HYDROLOGY

INTERIM PPWB WATER QUALITY REQUIREMENTS FOR THE BEAVER RIVER AT THE ALBERTA-SASKATCHEWAN BOUNDARY

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PRAIRIE PROVINCES WATER BOARD

CANADA ALBERTA SASKATCHEWAN MANITOBA

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INTERIM PPWB WATER QUALITY REQUIREMENTS FOR THE BEAVER RIVER AT THE ALBERTA-SASKATCHEWAN BOUNDARY

OCTOBER 5, 1979

PRAIRIE PROVINCES WATER BOARD

SUMMARY

The Board has adopted Interim Water Quality Requirements for the Beaver River at the Alberta-Saskatchewan boundary. These requirements define acceptable levels of water quality pending finalization of an overall water quality management approach.

The Board recommends that these requirements be used to assess the effect of the proposed Esso Resources Cold Lake project on the Beaver River at the interprovincial boundary.

PRAIRIE PROVINCES WATER BOARD

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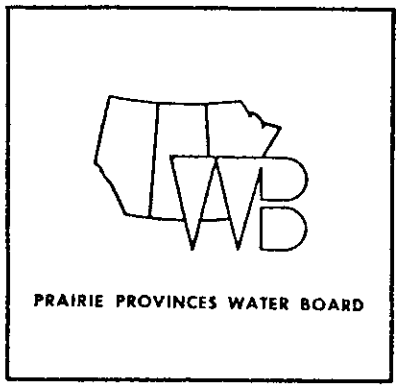

INTERIM PPWB WATER QUALITY REQUIREMENTS

INTRODUCTION

The Prairie Provinces Water Board (PPWB) has an ongoing responsibility

> *".....to review water quality problems, particularly such problems located at the interprovincial boundaries, and to recommend to the parties hereto, appropriate management approaches for their resolution including the establishment of new institutional arrangements." (Board Duty 4[b]).*

On March 20, 1973 the Board adopted the water quality objectives which were developed jointly by the Provinces of Alberta, Saskatchewan and Manitoba and recommended to the Board by the PPWB Committee on Water Quality. The Board recognized that these objectives

> *".....will be applied to interprovincial streams under the jurisdiction of the Board as defined in the Master Agreement and the Prairie Provinces Water Board Agreement. The Board recognizes that the objectives may be amended from time to time by mutual agreement." (Excerpt Board Minute 8-26).*

Monthly water quality monitoring has been conducted at the eleven PPWB monitoring stations since April 1974. Analysis of the five years of data collected at these stations has shown that some of the 1973 objectives were not adequate and that revised objectives are required.

The Board is in the process of revising the 1973 PPWB Water Quality Objectives. At the May 23-24, 1979 meeting of the Board the Committee on Water Quality recommended that the 1973 objectives be revised by formulating basin specific PPWB Water Quality Requirements. This recommendation was based on the concept that, in keeping with the intent of the Master Agreement on Apportionment, the Provinces should agree to apportion the defined assimilative capacity of eastward flowing streams at the interprovincial boundary.

RATIONALE

~~This concept~~ is based on the following rationale:

1. Many substances, if concentrated sufficiently, can adversely affect beneficial water uses, yet, if diluted adequately, will not impair selected beneficial uses. However, some substances which accumulate in the environment should not be introduced into the water column.

2. The Provinces are custodians of the water resource and may manage this resource to assimilate wastes as long as water uses in downstream provinces are not foregone and federal interests are protected.

3. When the waters cross the interprovincial boundaries both the quantity and assimilative capacity of the stream should be apportioned.

4. The assimilative capacity of the stream should be defined as the difference between the defined natural concentration and the level which must be maintained to secure and protect a designated set of uses (the maximum acceptable concentration).

5. The Provinces should agree to apportion the defined assimilative capacity of the stream for each parameter on a 50-50 basis.

6. PPWB Water Quality Requirements applied at the interprovincial boundary should be defined as 50% of the defined assimilative capacity of each interprovincial stream at the boundary.

This concept can be further illustrated by considering Figure One.

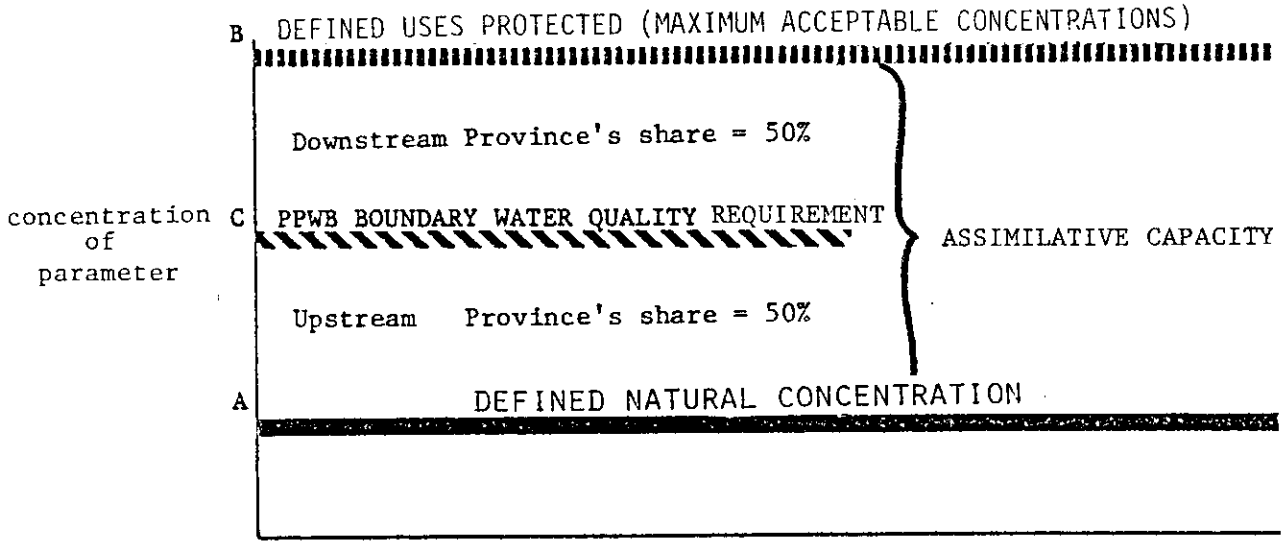

Figure One.

In summary, it is suggested that the difference between the defined naturally occurring concentration (Concentration A) and the maximum acceptable concentration which is prescribed to protect and secure all uses (Concentration B) should be defined as the assimilative capacity of the river crossing the interprovincial boundary. The defined assimilative capacity negotiated by the Provinces would be apportioned on a 50-50 basis. Assessment of compliance with the PPWB Requirements at the interprovincial boundary would be based on Concentration C, 50% of the assimilative capacity.

ADMINISTRATIVE PROCEDURES

It is suggested that the Prairie Provinces Water Board Requirements would be applied in the following manner.

1. Results of water quality monitoring conducted by Canada, on behalf of the Board, at the interprovincial boundary would be reported, via the Committee on Water Quality, to provincial water quality monitoring officers. A report on these results will also be prepared and submitted to the Board and associated agencies as part of the Secretariat's Quarterly Report.

2. If the PPWB Water Quality Requirements are exceeded, a province may request, through the Board, that an investigation be made to determine whether the exceedence was caused by natural or man-induced phenomena.

3. If the exceedence at the boundary is man-induced the appropriate upstream jurisdiction may be requested to take all reasonable and practical measures to restore the quality of the waters crossing the interprovincial boundary to the acceptable levels documented in the PPWB Water Quality Requirements, and to prevent further violations of these requirements.

4. As the uses and criteria used to generate these requirements will change with time these requirements would be amended by the Prairie Provinces Water Board.

RECOMMENDED INTERIM PPWB BEAVER RIVER WATER QUALITY REQUIREMENTS

In compliance with instructions given in Board Minute 20-48 the Committee on Water Quality has formulated the proposed PPWB Beaver River Water Quality Requirements for all constituents known to be present in the effluent of the proposed Esso Resources Cold Lake Oil Sands Project (Table 1). Beneficial uses of water which will be assured and protected if these requirements are met include municipal and industrial water use, agricultural (livestock watering), and the propogation and maintenance of aquatic life and wildlife indigenous to the Beaver River Basin. Best estimates of defined natural concentrations, based on the ninetieth percentile of five years of data collected at the PPWB Beaver River station, and the maximum acceptable concentrations required to protect domestic water uses and the aquatic life of the Beaver River are also included in Table 1.

RATIONALE FOR SPECIFIC INTERIM PPWB WATER QUALITY REQUIREMENTS

The rationale used to establish these interim requirements for specific parameters are described in the following paragraphs.

Nutrient concentrations in the Beaver River at the boundary have frequently exceeded the 1973 PPWB Water Quality Objectives. However, the Committee on Water Quality has concluded that the 1973 total nitrogen and total phosphorus objectives were not appropriate for this river. They have recommended and the Board has agreed that the interim PPWB Water Quality Requirements for total nitrogen and total phosphorus be revised upward to 2.6 mg/l N and 0.22 mg/l P respectively. The Board recognizes that further work based on nutrient loading concepts may be required to further refine these interim nutrient requirements.

Concentrations of phenolic compounds as low as 0.005 mg/l have been found to cause taste and odour problems in chlorinated domestic and municipal supplies and cause tainting of edible fish flesh. The Board recognizes that both Ontario and the United States Environmental Protection Agency have recommended that concentrations of phenols not be allowed to exceed 0.001 mg/l to protect chlorinated domestic water supplies from taste and odour problems and prevent fish flesh tainting. As some phenolic compounds may not cause taste and odour problems, and as the analytical method now used detects phenolic compounds as opposed to phenols, the Board has agreed that municipal uses and aquatic life should be protected if phenolic compounds detected by the 4-amino Antipyrene Method do not exceed 0.005 mg/l.

The concept shown in Figure 1 cannot be strictly applied when there is insufficient data to define natural or maximum acceptable concentrations for the Beaver River. Thus PPWB Requirements for dissolved oxygen, total dissolved solids, dissolved iron, ammonia and sulphides are based on the following rationale.

Monitoring at the PPWB Beaver River station has shown that dissolved oxygen concentrations frequently fall to 3.0 mg/l in late winter when flows are low. These depressed dissolved oxygen values are thought to be caused primarily by natural oxygen demanding processes and groundwater discharge depleting the stream's oxygen resources which are limited under ice. The Committee on Water Quality has therefore concluded that, until more information is available, the December to March Beaver River dissolved oxygen requirement should be set at 3.0 mg/l.

After examining a literature review entitled "The Impact of Saline Waters Upon Freshwater Biota", January 1977, prepared by the Alberta Oil Sands Environmental Research Program the Committee on Water Quality concluded it could not identify specific dissolved ion toxicity limits which would protect aquatic life in the Beaver River. However, to ensure that aquatic life in Saskatchewan would not be impaired the Committee on Water Quality agreed that, as a general rule, the total dissolved solids* concentration should not be increased by more than one third, and that an attempt should be made to maintain the natural ionic character of the river. Therefore, the one third criteria was applied to determine the maximum acceptable concentration of total dissolved solids, and the maximum acceptable concentrations for specific major ions were adjusted to approximate the natural ionic balance of the river.

In addition, because there were insufficient data available to define natural concentrations of dissolved iron, sulfides, and ammonia, the PPWB Requirements have been set at the maximum acceptable concentration to protect aquatic life and domestic uses. Criteria for these parameters are subject to review when sufficient background data have been gathered.

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* *Total dissolved solids are defined as the sum of the following ions: calcium, magnesium, sodium, potassium, bicarbonate, chloride, and sulphate determined by individual analyses.*

TABLE 1

INTERIM PPWB WATER QUALITY REQUIREMENTS FOR THE BEAVER RIVER AT THE ALBERTA-SASKATCHEWAN BOUNDARY FOR CONSTITUENTS PRESENT IN THE COLD LAKE OIL SANDS EFFLUENT

(all units mg/l unless otherwise specified)

		DEFINED NATURAL CONCENTRATION	MAXIMUM ACCEPTABLE CONCENTRATION	PPWB REQUIREMENT
1.	DISSOLVED MAJOR IONS			
	Alkalinity Bicarbonate (as HCO_3)	300	420	360
	Calcium	60	100	80
	Chloride	5	55	30
	Magnesium	25	55	40
	Potassium	5	15	10
	Sodium	25	55	40
	Sulphate	30	70	50
2.	TOTAL DISSOLVED SOLIDS[a]	450	600	525
3.	pH UNITS	7.0-8.5	6.5-9.0	6.5-9.0
4.	REACTIVE SILICA (SiO_2)	10	50	30
5.	TOTAL CHROMIUM	< 0.02	0.10	0.05
6.	TOTAL COPPER	0.002	0.005	0.003
7.	PHENOLICS	0.004	0.005	0.005
8.	DISSOLVED OXYGEN			
	April to December	7.0	5.0[b]	6.0 or 50% of saturation
	December to March	3.0	4.0[b]	3.0[c]
9.	MACRO NUTRIENTS *(except during April & May)*			
	Total Phosphorus (as P)	0.15	0.30	0.22
	Total Nitrogen (as N)	1.72	3.5	2.6
	Ammonia (un-ionized NH_3)	no data	0.02	0.02[c]
10.	SULFIDES	no data	0.002	0.002[c]
11.	DISSOLVED IRON	no data	0.3	0.3[c]
12.	ORGANIC COMPOUNDS			
	Soluble Hydrocarbons			
	Aliphatic compounds	< 0.001	0.005	0.002
	Aromatic compounds	< 0.001	0.005	0.002

Waters crossing the boundary should be:

- free from organic compounds which may impart undesirable odours or tastes to domestic waters;
- free from organic compounds which float upon or impart a visible sheen to the surface of the water;
- free from organic compounds which may accumulate in sediments;
- free from compounds which cause tainting of, or are toxic to, aquatic life.

(a) Total Dissolved Solids - calculated from dissolved major ions listed in 1.

(b) These values are minimum desirable concentrations.

(c) Rationale for these Requirements is explained on page 6.

INTERIM PPWB WATER QUALITY REQUIREMENTS FOR THE BEAVER RIVER AT THE ALBERTA-SASKATCHEWAN BOUNDARY FOR CONSTITUENTS PRESENT IN THE COLD LAKE OIL SANDS EFFLUENT

(all units mg/l unless otherwise specified)

	DEFINED NATURAL CONCENTRATION	MAXIMUM ACCEPTABLE CONCENTRATION	PPWB REQUIREMENT
13. SUSPENDED SOLIDS (NON-FILTERABLE RESIDUE)			
(except during April & May)	30	50	40

Waters crossing the boundary should not contain concentrations of man induced suspended solids which:

- accumulate and interfere with the reproduction or cause species diversity shifts in aquatic populations,
- contribute to excessive benthic oxygen demands.

14. TEMPERATURE

The natural temperature of the stream should not be altered by more than ±3°C.

DEFINITIONS

DEFINED NATURAL CONCENTRATION

The concentration of constituent, biological or physical effect which the Provinces of Alberta and Saskatchewan and the Prairie Provinces Water Board agree to recognize as the defined naturally occurring condition for a parameter at the interprovincial boundary. For the Beaver River natural concentrations have been defined as the ninetieth percentile of all data collected at the PPWB Beaver River monitoring station from April 1974 to December 31, 1978.

MAXIMUM OR MINIMUM ACCEPTABLE CONCENTRATION

The maximum or minimum concentration of constituent, biological or physical effect which the Provinces of Alberta and Saskatchewan and the Board agree is necessary to ensure and protect downstream water uses on the Beaver River.

Downstream water uses which will be protected if these maximum or minimum acceptable conditions are met include municipal and industrial water use, agricultural water use, and the propagation and maintenance of aquatic life and wildlife indigenous to the Beaver River Basin.

PPWB WATER QUALITY REQUIREMENT

The concentration of constituent, biological or physical effect which the Provinces of Alberta and Saskatchewan and the Board agree should not be exceeded in waters of the Beaver River crossing the Alberta-Saskatchewan interprovincial boundary.

SUMMARY

The Board has adopted Interim Water Quality Requirements for the Beaver River at the Alberta-Saskatchewan boundary. These requirements define acceptable levels of water quality pending finalization of an overall water quality management approach.

The Board recommends that these requirements be used to assess the effect of the proposed Esso Resources Cold Lake project on the Beaver River at the interprovincial boundary.