APPENDIX E

LETTER - HUTCHINSON TO HEBERT, AUGUST 24, 1993

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August 24, 1993

Mr. Craig Hebert
Conestoga-Rovers & Associates
651 Colby Drive
Waterloo, Ontario
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Re: Haliburton STP - Trophic Status Modelling

Dear Craig:

Enclosed are the four tables which summarize my most recent modelling, which I undertook at your request. Each table gives results under each of the five treatment options you requested and these are presented as the modelled ice-free mean total phosphorus concentration in each lake (in $\mu g/L$) and the mass of phosphorus exported downstream from each lake (in kg).

To summarize - you requested six treatment options but we dropped Option 2 because discharge to the Drag River is equivalent to discharge to Grass Lake.

Case 1 The STP produces 1933 m^3/d (= 705,545 m^3/yr) at 0.2 $\mu g/L$ TP for a total loading of 141.1 kg/yr to Grass Lake.

Case 2 The existing STP discharges 1231 m^3/d (= 89.9 kg/yr) to Grass Lake and a new STP discharges 702 m^3/d (= 51.2 kg/yr) to North Kashagawigamog Lake.

Case 4 A new STP discharges 1933 m^3/d (= 141.1 kg/yr) to North Kashagawigamog Lake.

Case 5 A pipeline moves treated sewage (= 141.1 kg/yr) to the Burnt River, and there is no discharge to the Canning Lake chain.

Case 6 Wetland polishing improves effluent quality so that 70.5 kg/yr are discharged to Grass Lake.

The results you requested are given in Tables 1 and 2. Table 1 assumes no phosphorus is retained in shoreline septic fields. Although this overestimates present-day phosphorus concentrations, I feel it is the most accurate estimate of conditions 20-30 years hence, when the phosphorus from present-day development has migrated to the lake. I will refer you to my memo of October 17, 1992 for further details. Table 2 assumes 80% of the phosphorus has not yet reached the lake. Although this is an accurate reflection of present-day conditions, I feel that it significantly understates the long term cumulative impact of development.

Tables 1 and 2 present baseline conditions in which all vacant lots are developed, resorts remain at existing sizes and present-day servicing exists. These baselines correspond to Scenarios 1.2 (No P retention) and 3.2 (80% P retention) from the October 19, 1992 modelling results. I have also modelled a Case 0, which shows baseline conditions but with resort expansion. This shows the worst case scenario of continued growth and further deterioration.

Servicing conditions for each of your cases are taken from Table 6 of my October 19, 1992 modelling. In all cases resorts have expanded and the resorts on the north shore of North Kashagawigamog Lake are serviced. This removes 414 ERUs (= 551 units) from North Kashagawigamog Lake but leaves 184 unserviced units on the south shore.

My judgement is that the best scenario is to build the outfall into North Kashagawigamog Lake (Case 4). This produces significant benefits on Grass Lake and minor benefits on North Kashagawigamog Lake compared to current conditions and produces no change from an outfall location in Grass Lake. Cases 1-4 produce no differences on the downstream lakes.

Note that moving the outfall to the Burnt River produces minor benefits which I would call insignificant in light of the cost and the ethical dilemma of shipping Haliburton's waste downstream. The fact that the benefit is minor reflects the fact that high effluent quality and servicing of resorts produce benefits under all scenarios.

The wetland treatment does improve water quality but the margin is small and must be considered against emerging evidence that wetlands transform nutrients but do not retain them over the long term.

The construction of a sewer line along Hwy. 121, and the fact that there are 199 permanent and 133 seasonal homes along the north shore of North Kashagawigamog Lake plus 269 permanent and 77 seasonal homes on Grass and

Head Lakes, suggests that significant benefits may result from servicing these homes. I have therefore repeated the modelling for all cases but have serviced all residences on Grass and Head lakes, and all north shore residences and resorts. Tables 3 and 4 present these results and the significant improvements show the impact of servicing a total of 388 homes, 210 cottages and 551 resort units.

My modelling thus suggests that the discharge of 0.2 μg/L effluent to North Kashagawigamog Lake or 0.1 μg/L effluent to Grass Lake, are the best treatment options. I would stress, however, the significant water quality benefits associated with servicing all units on the Grass and Head lakes and the north shore of North Kashagawigamog Lake.

I hope this is useful to you. Please call if you have further questions.

Yours truly,

Neil J. Hutchinson
Limnology Section
Dorset Research Centre

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encls.

cc: Terry O'Neill, MOEE Gravenhurst
Chris Hodgson, Town of Haliburton
Steve Maude, MOEE, Central Region, Toronto

Table 1 No P retention, resorts expand and are serviced by STP, all vacant lots developed (see Table 3 and 6 of original report, October 17, 1992).

Case	"Baseline"		0		1		3		4		5		6	
Scenario	1.2		12.1		12.2		12.3		12.4		12.5		12.6	
	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg
Kennibik	4.7	14.1	no		-	-	-	-	-	-	-	-	-	-
Art	8.7	32	change			-	-	-	-	-	-	-	-	-
Drag	7.9	313	from		-	-	-	-	-	-	-	-	-	-
Head	15.6	1023	baseline		-	-	-	-	-	-	-	-	-	-
Grass	19.4	1279	-	-	20.7	1360	19.9	1313	18.7	1229	18.7	1229	19.7	1294
N. Kashag.	21.2	1777	24.3	2041	20.2	1698	20.3	1701	20.3	1705	19.1	1604	19.7	1651
Soyers	7.4	143	-	-	-	-	-	-	-	-	-	-	-	-
S. Kashag.	14.6	1609	16.2	1786	14.1	1555	14.2	1557	14.2	1560	13.6	1492	13.9	1524
Canning	14.4	1648	15.7	1794	14.0	1603	14.0	1605	14.0	1607	13.5	1551	13.8	1578

Baseline: All vacant lots develop, resorts at existing levels, original scenario 1.2
Case 0: All vacant lots develop, resorts expand without STP connection
Case 1: Expansion to 1933 m^3/d = 705,545 m^3/yr at 0.2 µg/L = 141.1 kg/yr to Grass Lake
Case 3: 1231 m^3/d = 449,315 m^3/yr at 0.2 µg/L = 89.9 kg/yr to
+ 702 m^3/d = 256,230 m^3/yr at 0.2 µg/L = 51.2 kg/yr to North Kashagawigamog Lake
Case 4: 141.1 kg/yr to North Kashagawigamog Lake
Case 5: Burnt River outfall, no effluent to lakes
Case 6: 1933 m^3/d, 0.1 µg/L = 70.6 kg/yr to Grass Lake

Table 1 No P retention, resorts expand and are serviced by STP, all vacant lots developed (see Table 3 and 6 of original report, October 17, 1992).

Case	"Baseline"		0		1		3		4		5		6	
Scenario	1.2		12.1		12.2		12.3		12.4		12.5		12.6	
	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg
Kennibik	4.7	14.1	no		-	-	-	-	-	-	-	-	-	-
Art	8.7	32	change			-	-	-	-	-	-	-	-	-
Drag	7.9	313	from		-	-	-	-	-	-	-	-	-	-
Head	15.6	1023	baseline		-	-	-	-	-	-	-	-	-	-
Grass	19.4	1279	-	-	20.7	1360	19.9	1313	18.7	1229	18.7	1229	19.7	1294
N. Kashag.	21.2	1777	24.3	2041	20.2	1698	20.3	1701	20.3	1705	19.1	1604	19.7	1651
Soyers	7.4	143	-	-	-	-	-	-	-	-	-	-	-	-
S. Kashag.	14.6	1609	16.2	1786	14.1	1555	14.2	1557	14.2	1560	13.6	1492	13.9	1524
Canning	14.4	1648	15.7	1794	14.0	1603	14.0	1605	14.0	1607	13.5	1551	13.8	1578

Baseline: All vacant lots develop, resorts at existing levels, original scenario 1.2
Case 0: All vacant lots develop, resorts expand without STP connection
Case 1: Expansion to 1933 m^3/d = 705,545 m^3/yr at 0.2 µg/L = 141.1 kg/yr to Grass Lake
Case 3: 1231 m^3/d = 449,315 m^3/yr at 0.2 µg/L = 89.9 kg/yr to
+ 702 m^3/d = 256,230 m^3/yr at 0.2 µg/L = 51.2 kg/yr to North Kashagawigamog Lake
Case 4: 141.1 kg/yr to North Kashagawigamog Lake
Case 5: Burnt River outfall, no effluent to lakes
Case 6: 1933 m^3/d, 0.1 µg/L = 70.6 kg/yr to Grass Lake

Table 2 80% P retention, vacant lots developed, STP expands to service resorts on north shore, resorts expand (x 0.2 to account for P retention unless serviced).

Case	"Baseline"		0		1		3		4		5		6	
Scenario	3.2		13.1		13.2		13.3		13.4		13.5		13.6	
	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg
Kennibik	4.2	12.7	no		-	-	-	-	-	-	-	-	-	-
Art	7.1	25.9	change		-	-	-	-	-	-	-	-	-	-
Drag	5.6	222	from		-	-	-	-	-	-	-	-	-	-
Head	10.5	685	baseline		-	-	-	-	-	-	-	-	-	-
Grass	11.6	760	11.6	760	12.8	841	12.1	793	10.8	709	10.8	709	11.8	775
N. Kashag.	10.7	894	11.3	946	11.0	924	11.0	927	11.1	931	9.9	830	10.4	877
Soyers	6.1	118	-	-	-	-	-	-	-	-	-	-	-	-
S. Kashag.	7.7	847	8.0	882	7.9	867	7.9	869	7.9	872	7.3	804	7.6	835
Canning	7.3	839	7.6	868	7.5	855	7.5	857	7.5	860	7.0	803	7.2	829

Baseline: All vacant lots develop, resorts at existing levels, original scenario 3.2
Case 0: All vacant lots develop, resorts expand without STP connection
Case 1: STP at 1933 m^3/d, 0.2 µg/L = 141.1 kg/yr. Grass Lake discharge
Case 3: STP at 1231 m^3/d = 89.9 kg/yr to Grass Lake, 702 m^3/d = 51.2 kg/yr to North Kashag.
Case 4: STP at 1933 m^3/d, 141.1 kg/yr to North Kashag.
Case 5: Burnt River outfall, no STP contribution
Case 6: STP at 1933 m^3/d, 70.5 kg/yr to Grass Lake

Table 3 No P retention, vacant lots developed, resorts expand and connect to STP, residences on Head, Grass and north shore of North Kashagawigamog Lake connect.

Case	"Baseline"		1		3		4		5		6	
Scenario	1.2		14.1		14.2		14.3		14.4		14.5	
	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg
Kennibik	4.7	14.1										
Art	8.7	32	no change from baseline									
Drag	7.9	313										
Head	15.6	1023	10.9	713	10.9	713	10.9	713	10.9	713	10.9	713
Grass	19.4	1279	12.4	817	11.7	769	10.4	685	10.4	685	11.4	751
N. Kashag.	21.2	1777	12.7	1069	12.8	1072	12.8	1076	11.6	975	12.2	1022
Soyers	7.4	143										
S. Kashag.	14.6	1609	10.3	1133	10.3	1185	10.3	1137	9.7	1069	10.0	1101
Canning	14.4	1648	10.9	1254	11.0	1256	11.0	1257	10.5	1201	10.7	1227

Baseline: All vacant lots develop, resorts at existing levels, original scenario 1.2
Case 1: STP at 1933 m^3/d, 0.2 µg/L = 141.1 kg/yr to Grass Lake
Case 3: STP at 89.9 kg/yr to Grass Lake, 51.2 kg/yr to North Kashag.
Case 4: STP at 141.1 kg/yr to North Kashag.
Case 5: STP to Burnt River, no STP to lakes
Case 6: STP at 70.5 kg/yr to Grass Lake

Table 4 80% P retention, vacant lots developed, resorts expand and connect to STP, residences on Head, Grass and north shore of North Kashagawigamog Lake connect.

Case	"Baseline"		1		3		4		5		6	
Scenario	3.2		15.1		15.2		15.3		15.4		15.5	
	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg	µg/L	kg
Kennibik	4.2	12.7										
Art	7.1	25.9	no change from baseline									
Drag	5.6	222										
Head	10.5	685	9.5	623	9.5	623	9.5	623	9.5	623	9.5	623
Grass	11.6	760	11.1	732	10.4	685	9.1	601	9.1	601	10.1	666
N. Kashag.	10.7	894	9.5	798	9.5	801	9.6	805	6.3	527	8.9	751
Soyers	6.1	118										
S. Kashag.	7.7	847	7.1	782	7.1	784	7.2	787	5.5	600	6.8	751
Canning	7.3	839	6.9	785	6.9	787	6.9	789	5.5	635	6.6	759

Baseline: 80% P retention, vacant lots developed, resorts at existing levels
Case 1: STP at 1933 m^3/d, 0.2 µg/L = 141.1 kg/yr to Grass Lake
Case 3: STP at 89.9 kg/yr to Grass Lake, 51.2 kg/yr to North Kashag.
Case 4: STP at 141.1 kg/yr to North Kashag.
Case 5: STP to Burnt River, no STP to lakes
Case 6: STP at 70.5 kg/yr to Grass Lake