Appendix K

Stakeholder Comments

Comments on the Upper Merrimack and Pemigewasset River Study

Submitted by: City of Manchester, Environmental Division
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with CDM Smith Response (December 18, 2012)

Item #1. The first big concern is with the wording on pg. 4-54. It states, "Downstream of Concord, all main stem river concentrations of total phosphorus were above the EPA recommended level for streams flowing into impoundments." That designation is 50 ug/l for streams flowing into impoundments. I believe the report considered the 25 ug/l number for in lake phosphorus.

CDM Smith has corrected the error and replaced "streams flowing into impoundments" with "water within impoundments"

The City of Manchester believes the criterion that should be used is for rivers which is 100 ug/l. In this case only one sample out of all taken exceeded that 102 ug/l (9/21/10 at 01X MER). This belief is supported by three documents.

First is the 1986 Gold Book phosphorus section (attached), which specifically outlines the 25 ug/l and 50 ug/l limit should be applied to lakes and reservoirs. In that section there is a place where the word impoundment is used interchangeably for reservoir. There is absolutely no mention of dams and impoundments behind dams and they further go on to describe Vollenweider formula. It describes total phosphorus grams loading per square meter of surface area per year. The hydraulic detention time is measured in years. None of the dam impounds below Eastman have residence times remotely close to a year even at 7Q10. A running river can't be a reservoir a few days a year for compliance calculations reasoning. It either is or isn't. Residence time has to be checked for each impoundment at mean river 7Q10 to determine if it is truly classified an lake/reservoir as was intended within the 1986 Gold Book Standards.

In my internet research below I found the EPA's Site-specific Targeted Monitoring Summary Results supplied by the NHDES to the EPA. If you click on the Lakes, Reservoirs, and Ponds link you find a listing of all of these within NH (as designed by the NHDES). You will not find any of the so called impoundment reservoirs (as mentioned in this report). However, if you click on the Rivers and Streams link you will find the river sections that contain the dams reported to be reservoir impounds in the reports. This is another reason the Merrimack from Concord south should be classified as a River and given the 100 ug/l.

http://iaspub.epa.gov/waters10/attains_state.control?p_state=NH#LAKE/RESERVOIR/POND

Site-specific Targeted Monitoring Summary Results

New Hampshire (2010)

Description of this table

	Size of Water		
	Rivers and Streams (Miles)	Lakes, Reservoirs, and Ponds (Acres)	Bays and Estuaries (Square Miles)
Good Waters			
Previously impaired waters			

now attaining all uses			
Threatened Waters			
TMDL completed			
TMDL alternative			
Non-pollutant impairment			
TMDL needed			
Impaired Waters	**16,896.3**	**185,272.5**	**99.3**
TMDL completed	12,759.3	103,023.5	
TMDL alternative			
Non-pollutant impairment			
TMDL needed	4,137.0	82,249.0	99.3
New TMDLs completed	309.1	3,747.7	.0
Remaining TMDLs needed	3,827.9	78,501.3	99.3
Total Assessed Waters	**16,896.3**	**185,272.5**	**99.3**
Total Waters	16,896.3	185,272.5	99.3
Percent of Waters Assessed	100.0	100.0	100.0

Lastly, in the Manual, *Limnology-Lake & River Ecosystems*, 3rd Edition, by Robert G. Wetzel, Chapter 2, River/Lakes – Their Distribution, Origins and Forms, pg 17, Chapter 2, Running Waters, Lotic Systems it states, "Flowing freshwater systems are called Lotic for obvious reasons of unidirectional water movement along a slope in response to gravity. Troughflows, termed the water renewal rates are often variable and very slow in lakes, but are continuous. The distinction between lakes and running waters focuses on the relative residence times of the running water. When the energy of flowing water is dissipated, as in the transitional zone of reservoirs, the change to lentic characteristics is rapid."

When you look at Appendix F "SMAST Report – Sediment Nutrient Flux and Oxygen Demand" and Section 5 of the report you only have a flux of > 1 mg/l of O2 with some accompanying phosphorus flux in Ayers Island 1 impoundment. All other measures are below the 1 mg/l limit for Oxygen flux which is in contrast to the Wetzel statement "in transitional zones of reservoirs, the change to lentic characteristics is rapid. Lentic (still waters) see a transition in CO2, O2, pH, Temperature and organisms. When looking at the field sheets, there seems to be little to no transition of the measured values (pH, temperature, and oxygen). The apparent worse case is the I003 sheet (pg 29 of 670). The temperature does swing from a low of 18.28 C at 30 feet to 22.52 C at 2 feet from the surface. That is 4.24 C swing. However, pH is between 6.62 and 6.70 and oxygen is between 8.25 mg/l and 8.71 mg/l – either measurement is hardly a rapid characteristic transition. Due to both the oxygen flux (albeit slight) and phosphorus flux it could be weekly argued that Ayers and Franklin Falls, fall into the reservoir/impoundment category.

Now noted in Section 1, the NHDES definition of impoundment was used for this study, as follows, from the Consolidated Assessment and Listing Methodology:

Impoundments (acres):

a. Impoundments will include all waters directly behind dams labeled as "active" by the

Dam Bureau (regardless of the dam height) that:

i. are not already included as a lake or reservoir
ii. are located on the NHD hydrology, or
iii. need to be added because we have data on them.

Item #2. Page 2-27 last paragraph raises the issue, "phosphorus concentrations in the lower impoundments were at levels that would generally be of concern for overproduction during the late summer conditions (greater than 25 ug/l). In looking through all the data tables there were only four instances where the Chlorophyll-a levels exceeded the 15 ug/l criterion for lakes and reservoirs (7/27/10 at 04AJMER-15.63ug/l, 02MER-20.85ug/l, 02KMER-16.09ug/l and 01XMER-19.26ug/l). Even thought he total phosphorus was above the 25 ug/l in lake limit, they were all well below the 100 ug/l river Gold Book criteria. Looking at the aggregate data and you'll see a good reason for higher chlorophyll-a. High chlorophyll-a only happens at peak sun growth, when enough orthophosphate is available, with some correlation to total phosphorus concentrations. Chlorophyll-a growth is always accompanied by a DO increase in these data sets. Indicating there is no oxygen problems being caused by the chlorophyll-a (as reported in the 24 hour DO monitoring locations). A study done by Dunne and Leopold indicate that long-term eutrophication will usually be prevented if total phosphorus levels are below 500 ug/l and orthophosphate levels are below 50 ug/l consistently. As the study has pointed out, there are no sighs of eutrophication on the Merrimack River.

The statement in question in its complete form reads, "The total phosphorus concentrations in the lower impoundments were at levels that would generally be of concern for overproduction during normal late summer conditions (greater than 25 ug/L), however there was not evidence of significant algal growth in the chlorophyll-a concentrations in September or October." CDM Smith believes that this statement communicates the findings (slightly high phosphorus in impoundments) and comments on the impacts of the findings (the nutrient levels did not translate into algal growth).

Dr. Dana Kester of URI developed a chlorophyll-a growth graph that is dependent on exposure to sunlight and time of day. Peak times of growth during the fall sampling season (9/21) were from 1:00 PM to 3:00 PM and for the early summer sample (7/27/10) were from 1:30 PM to 5:30 PM. It would be prudent to mention this in the report as the premise is to develop a maximum daily load of chlorophyll-a and not an instanteous hourly peak.

I have attached a model which I developed and extrapolated from Kester's graph. Until such time an hourly chlorophyll-a sample is taken over the course of the day in the Merrimack, I believe Kester's graph is very representative of the growth that would also be expected in the Merrimack. The first worksheet has the basis for the model, the second worksheet is the extrapolated model for 9/21, the 3rd worksheet is the basis for the 7/27 model and the 4th worksheet is the 7/27 model. Information contained within the worksheet is self-explanatory and the 4th worksheet is where I'll focus your attention.

The highest measured chlorophyll (20.85 ug/s) was at 1:10 AM on 7/27/10 at station 02MER (just below the Nashua outfall). If you open the model and go to that worksheet you see the date, time, measure chlorophyll-a concentration and 15 ug/l criteria. Go to the 1:00 PM table at cell T25 and you see a pink box with 20.85 placed in this box. This gives an effective daily mean of 18.1 ug/l of chlorophyll-a. The only sample of all samples measured that is above the 15 ug/l criteria for chlorophyll-a when using Kester's graph. You can run any sample from the data set in their respective 9/21 or 7/27 models. You will find the early morning samples show higher daily chlorophyll-a mean than the concentration measured and those in the afternoon less.

CDM Smith has not attempted to calculate load allocations in this report. The purpose of this report is to present the data collected in the field and report general observations based on the data values. The chlorophyll-a samples were discrete grabs, and are presented as such in Section 2 and Tables 4-3, 4-12, and 4-20.

Another concern is that all the chlorophyll-a samples were lab filtered rather than field filtered. In the Abstract "*A Comparison of Water-Quality Sample Collection Methods Used by the USGS and Wisconsin Department of Natural Resources"* documents the fate of four sets of samples (two taken at base flow and two at high flow). The last sentence of the second paragraph of the first page states, "Lab-filtered samples analyzed at WSLH gave higher concentrations of chlorophyll-a than field filtered samples at all times." Once you read through the entire document (attached), it is clear to expect that this would be the case with the Merrimack River sampling. I say this because rinsate blanks in that study had quantities higher than what was measured and we have seen that within the data validation section of this report. It could be assumed that the four samples measured above the 15 ug/l criterion are more than likely overstated.

The chlorophyll-a samples were collected and analyzed using current EPA-accepted sampling and analysis methods (See the Quality Assurance Project Plan & Addendum, 2008-2009).

All sampling events indicate on pg. 6-5 of Appendix D indicates that numerous field blanks had concentrations greater than sample results and that some of the field blank samples had minor contamination. This follows with the USGS/Wisconsin study and should be noted in the report text in some fashion rather than the reader digging through the appendices to find it

CDM Smith has added clarification in the Data Usability and Assessment Review (Appendix D). The data review did not find evidence of quality infractions to the level that would require mention in the main text of the report where results are discussed.

The report is quick to note in a couple of sections that Maine's criteria for phosphorus is a limit of 0.03 mg/l (30 ug/l) for wadable streams. The Maryland Coastal Bays Program has adopted a 15 ug/l chlorophyll-a standard for open bays and has set the threshold of 50 ug/l in upper tributaries and prongs. These thresholds were derived from sea grass habitat requirements. It would be balanced if this was mentioned in the report on pg. 4-41 where the NHDES standard of 15 ug/l is mentioned (as a side note, the page numbers in the table of contents do not always match the report numbers as with chlorophyll-a referencing pg 4-30 in the table of contents and it is actually found on 4-41).

Other states' guidance thresholds are mentioned at the request of NHDES, for parameters that NH has yet to determine a threshold for. NHDES has determined 15 ug/l as the chlorophyll-a threshold for listing impairments (it is a guidance, not a standard, and the text has been edited to reflect this).

One big item no one has looked is what is the required phosphorus to produce enough phytoplankton and zooplankton to support menhaden in the bay. A newsletter article co-authored by NOAA , Old Dominion University, William & Mary, Hood College, University of Maryland and the Maryland Department of Natural Resources indicated that water temperature and food source (phytoplankton) play and important part in menhaden recruitment and potential growth rate. Menhaden recruitment in the Bay correlates with chlorophyll-a. Chlorophyll-a concentration vary from year to year and month to month in the bay. A graph in this newsletter illustrates how menhaden recruitment increases as the log mg chl $^{m-2}$ increases.

Future Items for Consideration. To validate, augment, or refute Kester's model, a full day with (24) hourly samples of chlorophyll-a at the same site needs to be completed. This should be done in the summer, when it is hot, the sun is shinning and the temperatures are up.

If the NHDES insists that the impounds behind the dams are characteristically lakes/reservoirs, run the Vollenweider calculation at mean flows, high flows and the 1.5 and 2.5 7Q10 flows listed in the report to determine if loading approaches that listed in the table. Also run a model to show the actual residence time behind these impoundments for the above conditions to determine if residence times do indeed meet the lake/reservoir conditions.

Check with the fisheries and determine what the net orthophosphate that is needed to provide enough phytoplankton if the bay is to come back to 100% menhaden stock. Nitrogen won't matter as phosphorus is the limiting growth component in chlorophyll-a (phytoplankton/zooplankton) growth curve. See what is truly needed out in the bay before assessing limits.

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