

Prepared by the North American Ice Service

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

4 December 2009

**Seasonal Outlook
Great Lakes
Winter 2009-2010**



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Great Lakes

WINTER 2009-2010

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 proceeding 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. Daily radio broadcasts of ice charts and forecasts will be made to support ongoing operations in the various areas where ice affects marine activity. For more information regarding the broadcast schedule, please consult the following Canadian Coast Guard web site (Appendix B - General information from the Canadian Coast Guard).

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

General Seasonal Outlook

Below normal temperatures were generally reported over the Great Lakes area in the past summer. So far fall temperatures have generally been near normal except above normal in Lake Superior. A moderate El Nino is now developing and is expected to persist through the next winter season. Typically El Nino brings warmer than normal temperatures over the Great Lakes area especially over the upper lakes.

Warmer than normal temperatures are generally forecast over the Great Lakes area for the month of December except near to slightly above normal over the lower lakes. This temperatures trend is forecast to persist for the rest of the winter.

The surface water temperature anomalies over the Great Lakes on November 25th are depicted in Figure 3. Water temperatures were in general above normal except near normal in Lake Ontario. At the beginning of December ice free conditions prevailed over the Great Lakes.

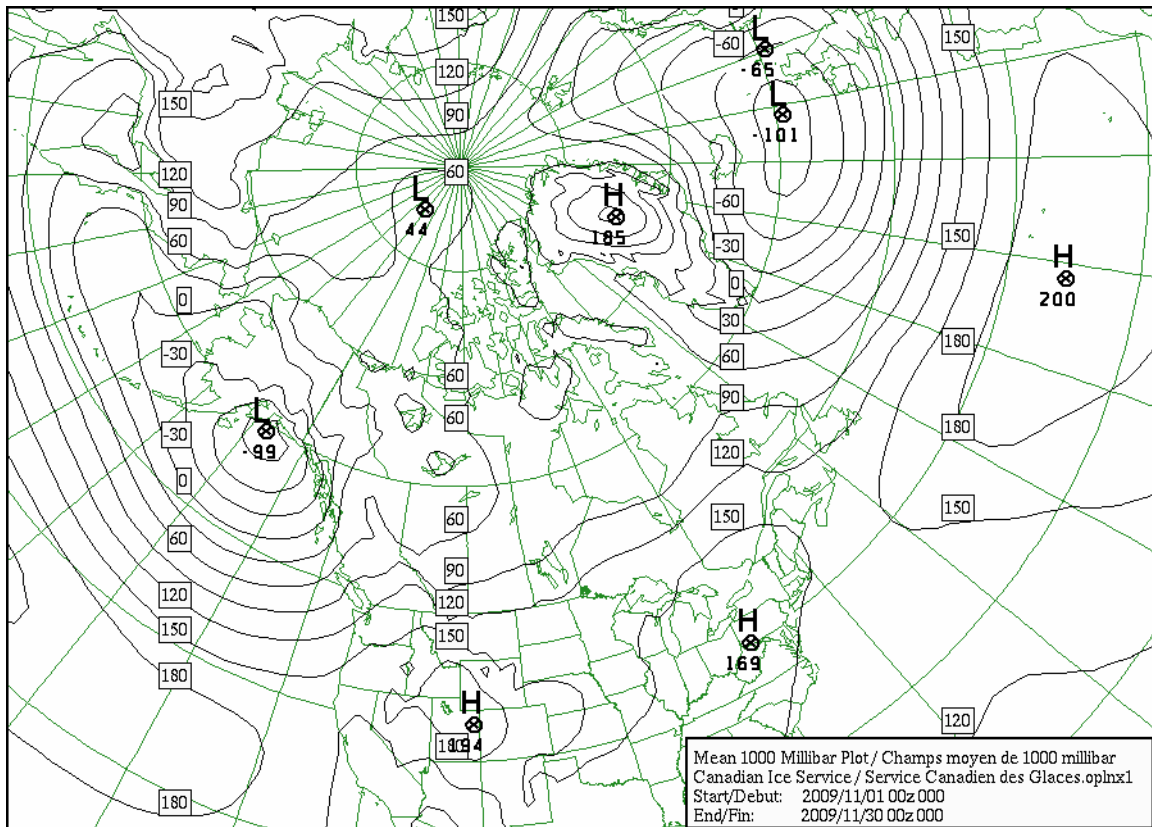


Figure 1: 1000 mbs pressure pattern – November 2009

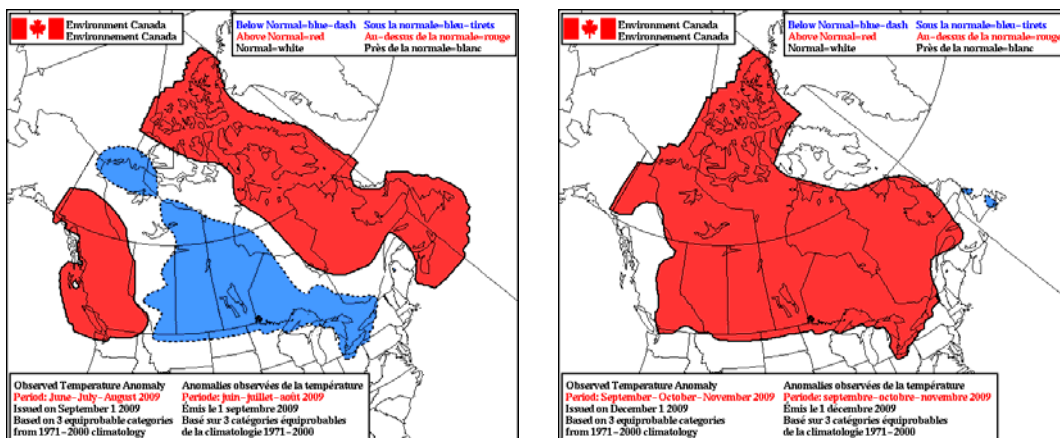


Figure 2: Temperature anomaly, June to August and September to November

Table 1: Departure from normal temperatures – November 2009

	Normal Temperatures	Observed	Departure
Duluth	-2.4	3.4	5.8
Thunder Bay	-2.9	2.5	5.4
Gore Bay	1.6	5.5	3.9
Sault Ste Marie	0.5	4.1	3.6
Chicago	4.4	7.5	3.1
Warton	2.6	5.3	2.7
Windsor	4.6	7.4	2.8
Buffalo	4.6	6.8	2.2
Toronto	3.1	6.1	3.0
Trenton	2.5	5.1	2.6
Average	1.9	5.4	3.5

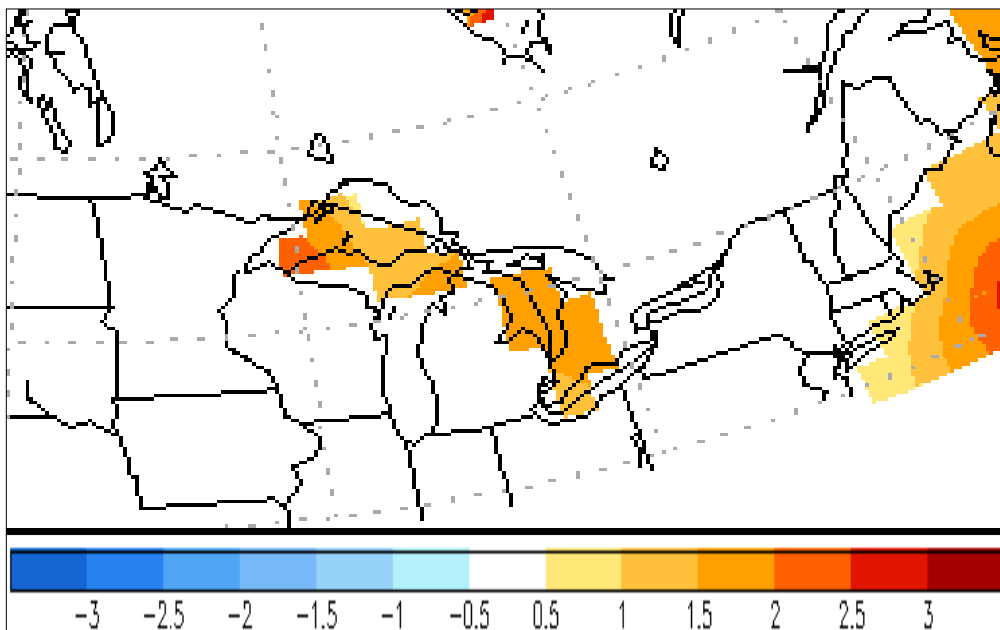


Figure 3: Water temperature anomalies – 25 November

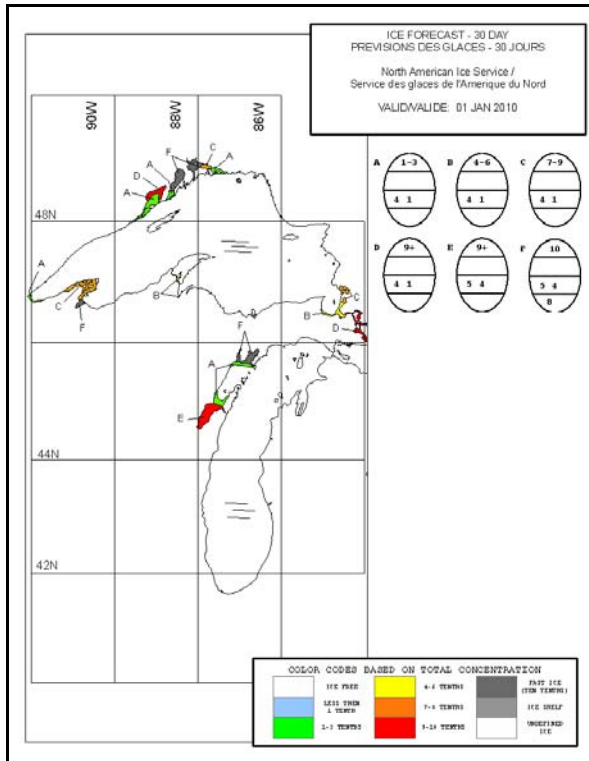


Figure 4: Expected ice conditions - Western Great Lakes - 1 January 2010

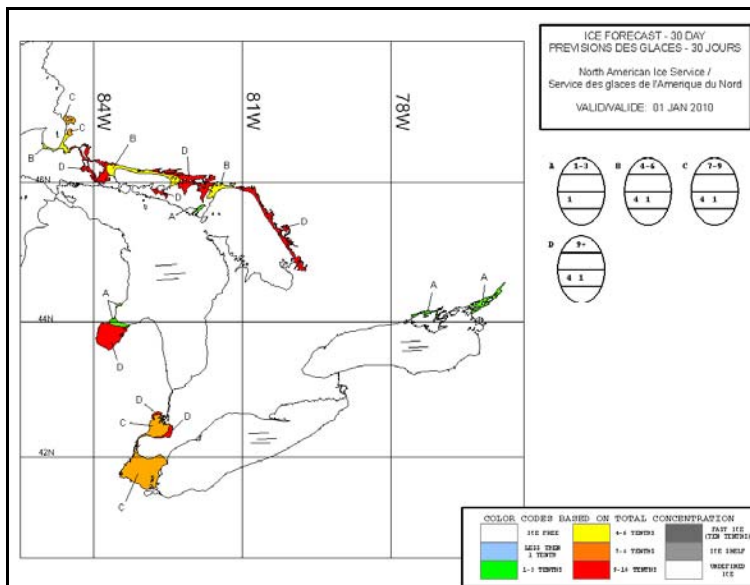


Figure 5: Expected ice conditions - Eastern Great Lakes - 1 January 2010

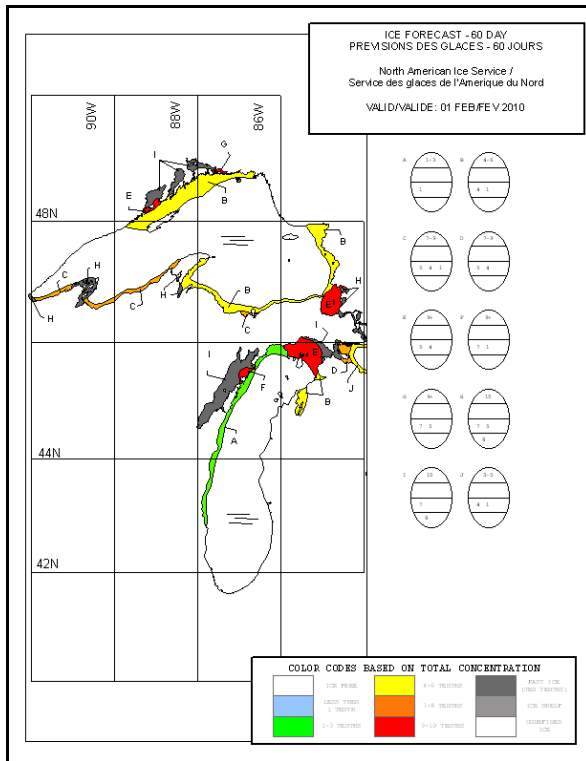


Figure 6: Expected ice conditions - Western Great Lakes - 1 February 2010

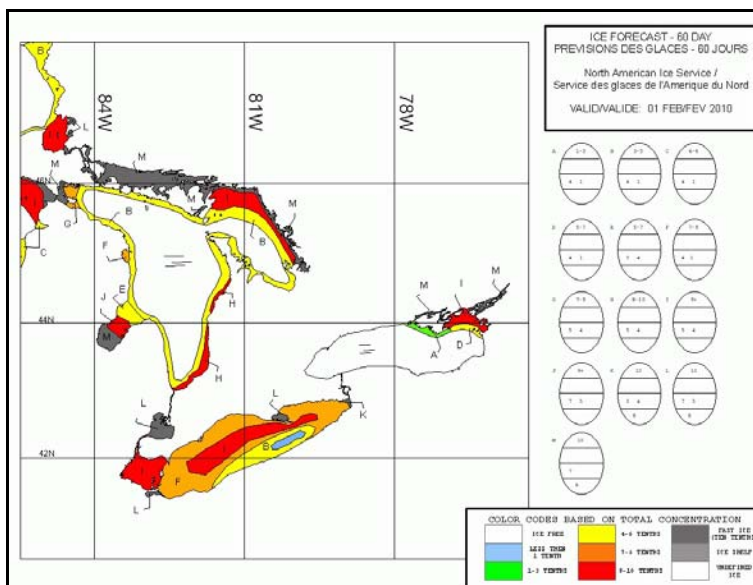


Figure 7: Expected ice conditions - Eastern Great Lakes - 1 February 2010

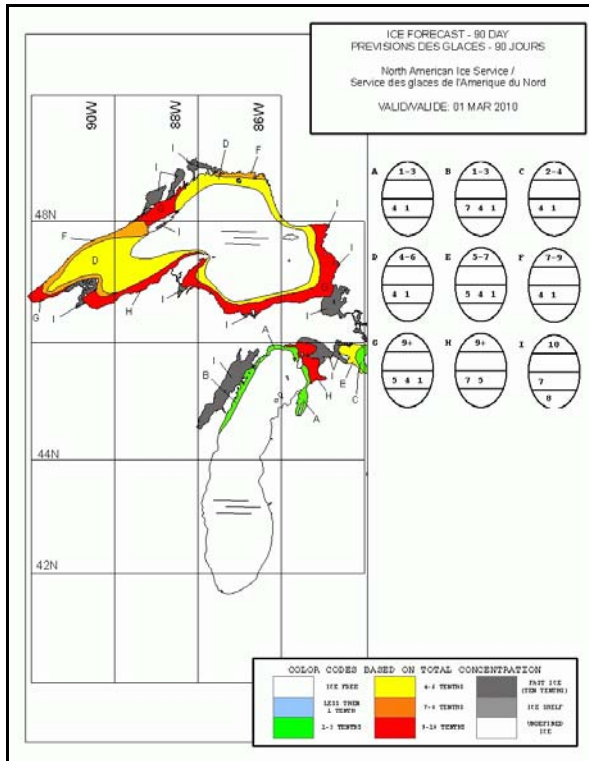


Figure 8: Expected ice conditions - Western Great Lakes - 1 March 2010

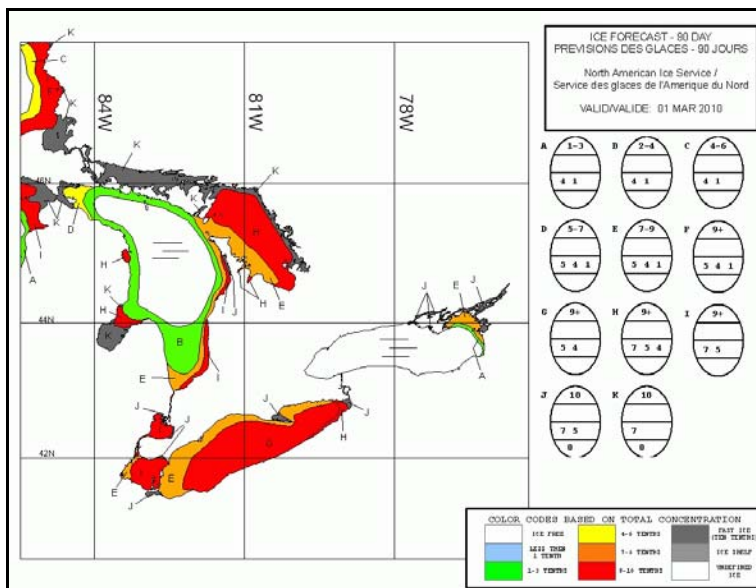


Figure 9: Expected ice conditions - Eastern Great Lakes - 1 March 2010

Lake Superior

Near the end of November the water temperatures in Lake Superior were generally above normal (Figure 3). Near to below normal air temperatures are expected for the month of December.

New and thin lake ice will start to develop in Black Bay, Nipigon Bay, Chequamegon Bay and in shallow bays along the St-Mary's River during the second week of December. Black Bay, Chequamegon Bay and western Nipigon Bay will be consolidated near Christmas Day. New and thin lake ice will develop in Thunder Bay near Duluth, around the Apostle Islands and in shallow bays of Whitefish Bay in the last week of 2009. Patchy areas of new lake ice will develop in St Mary's river near Christmas Day and will thicken to thin lake ice and spread in the rest of the river during the last week of the year. Otherwise in the rest of the lake ice free conditions will prevail, except open water along the shore. Figure 4 indicates the expected ice conditions on January 1st, 2010.

Above normal temperatures are generally expected for the month of January and February in Lake Superior. With a slight delay in the freeze-up dates and above normal forecast air temperatures, the ice extent and thicknesses, at the peak of the ice season, should both be below normal. The ice in Black Bay and Nipigon Bay will reach the thick lake ice stage during the first week of 2010. Ice will continue to develop in Thunder Bay and by mid-January thin and medium lake ice will cover the bay with consolidated thick lake ice right along the shore. At that time a narrow band of new and thin lake ice will be present along most of the southern shore of Lake Superior and along the northern shore east of Grand Marais. Ice will gradually spread in Whitefish Bay during the first half of January and at mid-month the bay will be covered with mostly thin lake ice except medium lake ice in shallow bays. St Mary's River and the coastal areas just north of Chequamegon Bay will become consolidated with medium and thick lake ice in the second week of January. The ice in Whitefish Bay will thicken to medium lake ice during the second half of January while remaining mobile. The exception will be consolidated thick lake ice in shallow bays and close to the shore. The band of ice along the southern shore of the lake will thicken to mostly thin lake with little seaward expansion. The ice around the Apostle Islands will consolidate just after mid-January. The area of consolidated ice in Thunder Bay will gradually expand to cover most of the bay at the end of January with the exception of the eastern entrance which will remain mobile and be covered with thinner ice. The coastal area between Grand Marais and Marathon will remain ice covered with thin lake ice. A 5 to 15 mile wide band of new and thin lake ice is expected to develop along the eastern shore south of Michipicoten bay during the last week of January. Figure 6 indicates the expected ice conditions on February 1st, 2010.

The ice will continue to develop during the first half of February but a somewhat slower pace than normal. Thunder Bay will remain consolidated with

thick lake ice except for large pieces of consolidated ice breaking off the in the eastern entrance and drifting south. A band of generally thin lake ice will continue to prevail along the northern shore east of Grand Marais except for medium lake ice north 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 mostly thin lake ice will prevail except for medium and thick lake ice west of the Keweenaw Peninsula. Thick lake ice will be prevalent in Whitefish bay during the first half of February with fast ice gradually developing in the southern section of the bay. At mid-February ice free conditions will predominate in the central section of the lake with open water along the ice edges. Little change will occur in Thunder Bay and Whitefish Bay during the second half of February except for an expansion of the consolidated ice into the northern half of Whitefish Bay. The band of thin and medium lake ice along the southeastern and eastern shores will expand to about 15 to 30 miles offshore. At the end of February thick lake ice will prevail along the southern shore west of the Keweenaw Peninsula while thin lake ice will be the norm elsewhere along the southern shore and along the northern shore. The exception will be medium lake ice between Isle Royale and the entrance to Thunder Bay. At the end of February open water will prevail in the east central section with a narrow open water area extending into the western section of the lake. The expected ice conditions on Mars 1st, 2010 are indicated in figure 8.

Limited ice development is expected in the first half of March as average temperatures start to increase. At mid-March ice conditions are expected to be easier than normal. Assuming near to above normal temperature in the second half of March break-up should proceed at a faster pace than normal

Lake Michigan

Above normal water temperatures were generally reported in Lake Michigan in late November (Figure 3). Near normal air temperatures are generally forecast for the month of for December.

Patches of new lake ice will develop in Little and Big Bay de Noc as well as in southern Green Bay during the third week of December. The ice will continue to develop and Little and Big Bay de Noc will become consolidated with medium lake ice by New Year's Day. At that time the southern third of Green Bay will be covered with thin and medium lake ice. Otherwise, at the end of 2009, open water to ice free conditions will prevail in the rest of Green Bay and in Lake Michigan. Figure 4 indicates the expected ice conditions on January 1st, 2010.

The long range temperature forecast is calling for near to above normal temperatures for January and February. The ice in Green Bay will gradually expand and at mid-January thin and medium lake ice will cover the entire bay. At that time the southern half of Green Bay will be consolidated. New and thin lake

ice will develop in the entrance and approaches to the Straits of Mackinac early in the New Year and at mid-January thin lake ice will prevail from Beaver Island to the Straits of Mackinac. Otherwise at that time ice free conditions will predominate in Lake Michigan except for open water along the shore and ice edges. The consolidated ice in Green Bay will expand northward to cover most of the bay at the end of January except for the entrance which will remain mobile. At that time thick lake ice will be the predominant ice type in Green Bay. Little change is expected northeast of Beaver Island except for a general thickening of the ice to medium lake ice. In addition, the ice near the entrance to the Straits of Mackinac will consolidate near the end of the month. Narrow bands of new and thin lake ice will occasionally form right along the onshore but will melt as it is pushed offshore into warmer waters. New and thin lake ice will start to develop in Little and Grand Traverse Bay in the third week of January. Otherwise, at the end of January, open along the shore and ice edges and ice free in the middle of the lake. Figure 6 indicates the expected ice conditions on February 1st, 2010.

The consolidated ice that just formed near the Straits of Mackinac will expand westward by about 10 to 15 miles in the first half of February. The ice east of Beaver Island will reach the thick lake ice stage during the second week of the month. Green Bay will remain consolidated with thick lake ice. New and thin lake ice will occasionally form along section of the shores of Lake Michigan but will not persist. At Mid-February the central section will remain ice free but open water will prevail along the shore and ice edges.

Little change is expected during the second half of February as average temperatures start to increase. Ice conditions at the beginning of March can be seen on Figure 8.

With near to above normal temperatures expected in March the break-up and clearing of Lake Michigan will occur somewhat earlier than normal.

Lake Huron and Georgian Bay

Above normal water temperatures were generally observed in Lake Huron and Georgian Bay in late November (Figure 3). Below normal temperatures is generally forecast until mid-December then near normal temperatures is expected for the rest of the month.

New and thin lake ice will develop in coastal areas of Saginaw Bay, in shallow bays along the northeast coast of Georgian Bay and along sections of the coast of the North Channel during the second week of December. The ice in Saginaw Bay will gradually spread over the rest of the bay and thicken to thin lake ice in the last week of 2009. At the end of December both ends of the North Channel will be covered with thin lake ice and open water will be predominant in the central section. A narrow band of thin lake ice will develop along the northeast shore of Georgian Bay late in December. Otherwise ice free conditions

will prevail in Lake Huron and Georgian Bay except for open water along the ice edge. Figure 5 indicates the expected ice conditions on January 1st, 2010.

Slightly above normal temperatures are forecast for the months of January and February. Ice will spread over the rest of the North Channel within a week into the New Year. A week later, most of the channel will be consolidated with medium lake ice except for mobile thin lake ice in the central section. The coastal ice in Saginaw Bay will consolidate in the first week of January and the rest of the bay a week later. At mid-January medium lake ice will be the predominant ice type in Saginaw Bay. New and thin lake ice will start to develop in the approaches to the Straits of Mackinac and along sections of the shore of Lake Huron in the first week of 2010 and further expand during the second week. At mid-January thin lake ice will prevail south and west of Bois Blanc Island and along much of the shore of the lake. In Georgian Bay most of the shallow bays along the northeast coast will become consolidated in the first week of January. The band of ice along the northeast shore of Georgian Bay will gradually expand during the first half of January and at mid-month the northeastern section will be covered with thin lake ice while the rest of the bay will remain as open water. The ice in the approaches to the Strait of Mackinac will grow to thick lake ice and become consolidated late in January. At that time, both the North Channel and Saginaw Bay will be covered with consolidated thick lake ice. Further ice development is expected in Georgian Bay and at the end of January the northeastern half of the bay will be covered with thin and medium lake ice. At that time open water will still prevail in the southwestern half of the bay except for new lake ice in shallow bays and along sections of the shore. At month's end open water will generally prevail in the rest of Lake Huron except for a narrow band of thin lake ice along the shore. In addition areas of medium lake ice will be found along the eastern shore of the lake and near the entrance to the St Clair River. Figure 7 indicates the expected ice conditions on February 1st, 2010.

The ice along the shore of Lake Huron will expand to about 10 to 20 miles offshore during the first two weeks of February. Thin lake ice will generally prevail inside the band except medium with some thick lake ice along the eastern and southeastern shores. At times, strong northwesterly winds will cause moderate to strong ice pressure along the eastern shore. The ice will further expand in Georgian Bay and at mid-February thin and medium lake ice will cover most of the bay except looser ice conditions in the southwestern third of the bay. Little change is expected in Saginaw Bay and in the approaches to the Straits of Mackinac as both areas remain covered with thick lake ice. Little overall change is expected in the second half of February except for a little seaward expansion of the coastal ice and a general increase in the ice thicknesses. Figure 9 indicates the expected ice conditions on March 1st, 2010.

Breakup in Lake Huron and Georgian Bay usually starts in late February or early March. 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 above normal (Figure 3). Slightly below normal air temperatures are expected for the rest of December.

Patchy areas of new lake ice will occasionally form in the Western Basin and in Lake St Clair during the third week of December but will not persist. The first permanent ice will develop in the last week of the month and, at the end of 2009, both the Western Basin and Lake St Clair will be partially covered with new and thin lake ice. At that time ice free conditions will predominate in the rest of Lake Erie. Figure 5 indicates the expected ice conditions on January 1st, 2010.

Temperatures for January and February in Lake Erie and Lake St Clair areas are expected to be close to the long term average. Within a week into the New Year, Lake St Clair, the Western Basin, Sandusky Bay as well as Long Point Bay will be covered with mostly thin lake ice. In that same time frame new lake ice will start to develop along portions of the northern shore of Lake Erie. In the second week of January the ice in Lake St Clair will thicken to medium lake ice and Sandusky Bay as well as most of the coastal areas of Lake St Clair will consolidate. At mid-January a 10 to 20 mile wide band of thin lake ice will be present along the north coast of the lake and in the eastern end near Buffalo. Ice development will continue in the second half of January. The ice in the Western Basin will thicken to reach the medium lake ice stage in the last week of the month. Ice will gradually spread in the northern section of the lake, including the approaches to Buffalo, and the area will be covered with mostly thin lake ice at the end of January. At that time open water or loose areas of new and thin lake ice will prevail in the southern third of the lake. Figure 7 indicates the expected ice conditions on February 1st, 2010.

Within a week into February, Lake Erie will be covered with mostly medium lake ice. Lake St Clair and the approaches to Buffalo will become consolidated early in the month. Leads will develop in strong offshore winds. Conversely ice congestion or pressure will develop in strong onshore winds. The ice in the Western Basin will generally remain mobile except for brief periods when it will be consolidated. At mid-February Lake Erie will be covered with mainly medium lake ice except thick lake ice in Lake St Clair, in the Western Basin and in the northeast end of the lake near Buffalo. Little overall change is expected to occur during the second half of February. Figure 9 indicates the expected ice conditions on March 1st, 2010.

Breakup usually starts during the third or last week of February. Assuming near normal temperatures in the spring, breakup should proceed as per normal.

Lake Ontario

At the end of November water temperatures were generally near normal (Figure 3). Air temperatures over Lake Ontario are forecast to be near to slightly below 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 near Christmas Day. Patches of new lake ice will form in the western end of the Seaway towards the end of the year. Otherwise at the end of December ice free conditions will prevail in Lake Ontario except open water along the northeast shore. Figure 5 indicates the expected ice conditions on January 1st, 2010.

Near normal temperatures are forecast for the first two months of 2010. Bay of Quinte will become consolidated with medium lake ice early in the New Year. Ice will continue to develop and at mid-January thin and medium lake ice will cover the western end of the Seaway and a narrow band of new and thin lake ice will be present along sections of the northeast coast. 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 northeastern 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 along the northern shore but will melt rapidly as it is pushed offshore. The ice in Bay of Quinte will reach the thick lake ice stage during the last week of January. Lake Ontario will generally be ice free at the end of January except for open water along the shore and ice edges. Figure 7 indicates the expected ice conditions on February 1st, 2010.

The ice in the western end of the Seaway will thicken to thick lake ice by mid-February. The area of thin and medium ice in the northeast section of the lake will expand slightly. New and thin lake ice will occasionally form along the shore but will not persist. Little change is expected during the second half of February. Figure 9 indicates the expected ice conditions on March 1st, 2010.

Assuming near normal spring temperatures, breakup should follow a near normal pattern.

Appendix

Appendix A - Stages of Development of Lake Ice

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

<http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=11040&LnId=78&Lang=eng>

or the one at the National Ice Center web site:

http://www.natice.noaa.gov/egg_code/index.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 links below:

<http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=11500&LnId=19&Lang=eng>

<http://www.natice.noaa.gov/sigrid/index.htm>

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.

North American Ice Service

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://ice-glaces.ec.gc.ca>) and the National Ice Center website (<http://www.natice.noaa.gov/products/gl-ches/index.htm>). 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 (613) 996-1550, facsimile (613) 947-9160 or e-mail at:

cis-scq.client@ec.gc.ca.

Or

National Ice Center by phone (301) 394-3100, facsimile (301) 394-3200 or e-mail at:

liaison@natice.noaa.gov