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Modeling Runs Update for Gulf Island Pond TMDL

The attachment contains schematics of updated model runs reflecting two changes.

1. Temperature has been changed to incorporate a temperature gradient vertically throughout the pond. Cooler temperature as depth increases is more realistically consistent with the low vertical mixing that was assigned for the model throughout the pond. Low mixing conditions can be defined by a larger vertical gradient (difference) in dissolved oxygen readings. The end result in the model is slight improvement in deep water dissolved oxygen (DO). A cold water habitat component can be directly observed for temperatures 24 C or less.

   There are separate schematics attached that show the temperature profiles assigned to each model segment as well as projected areas of cold water habitat. The temperatures assigned are an average of worst case conditions for temperature and mixing for the last four summers in July and August, using the monitoring data at the continuous monitors at Gulf Island dam. Dissolved oxygen and temperature are monitored continuously in the summer months at depths of 5, 20, 35, 50, and 70 feet here.

2. A sediment oxygen demand (SOD) temperature correction is incorporated into the model. This was not included in the original model. The older version of WASP that was being used in 2001 did not have a SOD temperature correction in the model. This has since been added in later WASP versions. Since the model was calibrated without a temperature correction for SOD, it is not correct just to add one now. The difference in the temperature under model calibration and model prediction runs (where a higher temperature was used in model runs than in calibration) was used to apply correction factors throughout the model. This resulted in a higher SOD than originally assigned for the model prediction runs. The end result is slightly lower dissolved oxygen in all model segments.

These two changes appear to offset one another when considering the different waste load allocations might make in modeled DO levels.

The model has been rerun for some of the basic runs in the matrix. These included actual discharge conditions (Matrix #A); and the April 15, 2003 runs requested by the mills (Matrix F with cluster). In addition, two model runs for establishing a TMDL are included, which result in attainment of water quality standards in both the Androscoggin River and in Gulf Island Pond everywhere above the thermocline. In the model runs for the TMDL, the municipal discharges were always run with BOD/ TSS at licensed conditions.

Note that in the model runs investigating river cleanup solutions, some nonattainment of DO criteria above the current GIPOP in the deeper segments is always predicted. This non-attainment is typically 1% to 3% of the modeled pond volume. This is true for both the monthly average and minimum DO criteria. There is no level of point source discharge reduction that will result in complete compliance of DO criteria. The only way that complete compliance of DO criteria above the thermocline could result is to install another GIPOP at Turner Bridge, which is about 2 miles above the current oxygen injection system. One option is oxygen injection systems at both Turner Bridge and Lower Narrows. This results in a total oxygen injection requirement of 160,000 pounds per day (ppd). The second option is an injection system at both Turner Bridge and Upper Narrows (current location). This results in a total oxygen injection requirement of about 210,000 ppd. The model runs assume that the same efficiency (1/3) can be obtained in the water column as the current system.

The Excel file attachment has tabs that are labeled as "TMDL" indicating that these are the model runs where attainment of DO criteria occur. To achieve attainment, the following are needed as point source controls:

- Reduce BOD/TSS in the paper mills as indicated in 4/15 memo. This results in collective mill reductions from current licensed levels of 23% for BOD and 32% for TSS.

- Include BOD cluster limit of 12000 ppd as a monthly average, where BOD5 is allocated according to the following formula: (.34 Fraser + .67 Mead + IP)
- Maintain BOD/TSS of municipal discharges at Best Practical Treatment.
- Reduce phosphorus entering the pond by 1/3. Mills are regulated at mass based limits determined by a .46 ppm TP concentration and actual flows. Three municipal discharges (Berlin, Rumford-Mexico, and Livermore Falls) are regulated at mass based limits determined by a 1 ppm concentration and actual flow.
- The summer TSS in IP should be reduced from 12000 to 8000 ppd due to aquatic life non-attainment in the Livermore Falls impoundment.
- Post monitoring of recommendations in a TMDL that allows implementation of limits and attainment within a reasonable period of time to assure compliance of DO criteria and elimination of algae blooms.

The following tables summarize the requirements for attaining Class C water quality standards.

Oxygen Injection Requirements

Option	Turner Bridge	Upper Narrows (current location)	Lower Narrows
#1	65,000		95,000
#2	60,000	150,000	

Point Source Loads – Summer Limits apply May - Sept

	Summer BOD5 Mo. Ave. PPD	Summer BOD5 Weekly Ave. PPD	Annual Mo. Ave TSS PPD	Summer Mo. Ave. TP PPD
Fraser	11000	14700	20000	109
Mead	9000	12800	15500	119
IP	8000	8100	25000 / 8000*	177
Berlin**	660	990	660	13
Rumford-Mexico**	663	994	663	11
Livermore Falls**	500	750	500	6

*IP – A summer TSS limit of 8000 ppd is needed for aquatic life non-attainment outside of Gulf Island Pond.
** For the municipal discharges, BOD5 and TSS are BPT that are applied annually.

Prepared by Paul Mitnik, P.E.
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