MAN-MADE STORAGE OF WATER RESOURCES - A LIABILITY TO THE OCEAN ENVIRONMENT

The above title was also the title of a January 1982 Report by Dr. Hans Neu, a Senior Research Scientist at Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Dr. Neu predicted that the huge storage lakes being built for power development would starve the fisheries (see my Fact Sheet "Hydro-Dams Blamed for Decline in Fish Stocks", Kasprzak, February 4, 2019) and weaken the seasonal strength of the density (thermohaline) current thereby warming the waters. The following excerpts were written by Dr. Neu in his 1982 Report:

> *"The most outstanding feature in the encounter between fresh water and salt water is the formation of a current which oceanographers refer to as haline circulation and engineers as density current"*. (Today, this is called a thermohaline current) and *"Obviously, the two-layer current system acts like a large natural pump which constantly transports large quantities of deep ocean water onto the continental shelf and then into the embayments and estuaries."*

Historically, before reservoir dams, both the natural flowing rivers and the upwelling of large quantities of deep ocean water transported dissolved silica and other essential nutrients to the coastal waters and were the major source of nutrients to the estuaries.

> *"Just as for the winds in the atmosphere, the magnitude of the current is proportional to the pressure difference. Hence in times where more fresh water enters the ocean, the longitudinal gradient seaward increases and with it the strength of the current system. From this it follows that in estuaries the density current varies with the seasonal run-off, being at a minimum during the low discharges in winter and at its peak during the large discharges in spring and summer. In coastal waters which are some distance away from the fresh water source (i.e. the Grand Banks, the Scotian Shelf and Georges Bank) there can be delays of from several month to almost a year before the freshwater peak arrives."*

THE DRIVING FORCE WEAKENING THE THERMOHALINE CURRENT, AND THEREBY WARMING THE WATERS IN GULF OF ST. LAWRENCE, GULF OF MAINE, HUDSON STRAIT AND LABRADOR CURRENT HAS BEEN THE PROLIFERATION OF RESERVOIR DAMS BY HYDRO-QUEBEC.

The dams have created huge storage lakes capable of holding the run-off of large drainage areas and storing it over entire seasons, years and even longer. The water volume in Moosehead Lake in Maine is 5.19 km³ and Hydro Quebec built the equivalent of 80 Moosehead Lakes in the three watersheds listed below and 67 of them were built between 1969-1985, which is an average of almost 4 per year.

Gulf of St. Lawrence Watershed		James Bay/Hudson Bay Watershed		Labrador Sea Watershed	
1956 Bersimis -1	13.9 km³	1979-81 Robert-Bourassa Generating Station	61.7km³	1971-74 Churchill Falls	32.64 km³
1969 Outardes-4	24.3 km³	1982-84 LaGrande -3 Generating Station	60.0km³		
1970 Daniel Johnson Dam	142.0 km³	1984-85 LaGrande-4	24.5 km³		
		1993 Brisay	53.8 km³		
	180.2 km³		200.0 km³		32.64km³

Fact Sheet by Stephen M. Kasprzak
February 11, 2019

NATURAL RIVER FLOW VERSUS REGULATED FLOW

Dr. Neu wrote the following in his 1982 Report:

> *"In higher latitudes during the winter, river run-off is at a minimum while power demand is at its maximum. This is shown in Fig. 7, where an average hydrograph and the seasonal power demand of a city in northern regions are plotted. As can be seen, water supply and power demand are out of phase by nearly half a year."*

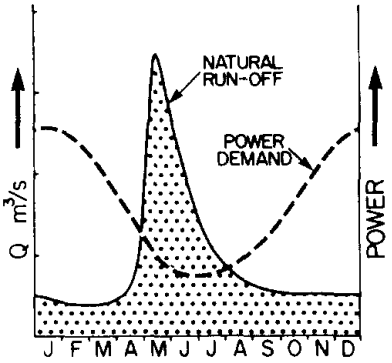

Fig. 7 Typical hydrograph and seasonal power demand.

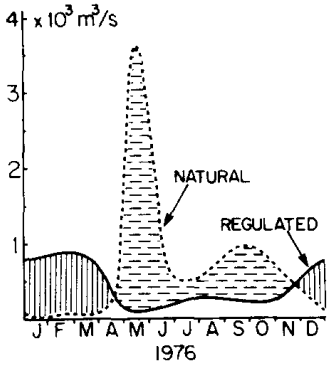

Fig. 8 Natural and regulated discharge of the Manicouagan River at Manic 5 power station.

> *"Developers of electrical energy view this as an inconvenience of nature; thus they reverse the natural run-off cycle by storing the spring and summer flow in artificial lakes to be released during the winter. An example is shown in Fig. 8 for the Manicouagan River at Manic 5 power station.*
>
> *Run-off is transferred from the biologically active to the biologically inactive period of the year. This is analogous to stopping the rain during the growing season and irrigating during the winter, when no growth occurs.*
>
> *Although temperature, particularly during warming in spring, plays an important role in the biological activities of the upper layer, it has less influence on the density of the water, and hence on the motion and mixing, than the fresh water of the river."*

Dr. Neu made the following observations and prediction, which again, have turned out to be true with the passage of time:

> *"Reducing the flow of fresh water during spring and summer and increasing it during the winter changes the seasonal composition of the water in the surface layer and the seasonal strength of the density current.*
>
> *As this trend continues, the cyclic variation will be reversed, the surface salinity becoming saltier in spring and summer, and fresher in the winter. This represents a fundamental change in the seasonal salinity patterns of the coastal region and continental shelf.*
>
> *There is a definite possibility that both winter and summer temperatures of the surface layer will increase; in winter due to an increase in upwelling of deeper warmer water, and in summer due to slower surface currents which will allow the surface layer to absorb more heat during its passage through the system. It can be assumed therefore that fresh water regulation modifies the climate of the coastal region to be more continental-like in the summer and more maritime-like in the winter."*