Gall, Jr., Camp, Dresser and McKee on behalf of the City of Keene

Comment C1: EPA erroneously characterizes information contained in the Gold Book.

EPA indicates that a value of 0.1 mg/1 P is the water quality criteria for flowing streams as presented in the 1986 Water Quality Criteria Guidance Document (the Gold Book). Fact Sheet at Page 18. This is incorrect; the Gold Book clearly indicates that there is no such criterion. See relevant portions of the Gold Book, attached hereto as Exhibit A, specifically the discussion on Phosphate Phosphorus, which concludes with the following:

> No national criterion is presented for phosphate phosphorus for the control of eutrophication

While the document does describe a variety of approaches that could be considered, including concentration values, Vollenweider loading rates, and a generic description of the factors influencing eutrophication induced by phosphorus, none of the approaches are criterion in the context of the EPA's Quality Criteria for Water.

Indeed, if phosphorus levels were so simple a matter to deal with, then phosphorus limits would have been incorporated into permits long ago, beginning as far back as 1986, including limits for the Keene discharge. However, the issue of phosphorus is not so simple, which is the reason that EPA has moved forward on the development of regional ecosystem guidance, and has required individual states to develop strategies for the development of nutrient water quality criteria. Any thoughtful evaluation of the impacts of phosphorus needs to be undertaken in the context of the various sources and the many physical, chemical and biological reactions that control the fate and impacts of phosphorus in the receiving waters. The TMDL and waste load allocation currently being developed by the New Hampshire DES is the appropriate vehicle for such an undertaking.

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uncertainty, as the record materials do not precisely dictate when the limit should be imposed. This uncertainty is compounded by the complexity typically associated with the response of nutrient impaired waters. When deriving permit limits, a conservative approach is generally warranted under applicable regulations, as the permit must "ensure" compliance with water quality standards, not simply be "reasonably capable" of achieving them. *See In re Gov't of D.C. Mun. Separate Storm Sewer Sys.*, 10 E.A.D. 323, 343 (EAB 2002); *In re City of Marlborough,* NPDES Appeal No. 04-13, slip op. at 22 (EAB, Aug. 11, 2005), 12 E.A.D. __ ("mere possibility" of compliance does not "ensure" compliance).

Response C1: The Region understands that the *Gold Book* does not contain a phosphorus criterion *per se*, but instead presents a "rationale to support such a criterion." *Gold Book* at 240. However, the guidance document then goes on to recommend in-stream phosphorous concentrations of 0.05 mg/l in any stream entering a lake or reservoir, 0.1 mg/l for any stream not discharging directly to lakes or impoundments, and 0.025 mg/l within the lake or reservoir. The Region used the formulation "Gold Book criterion" as shorthand and regrets any confusion the phrase may have caused the commenter. Still, the *Gold Book*, in addition to the recommended Ecoregional Nutrient Criteria, is an appropriate source to consider pursuant to 40 CFR § 124.44(d)(1)(vi)(B) (allowing the Region to, "Establish effluent limits on a case-by-case basis, using EPA's water quality criteria, published under section 304(a) of the CWA, supplemented where necessary by other relevant information" when implementing a narrative water quality standard).

The Region agrees that the imposition of phosphorus effluent limits is technically complex and that a variety of approaches exist for setting protective limits. EPA agrees with the commenter's position that an evaluation of phosphorus impacts on in-stream water quality should consider all sources, as well as relevant physical, chemical and biological aspects of phosphorus impacts on the receiving water. EPA, however, is not required to await completion of a TMDL prior to evaluating these factors for the purposes of issuing an NPDES permit. *See* Response B4 above. Although EPA acknowledges that there are other sources of phosphorus that contribute to the phosphorus impairment in the receiving waters, the decision to move forward despite the lack of a completed TMDL is reasonable given that the Keene WWTF is the dominant source of bioavailable phosphorus under critical low flow conditions.

Comment C2: EPA erroneously characterizes NH's "level of concern."

EPA characterizes NH's 0.05 mg/l total P level of concern in such a way as to infer that is somehow a criterion. *See* Fact Sheet, page 16. However, a more accurate description of the 0.05 level is presented in the documents cited by EPA. For example, the Volunteer River Assessment Program for 2002 for the Ashuelot says:

> Phosphorus can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. There is no surface water quality standard for phosphorus due to the high degree of natural variability and the difficulty of pinpointing the exact source. However 0.05 mg/L total phosphorus is typically used as a level of concern, which means DES pays particular attention to readings above this level. *See* NHDES, New Hampshire Volunteer River Assessment Program 2002 Ashuelot River Water Quality Report at p. 10 (attached hereto as Exhibit B.)

Thus, while New Hampshire may use 0.05 mg/l to identify waters of concern for nutrient management, the state has expressly disavowed this as a criterion. NH's approach to nutrient management is described more fully below.

Response C2: EPA recognizes that the 0.05 mg/l total phosphorus is not a criterion, and quoted that the NHDES considers it as a "level of concern." *See* Fact Sheet at 16.[30]

Comment C3: EPA ignores New Hampshire's stated nutrient management strategy.

EPA makes reference to national *(Ambient Water Quality Criteria Recommendations, Information Supporting the Development of State and Tribal Nutrient Criteria, Rivers and Streams in Ecoregion VIII)* and draft regional (Mitchell, Liebman, Ramseyer, and Card, draft 2004) studies of phosphorus levels in reference streams to infer that numeric water quality criteria ought to be even lower than the recommendations of the Gold Book, sometimes as low as 0.01, or 0.02 mg/l, to prevent eutrophication. Fact Sheet at page 16.

But as EPA assuredly knows, many states, including New Hampshire have eschewed the use of this approach to the development of nutrient criteria. Ever since EPA directed the States to develop numeric nutrient criteria in November 2001, New Hampshire has indicated its intention to develop their own criteria. Under New Hampshire's approach, chlorophyll *a* is proposed as the standard for assessing use impairment due to cultural nutrient enrichment, either aquatic life use support or recreational. New Hampshire's rational for developing a different approach is that

> the statistical approach recommended by EPA ... do[es] not (in our [DES'] opinion) directly relate to use support, whereas the Clean Water Act water quality standards process explicitly provides for "setting criteria necessary to protect the uses" (40 CFR 131.2). DES-WMB Policy No. 3 dated Nov. 14, 2002 at p. 1, attached hereto as Exhibit C.

This approach has been part of DES' Performance Partnership Agreement with EPA every year since FFY 2004. (*See* 2004 DES Comprehensive Action and Assessment Workplan, attached hereto as Exhibit D.)

Not only has EPA been advised of this approach, but it has implicitly approved it, through the approval of the State's List of Impaired Waters. That document explicitly characterizes 15 ug/l as the water quality criteria for chlorophyll a that is used as a metric for assessing nutrient enrichment impairment of designated uses. See *2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology, NHDES-R-WD*-04-5, pages 3-33 to 3-37, relevant portions of which are attached hereto as Exhibit E. Because the State has formulated a chlorophyll a standard for assessing use support, EPA cannot supplant it with its own version of this standard.

Response C3: To date, New Hampshire has not promulgated, and EPA has not approved, numeric water quality criteria for nutrients. New Hampshire's nutrient plan

[30] Further, EPA fails to understand why pinpointing the exact pollutant *sources* of phosphorus is a necessary prerequisite for developing *ambient* criteria. Regardless, in this case, the record indicates that Keene is the dominant source of phosphorus loading in the Ashuelot River. *See* Response B3 above.

document represents a step in that direction. However, the plan remains in draft form.[31] The purposes of such plans, as explained by the 2001 EPA Nutrient Policy Document, is as follows:

> A plan will enable EPA and the states and authorized tribes to gain a better understanding of the scope, level of effort, and time needed to accomplish the goal [of readily approving state/tribal standards when they are ultimately submitted]. By collaboratively developing these plans, states and authorized tribes can help EPA set realistic expectations, as well as ensure that EPA concurs with their approach to developing nutrient criteria as early in the process as possible.
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> ***
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> While the plan should characterize state/tribal intentions as clearly as possible, the plan does not represent a binding commitment.

See Nutrient Policy at pp. 4-5. EPA's concerns with the approach reflected in the draft nutrient policy, *e.g.* over-reliance on chlorophyll *a* levels as a single indicator of eutrophication, are discussed in more detail in Response B9. Thus, while EPA applauds DES for the work it has completed to date on its plan for adopting numeric nutrient criteria, EPA is not bound by that document for the purposes of establishing a phosphorus effluent limit in an NPDES permit.

EPA approves a state's 303(d) listing decision if the list meets the requirements of CWA 303(d). EPA has not approved, implicitly or otherwise, the use of a chlorophyll *a* value of 15 ug/l as the metric for assessing use impairment due to nutrients. EPA does not approve the specific listing methodology. As noted earlier, NHDES has been using a chlorophyll *a* value of 15 ug/l as a threshold value for 303(d) listing determinations related to nutrient impacts to a single designated use, primary contact recreation. This number has not been adopted by NHDES as a water quality criterion, nor does it address nutrient related impacts on other designated uses, such as aquatic life. In fact, in the portions of the listing document cited by the commenter, NHDES specifically states that chlorophyll *a* categories, which sets forth thresholds concentrations associated with levels of impairment, are provided "only as general guidance." Finally, even if the chlorophyll *a* value of 15 ug/l were to be used, the data documented in the Fact Sheet (p. 17) demonstrates that it is being exceeded in the receiving waters. *See* Response B3 above.

Neighboring states of Maine and Vermont have made significant progress in developing numeric criteria for phosphorus. Presentations given by these two states have included total phosphorus criteria for Class B waters of 27 ug/l for Maine and a range from 10- 30 ug/l for Vermont. These criteria have not yet been formally proposed and are subject to change, but do show that total phosphorus numeric criteria are being considered by neighboring states and are within the range of the Gold Book and ecoregion values cited by EPA in the Fact Sheet.

[31] The plan is also not an EPA-approved policy within the meaning of 40 CFR § 131.13.

Comment C4: EPA's analysis of chlorophyll *a* data is erroneous.

EPA uses chlorophyll *a* concentrations as an indicator of algal activity, and extrapolates this indicator to suggest that there are problems with respect to the achievement of the State's narrative water quality standard for nutrients and that it presages problems with respect to attainment of the state dissolved oxygen standards. The data do not support the Agency's conclusions.

Based on chlorophyll-*a* data taken during sampling events of 2001 and 2002 EPA concludes that "the Ashuelot River would be considered, at a minimum mesotrophic, and thus at risk for eutrophication, and eutrophic." Fact Sheet, page 16. The trophic status—oligotrophic, mesotrophic, eutrophic or hypereutrophic—refers to increasing levels of biological productivity. Oligotrophic waters have the lowest productivity, low nutrients and usually high clarity. Eutrophic waters have higher levels of nutrients and biological productivity and are often less clear. EPA uses various sources to characterize the condition of the river including a value of 0.63 ug/l chlorophyll-*a* as derived from studies of reference sites, and a suite of chlorophyll-*a* values to characterize the trophic status of the river, as presented in their Table 4. This is erroneous for several reasons:

First, NH has established a *de facto* chlorophyll-a criterion of 15 ug/1, as part of the development of their impaired waters list. This effectively serves as the State's interpretation of their narrative water quality standard for nutrients. It is thus improper for EPA to ignore the State's interpretation of the State's narrative water quality standard.

Secondly, the segments to which Keene discharges, and that are immediately downstream are shown by the data in the Fact Sheet to be oligotrophic. Chlorophyll-*a* concentrations in these segments as presented in EPA's Table Three are less than 4 ug/1, consistent with the character of oligotrophic waters as presented in EPA's Table 4. Only below the Swanzey wastewater treatment plant do the chlorophyll-*a* levels rise above the NH criterion of 15 ug/1 chlorophyll-*a*.

In addition, more data from the State's ambient River Monitoring Program for the period 2002 through 2005, which was available to EPA, supports the classification of the system as oligotrophic. The data for this period is included in Exhibit F. The following chart, Figure 1, shows chlorophyll-*a* values for various stretches of the Ashuelot River, including segments directly downstream of Keene (16-ASH), and segments further downstream (10-ASH and 02-ASH). As with the data presented in EPA's Fact Sheet, this confirms that as measured by chlorophyll-*a*, these segments are oligotrophic according to EPA's approach

[Figure Not Reproduced]

Additionally, the data upon which EPA relies are suspect with respect to chlorophyll-*a*. The 2001/2002 TMDL studies showed that the Swanzey WWTF discharged very high concentrations of chlorophyll-a, ranging from 7 to well over 200 ug/1. This is not inconsistent with the type of treatment provided. However, Swanzey also chlorinates its effluent, and had effluent residual chlorine concentrations of from 1.7 to 3 mg/1 in August of 2001 and .5 to 1.7 mg/l in August, 2002. *See* Exhibit G, excerpts from Swanzey Permit Fact Sheet and effluent quality from EPA's ECHO database. This likely kills the algae contained in its effluent. This is important because the tests used for chlorophyll-a were not corrected for pheophytin, and thus are measuring both live and dead algae. The existence of dead algae in the stream from a point source would not be indicative of an algae problem in the River itself.

Finally, EPA's implied argument that high levels of algal activity are indicators of dissolved oxygen problems are contravened by the data. As discussed below, the Ashuelot River regularly complies with the state's dissolved oxygen water quality standards, except for those periods when the quality of water upstream of Keene's discharge violates the standards.

Response C4: As discussed in Responses C3, the chlorophyll *a* value of 15 ug/L has not been adopted by NHDES as a water quality criterion, *de facto* or otherwise, and has not been approved by EPA.

The Region does not believe that algae, dead or alive, in Swanzey WWTF effluent discharges are the sole, or even primary, source of elevated chlorophyll *a* concentrations downstream of the discharge. Instead, the Region believes that the chlorophyll *a* levels are largely a result of excess plant productivity, which is primarily caused by upstream phosphorus discharges from the Keene WWTF and to a lesser extent by much smaller phosphorus loading from the Swanzey WWTF.

Swanzey's chlorophyll *a* contribution constitutes a small fraction of the chlorophyll *a* quantity measured downstream at Stations 14-Ash and 12-Ash. *See* Fact Sheet at p. 14. For example, based on an average discharge flow from the Swanzey WWTF (0.078 MGD, August 2005, 2004) and a maximum recorded effluent chlorophyll *a* value of 250.8 ug/l (August 16, 2001 data, Table Three of Fact Sheet), the Swanzey WWTF contributes 0.163 lbs/day of chlorophyll *a* (0.078 MGD x 8.34 x.0.2508 mg/l). Similarly applying chlorophyll *a* levels found at Station 14-Ash on August 16, 2001 (see Table Three of the Fact Sheet) at the 7Q10 flow estimated just downstream of the Swanzey discharge (31.5 cfs, or 20 mgd plus an estimated treatment plant discharge of 0.078 MGD), yields about 1.3 lbs/day of chlorophyll *a* (20.078 MGD x 8.34 x 0.0783mg/l). The Swanzey discharge quantity represents about 12 percent of the in-stream total quantity calculated at Station 14-Ash (0.163/1.3). It is clear that the Swanzey WWTF chlorophyll *a* accounts for a relatively small fraction of in-stream chlorophyll *a* observed downstream.

Viewed from the perspective of in-stream concentration, the highest observed effluent chlorophyll *a* concentration (250.8 ug/l) discharged at the full design flow of 0.167 MGD

under 7Q10 flow conditions would result in an in-stream concentration of 2.3 ug/l (250.8 ug/l divided by the dilution factor, 250.8/111), which is below the observed in-stream levels of 7.83 ug/l at Station 14-Ash and 5.76 ug/l at Station 12-Ash (August 16, 2001) and far below maximum observed in-stream values 69.64 ug/l (Station 14-Ash) and 23.77 ug/l (Station 12-Ash) observed on August 29, 2001. A comparison of these values demonstrates that the Swanzey WWTF cannot account for the majority of total chlorophyll *a* observed in-stream. As noted, this example applied the maximum chlorophyll *a* level from the Swanzey WWTF; on other days its contribution is even less.

As discussed more fully above, the Region does not believe that the chlorophyll *a* data cited by the commenter is alone sufficient to provide an accurate assessment of the trophic status of the Ashuelot River. The Region also reminds the commenter that the agency did not base its conclusion that the receiving waters were eutrophic on chlorophyll *a* data alone.

In its Fact Sheet, the Region noted that supersaturation (DO concentrations >100 % of the theoretical concentration at the observed temperature) can occur under conditions of excessive algae/plant growth, which produce oxygen during photosynthesis. Hence, the supersaturation can be indicative of eutrophic conditions. The Region noted the occurance of supersatuation events downstream of the Keene outfall but also expressly qualified the finding by noting that data were limited. The commenter should note that a water body can be eutrophic without evidencing large diurnal swings in dissolved oxygen levels due to excessive plant growth. *See Nutrient Criteria Technical Guidance* at 35 (noting that the extent of diurnal swings will depend on turbulence, light, temperature, buffering capacity and the amount and health of algal and/or macrophyte biomass); EPA Nutrient Criteria Memorandum at 8 ("In some streams, algal growths may develop into nuisance levels but the stream may not have a dissolved oxygen problem, especially if physical aeration occurs at a high level."). For this reason that EPA guidance recommends that direct measures of algal biomass (chlorophyll *a*) rather than DO as a preferred response variable.

Comment C5: EPA's analysis of dissolved oxygen is flawed.

EPA attempts to support its arguments with respect to cultural eutrophication by evaluating DO data from the period 1990 through 1995, 1997 and 1998 for station 16-ASH, below the Keene gage. EPA gives a range of saturation values, with a maximum of 114 %, and an average of 88 %. EPA concludes that "...although this data is [sic] limited, it indicates that supersaturated conditions occur and serve as another indictor of eutrophic conditions in the Ashuelot River." Fact Sheet, pages 16 and 17.

There is no evidence presented to suggest that *any* level of saturation above 100 % is indicative of a water quality problem as the Fact Sheet implies. Since algae are natural constituents of a functioning ecosystem (the algae are food for higher forms of life), some incidental supersaturation should be expected. References to acceptable levels of supersaturation are few; but a University of Wisconsin report states the following:

> Values between 90% and 110% of saturation are good. Supersaturated (over 100%) values may sound good but they can also indicate problems, such as excessive plant growth. High day-time levels of D.O. are often countered with low night-time levels due to respiration and the cessation of photosynthesis. See Water Action Volunteers Factsheet Series, 2003, attached hereto as Exhibit H.

In addition, work conducted by the Oklahoma Conservation Commission on Lake Creek indicates that they use 125 % as a level of saturation that they considered "supersaturation" and "may indicate high levels of primary productivity resulting from elevated nutrient levels." *See* Lake Creek Demonstration Project, Oklahoma Conservation Commission, at page 7, included in Exhibit H

As discussed above, the chlorophyll-*a* data indicate that the receiving waters do not suffer from excessive plant growth, and thus should not suffer from high day time DO values and low night time levels that would be associated with unacceptable levels of phosphorus. Continuous recording DO data discussed below show that within-day variability does not exhibit wide fluctuations in dissolved oxygen that would normally be associated with excessive algal growth.

For some reason, EPA ignores DO data collected more recently, including the 2001/2002 TMDL data, portions of which are referenced elsewhere in the document, and the volunteer river monitoring program data, also referenced in the Fact Sheet. In particular, the volunteer monitoring data, included in Exhibit F, clearly shows that supersaturated conditions exist above the Keene discharge, where P concentrations are well below EPA's suggested criteria value – which is evidence that these levels of supersaturation are *not* indicative of a phosphorus-related problem. Figure 2, below shows the oxygen saturation values using data from the volunteer program for the period May, 2002 to September, 2005.

In addition, the volunteer monitoring clearly indicates that supersaturation is an infrequent event; of the 240 sampling events spanning 5 years, supersaturation was evidenced only 13 times.

[Figure Not Reproduced]

As part of DES' 2001/2002 TMDL studies (attached hereto as Exhibit I), continuously recording DO and temperature instruments were deployed at several locations along the River, including the impoundment of the Homestead Mill Dam at 15-ASH. The State, in its 1989 Waste Load Allocation Study (relevant portions of which are attached hereto as Exhibit J) had expressed concern that algae might have adverse oxygen impacts in this impoundment. Inspection of the 2001/2002 data (see 2002 Ashuelot TMDL Data Report, NHDES, at Section 5, Exhibit I) indicate that there have never been any violations of the State's 5 mg/1 DO water quality criteria in the impoundment, and that the only time that oxygen saturation fell below the 75% saturation criterion was when far upstream sources

were well below standards. Thus the TDML data indicate that algae have no particular adverse impacts on the dissolved oxygen regimen of the Ashuelot.

More current data, recently provided by the New Hampshire DES and shown below, demonstrates a comparable conclusion: that DO in the Ashuelot is well with the State's saturation criteria. At most stations dissolved oxygen varies between 87 and 95% saturation. The dissolved oxygen values at station 19-ASH, above the Keene discharge, exhibit the greatest variability, and drop to the lowest levels. As with other data discussed in this document, this indicates that conditions above the Keene WWT[F] discharge are having significant impacts on the dissolved oxygen conditions of the River. (NHDES 2006 Data Logger Data, Preliminary Plots. Personal Communication from Ted Walsh to Donna Hanscom, attached hereto as Exhibit K.)

[Figure Not Reproduced]

EPA's analysis of the system ignores the most significant data from the TMDL that shows that sampling points upstream of the Keene discharge clearly violate State water quality Standards. For example, data collected at station 19-ASH, adjacent to Tenant Swamp and upstream of the WWTF discharge, shows dissolved oxygen values below the 5 mg/1 state standard, and saturations below the state's 75% requirement. The influence of these observations on downstream DO has not been evaluated by EPA.

New Hampshire's listing of the Ashuelot River on its EPA-approved 2004 303(d) listing disputes EPA's analysis. EPA's analysis of the dissolved oxygen conditions in the river is focused entirely on phosphorus in Keene's discharge. However, the State, in listing section 11 of the Ashuelot River in its 303(d) list characterizes the source of the dissolved oxygen saturation problem as Municipal (Urbanized High Density Area). *See* page 134 of Final 2004 List of Threatened or Impaired Water That Require a TMDL, included in Exhibit I. In contrast, when the State suspects the source of the problem to be a treatment plant, it specifically says so. *See* the listing for the Cocheco River, page 75 where municipal point source discharges are specifically identified as a suspected source of nonattainment.

EPA's claim of impaired waters is confounded by the fact that phosphorus levels in Keene's discharge have historically been significantly above the limit the agency proposes, yet the receiving waters do not exhibit significant impairment. Over the past 8 years the City's discharge has average 2.7 mg/1 and 68.7 pounds per day of phosphorus in its discharge. These represent, respectively, 13 and 7 times the amount of phosphorus allowed under the proposed permit. With loadings almost 10 times as much as EPA claims is necessary to protect the receiving water quality, one would naturally expect extreme problems in the receiving waters. Yet as the data discussed above shows, the dissolved oxygen levels in the Ashuelot consistently meets the state's standards.

Response C5: As discussed above, the chlorophyll *a* data cited does not support the conclusion that the receiving waters are free from excessive plant growth. It only indicates that some stations do not have excessive water column algae, which is one

component of aquatic plant growth. As documented in the Fact Sheet, excessive water column algae is present at other stations.

The Region uses evidence of low DO and supersaturation as possible indications of large diurnal fluctuations in DO, which is a hydrological dynamic commonly associated with eutrophic water bodies. As the commenter suggests, there may not be technical consensus around a specific value for DO supersaturation which indicates a water quality impairment. In the Fact Sheet, the Region was careful to qualify its use of DO data as an indicator of eutrophication in this case given the limited data. The Region pointed to the existence of data indicating DO supersaturation as yet another piece of information that would be consistent with other information in the record that suggested the receiving waters were eutrophic. As explained above, a water body can be eutrophic without evidencing large diurnal swings in dissolved oxygen levels. However, absent a mechanical aeration mechanism, a water body would be unlikely to become supersaturated except due to photosynthesis. Again, the Region selected a direct measure of algal biomass (chlorophyll *a*) as a primary response variable for this reason.

Notwithstanding the foregoing, it is not unexpected that the data cited by the commenter did not indicate frequent DO supersaturation. The volunteer monitoring data is of little use for evaluating DO supersaturation because many of the samples were collected in the early morning when DO levels would be near minimum daily values.[32] Out of five years worth of volunteer monitoring data, only data on July 26, 2003 showed DO levels above saturation. Supersaturated levels of DO in ambient waters can result from excessive plant productivity and/or the entrainment of oxygen as water flows over a dam. Since the data was taken in the early morning when the DO levels would not be elevated by plant productivity (*i.e.*, photosynthesis), and the stations are not below dams, the validity of this sample is questionable. This conclusion is further supported by the low pH values (plant productivity/photosynthesis elevates in-stream pH levels), and the fact no other surveys show supersaturated DO levels above the Keene WWTF. In fact, only one volunteer monitoring survey (July 31, 2001) collected afternoon DO data. Although these data were taken in early afternoon, and not late afternoon when DO levels would peak, they indicated supersaturated values at several downstream stations with a peak value of 144% at station 7 on July 31, 2001. It is unclear why the July 31, 2001 data were not included in Figure 2. EPA notes that this figure exceeds the supersaturation threshold of 125% apparently used by the Oklahoma Conservation Commission.

Contrary to the commenter's assertion, it is not appropriate to infer that NHDES's broad characterization of the source of the impairment as "municipal (urbanized high density area)" was intended to exclude the Keene facility. NHDES has clarified to EPA that the broad phrasing was used because the DO violations were occurring upstream and

[32] Aquatic animals are affected most by minimum DO rather than by the daily mean for this variable (Welch 1992). Hence, monitoring for water quality should include pre-dawn hours to observe the minimum DO. Routine grab samples in monitoring programs usually do not include such strict protocols.

downstream of the WWTF and, consequently, DO violations were not due entirely to the Keene WWTF but rather to a combination of point and nonpoint sources.[33]

The 2006 data are preliminary data and were not used in developing the draft permit. These data were collected at stream flows that were approximately 10 times 7Q10 and are therefore of little use when evaluating receiving water impacts at or near 7Q10 conditions, which EPA is required to do under NH Standards. *See* Env-Ws 1705.02. The fact that nonpoint sources of pollutants, including phosphorus, may be causing some impairment at upstream stations does not change the fact that under 7Q10 conditions there is documented cultural eutrophication and the Keene WWTF dominates the phosphorus loading even when considering upstream loadings of phosphorus.

The commenter should be aware that eutrophic systems can maintain DO levels above 5mg/l. The high productivity during the day elevates DO levels to a point where they do not fall below 5 mg/l when respiration occurs at night. Just as EPA would not conclude that Ashuelot River is eutrophic based on DO data alone, the fact that minimum DO levels remain above 5 mg/l, at least near the surface, does not demonstrate that the system is healthy. As explained in Responses B2 and B3, EPA looks to a broad range of causal and response variables. As also noted above, DO may not be the most reliable indicator of eutrophic conditions. *See* Response C4; *see further, Nutrient Criteria Technical Guidance Manual.* More generally, as the commenter is aware, eutrophication has serious impacts on uses (*e.g.* aesthetics and recreation) independent of its impact on DO.

The relationship between nutrient concentrations and the level of impairment is not as linear as suggested by the commenter ("With loadings almost 10 times as much as EPA claims is necessary to protect the receiving water quality, one would naturally expect extreme problems in the receiving waters"). The algal biomass or DO impairment will not necessarily occur in proportion to nutrient loadings. Low biomass may be observed in highly enriched waters, and vice versa, depending on whether optimal conditions exist for growth. *See Nutrient Criteria Technical Guidance Manual* at 21. The Region notes that the commenter appears to acknowledge that there is some level of impairment as a result of Keene WWTF phosphorus effluent discharges to the receiving waters ("the receiving waters do not exhibit significant impairment").

Comment C6: EPA fails to consider ongoing actions.

EPA's analysis has failed to consider complementary, ongoing actions that could serve to lessen any impacts from phosphorus contained in the Keene effluent discharge and improve the overall quality of the river. In particular, EPA fails to acknowledge that it is

[33] More generally, it may be useful to clarify the role of the 303(d) list for the purposes of the NPDES permitting process. Both the States and EPA use the 303(d) list as a planning tool to identify impaired water bodies to prioritize restoration of uses in such waters. Information regarding the nature and source of impairment can be useful evidence when EPA is developing NPDES permits. However, irrespective of whether the specific pollutants/impairments appear on the state's current 303(d) list, EPA is obligated to impose a water quality-based effluent limit for a pollutant if there is a reasonable potential that the discharge will cause or contribute to a violation of water quality standards. *See* CWA § 301(b)(1)(C) and 40 CFR § 122.44(d)(5).

quite likely that the Homestead Mill Dam in West Swanzey will be removed in the very near future, resulting in potentially substantial water quality benefits. Documentation included in Exhibit L indicates that removal of that dam is imminent.

This impoundment behind this dam was an area of particular concern noted in DES' 1989 waste load allocation study. That study indicated that:

> ...since the extent of algal influences before the dam in West Swanzey (station 15-ASH) are not entirely known, a study to assess the impact algae on the Ashuelot River within this reservoir needs to be conducted. A diurnal DO/water temperature/chlorophyll a study should be made during low flow, high temperature and no precipitation conditions to see if stream standards are being met on a 24 hour basis.

(*See* Exhibit J at p. 46).

The reason that the impoundment behind the dam is of concern is because it provides habitat for the growth of algae – notably in the form of increased temperatures and residence times not otherwise naturally available in the River. Removal of the dam would eliminate the impoundment, and minimize residence times and temperature effects which serve to stimulate the growth of algae.

Dams along the Ashuelot have been a particular focus of natural resource management agencies for some time. Both of the dams downstream of the Homestead Dam have been removed in the recent past. According to the New Hampshire DES Dam Bureau, the McGoldrick Dam in Hinsdale was removed in 2001, and the Winchester Dam was removed in 2002. *See* Exhibit M. These actions served to open up portions of the river to migrating anadramous fisheries, and to eliminate potential water quality degradation in the impoundments behind the dam. Studies on the Homestead Dam completed in 2005 concluded that removal of the dam, in addition to being the most cost effective option, "...provides the greatest ecological and water quality restoration benefits..." and would serve to enhance salmon, shad and alewife fisheries and to improve the habitat of endangered the dwarf wedge mussel, a federally endangered species (Homestead Dam Final Report, pages 15 and ES-11 respectively, attached hereto as Exhibit N).

EPA also fails to properly consider that the State is in the process of conducting a TMDL on this River section in order to analyze the dissolved oxygen conditions in the River and to develop strategies to address any identified problems. Because there is significant uncertainty that any problem exists, or will exist after the completion of complementary ongoing activities, the TMDL is the most appropriate vehicle for addressing the future quality of the River, especially as it relates to the discharge from the wastewater treatment facility. It provides a reasoned, scientific basis for assessing the conjunctive impacts of enhanced phosphorus treatment as is now being provided by the City through the use of Polyaluminium chloride, removal of the Homestead Dam, correction of water quality problems (including low DO) in the upper watershed and correction of potential nonpoint pollution sources throughout the watershed.

The City believes that EPA should await the completion of the TMDL, not simply because it believes that EPA's logic for the new permit limits is flawed, but also because (1) data collected from 2001 to the present indicates that there is no significant water quality impairment that presents an imminent threat to the River's ecosystem, and (2) proceeding without the benefit of the TMDL could lead to the unwise expenditure of it's rate payers money. Studies conducted on behalf of the City by Stantec, Inc. concluded that process technologies that the City might use to meet various levels of phosphorus control could range up to $17 Million in today's dollars. Even at these higher costs, some of the technologies are only now emerging, and their application in full scale operation is limited. It is inappropriate to expend such significant sums of money to address an issue that is not well documented, potentially with technologies not well proven.

Response C6: The Homestead Woolen Mill Dam is currently scheduled for removal in 2008. Removal of this dam will have some beneficial effect on water quality and, in particular, will improve aquatic life habitat in certain stretches of the river. However, its removal will result in the transport of greater amounts of phosphorus downstream to other reaches with significant aquatic plant growth and may exacerbate nutrient impacts below the Keene WWTF. For example, there is still a potential for phosphorus to settle behind impoundments downstream, for example in South Winchester and Hinsdale. Merely displacing the effects of such loading further downstream does not address the underlying water quality concern.[34]

The Region understands that Keene has begun chemical addition (aluminum) for removal of copper that has also resulted in lower phosphorus effluent discharges. The phosphorus reductions realized subsequent to copper treatment, however, would not have had an appreciable affect on in-stream total phosphorus concentrations. Even after such treatment, the Keene WWTF effluent discharge still contains phosphorus in concentrations that will cause or contribute to violations of water quality standards. According to DMR data, in recent months average monthly phosphorus effluent concentrations have ranged from a low of 0.75 mg/l in June 2006 to a high of 1.55 mg/l in April 2006, both well above the 0.2 mg/l that the Region has determined to be necessary to ensure compliance with water quality standards.

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[34] EPA nutrient guidance notes that consideration of downstream impacts such as these is a fundamental aspect to establishing phosphorus limits:

> There are two basic needs in establishing a phosphorus criterion for flowing waters: one is to control the development of plant nuisances with the flowing water and, in turn, to control and prevent animal pests that may become associated with such plants; the other is to protect the downstream receiving waterway, regardless of its proximity in linear distance. It is evident that a portion of that phosphorus that enters a stream or other flowing waterway eventually will reach a receiving lake or estuary either as a component of the fluid mass, as bed load sediments that are carried downstream, or as floating organic materials that may drift just above the stream's bed or float on its water's surface.

See Gold Book at 241; *see also*, Ecoregional Nutrient Criteria at iii; EPA Nutrient Criteria Memorandum at 7.

The Region is also aware that several illicit wastewater connections to Keene's storm drain system have been redirected to the Keene WWTF. *See* Affidavit of Eric Swope, dated August 22, 2006. The information provided by Keene does not identify the magnitude of the nonpoint source load reductions associated with these improvements. However, it is very unlikely they would impact water quality sufficient to justify imposition of a less stringent phosphorus limit, in part because these loadings would be relatively small in proportion to point source loading. For instance, under current conditions (*i.e.*, West Swanzey and Keene WWTFs existing flows), at sample station 14-ASH, located just below the Swanzey WWTF, the combined TP loading from the Keene and Swanzey WWTF's represents approximately 65% of the TP loading and the nonpoint sources represent approximately 35% of the TP load when calculated on an annual loading basis. *See NHDES Total Phosphorus Loading Analysis for the Ashuelot River TMDL* at p. 3. While stormwater events can deliver substantial amounts of total phosphorus, much of it is in particulate form, which is not as readily available for uptake by aquatic plant growth as the dissolved form discharged by the WWTFs. In the Ashuelot River, the impact of point source loading from the Keene and West Swanzey WWTFs will be more pronounced relative to stormwater contributions during the low flow conditions under which standards must be met. Therefore, while it is important to address, the stormwater source reductions in this case have a comparatively minor effect on the analysis of permit limits necessary to achieve standards under 7Q10 conditions.

The Region believes that reliance upon the earlier data collected in 2001 and 2002 is reasonable given that the phosphorus reductions described above would not have had an appreciable affect on in-stream phosphorus concentrations. Without more, the Region also does not regard future potential reductions (for instance, associated with an interim limit that may be imposed after the permit is issued) to be relevant in determining whether reasonable potential now exists for the facility's discharges to cause or contribute to a violation of standards. In order to reasonably factor future reductions into its analysis, the Region would require a heightened level of assurance and specificity in order to conclude that such reductions will actually occur. *See, e.g.*, 40 CFR § 122.44(d)(1)(ii) (directing EPA to consider "existing controls on point and nonpoint sources of pollutions" when evaluating reasonable potential).

For a discussion of the Region's decision to impose a phosphorus limit in the absence of a TMDL, please see Response B4 and B5 above. With respect to the commenter's point regarding treatment technology and the cost of complying with permit limits, please see Response B7 and B8. The Region notes that technology capable consistently meeting phosphorus effluent limits of 0.2 mg/l have been successfully implemented in past.

Comment C7: EPA incorrectly calculates required level of treatment.

EPA's calculations of the required level of treatment are based on a dilution factor of 2.08. That dilution factor is derived from the *annual* 7 day 10 year low flow in the river, and reflects low flow conditions in the deep summer. The Region then applies this value to the April through October time frame, generally reflecting the growing season for New England's climate. In contrast, flows during other times of year are substantially higher,

and afford greater dilution. This greater dilution lowers in-stream nutrient concentrations, which serves to protect the quality of the receiving waters. This is especially true during the spring, when low temperatures and shorter days (resulting in less energy for photosynthesis) also serve to suppress algal growth and thus protect in stream water quality. Preliminary estimates of monthly 7Q10 flows for each month of the period April through October have been developed, as well as estimated dilutions and effluent limits, assuming the application of EPA's 0.1 mg/l "criterion" value. The data from which these results were obtained are included in Exhibit O. The results are presented in Table 1 below,

[Table Not Reproduced]

New Hampshire's Water Quality regulations (Env-Ws 401.17(c)) specifically allow considerations such as these in the development of permits.

Failing the elimination of phosphorus limits, or adoption of effluent limits as suggested above, the effluent limits should be based on mass emission rates. Concentration based limits need not be applied to this discharge, and would be overly protective of the receiving water quality. The State requires that effluent limits be calculated using 7Q10 (*see* Env-Ws 1705.02 Low Flow Conditions). Concentration limits are not needed at flows above 7Q10 because at these flows there is additional dilution available to accommodate that mass. This results in in-stream concentrations lower than EPA's "criterion" and are thus protective of the receiving water. By requiring calculation of permit limits at 7Q10 the State is effectively acknowledging that the State standards do not apply at flows below 7Q10. At river flows lower than 7Q10 the in-stream concentrations from permissible levels of discharge will, by simple mathematics, exceed the criterion value, because there is less dilution available. Thus, there is no need for a concentration limit for flows below 7Q10.

Response C7: There is no basis for applying a monthly 7Q10 in the state regulations considering that the 7Q10 is defined on an annual basis. *See* Env-Ws 1702.44. Under New Hampshire's water quality standards, the annual 7Q10 flow must be used to calculate permit limits. *See* Env-Ws 1705.02(a) and (d). Such an assumption will not necessarily reflect actual flow conditions—which may be more or less than the 7Q10 on any given day—nor is it intended to. The requirement that EPA conservatively assume critical low flow conditions when calculating permit limits is designed to ensure water quality criteria exceedances remain very infrequent (thus enhancing the goal of achieving uses). The notion that a permittee should have a license to discharge pollutants unfettered by permit limitations under the most severe hydrological conditions would turn this objective on its head. The proposal that additional dilution available during higher flow periods should be considered when determining the need for a permit limit is similarly counter to the conservative approach unambiguously outlined by the regulations.

As noted by CDM, under New Hampshire's State Surface Water Discharge Permit Rules (as opposed to its Surface Water Quality Standards) applicants may propose effluent

limits based on dynamic modeling, instead of the steady-state flow conditions specified in Env-Ws 401.17(b). *See* Env-Ws 401.17(c). However, these rules apply to discharges that require only a state discharge permit and do not apply to the Keene WWTF because it requires both a state and federal permit. See Env-Ws 401.02. Dynamic modeling combines the statistical characteristics of the effluent flow and quality with the characteristics of the receiving water flow and quality to arrive at limits that are protective of the water quality standards. Dynamic modeling requires extensive effluent and receiving water monitoring to statistically characterize the effluent and receiving water for each pollutant in the discharge over a broad range of climatic conditions. At a minimum, two to three years of daily sampling data would be required to provide sufficient information to run the dynamic model.

The effluent limits proposed in CDM's comments on the Keene draft are based on monthly 7Q10 stream flows, which are really a series of steady-state flow conditions, not a dynamic model. Effluent limits derived by this method would not be protective of any applicable numeric water quality criteria, and would not be acceptable under Env-Ws 401.17(c). Also, as noted above, there is no basis for this method in state regulations considering that 7Q10 is defined on an annual basis and not a monthly basis. *See* Env-Ws 1702.44.

There is a 10 percent chance that stream flow will drop below the annual 7Q10 in any given year, and excursions below this flow are rare enough that the corresponding effluent limits will be protective of the aquatic environment. The annual 7Q10 flow has been demonstrated to be approximately equal to the chronic biological flow, which is typically calculated as the four-day harmonic mean low flow that occurs on average once in three years (4B3) (*see* http://epa.gov/waterscience/dflow/apps.htm). Accordingly, it is assumed that steady-state permit limits calculated using the annual 7Q10 will provide a level of water quality protection equal to that envisioned in the water quality criteria documents, *i.e.* no more than one excursion every three years on average.

Effluent limits calculated using the proposed monthly 7Q10s would not be adequately protective of water quality because there is a much greater chance that stream flow would drop below one or more of the monthly 7Q10 levels in any given year. Under the proposed scenario, there is a 10 percent chance that flow in any month will drop below the monthly 7Q10. Assuming that the monthly 7Q10s are independent events (binomial distribution with a 10 percent chance of occurrence in any month), there is a 52 percent chance, over the seven month period that the seven day average stream flow will drop below at least one of the monthly 7Q10s. The proposed effluent limits would allow much more frequent exceedances of numeric criteria than would those calculated using the annual 7Q10.

It is unclear what precisely the commenter means by "mass emission rates." For example, mass limits could be applied on a daily, weekly, monthly or even yearly basis. Without more information, it is difficult to provide a meaningful response addressing the merits or demerits of such an approach in the case of the Keene WWTF discharge. In general, the commenter does not provide a persuasive rationale for choosing mass over

concentration based limits from the standpoint of ensuring compliance with water quality standards to the extent that rationale is based on a misapplication of the 7Q10 requirement (as discussed in the first paragraph of this response). EPA believes the total phosphorus is appropriately expressed in terms of concentration given that the nutrient criterion (Env-Ws 1703.14) and the in-stream target of total phosphorus (0.1 mg/l) are expressed in terms of concentration. This approach is also consistent with 40 CFR § 122.45(f)(ii), which states that permit limitations shall be expressed in terms of mass except when applicable standards are expressed in terms of other units of measurement (*i.e.*, ug/l, mg/l and other concentration-based units). This is a common approach with other pollutants for which criteria are expressed in terms of concentration, such as metals. (EPA also observes that a mass based limit could effectively impose a flow limit on the facility, which presumably is not the permittee's intent.)

D. Comments Submitted by the Swanzey Sewer Commission

Comment D1. The North Swanzey area of our Town as well as Matthews Road in West Swanzey conveys wastewater to the Keene Wastewater Treatment Facility, so our sewer users are directly impacted by any new requirements included in this draft permit. We have approximately 300 units that could connect to the sewerage system that conveys wastewater to the Keene WWTF. We also will have to pay our proportionate share of all capital and operation and maintenance costs for any improvements made to the Keene WWTF in order to meet the new permit requirements.

The changes to the NPDES will require new treatment processes that require planning, design and construction. The final cost impacts of these changes are not known at this point, but they are thought to be significant, in the order of $8 to $9 million dollars. Our sewer users may be significantly impacted. We need time to understand the ramifications and educate our users. Any plans for plant upgrades in order to meet the new NPDES permit conditions should include time for the Swanzey Sewer Commissioners and our users to review any studies, reports, cost estimates, user rate impacts and other issues relative to this issue. Of particular concern is the information included in the fact sheet for the draft permit. This information indicates that all the studies have not been completed and will not be completed until 2009 and therefore these treatment plant changes may or may not be necessary.

Response D1: The Region anticipates that a reasonable compliance schedule will be established through an administrative compliance order that will allow for necessary planning, design and construction. Compliance schedules that are implemented through administrative compliance orders typically establish a reasonable timeframe for planning to consider alternatives and their associated costs, including an affordability analysis.

Please see Response B4 regarding the Region's decision to impose a phosphorus effluent limitation prior to completion of the TMDL.

The Region believes that the proposed limit represents the minimum level of control necessary to achieve water quality standards, so it is unlikely that the Permittee's resources will be wasted by upgrading to meet a phosphorus effluent limit of 0.2 mg/l.

In the event that the TMDL results in an effluent limitation that is more stringent than 0.2 mg/l, the range of phosphorus removal technologies currently being considered by Keene are compatible with meeting tighter limits, for instance through the addition of filters or other processes at a comparatively incremental cost. If the TMDL results in a limit that is less stringent than 0.2 mg/l, there may be an opportunity to implement a trading scheme with the West Swanzey WWTF along the lines suggested by the Town in Comment D5 below.

Comment D2: We ask that EPA and NHDES revisit the sampling data performed in 2001 and 2002 because the data was collected prior to improvements made to the Keene WWTF and may not reflect the current state of the river. We also ask that EPA wait until the TMDL river study is performed with the new data before imposing these new limits. There are also plans to remove a dam in West Swanzey which may change the characteristics of the river and any assumptions in the TMDL study.

We would like to bring your attention that the chlorophyll *a* values measured in the Ashuelot River below the Swanzey WWTF are increased due to our discharge. The interpretation that these measurements indicate pollution (algal growth due to nutrient input) may be in error due to the fact that our wastewater lagoons produce algae. The wastewater is disinfected prior to discharge and that the chlorophyll *a* values, used as an indicator of pollution, are measuring dead algae cells from our facility rather than nutrient impacts producing algae in the river.

Response D2: Please see Response C6 for a discussion of the improvements undertaken by Keene and future dam removal. Response C4 addresses the potential (or lack thereof) for dead algae from the Swanzey WWTF to skew the Region's analysis of biomass as chlorophyll *a* in the receiving waters.

Comment D3: Our engineers have indicated that there is some research work that indicates measuring $CBOD_5$ of the influent may be problematic. The chemicals that are used to inhibit nitrification may also inhibit carbonaceous BOD_5. If this is the case, then Keene may have some problems meeting the 85% $CBOD_5$ removal during some months. This situation could occur during high flows which dilute the influent or during dry weather flows when the concentrations are high.

Response D3: EPA is unsure of the commenter's concern. The $CBOD_5$ test is based on the inhibition of nitrification, so the presence or absence of nitrifying bacteria is of no practical concern. The commenter adds the concern that the chemicals used to inhibit nitrification in the influent sample may also be inhibiting carbonaceous BOD_5. The $CBOD_5$ test is an EPA-approved method and if performed correctly should not inhibit carbonaceous BOD_5 in either the influent or effluent samples.

Comment D4: The Keene draft permit indicates a total phosphorus limit of 0.2 mg/l for seven months and a 1 mg/l for five months. We question the need for year round phosphorus limits. If there is concern over particulate phosphorus settling in the river and resolubilizing, it should be weighed against the high river flow and shallow depth, which

imply low potential for resolubilization of phosphorus in deep, low DO sections of the river.

Response D4: The Region imposed the winter limit in order to minimize the impact of particulate phosphorus to settle in the sediments, recycle in the water column during the warmer months and promote plant growth. Merely displacing the effects of such loading further downstream does not address the underlying water quality concern. Although high river flow will help to flush particulate phosphorus downstream, there is a still a potential for phosphorus to settle behind impoundments downstream, for example in Hinsdale. As discussed above, one key function of a nutrient criterion is to protect downstream receiving waters, because phosphorus has the ability to persist and accumulate in the water column and sediments. *See Gold Book* at 241.

Comment D5: Keene and West Swanzey have been issued a new draft NPDES at the same time. The Keene WWTF was issued a total phosphorus limit of 0.2 mg/l and the West Swanzey WWTF was issued a total phosphorus limit of 1 mg/l. Keene's design flow is 6 MGD while the West Swanzey design flow is 0.167 MGD. We ask that EPA consider lowering the Keene limit and raising the Swanzey limit (while holding the mass constant), should Keene select a technology that reliably removes phosphorus to a lower limit. An example of this type of arrangement is Keene at a limit of 0.1 mg/l and Swanzey at a limit of 4.6 mg/l. This limits the total phosphorus to the same mass levels of discharge. We believe that the cost for Keene to install new technology to meet a 0.1 mg/l or 0.2 mg/l TP is incrementally insignificant. However, technology to meet a phosphorus limit of 1 mg/l for a lagoon treatment system spread over our small user base is prohibitive.

Response D5: EPA supports the implementation of voluntary water quality trading that reduces the cost of compliance with water quality-based requirements (including pre-TMDL trading in nutrient impaired waters) so long as the trades are properly designed. *See* EPA Office of Water Quality Trading Policy (January 13, 2003). As the Trading Policy states:

> EPA supports pre-TMDL trading in impaired waters to achieve progress towards or the attainment of water quality standards. EPA believes this may be accomplished by individual trades that achieve a net reduction of the pollutant traded or by watershed-scale trading programs that reduce loadings to a specified cap supported by baseline information on pollutant sources and loadings.
>
> EPA also supports pre-TMDL trading that achieves a direct environmental benefit relevant to the conditions or causes of impairment to achieve progress towards restoring designated uses where reducing pollutant loads alone is not sufficient or as cost-effective.

The Region encourages Swanzey to review the Trading Policy, particularly the section entitled "Common Elements of Credible Trading Programs." The Region believes that it is premature to provide for a trading mechanism in the final permit given that there is no

indication that the City of Keene is willing to undertake greater than required control in order to generate saleable pollution credits. However, if the City of Keene and the Town of Swanzey agree to an acceptable trading arrangement that meets the requirements of the CWA, the municipalities can seek a modification of their respective permits to incorporate the specifics of the trading plan.

Comment D6: The draft permit, if finalized, will put Keene into non-compliance immediately. There is no information in the draft permit or fact sheet indicating a compliance schedule. Keene should not be penalized or have to pay fines for non-compliance without the opportunity to negotiate a reasonable schedule to meet the new limits. Any fines may have an impact on our users. The schedule should also include permit limits that Keene can achieve in the interim period while work is performed to upgrade the WWTF.

Response D6: EPA may add a schedule of compliance to a permit when EPA is the permit issuer if a State has laid the necessary groundwork in its standards or regulations. See *In re Star Kist Caribe, Inc.*, 3 E.A.D. 172, 177 (CJO 1990), *aff'd*, (EAB 1992, Order Denying Modification Request). As the Administrator stated in *Star-Kist*:

> The only instance in which the permit may lawfully authorize a permittee to delay compliance after July 1, 1977, pursuant to a schedule of compliance, is when the water quality standard itself (or the State's implementing regulations) can be fairly construed as authorizing a schedule of compliance.

Star-Kist, 3 E.A.D. at 175. In order for compliance schedules to be included in an EPA-issued NPDES permit, they must first be clearly authorized by the state under its water quality standards or implementing regulations, which is not the case in New Hampshire. New Hampshire makes no allowance for compliance schedules in its Standards.[35] Thus, EPA cannot include a schedule in the City's NPDES permit for the purposes of complying with water quality-based limits.

A compliance schedule, including interim limits, may be established through an EPA-issued administrative compliance order. The Permittee should contact Joy Hilton (617.918.1877) of EPA's Office of Environmental Stewardship to discuss the development of an administrative order, including a reasonable compliance schedule. The final permit does not become effective until sixty (60) days after issuance, which should provide the Permittee with sufficient time to negotiate the terms of an order.

[35] While the New Hampshire water management and protection statute authorizes schedules of compliance for state water discharge permits, *see* RSA 485-A:13 I.(a), there is no corresponding provision in the state water quality standards that could be relied upon to authorize a compliance schedule in an EPA-issued discharge permit.

E. Comments Submitted by Ms. Barbara Skuly, Chairman, Ashuelot River Local Advisory Committee

Comment E1: There is some confusion as to the flow information that was used to determine the new 7Q10 flow. Page 11 of the Fact Sheet mentions additional flow data has been recorded since 1989 and the West Swanzey gage station was installed in 1994 which provided another new source of flow data. It then explains that NHDES conducted an investigation of the river's 7Q10 in the vicinity of the WWTF's outfall incorporating new data. We would hope the data from the West Swanzey gage would not have been used to determine the flow at the WWTF which is a considerable distance upstream of this gage and also upstream of the inflow of the South Branch, which substantially augments flow in the Ashuelot.

Response E1: Data from the West Swanzey gage was not used to determine the new 7Q10 flow. NHDES did not choose to use the West Swanzey gage data given that the record was considered too short to provide an accurate estimate of the 7Q10. *See* State of New Hampshire Inter-Department Communication, March 25, 2004, from Dan Dudley to George Berlandi, Jeff Andrews, and Sterg Spanos.

Comment E2: If the Keene WWTF's effluent was reported with a $CBOD_5$ monthly average of 3.64 mg/L, a weekly average of 4.75 mg/L and a maximum daily level of 6.03 mg/L, why are the new limits 25 mg/L, 40 mg/L, and 45 mg/L, respectively? Even with the new dilution factor based on the new 7Q10, this would represent a significant increase in the $CBOD_5$ (2253 lbs/day!) in the river. Doesn't the antidegradation provision come into play here to maintain existing water quality standards in regard to $CBOD_5$?

Response E2: Under New Hampshire's antidegradation provisions, existing water quality is determined on the assumption that point sources are discharging at their allowed loadings under low flow conditions. *See* Env-Ws 1708.08(b). An antidegradation analysis is not applicable here because there has been no proposed increase in the permitted loadings to the water body. *See* Env-Ws 1708.02(b). The fact that the Permittee is discharging below its $CBOD_5$ limit is not a basis to impose a more stringent limit. An NPDES permit is designed to ensure that a permittee discharging at its permitted limits will ensure compliance with applicable water quality standards. The Region has determined that the $CBOD_5$ limits, which are consistent with secondary treatment standards set forth in 40 CFR § 133.102(a), are sufficiently stringent to ensure compliance with water quality standards.

Comment E3: Likewise the reported TSS monthly average is 5.89 mg/L, the weekly average is 9.88 mg/L, and the maximum daily level is 11.1 mg/L. The limits in the proposed permit are 30 mg/L, 45 mg/L, and 50 mg/L. Again this translates into 2504 lbs/day! Isn't this backsliding?

Response E3: The anti-backsliding provisions of the CWA and federal regulations do not require imposing more stringent limits based on a facility's performance from permit to

permit. Rather, anti-backsliding provisions are triggered if permit limits and conditions are less stringent than those in the previous permit. In this case, the TSS limits are the same as in the previous permit.

Comment E4: Conversely, the ammonia average monthly limits of 12 mg/l in the winter, and 2.1 mg/l in summer were kept in the proposed permit "to ensure that ammonia does not contribute to the further depletion of the dissolved oxygen." We agree with this provision.

Response E4: This comment is noted for the record.

Comment E5: After 12 years of monitoring and without phosphorus limits, we applaud the inclusion of limits for this critical pollutant in the Ashuelot River. The Fact Sheet states that a total phosphorus limit of 0.2 mg/l (Apr. 1-Oct. 31) would result in an in-stream concentration of total phosphorus of 0.096 mg/l, which would just barely meet the 1986 Quality Criteria of Water (Gold Book) criterion for free flowing streams (0.1 mg/l). However, this does not meet the NHDES level of concern at 0.05 mg/l, nor does it take into account the phosphorus level of the receiving water. Given the eutrophic conditions noted in the river in the past, ARLAC would like to see the more stringent standards applied.

Response E5: As noted in Response C2, 0.05 mg/l total phosphorus concentration is not a state criterion. New Hampshire is still in the process of developing numeric nutrient criteria. The value was identified by NHDES as a "level of concern" in New Hampshire's Volunteer River Assessment Program water quality reports. The Region regards this statement as one relevant fact among many in its derivation of a phosphorus effluent limit for the Keene WWTF. However, its relevance should not be overemphasized. The value has not been adopted by New Hampshire as a numeric water quality criterion. As such, it does not in itself provide a regulatory basis for establishing a water quality-based effluent limitation.

EPA employed the *Gold Book* recommended concentration (0.1 mg/l) rather than the more stringent ecoregional criteria or the draft New England-wide value. The *Gold Book* value is based on effects as opposed to the ecoregion criterion, which was developed on the basis of reference conditions. EPA opted for the effects-based approach because it is often more directly associated with an impairment to a designated use (*i.e.* fishing, swimming). The effects-based approach provides a threshold value above which adverse effects (*i.e.*, water quality impairments) are likely to occur. It applies empirical observations of a causal variable (*i.e.*, phosphorus) and a response variable (*i.e.*, chlorophyll *a*) associated with designated use impairments. Reference-based values are statistically derived from a comparison within a population of rivers in the same eco-region class. Specifically, reference conditions presented are based on the 25th percentile of *all* nutrient data, including a comparison of reference conditions for the aggregate ecoregion versus subecoregions. *See* Ecoregional Nutrient Criteria at vii. They are a quantitative set of river characteristics (physical, chemical and biological) that represent minimally impacted conditions. Thus, while reference conditions, which reflect

minimally disturbed conditions, may meet the requirements necessary to support designated uses, they may also *exceed* the water quality necessary to support such requirements.

Use of an effects-based approach is consistent with the Ecoregional Nutrient Criteria guidance. In order of preference, EPA recommends the following approaches to deriving nutrient criteria:

1. Whenever possible, develop nutrient criteria that fully reflect local conditions and protect specific designated uses through the process described in EPA's technical guidance manuals for nutrient criteria development.
2. Adopt EPA's section 304(a) water quality criteria for nutrients, either as numeric criteria or as procedures to translate a State or Tribal narrative nutrient criterion into a quantified endpoint.
3. Develop nutrient criteria protective of designated uses through other scientifically defensible methods and appropriate water quality data.

See Ecoregional Criteria at iv. *See also* Nutrient Criteria Technical Guidance Manual at p. 100 (describing use of published nutrient thresholds as a basis for nutrient criteria). Consistent with approach number 1 above, the Region characterized the trophic state of the river by analyzing the relationship between in-stream phosphorus and chlorophyll *a* levels, and by examining field surveys prepared by state and federal agencies, as well as volunteer monitoring reports. The Region then looked to a broad range of relevant evidence, including the Ecoregional Nutrient Criteria, the New England-wide recommended value, the Gold Book recommended value, and other effects-based values to determine a protective phosphorus effluent limit.

Under 7Q10, which again is the hydrological condition under which NH Standards must be met and water quality-based permit limits calculated, a phosphorus effluent limit of 0.2 mg/l will result in an in-stream concentration (including background phosphorus levels in the receiving water) of 0.096 mg/l. This ambient concentration is consistent with the *Gold Book* recommended value of .1 mg/l.

A 0.2 mg/l limit also falls within the range of effects-based values cited in the *Nutrient Criteria Technical Guidance Manual* and in the peer-reviewed scientific literature (10-90 ug/l to control periphyton and 35 to 70 ug/l to control plankton) after adjustments are made to account for the differing flow assumptions underlying the permit limit and the literature values (*i.e.*, 7Q10 versus 3-month summer seasonal flows). *See, e.g.*, *Developing Nutrient Targets to Control Benthic Chlorophyll Levels in Streams: A Case Study of the Clark Fork River* (Dodds *et al.*, 1997) at p. 1739 (citing use of flows from June 21 to September 21 to calculate recommended values); *Suggested Classification of Stream Trophic States: Distributions of Temperate Stream Types by Chlorophyll, Total Nitrogen, and Phosphorus*, (Dodds *et al.*, 1998) (citing use of 2-3 month seasonal means). In addition, it approaches the ecoregional reference-condition criterion of 10 ug/l under average summer flow conditions.

For the purposes of comparison, the Region estimated flows upstream of the Keene treatment plant for average summer flow conditions, low flow average summer conditions, and low month flow conditions using flow data collected at the West Swanzey gage from 1996 through 2005. An upstream total phosphorus concentration was estimated by averaging the summer VRAP data collected at Station Ash-18 over the past 5 years. This analysis shows that the expected in-stream concentrations fall within the threshold concentrations recommended in Table 4 of the *Nutrient Criteria Technical Guidance Manual* under various summer average conditions and are slightly above the ecoregion criteria under average summer conditions. Specifically, under average summer conditions (the mean flow for all summer months from 1996 through 2005) the estimated in-stream concentration of total phosphorus would be about 26 ug/l, under average low flow summer conditions (the mean summer flow in 1997, the lowest mean summer flow from 1996 through 2005) the concentration would be about 39 ug/l, and under the low monthly average flow condition (the mean flow in August 2002, the lowest observed summer monthly average flow) the instream concentration would be about 65 ug/l. The results of this analysis are attached as Exhibit C.

Based on the current record, the Region has concluded that achievement of the recommended *Gold Book* value in-stream will be sufficient to ensure compliance with NH Standards, as it can be expected to control excessive aquatic plant growth. Following the upgrade, the Region will monitor the response of the river to the significant phosphorus load reductions associated with the new permit limit, including by reference to Volunteer River Assessment Program reports conducted under low flow conditions and any other relevant data that becomes available, to confirm the adequacy of such limit.

F. Summary of Changes to the Permit

1. The maximum daily limit for lead was eliminated. Reporting of the maximum daily discharge is required (see Part I.A.1., page 3).

2. The schedule for submitting the local limits report (Part I.A.8.c.) was removed because the report was received by EPA on January 31, 2007.

3. The frequency of WET testing using Daphnids (*Ceriodaphnia dubia*) has been reduced to once per year. The test must be conducted during the quarter ending September 30th. The chemical analyses and reporting done in conjunction with the WET test has also been reduced to once per year. (see Part I.A.1, page 4 and Footnote 7, page 5).

4. Footnote number 5 in has been changed from:

   The average monthly value for Escherichia coli shall be determined by calculating the geometric mean. Escherichia coli shall be tested using test method 1103.1 found in *Escherichia coli (E. Coli)* in *Water by the Membrane Filter Using Membrane-Thermotolerant Escherichia coli Agar (mTec)*, EPA-821-R-02-020.

This monitoring shall be conducted concurrently with the TRC sampling described below.

to:

The average monthly value for *Escherichia coli* shall be determined by calculating the geometric mean. *Escherichia coli* shall be tested using an approved method as specified in 40 CFR 136. (See list of Approved Biological Methods for Wastewater and Sewage Sludge) The grab samples for *Escherichia coli* analyses must be collected concurrently with a sample for total residual chlorine.

This change has been made to reflect EPA *Guidelines Establishing Test Procedures for the Analysis of Pollutants: Analytical Methods for Biological Pollutants in Wastewater and Sewage Sludge: Final Rule,* published in the Federal Register on March 26, 2007. The *Escherichia coli test* method required in the draft permit is not listed as an approved wastewater and sludge method in the new rule.

5. The address for the Keene Wastewater Treatment Facility has been changed from Keene, New Hampshire 03431 to Swanzey, New Hampshire 03446 to correctly reflect the onsite location of the facility.

6. An updated version of Part II: Standard Conditions has been attached to the final permit. The updated version has no substantives changes from the version attached to the draft permit.

   On page number one of the final permit, the number of pages specified for Part II: Standard Conditions was changed from 27 in the draft permit to 25 in the final permit to reflect the number of pages in the updated version.

EXHIBIT A

Location of the WWTFs and Ashuelot River Sampling Stations

EXHIBIT A

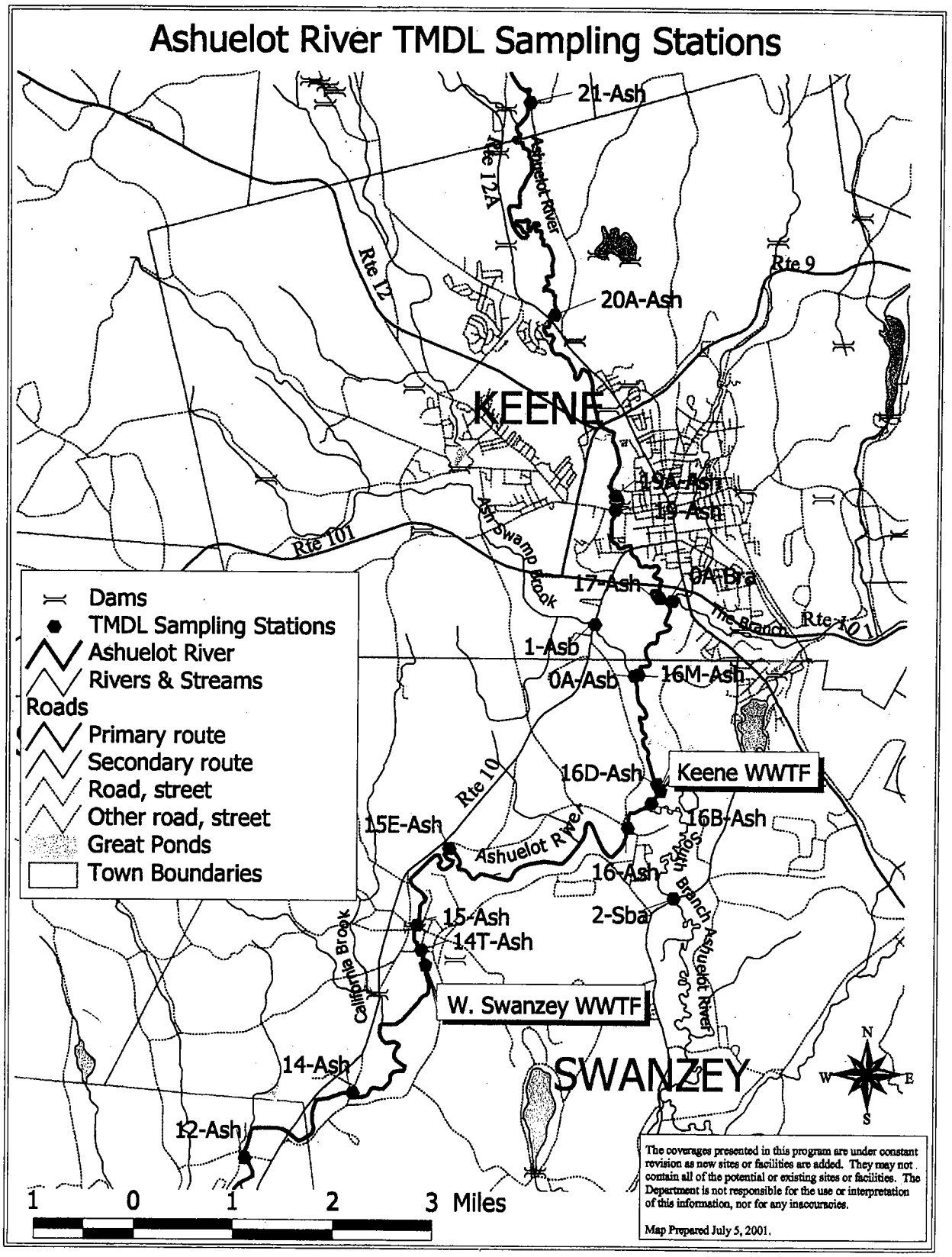

Ashuelot River TMDL Sampling Stations
21-Ash
Rte 12A
Ashuelot River
Rte 12
Rte 9
20A-Ash
KEENE
19A-Ash
19-Ash
Rte 101
Ash Swamp Brook
17-Ash
0A-Bra
The Branch
Rte 10
1-Asb
0A-Asb
16M-Ash
16D-Ash
Keene WWTF
Rte 10
15E-Ash
16B-Ash
Ashuelot River
South Branch Ashuelot River
16-Ash
2-Sba
15-Ash
14T-Ash
California Brook
W. Swanzey WWTF
14-Ash
SWANZEY
12-Ash
Dams
TMDL Sampling Stations
Ashuelot River
Rivers & Streams
Roads
Primary route
Secondary route
Road, street
Other road, street
Great Ponds
Town Boundaries
1 0 1 2 3 Miles
N
W
E
S
The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.
Map Prepared July 5, 2001.

EXHIBIT B

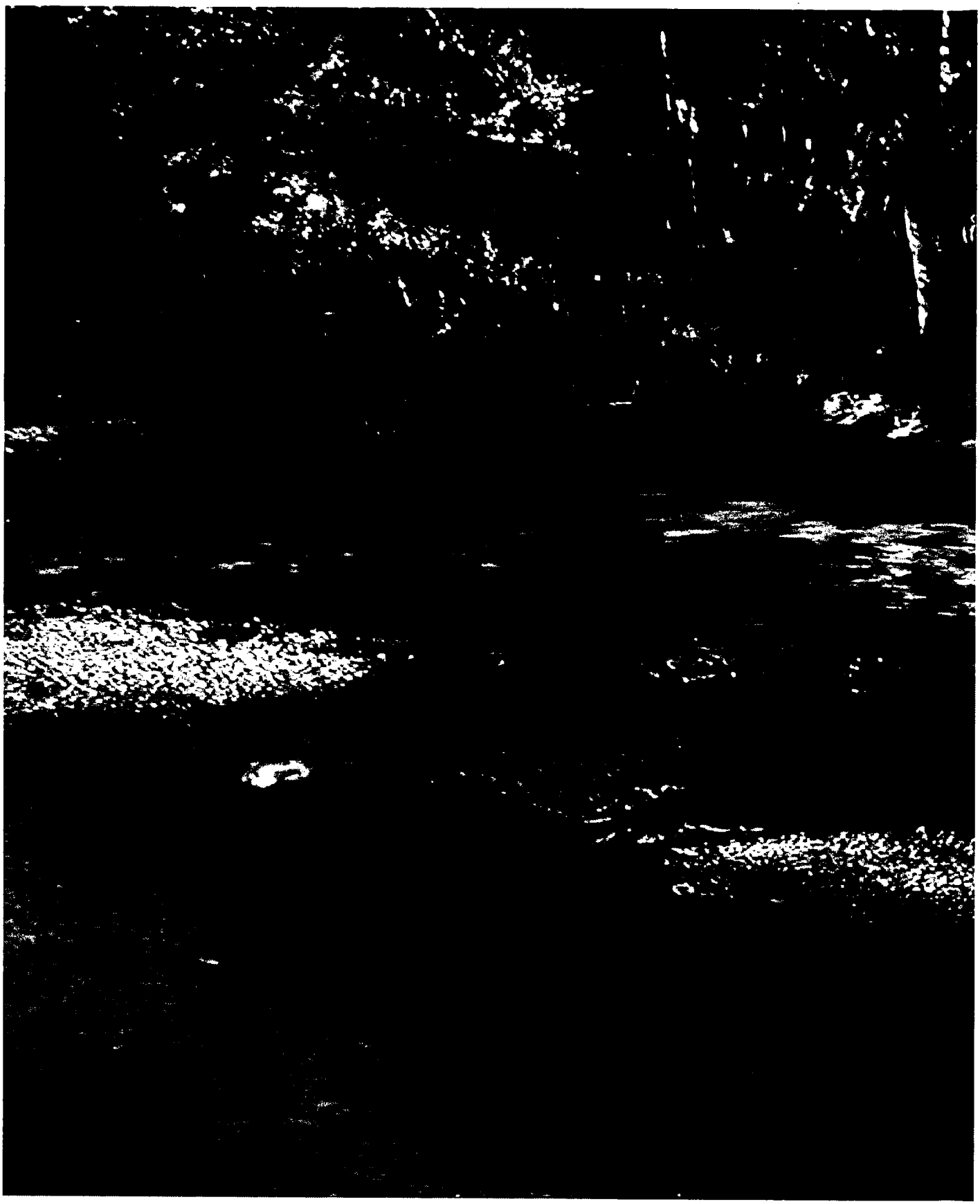
EXHIBIT B

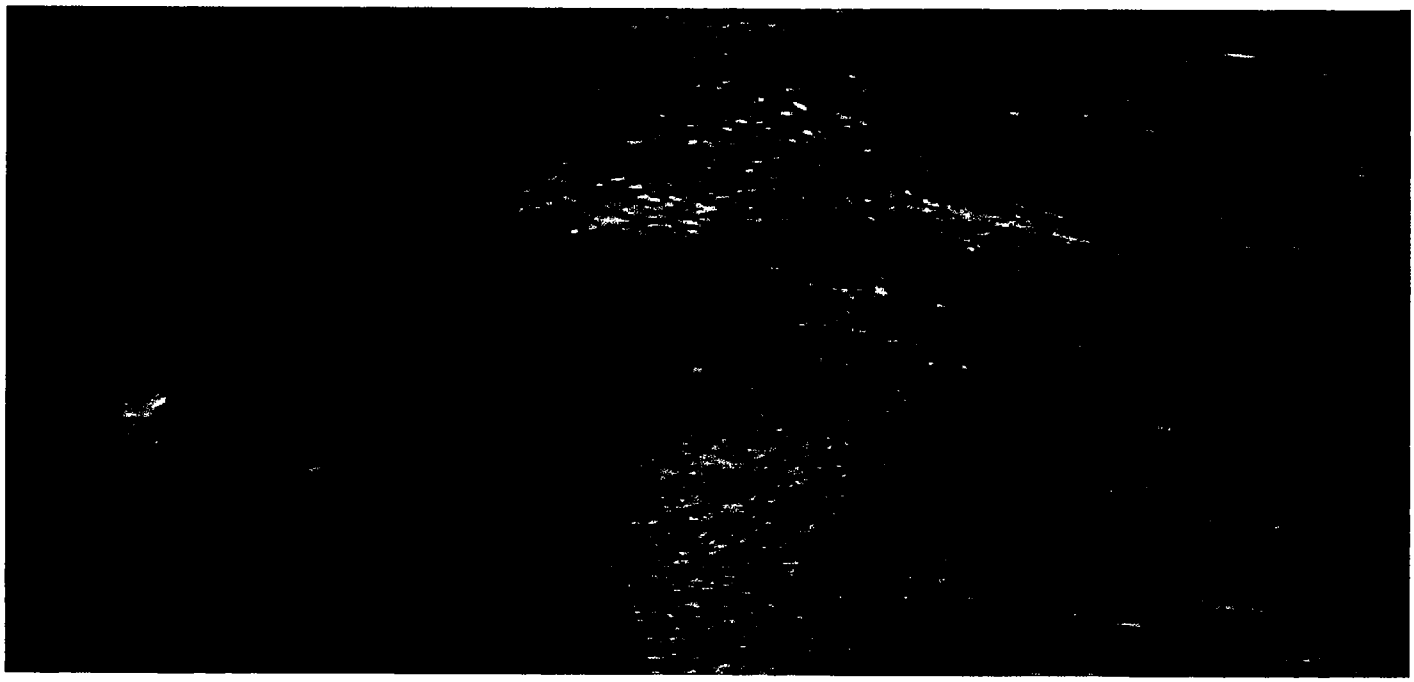
Barbara Skuly
<bskuly@earthlink.net>
09/11/2006 09:58 AM

To Jeanne Voorhees/R1/USEPA/US@EPA
cc
bcc
Subject Ashuelot streambed

History: This message has been replied to and forwarded.

Jeanne,
Below are two photos taken in August when the water was low in the Ashuelot River. They are downstream of the Homestead Woolen Mill dam and upstream of the outfall of the W. Swanzey WWTF. I did not take these, but I believe the first is looking upstream from the concrete Denman Thompson Bridge, the second is looking downstream from that site.
Barbara





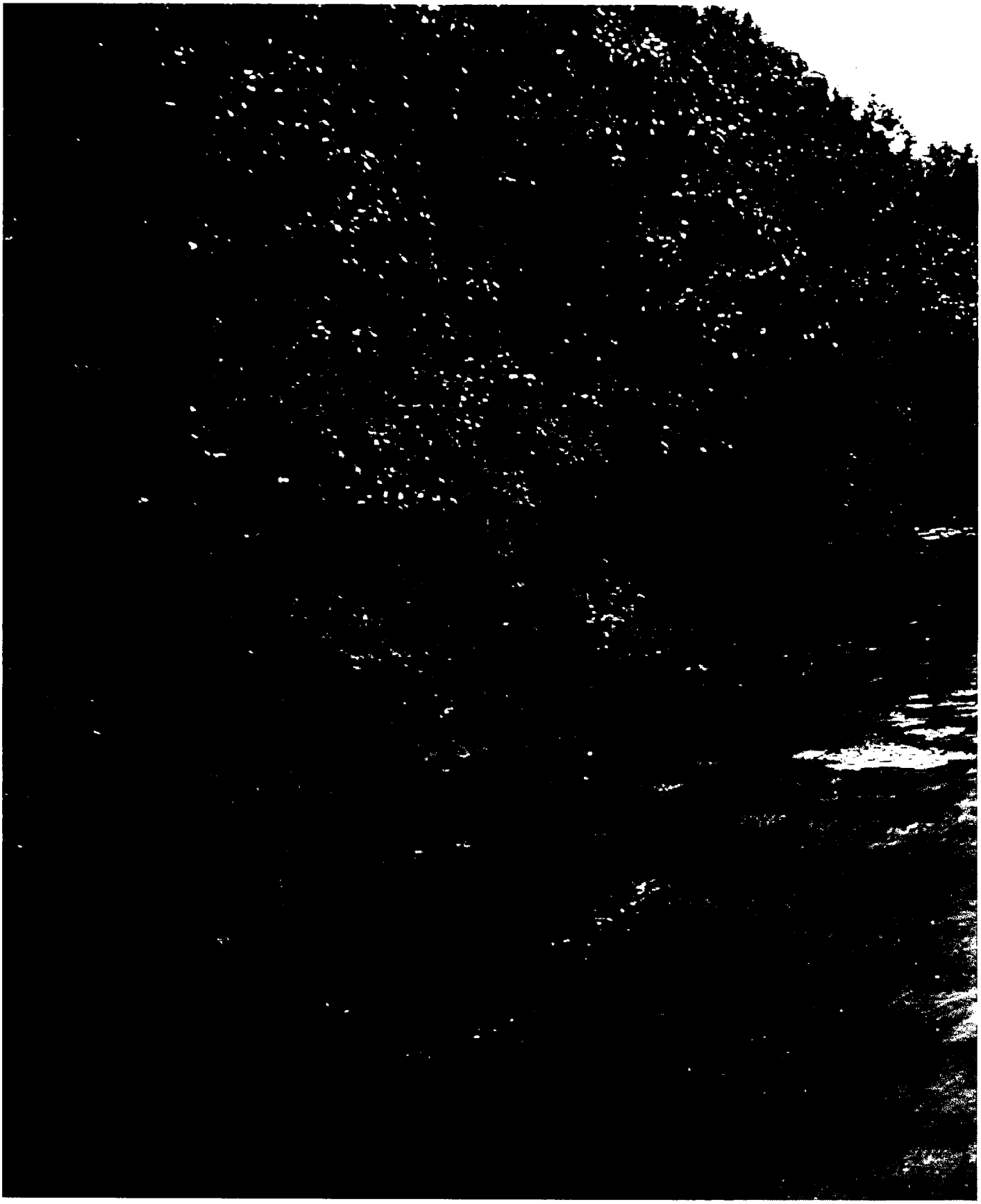


EXHIBIT C

Instream Phosphorus Concentrations After Adjusting for Flow

EXHIBIT C

Estimated Instream Total Phosphorus Concentrations at Various Summer Receiving Water Flows

		July	August	Sept	June-Sept Avg	
Mean Monthly Flow at Surry Mountain Gage	1996	119.4	14.9	39.3	57.9	
	1997	36.4	11.8	15.1	21.1	21.1 cfs = low mean summer flow
7Q10 = 2.2 cfs	1998	114.8	15.4	25.1	51.8	
	1999	25.6	13.6	227.5	88.9	
	2000	81.4	148.5	62.7	97.5	
	2001	31.1	7.52	13.4	17.3	
	2002	32.5	7.05	8.68	16.1	7.05 cfs = low summer month flow
	2003	14.1	313.5	128.6	152.1	
	2004	38.2	128.3	219	128.5	
	2005	104	28.6	54.1	62.2	
		59.8	68.9	79.3	69.3	69.3 cfs = mean summer flow

		July	August	Sept	June-Sept Avg	
Mean Monthly Flow at West Swanzey Gage	1996	361.5	78.7	139.8	193.3	
	1997	136.7	71.3	70.2	92.7	92.7 cfs = low mean summer flow
7Q10 = 20.1 cfs	1998	357.6	62.7	79.3	166.5	
	1999	91.9	53.0	513.8	219.6	
	2000	221.9	423.3	189.7	278.3	
	2001	120.5	44.9	62.4	75.9	
	2002	114.9	42.6	47.8	68.4	42.6 cfs = low summer month flow
	2003	88.2	555.0	300.0	314.4	
	2004	164.1	254.3	539.9	319.4	
	2005	448.4	131.7	111.7	230.6	
		210.6	171.8	205.5	195.9	195.9 cfs = mean summer flow

Flow ratios at Surry Moutnain and West Swanzey gages.

Average Summer Flow/7Q10		Low Mean Summer Flow/7Q10		Low Summer Month Flow /7Q10	
Surry Mountain = 69.3/2.2 =	31.5	Surry Mountain = 21.1/2.2 =	9.6	Surry Mountain = 7.05/2.2 =	3.2
West Swanzey = 195.9/20.1 =	9.7	West Swanzey = 92.7/20.1 =	4.6	West Swanzey = 42.6/20.1 =	2.1

Upstream Total Phosphorus Concentrations

Ash - 18	Date	Flow at West Swanzey	Total P (mg/l)
	9/19/2004	2250	0.022
	7/23/2005	232	0.018
	9/17/2005	88	0.018
	6/18/2005	656	0.016
	6/28/2003	191	0.014
	6/16/2001	393	0.013
	6/19/2004	225	0.012
	8/20/2005	129	0.012
	7/14/2001	116	0.012
	8/18/2001	40	0.012
	8/16/2003	1030	0.01
	6/22/2002	345	0.01
	9/13/2003	96	0.008
	7/26/2003	134	0.007
	7/17/2004	93	0.007
	8/21/2004	342	0.006
			0.012

Use West Swanzey factors, Surry Mountain appear artificially high due to regulation at 7Q10

7Q10 above Keene outfall = 12.18 cfs
Keene design flow = 9.3 cfs

Average Summer Flow above Keene outfall = (12.18)(9.7) = 118 cfs
Low Summer Average Flow above Keene outfall = (12.18)(4.6) =56 cfs
Low Summer Month Flow above Keene outfall = (12.18)(2.1) = 24 cfs

Upstream concentration = 0.012 mg/l

Instream concentration at average summer flow = [(0.2)(9.3) + (118)(0.012)]/(9.3+118) = 0.026 mg/l

Instream concentration at low average summer flow = [(0.2)(9.3) + (56)(0.012)]/(9.3+56) = 0.039 mg/l

Instream concentration at low summer month flow = [(0.2)(9.3) + (24)(0.012)]/(9.3+24) = 0.064 mg/l