

Prepared by the North American Ice Service

**A collaboration of the Canadian Ice Service and
the National/Naval Ice Center**

2 December 2010

**Seasonal Outlook
Great Lakes
Winter 2010-2011**



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Great Lakes

WINTER 2010-2011

Introduction

This outlook of the expected pattern, timing, and the extent of ice growth attempts to identify areas and periods where conditions should be more or less favourable than normal. It has been developed through an analysis of the oceanographic and meteorological parameters for the summer and the fall preceding the ice season. These conditions are compared with earlier years, the December wind and temperature forecasts plus the seasonal temperature outlook. A prediction of the ice regime is then produced. **It should be noted that significant variations of these conditions will have an impact on the timing and extent of ice formation.**

Throughout the winter, this outlook will be updated by a twice monthly issue of 30-day forecasts. These forecasts will also indicate the beginning of the spring break-up process throughout the area.

Mariners planning operations in waters impacted by hazardous ice conditions may obtain details regarding ice conditions by consulting the CIS website at <http://www.ec.gc.ca/glaces-ice/>, or by contacting their regional MCTS centre (http://www.ccg-gcc.gc.ca/eng/Ccg/mcts_Home).

General Seasonal Outlook

Temperatures over the Great Lakes during the past summer were slightly above normal and that trend has so far continued into the fall. La Nina conditions are now occurring in the Pacific Ocean and are forecast to persist through the winter. Typically La Nina brings colder temperatures over the Great Lakes and more severe than normal ice conditions. However, temperatures were milder than normal over the Great Lakes during the last 4 La Nina (1998-1999, 1999-2000, 2000-2001 and 2007-2008). This is consistent with the positive temperature trend experienced over the last decade.

Near normal temperatures are forecast over the Great Lakes for the month of December. This temperature trend is forecast to persist for the rest of the winter.

The surface water temperature anomalies over the Great Lakes on November 25 are depicted in Figure 2. Water temperatures were in general near to warmer than normal. At the beginning of December ice free conditions prevailed over the Great Lakes except for new lake ice in Black Bay.

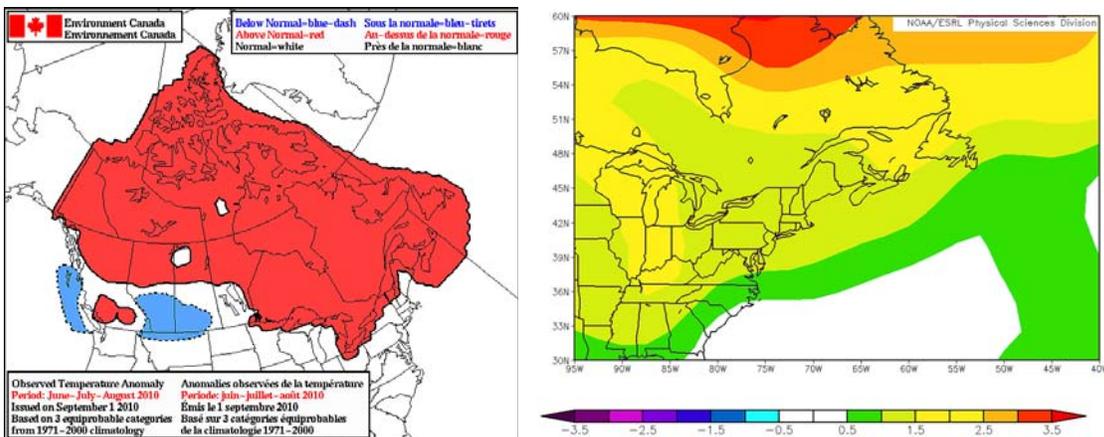


Figure 1: Temperature anomaly, June to August from CMC and September 1st to November 27th from NOAA

Table 1: Departure from normal temperatures over the last month (to November 29th 2010)

	Normal Temperatures	Observed	Departure
Duluth	-1.2	0	1.2
Thunder Bay	-1.8	0.2	2.0
Gore Bay	2.5	4.4	1.9
Sault Ste Marie	1.4	3.2	1.8
Chicago	5.3	6.4	1.1
Wiaraton	3.4	5.1	1.7
Windsor	5.5	6.8	1.3
Buffalo	5.4	6.3	0.9
Toronto	3.9	5.6	1.7
Trenton	3.3	4.5	1.2
Average	2.8	4.3	1.5

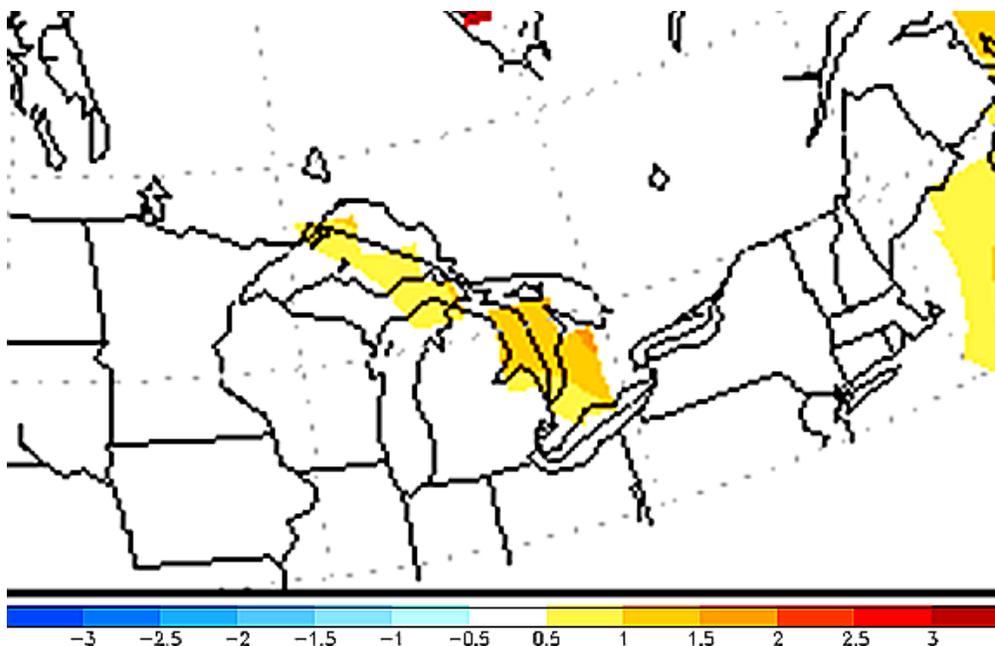


Figure 2: Water temperature anomalies – 24 November (NOAA)

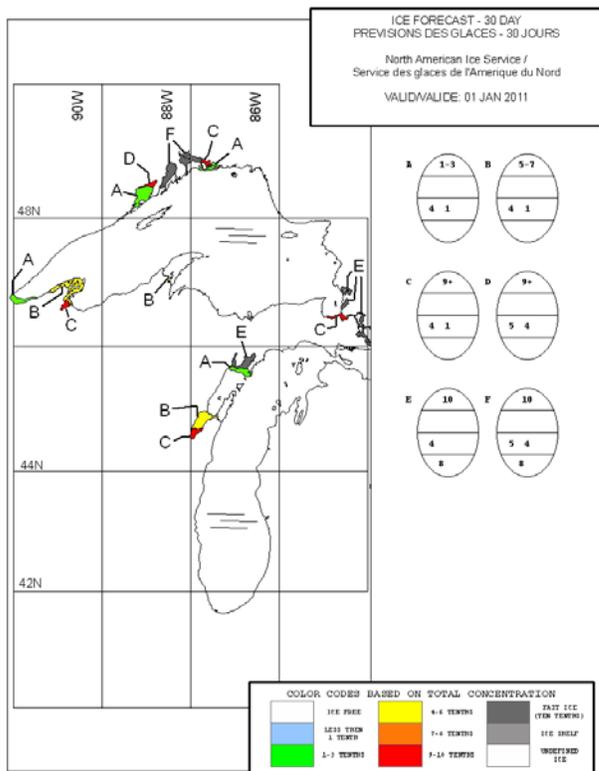


Figure 3: Expected ice conditions - western Great Lakes - 1 January 2011

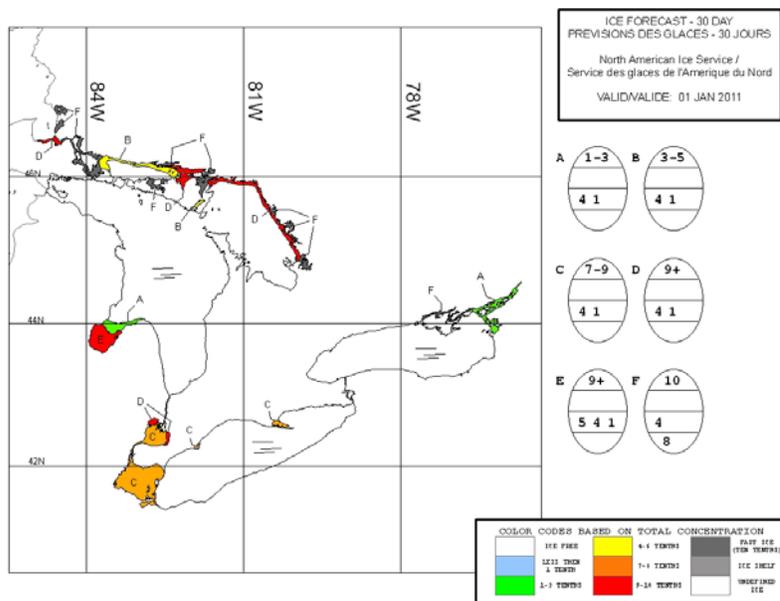


Figure 4: Expected ice conditions - eastern Great Lakes - 1 January 2011

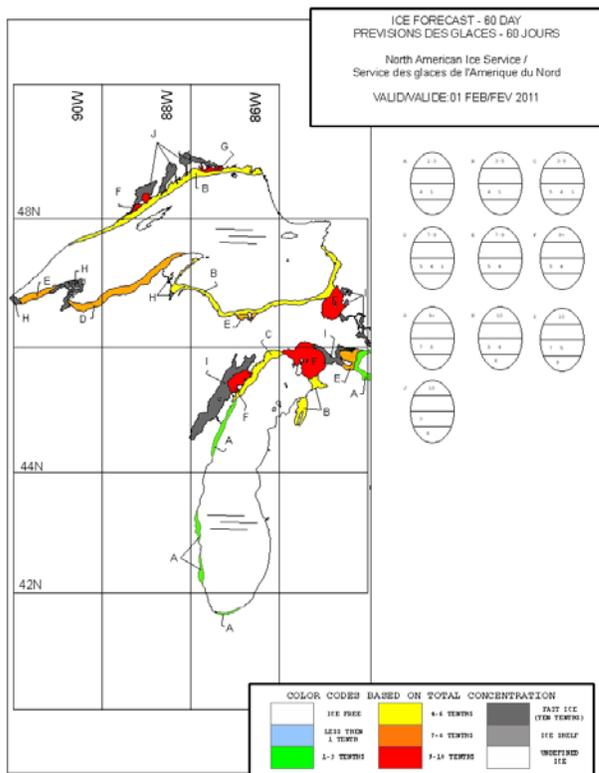


Figure 5: Expected ice conditions - western Great Lakes - 1 February 2011

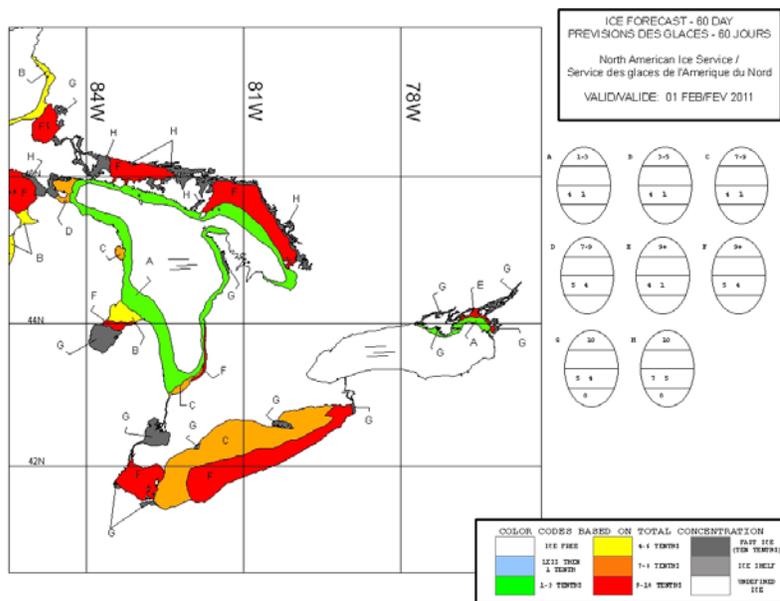


Figure 6: Expected ice conditions - eastern Great Lakes - 1 February 2011

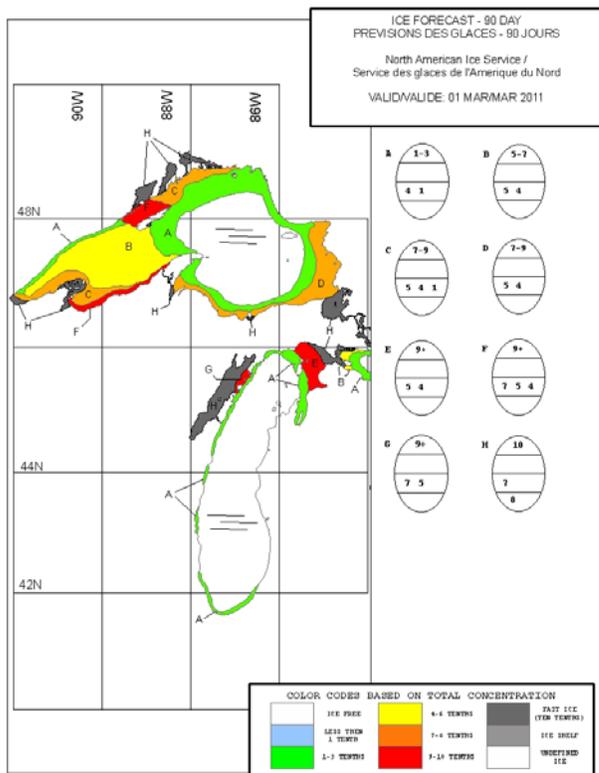


Figure 7: Expected ice conditions - western Great Lakes - 1 March 2011

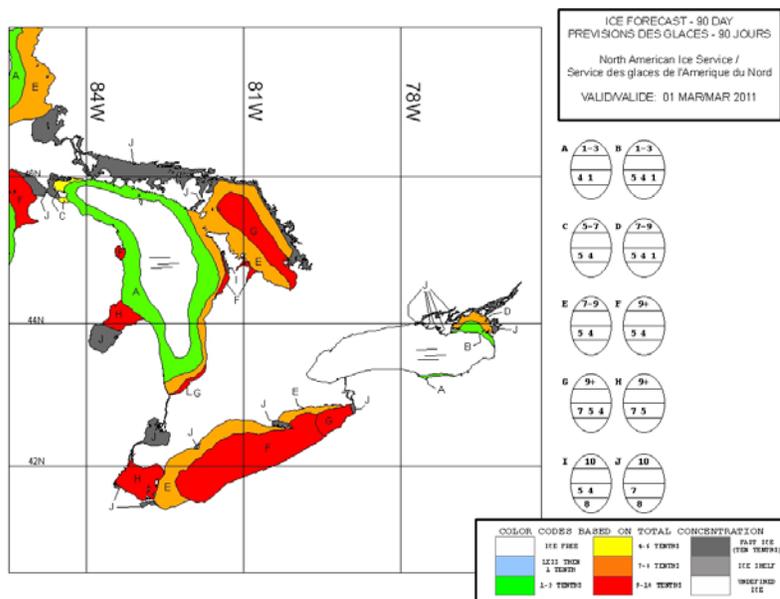


Figure 8: Expected ice conditions - eastern Great Lakes - 1 March 2011

Lake Superior

Near the end of November water temperatures in Lake Superior were generally near normal (Figure 2). Normal air temperatures are expected for December. New and thin lake ice will continue to develop in Nipigon Bay, Black Bay and Chequamegon Bay in the first week of December. New and thin lake ice will develop in shallow bays along the St-Mary's River in the second week of December. New and thin lake ice will develop in the rest of St. Mary's River in the 3rd week of December. New and thin lake ice will develop in Thunder Bay, near Duluth, around the Apostle Islands and in shallow bays of Whitefish Bay during the last week of December. Nipigon and Black Bays will consolidate near mid-month with thin lake ice. Consolidated thin lake ice will be found late in the month in St Mary's River. In the rest of the lake ice free conditions will prevail except for open water along the shore. Figure 3 indicates the expected ice conditions on January 1st 2011.

Near normal temperatures are generally expected for the months of January and February in Lake Superior. The ice in Black Bay and Nipigon Bay will reach the thick lake ice stage in the 1st week of January 2011. New and thin lake ice will cover most of Thunder Bay with some consolidated thick lake ice along the shore at the end of the first week of January. By that time a narrow band of new and thin lake ice will extend from the Apostle Islands to Duluth. New and thin lake ice will be found in the shallow bays around Whitefish Bay and consolidated medium and thick lake ice will cover St. Mary's River. New and thin lake ice will be found in a narrow band along the south shore of Lake Superior and just outside of Thunder Bay, Nipigon Bay and Black Bay near mid-January. Also around mid-January, mobile new and thin lake ice will be found in Whitefish bay with some consolidated medium lake ice in shallow coastal areas around the bay. Thin to medium lake ice will consolidate around the Apostle Islands in the second half of January. A band of ice along the south shore of the lake west of the Keweenaw Peninsula, including the approaches to Duluth, will thicken to thin and medium lake ice in the last week of January and extend at most 10 to 20 miles offshore. Mostly consolidated thick lake ice will be found in Thunder Bay, Nipigon Bay, Black Bay and Chequamegon Bay. A narrow band of thin lake ice will exist from Grand Marais Minnesota to Marathon Ontario. Also in the second half of January, a 5 to 15 miles wide band of thin lake ice will develop along the east shore of the lake south of Michipicoten Bay. At that time, mobile medium lake ice will cover Whitefish Bay. Figure 5 indicates the expected ice conditions on February 1st 2011.

The ice will continue to develop during the first half of February at a somewhat slower pace than normal. Thunder Bay will remain consolidated with thick lake ice except for large pieces of consolidated ice breaking off and drifting south. A band of thin lake ice will still be present from Grand Marais to Marathon but with some medium and thick lake ice northwest of Isle Royale. Along the

southern and eastern shores of Lake Superior, and in the approaches to Whitefish Bay, a 10 to 25 mile wide band of thin to medium lake ice will continue to exist. In the second half of February, this band of ice will thicken to medium to thick lake ice west of the Keweenaw Peninsula. Whitefish Bay will be mostly covered with mobile medium and thick lake ice but will be consolidated thick lake ice at the end of the month. At the end of the month the middle portion of the lake between the Keweenaw Peninsula and the western shores will be covered with open drift to close pack thin lake ice. Ice conditions expected on March 1st are depicted in figure 7.

In early March, thin to medium lake ice will extent seaward from the eastern shore of the lake to Michipicoten Island with consolidated thick lake ice along the shore. Ice at the peak of the season, just before mid-March, will reach a below normal extent and thickness in Lake Superior. Areas of close to very close pack medium to thick lake ice will be present around most of Lake Superior but a larger than normal area of open water will exist in the eastern portion of the lake. In the middle of the lake between the Keweenaw Peninsula and the western shore of Lake Superior, concentrations will vary from open drift to very close pack thin and medium lake ice.

Limited ice development is expected after the first half of March as temperatures start to increase. In the 3rd week of March ice conditions are expected to be somewhat easier than normal. Assuming near normal temperature in the second half of March break-up should proceed at a close to normal pace.

Lake Michigan

In Lake Michigan water temperature, at the end of November, were in general near normal except slightly above normal in the northern section (Figure 2). Air temperature for the month of December should average near normal.

Patches of new lake ice will develop in Little and Big Bay de Noc as well as in southern Green Bay during the second week of December. Ice will continue to develop in these areas and shortly after Christmas Day, Little and Big Bay de Noc will be covered with consolidated thin lake ice. Elsewhere at the end of the year open water to ice free will prevail in Lake Michigan except for areas of thin lake ice covering the southern third of green Bay. Ice conditions on January 1st are depicted in figure 3.

Near normal temperatures are generally forecast for the Great Lakes area in January and February. The ice will gradually spread in the rest of Green Bay during the first half of January and at mid-month medium lake ice will

predominate inside most of the bay. At that time the consolidated lake ice in the southern section would have expanded northward to cover the southern third of the bay. Strips and patches of new lake ice will start to form in the northeast end of the lake, near the entrance to the Straits of Mackinac, early in the New Year. By mid-month thin and medium lake ice will cover the northeast section of the lake east of Beaver Island including the approaches to the Straits of Mackinac and the strait itself. The consolidated ice in Green Bay will keep expanding in the second half of January and at the end of the month only the northern section near the entrance will remain mobile. Medium lake ice will remain the predominant ice type in the bay. In the northeast section of Lake Michigan the ice will gradually thicken to mainly medium lake ice before the end of the month with some consolidated ice developing along the shore. Bands of new and thin lake ice will occasionally develop along the rest of the shores but will melt as they are pushed towards the middle section of the lake. Loose areas of new and thin lake ice will develop in Little and Grand Traverse Bay late in January. Figure 5 indicates the expected ice conditions on February 1st, 2011.

The Straits of Mackinac and its approaches will consolidate with medium lake ice in the first week of February. A week later thick lake ice will generally predominate in the strait. The area of medium lake ice in the northeast section of the lake will expand westward to just west of Beaver Island near mid-February. Patchy areas of thin lake ice will be found in Little and Grand Traverse Bay. Little change is expected in Green Bay in the first half of February except for the thickening of the ice to the thick lake ice stage by mid-month. Narrow bands of thin with some medium lake ice will generally be found along most of the shores, including in the approaches to Chicago, in the first two weeks of February.

Little change is expected in the second half of February in most of the lake as temperatures start to increase except for the melting of the coastal ice in the southern half of the lake.

With near to above normal temperatures expected in March, and the facts that the ice extents and thicknesses are somewhat less than normal, break-up and clearing of Lake Michigan will occur a little earlier than normal. Figure 7 indicates the expected ice conditions on March 1st, 2011.

Lake Huron and Georgian Bay

Near or above normal water temperatures were generally observed in Lake Huron and Georgian Bay in late November (Figure 2). Temperatures are forecast to be near normal in the December to February period.

New and thin ice lake ice will develop in narrow bands along the coast in Saginaw Bay and in shallow bays in the North Channel and along the eastern shores of Georgian Bay during the second week of December. Most of Saginaw Bay will be covered with new and thin lake ice in the third week of December. At

that time, consolidated thin lake ice will be present in shallow bays around the North Channel and in eastern and northern Georgian Bay. Narrow bands of new and thin lake ice will also be present along the shores of the North Channel and in eastern and northern Georgian Bay. Also in the third week of December, narrow bands of new lake ice will occasionally form along the shores of Lake Huron. This will persist into the last week of December. A map of the expected ice conditions on January 1st 2011 is shown in figure 4.

Ice will continue to develop at a slower than normal pace in January and February. Consolidated thin lake ice will appear in shallow coastal areas of Saginaw Bay in the first week of January. Mobile medium lake ice will be present in Saginaw Bay near mid-January with consolidated medium lake ice along the shores. Also at that time, consolidated medium lake ice will be found in the shallow bays of the North Channel and in northern and eastern Georgian Bay. Narrow areas of new and thin lake ice will be found along the shores of Lake Huron. Thin and medium lake ice will be found in the approaches to the Straits of Mackinac and in the strait itself. Also around mid-January, the North Channel will become covered with thin and medium lake ice. New and thin lake ice will be extending seaward by up to 10 miles in Georgian Bay and around the shores of Lake Huron. In the last week of January consolidated medium lake ice will predominate in the North Channel with consolidated thick lake ice appearing in the shallow areas. Consolidated thick lake ice will also be present in shallow coastal waters of northeastern Georgian Bay. Thin to medium lake ice will cover 40 to 60 percent of Georgian Bay. Thin to medium lake ice will be found within 10 miles of the eastern shore of Lake Huron. New to thin lake ice will extend within up to 20 miles of the western shores of the lake with consolidated medium lake ice in Saginaw Bay and in the shallower bays of Lake Huron. The expected ice conditions on February 1st are shown in figure 6.

In the first week of February, more ice will be grow in the southern portion of Lake Huron; the southern portion of the lake will be 30 to 40 percent ice covered with mostly with new and thin lake ice and consolidated medium lake ice will be found west of Bois Blanc Island and in the Straits of Mackinac. Near mid-February, consolidated thick lake ice will be found in Saginaw Bay and west of Bois Blanc Island to the Straits of Mackinac. Also at that time, consolidated thick lake ice will cover the North Channel and the northern and eastern shores of Georgian Bay and the rest of Georgian Bay will be 60 percent covered with thin and medium lake ice. Narrow bands of medium and thick lake ice will be found along the eastern shore of Lake Huron while new and thin lake ice will extend up to 20 miles off the western shores. Into the third week of February, southern Lake Huron will be 50 to 70 percent covered with thin and medium lake ice. At the end of February Georgian Bay will be 70 to 90 percent covered with mostly medium lake ice. Ice around Lake Huron will expand farther offshore; the ice edge will be found from 10 to 30 miles off the western shores of the Lake and 10 to 20 miles off the eastern shores. A roughly 70 percent ice cover will persist in southern Lake Huron. A map of the expected ice conditions on March 1st is shown in figure 8.

Late February conditions will persist into the first week of March. More thick lake ice will be found in southern Lake Huron by mid-March. Near or shortly after mid-March, break up will start in Lake Huron and Georgian Bay. Assuming near normal temperatures for the month of March break-up will follow a near normal pattern.

Lake Erie and Lake St Clair

Water temperatures near the end of November were generally near normal. Near normal air temperatures are expected for December and the rest of the winter.

Patchy areas of new lake ice will develop in Lake St Clair near mid-December. In the last week of December, Lake St Clair, the Western Basin, Sandusky Bay and Long Point Bay will be covered with new and thin lake ice. Stormy weather could destroy a lot of the ice and reduce ice coverage. The rest of Lake Erie will be ice free. Expected conditions on January 1st are shown in figure 4.

Near normal temperatures are expected for January. Around mid-January new and thin lake ice will completely cover Lake St Clair and the Western Basin. Also around that time, ice will be found in the portion of Lake Erie west of Cleveland and elsewhere within a few miles of the shores. The middle of the lake will be open water. In the third week of January, ice cover will be similar but ice will continue to thicken. Thin and medium lake ice will be found in Lake St Clair and in the Western Basin. Also in the 3rd week of January, Sandusky Bay and most of the coastal areas of Lake St Clair will be covered with consolidated thin lake ice. By the end of January, Lake St Clair and the approaches to Buffalo will be consolidated with thin and medium lake ice. Thin and medium lake ice will be found in the Western Basin. In the second half of January the rest of Lake Erie will remain mostly open water except for thin and medium lake ice spreading rapidly in most of the lake near the end of the month. Expected conditions on February 1st are shown in figure 6.

Near normal temperatures are expected for February. The ice cover will continue to increase and most of Lake Erie will be covered with thin and medium lake ice in mid-February. Throughout the first two weeks of February, mainly medium lake ice will be found in Lake St Clair, the Western Basin and in the approaches to Buffalo. At the end of the month, Lake St Clair, the Western Basin and the northeast end of Lake Erie near Buffalo will be covered with medium and thick lake ice. The ice in the Western Basin will generally remain mobile except for brief periods when it will be consolidated. The rest of Lake Erie will be covered with medium lake ice except for areas of open water developing along

the northern shore of the lake late in the month. Figure 8 indicates the expected ice conditions on March 1st.

Breakup usually starts in the last week of February. This year it should proceed a little faster than normal.

Lake Ontario

At the end of November water temperatures were generally near normal (figure 2). Air temperatures over Lake Ontario are forecast to be near normal for the month of December.

Lake Ontario will remain ice free in the first three weeks of December. New and thin lake ice will form in Bay of Quinte in the third week of December. Consolidated thin lake ice will cover the bay around Christmas Day. Patches of new lake ice will form in the western end of the Seaway and in shallower bays of the northeast shore around that time. Otherwise at the end of December ice free conditions will prevail in Lake Ontario except open water along the northeast shore. Figure 4 indicates the expected ice conditions on January 1st 2011.

Near normal temperatures are forecast for the January to February period. Around mid-January, narrow bands of new lake ice will be present at times near the shores of the lake. Also at that time thin lake ice will be found in the western end of the Seaway. Otherwise ice free conditions will prevail in Lake Ontario except for open water along the ice edges. The ice in the western end of the Seaway will thicken to medium lake ice and consolidate shortly after mid-January. The coastal ice in the north-eastern section of the lake will gradually expand to about 10 to 20 miles offshore in the second half of January. New and thin lake ice will occasionally form around the shores but will melt rapidly as it is pushed offshore. The ice in Bay of Quinte will reach the thick lake ice stage in the 3rd week of January. By the end of the month, most of the north-eastern portion of the lake will be covered with thin lake ice. Consolidated medium lake ice will cover the western end of the Seaway. New to thin lake ice will be found at times along the shores elsewhere around the lake but will melt as storms push the ice offshore. The rest of the lake will be ice free. Figure 6 indicates the expected ice conditions on February 1st, 2011.

The ice in the western end of the Seaway will thicken to thick lake ice near mid-February. By the end of February thin and medium lake ice will be found in the north-eastern portion of the lake. Narrow bands of new and thin lake ice will be found at times along the shores of the rest of the lake but will be blown offshore and melt rapidly. Conditions on March 1st 2011 are shown in figure 8.

As near to above normal temperatures are forecast, breakup should be a little faster than normal.

Appendix

Appendix A - Stages of Development of Lake Ice and Egg Code

For more information on this section, please refer to the following web link on the Canadian Ice Service web site:

<http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=84F6AA59-1&wsdoc=FE5C2688-21A8-4165-8FFB-5D28B2A1D943>

or on the National Ice Center web site:

http://www.natice.noaa.gov/products/egg_code.html

Appendix B - General information from the Canadian Coast Guard

General information regarding transmission times for bulletins and charts from various radio broadcast stations:

http://www.ccg-gcc.gc.ca/eng/CCG/MCTS_Radio_Aids

Appendix C - WMO (World Meteorological Organization) Colour Code

Information regarding the ice chart colour code using the WMO standard could be found at the link below:

<http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=D5F7EA14-1&offset=1&toc=show>

Appendix D - Ice Services for Canadian Great Lakes Waters

In Canada, ice services are provided to shipping, fishing and in-lake operators by a co-operative effort of Environment Canada and the Department of Fisheries and Oceans. Department of Fisheries and Oceans, through the Canadian Coast Guard, provides icebreaker services and operates a seasonal Ice Operations Office at Sarnia. Canadian Ice Service of the Atmospheric Environment Service (division of Environment Canada) is responsible for gathering and generating ice information services and forecasts.

The following forecasts are issued:

Great Lakes Ice Hazard Bulletin (FICN19): A general ice description of conditions in each of the Great Lakes and, if required, a warning of hazardous ice conditions for the next 36 hours.

Twice-a-week Ice Analysis Charts and Regional Ice Chart covering a larger area are issued by the North American Ice Service. The Great Lakes Ice Analysis Charts are issued in two sections: the western portion of the Great Lakes which includes Lake Superior and Lake Michigan and the eastern portion of the Great Lakes which includes Lake Huron, Lake St Clair, Lake Erie and Lake Ontario. In addition to the distribution outlined in Appendix B, ice forecasts and bulletins and the Seasonal Outlook are available from the Canadian Ice Service website (<http://www.ec.gc.ca/glaces-ice/>) and the National Ice Center website (<http://www.natice.noaa.gov/>). The seasonal outlook is issued once yearly then updated twice monthly by 30-day forecasts.

For further information concerning these services please contact Canadian Ice Service by phone (877) 789-7733, facsimile (613) 947-9160 or e-mail at:

ECWeather-meteo@ec.gc.ca

or the national ice centre:

http://www.natice.noaa.gov/contact_us.html