A REPORT ON 1995 WATER LEVELS OF THE GREAT LAKES AND THE ST. LAWRENCE RIVER

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SUMMARY

The winter of 1994-1995 was mild with little ice formed on the Great Lakes and in the St. Lawrence River. The ice break-up in the spring of 1995 was uneventful.

During 1995, precipitation on the Great Lakes basin was slightly above average, with the relatively dry winter and spring months offset by a much wetter October and November.

Lake Superior water levels started 1995 at its long-term average. The level fell below average from February until November at which time much higher than average rainfall brought its level back to average. Except for the first three months in 1995 when their levels were above average, Lakes Michigan-Huron followed closely their long-term average seasonal pattern during the year. Lake St. Clair and Lake Erie were above average throughout 1995, but they were also well within the historical range. Lake Ontario levels were above and below average at different times of the year.

Record low water level conditions (since the mid-1960's) occurred at the Port of Montreal, during the months of April, May, July, August and September, seriously affecting commercial navigation at the port. The low water level condition on Lake St. Louis caused concern to shippers transiting that part of the Seaway.

Several severe weather systems entered the Great Lakes area in 1995, some causing rapid changes in the water levels in some areas. No serious damage occurred, because water levels were generally low enough to allow a substantial surge without serious flooding.

Low water levels were a concern for some residents in the Bay of Quinte area on Lake Ontario during March and again in early October. In March, some marina operators in the Thousand Islands area of the upper St. Lawrence River were concerned about possible low levels at the start of the recreational boating season. Low water levels on Lake St. Louis were less than satisfactory for marinas in that area during the boating season.

In contrast to the mild winter of 1994-95, very cold temperatures arrived in early November and persisted through December, causing an early freeze up of bays and rivers. Ice caused serious difficulties to commercial navigation in December in the Welland Canal and the St. Lawrence River between Cornwall and Montreal.

At the end of 1995, the levels of all the Great Lakes are at or slightly above average. There is little risk of serious flood damage or, alternatively, extreme low levels in the spring of 1996.

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1.0 INTRODUCTION

This report summarizes information related to water level fluctuations in the Great Lakes - St. Lawrence River system in 1995. It uses information provided by the International Lake Superior, Niagara, and the St. Lawrence River Boards of Control, Environment Canada's Great Lakes - St. Lawrence Water Level Information and Geomatics Office, and Conservation Authorities in Ontario. It also provides an assessment of hydrologic data collected by other agencies.

Water level elevations are in metres above sea level at Rimouski, Quebec and are referred to International Great Lakes Datum (IGLD) of 1985. River flows are in cubic metres per second (m^3/s).

2.0 THE GREAT LAKES - ST. LAWRENCE SYSTEM

The Great Lakes - St. Lawrence River basin (including land and lake surface) covers an area of more than one million square kilometres (see Figure 1). As shown in Figure 2, the Great Lakes comprise a series of natural reservoirs positioned in a step-wise manner, with Lake Superior as the highest step and Lake Ontario the lowest. Lakes Michigan and Huron are considered one lake in hydraulic terms, because they are connected by the wide and deep Straits of Mackinac and stand at the same elevation.

Lakes Superior and Ontario are the only two lakes that have their outflows regulated by structures at their outlets.

Water levels fluctuate according to the climate of the region. Over-lake precipitation, evaporation and runoff are the main factors that affect water levels. Other factors include flow retardation due to ice in winter, or aquatic vegetation in the rivers in the summer. Weather disturbances cause short-term fluctuations in water levels. Artificial effects on water levels include regulation of lake outflows, dredging of outlet channels, water diversions, and consumption of water.

The outflows of the un-regulated lakes (Michigan-Huron, St. Clair and Erie) are dependent on their water levels. For Lakes Michigan-Huron and Lake St. Clair, their outflows through the St. Clair - Detroit River system depend also to a minor extent on the levels of Lake Erie due to backwater effect on these rivers.

Water level fluctuations on Lake Ontario do not affect the upstream lakes due to the rapids and Falls at Niagara.

3. HYDROLOGIC CONDITIONS IN 1995

3.1 General Weather Conditions

The winter of 1994-95 was mild with little ice formed on the Great Lakes and the St. Lawrence River. The ice break-up in the spring of 1995 was uneventful. This was in contrast to the winter one year earlier, which saw extensive ice formation on the Great Lakes and the St. Lawrence River.

For example in the St. Lawrence River near Cornwall, Ontario, while there were several days with very cold temperatures (minus mid-20's Celsius) in January, they were followed immediately by air temperatures as high as 20°C on one day. This led to a rapid melting of the snow on the Lake Ontario basin and increased tributary flows to the lake. The mild winter enabled early opening of the navigation season in the St. Lawrence River and the Welland Canal without difficulties.

The spring and summer of 1995 were relatively mild and dry. A short period of inclement weather in late March delayed the removal of the Lake Erie - Niagara River Ice Boom. The fall months appeared to be slightly on the mild side.

Several storm events took place in 1995. However, no flood or erosion damage problems of consequence were reported.

In early October, the remnant of Hurricane Opal brought abundant rainfall to the lower Great Lakes basin and the St. Lawrence River area. Several other weather systems that followed also increased water supplies to the lakes during October and November.

Below freezing temperatures first occurred in the lower Great Lakes region in early November. Conditions remained cold the rest of November and December. By mid-December, extensive ice covers had formed in the St. Lawrence River between Cornwall and Montreal. Record amounts of snowfall were recorded in parts of the lower Great Lakes region.

3.2 Precipitation

On average, about 820 millimetres (mm) of precipitation falls on the Great Lakes Basin each year. Table 1 compares the 1995 monthly precipitation for each lake basin with long-term averages. The basin-wide figure for 1995 was about 860 mm, about 105 percent of average. February, March, June and September were dry while October and November had plenty of rain.

Basin-by-basin, Lake Superior received 110% of average precipitation, with record rainfall in October. Lakes Michigan-Huron basin also received slightly higher than average precipitation. Lake Erie basin precipitation was below average.

Lake Ontario basin received average precipitation. February through June were the dry months whereas abundant rainfall occurred in October and November.

3.3 Water Levels and Outflows

Table 2 lists the water levels for the Great Lakes and Montreal Harbour in 1995. The tables also show how the 1995 figures compare with historical data. The information is also shown graphically in Figures 3 to 8.

Lake Superior started 1995 at its long-term average level. Levels then fell below average due to below average water supplies to the lake, and this condition lasted until early November when levels returned to average after three months of above average rainfall. While the lake was as much as 17 cm below average during the summer months, it was well above the record lows of the mid 1920's.

During the first few months of 1995, Lakes Michigan-Huron levels were 10 to 20 cm above average. By mid-summer, levels were very close to the long-term seasonal values, due to high evaporation from the lake and reduced runoff from their basins.

Lakes St. Clair and Erie levels were above average during 1995. The two lakes started the year as much as 40 cm above average, but the differences diminished considerably by the summer. At the end of the year, they were about 10 to 15 cm above average.

The water level fluctuations on Lake Ontario can best be described by following the climatic conditions on the Lake Ontario basin. The thaw in mid-January raised the lake level from slightly below average to above average. However, the lack of snow on the Lake Ontario basin, along with below average precipitation from February through June, resulted in virtually no noticeable spring rise. Levels were below average from April until early August. The seasonal decline in the levels through the late summer and fall was also less than normal due to the rainfalls of October and November.

During October and November, several weather systems, led by that associated with Hurricane Opal, brought significant amounts of rain to the lower Great Lakes basin. As a result, Lake Ontario rose rapidly and by mid-November, daily water level readings were as much as 16 cm above average. The lake then levelled off to about 4 cm above average by the end of the year.

Montreal Harbour levels fell to record lows (since 1967) for five months in 1995 - April, May, July, August and September. This was the result of low flows from Lake Ontario and other tributaries, particularly the Ottawa River. The rain in October and November raised levels in the harbour rapidly to near average conditions in both November and December.

Table 3 lists 1995 monthly outflows from each of the Great Lakes. The Lake Superior outflow for the year averaged 1940 m^3/s, about 9% below average. The low flows reflected the below average water level conditions on the lake. Lakes Michigan-Huron's outflow for the year was slightly above average, a reflection of the slightly above average lake levels. Lake Erie outflows throughout the year were also above average. The outflows of Lake Ontario were generally below average until September, followed by higher than average flows the rest of the year.

4.0 WATER MANAGEMENT RELATED TO WATER LEVELS

4.1 Lake Superior Regulation

The outflow of Lake Superior is regulated by structures and hydropower dams across the St. Marys River between Sault Ste. Marie, Ontario and Sault Ste. Marie, Michigan.

Lake Superior's Regulation Plan 1977-A specifies monthly outflows from the lake based upon this lake's level and the level of Lakes Michigan-Huron downstream. The practice of taking downstream lake levels into account is referred to as systemic regulation. This is a requirement of the International Joint Commission (IJC), whose International Lake Superior Board of Control oversees the operations of the regulation structure.

A number of structures combine to regulate the outflow of Lake Superior. Water leaving the lake flows through three hydropower plants, four navigation locks, and the Lake Superior compensating works. The 16-gated compensating works were built to offset the extra flow capacity added to the St. Marys River by the hydropower developments.

The IJC requires a minimum setting of one-half gate open at the compensating works in order to supply water to the St. Marys Rapids. Changes to the lake's outflow are usually made by adjusting the amount of water used by the hydropower plants. When the regulation plan specifies flows larger than the capacities of the hydropower plants, additional gates at the compensating works are opened.

The Lake Superior Board, with the approval of the IJC, made some minor outflow deviations from the regulation plan in 1994 and 1995, as discussed below.

Lake Superior outflows were slightly less than those specified by the regulation plan from June to October of 1994. The purpose was to avoid having to spill water through the rapids during repairs at the hydropower facilities on the St. Marys River. Plan flow was released in November 1994 as the capacity of the hydropower plants was sufficient to flow the amount of water allocated by the regulation plan. Flows were higher than plan during the period December 1994 to February 1995. By the beginning of 1995, the effects of these previous deviations from the regulation plan, estimated to be a 2 cm rise on Lake Superior and a 1 cm fall on Lakes Michigan-Huron, had been eliminated.

By the end of February, the over-discharges lowered Lake Superior by 1 cm and raised Lakes Michigan-Huron by 1 cm compared to what they would have been with strict regulation plan outflows. In March and April, plan flows were released. During this two month period, the balancing nature of the regulation plan specified reduced Lake Superior outflows such that by May, the effects of the previous flow deviations were completely dissipated.

Subsequently, plan flows were released the rest of the year, except for a very minor flow reduction in June. The impacts of this deviation was negligible on the levels of the lakes.

On June 27, the Lake Superior Board held a meeting with the public in Sault Ste. Marie, Ontario to provide information and receive feedback on the Board's operations.

4.2 Lake Ontario Regulation

The outflow of Lake Ontario is regulated using the hydropower dam and spillway in the St. Lawrence River near Cornwall, Ontario and Massena, New York. Lake Ontario Regulation Plan 1958-D specifies weekly outflows based upon the lake's levels and trends in water supplies. The regulation plan helps prevent water level extremes both upstream and downstream of the regulation structures, and it attempts to balance the interests of shoreline property owners, commercial navigation and hydropower interests. The operations are overseen by the IJC's International St. Lawrence River Board of Control.

The 1994-95 winter season was very mild. As a result, the extent of ice in the St. Lawrence River was much less than usual and did not pose any problem to regulation.

The dry conditions on the Lake Ontario basin during February through July and again in September, followed by a rather wet October-November period, caused Lake Ontario levels to be both below average and above average during portions of the year. In response to these water supply conditions, the St. Lawrence Board took a number of actions, as summarized below.

In anticipation of possible prolonged dry conditions, the Board reduced Lake Ontario outflows whenever downstream conditions permitted from early April until mid-June to conserve as much water on the lake as possible. Up to 4 cm of water was retained on Lake Ontario as a result. After mid-June, no further flow reductions were possible due to extremely low water level conditions at the Port of Montreal.

Very low water level conditions began at the Port of Montreal in July, and by September they were causing serious problems for commercial navigation at the port. To help alleviate the problem, during September and early October the Board released the water previously retained on Lake Ontario.

As a result of abundant precipitation in October and November, the low water level crisis at the port ended and Lake Ontario levels rose from below average to above average in November. In response to the high supplies and rising levels, Regulation Plan 1958-D began to specify higher outflows.

As a longer term activity, the Board continued to assess two alternate regulation plans in order to examine potential improvements to Lake Ontario regulation. This 3-year assessment began in early 1994. One plan, called Plan 35-P, is a product of the IJC Levels Reference Study completed in 1993 and is a modified version of the current regulation plan. The other plan, called IS4, uses an optimization technique that attempts to achieve best possible compromises among all interests.

In 1995, the St. Lawrence Board was also requested by the IJC to prepare a scope of work of the studies that would be required to update the Lake Ontario regulation criteria. This request was in response to the 1993 Reference Study report which recommended, among other things, that new regulation criteria be added to consider the needs of the recreational boating and environmental interests. The Board held six public meetings in the Lake Ontario - St. Lawrence River area to collect ideas from the public and government agencies. The Board completed the scope of work in December.

4.3 Activities by Environment Canada

Environment Canada continued to provide technical support to the IJC's Boards in the regulation of the outflows of Lake Superior and Lake Ontario, which are discussed in earlier sections.

Six-month water level forecasts for the Great Lakes and Montreal Harbour were issued jointly with the U.S. Army Corps of Engineers. A monthly newsletter was also published to update readers on current issues related to water levels. The forecasts

and the Levels News appear monthly in the water level bulletins distributed by Fisheries and Oceans Canada.

As in previous years, the Department also issued monthly water level bulletins during the recreational boating season for Lake Ontario and locations on the St. Lawrence River as far downstream as Lake St. Louis. The bulletins were distributed to local media, shore property owners and marinas to advise citizens of water level and flow conditions in the river.

In support of the International St. Lawrence River Board of Control, a weekly distribution of the Lake Ontario and St. Lawrence River hydrologic data is also made to subscribers on an E-mail list.

Environment Canada has undertaken a project to increase the availability of information to the public through the World Wide Web. The Great Lakes Information Management Resource (GLIMR) is a catalog of available information on the Great Lakes, and it contains links to many other information sources. Through GLIMR, both water level bulletins and the Levels News can be viewed. It is also possible to access daily water level and precipitation data. For those with access to the World Wide Web, GLIMR's URL is http://www.cciw.ca/glimr/intro.html.

Cornwall and Burlington offices of Environment Canada continue to respond to requests for information related to Great Lakes levels, flows, and Lake Superior and Lake Ontario outflow regulation.

5.0 EFFECTS OF WATER LEVEL FLUCTUATIONS

5.1 Shore Properties

No serious shoreline flood or erosion damage was reported on the Great Lakes in 1995. Low flows in the St. Lawrence River during the Ottawa River spring freshet prevented any flooding of Lake St. Louis area communities.

Several severe weather systems caused large but temporary water level fluctuations at some locations on the lakes. There were no reports of any serious flood damage, because the events were of extremely short duration and the levels of the lakes and rivers were low enough to accommodate a substantial surge.

On July 13, a severe weather system moved across the upper Great Lakes system, bringing rapid and large changes in the air pressure across the lakes. In response, the water levels at Point Edward, Ontario, at the head of the St. Clair River, rose 50 cm in about two hours' time. Water levels at Goderich on Lake

Huron rose by almost 60 cm. Water level fluctuations of similar magnitudes were also observed at Gros Cap on Lake Superior.

The rapid change in the water level was most dramatic at the upstream end of the navigation lock at Sault Ste. Marie, Ontario. At the beginning of the storm, the level there dropped by about 1.3 metres during the course of two hours, followed by a rapid rise of 1.8 m over about the same interval of time. A series of water level oscillations followed with gradually reducing amplitudes during the next two days.

Following the July 13 event, several Conservation Authorities in Ontario provided the following information:

The Maitland Valley Conservation Authority reported some inland structural damage and numerous trees were blown over. Although there were large water level fluctuations at the mouth of the Maitland River, no serious flood or erosion damage occurred.

The Ausable-Bayfield Conservation Authority reported some damage to moorings and docks at marinas at the Villages of Grand Bend and Bayfield. The Authority also reported that other earlier summer storms triggered isolated land slides and bluff slumps along the till bluff shoreline between Grand Bend and Bayfield.

The St. Clair Region Conservation Authority reported some trees damaged while the Sault Ste. Marie Region Conservation Authority reported no damage as a result of the July 13 storm.

In March and again in early October 1995, Environment Canada's office in Cornwall received calls from residents in the Bay of Quinte area of Lake Ontario expressing concern about low water levels at shore wells. Many of these wells are shallow and located on bedrock. Thus, they are easily affected by low water levels prior to the seasonal lake level rise in spring and again in the fall when levels decline.

The water levels at Glen Walter, a small community on Lake St. Francis just below Cornwall, rose to near flood threshold elevation for a short time in early February. This was caused by very strong easterly winds which caused a set up on the lake.

In May and June, several residents at Summerstown on Lake St. Francis had problems with low water levels at their intakes. The residents also experienced increased water turbidity caused by recreational boaters near their intakes.

5.2 Commercial Navigation

Water levels on all the Great Lakes in 1995 were above chart datum. The mild winter of 1994-1995 with its absence of ice led to a smooth opening of the 1995 Seaway navigation season at the Welland Canal and in the St. Lawrence River on March 24. However, shippers in parts of the system faced difficulties due to low water levels at various times during the year, and ice conditions late in December 1995.

The Lake Superior water level was at chart datum (183.2 m, IGLD 1985) in March and April. Several times in April, it was reported that ships were delayed going through the locks at Sault Ste. Marie, Michigan due to low water levels in the upper St. Marys River.

As previously described, a combination of low flows from Lake Ontario, and tributaries to the St. Lawrence River, especially the Ottawa River, resulted in record low water level conditions at the Port of Montreal for five months in 1995. The Port of Montreal and the shipping industry reported economic losses due to reduced cargo loading and re-routing of ships to other ports. Rain in early October and November ended the low water level crisis.

On Lake St. Louis, which is a part of the St. Lawrence Seaway linking Montreal and Lake Ontario, low water levels were of particular concern to the seaway entities in Canada and the United States. Water levels were very low during the summer months, which prompted the seaway entities in early July to consider reducing allowable vessel drafts in the system. However, the need to reduce draft did not arise as water level conditions later improved, due mainly to the increased Lake Ontario outflows directed by the St. Lawrence River Board, and rain in October.

Cold temperatures arrived in early November. By December 4, a thin ice cover had formed in parts of the St. Lawrence River from Montreal to Cornwall. The extent of the ice caused very serious difficulties for ships until December 28 when the last ocean vessel exited the Seaway system. In the St. Marys River, it was reported also that ships had difficulties with ice in the river.

Ice began to form on December 13 in Lake Erie at Port Colborne, the entrance to the Welland Canal. Ice problems for ships entering the canal became progressively worse until December 26 when the last vessel cleared the canal.

5.3 Recreational Boating

During the year, some marina operators on Lake St. Clair, on eastern Lake Ontario, in the Thousand Islands area of the upper St. Lawrence River, and on Lake St. Louis near Montreal, expressed concern with low water levels and had difficulties removing boats from the water.

For Lake Ontario and the upper St. Lawrence River, the difficulties faced by boaters were primarily in the early spring and summer. The rise in the levels during October when the boating season ended eliminated the problem of bringing large sailboats on shore. Except for short durations when levels rose temporarily during rainfall events, water levels on Lake St. Louis were unsatisfactory to marina operators over the entire boating season.

No information was available to assess the extent of problems with recreational boating on Lake Superior due to below average levels during the summer season.

5.4 Hydropower Generation

Hydro-electric facilities at Sault Ste. Marie in the St. Marys River continued to use amounts of water specified by the regulation plan for power generation. However, repairs at times reduced the plants' capabilities to use their full share of water. The unusable amount, however, was very small and was temporarily retained on Lake Superior.

Higher-than-average flows in the Niagara River resulted in above average power production. The minimal amount of ice in eastern Lake Erie in the spring led to a decision on March 29 to remove the Lake Erie - Niagara River Ice Boom. However, high winds and waves on Lake Erie in early April delayed completion of the operation until April 17. The ice boom, placed each winter at the entrance to the Niagara River, prevents large scale ice runs in the river that can cause ice jams and affect hydro operations at Niagara Falls.

Hydropower generation at the Moses-Saunders Generating Station near Cornwall, Ontario was about average, with low production during the spring and summer months offset by higher production in October and November. The Long Sault Spillway near Cornwall normally remains closed because the power dam can use the entire Lake Ontario outflow. However, there were instances in 1995 when a very small portion of the flow was released at the spillway. This occurred when a temporary energy surplus existed in Ontario Hydro's system and the utility could not use its full share of the water for power generation.

6.0 FORECAST OF FUTURE WATER LEVEL CONDITIONS

A six-month water level forecast for the Great Lakes and Montreal Harbour is shown in Figures 3-8. Water levels of the Great Lakes fluctuate according to weather conditions. Since it is not possible to accurately forecast weather conditions several months in advance, these forecasts are made assuming average, wet and dry weather conditions for the next six months.

Assuming most probable (average) water supplies over the next six months, the water levels on Lake Superior and Lakes Michigan-Huron will stay very close to their seasonal values whereas Lakes St. Clair and Erie will remain slightly above average. With average supplies, Lake Ontario is also expected to remain near average. A mild spell in January or February, similar to that in January 1995, could hasten the snow melt and raise Great Lakes and St. Lawrence River levels.

7.0 CONCLUSIONS

1. No extreme water level conditions occurred on the Great Lakes in 1995. Although the year had several storm events, there was no serious shoreline damage reported.

2. The mild winter of 1994-95 caused few ice-related problems on the Great Lakes. The winter of 1995-96 arrived early in November causing extensive ice cover formation in parts of the St. Lawrence River and the Welland Canal. Shipping experienced serious difficulties prior to the close of the Seaway season.

3. Very minor flow deviations from Lake Superior's regulation plan took place to allow for repairs to hydropower facilities in the St. Marys River.

4. Deviations from Lake Ontario's regulation plan resulted in 4 cm of water being stored on that lake by mid-June. This water was later released in September to help shipping at Montreal.

5. The relatively low water levels of the late summer and early fall were less than satisfactory for marinas and recreational boaters in the Thousand Islands area of the upper St. Lawrence River and on Lake St. Louis.

6. The record low water level conditions during the five months in 1995 were a source of considerable concern and economic loss for the Port of Montreal.

7. Declining Lake Ontario levels in the Fall of 1995 were a concern to some Bay of Quinte residents who depend on shore wells.

8. The lack of snowmelt and precipitation led to below average water level conditions on Lake Ontario in the spring and summer of 1995. The abundant rainfall in October and November reversed the condition on the lake.

9. At the end of 1995, Lake Superior and Lakes Michigan-Huron levels were at average, whereas Lakes St. Clair and Erie were 10-15 cm above average. Lake Ontario was slightly above average. Neither extreme high nor low water levels are forecast for the first half of 1996.

Table 1 Comparison of 1995 Great Lakes Basin Precipitation and Long-Term Average (millimetres)

Superior Basin

	1995	Percentage of average	Average 1900-1992	Previous Maxima and Minima (Year of Occurrence) Maximum	Minimum
Jan	40.6	82	49.4	91.4 (1935)	22.5 (1961)
Feb	46.0	123	37.2	84.4 (1939)	12.3 (1912)
Mar	39.9	89	44.4	101.6 (1979)	9.6 (1910)
Apr	48.0	97	49.2	105.6 (1960)	17.4 (1949)
May	86.9	126	68.6	129.4 (1970)	21.1 (1948)
Jun	33.8	40	83.3	151.4 (1943)	22.7 (1910)
Jly	88.9	107	82.1	141.7 (1952)	27.7 (1936)
Aug	103.9	127	81.6	185.9 (1988)	26.3 (1930)
Sep	108.5	122	89.4	163.5 (1941)	32.7 (1967)
Oct	136.6R	199	69.0	122.4 (1982)	15.6 (1947)
Nov	61.0	96	63.8	119.5 (1985)	11.0 (1939)
Dec	55.6	108	51.6	90.1 (1984)	9.0 (1913)
Sum	850	110	770		

Michigan-Huron Basin

	1995	Percentage of average	Average 1900-1992	Previous Maxima and Minima (Year of Occurrence) Maximum	Minimum
Jan	65.0	124	52.6	91.8 (1950)	20.5 (1956)
Feb	30.3	69	43.8	86.2 (1908)	14.3 (1969)
Mar	46.7	84	55.2	116.2 (1976)	15.1 (1958)
Apr	86.9	133	65.1	125.6 (1929)	25.6 (1946)
May	78.2	103	75.6	141.6 (1983)	31.0 (1925)
Jun	48.8	62	78.5	143.8 (1969)	29.3 (1988)
Jly	80.3	106	75.6	132.2 (1952)	29.9 (1936)
Aug	110.0	140	77.8	136.1 (1972)	23.8 (1927)
Sep	60.4	69	88.2	213.3 (1986)	29.6 (1979)
Oct	96.0	134	72.0	147.4 (1954)	13.9 (1924)
Nov	115.1	164	70.2	127.8 (1985)	18.6 (1904)
Dec	53.8	91	59.0	105.6 (1971)	14.4 (1913)
Sum	870	107	810		

Erie Basin

	1995	Percentage of average	Average 1900-1992	Previous Maxima and Minima (Year of Occurrence) Maximum	Minimum
Jan	96.5	158	61.1	160.5 (1950)	14.3 (1961)
Feb	32.0	60	52.9	117.1 (1990)	10.4 (1987)
Mar	46.2	65	70.6	170.6 (1913)	11.0 (1910)
Apr	99.3	126	79.1	152.1 (1961)	23.5 (1946)
May	89.2	106	83.8	175.8 (1943)	16.8 (1934)
Jun	81.3	94	86.6	167.9 (1937)	19.0 (1988)
Jly	63.5	75	84.6	190.5 (1992)	29.3 (1930)
Aug	70.9	87	81.0	179.7 (1975)	33.1 (1969)
Sep	27.9	35	79.8	176.0 (1926)	19.3 (1908)
Oct	91.4	132	69.6	196.2 (1954)	11.2 (1924)
Nov	98.3	136	71.8	191.8 (1985)	9.8 (1904)
Dec	42.2	64	66.7	160.0 (1990)	21.1 (1943)
Sum	840	94	890		

Table 1 (continued)

Ontario Basin

	1995	Percentage of average	Average 1900-1992	Previous Maxima and Minima (Year of Occurrence) Maximum	Minimum
Jan	96.3	143	67.3	137.2 (1978)	27.6 (1981)
Feb	40.4	67	60.2	112.5 (1971)	22.9 (1969)
Mar	36.1	53	67.8	143.4 (1936)	18.2 (1915)
Apr	53.8	73	72.9	126.6 (1929)	28.6 (1915)
May	62.0	79	78.2	144.7 (1943)	15.9 (1920)
Jun	34.5	44	77.6	159.1 (1972)	30.3 (1912)
Jly	78.0	99	79.4	159.5 (1992)	31.7 (1933)
Aug	95.2	120	79.3	142.3 (1977)	32.1 (1907)
Sep	50.8	63	80.8	159.2 (1945)	24.3 (1964)
Oct	163.3	214	76.8	211.5 (1955)	12.9 (1963)
Nov	131.3	166	78.5	168.0 (1927)	15.4 (1904)
Dec	52.3	71	74.1	139.9 (1990)	27.0 (1943)
Sum	890	100	890		

Great Lakes Basin

	1995	Percentage of average	Average 1900-1992	Previous Maxima and Minima (Year of Occurrence) Maximum	Minimum
Jan	66.3	121	54.6	100.5 (1950)	21.9 (1961)
Feb	36.1	80	45.1	80.1 (1908)	16.8 (1969)
Mar	43.7	79	55.6	110.7 (1976)	15.4 (1910)
Apr	74.2	117	63.5	106.0 (1929)	28.6 (1915)
May	80.3	107	75.0	116.1 (1983)	32.7 (1934)
Jun	47.2	58	80.6	121.1 (1968)	36.5 (1910)
Jly	80.0	101	78.9	123.7 (1992)	31.7 (1936)
Aug	101.4	127	79.4	128.1 (1977)	28.7 (1930)
Sep	67.8	79	86.4	166.2 (1986)	38.9 (1948)
Oct	114.3	161	71.4	127.0 (1954)	20.7 (1924)
Nov	100.1	144	69.6	136.7 (1985)	18.0 (1904)
Dec	52.6	88	59.8	92.5 (1983)	16.9 (1913)
Sum	860	105	820		

Source: Preliminary data provided by NOAA, Corps of Engineers
R denotes new record
Figures are in millimetres rounded to one decimal place.

Table 2 Great Lakes Water Levels in 1994 and 1995 and Their Comparison with Previous Records (Metres, IGLD-1985)

Lake Superior

	1994	1995	1918-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	183.39	183.33	183.35	183.70 (1986)	182.83 (1926)
Feb	183.32	183.24	183.29	183.63 (1986)	182.76 (1926)
Mar	183.28	183.19	183.26	183.61 (1986)	182.74 (1926)
Apr	183.30	183.20	183.29	183.68 (1986)	182.72 (1926)
May	183.40	183.26	183.39	183.74 (1986)	182.76 (1926)
Jun	183.46	183.31	183.47	183.76 (1986)	182.85 (1926)
Jul	183.53	183.37	183.54	183.82 (1950)	182.96 (1926)
Aug	183.56	183.40	183.57	183.86 (1950)	183.02 (1926)
Sep	183.59	183.44	183.57	183.86 (1985)	183.12 (1926)
Oct	183.56	183.49	183.54	183.91 (1985)	183.10 (1925)
Nov	183.50	183.48	183.50	183.89 (1985)	183.01 (1925)
Dec	183.42	183.41	183.43	183.81 (1985)	182.92 (1925)

Lakes Michigan-Huron

	1994	1995	1918-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	176.57	176.53	176.35	177.18 (1987)	175.60 (1965)
Feb	176.56	176.49	176.33	177.11 (1986)	175.59 (1964)
Mar	176.59	176.47	176.35	177.12 (1986)	175.58 (1964)
Apr	176.63	176.49	176.43	177.23 (1986)	175.61 (1964)
May	176.70	176.58	176.53	177.28 (1986)	175.74 (1964)
Jun	176.72	176.64	176.59	177.33 (1986)	175.76 (1964)
Jul	176.81	176.63	176.62	177.39 (1986)	175.78 (1964)
Aug	176.81	176.64	176.60	177.39 (1986)	175.77 (1964)
Sep	176.78	176.55	176.55	177.38 (1986)	175.76 (1964)
Oct	176.71	176.46	176.49	177.50 (1986)	175.70 (1964)
Nov	176.65	176.44	176.43	177.38 (1986)	175.65 (1964)
Dec	176.59	176.41	176.38	177.26 (1986)	175.62 (1964)

Lake St. Clair

	1994	1995	1918-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	175.05	175.22	174.82	175.80 (1986)	173.88 (1936)
Feb	175.16	175.09	174.76	175.80 (1986)	173.89 (1926)
Mar	175.18	175.08	174.89	175.80 (1986)	174.05 (1934)
Apr	175.31	175.19	175.04	175.82 (1986)	174.32 (1926)
May	175.37	175.26	175.12	175.83 (1986)	174.42 (1934)
Jun	175.40	175.31	175.17	175.92 (1986)	174.45 (1934)
Jul	175.49	175.34	175.18	175.93 (1986)	174.50 (1934)
Aug	175.48	175.35	175.15	175.90 (1986)	174.41 (1934)
Sep	175.39	175.22	175.08	175.84 (1986)	174.34 (1934)
Oct	175.29	175.08	175.00	175.96 (1986)	174.27 (1934)
Nov	175.18	175.05	174.91	175.82 (1986)	174.18 (1934)
Dec	175.16	175.01	174.91	175.80 (1986)	174.24 (1964)

(Continued on next page)

Table 2 (Continued)

Lake Erie

	1994	1995	1918-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	174.21	174.24	173.98	174.86 (1987)	173.21 (1935)
Feb	174.18	174.26	173.96	174.78 (1987)	173.18 (1936)
Mar	174.28	174.29	174.05	174.88 (1986)	173.20 (1934)
Apr	174.48	174.37	174.20	174.98 (1985)	173.38 (1934)
May	174.54	174.43	174.29	174.97 (1986)	173.44 (1934)
Jun	174.53	174.46	174.32	175.04 (1986)	173.45 (1934)
Jul	174.58	174.43	174.30	175.03 (1986)	173.45 (1934)
Aug	174.53	174.41	174.24	174.94 (1986)	173.43 (1934)
Sep	174.42	174.25	174.15	174.83 (1986)	173.38 (1934)
Oct	174.31	174.16	174.05	174.94 (1986)	173.30 (1934)
Nov	174.24	174.10	173.98	174.85 (1986)	173.20 (1934)
Dec	174.21	174.09	173.98	174.90 (1986)	173.19 (1934)

Lake Ontario

	1994	1995	1918-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	74.55	74.54	74.55	75.16 (1946)	73.81 (1935)
Feb	74.52	74.72	74.58	75.27 (1952)	73.78 (1936)
Mar	74.55	74.72	74.66	75.37 (1952)	73.94 (1935)
Apr	74.87	74.70	74.87	75.65 (1973)	74.03 (1935)
May	75.10	74.80	75.00	75.73 (1973)	74.11 (1935)
Jun	75.08	74.90	75.04	75.76 (1952)	74.19 (1935)
Jul	75.02	74.90	74.98	75.66 (1947)	74.14 (1934)
Aug	74.93	74.88	74.87	75.58 (1947)	74.00 (1934)
Sep	74.78	74.70	74.74	75.41 (1947)	73.91 (1934)
Oct	74.62	74.65	74.61	75.22 (1945)	73.82 (1934)
Nov	74.54	74.70	74.54	75.18 (1945)	73.75 (1934)
Dec	74.50	74.65	74.52	75.20 (1945)	73.74 (1934)

Montréal Harbour (Jetty No.1)

	1994	1995	Average 1967-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	6.48	6.63	6.95	8.96 (1968)	6.18 (1992)
Feb	6.87	6.64	7.13	9.04 (1967)	6.34 (1989)
Mar	6.58	7.10	7.13	8.36 (1973)	6.13 (1989)
Apr	7.18	6.23R	7.66	8.82 (1976)	6.44 (1989)
May	7.02	6.13R	7.42	8.93 (1974)	6.42 (1968)
Jun	6.79	6.14	6.84	8.12 (1974)	5.93 (1988)
Jul	6.81	5.66R	6.58	7.49 (1973)	5.72 (1988)
Aug	6.46	5.84R	6.49	7.27 (1972)	5.93 (1991)
Sep	6.18	5.64R	6.43	7.08 (1986)	5.85 (1991)
Oct	6.02	5.83	6.50	7.16 (1986)	5.82 (1991)
Nov	6.19	6.58	6.62	7.31 (1967)	5.64 (1991)
Dec	6.20	6.56	6.68	7.24 (1972)	5.87 (1978)

Source: Environment Canada, Ontario Region
R denotes new record.
December 1995 figures are preliminary.

Table 3 Outflows from the Great Lakes in 1994 and 1995 (cubic metres per second)

Lake Superior

	1994	1995	Average 1900-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	2120	2160	1950	2630 (1971)	1250 (1922)
Feb	2150	2030	1910	2610 (1969)	1270 (1922)
Mar	2130	1730	1880	2690 (1969)	1290 (1982)
Apr	2050	1810	1950	2940 (1951)	1300 (1922)
May	2390	1950	2120	3450 (1951)	1250 (1931)
Jun	2340	1850	2200	3480 (1951)	1220 (1922)
Jul	2190	1700	2280	3570 (1938)	1270 (1922)
Aug	2210	1990	2370	3600 (1950)	1270 (1926)
Sep	2140	1730	2360	3570 (1950)	1160 (1955)
Oct	2140	1920	2300	3510 (1968)	1250 (1926)
Nov	2160	2370	2260	3750 (1985)	1250 (1981)
Dec	2180	2040	2070	3170 (1950)	1310 (1981)
Annual	2180	1940	2140		

Lakes Michigan-Huron

	1994	1995	Average 1900-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	4200	5320	4500	6060 (1987)	3060 (1934)
Feb	4960	4780	4370	5720 (1974)	3000 (1942)
Mar	5380	4940	4820	5830 (1986)	3510 (1931)
Apr	5460	5250	5140	6260 (1986)	3600 (1901)
May	5580	5390	5360	6370 (1986)	4390 (1964)
Jun	5580	5460	5460	6430 (1985)	4420 (1964)
Jly	5630	5370	5520	6570 (1974)	4500 (1964)
Aug	5680	5320	5520	6630 (1986)	4530 (1964)
Sep	5690	5410	5480	6600 (1986)	4470 (1933)
Oct	5620	5230	5430	6740 (1986)	4420 (1933)
Nov	5550	5340	5370	6650 (1986)	4390 (1934)
Dec	5430	5210	5190	6230 (1986)	3990 (1935)
Annual	5400	5250	5180		

(Continued on next page)

Table 3 (Continued)

Lake Erie

	1994	1995	Average 1900-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	5850	6490	5600	7420 (1987)	4050 (1936)
Feb	5820	6090	5480	7050 (1987)	3340 (1936)
Mar	6160	6210	5640	7480 (1986)	4110 (1934)
Apr	6440	6390	5920	7700 (1974)	4390 (1935)
May	6800	6540	6210	7760 (1974)	4590 (1934)
Jun	6450	6200	6240	7820 (1986)	4560 (1934)
Jly	6590	6340	6120	7670 (1986)	4450 (1934)
Aug	6550	6130	6020	7420 (1986)	4470 (1934)
Sep	6350	5800	5910	7140 (1986)	4450 (1934)
Oct	6140	5940	5810	7450 (1986)	4420 (1934)
Nov	6420	6160	5810	7280 (1986)	4280 (1934)
Dec	6190	6010	5800	7620 (1985)	4330 (1934)
Annual	6310	6190	5880		

Lake Ontario

	1994	1995	Average 1900-1993	Previous Recorded Maxima & Minima (Year of Occurrence) Maximum	Minimum
Jan	6440	6520	6290	8470 (1987)	4700 (1935)
Feb	7030	6740	6350	8160 (1986)	4360 (1936)
Mar	7090	7480	6650	8890 (1991)	5010 (1935)
Apr	7370	7160	7080	9200 (1973)	5070 (1964)
May	8020	6460	7330	10100 (1993)	4980 (1965)
Jun	8150	6640	7430	10010 (1993)	5350 (1965)
Jly	7900	6660	7370	9910 (1976)	5520 (1934)
Aug	7690	6920	7210	9340 (1974)	5300 (1934)
Sep	7660	6890	7020	9230 (1986)	5100 (1934)
Oct	7550	6880	6840	9170 (1986)	4960 (1934)
Nov	7440	7560	6720	9570 (1986)	4810 (1934)
Dec	7250	7180	6600	9260 (1986)	4810 (1934)
Annual	7470	6920	6910		

Source: Environment Canada, Ontario Region

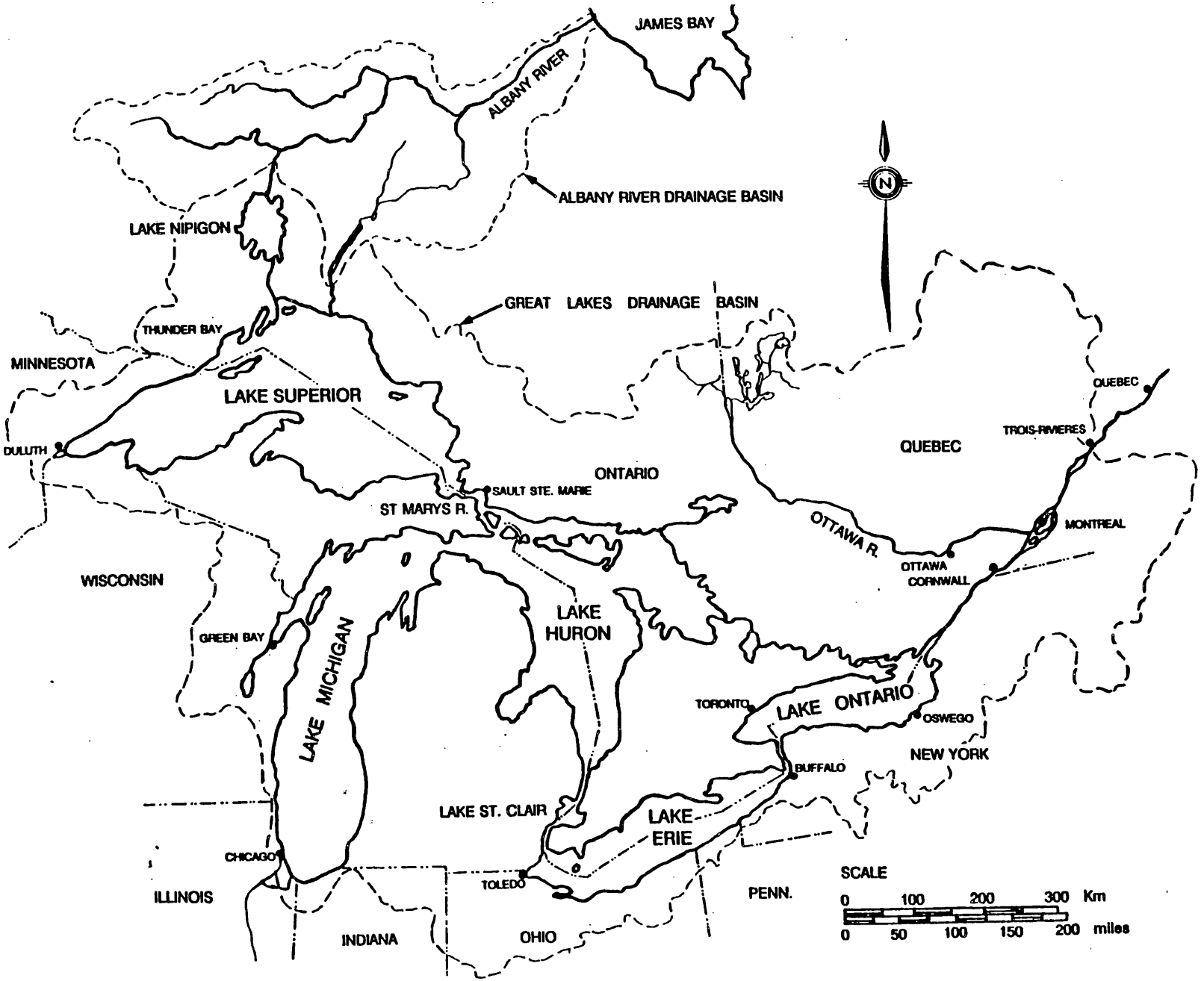

FIGURE 1. **Great Lakes-St. Lawrence River Basin**

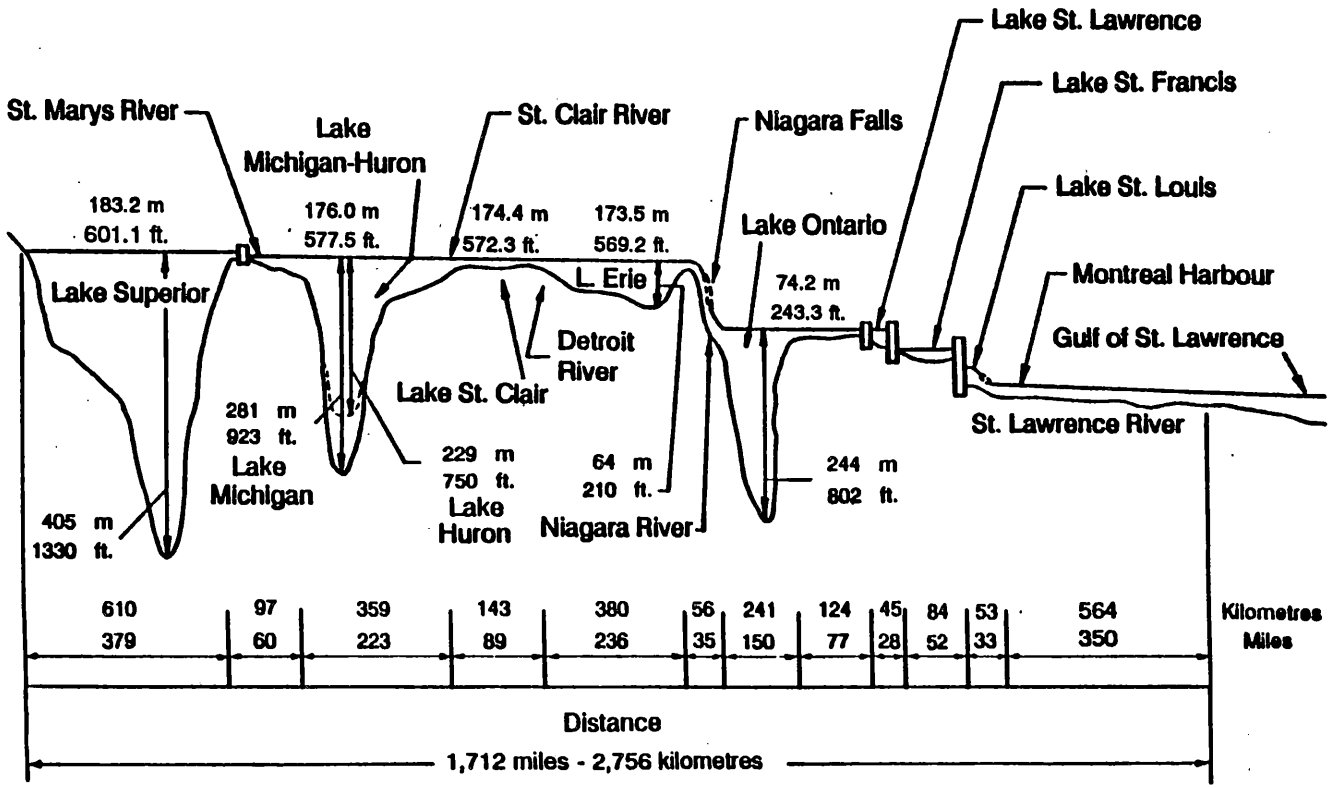

FIGURE 2. **Profile of Great Lakes-St. Lawrence River System**

FIG.3 LAKE SUPERIOR MONTHLY MEAN LEVEL

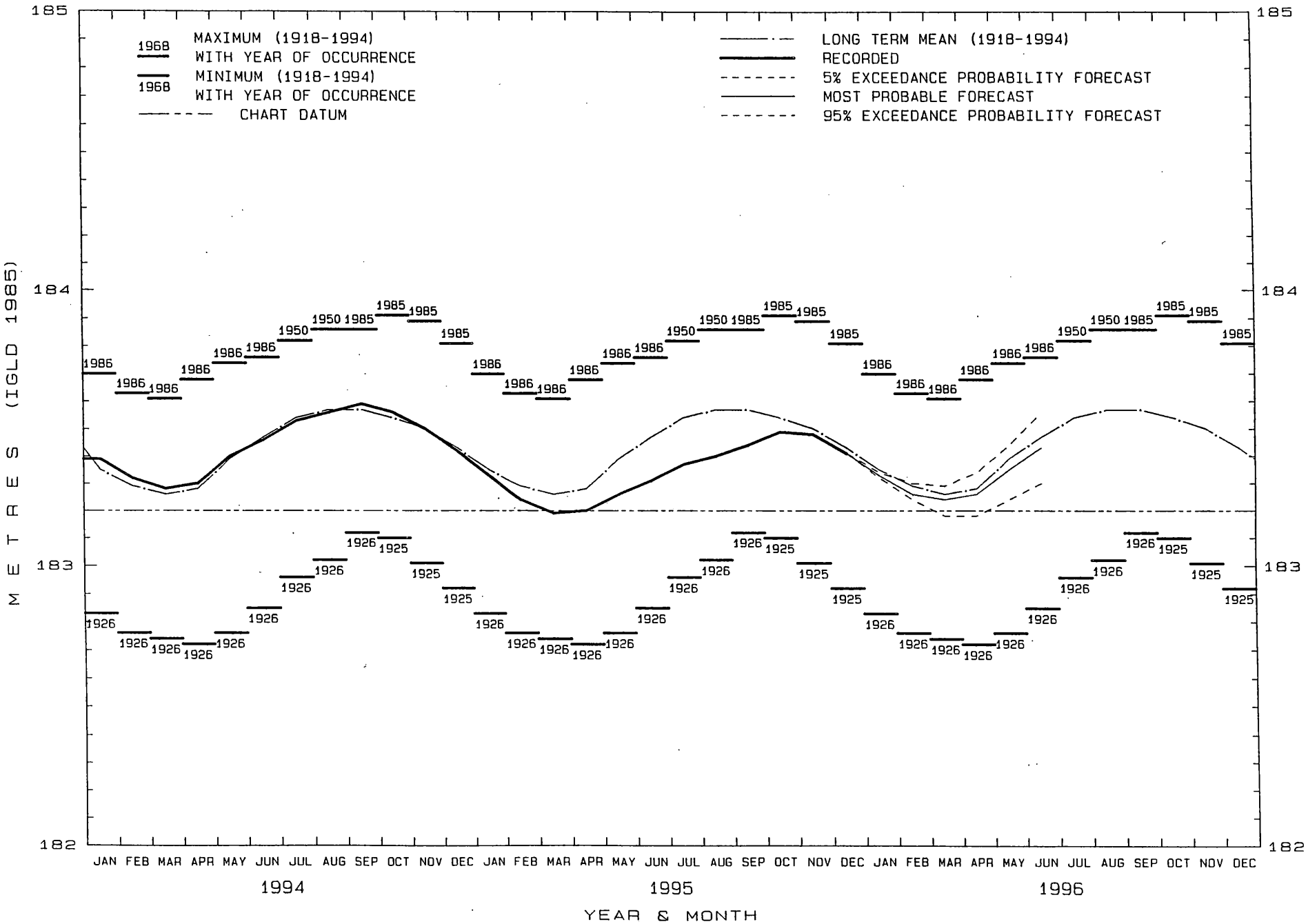

FIG.4 LAKE MICHIGAN-HURON MONTHLY MEAN LEVEL

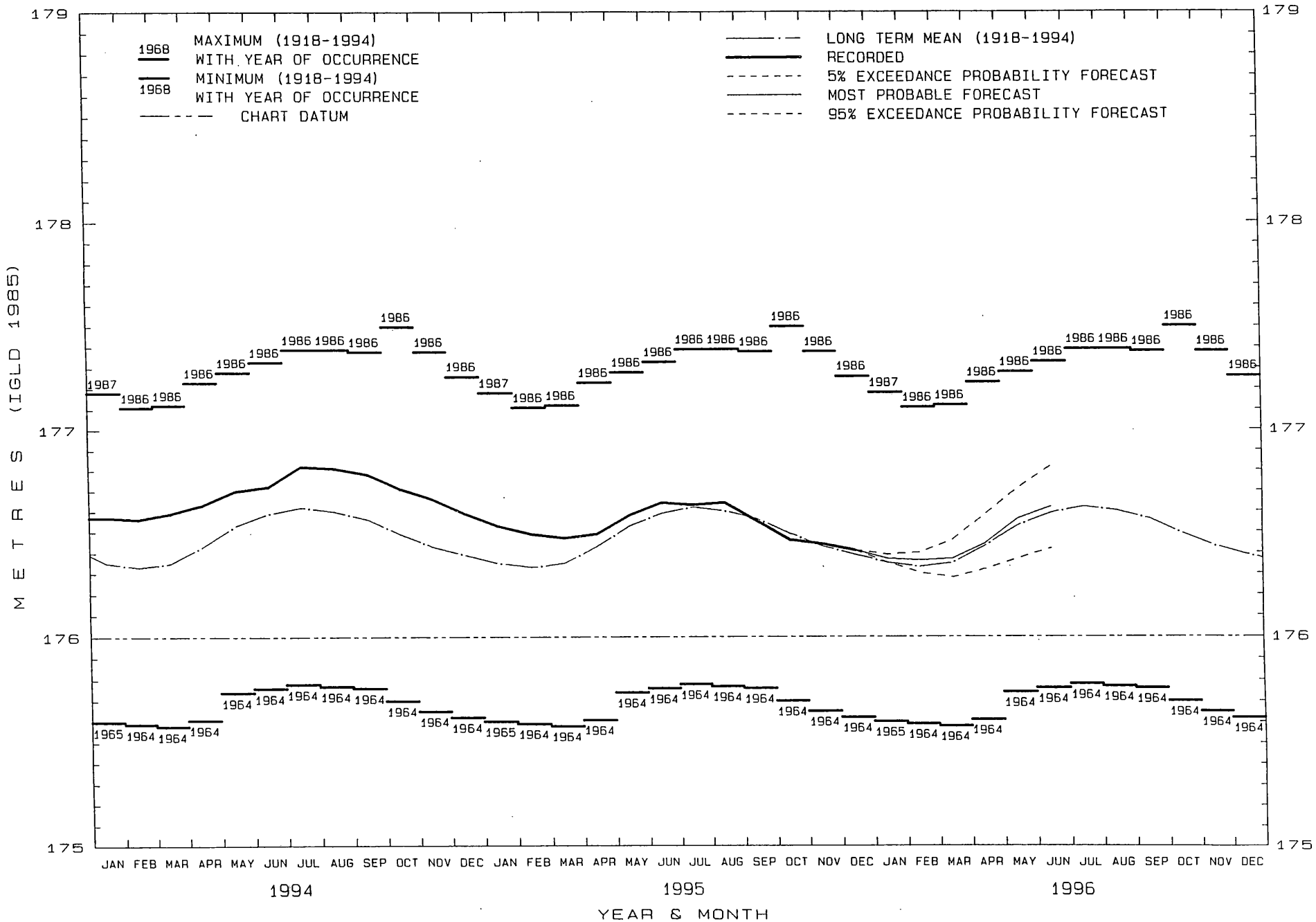

FIG.5 LAKE ST. CLAIR MONTHLY MEAN LEVEL

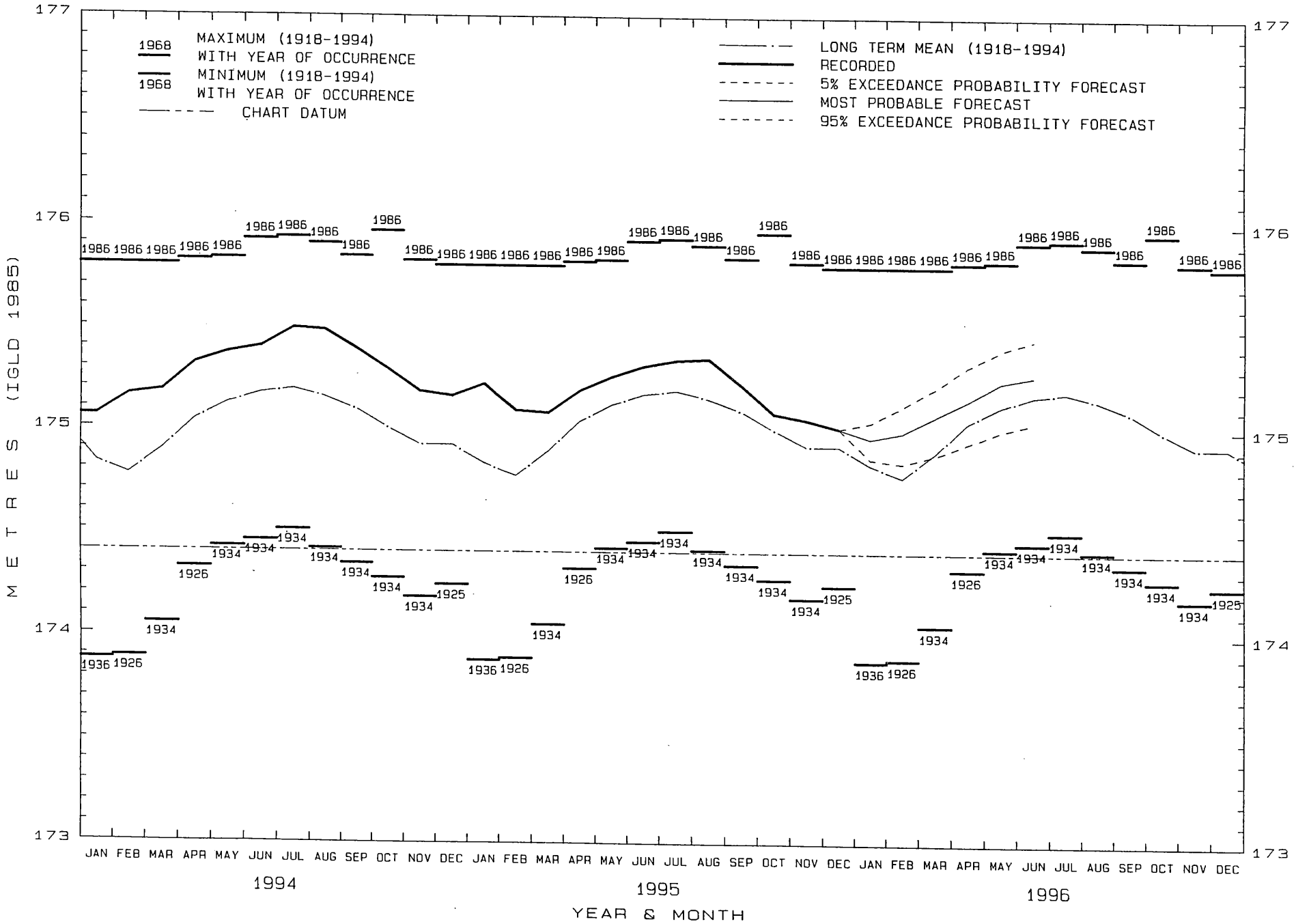

FIG.6 LAKE ERIE MONTHLY MEAN LEVEL

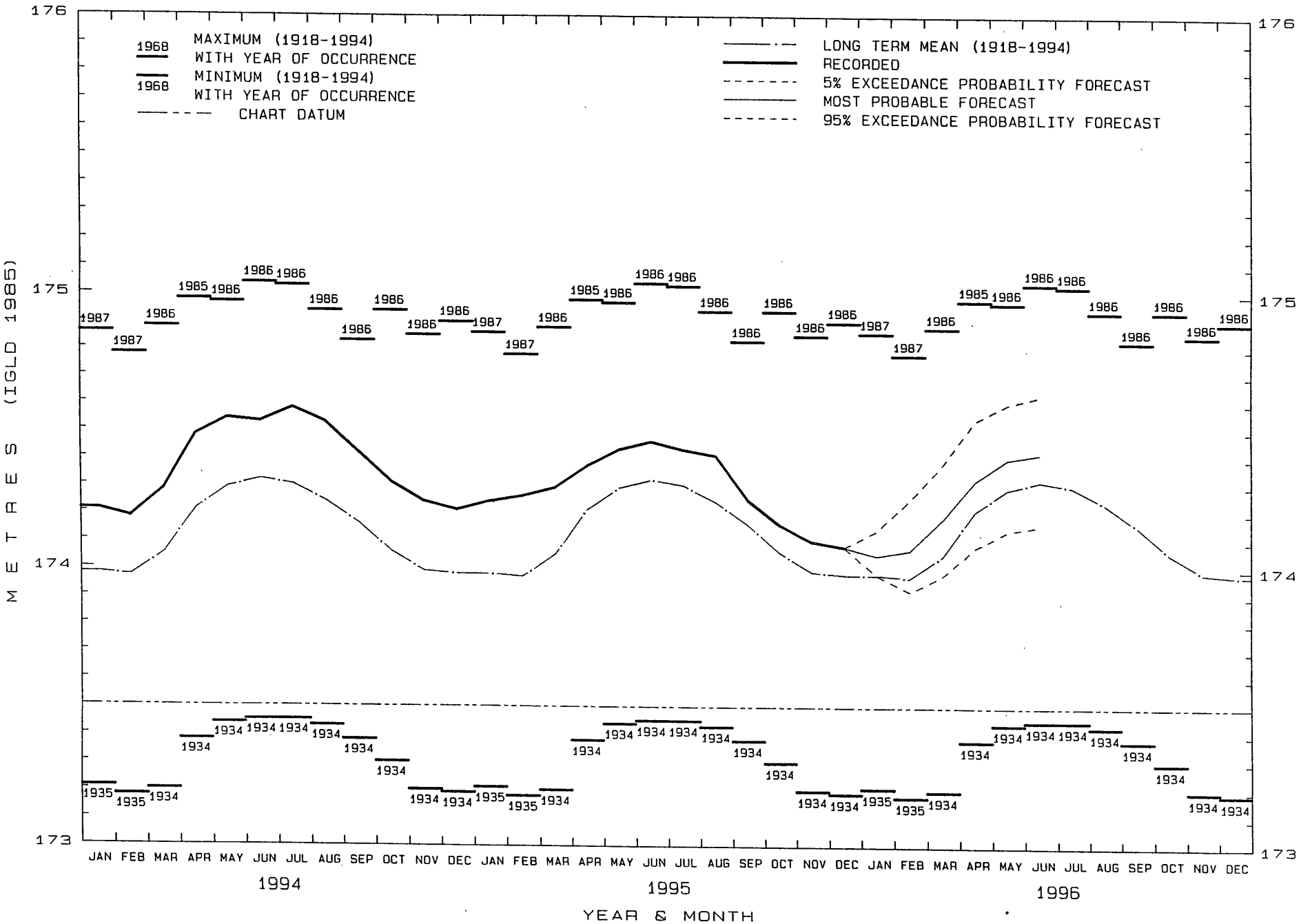

FIG.7 LAKE ONTARIO MONTHLY MEAN LEVEL

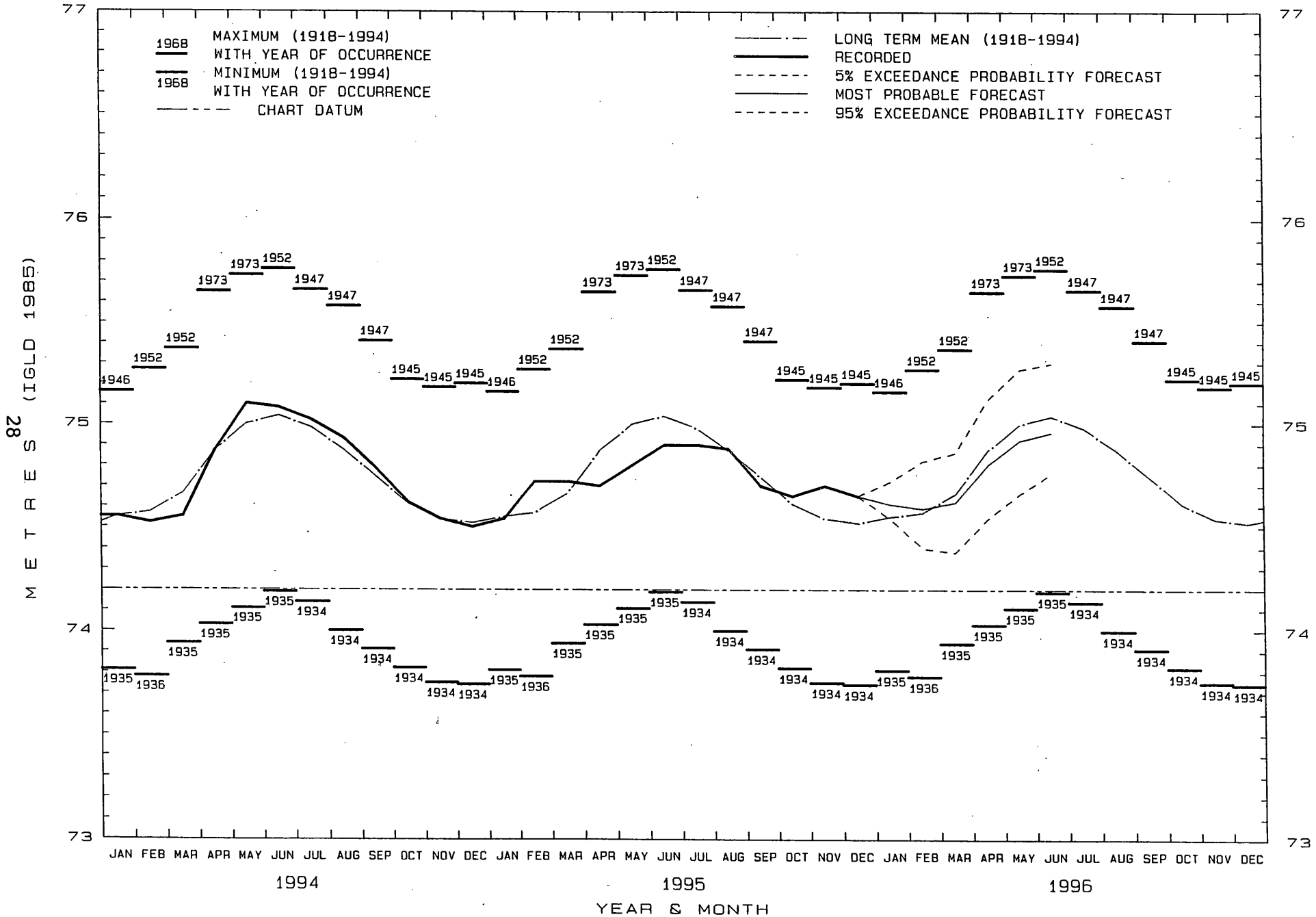
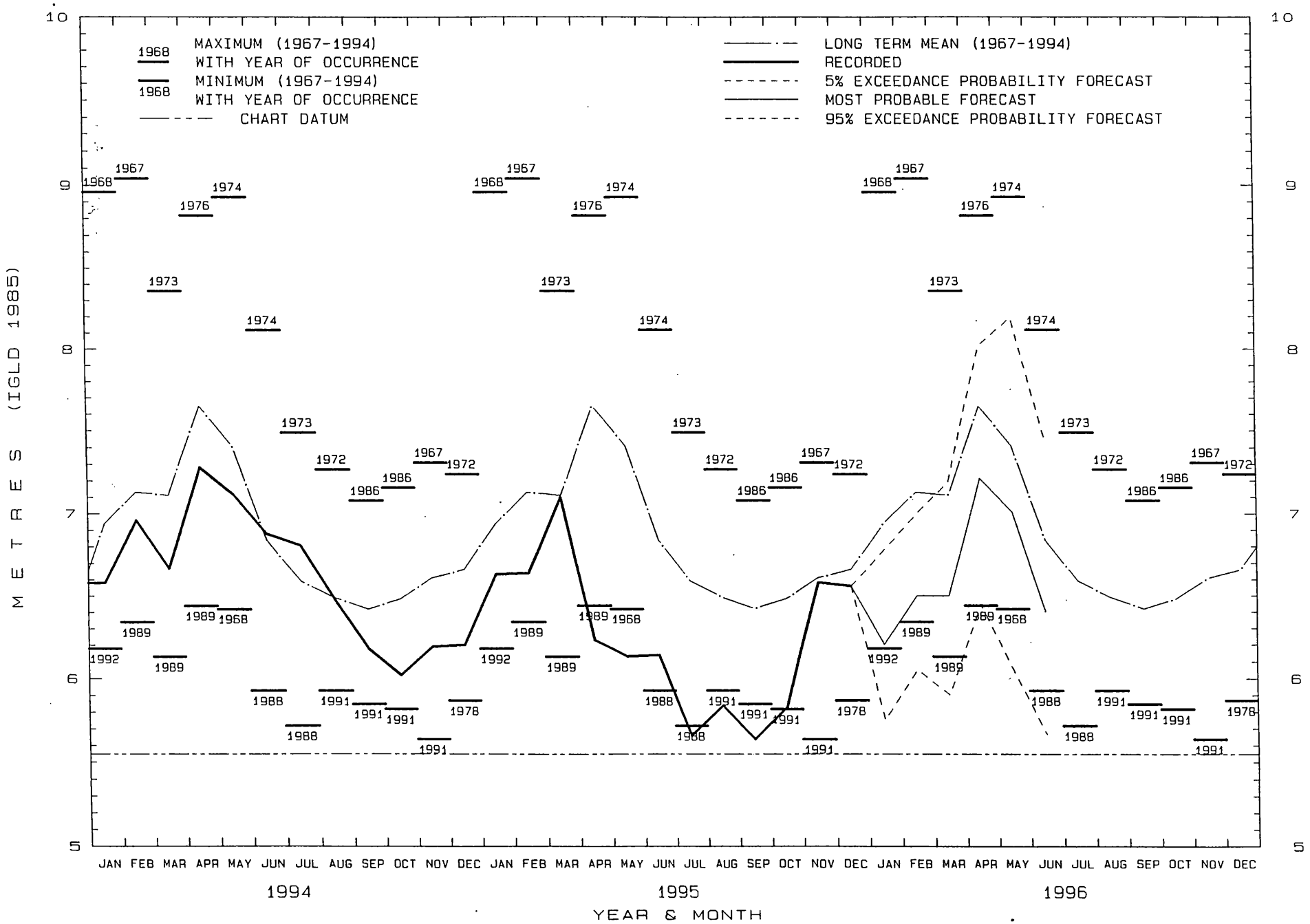
FIG.8 MONTREAL HARBOUR (JETTY NO.1)