APPENDIX E

Comments: Acheron to David Van Wie and Gregg Wood dated March 1, 2000

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In summary, the HWC questions the validity and scientific basis of the DEP model of the river, upon which all proposed TP limits are based. The following points outline the concerns the HWC has regarding the predictive capabilities of the model:

1. The QUAL2 model utilized by the DEP does not provide for the modeling attached plants, the major factor identified by the DEP as causing sporadic non attainment of Class B water quality standards for dissolved oxygen (DO) in this river segment. By design, the model is intended to simulate the effects of floating algae in streams. The data for the Meduxnekeag River show relatively low levels of chlorophyll - clearly indicating low concentrations of floating algae.

Response: The model was not used or intended to simulate plant growth kinetics, but to model the indirect effect of attached plants upon instream DO.

2. To compensate for the model's inability to simulate the effects of attached plant growth, the DEP manipulated the model. To account for the net daily gain in DO concentration due to attached plant growth, the DEP used varying negative sediment oxygen demand (SOD) values along the river segment to calibrate the model. Normally SOD represents an oxygen demand exerted by sediments in terms of mass of oxygen per unit bottom area. In the end, the DEP utilized six (6) different SOD values for the 22 reaches of the river it modeled. However, no actual SOD values were ever measured. This is especially concerning, since the sensitivity analysis performed by the DEP determined that the choice of SOD and reaeration inputs are critical (emphasis added) to the model's calibration.

Response: The model can simulate the effects of attached plants. The use of SOD to represent the net effect of all benthic sources and sinks of DO, including attached plants, is valid for a steady state, daily averaged condition. It is clear that the extremely large diurnal swings below Houlton result in elevated daily average DO concentrations and this increase must be accounted for in the model. SOD represents DO benthic flux and is valid for application to non mobile plants. While the DO from the plant mass is not measured directly in terms of mg/l DO per bottom area (this would be complex and difficult, if possible at all), it’s effect is measured indirectly through diurnal DO sampling. The SOD specifications in the model are consistent with diurnal DO readings (higher diurnal range correlated to lower SOD) and are calibrated to three separate datasets. Reaeration (the other major component of DO identified by sensitivity analyses), on the other hand, is more completely understood and the model specifies accepted values based on river hydraulics which were thoroughly characterized by transect and flow data.

The model is unconservative in that no change of SOD values is assumed when applying a reduced diurnal range representing TP treatment. A more realistic representation would be to increase SOD (decrease negative SOD) at the same time that diurnal range is reduced. If this had been done, more restrictive TP limits would have resulted.

3. A very limited database has been used in both developing and calibrating the model. A total of 12 sampling dates over a period of three (3) separate years forms the basis for the model. To date, this initial data set has only been supplemented by data collected on seven (7) additional days during the summer of 1997. This additional data was averaged to produce a single data point that the DEP cited as proof of their model's predictive capabilities. While the DEP contends that it has conducted a nearly decade long study, 19 data points do not constitute a thorough and scientifically significant study.

Response: Three intensive surveys were performed to calibrate the QUAL2E model. For typical studies, resource limits result in the use of two surveys. Since 1990 three intensive surveys (1990, 1993, 1995), one partial chemistry sampling survey (1992), one summer-long phosphorous study (1997) and three years of spring to fall DO/temperature sampling (1996, 1998, 1999) have resulted in 377 individual water samples being collected and analyzed and 592 in-situ measurements being performed at 10 river stations and on 2 effluents. When compared to other studies and projects, this project has collected far above the normal minimum data requirements for a WLA or TMDL study.

In general, conditions exhibiting an obvious impact require fewer data to characterize. Despite the clear nutrient impact of the Houlton discharge, DEP has continued the study beyond the development of a predictive model and as a result has been able to directly measure in the field not only the impact of the nutrient load but also the effect of reducing this loading to the point where the data can be used to develop maximum nutrient loads.

4. It should also be noted that the majority of the data in the limited data are now over 7 to 10 years old. Given that an ecosystem, such as the Meduxnekeag River, is constantly changing, it seems reasonable to question the applicability of "old" data in a predictive model.

Response: The models were developed during 1995-96 using data from 1990, 1993 and 1995. The allocation model was further verified using 1997 data. Data collection and monitoring has been ongoing on a yearly basis from 1995 through last year (1999). Staley has monitored river flows each summer since 1996 using a USGS calibrated gage. No new dischargers have been licensed on the river and no significant changes to the hydrology or morphology of the river has been documented since the study began. There is no reason to believe that the data is not representative of current conditions.

Phosphorous limits could have been imposed during 1996 after completion of the modeling but this study has been prolonged due to the insistence of the discharger for additional study.

5. The model does not allow direct means for performing either nutrient analyses or load allocations. Therefore, the DEP "designed" a phosphorus load allocation "based upon an assumed relationship between TP loading and diurnal DO range." In "designing" this allocation the DEP made the following assumptions:

a. "Phosphorus limited conditions are assumed. This may not be the case below the Houlton outfall."

b. "The 7Q10 model diurnal range is assumed to be equal to that of the 1995 data set."

c. "The relationship between diurnal DO range and TP concentration is based on averaging of a limited database."

Response: The allocation model is based on actual data that correlates to a high degree and was subsequently verified further by additional field data.

(a) Phosphorous is generally limiting in this system (see Phosphorous Limiting Assumption section of this report for evaluation)

(b) This is an unconservative assumption. It is likely that the diurnal range would be greater under 7Q10 river flow and full permit loading. Therefore the model may underestimate the extent of non attainment of DO standards. The 1995 data represented the condition closest to 7Q10 in terms of river flow.

(c) Subsequent to this report additional data was collected which further verifies the model.

6. The model used a 7Q10 flow of 5.5 cfs, yet the 7Q10 flow used in establishing discharge limits for the HWC is 7.1 cfs. The DEP has indicated that the 5.5 cfs value is the 7Q1O value at the USGS gauging station near Staley. Therefore, there is apparently a greater than 29 percent difference in the critical low flow of the river between Staley and the HWC discharge. The HWC believes that modeling the river at a 29 percent higher 7Q10 flow would produce substantially different model results. The variation in the 7Q10 values highlights the concerns that the HWC has regarding the overall accuracy and applicability of the DEP model.

Response: The 7Q10 model was set up to include three tributary flows and to account for other, more disperse, intervening drainage through the use of incremental inflow.

As such the resulting model flows at selected points are:

Above Staley – 3.0 cfs
At the USGS gage – 5.5 cfs
Above Houlton outfall – 7.5 cfs

The model flows are accurate and consistent (in fact somewhat over-represents river flow at the outfall).

7. According to the EPA, the QUAL2E model is applicable to well mixed, dendritic, or branched streams. The Meduxnekeag River meets these criteria. However, upon review of the river reaches that the DEP utilized in its model, there are no branch reaches included. The model appears to have been developed under steady-state hydraulic conditions; that is, flow in equals flow out. Yet, without branch reaches in the model, it does not appear that any tributary flows have been accounted for in the model. In contrast, USGS maps for the modeled 13.3 mile Meduxnekeag segment clearly show a minimum of eight (8) tributaries to the river between the Interstate 95 overpass and the covered bridge on Carson Road. If these tributaries are not accounted for in the model, it cannot accurately simulate actual stream conditions, much less predict future conditions based on changes in river loadings.

Response: There was never an intention of modeling the tributaries themselves. Sampling sites were established at the mouths of the major tributaries to provide tributary loadings (no water quality problems were measured on these tributaries). Tributaries were set up as point source inputs to the main stem. The major tributaries were accounted for: Moose Brook (DA=17.5 $mi.^2$), South Branch (DA=68.5 $mi.^2$) and B Stream (DA=45.5 $mi.^2$). The intervening drainage area below Houlton (total of 58 $mi.^2$ between Rt. 1 bridge and the border) was accounted for by using incremental inflow. This inflow was assigned based on an evaluation of change in drainage area with rivermile with consideration of flow measurements and gage data.

8. The DEP's conclusion that limiting TP levels in the HWC discharge to 0.25 mg/l and 1.25 lbs/day, will lead to improved DO levels in the Meduxnekeag River is not technologically sound or scientifically defensible. The only factor thoroughly evaluated in the DEP model was the HWC discharge. The data collected during the summer of 1997, when the HWC was treating for TP, found the river attained Class B DO standards. Therefore, the DEP made the conclusion that reduced TP levels from the HWC allowed the river to attain the Class B DO standards. However, the DEP did not consider any other potential factors that could have played a role in the marginally improved river DO levels. Changes in non-point source pollution, water withdrawal practices, or any other factors were not evaluated.

Response: Comparison of the data from 1995 (no treatment) and 1997 (TP treatment) provided an excellent real world evaluation of phosphorous control. In each case river flows were similar (1995=10.5 cfs, 1997=13.9 cfs), Staley was not discharging, background (non point loading) TP concentrations were similar (1995=12.5 ppb, 1997=13.0 ppb) and morning DO readings at the station above Houlton were comparable (1995=8.3 ppm, 1997=8.0 ppm). In fact, despite marginally higher background TP and marginally lower background DO the 1997 data indicate that DO attainment was achieved during the period of phosphorous treatment. The marginally higher river flows for 1997 may have contributed to DO improvement; but this indicates further that the 1997 TP loading which DEP is recommending as a limit, may not be low enough to meet water quality standards.

9. The model has made no allowances for nutrient loads or DO demands from non-point sources of pollution. Yet, both of the DEP's reports on the river modeling clearly state that non-point sources should be considered. Agricultural activities are known to be widespread in this river basin, both upstream and downstream of the HWC discharge. Any TMDL must include such provisions.

Response: Non point loading was included in the form of background and tributary loadings. The relative impacts of non point loading verses point loading is thoroughly discussed in the TMDL report. The impact of Houlton's nutrient loading would mask any NPS reductions. The point source loading must be addressed before or concurrently with any NPS efforts. The data indicate that if diurnal variation below Houlton were reduced to background ranges, DO standards would be consistently attained. Only after this is achieved can any benefits from NPS controls be realized.

10. The impact of non-point sources (NPS) of pollution have previously been cited as being a major contributor to the water quality issues that exist in the Meduxnekeag. [Comment then lists conclusions (lettered a through k) from a 1993 report titled Watershed Protection Plan Environmental Assessment Main Branch Meduxnekeag River Watershed Aroostook County, Maine, the Southern

Aroostook Soil and Water Conservation District and the Houlton Band of Maliseet Indians]

Response: The data clearly show that the nutrient (phosphorous) loading from the Houlton plant dominates background and tributary loading within the river segment below the STP outfall (see TMDL report). Point source loading must be controlled before any water quality improvements can be realized from NPS reductions.

One of the above report conclusions appears to relate directly to DEP's ongoing river study and requires a response:

k. "The MDEP has reported that attempts to monitor the biochemical oxygen demand (BOD) in sewage treatment plant effluent to evaluate its effect on the river have been difficult because the effects are masked by the high NPS loads in the stream during periods of runoff."

Response: If this is in reference to the postponement of intensive river studies due to high flow, the reasoning is incorrect. Surveys are made at low flows to capture critical conditions. High flow presents less critical conditions in terms of water quality due to greater dilution, greater flushing, greater reaeration, etc.

11. The concept of limiting the HWC's TP discharge based on demonstrated plant performance does not consider that elevated plant flows occur during wet weather periods when river flows and velocities are also elevated and scour off attached plant growth.

Response: To be effective TP control must be continuous and not intermittent. It has also been shown that a lead time of up to two weeks or more is required to optimize treatment efficiency.

12. The DEP's data indicate that non-attainment of Class B DO standards have been recorded above as well as below the HWC discharge. In addition, actual instream TP data show that phosphorus concentrations in the river downstream of the HWC discharge continue to rise above the levels measured immediately below the HWC discharge. These facts clearly indicate that the HWC discharge is not the sole factor impacting the water quality of the Meduxnekeag River.

Response: Non attainment of DO standards above Houlton outfall has been infrequent and marginal. Measurements of non attainment of DO standards (minimum of 7.0 mg/l DO) above Houlton consist of 5 (6.9,6.5,6.9,6.5,6.9) out of 60 morning measurements at MDX1 above Staley and only 2 (6.8,6.9) out of 62 morning measurements at MDX11, the site immediately above the Houlton outfall. No non-attainment was measured above Houlton during 1990, 1993, 1996, and 1997. We recognize the impact of background (NPS) loading which

should be addressed once the impact of the Houlton nutrient loading is controlled. As discussed in the TMDL report, any effects of NPS reductions would be masked by the effect of the Houlton TP load.

The 1993 and 1995 surveys (representing no TP treatment) show a large immediate increase in instream TP immediately below the outfall followed by a rapid decrease in concentration at the successive downstream river stations. The above comment is apparently in reference to the 1990 data. Close examination of these data show that Staley was discharging above Houlton and that TP was elevated at station MDX4 above Houlton's outfall as a result. This high TP concentration above Houlton tended to mask the impact of the Houlton discharge. The 1990 instream TP concentration increased slightly (3 to 15%) between stations MDX13 and MDX15 below Houlton. The variability of TP concentration at each site over the three day survey was greater than this increase from MDX13 to MDX15. The TP concentration decreased between the last two sampling stations (MDX15 and MDX17). The same data also show that PO4 levels did not increase below the Houlton outfall during 1990.