Presumpscot River
Supplemental Report to Waste Load Allocation
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Executive Summary

1. This report is a follow up of an earlier effort (Presumpscot River Waste Load Allocation, Nov 1995) as a result of a work plan of action items in the S.D. Warren Co. relicensing process and additional information requests from USEPA. The action items are a series of steps with deadlines that will bring the Presumpscot River into compliance with water quality standards. The Waste Load Allocation and this report will be submitted to USEPA as a TMDL for the Presumpscot River watershed.

2. The accuracy of the water quality model was retested with 42 additional verification runs of 1994 and 1995 data from the continuous four parameter monitor at the Smelt Hill dam. The model output of dissolved oxygen was compared to the monitor dissolved oxygen in these runs. All of the assumptions of the original model were found to be accurate with the exception of the diurnal dissolved oxygen adjustment of the lower Presumpscot which was adjusted from 0.0 to 0.4 ppm.

3. BOD5 loads from S D Warren Co. of 4200 and 2400 lb/day for a daily maximum and monthly average, respectively (65% reduction) will be necessary to attain riverine and estuarine dissolved oxygen standards in the summer period (June 1 to Sept 30) at 10 year low flow conditions with no flow augmentation from Sebago Lake.

4. Flow augmentation from Sebago Lake and summer BOD5 loads from S D Warren of 6780 and 3565 lb/day for a daily maximum and monthly average, respectively (45% reduction) are the chosen alternatives to comply with dissolved oxygen standards. The water quality model was used to derive a final temperature based flow augmentation (QVT) curve for the Presumpscot River which will result in compliance of dissolved oxygen standards (see next page) in the lower Presumpscot River and estuary.

5. Both the water quality model and actual data taken in 1993 indicate that minor non attainment of class B dissolved oxygen standards (0.2 to 0.3 ppm under standards) occurs in the upper Presumpscot River at the Little Falls, Mallison Falls, and Saccarappa dam impoundments. Additional data collection in the early morning hours (before 8 AM) is recommended to confirm non attainment.

6. To assure adequate water levels in Sebago Lake in extreme drought conditions, minimum flow from Sebago Lake should be reduced to 250 cfs during emergency low lake level conditions. Emergency low lake level conditions are defined as follows: When the level of Sebago Lake is one foot below its allowable target range (see Sebago Lake management plan, appendix) between May 1 and November 1 and flow releases from Sebago Lake have been greater than 270 cfs for at least four weeks in order to maintain the water quality in the river as required by the flow augmentation QVT curve. Reduced point source loadings from S D Warren Co. that are necessary to meet dissolved oxygen standards under this flow cap are presented as a function of river temperature and daily maximum loads in the chart following the QVT curve.

7. Federal regulations (40CFR125.3) require that before flow augmentation may be considered as an alternative, a demonstration must be made that flow augmentation is the preferred environmental and economic alternative to achieve standards after consideration of other alternatives such as advanced treatment. It is believed that the public participation process involving stakeholders that developed the Sebago Lake level management plan satisfies this requirement. It has been assumed for state licensing that the required level of treatment for S D Warren Co. with no flow augmentation (see recommendation #3) would result in undue economic hardship, although no cost estimates for this have been made and no significant environmental benefits could be gained. Thus the chosen alternative is preferred over others.

8. Current TSS loading from S D Warren Co. is considered to be the cause of noncompliance of class C aquatic life standards and, from an aesthetic stand point, impairment of designated uses of fishing and swimming. To address compliance of aquatic life standards, TSS limits for S D Warren Co. of 5500 and

12700 lb/day for a monthly average and daily maximum, respectively, from May 1 to Sept 30 should be required as the starting point in a phased approach to licensing. TSS limits in the nonsummer should be limited to past demonstrated performance or 9950 and 22850 lb/day for a monthly average and daily maximum, respectively. The licensing should be conditioned to annual summer monitoring to assure compliance of aquatic life standards, and be subjected to annual reductions in TSS should monitoring continue to show noncompliance of aquatic life standards. Licensing should require that a study plan should be submitted to the DEP for approval to assure macroinvertebrate monitoring is consistent with DEP methods and protocol.

9. A temporary 6.5 mile mixing zone was established in January of 1996 to comply with emergency legislation that required facility specific solutions for dischargers unable to comply with the temperature regulation. It is recommended that ambient continuous temperature monitoring be implemented in a number of locations with the goal of greatly reducing the size of this mixing zone.

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Introduction

The Presumpscot River Load Allocation (Nov. 1995) utilized temperature based flow augmentation from Sebago Lake (i.e., discharge more flow from the lake as water temperatures increase) to maintain acceptable dissolved oxygen levels in the river under summer low flow conditions. Licensed BOD5 loads were used as inputs to the water quality model in the development of these curves. The flow regulation recommended by the report was used voluntarily by the S. D. Warren Co. (SDW) in 1995. The summer of 1995 was a year in which extreme drought conditions were experienced statewide. As a result of the very low lake levels experienced in that summer, and the overall non attainment status of the river, it became evident that additional measures were necessary. A work plan of action items (see appendix) was developed in the waste discharge relicensing process of SDW that sets deadlines for a series of additional measures to bring the river into compliance with water quality standards .

This supplemental report to the Presumpscot River Waste Load Allocation is primarily a result of specific action items of the work plan and tests the accuracy of the model with additional verification runs in which the model dissolved oxygen is compared to the continuous four parameter monitor at the Smelt Hill dam. In addition, this report is intended to provide additional information that USEPA requested in a preliminary assessment of the adequacy of the Waste Load Allocation Report for fulfillment as a Total Maximum Daily Load (TMDL). The Waste Load Allocation is occasionally referenced but not discussed. For a detailed discussion of the prior modeling effort, one should refer to the Presumpscot River Waste Load Allocation (Nov 95). Both this report and the Waste Load Allocation will be submitted to EPA as a TMDL for the Presumpscot River.

Action item 4 of the work plan instructs SDW to submit a proposal for technology based seasonal reductions of BOD discharged to the river. The reduced BOD load to the river will lessen flow passage requirements from Sebago Lake. The following seasonal reduction (June 1 to Sept 30) resulted for BOD5:

	Current	Proposed
BOD5 Daily Maximum (lb/day)	12000	6780
BOD5 Monthly Average (lb/day)	6500	3565

Action item 6 of the work plan instructs the Department to develop new temperature based flow regulation (QVT) curves jointly with SDW to maintain the Presumpscot River at acceptable dissolved oxygen levels. These curves are developed with the DEP model of the Presumpscot River based upon the reduced loadings proposed by SDW.

Action item 8 of the work plan requires the DEP to establish a minimum flow for the Presumpscot River under emergency low lake levels at Sebago Lake and effluent limits under this flow cap. This flow cap agreed to by S D Warren and the DEP is 250 cfs from Sebago Lake. Both the flow cap and the associated effluent reductions under the flow cap are actions above and beyond the QVT curves to be used in extreme drought years when emergency low lake levels are experienced. The goal of the proposed flow management plan is to use the water volume in the lake to maintain adequate water quality in the Presumpscot River, but at the same time minimizing the use of this water to the maximum extent possible while still maintaining adequate lake levels.

The 1995 data at the four parameter monitor at the Smelt Hill dam resulted in ideal data to retest the accuracy of the model, i.e. additional verification runs. This data together with the 1994 data resulted in 42 additional model runs. This analysis goes above and beyond what is typically done for a waste load allocation, and results in a very high quality model for the Presumpscot River. In general, all of the original assumptions used in the modeling analysis of the Waste Load Allocation were found to be accurate, with the exception of the diurnal dissolved oxygen adjustment that was used in the lower Presumpscot River. The original model had no diurnal adjustment here, but the new analysis indicates that an adjustment of 0.4 ppm is necessary and should be subtracted from the model results to obtain the daily minimum dissolved oxygen.

Model Verification Based Upon 1994 and 1995 Four Parameter Monitor Data

A limitation to the original model calibration to the 1993 data was described in the Waste Load Allocation (p 22):

"The major disadvantage to the data sets collected in 1993 is that minimal point source loading was occurring during the surveys and hence the dissolved oxygen deficit at the sag point was not large. A larger deficit would have resulted in greater model sensitivity to parameter rate changes and a better calibration. In addition to the calibration and verification data sets, the four parameter monitor could serve as additional model verification in the future. The dissolved oxygen at the monitor could be observed during a higher loading condition in the future and the model rechecked and adjusted, if it is appropriate."

The four parameter monitor at the Smelt Hill dam is located at the river's dissolved oxygen sag point which is the location where the lowest dissolved oxygen occurs. Continuous data at a river's sag point is best mechanism for checking compliance with dissolved oxygen standards. If standards are met here, then they should be met everywhere. Model verification to continuous data at this location has the advantage of utilization of longer term averages of 7 and 30 days than what was used in the 1993 data (three days). The river is much more likely to be in an equilibrium or steady state condition over a period of several days. An important assumption in the Qual2e model is the assumption of steady state conditions throughout the system. The 1993 data has the advantage of more spatial coverage, i.e. many sample locations.

The 1995 data was ideal data to further verify the model. SDW BOD5 discharged to the river, contrary to the 1993 data sets which was taken under 20% loading conditions, reached 60% of licensed values which is similar to the proposed seasonal licensed BOD5. The flow conditions in the watershed reached levels more extreme than a 10 year low flow. In some of the runs, river flow losses actually occurred from Sebago Lake to Westbrook. As a result, larger dissolved oxygen deficits resulted in the river than what occurred in 1993. The dissolved oxygen levels in the river in 1995 in some cases approached the minimum values allowed under state law. This data represent conditions similar to the design criteria, i.e. licensed load, dissolved oxygen just barely meeting standards and are good to test the model's reliability under the worst case design runs in the development of the QVT curves. The 1994 data were used to a lesser extent to further test the reliability of the model under less extreme conditions.

The following data were used in the Smelt Hill dam monitor verification runs:

Flow - Flow gages at Sebago Lake and Westbrook as reported by USGS
Temperature and Dissolved Oxygen - The continuous data at the four parameter monitor
Point Source Loads - As reported on DMR's by SDW and PWD, Westbrook

The model verification runs were made as 30 day, 7 day and 2 day average conditions. A spreadsheet was set up to calculate the values used as inputs to the model. In addition a spreadsheet was set up to calculate a flow balance for each data set, based upon the two flow gages and drainage area proportions. Both of the spreadsheets are in the appendix to this report. The following number of runs were made:

1995 30 day average	11 runs
1995 7 day average	8 runs
1995 2 day average	10 runs
1994 30 day average	4 runs
1994 7 day average	4 runs
1994 2 day average	5 runs
Total	42 runs

The upstream boundary conditions, had to be assumed for each run at conditions used for the design model runs, (dissolved oxygen at 93% of saturation; CBODu and NBODu at 3.4 and 1.1 ppm, respectively; and temperature of upper Presumpscot at 1°C less than the monitor temperature). All of the other calibrated parameter rates, i.e. BOD decay rate, reaeration rate, SOD rate, were held constant to the prior calibrated rates of the 1993 data. In addition, the same five day to ultimate BOD factors determined for the various effluents were used as determined in the Waste Load Allocation. For most effluents, this was a straight average, but for SDW, a function was derived based upon the BOD5 concentration (figure 3a of the WLA report is repeated on the next page for convenience).

The five day to ultimate BOD factor for SDW's effluent as a function based upon five day BOD concentration is considered to be another questionable portion of the model. The BODu/BOD5 for the higher BOD5 concentrations (lower end of curve) had to be derived based upon a mix of primary and secondary effluent, due primarily to the lack of BODu data at the higher BOD5 concentrations. To compensate for this data deficiency, model calibration was used to check the BODu/BOD5 function The verification runs were initially run utilizing both the function derived values and a straight average of 5.33 when computing SDW's ultimate BOD input. This resulted in different BODu inputs for SDW's effluent, and the different model output values for dissolved oxygen could then be compared to the monitor values. When the straight average of 5.33 for SDW's effluent BODu/BOD5 was used to derive the ultimate BOD model input, the model dissolved oxygen was slightly lower than the monitor dissolved oxygen, when considered collectively, by a value of 0.07 to 0.23 ppm. When the function derived BODu/BOD5 for SDW's effluent was used to derive the ultimate BOD model input, the model prediction of the monitor dissolved oxygen was high, when considered collectively, but was within .01 to .06 ppm. For this reason the function derived BODu/BOD5 for SDW's effluent is considered to be the better of the two options for characterizing SDW's ultimate BOD inputs.

The 42 verification runs are summarized in table 1. The model dissolved oxygen and monitor dissolved oxygen are compared both individually as a difference and collectively as an average difference and average deviation. The average difference considers the sign (+ or -) and is hence an indication of the model being high or low collectively in its estimate of dissolved oxygen. The average deviation pays no attention to sign and hence is an estimate of the model precision. The average deviation of all of the model runs when compared to the monitor values, collectively, was within 0.2 ppm. When considered individually, in 27 of the 42 runs (64%), the model dissolved oxygen came within 0.2 ppm of monitor values and in 37 of the 42 runs (88%) the model dissolved oxygen came within 0.3 ppm of the monitor dissolved oxygen. This is considered to be a satisfactory verification of the model. It is likely that other factors such as the accuracy of the monitor data and the assumptions for upstream boundary conditions are also limiting the accuracy of the model verification, rather than the model, itself. The model and monitor dissolved oxygen for the 42 runs are also compared as time series plots in figures 1,2,3, and 4.

The model values in table 1 represent a long term average dissolved oxygen of 2, 7, or 30 days. Even though the model prediction of average dissolved oxygen levels is considered adequate, it became evident that the diurnal adjustment of 0.0 ppm in the lower Presumpscot River was not adequate to characterize daily minimum dissolved oxygen. The diurnal adjustment (daily average D.O. - daily minimum D.O.) at the continuous four parameter averaged over the entire summers of 1994 and 1995 resulted in diurnal adjustments of 0.39 and 0.43 ppm, respectively. A value of 0.4 ppm is subsequently being used as the diurnal adjustment for the lower Presumpscot and the adjustment in the rest of the river remains unchanged (figure 5).

Model Projections at Design Conditions

The model runs at design conditions are simulations at worst case conditions of high water temperature, low river flow, and maximum licensed loading from all point sources. The design condition is when D.O. readings are likely to be lowest and is something that occurs infrequently (once in ten years). The model predictions are subsequently compared to dissolved oxygen standards specified by state law to check compliance with water quality standards. There are two separate tests which must be made; assessment of minimum dissolved oxygen standards and assessment of monthly average standards. The 7Q10 flow is used in the assessment of the former and the 30Q10 flow of the latter. These values are difficult to determine on a regulated river, in particular, on one such as the Presumpscot, where flow regulation in the future may be quite different than historical flow regulation. Low flow values of 300 and 330 cfs for a 7Q10 and 30Q10, respectively at Westbrook were used in this analysis. In a meeting in February of 1998, S D Warren and the DEP agreed to these values for regulatory purposes. After adjusting flow for intervening drainage from Westbrook to Sebago Lake (contributions from tributary

Figure 3a
S D Warren Effluent Data

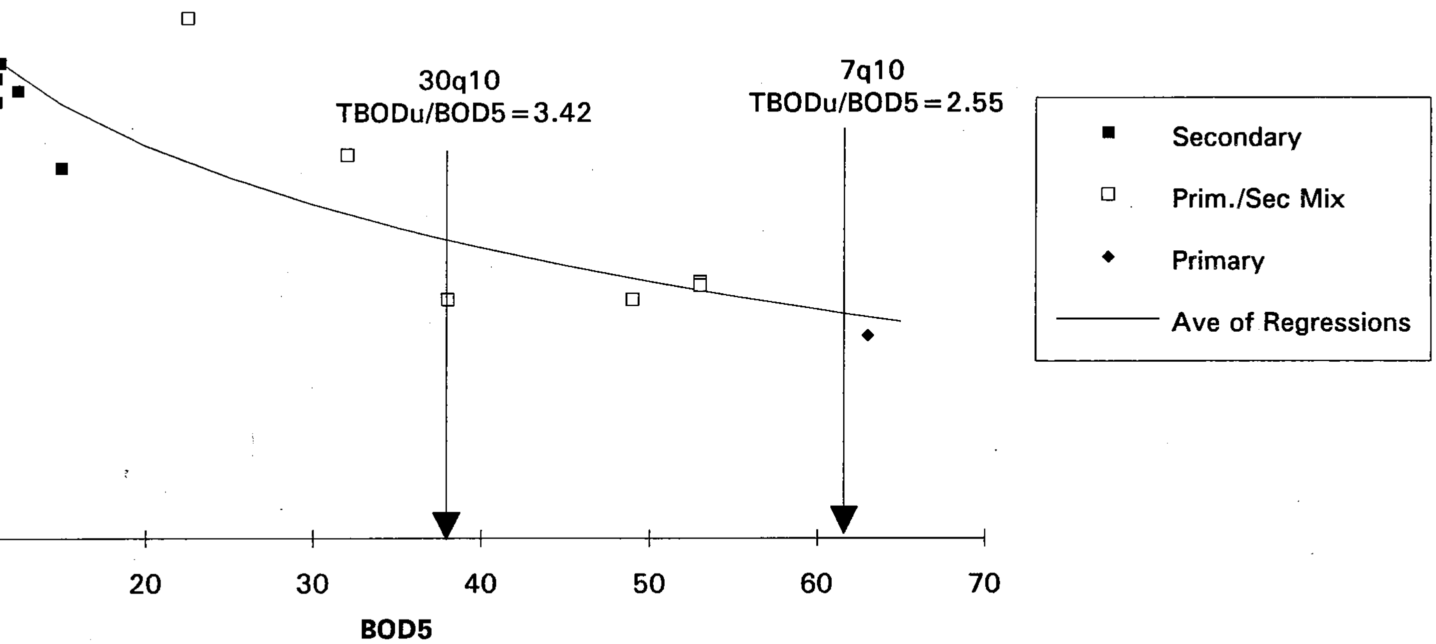

Table 1 Summary of Additional Model Verification Runs

1995 30 Day

Date 1995	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l
18-Jul	6.72	6.91	0.19
25-Jul	6.76	6.9	0.14
1-Aug	6.86	6.97	0.11
8-Aug	7.16	7.01	-0.15
17-Aug	7.22	6.96	-0.26
25-Aug	7.02	6.82	-0.2
2-Sep	6.85	6.72	-0.13
9-Sep	6.56	6.75	0.19
17-Sep	6.74	6.91	0.17
24-Sep	6.94	7.15	0.21
30-Sep	7.28	7.36	0.08
		Ave	0.032
		Ave Dev	0.158

1995 7 day

Date 1995	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l
11-Jul	6.37	6.56	0.19
17-Jul	6.7	6.74	0.04
6-Aug	7.37	6.87	-0.5
20-Aug	6.34	6.6	0.26
28-Aug	6.13	6.52	0.39
4-Sep	7.21	7.12	-0.09
22-Sep	7.26	7.44	0.18
27-Sep	7.63	7.69	0.06
		Ave	0.066
		Ave Dev	0.189

1995 2 day

Date 1995	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l
8-Jul	6.2	6.41	0.21
17-Jul	6.25	6.58	0.33
26-Jul	6.8	6.76	-0.04
3-Aug	7.1	6.72	-0.38
15-Aug	6.3	6.56	0.26
24-Aug	6.65	6.38	-0.27
25-Aug	6.2	6.34	0.14
5-Sep	7.1	6.87	-0.23
16-Sep	7.15	7.12	-0.03
26-Sep	8	7.92	-0.08
		Ave	-0.009
		Ave Dev	0.195

1994 Data

Date 1994	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l
30 Day			
31-Jul	7.05	6.91	-0.14
13-Aug	6.63	6.7	0.07
20-Aug	6.74	6.74	0
30-Aug	6.84	6.91	0.07
7 Day			
24-Jul	6.99	6.57	-0.42
7-Aug	6.86	6.89	0.03
15-Aug	6.11	6.65	0.54
31-Aug	7.13	7.11	-0.02
2 Day			
24-Jul	6.4	6.28	-0.12
3-Aug	6.7	6.76	0.06
14-Aug	6.35	6.65	0.3
22-Aug	7.55	7.3	-0.25
31-Aug	6.85	7.01	0.16

1995 D.O. Diff

Ave	0.027
Ave Dev	0.185

1994 D.O. Diff

Ave	0.022
Ave Dev	0.166

Figure 1
Model Verification Runs
1995 30 Day Average Data

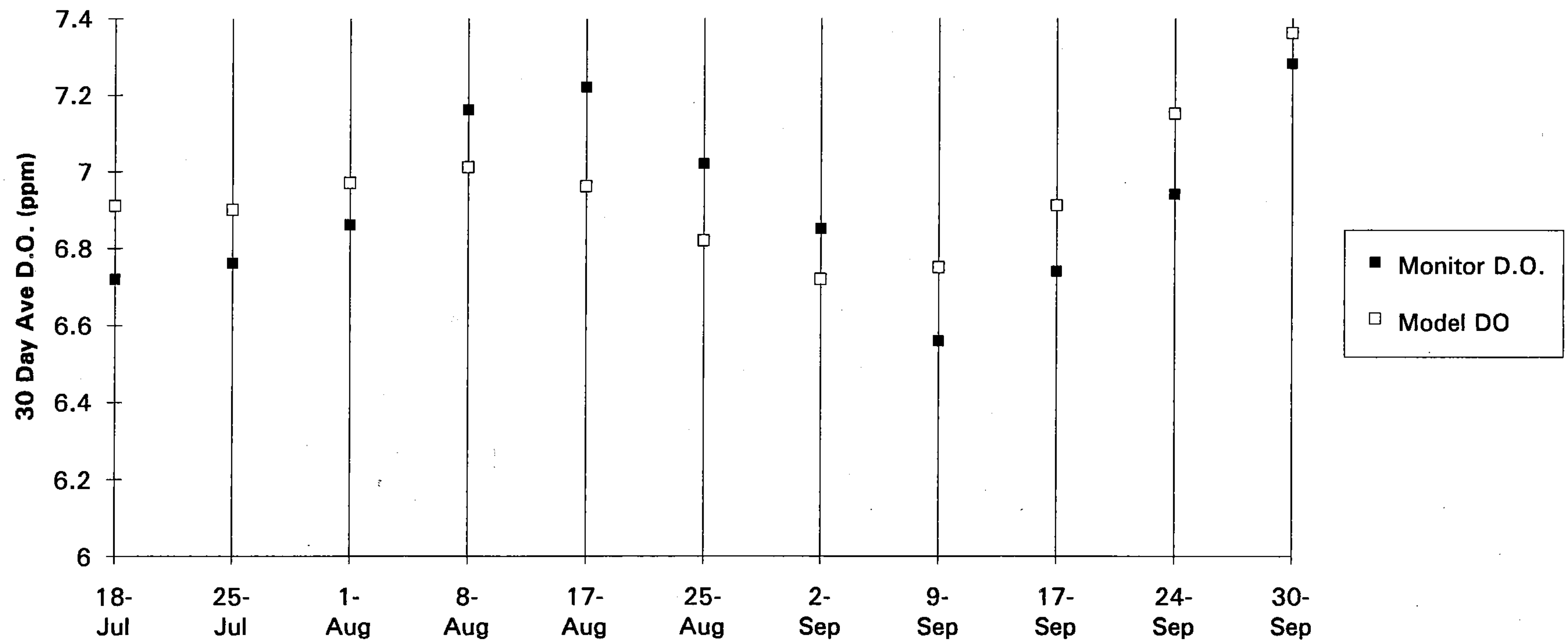

Figure 2
Model Verification Runs
1995 7 Day Average Data

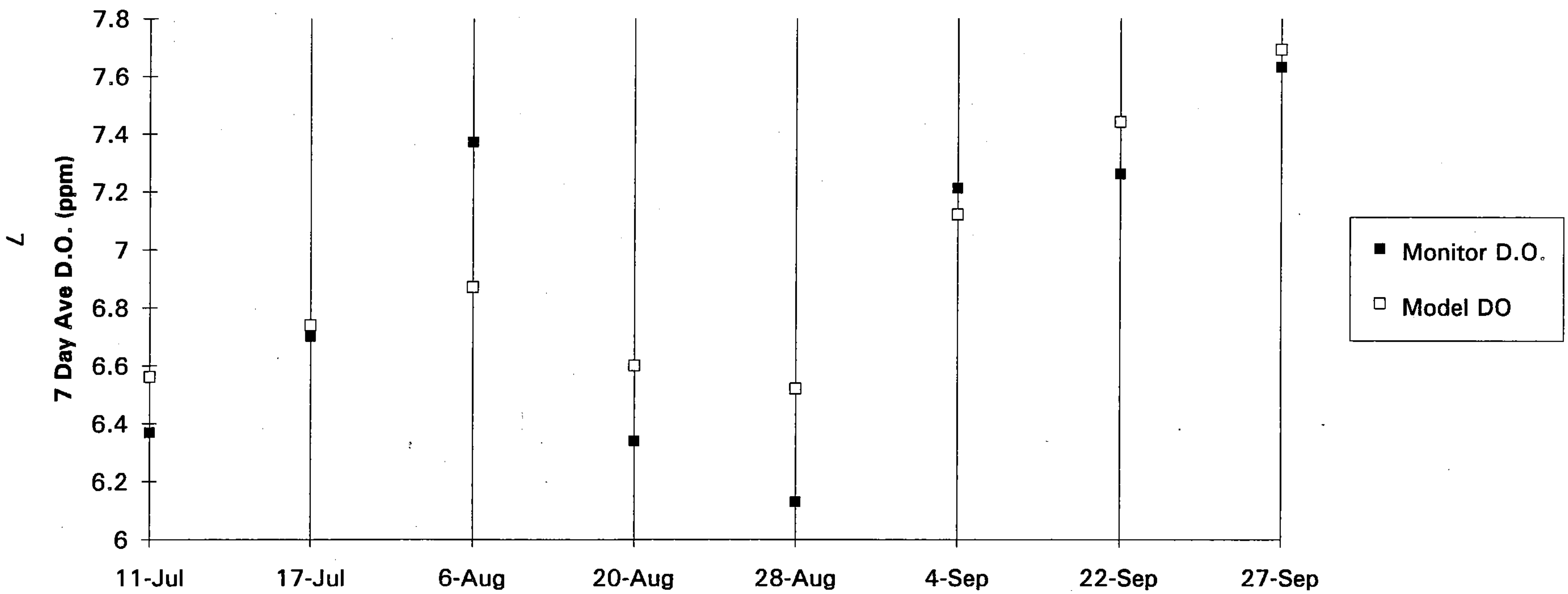

Figure 3
Model Verification Runs
1995 2 Day Average Data

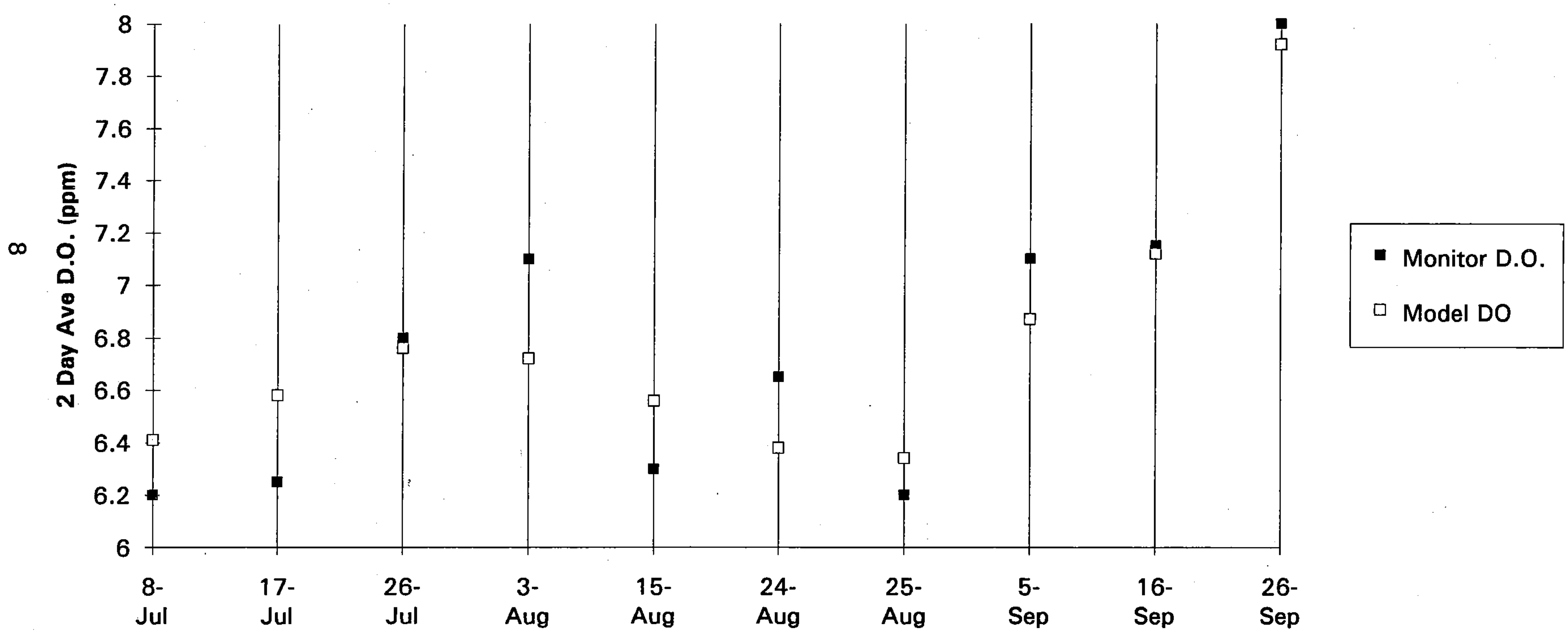

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Figure 4
Model Verification Runs
1994 30, 7, and 2 Day Average Data

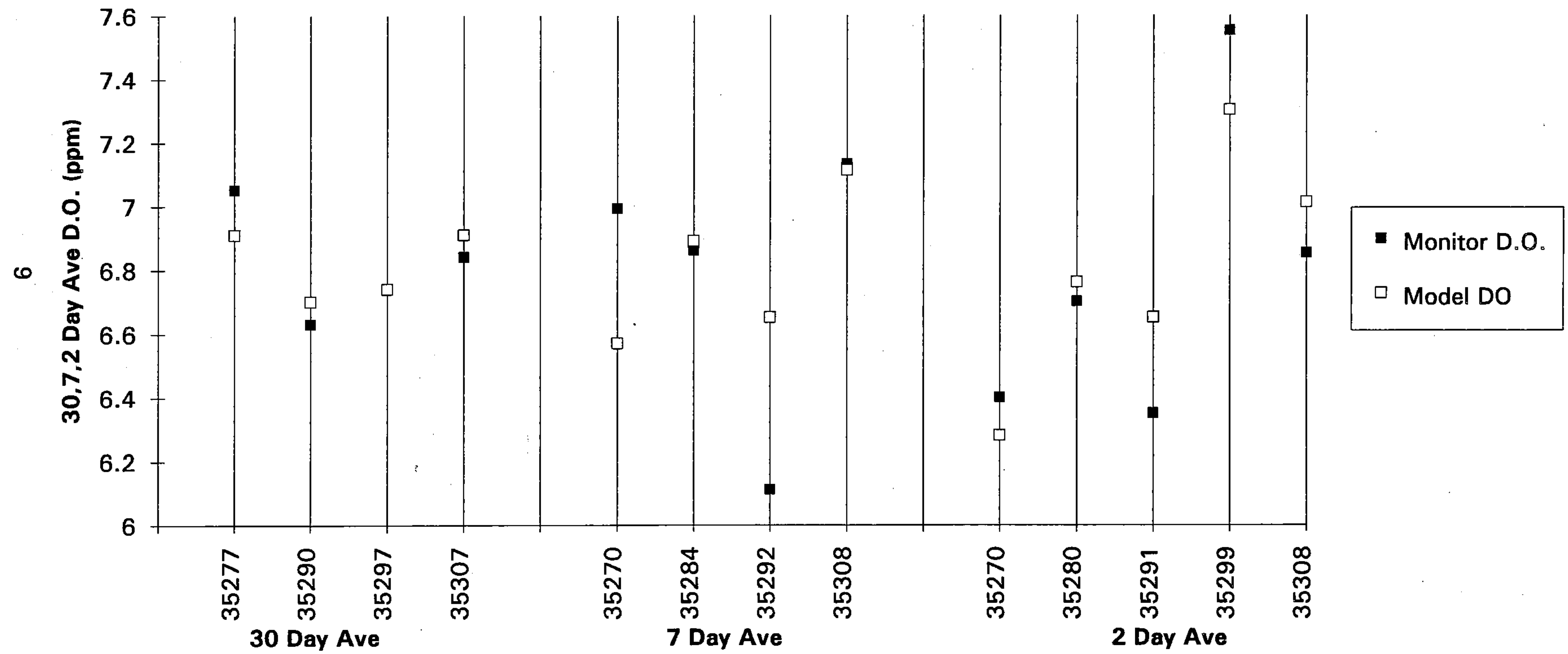
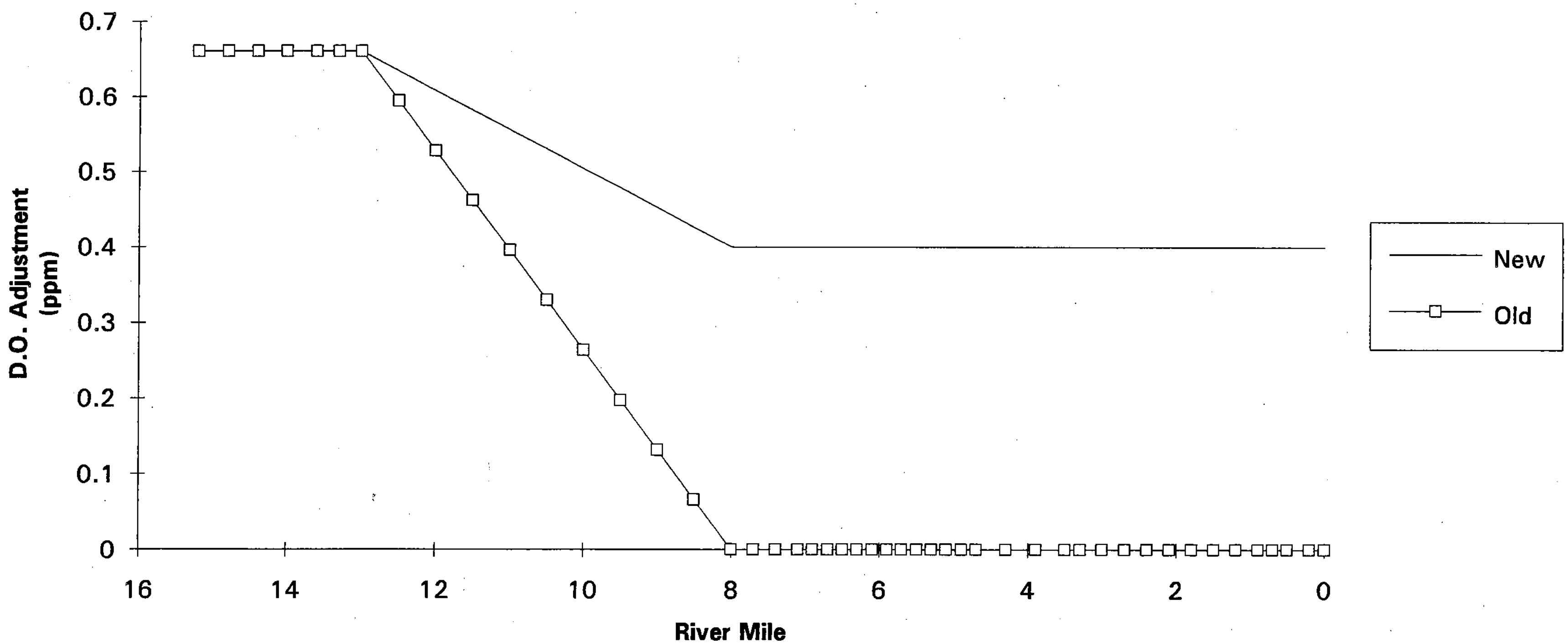


Figure 5
Diurnal Adjustment of Model to Obtain the Daily Minimum Dissolved Oxygen



standards would occur for 1.3 miles and the dissolved oxygen would reach a daily minimum of 4.6 ppm above the Smelt Hill dam (figure 6). A daily maximum BOD5 of 4200 lb/day is necessary to meet both class C and SC standards (figure 6).

The model simulation at 30q10 at current BOD5 loading conditions indicates that about 2 miles of the river would not meet the monthly average dissolved oxygen standard of 6.5 ppm, but would be within 0.6 ppm of attainment (figure 7). With the proposed loading reductions, the model simulation estimates that about 1.2 miles of the river would not meet the monthly average dissolved oxygen standard of 6.5 ppm, but would be within 0.25 ppm of attainment (figure 7). A monthly average BOD5 of 2400 lb/day is necessary to meet monthly average dissolved oxygen standards. (figure 7).

The model runs at 270 cfs (7Q10) also indicate that about 8 miles of the Upper Presumpscot, including the Little Falls, Mallison Falls, and Saccarappa dam impoundments fail to meet minimum class B criteria, but are within 0.2 ppm of attaining standards in the first two impoundments and 0.35 ppm in the last impoundment. This is not a surprising finding since minor non attainment occurred in the 1993 data in two of these three impoundments, and marginal compliance was also often observed. It is surprising that the data taken in what most would consider relatively pristine waters would have moderately depressed dissolved oxygen. Since a diurnal trend was evident here, the source of the dissolved oxygen depression is believed to be respiration from bottom attached algae (which was also observed in these impoundments).

It is unclear if the 1993 data was an anomaly and/or if the proposed Sebago Lake management plan will improve water quality enough to meet standards. EPA has suggested in a letter (Steve Silva, USEPA, letter to Dave Courtemanch, MDEP, June 1996) that a TMDL be developed here to bring the river into compliance with D.O. standards. It is felt that the non attainment here is based upon limited data (unlike the lower Presumpscot which has a continuous monitor) and both the data and model indicate that the non attainment is minor and within measurement error. The large amount of effort required for a TMDL here is not warranted at this time. The upper Presumpscot should be closely watched in the future, since existing data may indicate the beginning of water quality problems from non point sources of pollution. Additional data collection in the early morning hours (before 8 AM) is recommended and if non attainment continues to occur, a TMDL should be implemented for non point sources.

When compliance with class SC estuarine dissolved oxygen standards of 70% of saturation are checked, the model estimates that with current BOD loading from SDW, about 1.6 miles of the estuary would not meet standards at low tide and 0.8 miles would not meet standards at high tide. Although the length of the estuary in non attainment with standards is not significantly different when comparing the model dissolved oxygen at current and proposed loading conditions, the estuary comes closer to attaining standards with the reduced loads. At low tide, the estuary is within 0.2 ppm of attaining standards at proposed loading conditions, compared with 0.5 ppm of attaining standards at current loading conditions (figure 8). At high tide, the estuary is within 0.5 of attaining standards at proposed loading conditions compared with 0.8 ppm of attaining standards at current loading conditions (figure 9).

In summary, although the proposed reduced loadings from SDW improve dissolved oxygen, some non attainment of standards is still possible and additional measures are necessary. Both flow augmentation from Sebago Lake and the proposed 45% reduction in summer BOD5 from S D Warren are the alternatives agreed to by S D Warren and DEP to comply with dissolved oxygen standards. The water quality model was used to derive a final temperature based flow augmentation (QVT) curve for the

Figure 6
Model Run at Design Conditions in Consideration of Minimum Riverine Dissolved Oxygen Standards
No Flow Augmentation

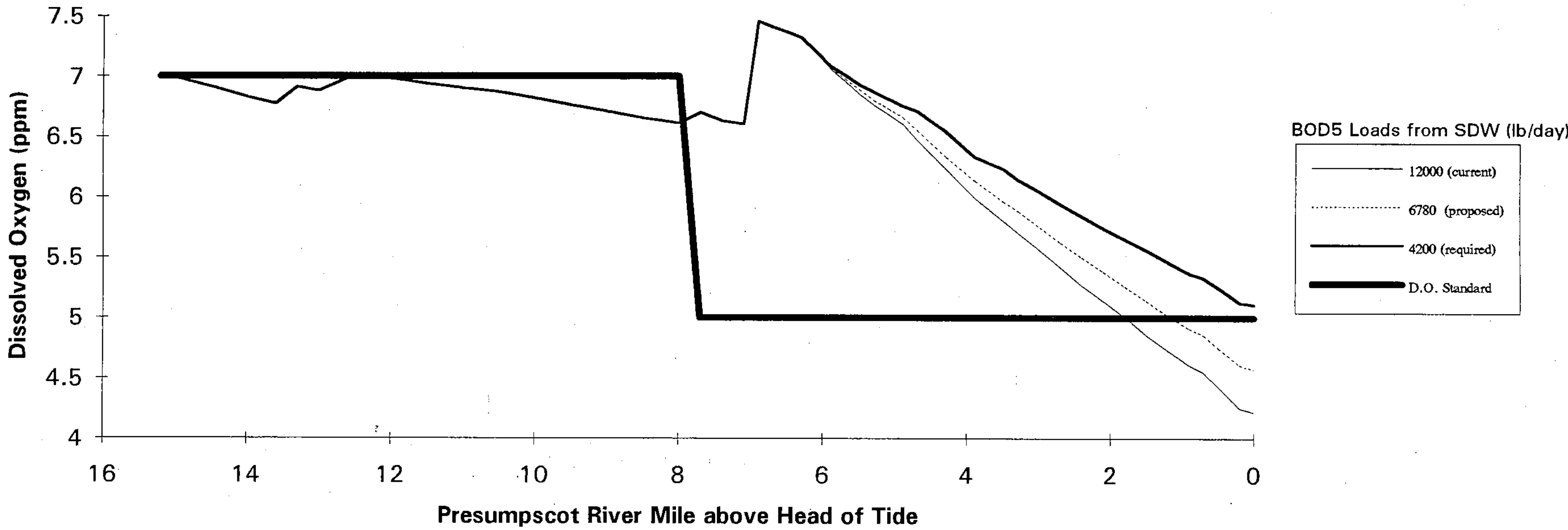


Figure 7
Model Run at Design Conditions in Consideration of 30 Day Average Riverine Dissolved Oxygen Standards
No Flow Augmentation

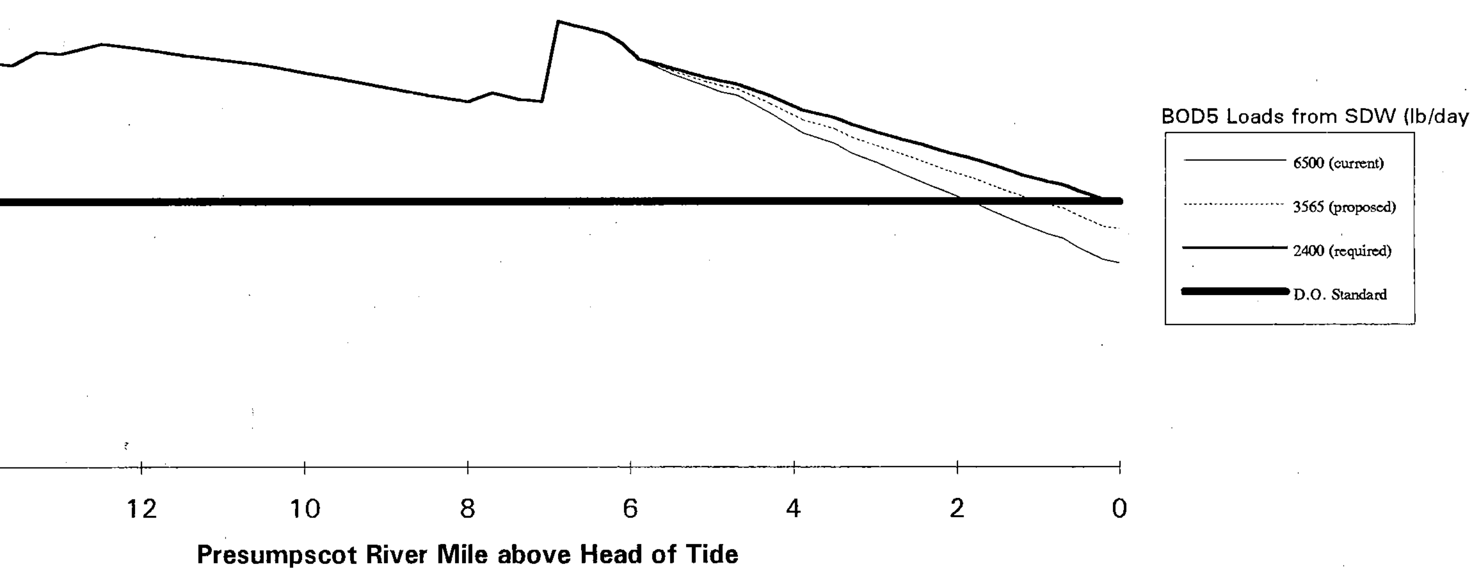


Figure 8
Model Run at Design Conditions in Consideration of Minimum Estuarine Dissolved Oxygen Standards at Low Tide
No Flow Augmentation

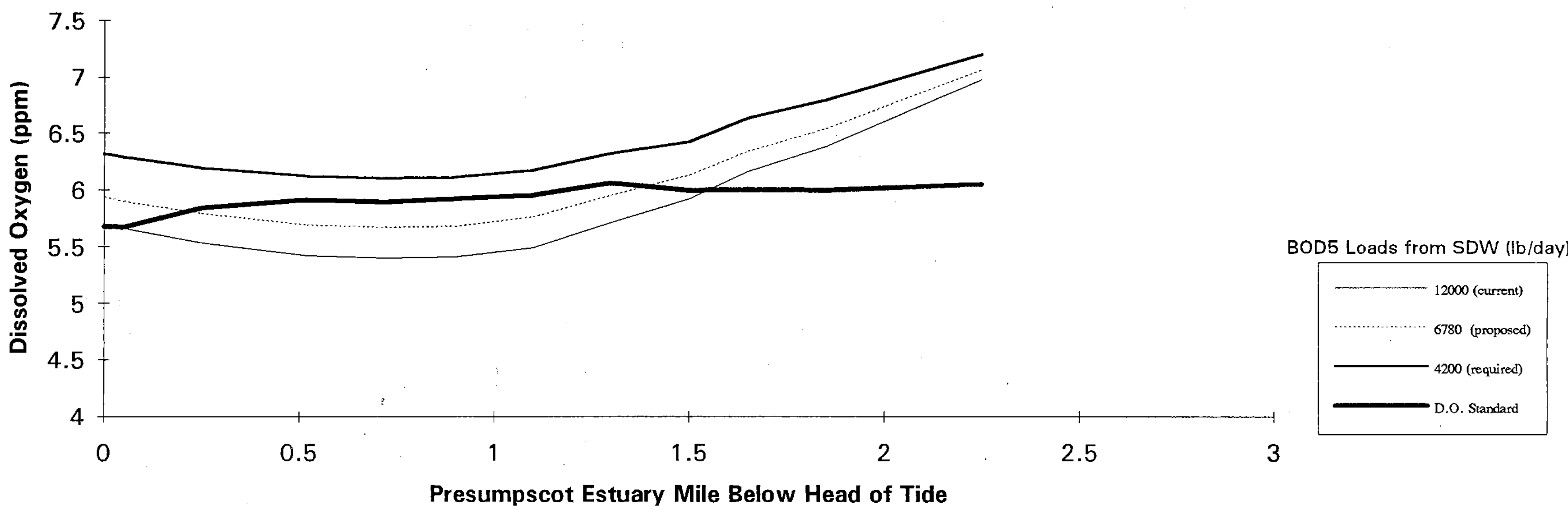
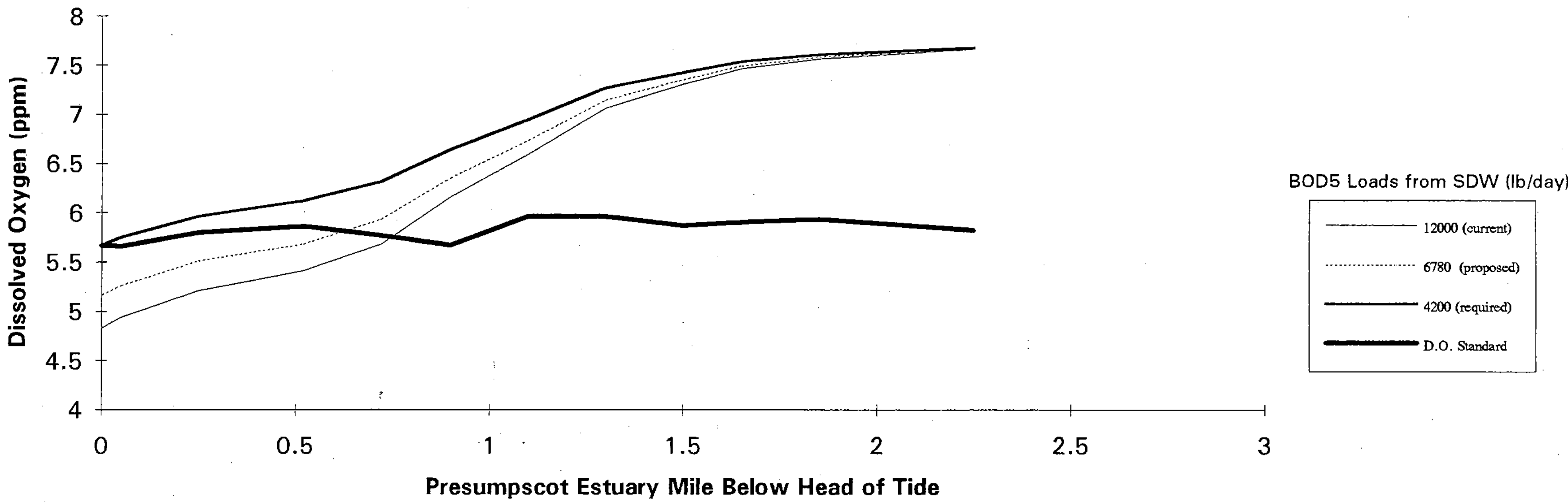


Figure 9
Model Run at Design Conditions in Consideration of Minimum Estuarine Dissolved Oxygen Standards at High Tide
No Flow Augmentation



Westbrook was proposed by SDW as a guaranteed minimum flow The minimum flows guaranteed by S D Warren Co. and agreed upon in a meeting in February of 1998 are 300 cfs for a 1Q10 and 7Q10 and 330 cfs for a 30Q10 at Westbrook. When adjusted downward for intervening drainage area in-between Sebago Lake and Westbrook, 7Q10 and 30Q10 flows of 270 and 300 respectively result at Sebago Lake. These flows or greater would be passed from Sebago Lake at all times, except when the flow cap is being implemented during emergency low lake level situations in extreme drought conditions.

The model runs presented in this analysis initially assume no minimum guaranteed flow. The model runs are made with all inputs constant except the temperature and boundary dissolved oxygen (93% of saturation assumed) which are changed for each run and then held constant. The flow is then varied in a trial and error process until dissolved oxygen standards are met. The runs are then plotted collectively in a flow vs temperature format (figure 10).

The final QVT curve is one in which all dissolved oxygen standards are met in the lower Presumpscot River and estuary (figure 11 and table 2) including minimum class C (5 ppm and 60% of saturation), minimum class SC (70% of saturation), and monthly average C (6.5 ppm). In the final curve, a minimum instantaneous flow of 270 cfs and 30 day average minimum flow of 300 cfs from Sebago Lake are used when developing the curves.

A dissolved oxygen saturation value of 68% of saturation for a daily average was used as the target dissolved oxygen level above the Smelt Hill dam which assures compliance of dissolved oxygen standards everywhere in the lower Presumpscot River and estuary. This threshold level of D.O. was determined in the final Waste Load Allocation Report (Nov 1995, p41). Note that temperature ceilings of 26^{o} C and 30^{o} C were used in this analysis for the 30 day average and daily average, respectively. These upper limits of temperature were derived from 16 years of record at the Smelt Hill dam continuous monitor.

Table 2 Final QVT Curve

Temp	Req. Flow (cfs) Sebago L	
	Min. C and SC	Ave C
16	270	300
18	270	300
20	270	300
22	270	300
24	300	340
26	330	445
28	380	
30	470	

Implementation of the QVT curve requires tracking of the running 30 day average for both flow (from Sebago Lake) and temperature (at the Smelt Hill dam continuous monitor). In addition, the daily average flow and mid day temperature at the same locations must be tracked. Each analysis is done individually and then the higher from each of the two curves is utilized. It is recommended that the actual regulation of flow be implemented so that a buffer of safety is maintained, i.e. the actual flow is slightly above the required flow.

Figure 10
Required Flow to Meet Presumpscot River Dissolved Oxygen Standards

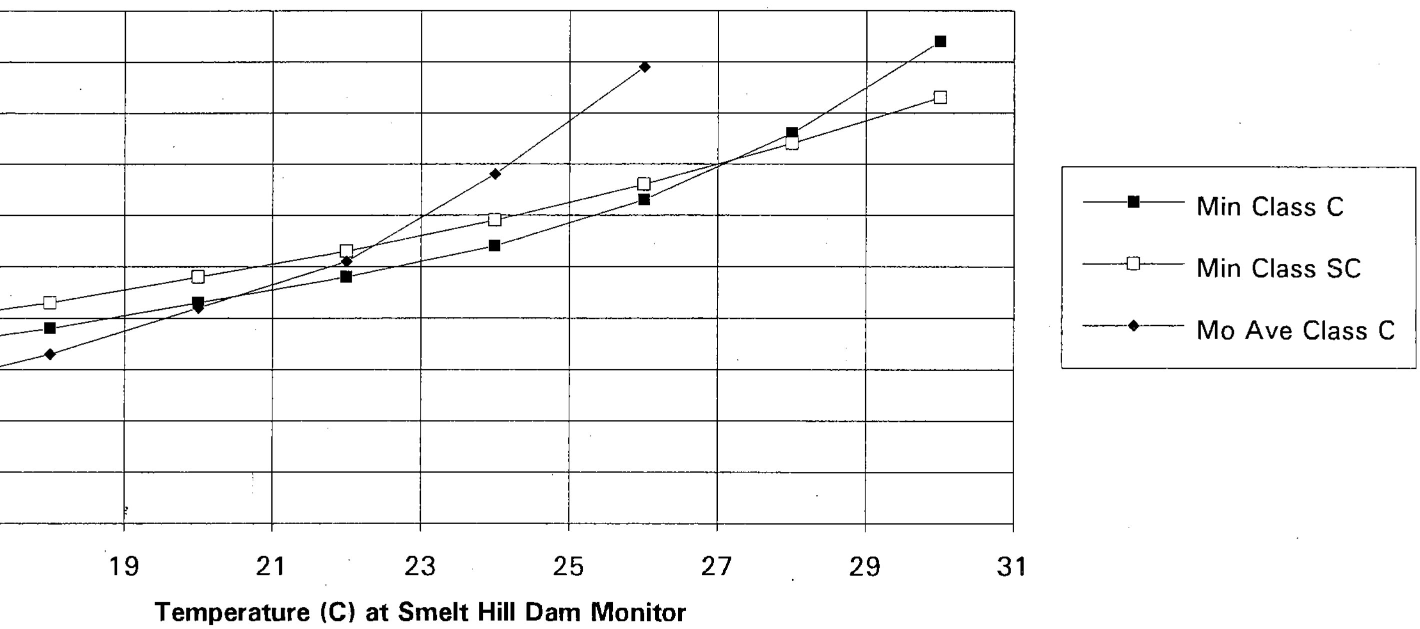
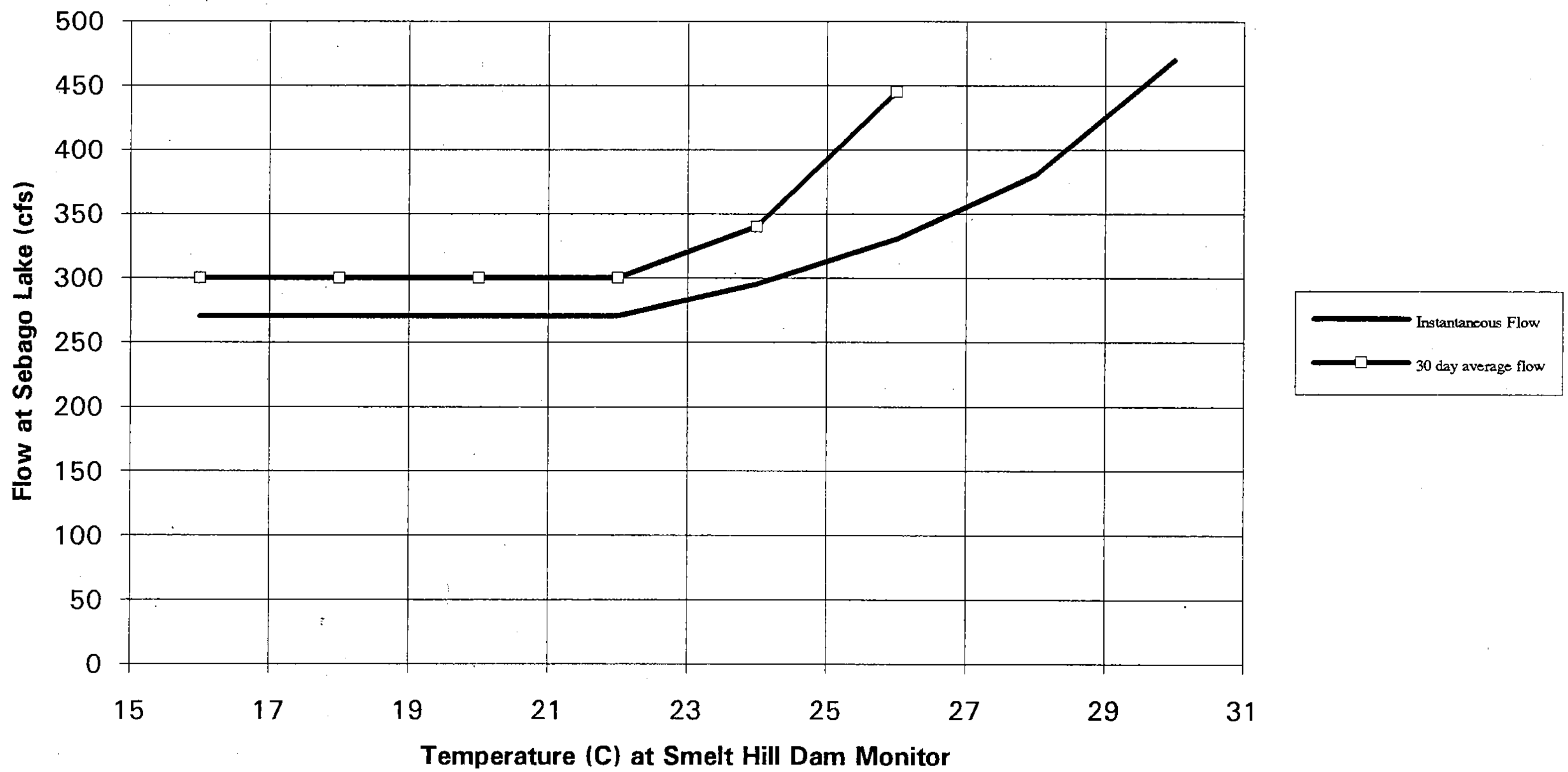


Figure 11
Final Temperature Based Flow Regulation Curve
For Presumpscot River*



*Developed in Jan of 1998 using SDW proposed license BOD5 of 6780 and 3565 lb/day, respectively for a daily maximum and monthly average. River design flows at Westbrook are 7q10 of 300 cfs and 30Q10 of 330 cfs, respectively. Instantaneous flow curve results in compliance of minimum class C (5 ppm and 60% saturation) and SC (70% saturation) D.O. standards. The 30 day average flow curve results in compliance of the 30 day average D.O. standard (6.5 ppm). Temperatures of 26 C and 30C assumed ceilings for daily and 30 day average river temperatures, respectively.

buffer.

About 350 cfs would be required for the 30 day curve but 400 cfs is needed for daily requirements, so 400 cfs should be passed that week. Since flow in the river will probably not be adjusted daily, it is important to maintain some buffer in the river for future uncertainty, i.e. changes in weather.

Federal regulations require a MOS in TMDL development. An acceptable MOS could be rounding up required flows from the QVT curve to the nearest 50 cfs. Some margin of safety is also realized due to the fact that the intervening drainage adjustment of 30 cfs from Sebago Lake to Westbrook is based upon 10 year low flow conditions. Most of the time, the intervening flow will probably exceed this value resulting in more flow at Westbrook than deduced by this analysis. The Royal River gage could be used as a check to estimate flow from intervening drainage. If flow here greatly exceeds the 30 cfs an adequate buffer would be maintained.

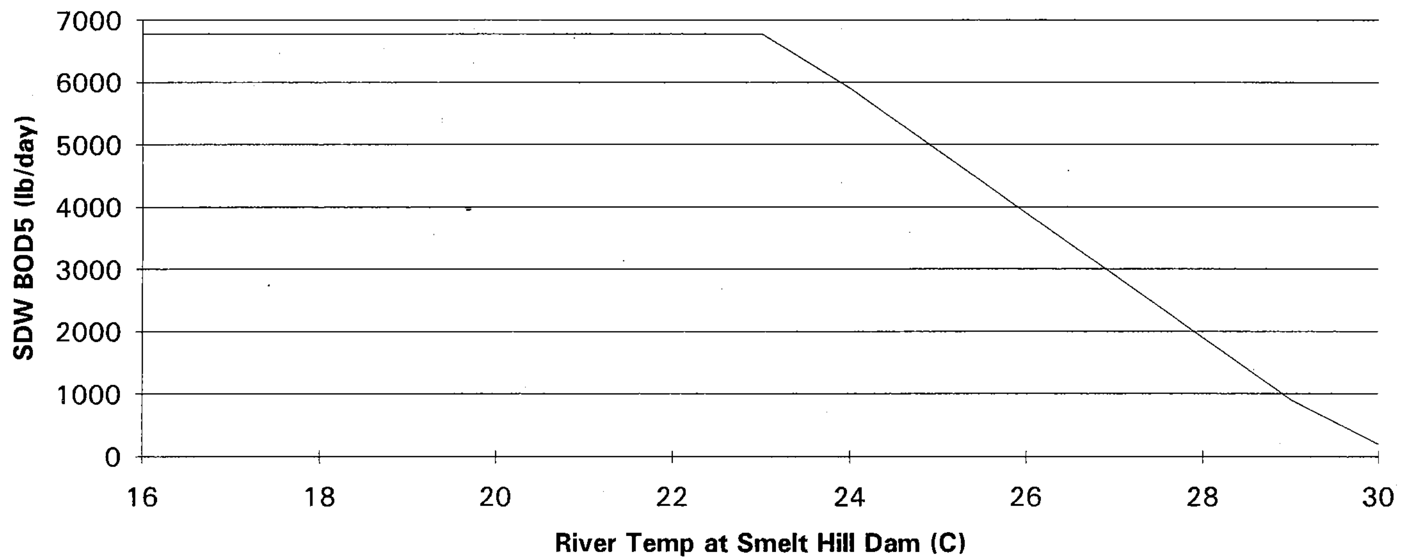
An important point to mention is that a buffer of .1 to .2 ppm for dissolved oxygen is automatically maintained in the lower Presumpscot, since 68% of saturation as a daily average is used to derive the QVT curve (the 68% of saturation above the Smelt Hill Dam results in attainment of SC D.O. standards in the estuary). Due to damage in the 1996 flood, the Smelt Hill dam is not used for hydropower currently. Therefore a MOS is automatically provided in the estuary, since dam reaeration is now provided for 100% of the flow spilling over the Smelt Hill dam. With this spillage, dissolved oxygen levels are actually significantly better in the estuary than model projections which assume hydropower is still intact with no spillage. If the dam is refurbished in the future, spillage could be required in low flow situations to maintain this MOS.

Federal regulations (40CFR125.3) require that before flow augmentation may be considered as an alternative, a demonstration must be made that flow augmentation is the preferred environmental and economic alternative to achieve standards after consideration of other alternatives such as advanced treatment. It is believed that the public participation process involving stakeholders that developed the Sebago Lake level management plan satisfies this requirement. This plan will become final when it is approved by FERC, but in the interim S D Warren has agreed to follow the management plan voluntarily. It has been assumed for state licensing that the required level of treatment for S D Warren Co. with no flow augmentation (2400 and 4200 lb/day BOD5 for monthly average and daily maximum, respectively) would result in undue economic hardship, although no cost estimates for this have been made. Thus a no flow augmentation alternative is not the preferred economic alternative. The Sebago Lake flow management plan represents a balance amongst competing uses and it is concluded that it is unlikely that significant environmental benefits could be gained without flow augmentation.

Flow Cap Runs

To assure adequate water levels in Sebago Lake in extreme drought conditions, a minimum flow of 250 cfs from Sebago Lake is required during emergency low lake level conditions. Emergency low lake level conditions are defined as follows: When the level of Sebago Lake is one foot below its allowable target range (see Sebago Lake management plan, appendix) between May 1 and November 1 and flow releases from Sebago Lake have been greater than 270 cfs for at least four weeks in order to maintain the water quality in the river as required by the flow augmentation QVT curve.

Figure 12
Allowable BOD5 Discharge for SDW
During Emergency Low Sebago Lake Levels
Flow = 250 cfs



Temp(C)	SDW BOD5 (lb/day)
22	6780
23	6780
24	5900
25	4900
26	3900
27	2900
28	1900
29	900
30	200

It is assumed in this analysis that emergency low lake levels would be encountered less than 30 days each summer. Therefore the required BOD reductions from S D Warren Co. are only daily maximum values and no reduction in monthly average limit is required. The allowable BOD5 is illustrated in both graph and tabular format as a function of river temperature (figure 12). This analysis shows that as long as the daily average river temperature above the Smelt Hill dam is less than 23 ^{o}C, no further BOD reduction from the 6780 lb/day is necessary. Above 23 ^{o}C, about 1000 lb/day less of BOD5 should be discharged for each ^{o}C rise.

Assessment of Aquatic Life Standards and Required TSS Reductions

The lower Presumpscot River has historically been plagued with high total suspended solids (TSS) as a result of TSS discharged from the S D Warren Co. outfall. Considering the high strength of SDW's waste and low dilution of waste water to river (9.2:1 at 7Q10 flow) when compared to other paper mills in the state, it is not surprising that the DEP staff considers the lower Presumpscot as the worst stretch river in the state, when considering TSS impacts. As a result, designated uses of fishing and swimming are clearly impaired due to poor aesthetic conditions on 6.5 miles of the lower Presumpscot River.

Macroinvertebrate data collected by Maine DEP in 1995 and 1996 below the mill outfall has revealed the lower Presumpscot does not attain class C aquatic life standards. However macroinvertebrate data taken about 1500 feet above the mill outfall in 1996 and preliminary data taken above the mill outfall in both the Gambo and Little Falls impoundments in 1997 indicate attainment of class C aquatic life standards. Since no toxic problems were apparent and dissolved oxygen levels were adequate in these years, it is presumed that the TSS discharged from SDW is the cause of the non attainment of aquatic life standards and reductions in TSS are necessary.

The assumption that reduced TSS levels will result in a positive community response of macroinvertebrates is supported by work undertaken by the DEP and International Paper Co. on the Androscoggin River. Below IP's discharge, aquatic life standards were similarly not met in impoundments below their discharge in 1995, a low flow year. In 1996 increased dilution of IP's discharge was gained from a wetter summer than normal and in addition, the mill experimented with polymer addition that resulted in significant TSS reductions. The river below the mill responded positively to this, and attainment of aquatic life standards resulted that summer.

S D Warren has recently made improvements to their treatment to address the TSS issue on the Presumpscot River. Action item #5 of the licensing work plan required SDW to submit a copy of their final secondary clarifier study and a proposal for TSS limits as a result of improvements to their treatment. S D Warren proposed a 15% cut in discharge from their past demonstrated performance (PDP). Action item #9 of the licensing work plan required DEP staff to determine whether or not the reduction of TSS proposed by SDW would be adequate to meet aquatic life standards below the mill discharge. The DEP staff determined that the 15% reduction would not be adequate and reductions of 45% from PDP or more would be necessary. The reasons for this determination are explained below.

While it is difficult to determine appropriate TSS limits based upon aesthetics, a methodology has been developed to determine limits based upon aquatic life considerations. It is assumed that the required TSS reductions to meet aquatic life standards will also result in improved aesthetic conditions and an overall attainment of standards. This methodology uses aquatic life assessment analysis (attainment / non attainment); river flow during macroinvertebrate colonization period (when rock baskets were in the river), and mill discharge of TSS during colonization period. For example in 1995 when SDW was discharging 7454 lb/day of TSS and river flow conditions were 25% higher than 10 year low flow conditions, aquatic life data showed non attainment of standards. Hence it can be concluded that limits would definitely have to be lower than 7454 lb/day. Since IP discharges to similar habitat as SDW, the Androscoggin River data was also used in this analysis. In summary, the methodology is as follows:

Input Data
1. Macroinvertebrate Data - The DEP methodology involves colonization of rock baskets for a minimum of 28 days but for up to two months in impoundments. The data is input into a statistical model developed by DEP that utilizes information gathered at over 400 sites throughout Maine. The model outputs attainment / non attainment status.

2. River Flow - This is generally averaged over a 3 month period including a month before the rock baskets are put into the river. Note that a floc from TSS can develop in the river even before the rock baskets are deposited, hence inclusion of the period before placement of the rock baskets. If the period before placement of the rock baskets was an extremely high flow period, such as July of 1996, it should be excluded, since significant TSS settling should not occur during high flows.

3. Mill TSS Mass Effluent Load - Averaged over the same time period as river flow data.

Calculation Procedure
1. Convert mill TSS discharge to 10 year low flow conditions by multiplying by ratio of 30Q10 / actual river flow. This calculates what the mill discharge would have to be at 10 year low flow conditions to get equivalent ambient TSS in the months from which the macroinvertebrate data was collected.

2. If other river data is used, convert other mill data to SDW standard. Multiply equivalent 30Q10 load (result in #1) by SDW 30 Q10 dilution/other mill dilution. This prorates other mill TSS loads to SDW data based upon dilution. In other words, what SDW would have to discharge to get similar TSS levels that were experienced on the other river at 10 year low flow conditions.

3. Plot up loads with non attainment / attainment information. Observe loads that resulted in non attainment and loads that resulted in attainment. A range of possible loads can be deduced that could result in attainment of standards.

The table below summarizes the calculations.

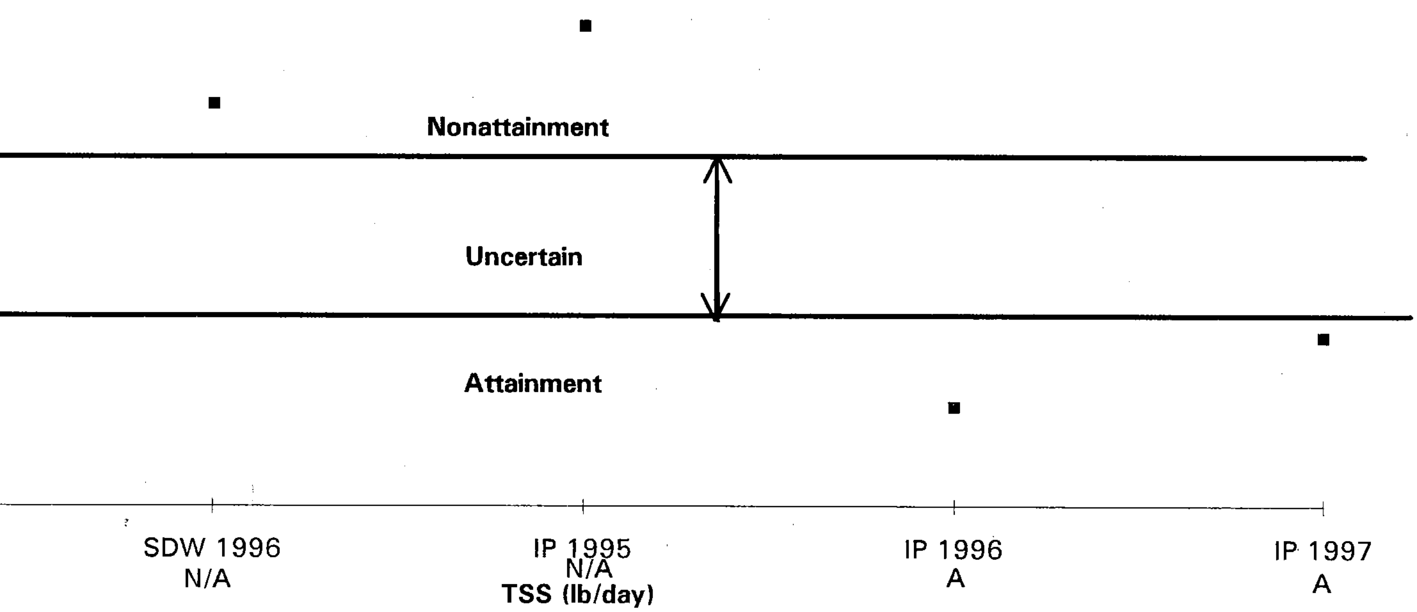
Table 3 Summary of TSS TMDL Calculations

	SDW 1995	SDW 1996	IP 1995	IP 1996	IP 1997
Aquatic Life Status	N/A	N/A	N/A	A	A
Months	June-Aug	Aug-Sept	June-Aug	Aug-Sept	June-Aug
Flow (cfs)	418	463	2114	2982	4116
30Q10 Flow (cfs)	330	330	1900	1900	1900
30Q10 Dilution (cfs)	10.1	10.1	24.0	24.0	24.0
TSS Discharged (lb/day)	7454	8795	19804	5750	13495
TSS Prorated 30Q10 (lb/day)	5885	6269	17800	3663	6229
TSS Prorated SDW (lb/day)	5885	6269	7491	1542	2621

A more detailed explanation of these calculations is contained in the appendix of this report. When this is plotted with attainment / non attainment lines, it can be deduced that the required TSS load would have to be somewhere in-between 2700 and 5900 lb/day (figure 13). If the range of uncertainty is split midway, a required TSS load of 4300 lb/day results. Another possible approach in a phased TMDL would be starting near the top of this range of uncertainty with annual ambient monitoring of macroinvertebrates to confirm attainment status. If non attainment of aquatic life standards still results, then TSS loads are further reduced, until attainment is confirmed. Since there is much uncertainty associated with the TSS allocation, the phased approach was chosen as the alternative.

This approach to calculating required TSS reductions has been the only major issue in the draft waste discharge license that S D Warren has objected to. Both the mill personnel and consultants for SDW have pointed out that other factors such as habitat, river velocities and depth, and background conditions also influence aquatic life status. The DEP generally agree that these other conditions do influence aquatic life status, but disagree that this methodology is inappropriate. Note that this methodology

Figure 13
TSS TMDL
Paper Mill Loads Prorated to Presumpscot River 30Q10 and SDW Dilution



macroinvertebrate sampling to confirm attainment. If ambient monitoring results in non attainment, further reductions in TSS should be implemented annually until attainment results. A study plan for the macroinvertebrate monitoring should be submitted by SDW for DEP approval to assure DEP methods and protocol are followed. Recognizing that TSS limits this low may not be necessary during colder weather when biological metabolism is also lower, it is recommended that limits for nonsummer Oct 1 to April 30) be based upon past demonstrated performance of 9950 lb/day and 22850 lb/day for a monthly average and daily maximum, respectively.

Smelt Hill Dam hydropower operation was severely damaged in the flood of October, 1996, to the extent that it is no longer operational. The owners of the dam, Central Maine Power, have no plans to refurbish this; in fact, they have been actively trying to sell the dam. SDW has been considering the purchase of this dam and its eventual removal. This would change the riverine impoundment below the mill to free flowing habitat with occasional riffles. If the dam is removed, or the impoundment is permanently drawn down to free flowing conditions, the DEP staff believes that the Presumpscot River would be able to withstand a much higher TSS load. With a free flowing habitat, initial summer TSS allocations could be set at 85% of past demonstrated performance in the summer period which would result in limits of 8460 and 19400 lb/day for a monthly average and daily maximum, respectively. There would still be annual monitoring requirements of macroinvertebrates to confirm attainment status.

Thermal Load and Mixing Zone

Temperature regulations require that no thermal discharge should raise the temperature of the receiving water by more than 0.5 ^{O}F outside of a mixing zone, whenever the USEPA national ambient water quality criteria (66 ^{O}F for the Presumpscot) are exceeded. A temperature of 66 ^{O}F is exceeded for a majority of the summer on the Presumpscot. The 1995 Waste Load Allocation (Nov 1995) documented that the SDW discharge cannot meet this criteria and is often discharging 4 to 6 times the heat required to meet the 0.5 ^{O}F differential. Emergency legislation passed in June of 1995 required the DEP to develop facility-specific solutions by Jan 1, 1996 for dischargers unable to comply with the temperature rule. As a result, a mixing zone 6.5 miles in length (from SDW outfall to the Smelt Hill dam) was established to comply with this emergency legislation in a timely manner.

EPA has expressed concern over the size of this mixing zone (Steve Silva, USEPA, letter to Dave Courtemanch, MDEP, June 1996) and has asked whether or not indigenous species of fish can be supported within the mixing zone. There are also other state laws that must be satisfied such as the zone of passage law that requires not less than 3/4 of the cross sectional area be available for zone of passage. However proof that these and other criteria are not being impacted by heat is problematic due to the fact that already large impacts are realized from TSS discharges. Until TSS discharges are reduced, it is not worthwhile to undertake studies addressing heat impacts.

The DEP views the size of this mixing zone as temporary, only to comply with the emergency legislation. It is believed that the overall length of the mixing zone can be reduced greatly through ambient temperature monitoring. In the past, efforts to assess the length and severity of heat impact through ambient temperature monitoring utilized grab sampling at a number of locations. With grab sampling it is difficult to differentiate temperature increases due to ambient diurnal fluctuations from the mill discharge. It is concluded that continuous monitoring is a better way to assess heat impacts. For this reason, it is recommended that continuous temperature devices be placed in the river at a number of locations in the summer whenever ambient background temperatures exceed 66 ^{O}F. The placement of these devices should cover (but not necessarily be limited to) the following locations at mid depth.

•Two Background Locations - Mid channel - Possible locations could be above Cumberland Mills dam and bridge in mill yard.
•Point of complete mixing - Quarter points - about 3/4 mile below outfall (established by dye study)
•Riverton (route 302 bridge) - Quarter points
•At least 3 other sites at mid channel down river from Riverton.

The mixing zone should be re - evaluated during the next round of licensing and appropriately be reduced in size. It is possible that the TSS issue will be resolved by then also and other issues can be addressed in the next round of licensing.

Appendix A
Model Inputs and Verification Data
Flow Balance Spreadsheets

ns 30 Day Ave

.O. Diff = Model D.O. - Monitor D.O.

.O. Diff mg/l	Temp C	Temp F	Qwestb cfs	Qseb cfs	SDW BOD5 lb/day	SDW BOD5 mg/l	SDW Bu/B5	SDW CBODu mg/l	SDW NBODu mg/l	West BOD5 lb/day	West BOD5 mg/l	West CBODu mg/l	West NBODu mg/l
0.19	24.38	75.88	402	314	2120	14.12	5.00	65.81	4.80	223	15.73	15.65	43.18
0.14	24.55	76.19	410	331	2177	14.50	4.90	66.23	4.83	209	14.74	14.67	40.47
0.11	24.72	76.50	447	347	2245	14.95	4.80	66.90	4.88	205	14.46	14.38	39.69
-0.15	24.61	76.30	455	363	2159	14.38	4.90	65.68	4.79	190	13.40	13.33	36.79
-0.26	24.78	76.60	447	370	2165	14.42	4.90	65.86	4.81	171	12.06	12.00	33.11
-0.2	25	77.00	430	373	2571	17.13	4.70	75.02	5.47	137	9.66	9.61	26.53
-0.13	24.24	75.63	382	371	3221	21.46	4.30	85.99	6.27	146	10.30	10.24	28.27
0.19	23.64	74.55	365	359	3513	23.40	4.10	89.42	6.52	153	10.79	10.74	29.62
0.17	22.12	71.82	335	335	3692	24.59	4.10	93.98	6.86	156	11.00	10.95	30.20
0.21	20.62	69.12	315	308	3670	24.45	4.10	93.42	6.82	183	12.91	12.84	35.43
0.08	19.5	67.10	300	285	3443	22.93	4.20	89.78	6.55	200	14.11	14.03	38.72
0.032													
0.158													

Hdwtr	Little	Incr1	Mill	Piscat	Incr2	inc1/ce	inc2/ce
354	32	16.2	8.4	26.5	6.5	0.193	0.095
366	29	14.5	7.6	23.8	5.8	0.173	0.085
392	37	18.4	9.6	30.1	7.4	0.219	0.108
404	34	16.9	8.8	27.7	6.8	0.202	0.099
405	28	14.2	7.4	23.2	5.7	0.169	0.083
399	21	10.5	5.4	17.2	4.2	0.125	0.062
376	4	2.0	1.1	3.3	0.8	0.024	0.012
362	2	1.1	0.6	1.8	0.4	0.013	0.006
335	0	0.0	0.0	0.0	0.0	0.000	0.000
311	3	1.3	0.7	2.1	0.5	0.015	0.008
292	6	2.8	1.4	4.5	1.1	0.033	0.016

Flow Balance Variables

Q westb=Presumpscot River flow at westrook USGS gage

Qseb=Presumpscot River flow at Sebago Lake gage

Hdwtr=Flow at model upstream boundary (Gambo Rd)

Little=Little River input

Incr1=Input from incremental drainage between Sebago and Westbrook gages excluding Little R drainage

Mill=Mill River input

Piscat=Piscataqua River Input

Incr2=Input from incremental drainage below Westbrook gage excluding Mill and Piscataqua R

Inc1/ce=Incr1 input per model computational element

Inc2/ce=Incr2 input per model computational element

1995 **Model Runs 7 Day Ave**

D.O. Diff = Model D.O. - Monitor D.O.

Date 1995	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l	Temp C	Temp F	Qwestb cfs	Qseb	SDW BOD5 lb/day	SDW BOD5 mg/l	SDW Bu/B5	SDW CBODu mg/l	SDW NBODu mg/l	West BOD5 lb/day	West BOD5 mg/l	West CBODu mg/l	West NBODu mg/l
11-Jul	6.37	6.56	0.19	25.24	77.43	363	313	2366	15.76	4.8	70.51	5.14	211	14.88	14.81	40.85
17-Jul	6.7	6.74	0.04	24.96	76.93	407	352	2701	17.99	4.6	77.14	5.63	190	13.40	13.33	36.79
6-Aug	7.37	6.87	-0.5	25.21	77.38	421	366	1564	10.42	5.6	54.38	3.97	125	8.82	8.77	24.20
20-Aug	6.34	6.6	0.26	25.81	78.46	416	383	2635	17.55	4.65	76.07	5.55	127	8.96	8.91	24.59
28-Aug	6.13	6.52	0.39	23.63	74.53	364	383	5440	36.24	3.5	118.21	8.62	139	9.80	9.75	26.91
4-Sep	7.21	7.12	-0.09	21.83	71.29	356	341	3320	22.12	4.2	86.57	6.32	147	10.37	10.31	28.46
22-Sep	7.26	7.44	0.18	18.63	65.53	286	268	3696	24.62	4.1	94.08	6.86	250	17.63	17.54	48.41
27-Sep	7.63	7.69	0.06	17.64	63.75	296	268	4007	26.69	4	99.51	7.26	262	18.48	18.38	50.73
		Ave	0.066													
		Ave Dev	0.189													

Flow Balance (cfs)

Note: On dates when Qwest < Qseb; all flow losses are withdrawn incrementally and trib flows = 0

Date	Qwest	Qseb	Hdwtr	Little	Incr1	Mill	Piscat	Incr2	inc1/ce	inc2/ce
11-Jul	363	313	335	18	9.2	4.8	15.1	3.7	0.110	0.054
17-Jul	407	352	377	20	10.1	5.3	16.6	4.0	0.120	0.059
25-Jul	445	369	403	28	14.0	7.3	22.9	5.6	0.166	0.082
6-Aug	421	366	391	20	10.1	5.3	16.6	4.0	0.120	0.059
14-Aug	367	368	368	0	-1.0	0.0	0.0	-0.5	-0.012	-0.007
20-Aug	416	383	398	12	6.1	3.2	9.9	2.4	0.072	0.036
28-Aug	364	383	374	0	-10.0	0.0	0.0	-8.9	-0.119	-0.131
4-Sep	356	341	348	6	2.8	1.4	4.5	1.1	0.033	0.016
11-Sep	297	307	303	0	-6.0	0.0	0.0	-4.7	-0.071	-0.069
22-Sep	286	268	276	7	3.3	1.7	5.4	1.3	0.039	0.019
27-Sep	296	268	281	10	5.2	2.7	8.4	2.1	0.061	0.030

Flow Balance Variables

Q westb=Presumpscot River flow at westrook USGS gage
Qseb=Presumpscot River flow at Sebago Lake gage
Hdwtr=Flow at model upstream boundary (Gambo Rd)
Little=Little River input
Incr1=Input from incremental drainage between Sebago and Westbrook gages excluding Little R drainage
Mill=Mill River input
Piscat=Piscataqua River Input
Incr2=Input from incremental drainage below Westbrook gage excluding Mill and Piscataqua R
Inc1/ce=Incr1 input per model computational element
Inc2/ce=Incr2 input per model computational element

1995 **Model Runs 2 Day Ave**

D.O. Diff = Model D.O. - Monitor D.O.

Date 1995	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l	Temp C	Temp F	Qwestb cfs	Qseb	SDW BOD5 lb/day	SDW BOD5 mg/l	SDW Bu/B5	SDW CBODu mg/l	SDW NBODu mg/l	West BOD5 lb/day	West BOD5 mg/l	West CBODu mg/l	West NBODu mg/l
8-Jul	6.2	6.41	0.21	25.75	78.35	347	297	2327	15.50	4.8	69.34	5.06	175	12.34	12.28	33.88
17-Jul	6.25	6.58	0.33	25.8	78.44	411	352	2620	17.45	4.6	74.82	5.46	329	23.20	23.09	63.70
26-Jul	6.8	6.76	-0.04	25.05	77.09	416	369	2398	15.97	4.8	71.46	5.21	283	19.96	19.86	54.79
3-Aug	7.1	6.72	-0.38	25.95	78.71	403	366	1372	9.14	5.7	48.55	3.54	73	5.15	5.12	14.13
15-Aug	6.3	6.56	0.26	25.75	78.35	405	383	2968	19.77	4.2	77.39	5.65	164	11.57	11.51	31.75
24-Aug	6.65	6.38	-0.27	24.3	75.74	364	383	5359	35.70	3.5	116.45	8.50	159	11.21	11.16	30.79
25-Aug	6.2	6.34	0.14	23.95	75.11	366	383	7269	48.42	3	135.39	9.88	78	5.50	5.47	15.10
5-Sep	7.1	6.87	-0.23	21.65	70.97	316	338	3953	26.33	4	98.17	7.16	50	3.53	3.51	9.68
16-Sep	7.15	7.12	-0.03	20.1	68.18	285	268	3422	22.80	4.2	89.23	6.51	219	15.45	15.37	42.40
26-Sep	8	7.92	-0.08	17.1	62.78	306	268	3720	24.78	4.1	94.69	6.91	231	16.29	16.21	44.73
		Ave	-0.009													
		Ave Dev	0.195													

Flow Balance (cfs)

Note: On dates when Qwest < Qseb; all flow losses are withdrawn incrementally and trib flows = 0

Date	Qwest	Qseb	Hdwtr	Little	Incr1	Mill	Piscat	Incr2	inc1/ce	inc2/ce
8-Jul	347	297	319	18	9.2	4.8	15.1	3.7	0.110	0.054
17-Jul	411	352	378	22	10.9	5.6	17.8	4.3	0.129	0.064
26-Jul	416	369	390	17	8.6	4.5	14.2	3.5	0.103	0.051
3-Aug	403	366	383	14	6.8	3.5	11.2	2.7	0.081	0.040
11-Aug	351	366	359	0	-8.3	0.0	0.0	-7.1	-0.098	-0.104
15-Aug	405	383	393	8	4.0	2.1	6.6	1.6	0.048	0.024
24-Aug	364	383	374	0	-10.5	0	0	-8.9	-0.125	-0.131
25-Aug	366	383	375	0	-9.4	0	0	-8.0	-0.112	-0.118
26-Aug	364	383	374	0	-10.5	0	0	-8.9	-0.125	-0.131
5-Sep	316	338	328	0	-12.1	0	0	-10.4	-0.144	-0.152
7-Sep	292	302	298	0	-5.5	0	0	-4.7	-0.066	-0.069
16-Sep	285	268	276	6	3.1	1.6	5.1	1.3	0.037	0.018
26-Sep	306	268	285	14	7.0	3.6	11.5	2.8	0.083	0.041

Flow Balance Variables

Q westb=Presumpscot River flow at westrook USGS gage
Qseb=Presumpscot River flow at Sebago Lake gage
Hdwtr=Flow at model upstream boundary (Gambo Rd)
Little=Little River input
Incr1=Input from incremental drainage between Sebago and Westbrook gages excluding Little R drainage
Mill=Mill River input
Piscat=Piscataqua River Input
Incr2=Input from incremental drainage below Westbrook gage excluding Mill and Piscataqua R
Incl/ce=Incr1 input per model computational element
Inc2/ce=Incr2 input per model computational element

Total D.O. Diff 1995 Data		
	Ave	0.027
	Ave Dev	0.185

Model Verification Runs with 1994 Data

D.O. Diff = Model D.O. - Monitor D.O.

Date 1994	Monitor D.O. mg/l	Model DO mg/l	D.O. Diff mg/l	Temp C	Temp F	Qwestb cfs	Qseb cfs	SDW BOD5 lb/day	SDW BOD5 mg/l	SDW Bu/B5	SDW CBODu mg/l	SDW NBODu mg/l	West BOD5 lb/day	West BOD5 mg/l	West CBODu mg/l	West NBODu mg/l
	Monthly															
31-Jul	7.05	6.91	-0.14	25.37	77.67	516	465	3386	22.56	4.2	88.29	6.44	128	9.03	8.98	24.78
13-Aug	6.63	6.7	0.07	25.63	78.13	475	430	4176	27.82	3.9	101.11	7.38	104	7.34	7.30	20.14
20-Aug	6.74	6.74	0	25.33	77.59	475	432	4260	28.38	3.9	103.15	7.53	106	7.48	7.44	20.52
30-Aug	6.84	6.91	0.07	24.11	75.40	442	399	3808	25.37	4.05	95.75	6.99	124	8.75	8.70	24.01
	Weekly															
24-Jul	6.99	6.57	-0.42	25.71	78.28	393	327	2915	19.42	4.2	76.01	5.55	111	7.83	7.79	21.49
7-Aug	6.86	6.89	0.03	26.07	78.93	638	599	6458	43.02	3.2	128.30	9.36	112	7.90	7.86	21.69
15-Aug	6.11	6.65	0.54	24.14	75.45	362	334	3457	23.03	4.2	90.14	6.58	111	7.83	7.79	21.49
31-Aug	7.13	7.11	-0.02	22.71	72.88	372	334	2482	16.53	4.7	72.42	5.28	139	9.80	9.75	26.91
	2 Day															
24-Jul	6.4	6.28	-0.12	27	80.60	392	327	3085	20.55	4.2	80.44	5.87	111	7.83	7.79	21.49
3-Aug	6.7	6.76	0.06	26.5	79.70	637	599	7960	53.02	2.9	143.31	10.46	58	4.09	4.07	11.23
14-Aug	6.35	6.65	0.3	24	75.20	360	334	3613	24.07	4.1	91.97	6.71	128	9.03	8.98	24.78
22-Aug	7.55	7.3	-0.25	22.5	72.50	406	334	2020	13.46	5	62.70	4.58	242	17.07	16.98	46.86
31-Aug	6.85	7.01	0.16	22.75	72.95	366	334	2826	18.82	4.6	80.71	5.89	151	10.65	10.60	29.24
		Ave	0.022													
		Ave Dev	0.166													

Flow Balance (cfs)	Date	Qwest	Qseb	Hdwtr	Little	Incr1	Mill	Piscat	Incr2	inc1/ce	inc2/ce
Monthly	31-Jul	516	465	488	19	9.4	4.9	15.4	3.8	0.112	0.055
	13-Aug	475	430	450	17	8.3	4.3	13.6	3.3	0.099	0.049
	20-Aug	475	432	451	16	7.9	4.1	13.0	3.2	0.094	0.046
	30-Aug	442	399	418	16	7.9	4.1	13.0	3.2	0.094	0.046
Weekly	24-Jul	393	327	357	24	12.1	6.3	19.9	4.9	0.145	0.071
	7-Aug	638	599	617	14	7.2	3.7	11.8	2.9	0.085	0.042
	15-Aug	362	334	347	10	5.2	2.7	8.4	2.1	0.061	0.030
	31-Aug	372	334	351	14	7.0	3.6	11.5	2.8	0.083	0.041
2 Day	24-Jul	392	327	356	24	12.0	6.2	19.6	4.8	0.142	0.070
	3-Aug	637	599	616	14	7.0	3.6	11.5	2.8	0.083	0.041
	14-Aug	360	334	346	10	4.8	2.5	7.8	1.9	0.057	0.028
	22-Aug	406	334	366	26	13.2	6.9	21.7	5.3	0.158	0.078
	31-Aug	366	334	348	12	5.9	3.1	9.6	2.4	0.070	0.035

Appendix B
Flow, Effluent, and Monitor Data in Spreadsheet Format

15-Jun	202	202			538				298			
16-Jun	83	143			617	578			298	298		
17-Jun		83			458	538			298	298		
18-Jun					399	429			298	298		
19-Jun	202	202			393	396			298	298		
20-Jun	246	224			418	406			298	298		
21-Jun	446	346	236		419	419	463		298	298	298	
22-Jun	202	324	236		427	423	447		298	298	298	
23-Jun	302	252	280		439	433	422		298	298	298	
24-Jun		302	280		377	408	410		298	298	298	
25-Jun			280		425	401	414		298	298	298	
26-Jun	375	375	314		405	415	416		298	298	298	
27-Jun	223	299	310		389	397	412		298	298	298	
28-Jun	102	163	241		397	393	408		298	298	298	
29-Jun	181	142	237		404	401	405		298	298	298	
30-Jun	211	196	218		410	407	401		298	298	298	
1-Jul		211	218		404	407	405		298	298	298	
2-Jul			218		428	416	405		297	298	298	
3-Jul	138	138	171		400	414	405		297	297	298	
4-Jul		138	158		378	389	403		297	297	298	
5-Jul	388	388	230		360	369	398		297	297	297	
6-Jul	111	250	212		348	354	390		297	297	297	
7-Jul	175	143	203		345	347	380		297	297	297	
8-Jul		175	203		348	347	372		297	297	297	
9-Jul			203		366	357	364		297	297	297	
10-Jul	259	259	233		378	372	360		352	325	305	
11-Jul	123	191	211		395	387	363		352	352	313	
12-Jul	227	175	179		402	399	369		352	352	321	
13-Jul	131	179	183		410	406	378		352	352	328	
14-Jul	138	135	176	213	408	409	387	410	352	352	336	307
15-Jul		138	176	213	409	409	395	405	352	352	344	309
16-Jul			176	220	409	409	402	398	352	352	352	310
17-Jul	329	329	190	225	413	411	407	397	352	352	352	312
18-Jul	166	248	198	223	569	491	431	402	352	352	352	314
19-Jul	113	140	175	218	559	564	454	408	369	361	354	316
20-Jul	397	255	229	226	461	510	461	409	369	369	357	319
21-Jul	231	314	247	215	452	457	467	411	369	369	359	321
22-Jul		231	247	216	436	444	471	411	369	369	362	323
23-Jul			247	211	394	415	469	409	369	369	364	326
24-Jul	293	293	240	216	390	392	466	410	369	369	367	328
25-Jul	83	188	223	209	420	405	445	410	369	369	369	331

Presumpscot River Data

30 Day Runs

7 Day Runs

2 Day Runs

1995	Westbrook BOD5(lb/day) Daily	2 day ave	7 day ave	30 day ave	River Flow @ Westbrook (cfs) Daily	2 day ave	7 day ave	30 day ave	River Flow @ Sebago (cfs) Daily	2 day ave	7 day ave	30 day ave
26-Jul	482	283	297	214	411	416	423	410	369	369	369	333
27-Jul	138	310	245	210	565	488	438	416	369	369	369	335
28-Jul	188	163	237	214	925	745	506	433	369	369	369	338
29-Jul		188	237	216	585	755	527	439	369	369	369	340
30-Jul			237	216	529	557	546	443	369	369	369	342
31-Jul	173	173	213	214	485	507	560	446	369	369	369	345
1-Aug	31	102	202	205	456	471	565	447	366	368	369	347
2-Aug	67	49	119	202	410	433	565	447	366	366	368	349
3-Aug	79	73	108	196	395	403	541	448	366	366	368	352
4-Aug	277	178	125	191	386	391	464	449	366	366	367	354
5-Aug		277	125	195	408	397	438	451	366	366	367	356
6-Aug			125	196	408	408	421	453	366	366	366	359
7-Aug	196	196	130	196	400	404	409	454	366	366	366	361
8-Aug	50	123	134	190	375	388	397	455	366	366	366	363
9-Aug	166	108	154	185	348	362	389	454	366	366	366	364
10-Aug	152	159	168	187	340	344	381	452	366	366	366	364
11-Aug	104	128	134	181	362	351	377	451	366	366	366	365
12-Aug		104	134	183	384	373	374	450	366	366	366	365
13-Aug			134	186	377	381	369	449	366	366	366	365
14-Aug	183	183	131	186	382	380	367	448	383	375	368	366
15-Aug	144	164	150	184	427	405	374	448	383	383	371	368
16-Aug	125	135	142	174	467	447	391	450	383	383	373	369
17-Aug	85	105	128	171	467	467	409	447	383	383	376	370
18-Aug	100	93	127	170	385	426	413	441	383	383	378	370
19-Aug		100	127	159	390	388	414	439	383	383	381	371
20-Aug			127	156	392	391	416	437	383	383	383	371
21-Aug	194	194	130	158	384	388	416	435	383	383	383	371
22-Aug	136	165	128	157	364	374	407	434	383	383	383	372
23-Aug	266	201	156	155	362	363	392	433	383	383	383	372
24-Aug	52	159	150	154	366	364	378	431	383	383	383	373
25-Aug	104	78	150	137	366	366	375	430	383	383	383	373
26-Aug		104	150	137	361	364	371	423	383	383	383	374
27-Aug			150	134	363	362	367	404	383	383	383	374
28-Aug	136	136	139	134	364	364	364	397	383	383	383	375
29-Aug	220	178	156	138	363	364	364	391	378	381	382	375
30-Aug	144	182	131	137	379	371	366	388	333	356	375	374
31-Aug	128	136	146	141	371	375	367	385	333	333	368	373
1-Sep	96	112	145	143	363	367	366	383	333	333	361	372
2-Sep		96	145	146	352	358	365	382	333	333	354	371
3-Sep			145	139	335	344	361	380	338	336	347	370
4-Sep			147	139	328	332	356	378	338	338	341	369

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

1995	Westbrook BOD5(lb/day)				River Flow @ Westbrook (cfs)				River Flow @ Sebago (cfs)			
	Daily	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave
5-Sep	50	50	105	135	304	316	347	374	338	338	335	368
6-Sep	370	210	161	143	294	299	335	371	302	320	331	366
7-Sep	119	245	159	146	290	292	324	368	302	302	326	363
8-Sep	305	212	211	153	306	298	316	366	302	302	322	361
9-Sep		305	211	153	295	301	307	365	302	302	317	359
10-Sep			211	156	297	296	302	363	302	302	312	357
11-Sep	177	177	204	157	294	296	297	360	302	302	307	355
12-Sep	119	148	218	155	302	298	297	357	302	302	302	353
13-Sep	96	108	163	151	302	302	298	354	302	302	302	350
14-Sep	42	69	148	146	300	301	299	350	268	285	297	346
15-Sep	219	131	131	150	290	295	297	344	268	268	292	342
16-Sep		219	131	154	279	285	295	338	268	268	287	339
17-Sep			131	156	294	287	294	335	268	268	283	335
18-Sep	289	289	153	163	289	292	294	332	268	268	278	331
19-Sep	213	251	172	165	287	288	292	328	268	268	273	327
20-Sep	165	189	186	164	289	288	290	325	268	268	268	323
21-Sep	173	169	212	166	286	288	288	322	268	268	268	319
22-Sep	409	291	250	173	276	281	286	320	268	268	268	316
23-Sep		409	250	179	295	286	288	317	268	268	268	312
24-Sep			250	183	314	305	291	315	268	268	268	308
25-Sep	252	252	242	186	309	312	294	314	268	268	268	304
26-Sep	209	231	242	187	302	306	296	312	268	268	268	300
27-Sep	266	238	262	193	289	296	296	309	268	268	268	296
28-Sep	201	234	267	192	286	288	296	307	231	250	263	292
29-Sep	220	211	230	196	287	287	297	304	231	231	257	288
30-Sep		220	230	200	279	283	295	300	231	231	252	285

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

	Dissolved oxygen (ppm)					Temp (C)				S D Warren BOD5 (lb/day)			
1995	Daily Ave	2 day ave	7 day ave	30 day ave	Ave-Min DO	Daily Ave	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave
15-Jun	8				0.4	18.7				2326			
16-Jun	8.8	8.40			0.4	18	18.35			1713	2020		
17-Jun	8.8	8.80			0.2	18.6	18.30			1815	1764		
18-Jun	8.3	8.55			0.4	19.9	19.25			1806	1811		
19-Jun	7.7	8.00			0.5	21.7	20.80			1642	1724		
20-Jun	7.2	7.45			0.4	23.3	22.50			2444	2043		
21-Jun	6.9	7.05	7.96		0.4	23.5	23.40	20.53		2227	2336	1996	
22-Jun	6.8	6.85	7.79		0.3	23.5	23.50	21.21		2024	2126	1953	
23-Jun	7	6.90	7.53		0.4	23.4	23.45	21.99		1625	1825	1940	
24-Jun	7.1	7.05	7.29		0.5	23.3	23.35	22.66		1487	1556	1894	
25-Jun	6.9	7.00	7.09		0.3	23.7	23.50	23.20		1379	1433	1833	
26-Jun	6.9	6.90	6.97		0.5	24.2	23.95	23.56		1080	1230	1752	
27-Jun	6.7	6.80	6.90		0.6	24.2	24.20	23.69		1634	1357	1637	
28-Jun	6.9	6.80	6.90		0.4	23.8	24.00	23.73		1425	1530	1522	
29-Jun	6.9	6.90	6.91		0.7	23.6	23.70	23.74		1649	1537	1468	
30-Jun	7	6.95	6.91		0.4	23.8	23.70	23.80		1961	1805	1516	
1-Jul	6.8	6.90	6.87		0.3	24.3	24.05	23.94		1973	1967	1586	
2-Jul	6.3	6.55	6.79		0.4	24.7	24.50	24.09		1917	1945	1663	
3-Jul	6.2	6.25	6.69		0.4	24.9	24.80	24.19		2163	2040	1817	
4-Jul	6.4	6.30	6.64		0.4	24.8	24.85	24.27		1825	1994	1845	
5-Jul	6.5	6.45	6.59		0.3	24.9	24.85	24.43		1785	1805	1896	
6-Jul	6.5	6.50	6.53		0.5	25.3	25.10	24.67		1828	1807	1922	
7-Jul	6.4	6.45	6.44		0.5	25.7	25.50	24.94		1843	1836	1905	
8-Jul	6	6.20	6.33		0.5	25.8	25.75	25.16		2810	2327	2024	
9-Jul	6.3	6.15	6.33		0.3	25.4	25.60	25.26		2615	2713	2124	
10-Jul	6.5	6.40	6.37		0.4	25.1	25.25	25.29		3408	3012	2302	
11-Jul	6.4	6.45	6.37		0.7	24.5	24.80	25.24		2271	2840	2366	
12-Jul	7.1	6.75	6.46		0.4	23.7	24.10	25.07		2971	2621	2535	
13-Jul	7.1	7.10	6.54		0.4	24.3	24.00	24.93		3435	3203	2765	
14-Jul	7.1	7.10	6.64	6.98	0.60	24.9	24.60	24.81	23.52	2435	2935	2849	2051
15-Jul	6.7	6.90	6.74	6.94	0.90	25.7	25.30	24.80	23.75	2554	2495	2813	2058
16-Jul	6.2	6.45	6.73	6.85	0.60	26	25.85	24.89	24.02	2321	2438	2771	2078
17-Jul	6.3	6.25	6.70	6.77	0.80	25.6	25.80	24.96	24.25	2919	2620	2701	2115
18-Jul	6.8	6.55	6.76	6.72	0.40	23.8	24.70	24.86	24.38	1947	2433	2655	2120
19-Jul	7.6	7.20	6.83	6.72	0.20	23	23.40	24.76	24.42	2009	1978	2517	2132
20-Jul	7.6	7.60	6.90	6.73	0.20	22.8	22.90	24.54	24.41	1810	1910	2285	2111
21-Jul	7.3	7.45	6.93	6.74	0.20	23.6	23.20	24.36	24.41	2621	2216	2312	2124
22-Jul	7.4	7.35	7.03	6.76	0.30	24.1	23.85	24.13	24.43	1709	2165	2191	2114
23-Jul	7.1	7.25	7.16	6.77	0.40	24.6	24.35	23.93	24.47	2093	1901	2158	2129
24-Jul	6.9	7.00	7.24	6.76	0.20	24.4	24.50	23.76	24.51	2300	2197	2070	2156
25-Jul	6.8	6.85	7.24	6.76	0.40	25	24.70	23.93	24.55	1996	2148	2077	2177

Presumpscot River Data

30 Day Runs

7 Day Runs

2 Day Runs

	Dissolved oxygen (ppm)					Temp (C)				S D Warren BOD5 (lb/day)			
1995	Daily Ave	2 day ave	7 day ave	30 day ave	Ave-Min DO	Daily Ave	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave
26-Jul	6.8	6.80	7.13	6.75	0.10	25.1	25.05	24.23	24.58	2800	2398	2190	2234
27-Jul	6.6	6.70	6.99	6.75	0.50	25.2	25.15	24.57	24.61	1615	2208	2162	2234
28-Jul	7.5	7.05	7.01	6.77	0.40	24.4	24.80	24.69	24.63	1611	1613	2018	2240
29-Jul	7.6	7.55	7.04	6.79	0.10	24	24.20	24.67	24.65	1921	1766	2048	2249
30-Jul	7.5	7.55	7.10	6.81	0.40	24.4	24.20	24.64	24.67	2678	2300	2132	2273
31-Jul	7.2	7.35	7.14	6.82	0.40	25.1	24.75	24.74	24.69	1613	2146	2033	2261
1-Aug	7.4	7.30	7.23	6.86	0.20	25.6	25.35	24.83	24.72	1444	1529	1955	2245
2-Aug	7.2	7.30	7.29	6.89	0.20	26.1	25.85	24.97	24.76	1546	1495	1775	2224
3-Aug	7	7.10	7.34	6.91	0.20	25.8	25.95	25.06	24.80	1197	1372	1716	2204
4-Aug	7.4	7.20	7.33	6.94	0.30	25.1	25.45	25.16	24.80	1457	1327	1694	2193
5-Aug	7.6	7.50	7.33	6.98	0.60	24.6	24.85	25.24	24.78	1989	1723	1703	2198
6-Aug	7.8	7.70	7.37	7.03	0.20	24.2	24.40	25.21	24.73	1705	1847	1564	2193
7-Aug	8.1	7.95	7.50	7.10	0.30	23.8	24.00	25.03	24.66	1750	1728	1584	2158
8-Aug	8.3	8.20	7.63	7.16	0.30	23.8	23.80	24.77	24.61	2646	2198	1756	2159
9-Aug	7.9	8.10	7.73	7.21	0.90	24.1	23.95	24.49	24.58	2558	2602	1900	2131
10-Aug	7.7	7.80	7.83	7.25	0.90	24.7	24.40	24.33	24.58	2301	2430	2058	2132
11-Aug	6.8	7.25	7.74	7.24	0.90	25.2	24.95	24.34	24.63	2800	2551	2250	2126
12-Aug	7	6.90	7.66	7.24	0.70	25.6	25.40	24.49	24.68	2386	2593	2307	2091
13-Aug	6.9	6.95	7.53	7.23	0.70	25.8	25.70	24.71	24.71	2498	2442	2420	2093
14-Aug	6.4	6.65	7.29	7.22	0.40	25.8	25.80	25.00	24.71	3220	2859	2630	2115
15-Aug	6.2	6.30	6.99	7.22	0.30	25.7	25.75	25.27	24.70	2716	2968	2640	2129
16-Aug	6.4	6.30	6.77	7.23	0.20	25.7	25.70	25.50	24.70	2882	2799	2686	2127
17-Aug	6.6	6.50	6.61	7.22	0.20	26.2	25.95	25.71	24.78	3070	2976	2796	2165
18-Aug	6.3	6.45	6.54	7.18	0.40	26.2	26.20	25.86	24.89	1852	2461	2661	2159
19-Aug	6	6.15	6.40	7.12	0.20	25.9	26.05	25.90	24.99	1890	1871	2590	2162
20-Aug	6.5	6.25	6.34	7.10	0.50	25.2	25.55	25.81	25.05	2817	2354	2635	2169
21-Aug	6.6	6.55	6.37	7.07	0.10	24.8	25.00	25.67	25.07	2016	2417	2463	2179
22-Aug	6.9	6.75	6.47	7.06	0.40	24.7	24.75	25.53	25.07	2445	2231	2425	2191
23-Aug	6.7	6.80	6.51	7.06	0.70	24.4	24.55	25.34	25.07	3976	3211	2581	2247
24-Aug	6.6	6.65	6.51	7.05	0.40	24.2	24.30	25.06	25.05	6702	5339	3100	2403
25-Aug	5.8	6.20	6.44	7.02	0.20	23.7	23.95	24.70	25.00	7835	7269	3954	2571
26-Aug	5.5	5.65	6.37	6.98	0.40	23.1	23.40	24.30	24.93	9382	8609	5025	2830
27-Aug	5.4	5.45	6.21	6.91	0.40	22.8	22.95	23.96	24.88	4358	6870	5245	2922
28-Aug	6	5.70	6.13	6.86	0.90	22.5	22.65	23.63	24.83	3382	3870	5440	2970
29-Aug	6.9	6.45	6.13	6.84	0.10	22.3	22.40	23.29	24.76	2478	2930	5445	2964
30-Aug	7.3	7.10	6.21	6.84	0.30	22.1	22.20	22.96	24.66	2811	2645	5278	3004
31-Aug	7.5	7.40	6.34	6.84	0.20	21.5	21.80	22.57	24.52	3850	3331	4871	3084
1-Sep	7.4	7.45	6.57	6.85	0.30	21.7	21.60	22.29	24.37	3304	3577	4224	3142
2-Sep	7.1	7.25	6.80	6.85	0.30	21.9	21.80	22.11	24.24	3550	3427	3390	3221
3-Sep	7.1	7.10	7.04	6.84	0.10	21.7	21.80	21.96	24.13	3441	3496	3259	3287
4-Sep	7.2	7.15	7.21	6.83	0.20	21.6	21.65	21.83	24.03	3804	3623	3320	3348

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

	Dissolved oxygen (ppm)				
1995	Daily Ave	2 day ave	7 day ave	30 day ave	Ave-Min DO
5-Sep	7	7.10	7.23	6.80	0.70
6-Sep	6.1	6.55	7.06	6.74	0.50
7-Sep	5.5	5.80	6.77	6.64	1.70
8-Sep	6.6	6.05	6.66	6.60	0.40
9-Sep	6.6	6.60	6.59	6.56	0.50
10-Sep	6.8	6.70	6.54	6.56	0.20
11-Sep	7	6.90	6.51	6.56	0.30
12-Sep	7.3	7.15	6.56	6.58	0.20
13-Sep	7.6	7.45	6.77	6.62	0.20
14-Sep	7.5	7.55	7.06	6.66	0.30
15-Sep	7.2	7.35	7.14	6.69	0.20
16-Sep	7.1	7.15	7.21	6.70	0.40
17-Sep	7.3	7.20	7.29	6.74	0.50
18-Sep	7.3	7.30	7.33	6.78	0.60
19-Sep	7.3	7.30	7.33	6.81	0.90
20-Sep	7.4	7.35	7.30	6.83	0.80
21-Sep	7.3	7.35	7.27	6.85	0.80
22-Sep	7.1	7.20	7.26	6.86	0.80
23-Sep	7.4	7.25	7.30	6.89	0.70
24-Sep	7.5	7.45	7.33	6.94	1.20
25-Sep	8	7.75	7.43	7.03	0.30
26-Sep	8	8.00	7.53	7.11	0.20
27-Sep	8.1	8.05	7.63	7.18	0.10
28-Sep	8.2	8.15	7.76	7.23	0.20
29-Sep	8.1	8.15	7.90	7.25	0.30
30-Sep	8.3	8.20	8.03	7.28	0.30
				Ave	0.43
				Ave < 1	0.39
				Median	0.40
				Mode	0.40

Temp (C)			
Daily Ave	2 day ave	7 day ave	30 day ave
21.7	21.65	21.74	23.95
21.9	21.80	21.71	23.88
21.9	21.90	21.77	23.82
22	21.95	21.81	23.75
21.5	21.75	21.76	23.64
20.9	21.20	21.64	23.50
20.4	20.65	21.47	23.33
19.9	20.15	21.21	23.13
19.8	19.85	20.91	22.93
20.2	20.00	20.67	22.75
20.4	20.30	20.44	22.57
19.8	20.10	20.20	22.36
19.2	19.50	19.96	22.12
19.1	19.15	19.77	21.90
18.5	18.80	19.57	21.67
18	18.25	19.31	21.45
17.8	17.90	18.97	21.22
18	17.90	18.63	21.00
18.4	18.20	18.43	20.81
18.1	18.25	18.27	20.62
17.2	17.65	18.00	20.43
17	17.10	17.79	20.23
17	17.00	17.64	20.05
16.8	16.90	17.50	19.87
16.5	16.65	17.29	19.68
16	16.25	16.94	19.50

S D Warren BOD5 (lb/day)			
Daily	2 day ave	7 day ave	30 day ave
4101	3953	3552	3427
3380	3741	3633	3482
3114	3247	3528	3497
2354	2734	3392	3491
2963	2659	3308	3513
3783	3373	3357	3545
2949	3366	3235	3564
3231	3090	3111	3589
3763	3497	3165	3607
2727	3245	3110	3607
3422	3075	3263	3625
3422	3422	3328	3637
3519	3471	3290	3692
3076	3298	3309	3732
3422	3249	3336	3752
3115	3269	3243	3789
4367	3741	3478	3853
4950	4659	3696	3885
4110	4530	3794	3799
3963	4037	3858	3870
4009	3986	3991	3491
3431	3720	3992	3460
3222	3327	4007	3454
2833	3028	3788	3466
2633	2733	3457	3460
3339	2986	3347	3443

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

	Dissolved oxygen (ppm)					Temp (C)				S D Warren BOD5 (lb/day)			
1994	Daily Ave	2 day ave	7 day ave	30 day ave	Ave-Min DO	Daily Ave	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave
1-Jul	7.8				0	23.5				3813	3813		
2-Jul	7.9	7.85			0.1	24	23.75			2784	3299		
3-Jul	7.7	7.8			0.1	25	24.5			2971	2878		
4-Jul	7.8	7.75			0.1	24.5	24.75			2128	2550		
5-Jul	7.9	7.85			0	24.5	24.5			2678	2403		
6-Jul	7.7	7.8			0.1	25	24.75			4719	3699		
7-Jul	7.6	7.65	7.77		0.1	25	25	24.50		5586	5153	3526	
8-Jul	7.5	7.55	7.73		0.2	25	25	24.71		4319	4953	3598	
9-Jul	7.6	7.55	7.69		0.2	24.5	24.75	24.79		3759	4039	3737	
10-Jul	7.6	7.6	7.67		0.2	24.5	24.5	24.71		2766	3263	3708	
11-Jul	7.6	7.6	7.64		0.5	24.5	24.5	24.71		2899	2833	3818	
12-Jul	7.1	7.35	7.53		0.9	25	24.75	24.79		2418	2659	3781	
13-Jul	6.7	6.9	7.39		0.9	25.5	25.25	24.86		2699	2559	3492	
14-Jul	6.5	6.6	7.23		0.7	25.5	25.5	24.93		2683	2691	3078	
15-Jul	5.6	6.05	6.96		2.4	25	25.25	24.93		2452	2568	2811	
16-Jul	4.6	5.1	6.53		1.2	25	25	25.00		2641	2547	2651	
17-Jul	6	5.3	6.30		2.1	25	25	25.07		1907	2274	2528	
18-Jul	7.2	6.6	6.24		0.3	24.5	24.75	25.07		2817	2362	2517	
19-Jul	7.3	7.25	6.27		0.2	24.5	24.5	25.00		2713	2765	2559	
20-Jul	7.2	7.25	6.34		0.2	25	24.75	24.93		2051	2382	2466	
21-Jul	7.3	7.25	6.46		0.4	25.5	25.25	24.93		3135	2593	2531	
22-Jul	7.1	7.2	6.67		0.7	26.5	26	25.14		3518	3327	2683	
23-Jul	6.5	6.8	6.94		0.8	27	26.75	25.43		3274	3396	2774	
24-Jul	6.3	6.4	6.99		0.6	27	27	25.71		2895	3085	2915	
25-Jul	6.5	6.4	6.89		0.7	27	27	26.07		2881	2888	2924	
26-Jul	6.7	6.6	6.80		0.5	26.5	26.75	26.36		3538	3210	3042	
27-Jul	7.3	7	6.81		0.4	27	26.75	26.64		4097	3818	3334	
28-Jul	7.2	7.25	6.80		0.2	26.5	26.75	26.79		4086	4092	3470	
29-Jul	6.9	7.05	6.77		0	26	26.25	26.71		5011	4549	3683	
30-Jul	7	6.95	6.84		0.1	26	26	26.57		5356	5184	3981	
31-Jul	7	7	6.94	7.05	0.1	26.5	26.25	26.50	25.37	6373	5865	4477	3386
1-Aug	6.9	6.95	7.00	7.03	0.3	26.5	26.5	26.43	25.47	7542	6958	5143	3506
2-Aug	6.6	6.75	6.99	6.98	0.2	26.5	26.5	26.43	25.55	8314	7928	5826	3685
3-Aug	6.8	6.7	6.91	6.95	0.3	26.5	26.5	26.36	25.60	7606	7960	6327	3834
4-Aug	6.7	6.75	6.84	6.92	0.3	26.5	26.5	26.36	25.66	6495	7051	6671	3975
5-Aug	6.6	6.65	6.80	6.88	0.8	26.5	26.5	26.43	25.73	5908	6202	6799	4079
6-Aug	7	6.8	6.80	6.85	0.5	25.5	26	26.36	25.74	4529	5219	6681	4073
7-Aug	7.4	7.2	6.86	6.85	0.8	24.5	25	26.07	25.73	4811	4670	6458	4048
8-Aug	7	7.2	6.87	6.83	1.5	24.5	24.5	25.79	25.71	4679	4745	6049	4060
9-Aug	5.8	6.4	6.76	6.77	0.9	24.5	24.5	25.50	25.71	3371	4025	5343	4047
10-Aug	5.6	5.7	6.59	6.71	1.4	24.5	24.5	25.21	25.71	3605	3488	4771	4074
11-Aug	6.3	5.95	6.53	6.67	0.2	24.5	24.5	24.93	25.71	3307	3456	4316	4087

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

	Dissolved oxygen (ppm)					Temp (C)				S D Warren BOD5 (lb/day)			
1994	Daily Ave	2 day ave	7 day ave	30 day ave	Ave-Min DO	Daily Ave	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave
12-Aug	6.3	6.3	6.49	6.64	0.3	24	24.25	24.57	25.68	3858	3583	4023	4134
13-Aug	6.4	6.35	6.40	6.63	0.2	24	24	24.36	25.63	4013	3936	3949	4176
14-Aug	6.3	6.35	6.24	6.63	0.1	24	24	24.29	25.58	3212	3613	3721	4193
15-Aug	6.1	6.2	6.11	6.64	0.3	23.5	23.75	24.14	25.53	2835	3024	3457	4206
16-Aug		6.1	6.17	6.71			23.5	24.08	25.55	3493	3164	3475	4233
17-Aug			6.28	6.73				24.00	25.57	2791	3142	3358	4262
18-Aug	7.2	7.2	6.46	6.73	0.2	22.5	22.5	23.60	25.50	2981	2886	3312	4267
19-Aug	7.2	7.2	6.64	6.73	0.2	22	22.25	23.20	25.41	2533	2757	3123	4261
20-Aug	7.6	7.4	6.88	6.74	0.3	22.5	22.25	22.90	25.33	2026	2280	2839	4260
21-Aug	7.6	7.6	7.14	6.76	0.1	22.5	22.5	22.60	25.22	1671	1849	2619	4213
22-Aug	7.5	7.55	7.42	6.77	0.2	22.5	22.5	22.40	25.09	2368	2020	2552	4176
23-Aug		7.5	7.42	6.78			22.5	22.40	25.02	2711	2540	2440	4158
24-Aug			7.42	6.80				22.40	24.94	2699	2705	2427	4152
25-Aug	7.5	7.5	7.48	6.83	0.6	22	22	22.30	24.76	2263	2481	2324	4132
26-Aug	7.5	7.5	7.54	6.86	0.3	22	22	22.30	24.59	2472	2368	2316	4097
27-Aug	7.2	7.35	7.46	6.86	0.2	23	22.5	22.40	24.44	2389	2431	2368	4042
28-Aug	7.1	7.15	7.36	6.86	0.4	23	23	22.50	24.31	2158	2274	2437	3980
29-Aug	6.9	7	7.24	6.86	0.2	23.5	23.25	22.70	24.22	2438	2298	2447	3897
30-Aug	6.7	6.8	7.15	6.84	0.6	23	23.25	22.75	24.11	2587	2513	2429	3808
31-Aug	7	6.85	7.13	6.84	0.5	22.5	22.75	22.71	23.96	3064	2826	2482	3701

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

	Westbrook BOD5(lb/day)				River Flow @ Westbrook (cfs)				River Flow @ Sebago (cfs)			
1994	Daily	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave	Daily	2 day ave	7 day ave	30 day ave
1-Jul					717				665	665		
2-Jul					715	716			665	665		
3-Jul					710	713			665	665		
4-Jul					706	708			665	665		
5-Jul	392	392			704	705			665	665		
6-Jul	158	275			704	704			665	665		
7-Jul	67	113	206		709	707	709		665	665	665	
8-Jul	75	71	173		711	710	708		665	665	665	
9-Jul		75	173		710	711	708		665	665	665	
10-Jul			173		373	542	660		327	496	617	
11-Jul	169	169	172		385	379	614		327	327	568	
12-Jul	244	207	143		386	386	568		327	327	520	
13-Jul	169	207	145		381	384	522		327	327	472	
14-Jul	41	105	140		359	370	472		327	327	424	
15-Jul	136	89	152		334	347	418		327	327	375	
16-Jul		136	152		359	347	368		327	327	327	
17-Jul			152		399	379	372		327	327	327	
18-Jul	209	209	160		397	398	374		327	327	327	
19-Jul	42	126	119		397	397	375		327	327	327	
20-Jul	204	123	126		394	396	377		327	327	327	
21-Jul	27	116	124		395	395	382		327	327	327	
22-Jul	73	50	111		387	391	390		327	327	327	
23-Jul		73	111		392	390	394		327	327	327	
24-Jul			111		392	392	393		327	327	327	
25-Jul	148	148	99		604	498	423		558	443	360	
26-Jul	42	95	99		542	573	444		497	528	384	
27-Jul	50	46	68		546	544	465		497	497	409	
28-Jul	146	98	92		549	548	487		497	497	433	
29-Jul	46	96	86		547	548	510		497	497	457	
30-Jul		46	86	128	547	547	532		497	497	481	
31-Jul			86	128	542	545	554	516	497	497	506	465
1-Aug	140	140	85	129	640	591	559	513	599	548	512	463
2-Aug	50	95	86	125	638	639	573	511	599	599	526	461
3-Aug	65	58	89	122	636	637	586	509	599	599	541	459
4-Aug	148	107	90	111	636	636	598	506	599	599	555	457
5-Aug	158	153	112	111	637	637	611	504	599	599	570	455
6-Aug		158	112	113	639	638	624	502	599	599	584	453
7-Aug			112	115	638	639	638	500	599	599	599	451
8-Aug	111	111	106	115	370	504	599	489	334	467	561	440
9-Aug	113	112	119	115	367	369	560	478	334	334	523	429
10-Aug	104	109	127	112	364	366	522	477	334	334	485	429
11-Aug	83	94	114	105	362	363	482	477	334	334	448	430

Presumpscot River Data

30 Day Runs
7 Day Runs
2 Day Runs

1994	Westbrook BOD5(lb/day) Daily	2 day ave	7 day ave	30 day ave	River Flow @ Westbrook (cfs) Daily	2 day ave	7 day ave	30 day ave	River Flow @ Sebago (cfs) Daily	2 day ave	7 day ave	30 day ave
12-Aug	85	84	99	101	360	361	443	476	334	334	410	430
13-Aug		85	99	104	359	360	403	475	334	334	372	430
14-Aug			99	102	361	360	363	475	334	334	334	430
15-Aug	171	171	111	105	362	362	362	476	334	334	334	431
16-Aug	154	163	119	108	362	362	361	476	334	334	334	431
17-Aug	102	128	119	103	361	362	361	475	334	334	334	431
18-Aug	113	108	125	106	373	367	363	474	334	334	334	431
19-Aug	133	123	135	103	425	399	372	475	334	334	334	431
20-Aug		133	135	106	403	414	378	475	334	334	334	432
21-Aug			135	108	388	396	382	475	334	334	334	432
22-Aug	242	242	149	114	423	406	391	476	334	334	334	432
23-Aug	150	196	148	116	419	421	399	477	334	334	334	432
24-Aug	58	104	139	112	392	406	403	477	334	334	334	433
25-Aug	128	93	142	116	381	387	404	470	334	334	334	425
26-Aug	100	114	136	118	376	379	397	465	334	334	334	420
27-Aug		100	136	117	374	375	393	459	334	334	334	415
28-Aug			136	120	371	373	391	453	334	334	334	410
29-Aug	163	163	120	122	369	370	383	448	334	334	334	404
30-Aug	150	157	120	124	367	368	376	442	334	334	334	399
31-Aug	152	151	139	124	364	366	372	436	334	334	334	394

Appendix C
SDW Relicensing Work Plan

1996 WORK PLAN FOR S.D. WARREN WASTE DISCHARGE LICENSE RENEWAL

SCHEDULE OF ACTION ITEMS

1) May 3, 1996 - The Department shall issue a draft Order for public comment regarding the establishment of a formal thermal mixing zone.

2) June 1, 1996 - The Department shall issue a final Order establishing a thermal mixing zone.

3) June 30, 1996 - SDW shall submit the results of the historical records search requested by the Department to determine what species and numbers of fish may have been or are now present in the segment of the Presumpscot River below the mill.

4) July 1, 1996 - S.D. Warren Company (SDW) shall submit a proposal for seasonal monthly average and daily maximum BOD_5 license limits based on a reduction in BOD_5 to the mill's waste water treatment facility.

5) July 30, 1996 - SDW shall submit a copy of the final secondary clarifier study which shall include a proposal for year-round monthly average and daily maximum license limits for TSS.

6) October 1, 1996 - The Department and SDW shall jointly develop a new temperature vs. minimum flow curve based on the new BOD_5 license limitations.

7) November 1, 1996 - SDW shall submit a copy of the 1996 macro-invertebrate study of the Presumpscot River conducted by SDW.

8) November 1, 1996 - The Department shall establish a minimum flow cap for the Presumpscot River under low lake level conditions as well as effluent license limits associated with the flow cap.

9) November 15, 1996 - The Department shall make a determination whether the proposed TSS limitations will improve conditions in the receiving waters to a point that, within the five year term of the license, Class C aquatic life standards will likely be met.

10) November 30, 1996 - The Department shall issue a draft waste discharge license for public comment.

11) December 31, 1996 - The Department shall issue a final waste discharge license document.

DRAFT

1996 WORK PLAN FOR S.D. WARREN
WASTE DISCHARGE LICENSE RENEWAL

SCHEDULE OF ACTION ITEMS

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Appendix D
Sebago Lake Management Plan

STATE OF MAINE

COMMENTS

August 16, 1996

Lois D. Cashell, Secretary
Federal Energy Regulatory Commission
Hydropower Licensing Office
Room 1A
888 First Street, N.E.
Washington, DC 20426

RE: SEBAGO LAKE WATER LEVELS
EEL WEIR HYDROELECTRIC PROJECT
FERC No. 2984-025

Dear Secretary Cashell:

The Maine Departments of Conservation, Environmental Protection, and Inland Fisheries and Wildlife are pleased to report that *an agreement has been reached by all parties* on a compromise water level management plan for Sebago Lake.

As we reported to you in our April 22, 1996 comment letter, the State had developed a compromise plan that had been accepted by a number of interested parties. This compromise plan was developed in response to FERC's March 1996 Draft Environmental Impact Statement (DEIS), which recommended as the preferred lake level management plan an alternative developed by the FERC staff. We also reported that we were continuing to consult with other parties to gain their support for the plan.

We have now completed our consultation. The result of this effort is that, at a meeting held on August 12, all parties present accepted a revised plan. A list of attendees and their affiliation is attached. The revised plan has been accepted by the Portland Water District and Friends of Sebago Lake, as well as by the parties that had accepted the earlier compromise plan (S.D. Warren, Sebago Lake Anglers Association, Sebago Lake Boating Club, Sebago Lake Landowners and Users Coalition, Sebago Lake Marinas Association, Maine Marine Trades Association, Maine State Bass Federation, and Frye Island Corporation). We have asked all parties to communicate their support for the revised plan directly to you.

Attached are a description and graph of the revised water level management plan, along with a revised statement of operating parameters for adusting flow releases from the lake. These documents show the revisions to the State's April 22 filing in an add and strike format.

The revisions to the April 22 plan and operating parameters have been made to address concerns expressed by several parties about the need to maintain the historic range of lake level fluctuations, to periodically reach a critical minimum level prior to ice-in, to maintain water quality, and to make the plan more workable. Most significant among these revisions is the requirement that water levels will be managed to achieve a target level of 261.0 ft (MSL) or lower in two out of every nine years sometime between November 1 and January 1. This requirement will approximate the historic 25th percentile low water level for the period and will encourage a return to historic rates of sand accretion at beaches around the lake.

We believe that the revised plan meets the five priorities we established in 1995 to guide our development of a water level plan that would strike an appropriate balance among the competing uses of the lake. First, the time that the lake is at or above spillway crest level should be limited to minimize shoreline erosion and water quality impacts from high water. Second, the lake should reach a critical minimum level in the fall, to allow for sand accretion at beaches and other shoreline areas as the lake rises in the winter and spring. Third, water levels should be managed prior to ice-out in the spring to limit the erosional effects of ice scouring of the shoreline. Fourth, water levels should be managed to maintain some useable beach areas during the summer and to maintain some water for recreational boating during the fall. And fifth, water quality should be maintained and protected in the lake and the downstream Presumpscot River.

We recommend that FERC adopt the revised compromise State water level plan in the Final EIS as the preferred management plan for Sebago Lake. We believe that this plan represents the best balance between the competing interests on the lake and is the only plan that will be deemed acceptable by all parties.

We also continue to recommend that a revised minimum flow release curve being developed by DEP be implemented to meet water quality standards in the lower Presumpscot River. Please review our April 22, 1996 comments for more information.

Finally, we believe that it is appropriate to monitor the long-term impacts of this management plan on the lake's resources and historic median water levels. However, we also understand that consultation and studies to support relicensing of the Eel Weir Project will begin shortly, and that it is important that any studies undertaken now be of value in the relicensing process.

Therefore, we intend to establish a steering committee to discuss and prioritize monitoring requirements and study needs with respect to the impacts of water level management on the quality and resources of Sebago Lake. The committee will be chaired by DEP and will include representatives from S.D. Warren and all other interested parties. We expect the committee to meet at least annually to review water level management and studies during the previous year and discuss future monitoring issues and plans. We plan to invite the FERC staff to participate in this effort.

We appreciate FERC's willingness to allow us the time that has been needed to bring the parties together on this important issue. Please direct any questions you have regarding these commments to Dana Murch of the DEP at 207-287-3901 or Bob Marvinney of the Maine Geological Survey at 207-287-2801.

Sincerely,

Edward O. Sullivan, Commissioner
Department of Environmental Protection

Ronald B. Lovaglio, Commissioner
Department of Conservation

Ray B. Owen, Jr., Commissioner
Department of Inland Fisheries & Wildlife

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Attachments

cc: FERC Review Coordinating Committee
Service List

SEBAGO LAKE WATER LEVEL MEETING

MONDAY, AUGUST 12, 1996

GOVERNOR'S CABINET ROOM
STATE HOUSE, AUGUSTA, MAINE

ATTENDANCE LIST

NAME	AFFILIATION
Ned Sullivan	Department of Environmental Protection
Ronald Lovaglio	Department of Conservation
Robert Marvinney	Maine Geological Survey (State Geologist)
Matt Scott	Department of Inland Fisheries & Wildlife
Phillippe Boissonneault	Portland Water District
Dana Perkins	Portland Water District
Vic Richards	Frye Island Corporation
Bob Smith	Sebago Lake Anglers Association
Charlie Frechette	Sebago Lake Marinas Association
Brooke Smith	Sebago Boating Club
Steve Nicoli	Sebago Lake Landowners & Users Coalition
Bob Calileo	Sebago Harmon Shores Association
Bob Hennick	Sebago Pines Property Owners Association
Jim Katsiaficas	Jensen Baird Gardner & Henry (counsel to Friends of Sebago Lake)
Steve Kasprzak	Friends of Sebago Lake
Barry Timson	Timson & Peters, Inc. (consultant to Friends of Sebago Lake)
Gerald Cole	Friends of Sebago Lake
Tom Howard	S.D. Warren
William Foley	S.D. Warren
Dana Murch	Department of Environmental Protection

c\attend

COMPROMISE STATE WATER LEVEL PLAN FOR SEBAGO LAKE

April 19, 1996
Revised August 12, 1996

*1 Whenever possible, the lake shall be managed during spring fill-up to reach a target level of 266.65 ft (spillway crest) no sooner than May 1 and no later than the second week in June. The allowable target range within this period is plus or minus 6 inches (267.15 ft - 266.05 ft).

*2 Lake levels shall be maintained at or above spillway crest for no longer than three weeks during any year.

*3 After spring fill-up, the lake shall be managed to achieve a target level of 265.17 ft (~1.5 feet below spillway crest) on August 1.

*4 Water levels above a line drawn from 266.65 ft on June 15 to 265.17 ft on August 1 shall trigger increased flows according to the State's proposed operating parameters to move the lake back within the target range.

*5 After August 1, water levels shall be managed to reach a target level on November 1 of 262.5 ft, plus or minus 6 inches, whenever possible. After August 1, water levels may remain at or below 265.17 ft so long as the lake is managed to reach the November 1 target ~~range~~ level.

*6 Lake levels below the target range between May 1 and November 1 shall trigger minimum flow according to the State's proposed operating parameters to move the lake back within the target range.

*7 After November 1, water levels will be managed to achieve a target level of 261.0 ft or lower in two out of every nine years sometime between November 1 and January 1. S.D. Warren will determine the years in which to manage for the 261.0 target level based on water levels and precipitation over the previous six months.

*8 During the mid-October to mid-November salmon spawning season, ~~normal operating flows will be passed~~ flows will be capped at 60,000 CFM (1000 CFS) unless the lake level is above the November 1 target range and is rising.

*9 Between November 1 and the following May 1, lake levels shall be managed as appropriate by S.D. Warren based on precipitation, snow pack, energy needs and other considerations, with the goal of reaching the spillway crest target level no sooner than May 1 and no later than the second week in June. Whenever possible, water levels shall be managed during this period to be no higher than a line drawn from 263.5 ft on January 1 to 266.65 ft on May 1.

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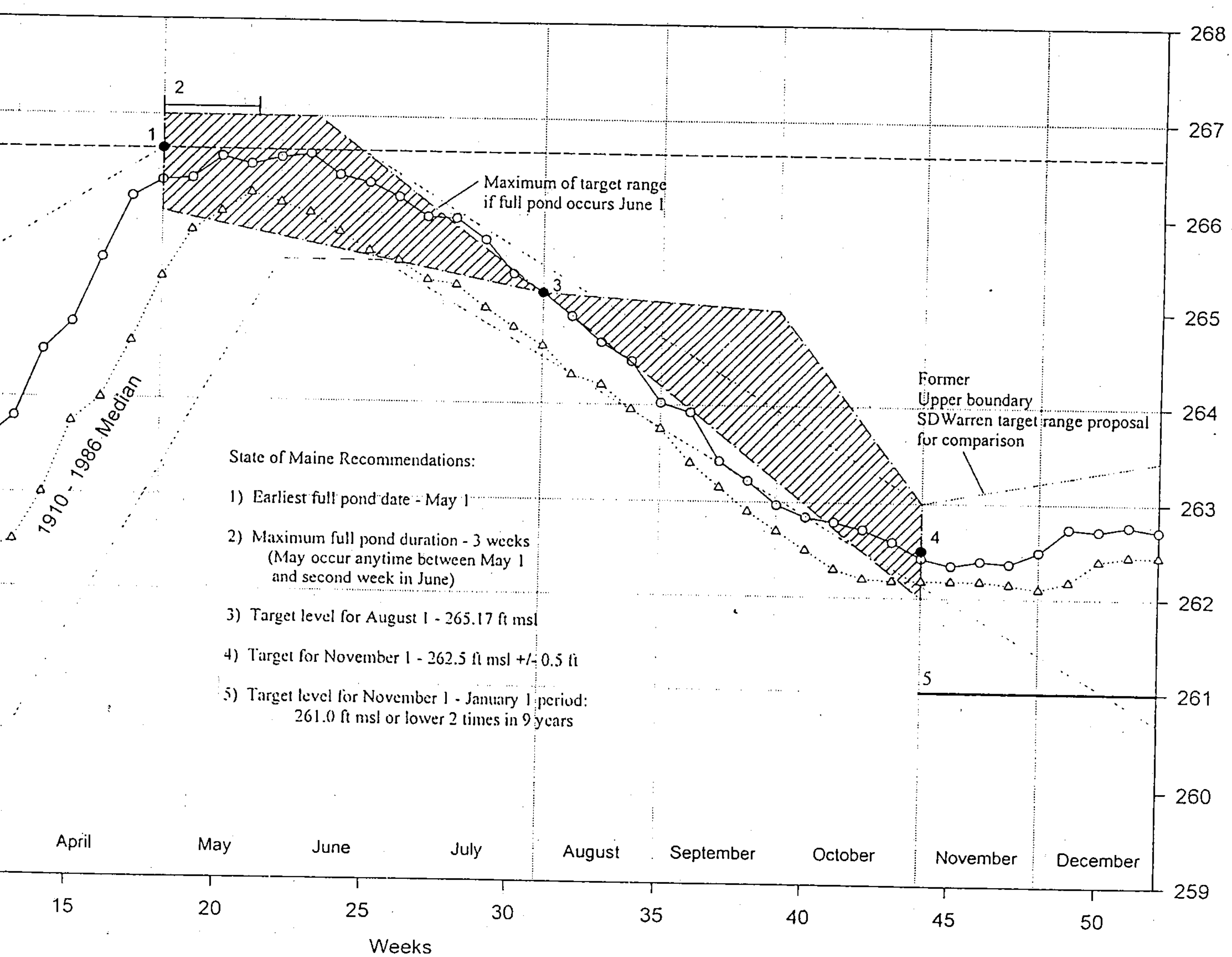
OPERATING PARAMETERS FOR
SEBAGO LAKE LEVEL MANAGEMENT PLAN
April 19, 1996
<u>Revised August 12, 1996</u>

NORMAL FLOWS:	When lake levels are within the target range between May 1 and November 1.
	Flows may vary between 20,000 CFM (333 CFS) and 50,000 CFM (833 CFS) and shall be adjusted to move the lake level toward the appropriate target level at all times.
ABNORMAL FLOWS:	When the lake levels are outside the target range between May 1 and November 1.
STAGE 1 FLOWS:	Flows shall be at the minimum (20,000 CFM) or maximum (50,000 CFM) <u>for at least one week</u> and the lake level shall be outside the target range prior to adjusting to Stage 1 flows, except that flows shall be increased as necessary to prevent water levels from reaching elevation 267.15 FT MSL (6 inches above spillway crest) or being above spillway crest (266.65 FT MSL) for more than three weeks during any year.
Minimum Flow:	The flow required to maintain mandatory water quality standards in the lower Presumpscot River, as determined by DEP.
Maximum Flow:	Up to 100,000 CFM (1667 CFS).
STAGE 2 FLOWS:	Stage 1 flows must be maintained for two weeks and the lake level is not moving toward the target range prior to adjusting to Stage 2 flows.
Minimum Flow:	Same as Stage 1 flows.
Maximum Flow:	Up to 150,000 CFM (2500 CFS).
STAGE 3 FLOWS:	Stage 2 flows must be maintained for two weeks and the lake level is not moving toward the target range prior to adjusting to Stage 3 flows.
Minimum Flow:	Same as Stage 1 flows.
Maximum Flow:	Up to 210,000 CFM (3500 CFS).

The flows stated in Stage 1 or 2 or 3 may be adjusted at any time that the lake level is moving toward the target range, but the lake level must continue to move toward the target range. <u>Flows may be temporarily adjusted outside the range of flows required above in the event of extreme meteorological events, equipment failure, approved maintenance activities, power supply emergencies, public safety considerations, or by order of local, state or federal authorities.</u>

c\parametr

go Lake Plan
ust 12, 1996



Power Systems Manager
S.D. Warren Company
PO Box 5000
Westbrook, ME 04092

RE: Sebago Lake Emergency Low Lake Level Conditions
Presumpscot River Minimum Flow Cap

Dear Tom:

This is a follow-up to the January 15 meeting at which DEP and Warren discussed various issues related to the renewal of the waste water discharge license for the Westbrook Mill.

At our meeting, we agreed that, for purposes of calculating dilution in the receiving water, the 7Q10 and 1Q10 flows in the river will be 300 cfs at Westbrook (270 cfs from Sebago Lake), and that the 30Q10 flow will be 330 cfs at Westbrook (300 cfs at the lake). We also agreed that the minimum flow cap would be 250 cfs at the lake.

We further agreed that, once emergency low lake level conditions no longer exist on the lake, the minimum flow cap will no longer be in effect, and it will take a minimum of 4 weeks of increased flow releases to again trigger the flow cap.

Finally, we agreed that the definition of emergency low lake level conditions and the requirement for a flow cap under these conditions need to be approved by FERC.

With the foregoing in mind, the DEP proposes the following revised definition of emergency low lake level conditions and requirement for a minimum flow cap (additions/changes from October 31, 1997 proposal are in italics):

In accordance with the approved Sebago Lake Water Level Management Plan (dated August 12, 1996), when lake levels are within the established target range between May 1 and November 1, flows from Sebago Lake shall be at least 333 cfs [20,000 cfm].

Further, in accordance with the approved Sebago Lake Water Level Management Plan, when lake levels are below the established target range between May 1 and November 1, flows from Sebago Lake shall be reduced to the minimum flow required to meet water quality standards in the lower Presumpscot River. Except where emergency low lake level conditions exist, as defined below, the minimum flow release from Sebago Lake shall be 270 cfs [16,200 cfm] or such higher flow as required by the DEP's Temperature Based Flow Regulation Curve to meet water quality standards.

For purposes of implementation of a cap on flow releases from Sebago Lake, "emergency low lake level conditions" shall exist when *(a)* the level of Sebago Lake is 1 foot or more below its allowable target range between May 1 and November 1 and *(b)* flow releases from Sebago Lake have been greater than *270 cfs [16,200 cfm]* for at least 4 *consecutive* weeks in order to maintain water quality in the river as required by DEP's *Temperature Based* Flow Regulation Curve.

When emergency low lake level conditions, as defined *above*, exist on Sebago Lake, flow releases from the lake shall be capped at *250 cfs [15,000 cfm]* for as long as these conditions exist. *When either of the prerequisites for emergency low lake levels ceases to exist, then the flow cap shall no longer be in effect, and shall not go back into effect until both prerequisities for emergency low lake level conditions again exist.*

When flow releases from Sebago Lake are capped at 250 cfs [15,000 cfm], effluent limits for the discharge of BOD_5 from Warren's Westbrook paper mill shall be reduced as a function of river temperature in accordance with the *Allowable BOD5 Discharge Curve contained in* the mill's waste discharge license.

The requirements for a minimum flow release cap under emergency low lake level conditions, as defined above, will take effect when approved by the Federal Energy Regulatory Commission.

A copy of the newly revised Temperature Based Flow Regulation Curve is enclosed. Please note that the flow regulation curve is really two curves, one of which establishes the instantaneous minimum flow needed to meet the instantaneous dissolved oxygen standard of 5.0 ppm, the other of which established the 30-day average minimum flow needed to meet the 30-day average DO standard of 6.5 ppm (these are really running 30-day averages), and that under these curves, the flow required to meet DO standards under full discharge conditions may be as high as 450 cfs.

A copy of the newly revised Allowable BOD5 Discharge Curve is also enclosed. Please note that, under the BOD5 discharge curve at the flow cap of 250 cfs, Warren's daily maximum BOD5 discharge does not become limited until the daily average temperature, as recorded at the Smelt Hill Dam, exceeds 23 degrees Celcius (73.4 degrees Fahrenheit), Further, please note that, while Warren's allowable BOD5 discharge declines to 3,900 lb/day at a river temperature of 26 degrees Celcius, Warren's BOD5 discharge must still be controlled to meet the required monthly average limit of 3,565 lb/day between June 1 and September 30.

We will be including our revised language on low lake level conditions and minimum flow cap in our public notice draft of Warren's waste discharge license renewal. Please let me know if you have any questions or suggestions for changes.

Sincerely,

Dana Paul Murch
Dams & Hydro Supervisor

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cc: Ray Pepin
Bill Taylor
Jim Fitch
Gregg Wood
Paul Mitnik
Stuart Rose
Mickey Kuhns

Appendix E
TSS Calculations

SDW 1995	SDW 1996	IP 1995	IP 1996	IP 1997	Calculations or Source
N/A	N/A	N/A	A	A	DEP Data + Model
June-Aug	Aug-Sept	June-Aug	Aug-Sept	June-Aug	
	402				USGS gage
	61				USGS Gage
418	463				USGS gage (in 1995); =#3+#4 (in 1996)
		1920	2715	3754	USGS gage
		2114	2982	4116	=#6+.35 x (#8 - #6)
		2474	3479	4789	USGS gage
330	330	1900	1900	1900	USGS gages (Andros) Assumption (Presump.)
10.1	10.1	24.0	24.0	24.0	=#9/mill flow
7454	8795	19804	5750	13495	Mill DMR's
5885	6269	17800	3663	6229	=#11 x (#9/#5) (Presump.) =#11 x (#9/#7) (Andros)
5885	6269	7491	1542	2621	=#12 (Presump) = #12 x (10.1/24) (Andros)

Correspondence 6/27/96
Silva to Courtemanch

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-0001

SAC

JUN 27 1996

David Courtemanch
Maine Department of Environmental Protection
State House Station 17
Augusta, Maine 04333-0017

Subject: EPA Review Comments on the Presumpscot River Waste Load Allocation Report

Dear Mr. Courtemanch:

EPA has completed its review of the Presumpscot River Waste Load Allocation Report dated November 1995 and the two related memorandums dated April 2 and 17, 1996 from Paul Mitnik to Dana Murch and Gregg Wood. The purpose of this letter is twofold 1) to convey our review comments on the Presumpscot River WLA Report and 2) to outline our Total Maximum Daily Load(TMDL) submission requirements as specified under Section 303(d) of the Clean Water Act.

With respect to the Presumpscot Study, we found the documents to be well prepared and informative and we commend MEDEP for the significant efforts put forth on this study. MEDEP has also actively involved the public in the study which we believe will be beneficial for developing a sound and comprehensive management plan that addresses important user issues and achieves water quality standards. We have reviewed these documents from the perspective of complying with the requirements of Section 303(d) of the Clean Water Act. As you know, Section 303(d) requires that each state develop a list of impaired waterbodies for which existing required pollution controls are not stringent enough to attain or maintain State water quality standards. For each listed water body the state is required to develop a TMDL or control plan that would, after implementation, result in the attainment of standards. The TMDL or control plan must be submitted to and approved by EPA.

The Presumpscot River WLA Report partially fulfills the requirements as a TMDL submission, however, in order for it to be approvable as a TMDL it must include additional information. Specifically, the TMDL must identify those specific actions that will be taken to meet water quality standards; in short a management plan. We understand that MEDEP is now developing the management plan for the Presumpscot River which will involve specific loading limitations for S.D. Warren and a flow release plan for the outlet of Sebago Lake. Once completed, this plan should be included in the final TMDL submission. Our specific comments on the study and additional points on TMDL submission requirements are presented below.

Comments/Questions:

- Dissolved oxygen violations in the upper Presumpscot River have been attributed to attached algae. The report does not recommend specific measures for attaining DO standards in the upper Presumpscot. It appears that insufficient information exists at this time to identify appropriate specific measures to correct the problem. If this is the case, a separate TMDL/control plan should be developed for this segment. Development of this TMDL can occur at a later date in accordance with MEDEP priorities.

- As noted in the report, impaired aquatic life standards exist below S.D. Warren. The final TMDL report should specify the necessary controls to remedy these violations below S.D. Warren. The violation of aquatic life standards is attributed to excessive deposition of solids from S. D. Warren's discharge. In this case, a TMDL should be set which specifies the daily allowable loading of solids to this segment of the river and the appropriate solids limit for S.D. Warren.

- S.D. Warren's discharges result in a temperature increase which exceeds standards. We understand that MEDEP has established a thermal mixing zone below S.D. Warren which extends 6.5 miles downstream to the Smelt Hill Dam. We are concerned with the size of the mixing zone as it represents approximately 25 % of the fresh water portion of the river. What impacts does the temperature increase have on aquatic life within the mixing zone? Can this segment of the Presumpscot River support all species of fish indigenous to the river?

- The report recommends using flow augmentation from Sebago Lake as a major mitigation measure for achieving DO standards. 40 CFR 125.3 states that flow augmentation may be considered as a method for achieving standards when the discharger has demonstrated that flow augmentation is the preferred environmental and economic method to achieve standards after consideration of other alternatives such as advanced treatment. Has S.D. Warren made such a demonstration?

- How much of an improvement in water quality will the BOD and TSS reductions required under the proposed cluster rule have below S.D. Warren? Will DO and aquatic life standards be attained?

- As proposed, the flow augmentation would be based on a flow vs. temperature curve developed to meet D.O. standards. The report states that flow augmentation would not be provided during extreme drought conditions when the water surface level in Sebago Lake falls below target levels. The final report needs to define extreme drought conditions and how frequently such conditions are expected to occur. The report will also need to indicate how standards will be met during those drought periods when flow augmentation is not occurring. Will S.D. Warren cease its discharge? Has a thorough water budget analysis based on historical flow data been conducted to determine the availability of water for flow augmentation during low flow conditions? For example, will flow augmentation be available during 7Q10 type conditions?

- The April 17, 1996 Memorandum from Paul Mitnik to Dana Murch and Gregg Wood presents a series of flow vs. temperature curves for various BOD loading levels from S.D. Warren. Is it MEDEP's intent to issue a "flow based" license that would allow S.D. Warren to augment flow according to their actual loadings? Such an approach will significantly increase the potential of exceeding criteria at an unacceptable frequency. If flow augmentation is viable and is determined to be the preferred environmental and economic method to attain standards, then it is EPA's position that flow augmentation must be based on design flows and loads. If S.D. Warren wishes to base the flow augmentation on their actual loading because it is significantly less than their current permitted loading, then their permitted and licensed loads should be reduced accordingly.

- Did the water quality model runs using 7Q10 flow conditions take into account the estimated temperature rise resulting from S.D. Warren's discharges?

We hope this letter clarifies our requirements for an approvable TMDL submission for the Presumpscot River. We appreciate the opportunity to review and comment on this report. If you should have any questions on our comments, please contact me at (617)565-4423 or Susan Beede at (617)565-3518 or Mark Voorhees at (617)565-4436.

Sincerely,

Stephen Silva, Manager
Maine State Office

cc: Dana Murch, MEDEP
Paul Mitnik, MEDEP
Gregg Wood, MEDEP
Raymond Peppin, S.D. Warren - Westbrook Division
[redacted]
David Cochrane, EPA
Roger Janson, EPA
Mark Voorhees, EPA

Maine State Office
USEPA, Region I
JFK Federal Building
Boston, Mass., 02203-0001

Re: Presumpscot River WLA/TMDL

Dear Mr Silva:

Thank you for your review and comments of both the Presumpscot River Waste Load Allocation (Mitnik, Nov 1995) and memorandums of April 2 and 17, 1996 (from Paul Mitnik to Dana Murch and Greg Wood). The memorandums discuss and summarize additional model runs that were undertaken this spring utilizing the 1995 summer data. The very low flow conditions that were encountered last summer served as useful information to test the model developed in the waste load allocation. The four parameter monitor located above the Smelt Hill dam at head of tide collects dissolved oxygen and temperature data continuously at the river's D.O. sag point. This data together with point source DMR and river flow data was used to further fine tune the model and improve the accuracy in its prediction of river dissolved oxygen levels. In general, the analysis undertaken on this data indicated that the model used in the waste load allocation development consistently predicted higher dissolved oxygen than what actually occurred at the monitor and hence the current TMDL was not protective enough of the river. As a result, 35 additional verification runs were undertaken with the appropriate adjustments made in the model.

This analysis goes above and beyond what is typically done for a waste load allocation and we believe it results in an very high quality model for the Presumpscot River. In the near future, a supplemental report will be written which discusses this analysis and the new flow vs temperature curves (FVT) that were derived for the Presumpscot River. The final management plan will be presented in this report. We also hope to include all of the necessary information that is necessary to fulfill the requirements that you outlined for an acceptable TMDL submission. As you are aware, S. D. Warren is currently engaged in a work plan of action items to be undertaken with the Department as part of their waste discharge renewal. It will be necessary for many of the action items to be completed before all of your concerns are completely addressed and a final TMDL can be submitted. In the interim, we can respond as follows to your comments and questions:

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826
OFFICE LOCATED AT: RAY BUILDING, HOSPITAL STREET

PORTLAND
312 CANCO ROAD
PORTLAND, ME 04103
(207) 822-6300 FAX: (207) 822-6303

BANGOR
106 HOGAN ROAD
BANGOR, ME 04401
(207) 941-4570 FAX: (207) 941-4584

PRESQUE ISLE
1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, ME 04769
(207) 764-0477 FAX: (207) 764-150

D.O. violations in the upper Presumpscot River - Develop TMDL - These were very minor, but still are justification for resticting any further BOD loading to the river. The supplemental report will probably recommend additional monitoring in the future to determine if the new management plan, ie. increased flows from Sebago Lake, solve the problem. If not, additional work may be warranted, but it is uncertain if any TMDL could be undertaken to improve water quality here. Considering that this is relatively pristine water from Sebago Lake, it was a big surprise that readings were this low here. We would want some additional information to determine the extent of the problem before we commit to a large time expenditure. It is possible that the Presumpscot River Watch, a volunteer monitoring group could agree do some of the monitoring.

Nonattainment of aquatic life standards - Develop TMDL for solids - Action items 5 and 9 of the work plan address this. It would be very difficult to develop a water quality based TMDL prior to these actions. Because the relationship between instream TSS and aquatic life response is not well established, both technical achievability and best professional judgement will be utilized to establish solids limits. After the waste discharge license is issued, aquatic life attainment / nonattainment will have to be revisited to verify original estimates and adjusted, if necessary. This may require several iterations and the need for "reopeners" in the license. This was acknowledged by all parties at our February 26 meeting.

6.5 Mile Thermal Mixing Zone - We are also concerned about the size of this mixing zone. High suspended solids, low dissolved oxygen, high color, and high river temperatures have collectively impaired the river below S.D. Warren's outfall. Action item 3 may confirm the presense or absense of indigenous fish species. The absense of indigenous species would not necessarily infer temperature impacts, since other water quality factors presently affect these populations. This issue may have to be revisited in the future.

40 CFR 125.3 Flow Augmentation Finding - No demonstration has yet been made that flow augmentation is the environmental and economic alternative. This is particularly important when one considers the sensitive issue of water levels at Sebago Lake in the drought years. Action item 4 in the work plan specifically requires S. D. Warren to propose lower licensed BOD limits than historical limits. We expect that S D Warren's proposal will be BOD numbers that are in line with advanced treatment, thus limiting the unnecessary waste of Sebago Lake water. It would be difficult to justify their current licensed limits which already allow for a large safety buffer for BOD (since actual performance records show that S D Warren is typically performing at 50% of their licensed load). Current licensed limits allow for an unnecessary wasting of water from Sebago Lake.

Proposed Cluster Rules Effect Upon Water Quality - This is a good point, but not relevant until the cluster rules are final. Keep in mind that the cluster rules cannot currently be used to develop a TMDL. This question could be answered in the future.

Flow Augmentation During Drought Conditions - Action Item 8 of the work plan indicates that the Department will establish a flow cap to be used during low water level conditions in Sebago Lake. Hence drought conditions will be specifically defined as a water elevation of the lake. Water levels that initiate the cap, the river minimum flow, and a TMDL under the flow cap will all be a part of the flow cap action item. We agree that a water budget should be undertaken to determine the availability of lake water. It is particularly important that the final FVT curves developed for the river are consistent with our goals for the lake. A water budget would give a good indication as to how often we can expect to be in the flow cap, and the achievability of the management plan.

Flow Augmentation Approach - The flow augmentation will be based upon licensed loads. Since the new licensed BOD numbers should be significantly lower than the current numbers, the April modeling effort generated a series of FVT curves at various BOD loads to be used as a management tool. For the final modeling effort, just one FVT curve will be used with a single BOD limit.

Did BOD Modeling Considered Temperature Effects? - Yes. The temperature on the lower Presumpscot was adjusted 1 °C higher than the upper Presumpscot. This was the average temperature increase in the river observed during the intensive surveys that also takes such factors as environmental cooling into effect.

If you have any further questions, they can be addressed to Paul Mitnik of my staff at 207-287-6093.

Sincerely,

David L. Courtemanch, PhD
Division of Environmental Assessment
Bureau of Land and Water Quality

cc: Martha Kirkpatrick, MEDEP
Dana Murch, MEDEP
Paul Mitnik, MEDEP
Greg Wood, MEDEP
Raymond Pepin, SDW
Susan Beede, EPA
David Cochrane, EPA
Roger Janson, EPA
Mark Voorhees, EPA

Emergency Temperature Legislation

APPROVED

JUN 26 '95

BY GOVERNOR

CHAPTER

312

PUBLIC LAW

STATE OF MAINE

IN THE YEAR OF OUR LORD
NINETEEN HUNDRED AND NINETY-FIVE

S.P. 328 - L.D. 909

An Act to Establish Temperature Limits for Certain Existing Discharges

Emergency preamble. Whereas, Acts of the Legislature do not become effective until 90 days after adjournment unless enacted as emergencies; and

Whereas, industrial dischargers may be affected by the application of an existing temperature rule in June 1995 with which, after application of best practicable treatment, they are unable to comply; and

Whereas, in the judgment of the Legislature, these facts create an emergency within the meaning of the Constitution of Maine and require the following legislation as immediately necessary for the preservation of the public peace, health and safety; now, therefore,

Be it enacted by the People of the State of Maine as follows:

Sec. 1. 38 MRSA §464, sub-§4, ¶I is enacted to read:

I. Temperature limits for certain facilities are governed by the following provisions.

(1) Dischargers licensed by the department prior to January 11, 1989 that raise the temperature of the receiving water more than 0.5°F when the receiving water temperature is above 66°F, as measured outside a mixing zone, and that have demonstrated to the satisfaction of the department that they are unable to

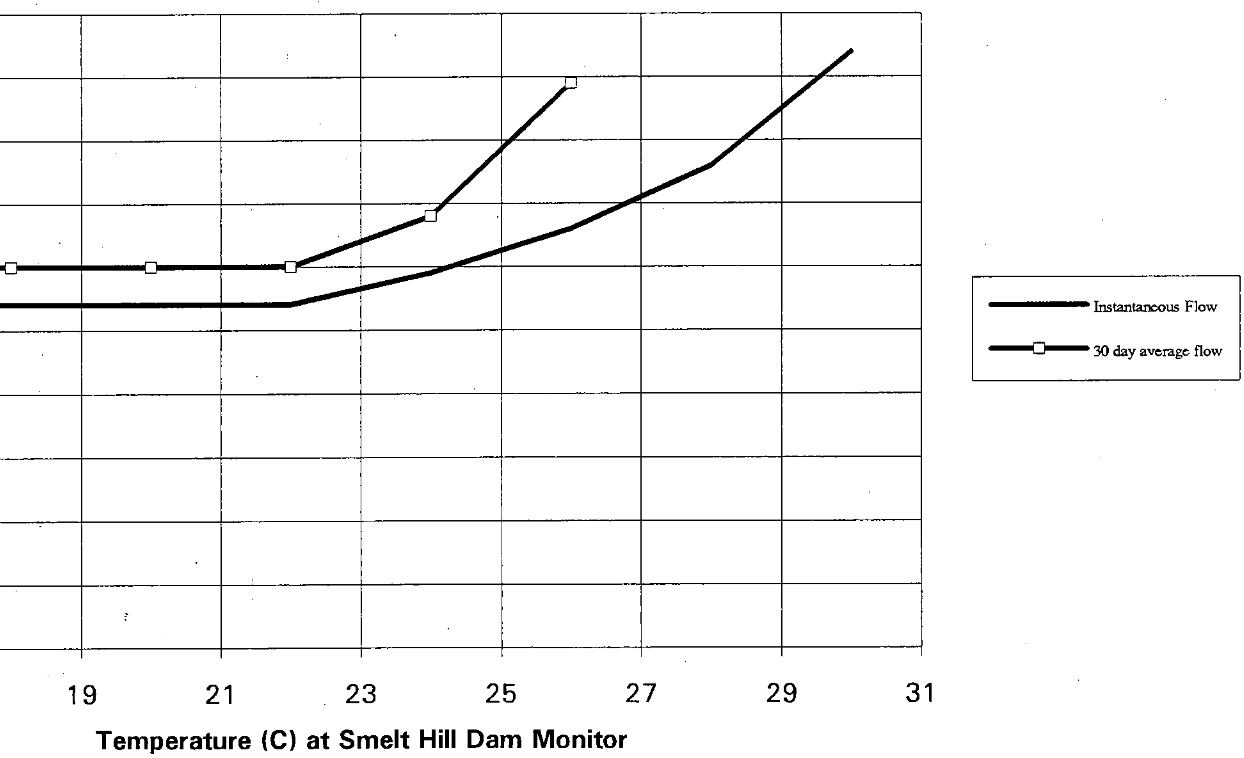
meet the standards in the existing temperature rule after application of best practicable treatment, are limited to discharging heat in an amount not exceeding the heat that has been discharged since January 11, 1989. The quantity of heat discharged during a 7-day period may not exceed the maximum heat discharged in any 7-day period between January 11, 1989 and January 11, 1995. The 7-day maximum quantity of heat discharged must be used to establish the interim license effluent limit that protects existing uses. The amount of heat discharged on any single day may not exceed 1.15 times the maximum 7-day average.

(2) The department shall develop, in consultation with the affected dischargers, facility-specific solutions and, no later than January 1, 1996, appropriate amendments to the license of the affected dischargers must be proposed. Until the facility-specific solutions are implemented, which in no case may be later than January 1, 1999, the criteria for temperature are the criteria established in subparagraph (1).

(3) This paragraph is repealed January 1, 1999.

Emergency clause. In view of the emergency cited in the preamble, this Act takes effect when approved.

Maine DEP
Final Temperature Based Flow Regulation Curve For Presumpscot River*



ODS of 6780 and 3565 lb/day, respectively for a daily maximum and monthly average. River design flows at Westbrook are 7q10 of 300 cfs and 30Q10 of 330 cfs, respectively.

n class C (5 ppm and 60% saturation) and SC (70% saturation) D.O. standards. The 30 day average flow curve results in compliance of the 30 day average D.O. standard (6.5 ppm).

and 30 day average river temperatures, respectively.

QVT Flow Example

1. *Step 1 - Check 30 day average required flow*

30 day average flow = 350 cfs

30 day average temperature = 23 ^{o}C

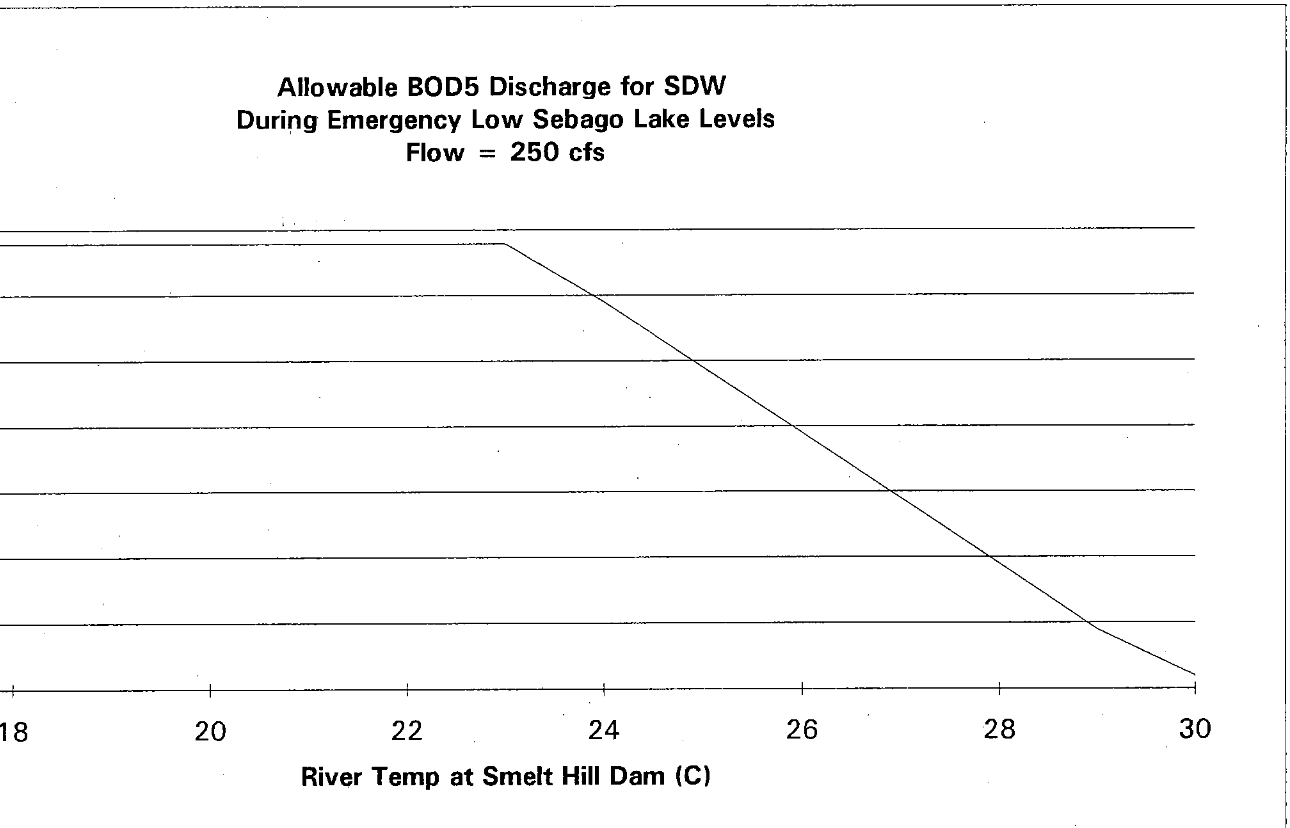
Solution - From QVT curve - Required flow = 320 cfs - 30 cfs buffer maintained

2. *Step 2 - Check daily average required flow*

An extended heat wave is forecast for the next three days. Mid day temp = 25 ^{o}C.

Solution - It is anticiated that temperature will reach 28 ^{o}C by mid week. Required flow from QVT curve = 380 cfs. From this analysis about 400 cfs should be passed which would still maintain a small buffer.

About 350 cfs would be required for the 30 day curve but 400 cfs is needed for daily requirements, so 400 cfs should be passed that week. Since flow in the river will probably not be adjusted daily, it is important to maintain some margin of safety (MOS) in the river for future uncertainty, ie changes in weather. An acceptable MOS could be rounding up required flows from the QVT curve to the nearest 50 cfs. Another possible MOS could be if flow from the intervening drainage from Sebago Lake to Westbrook greatly exceeds the 30 cfs that was used in the water quality modeling to derive the QVT curve. The Royal River gage could be used as a check to estimate flow from intervening drainage. If flow here greatly exceed the 30 cfs an adequate buffer would be maintained.



Temp(C)	SDW BOD5 (lb/day)
22	6780
23	6780
24	5900
25	4900
26	3900
27	2900
28	1900
29	900
30	200