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Prairies Regional Guide

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Sunset over Lake Winnipeg, Manitoba. Photo: Jeremy Kusyk

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PRAIRIES REGIONAL GUIDE PART 1: INTRODUCTION

1. Introduction

This chapter contains information on local weather effects for marine areas in the Prairies. The corresponding maps indicate the type and location of effects through the use of special symbols, as defined in the following chart. It is recommended that the chart be printed for cross-referencing purposes in using this guide. The meteorological theory behind these effects is described in detail in the Met 101 section of the *National Marine Weather Guide*.

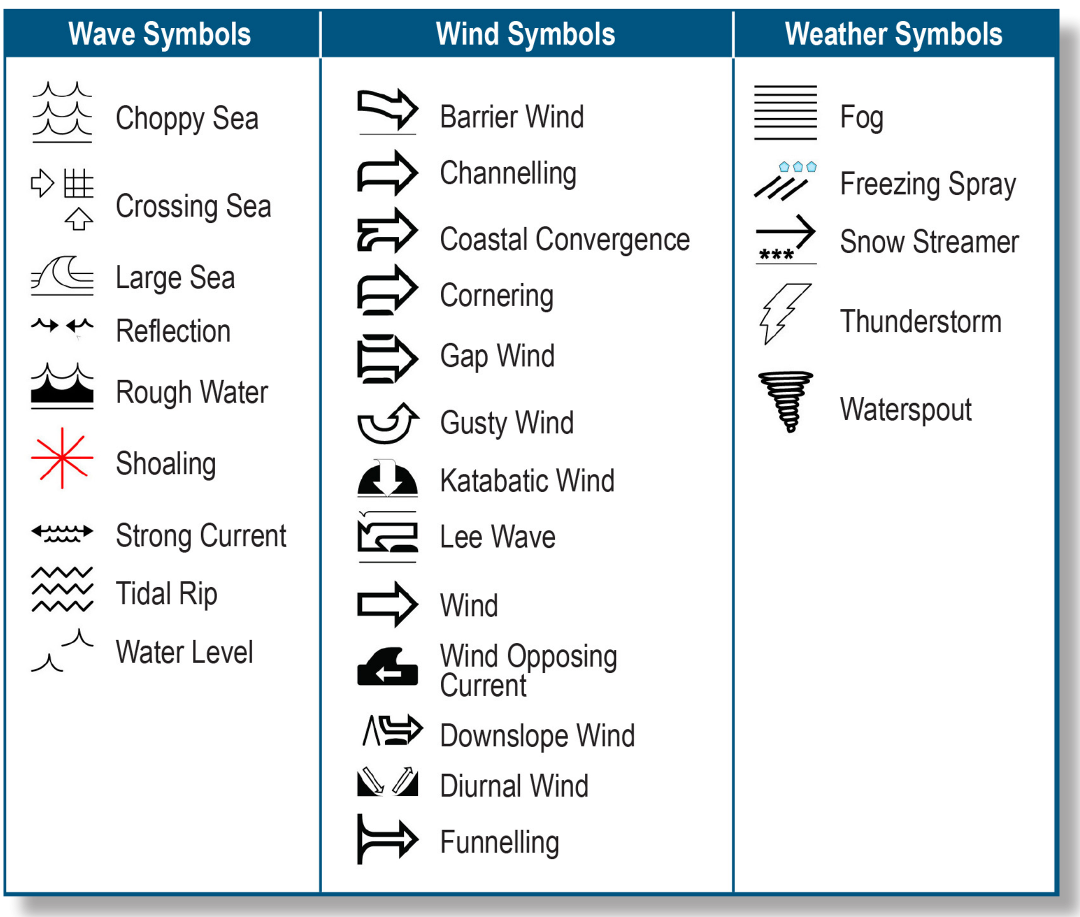

Figure 1: Wind, weather and wave symbols used in this guide.

2. Marine Weather Services

Marine weather conditions are constantly changing and are affected significantly by local variations in topography, coastline, currents, water depth and temperature, fetch, and other factors. To help boaters make informed decisions on how the weather will affect them and to enhance marine safety, Environment Canada provides a broad range of specialized weather services and products. Since these may differ from one area to another, boaters are advised to know before they leave shore where to find weather information for their route and how to interpret it properly. Understanding current and forecast weather conditions and local peculiarities increases both the safety and enjoyment of boating.

In the Prairies, Environment Canada issues marine forecasts for Lake Manitoba, Lake Winnipegosis, Lake Winnipeg (South Basin), Lake Winnipeg (North Basin), Lake Athabasca (Eastern half), and Lake Athabasca (Western half). Additional information is also available online through various websites operated by Environment Canada—including the *National Marine Weather Guide*, which provides marine related weather safety information for most of Canadian waters. To speak with a forecaster, call the user-pay marine weather line at 1-900-565-6565.

Marine forecasts are not issued for other lakes in the prairie region; however, local, land-based forecasts and observations from nearby weather stations can be interpreted in order to assess current conditions over water. Warnings, including those for high winds, are also issued differently than they are for marine forecasts. To learn more about public weather-alerting criteria, visit the Public Alerting Criteria page.

For more information, contact Environment Canada's National Inquiry Response Team:
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E3B 6Z3
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Gimli Beach, Lake Winnipeg, Manitoba. Photo: Justin Hobson

2.1 Finding Local Marine Forecasts and Warnings

The Canadian Coast Guard relays weather forecast information via VHF radio on Lake Winnipeg. Environment Canada's Weatheradio network—which broadcasts weather and environmental information 24 hours a day—also provides coverage for some lakes in the prairie region; however, some have neither VHF nor Weatheradio access. It is of particular importance, when travelling in such uncovered areas, to gather detailed forecast information prior to departing.

Figure 2: VHF radio coverage on Lake Winnipeg.

2.2 Using Land-Based Forecasts and Observations Over Water

Marine weather buoys and island weather observation stations adequately represent winds for the area of the lake where they are stationed but do not necessarily represent the wind experienced across the entire lake. Land stations, on the other hand, can indicate wind speeds that are significantly different from those over nearby waters. As such, it is especially important for mariners to read and understand Chapter 2: Wind of the *National Marine Weather Guide*.

It is important to note that the difference in wind speed observed over land compared to adjacent water is affected by the ground cover in the vicinity of the land-based weather station. For example, since there is more friction in a forested area than there is in one free of obstructions, weather stations surrounded by open land better represent wind speeds over nearby water. The stability of the air over the water is another important consideration. Unstable air occurs most often in fall but also happens in summer when there is a cold outbreak of air over the water and is usually accompanied by a northwest flow. Stable air over the water, on the other hand, occurs most often in the spring and early summer and is common with easterly to southerly winds.

3. Prairie Geography

The Prairies, as referred to in this guide, encompass the provinces of Alberta, Saskatchewan, and Manitoba. They cover a large expanse of land of varying topography, ground cover, and climate and three principal topographical areas: the Rocky Mountains and Foothills to the west; the prairie region that covers most of the southern portions of the provinces; and the Canadian Shield to the northeast. The lakes covered in this guide reside in either the prairie region or the Canadian Shield.

3.1 The Prairie Region

The prairie region lies between the Rocky Mountains to the west and the Canadian Shield to the northeast. Although the general impression of the Prairies is of a flat expanse of land, topographical features have a significant impact on the weather. Numerous shallow lakes and several hill ranges dot the landscape.

Figure 3: Image depicting shallow lakes portion of the prairie region.

3.2 The Canadian Shield

Northeast of the prairie region is the Canadian Shield. A large and heavily glaciated expanse of rock, more than half of its area is covered by lakes, of which Lake Athabasca and Lake Winnipeg are the largest.

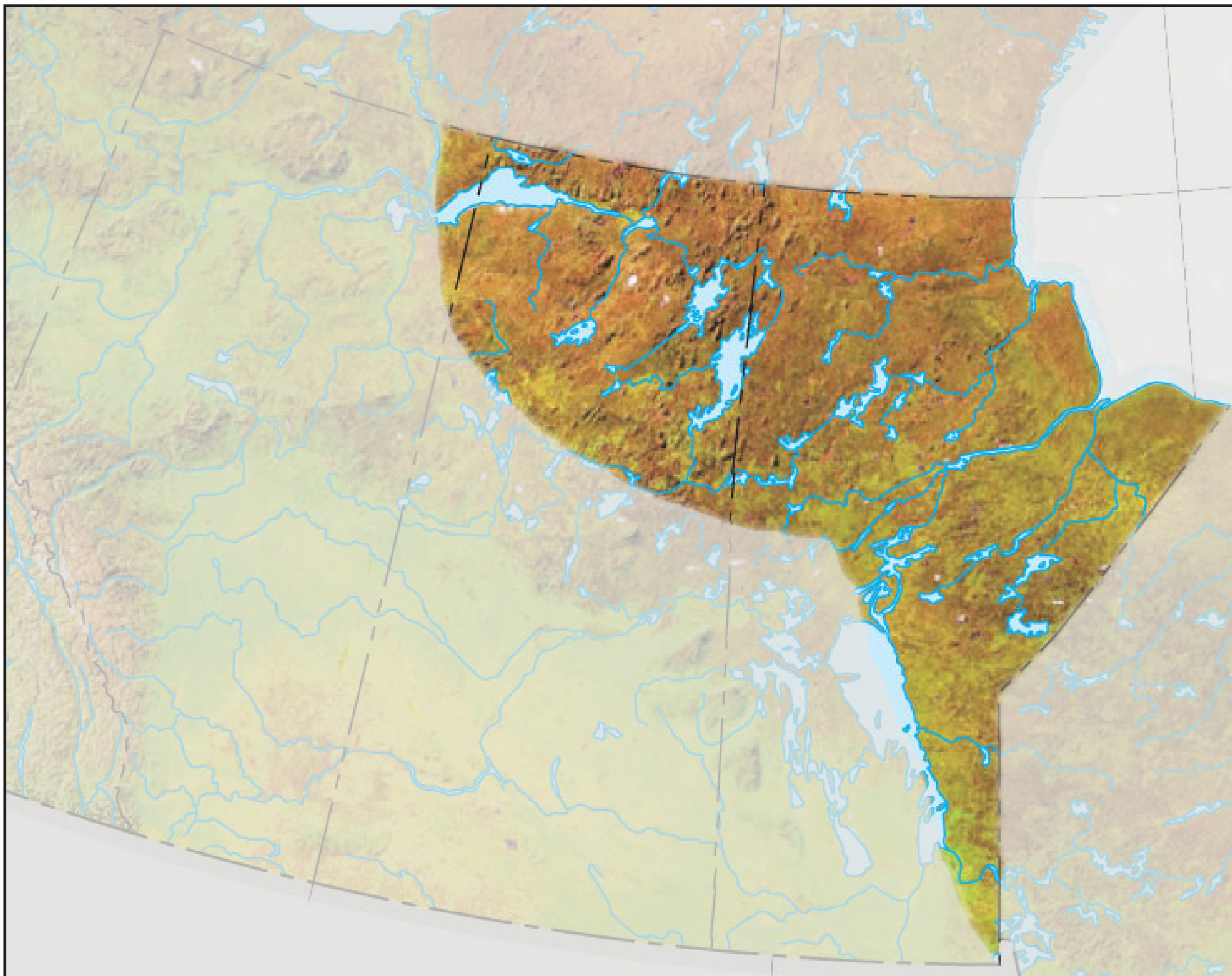


Figure 4: Image depiction area where Canadian Shield exists with deeper lakes.

4. Prairie Weather

In summer, the general mean flow across the Prairies is from the west or southwest. Air masses move into the region from the Arctic, the Pacific (after passing over the Rocky Mountains and drying out), or the American Midwest—each one bringing the potential for very different weather. In the spring, summer, and fall, adverse weather can be caused by the storm tracks followed by individual storms, cold lows, outbreaks of cold air over warm bodies of water, and thunderstorms.

4.1 Storm Tracks

In fall, spring, and summer, intense low-pressure systems from the Arctic, Pacific, and southwest United States can move through the Prairies, bringing a variety of weather. Low-pressure systems affecting the Prairies can be categorized by their most common storm tracks. Mackenzie lows originate in the Mackenzie Valley and track southeast,

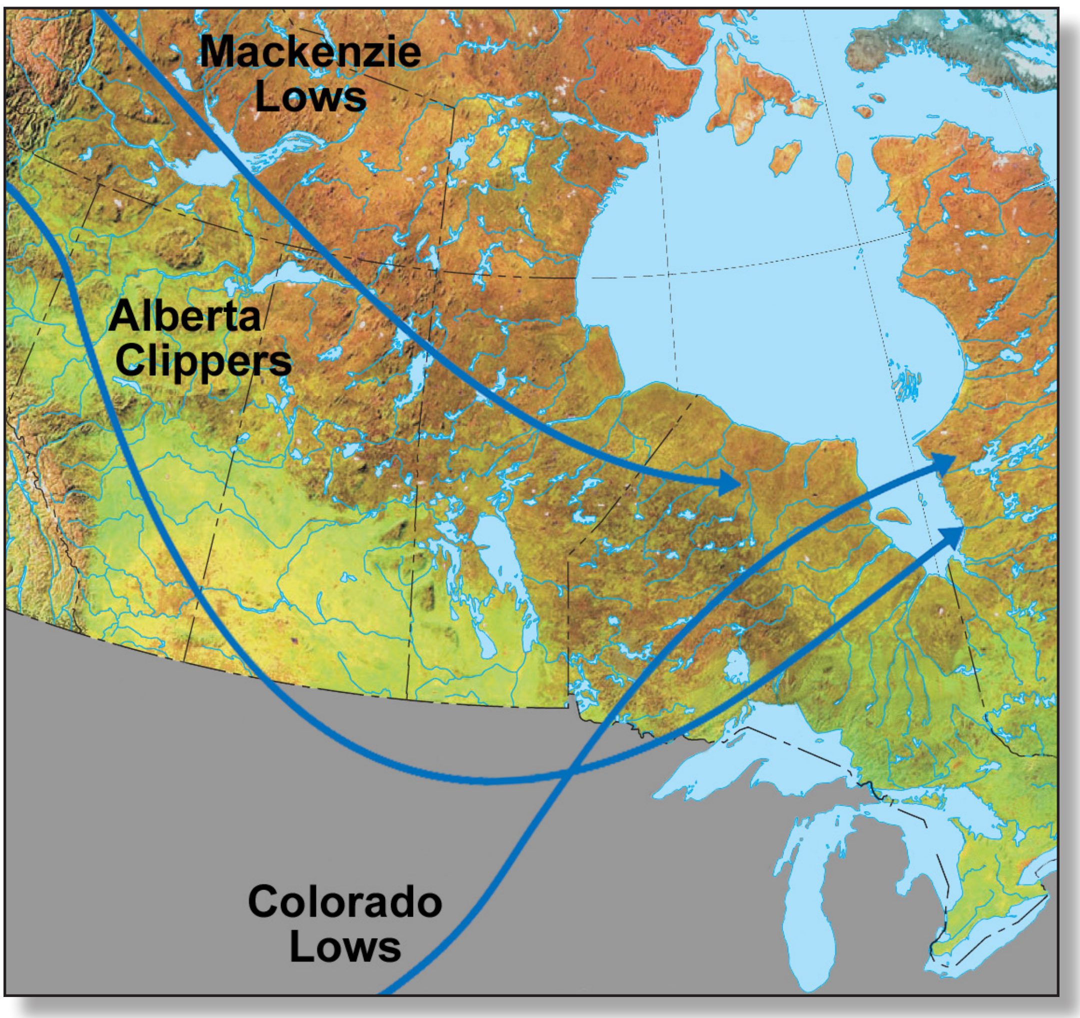


Figure 5: The most common storm tracks across the Prairies, categorized loosely by where they form.

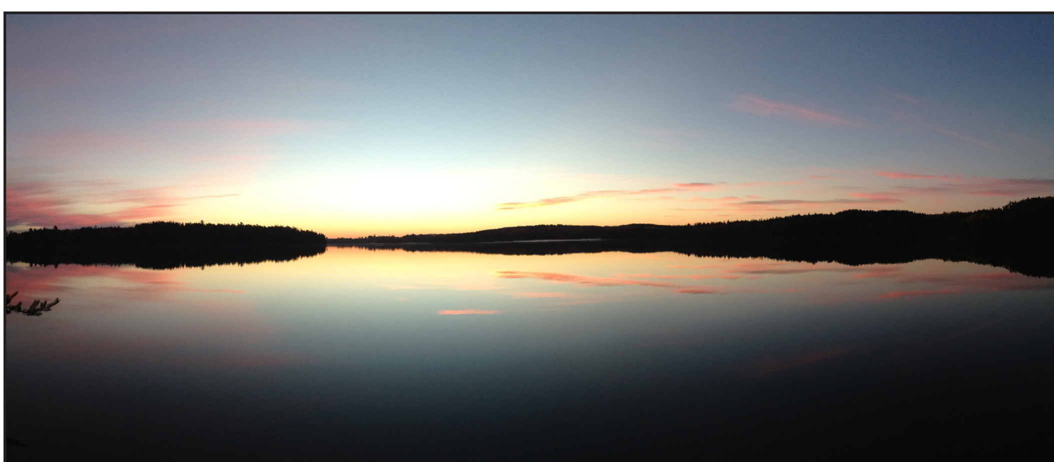
most often affecting northern Alberta, northern Saskatchewan, and northern Manitoba. Colorado lows originate in the United States and track northeast, usually affecting southern Saskatchewan and Manitoba. Alberta lows form in the lee of the Rocky Mountains and often track southeast or east, affecting Alberta, southern Saskatchewan, and southern Manitoba. Intense low-pressure systems are less common in the summer months and usually less intense than they are in spring and fall. In summer, convection and its associated weather becomes the dominant danger to mariners, while the threat of intense, low-pressure systems decreases.

4.2 Cold Lows

A cold low is a large, nearly circular area of low pressure that extends from the ground to the upper levels of the atmosphere, in which temperatures get colder towards the centre. They often produce extensive cloud cover and precipitation. Cold lows occur a few times each summer, on average, and can produce very poor boating conditions over large areas of the Prairies for a number of days. Although they can occur at any time of the year, they are most common from the end of May to mid-July. If the air associated with a cold low is sufficiently unstable, it can generate cold core funnels or waterspouts. Although still hazardous, this type of waterspout is less severe than those formed in a thunderstorm. For more information, read Chapter 6: Other Hazardous Weather of the *National Marine Weather Guide.*

4.3 Cold Outbreaks

From September through November, before the lakes freeze over, cold frontal passages can bring in air temperatures that are significantly colder than the water temperatures over which they move. This results in an unstable air mass that, combined with an energetic low-pressure system, can cause gale-force winds. During the fall (and on rare occasions in the spring), while the lakes remain ice free, the air being driven south is sometimes cold enough to trigger snowsqualls. During October and November, the combination of below-freezing temperatures and strong to gale-force winds can also cause freezing spray.



Sunset at High lake, Manitoba. Photo: Jeremy Kusyk

4.4 Thunderstorms

Thunderstorms are frequent over prairie lakes, especially near the foothills of Alberta and in the southern regions of Saskatchewan and Manitoba. The convective season in the Prairies runs from May to September, but June, July, and August are the most active months. Although the most active time of day for thunderstorms is the afternoon, they can occur at any time of day or night. To avoid such conditions, boaters should review the most current weather forecasts before setting sail and learn how to spot the threat of severe weather. For more information, consult Chapter 6: Other Hazardous Weather of the *National Marine Weather*.

To help reduce the risk of being struck by lightning, consult Environment Canada's Lightning Danger Maps when thunderstorms are forecast in the area.

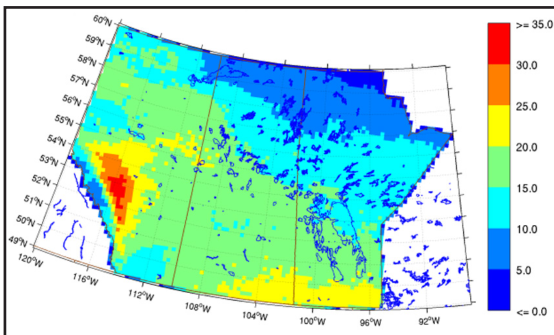


Figure 6: Colours show the average number of lightning days per year during the period 1999-2015

Thunderstorm over lake. Photo: Patrick McCarthy

PRAIRIES REGIONAL GUIDE PART 2: ALBERTA

5. Alberta

Thunderstorms are common in Alberta, often developing over the foothills during the morning or early afternoon and moving eastward over the course of the day. Convective clouds often dissipate as they move away from the mountains but can, under certain conditions, persist late into the evening. The passage of a cold front is usually associated with the development of the most severe thunderstorms affecting the province, including the 1987 Edmonton and 1993 Holden tornadoes. Night time thunderstorms can occur during the summer but are much rarer in Alberta than they are elsewhere in the Prairies. A persistent, easterly flow against the foothills can bring prolonged periods of drizzle and sometimes fog over marine areas.

Temperatures in Alberta can vary significantly in the spring and fall, with Edmonton seeing an average of 7.4 days in May and 6.7 days in September with minimum temperatures below zero. By October, daytime highs can reach the mid-20s, while daytime lows can dip to the mid-minus 20s, with rapid temperature changes possible from one day to the next.

Rain over typical Prairie lake. Photo: Garth Vanderkamp

5.1 Lake Wabamun

Lake Wabamun is a relatively shallow body of water that lies 60 km west of Edmonton. An important sailing lake, it has a surface area of 81.8 km^2, a max depth of 11 m, and a mean depth of 6.3 m. It is 19.2 km long and 6.6 km wide, with a northwest-southeast orientation that allows for a long fetch. This results in large seas on the east side of the lake in west and northwest winds and on the west side of the lake in east and southeast winds.

Lake Wabamun sees a lot of thunderstorm activity—in particular, during the afternoon. In the years from 1999 to 2012, there were between 14 to 26 days from May through September with lightning over Lake Wabamun. During the same time period, peak lightning activity occurred during the month of July when the lake experienced lightning one out of every 3.5 days, on average. It is important for boaters to keep on top of the latest weather forecasts and a sharp eye looking for signs of a storm on the horizon, as conditions on the water can quickly become hazardous. At the north end of the lake, thunderstorms coming from the west (as they typically do) may be blocked from view by the topography of the lakeshore. Large waves can develop at the east end of the lake in west and northwest winds. When setting sail from Wabamun, Point Alison can create a natural shelter from the winds and waves, which can increase dramatically and unexpectedly out on the open water.

Figure 1: Local effects map of Wabamun Lake.

Although the slope of the lake bed near the shore is generally steep, there are a few shallow areas where shoaling, breaking waves, and refraction could cause problems, including areas just south of Coal Point, just west of Sundance, and east of the power generation station. In east and southeast winds, a cornering effect can enhance the winds off Coal Point. From north of Seba beach to east of Coal Point, nearshore hills can create barrier winds, downslope winds, and lee effects, depending on the direction of the winds and the orientation of the cliff side.

5.2 Lesser Slave Lake

Lesser Slave lake has a surface area of 1160 km^2 and is one of Alberta's largest bodies of water. Oriented east to west, its long, 90-km fetch results in large seas at both ends of the lake in strong west, northwest, southeast, and east winds. As a result, very large waves can develop in the east and west portions of both basins. Remote and unpopulated, the north shore of the lake offers little shelter from such conditions.

Lesser Slave Lake also experiences a lot of thunderstorm activity, although not as much as Lake Wabamun. In the years from 1999 to 2012, there were between 8 to 19 days from May through September with lightning over Lesser Slave Lake. During the same time period, peak lightning activity occurred during the month of July when the lake experienced on average 6 days with lightning. It is important for boaters to keep on top of the latest weather forecasts and a sharp eye looking for signs of a storm on the horizon, as conditions on the water can quickly become hazardous.

Lesser Slave Lake is separated into two basins by a stretch of shallow water known as "the narrows." Shoaling is often a concern in this area, and the narrowing of the lake can create a gap wind in either direction when a strong westerly or easterly flow develops. As such, the narrows are a high hazard area for boaters. The east basin of the lake has a maximum depth of about 20.5 m and the west basin, about 15.5 m, with a mean overall depth of 11.4 m.

In the east basin, the lake bottom has a steep slope along the north, west, and south shores and a more gradual slope along the far east shore, near the town of Slave Lake. Shallower waters can cause shoaling, refraction, and breaking waves near the town, where added navigational hazards are posed by higher traffic, rapidly changing weather, and an extensive fetch. The waters off Auger Bay and Dog Island are also quite shallow and susceptible to shoaling, refraction and breaking waves. Depending on water levels, a rock spit that reaches from the island to about 200 m offshore can be a serious hazard, as it lies not far below the surface. Snow squalls have been reported at the extreme east end of the basin in the early fall months when a cold northwest wind develops.

The west basin is shallower, and the more gradual slope of the lake bottom makes it susceptible to dangerous conditions caused by shoaling, refraction, and breaking waves. Areas to watch out for, in particular, are near the shores of Little Grassy Point, Shaw Point, Hilliards Bay, Joussard, and Giroux Bay (near Faust).

Cornering winds can develop off the west side of Giroux Bay. Buffalo Bay—a shallow body of water joined to the west basin by a narrow channel—is subject to fluctuations in water levels.

Figure 2: Local effects map of Lesser Slave Lake.

PRAIRIES REGIONAL GUIDE PART 3: SASKATCHEWAN

6. Saskatchewan

Saskatchewan's climate is characterized by extremes. Its summers are the hottest, driest, and sunniest of the three prairie provinces and also experience the greatest temperature variation between day and night. The province receives relatively little precipitation—most of it falling from May to August, with June generally the wettest month of the year.

Southern Saskatchewan has seen temperatures as high as 45°C and as low as -5°C in the summer, and can experience a great deal of thunderstorm activity in late spring and summer. The northern half of the province, on the other hand, has a sub-arctic climate, with a shorter summer and cooler temperatures.

This section describes the weather and local effects boaters can expect on Saskatchewan's main boating lakes: Lake Athabasca, Lac La Ronge, Lake Diefenbaker, and Last Mountain Lake.

Although Environment Canada produces an Inland Waters Marine Forecast (FQCN13 CWNT) for Lake Athabasca during the open-water season, there are no marine forecasts produced for the other three lakes.

6.1 Lake Athabasca

Lake Athabasca is located in the northwest corner of Saskatchewan and extends into northeast Alberta. It covers an area of approximately 7,770 km^2, making it the eighth-largest lake in Canada, and is 280 km long and 50 km across at its widest point. The depth of the lake varies considerably, with a maximum depth of 124 m but a mean depth of only 20 m. The western end of the lake is generally shallow, with a gradually sloping bottom.

The north and south shores of Lake Athabasca are very different from one another. The north shore has a landscape typical of the Canadian Shield: rough, rocky, and with a sharp escarpment sometimes rising more than 350 m above lake level. The south shore is characterized by an extensive area of sand dunes. The eastern end of the lake narrows into a long channel (Pine Channel), where the communities of Fond Du Lac and Stony Rapids are located. They and the other major settlements on the lake—Fort Chipewyan, Uranium City, Eldorado, and Camsell Portage—are all located on or near the north shore.

In the late spring and early fall, air temperatures over the lake can vary drastically from both one day and one year to the next, and have been known to drop to as low as -20°C in May, -10°C in September, and -30°C in October.

Because of its size, Lake Athabasca can have a marked influence on the weather around it. The generally cold temperature of the lake helps to suppress convective development from weaker cells, leading to fewer thunderstorms over the water than over nearby land. Those that do occur tend to happen in the afternoons and can pose a threat to the safety of mariners. In the years from 1999 to 2012, there were between 4 to 10 days from May through September with lightning over Lake Athabasca. During the same time period, peak lightning activity occurred during the month of July when the lake experienced on average 3 days with lightning.

Lake Athabasca is known to produce snow squalls—most often in the fall, when cold Arctic air moves over the warmer lake water. Toward the end of November, the lake cools sufficiently and begins to freeze, ending the lake-effect snow. These snow squalls often drop 10 to 15 cm of snow in a short period of time, creating a very narrow swatch of whiteout conditions with near-zero visibility.

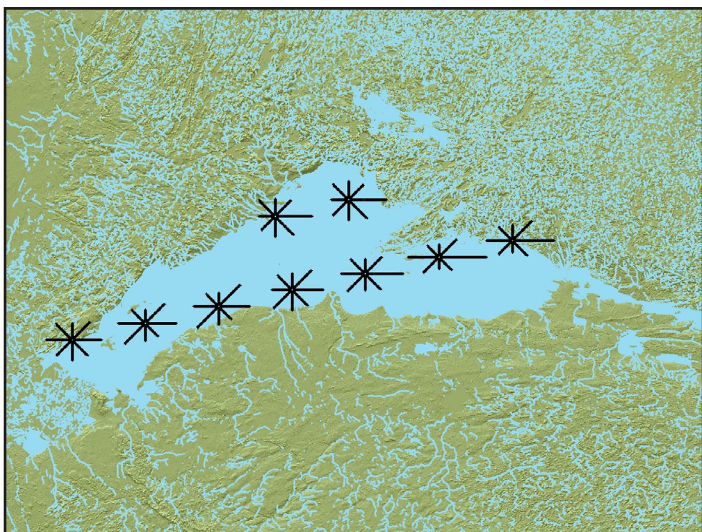
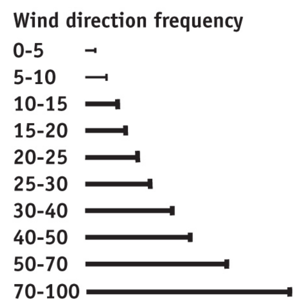


Figure 1: RADAR SAT derived wind roses indicating the most frequent wind directions in June, July, and August: Lake Athabasca.



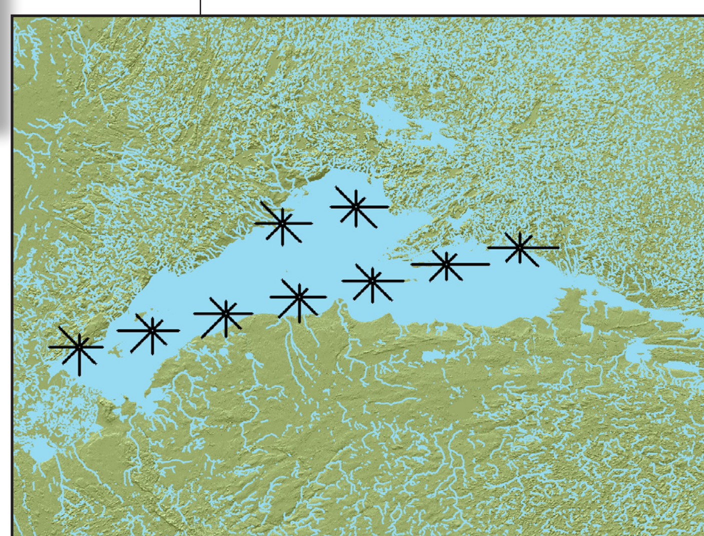


Figure 2: RADAR SAT derived wind roses indicating the most frequent wind directions in September, October and November: Lake Athabasca.

In the summer, the lake's surface temperature can reach 17 to 19°C in the delta area but remains cooler everywhere else. Since moderate to strong winds mix the surface layer with the colder, deeper water, hypothermia can be a concern, even in the summer.

The cooler lake temperatures can also be a factor in the development of advection fog, which usually forms in spring and early summer but can also occur into late summer. This occasionally leads to dense fog and greatly reduced visibility over the lake. Fall fog is more likely to develop as a result of rapid, localized cooling over the surface of the surrounding land. This radiation fog frequently develops during the evenings and is especially noticeable along shorelines and over wetlands; however, it usually dissipates quickly with the rising of the early morning sun. Morning radiation fogs are most common from July to September.

Lake Athabasca is well known for its rough, unforgiving seas. The lake is shallow on the Alberta side, with the average depth west of Bustard Island only around 2.5 m. In the much deeper waters in the middle of the lake, moderate to strong winds can generate large, rolling waves that eventually (if winds are from the North/Northeast/East direction) steepen and break into short, choppy waves as they approach the shallows at its western end.

It takes no time for even a minor disturbance to generate high waves, with winds blowing from west to east, east to west, southwest to northeast, and northeast to southwest owing to the long fetch. Calculations show that sustained winds of 40 kt from these directions can create waves of 3 to 4 m over the lake.

Wind	20 knots	30 knots	40 knots	50 knots
N	1.1 m	1.8 m	2.4 m	3.1 m
NE	1.2 m	1.9 m	2.5 m	3.4 m
E	1.5 m	2.5 m	3.4 m	4.6 m
SE	1.0 m	1.7 m	2.4 m	3.0 m
S	0.8 m	1.4 m	1.9 m	2.6 m
SW	1.8 m	2.9 m	4.1 m	5.4 m
W	1.2 m	1.9 m	2.5 m	3.4 m
NW	1.0 m	1.7 m	2.3 m	3.0 m

Figure 3: Estimated significant wave heights, based on wind speed and direction, for the middle of Lake Athabasca.

Because of the shallow nature of the western end of Lake Athabasca, wind set-up can cause noticeable day-to-day fluctuations in water level, especially when winds are oriented with the northeast-southwest axis of the lake. During windy periods, water levels at Fort Chipewyan and Crackingstone Point may differ by as much as 1 m for a period of several days.

Ice break-up usually begins at the western end of the lake by mid-April, with the lake ice-free from late May to early June. Freeze-up typically begins by mid- to late October and is complete by mid-December.

6.1.1 Local Effects

The topography of the north shore makes gap winds, barrier winds, downslope winds, and lee effects possible problems when sailing near shore. Barrier winds are more of a concern east and west of Camsell Portage, while gap winds are more common between Easter Headland and Fond du Lac.

6.1.1.1 Lake Athabasca Western Half

The Peace-Athabasca Delta, located at the west end of Lake Athabasca, is characterized by numerous muskegs, lake-like bodies of water, and both active and inactive distributary channels of the Athabasca River. Navigational problems may occur in the 50 km of the Athabasca delta, where the channel divides into several branches and new channels are constantly being opened and old ones closed by the spring floods.

Sandbars are a major navigational bottleneck, especially during low waters. The current flowing into and out of Lake Athabasca through the Peace-Athabasca Delta can combine to cause choppy waves where the two bodies meet.

Although currents from the lake's tributaries are not generally strong, when the Peace River is high, those on the Chenal des Quatre Fourches and the Rivière des Rochers sometimes reverse, leading to confused seas in front of the delta and changes in lake depths.

The western end of the lake is shallow and has a gradually sloping bottom. The average depth west of Bustard Island is around 2.5 m, although a 15-m deep, 500-m wide channel leads to the lake outlet starting at about 8 km east of the head of the Rivière des Rochers. Sand extends to roughly 5 km from the delta shoreline, except opposite Big Point Channel, where it reaches out about 8 km. Ideal conditions for shoaling and wave refraction result in increased wave heights, breaking waves, and confused seas in the area. Wave heights are magnified

Figure 4: Local effects for the western half of Lake Athabasca.

when winds are strong from the northeast, due to the long fetch of the lake. Local effects for the south and north shores of the western half of the lake follow.

- **Old Fort Point:** Reflection and refraction effects can occur with northwest to northeast winds.
- **Moose Point to William Point:** Shallow waters and marshy shores offer little protection against strong winds from the west, northwest, North and northeast and associated large seas on this stretch of shoreline;
- **Fort Chipewyan to Sandy Point:** This rugged shoreline has many small bays, points, and inlets that offer shelter from high winds and waves.
- **Sandy Point:** Shoaling and refraction effects around the point give rise to large, sharp waves when winds are southerly.
- **Bustard Island:** In addition to scenic storm beaches and driftwood, Alberta's largest island can provide shelter from waves—although caution must be exercised due to shifting sandbars.
- **Fidler Point:** High seas can occur in moderate to strong winds from the southeast to southwest, while shoaling and refraction around the point cause large, sharp waves deep inside the bays.
- **Fidler Point to Greywillow Point:** Sandstone outcrops, sandy beaches, and stranded beach ridges characterize this stretch of shoreline, with numerous small coves that offer shelter from wind and waves. Large waves are possible over the open water, especially with east to northeast winds.
- **Greywillow Point:** Shoaling and refraction around the point and some of its outlying islands give rise to large, sharp waves and confused seas in the area.
- **Greywillow Point to Maurice Point:** Many protective coves and large bays are found along this stretch. Large waves are possible over the open water—especially with east to northeast winds—and several spits and sandbars can make navigation tricky when seas are rough.
- **Maurice Bay:** Choppy, rough seas are possible at the southeast-facing entrance to the bay in strong northeast to southeast winds, while a shallow sandbar extends southwest of the north entrance of the bay.
- **Spring Bay:** Rough and choppy seas are possible at its east-facing entrance in strong east to southeast winds.
- **Lobstick Island to Halfway Point:** East to southwest winds strengthened by barrier-jet effects can cause large waves along this shoreline. Southeast to south winds can create large, rolling waves due to the long fetch. Shallow waters exist to the west and south of Lobstick Island.

6.1.1.2 Lake Athabasca Eastern Half

This section includes local effects for the south and north shores of the eastern half of Lake Athabasca.

Figure 5: Local effects for the eastern half of Lake Athabasca.

South Shore

On the south shore, the offshore region is sandy and shallow, especially near Athabasca Sand Dunes Provincial Park—making travel difficult for small watercraft when waves are high. Small deltas at the mouths of the William, Archibald, and McFarlane rivers result in ever-shifting sand shoals that can extend up to a few kilometres from shore.

- **Poplar Point to William Point:** This shoreline is sandy and shallow off shore, especially along Athabasca Sand Dunes Provincial Park. Sediment transport creates small deltas at the mouths of the William, Archibald, and McFarlane rivers, causing ever-shifting sand shoals. These can extend a few kilometres from shore—in particular, off Turnor Point and Wolverine Point, the latter experiencing shoaling up to 2 km out due to the shallow waters.

- **Ford Bay to Poplar Point:** A number of small bays and islands provide limited protection from wind and waves in this area, although northwest, west, and southwest winds can create large seas at their entrances.

North Shore

Due to the topography of the north shore, gap winds and barrier winds can cause problems for boaters near shore. The latter are more of a concern east and west of Camsell Portage; the former, between Easter Head and Fond-du-Lac.

- **Camsell Portage:** Barrier winds are possible in the vicinity, giving rise to higher nearshore winds and waves than expected, and strong southwest to west winds can cause large waves past Camsell Point.
- **Camsell Portage to Crackingstone Point:** Southwest to west winds can cause large waves, while the steep topography can cause barrier winds to set up.
- **Crackingstone Peninsula:** Shoaling and refraction near the Crackingstone Peninsula can cause increased wave heights, breaking waves, and confused seas—all of which are exacerbated in strong winds from the southwest or west due to the long fetch. The channeling of winds between the islands at the south end of the peninsula can also generate large waves and rough seas. Barrier-jet effects can occur on the west side due to its steep slopes.
- **Crackingstone Peninsula to Smith-Windsor Islands:** Numerous reefs and islands along the shore make navigation tricky in this area. East to southwest winds can cause large waves along the shoreline. Channeling and gap winds, caused by homogeneous outcrops strongly lineated by glacial scouring, add strength to northwest to northeast winds, creating choppy, confused seas at the entrances to the many bays and inlets.
- **Smith-Windsor Islands/Poplar Point to Tyrell Point/Pine Channel:** The lake narrows to a channel of 5 to 6 km wide at its easternmost end. A number of reefs and small islands are found along the north shore, while the south shore features several large, silt-bottomed bays, including Brochet Bay and Ferguson Bay. An abrupt rise in the shore east of Fraser Point makes gap winds a possibility, especially with west or east winds, so higher winds and waves should be anticipated. The channeling of winds down the numerous bays and inlets along the north shore can give rise to strong crosswinds and confused seas at their entrances, especially if winds are from the northeast. The channel narrows to just 1 km between Fond-du-Lac and Fraser Point, creating a funneling effect that results in stronger winds and larger waves downwind.
- **Pine Channel:** This narrow channel, which connects Lake Athabasca to Fond-du-Lac, is about 10 km long and 230 to 600 m wide, with steep escarpments on both sides and many small reefs, islands, and outcrops along its north shore. Funneling can cause increased wind speeds and rough seas through the channel, while gap winds are possible when winds are from the northeast, leading to rough, confused seas near bays and islands.
- **Fond-du-Lac:** This lake is about 27 km long and has a maximum width of 2.8 km. Its south shore is smooth and rocky, while its north shore features rugged granite hills and is lined with reefs and small islands. Winds over the lake are predominantly east-west, with both channeling and funneling effects possible, the later near MacDonald Point, where the lake narrows to about 775 m wide.

- **Fond-du-Lac River to Stony Rapids:** Stretching 12 km from its mouth at Fond-du-Lac to Stony Rapids, this river is less than 500 m wide. East-west winds increase in speed over the river due to the channeling effect of its orientation.

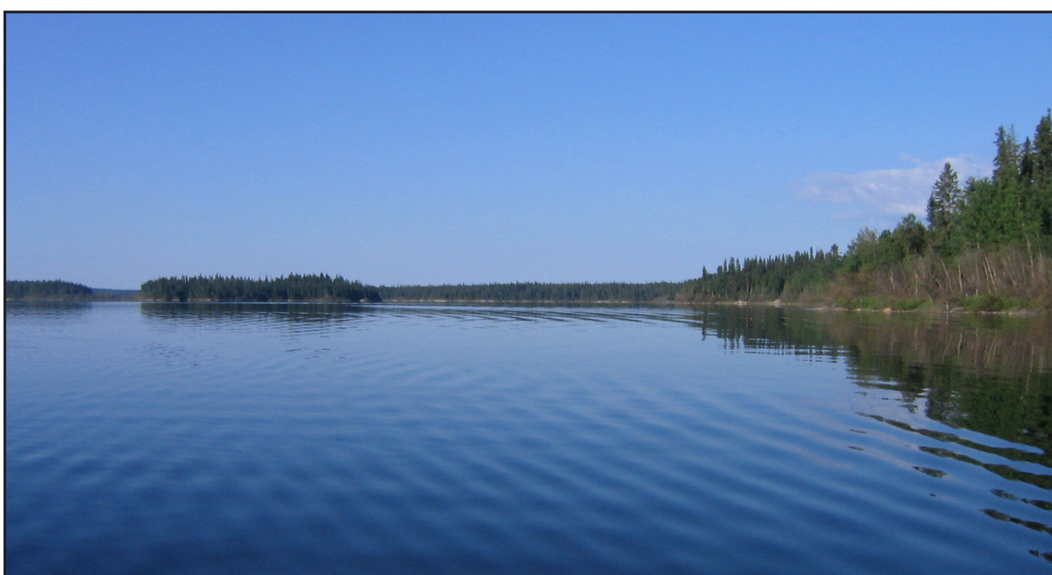
6.2 Lac La Ronge

Lac la Ronge is a large lake, covering 1,414 km^2. Located on the southern margin of the Canadian Shield, the lake's north shore has a rugged shoreline and numerous islands, while its south shore is much less rugged and has more even topography. The main body of the lake has an average depth of 14.6 m and a maximum depth of 18.3 m. The mean depth of the lake as a whole is 12.7m, with the deepest part being in Hunter Bay.

In the late spring and early fall, air temperatures over the lake can vary drastically from one day and one year to the next. Temperatures can drop as low as -18°C in May, -8°C in September, and -21°C in October, yet reach as high as 32°C, 34°C, and 27°C during those same respective months. In the years from 1999 to 2012, there were between 8 to 16 days from May through September with lightning over Lac La Ronge. During the same time period, peak lightning activity occurred during the month of July when the lake experienced on average 6 days with lightning.

During outbreaks of very cold air (usually in north and northwest flows) it is possible for snow squalls to form over the lake in the fall and, more rarely, the spring.

Freeze-up typically occurs in late November, with break-up occurring in late May. During July and August, the mean near-surface water temperature (0-10 m) in Lac La Ronge is 16.5°C. Hunter Bay has colder waters because it is deeper than the main body of the lake.



Typical Canadian shield lake. Photo: Craig Smith

6.2.1 Local Effects

Lac La Ronge is popular for fishing and pleasure boating. Like any large expanse of water, however, its long fetches can create large seas. The immensity of the lake is partly concealed by the numerous islands that lie within the Canadian Shield. These islands and peninsulas can, however, provide protection from the strong winds and large waves that build up across the expanse of the lake.

6.2.1.1 Lac La Ronge Southern Half

- **La Ronge to Fox Point:** Large waves can be expected in this area in moderate to strong winds due to the long fetch available.
- **Sandy Point to Meeyomeet Bay:** Shoaling occurs near shore due to the sandy beaches in this area.
- **La Ronge, Air Ronge, and Area:** The large islands at the entrance to the Montreal River provide protection to boaters near shore; however, shoaling is possible near the reefs that extend southwest to northeast from the islands.

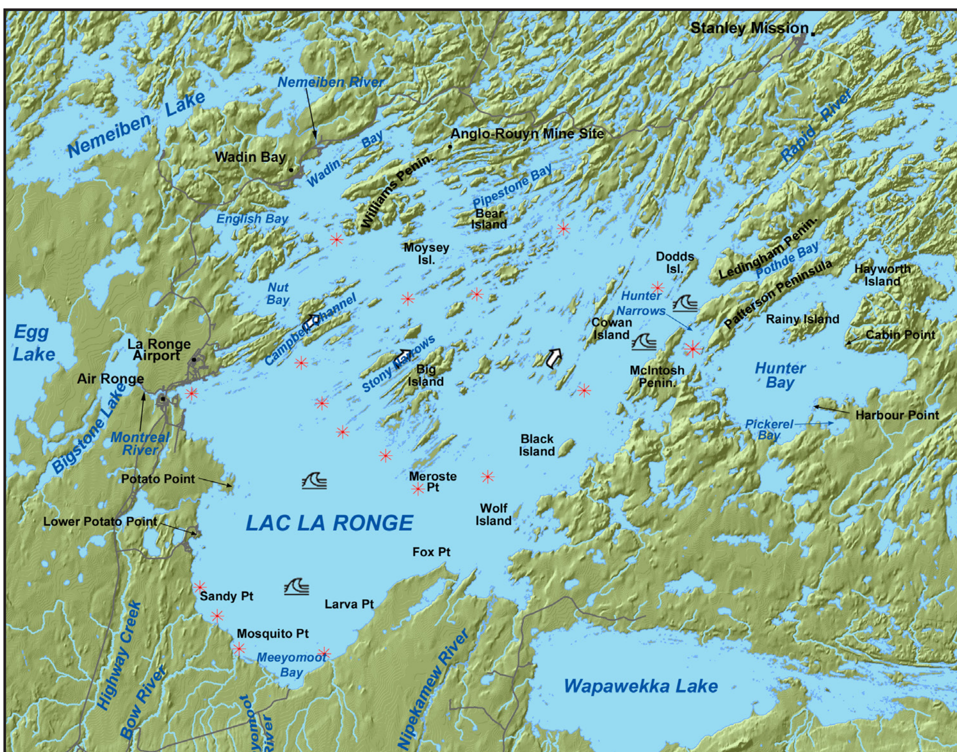


Figure 6: Local effects for Lac LaRonge.

6.2.1.2 Lac La Ronge Northern Half

The northern half of the lake is riddled with reefs and shoals that are hidden just below the surface of the water. These not only pose a hazard to equipment but also cause difficult water conditions due to various effects, such as shoaling and wave refraction. Mariners must be extremely careful in these waters and fully aware of the direction of the wind and location of shoals.

The retreating glaciers of the last ice age left their mark on the lake by creating many elongated islands that are oriented in a southwest to northeast fashion. The islands combine to create channeling effects. Many reefs and shoals are also located in a line southwest and northeast of the islands.

Many fishermen are drawn to Hunter Bay, which lies in the extreme northeast part of the lake. A morning arrival is usually ideal, as winds from the southwest tend to increase over the course of the day. This can result in extremely large seas outside the entrance to the bay (Hunter Narrows) due to the long fetch that develops by afternoon. Shoaling caused by reefs and shallow shelves through the Narrows (between Patterson and McIntosh Peninsulas) can exacerbate conditions, especially in west to northwest or east to southeast winds. Waves of more than 3 m in height can make navigation nearly impossible—and many boats have capsized in the area, with lives lost. Mariners must also be aware that winds over the lake may be stronger than those forecast for the town of Lac La Ronge.

6.3 Lake Diefenbaker

Image of typical shoreline on Lake Diefenbaker.

A T-shaped reservoir that powers a hydro dam at its northern end, Lake Diefenbaker is 2 to 3 km wide in most places and 225 km long, with more than 800 km of sandy, undeveloped shoreline. At full-supply level, its mean depth is 22 m and its maximum depth, 58 m; however, the lake's water levels can fluctuate by 3 to 9 m over the course of a year. These changing levels—combined with long stretches of open water, wind and wave action, and poorly consolidated shore materials—make its shoreline highly vulnerable to erosion. Vast expanses of sand and gravel beach are exposed when the water level is low.

In the late spring and early fall, air temperatures over the lake can vary drastically from one day and one year to the next. In the past, lows of -13°C, -16°C, and -26°C have been experienced in May, September, and October, respectively, while highs for those months have reached 37°C, 37°C, and 32°C.

In the years from 1999 to 2012, there were between 11 to 21 days from May through September with lightning over Lake Diefenbaker between Danielson and Douglas. Most of this activity took place between June and August. Other parts of Lake Diefenbaker have a similar number of lightning days.

6.3.1 Local Effects

Lake Diefenbaker's unique shape creates some unique marine hazards. The many long valleys and coulees that run along (and often perpendicular) to the lake's shoreline can create localized, miniature fiord winds. As a result, winds along the shore in many parts of the lake are stronger than the prevailing winds and blow in unexpected directions.

The channelling and funneling of winds occurs along the length of the lake, leading to highly variable wind speeds and directions that are much different over the water than reported over the land. As such, winds blowing along its three arms toward the T-junction near Elbow can come from different directions. This can cause the waves created by the winds to converge at different angles, creating confused seas in the area. Gap winds can also occur at the openings near the town of Elbow due to the narrowing of the lake and the steepening of the valleys in some places.

Figure 7: Local effects for the Thomson and Gordon Mackenzie arms of Lake Diefenbaker, as well as from Elbow to Riverhurst.

Storm surges can occur at the Gardiner and Qu'Appelle dams, where water levels have been known to fluctuate wildly in strong north or south winds. When the wind finally and suddenly drops, these parts of the lake can experience significant seiches.

Elbow Harbour Marina, on Lake Diefenbaker.

In the Gordon Mackenzie Arm of the lake, southeast and northwest winds can be channelled, causing stronger winds and larger waves than otherwise expected. A large sandbar extends from the west shore to mid-channel, opposite the Mistusinne cottage subdivision. An old, abandoned railway line near Douglas Provincial Park creates shoaling conditions in north or south winds. Very shallow water in the bays on the west shore near the Qu'Appelle Valley Dam can cause shoaling with north to northwest winds.

The lake's orientation in a mainly east-west direction in the arm from Saskatchewan Landing to Elbow means that east and west winds are channelled and at some points funneled along its length.

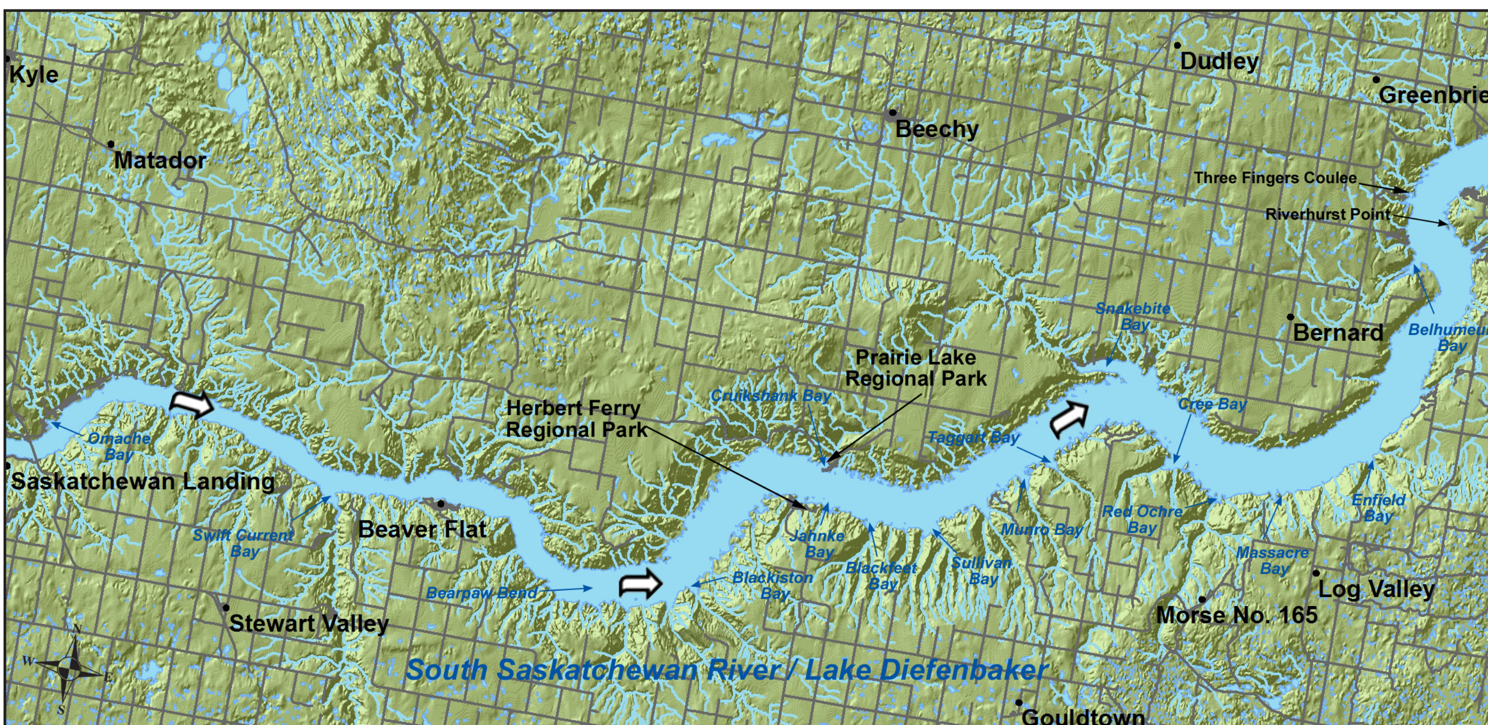


Figure 8: Local effects on Lake Diefenbaker, from Little Saskatchewan Landing to Riverhurst.

6.4 Last Mountain Lake

Last Mountain Lake, also known as Long Lake, is located in south central Saskatchewan, nearly 50 km northwest of Regina. Approximately 93 km long but only 3 km across at its widest point, it is the largest naturally occurring body of water in southern Saskatchewan.

Popular with boaters, anglers, and sailboats, the lake has an average depth of 20 m and reaches a maximum of approximately 30 m north of Sarnia Beach. From Collingwood Lakeshore Estates to Grandview Beach, depths average 20 to 30 m; however, they drop to 15 to 20 m between Grandview Beach and Pelican Point, and to 10 to 15 m southeast of Pelican Point.

Both the southern and northern ends of the lake are very shallow, with extensive marshes and wetlands. Last Mountain Lake's irregular shoreline is dotted with small coves and inlets, sand spits, and sandbars, while its surrounding landscape is generally flat.

In the late spring and early fall, air temperatures over the lake can vary drastically from one day and one year to the next. In the past, lows of -13°C, -16°C, and -26°C have been experienced in May, September, and October, respectively, while highs for those months have reached 37°C, 37°C, and 32°C.

In the years from 1999 to 2012, there were between 11 to 22 days from May through September with lightning over Last Mountain Lake—most of the activity taking place between June and August.

6.4.1 Local Effects

Last Mountain Lake's north-south orientation is conducive to large waves and seiches when strong north or south winds occur. North winds are also affected by the shape of the lake, since its north end is significantly wider than its south. Because of these two factors, north winds are amplified by funneling toward the south end of the lake.

- **Valeport Marsh:** Located at the southeast end of Last Mountain Lake, this wetland is very shallow, and shoaling can be expected with strong northwest winds.
- **Valeport Marsh to Pelican Point:** Funnelling can cause northwest and southeast winds in the area to be higher than expected.
- **Pelican Point:** The lake's long fetch and much wider north end enable north to northwest winds to become amplified by funnelling and channelling near its south end. As a result, while wind and waves south of Regina Beach might be low, they can increase dramatically at Pelican Point, with rough seas occurring where the waves crash into the point. A sand and gravel spit extends south from Pelican Point, so caution must be exercised when passing through this area.

Figure 9: Local effects on Last Mountain Lake.

- **Sarnia Beach:** Shoaling is often a concern on the west shore of the lake just north of Sarnia Beach due to shallow waters and reefs.
- **Etters Beach:** Shoaling is often a concern on the west shore of the lake near this beach, due to shallow waters and reefs.
- **Last Mountain Lake Bird Sanctuary:** Shoaling is a concern, especially in strong south winds, as waters in the area are less than 2 m deep. Refraction can also occur just upstream of the Royal and Bird islands.

PRAIRIES REGIONAL GUIDE PART 4: MANITOBA

7. Manitoba

Manitoba is located at the eastern edge of the Prairies. Its three largest lakes—Winnipeg (24,387 km^2), Winnipegosis (5,374 km^2), and Manitoba (4,624 km^2)—are located in its southern region, which has the lowest and most uniform elevations of the three prairie provinces. These lakes cover much of the lowland area between the Manitoba escarpment (to the west) and the start of the Canadian Shield (to the east) that was once a prehistoric glacial lake called Agassiz.

Although some topographically related local effects may not be as pronounced as they are in other lakes due to the uniformity of this landscape, they should still be taken into consideration when boating.

7.1 Weather Conditions

7.1.1 Climate and Temperature

The presence of its three large lakes has an influence on south-central Manitoba's regional climate. Phenomena such as land and lake breezes and evaporative cooling have a direct influence on temperatures experienced on and off shore. Its location far away from any sea or ocean gives southern Manitoba a continental climate. Summers are short and warm, with daytime highs averaging more than 20°C during June, July, and August. Although temperatures can still become quite cold overnight at that time of year, they rarely dip below zero.

Temperatures in the spring and fall can fluctuate dramatically in southern Manitoba, both from day to day and from year to year. For example, October sees an average of 15 to 20 days when the temperature drops below zero overnight (depending on location). These variations are reflected in the extreme maximum and minimum temperatures recorded at the Arborg weather station: 37°C to -14°C in May, 37°C to -8°C in September, and 29°C to -21°C in October.

7.1.2 Storms and Precipitation

Low-pressure systems originating from the Colorado area can bring extended periods of rain or snow and very strong winds between the fall and spring. Colorado lows can occur at any time of the year. Although rare, May and October can see heavy snowfall during this period, with Winnipeg's climate station seeing records of 29 cm and 24.6 cm in under 24 hours.

During the summer months, southern Manitoba sees a lot of thunderstorm activity, which can develop quickly and cause many types of severe weather over its lakes. Each year, Lake Manitoba and Lake Winnipeg's south basin experience an average of 15 to 20 days with lightning, while Lake Winnipeg's north basin and Lake Winnipegosis see an average of 10 to 15. Because of its more easterly location, Manitoba receives more nocturnal and morning thunderstorms than the other prairie provinces.

If they are strong enough, thunderstorms that form in the west and southwest can track into southern Manitoba late in the day and overnight. In the spring, the colder waters of the lakes can help to suppress thunderstorms.

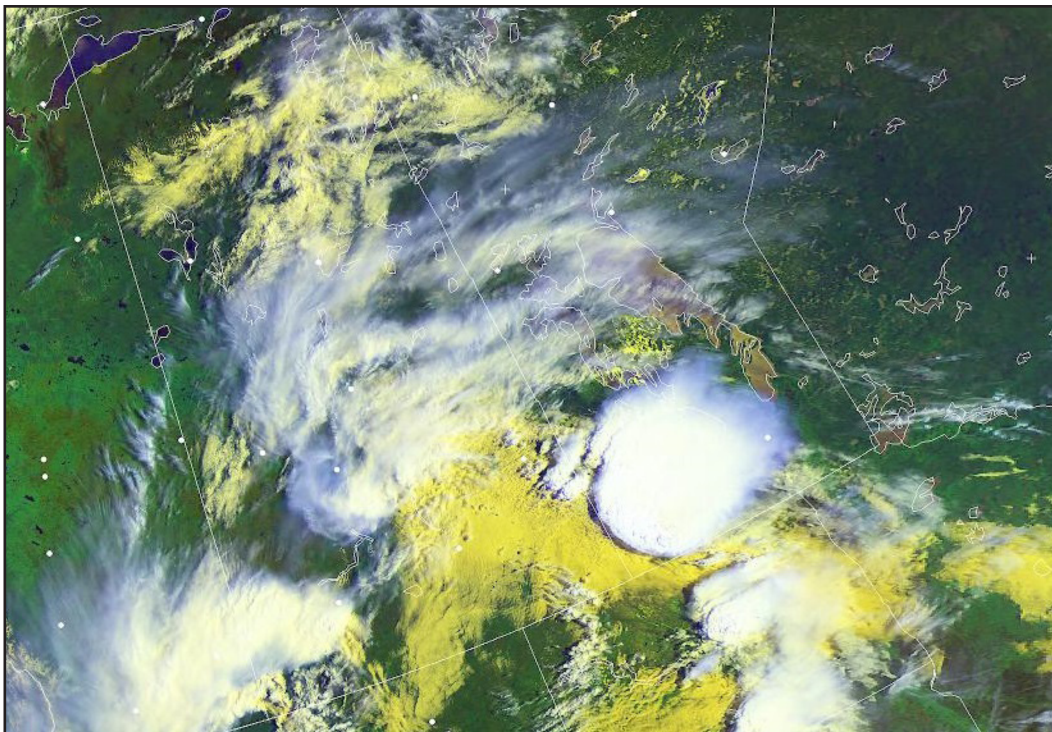


Figure 1: Satellite image of a large thunderstorm over southwestern Manitoba.

7.1.3 Fog

Advection fog is most common in the spring, when air temperatures are warm and lake temperatures are still cold. Since the Manitoba lakes are quite shallow, they warm up quickly—as such, ideal conditions for advection fog do not generally last past June. The longer the water remains in a relatively cool state, however, the greater the chance of fog occurring into the summer. In the fall, steam fog can form as air temperatures cool down and lake temperatures remain warm, while radiation fog can be a problem overnight and in the early morning, mostly along shorelines and over marshes.

7.1.4 Winds

Lake Winnipeg, Lake Winnipegosis, and Lake Manitoba are all large enough to set up lake- and land-breeze circulations, producing quite variable winds throughout the area. Lake-breeze circulations can help keep the skies over the lakes clear, while enhancing convective development over the land adjacent to the lakes. Conditions that lead to lake- and land-breeze formation include light winds, moderately clear skies, and a temperature difference between the lake and the land—the higher the difference, the stronger the breeze. See the *National Marine Weather Guide* for more details.

7.1.5 Snow Squalls

Strong winds and rough seas are common over Manitoba's lakes when an outbreak of cold air behind an intense area of low pressure moves over warmer water, causing the air mass to become unstable. This is especially true in the fall, when air temperatures can be very cold and the lakes' surface water is still relatively warm. Cold-air outbreaks can also cause lake-effect snow or snow squalls to develop—most commonly in the fall but sometimes after the spring break-up. Lakes Winnipeg, Manitoba, and Winnipegosis are well known for experiencing snow squalls, which can results in localized areas of moderate to heavy snow, ice pellets, or mixed rain and snow.

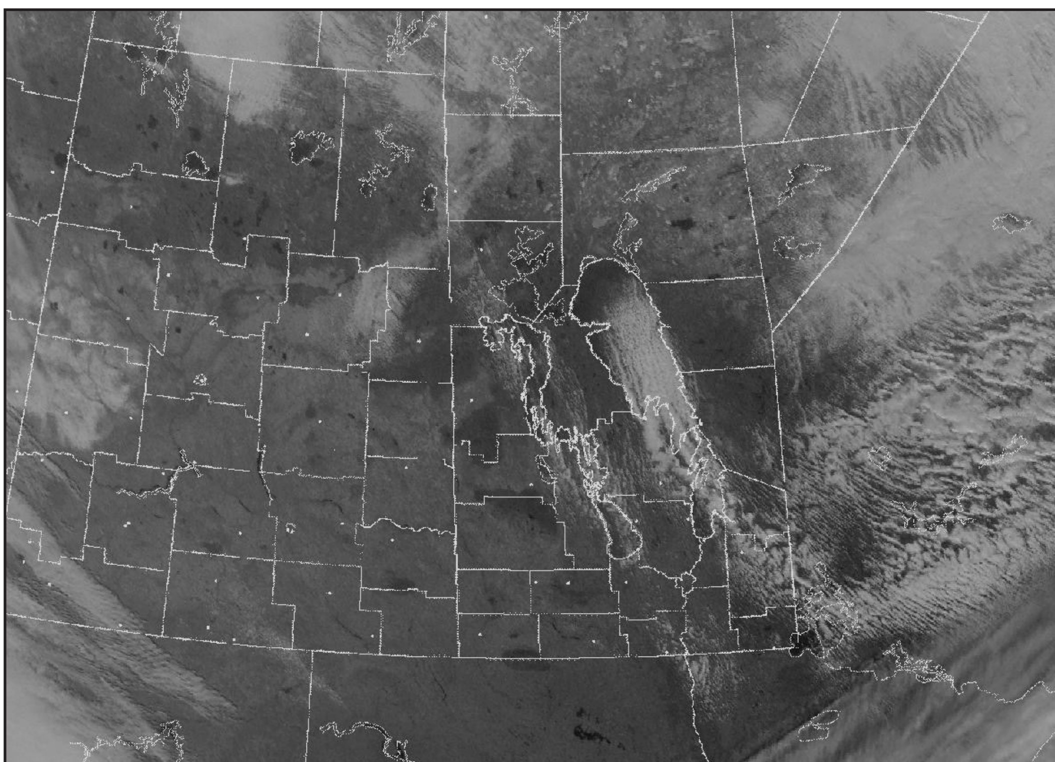


Figure 2: Visible satellite image of lake-effect cloud and snow that formed when cold, dry continental air moved across the warm Manitoba lakes on November 10, 2004. The convective cloud streamers are aligned with the northwesterly surface winds.

7.1.6 Water Temperatures

Surface-water temperatures in Lake Winnipeg range from 14°C in early June to an average in July and August of around 18.5°C in the north basin and 21°C in the south. Due to their shallow nature, summer water temperatures in Lake Winnipegosis and Lake Manitoba are likely slightly warmer, respectively, than they are in the north and south basins of Lake Winnipeg; however, their temperatures cool off faster in the fall.

7.1.7 Waves

Manitoba's "big three" lakes are known for their rough seas and choppy waves, which are due, in part, to their large size and shallow nature. Wave conditions can change very rapidly as a result of changing wind speeds and directions, and even minor disturbances can create wave conditions that are dangerous for small boats. Shoaling can play a big part in the rapid generation of large waves, as waves moving over a shallow area slow down, causing them to steepen and increase in height, and for their crests to move closer together. When they are approximately as high as the water is deep, they curl forward and break or tumble into surf. See chapter 3 of the *National Marine Weather Guide* for a more complete description of these effects.

7.1.8 Seiches

Seiches can have a significant impact on circulation in Manitoba's large lakes. Due to their north-south orientation, shape, and shallow bathymetry, these lakes generally experience a higher rise in water level on the lee shore (set-up or storm surge) than other lakes with similar wind regimes.

Large seiche waves can combine with wind-driven waves to create destructive wave action and can also affect daily water levels at facilities such as wharfs and launching ramps. Manitoba's "big three" lakes experience similar seiche conditions, so the more specific information contained in section 7.3.2 on Lake Winnipeg generally applies to all.

For more on seiches and how they form, refer to Chapter 3: Sea State of the *National Marine Weather Guide*.

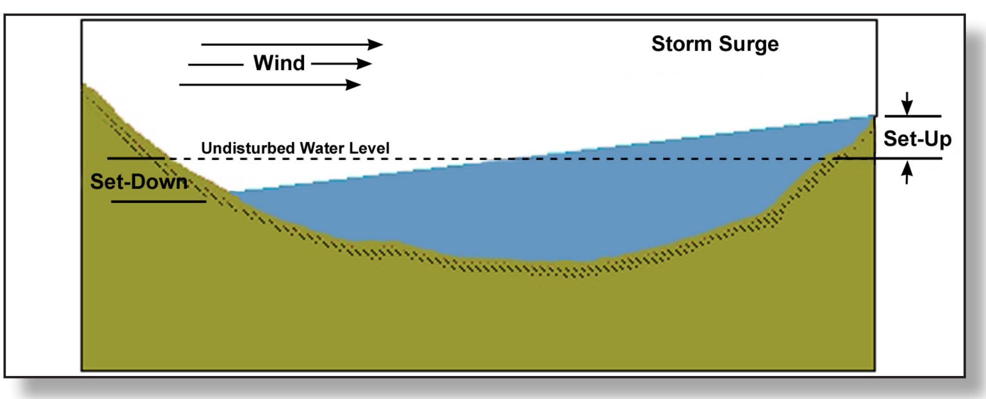


Figure 3: Depiction of Storm Surge set up.

7.1.9 Freeze-up and Break-up

While there is not specific information available on freeze-up and break-up dates for all three of Manitoba's large lakes, section 7.3.3 on Lake Winnipeg provides some indication of the conditions that can be expected. In general, the shallower Lake Winnipegosis is the first to freeze up in late November, followed by Lake Manitoba, Lake Winnipeg's south basin, and, finally, Lake Winnipeg's north basin by mid-to-late December.

7.2 Lake Winnipegosis

Lake Winnipegosis, Canada's eleventh-largest lake, is 195 km long and 51 km wide at its maximum, giving it a surface area of 5,370 km^2. The irregularly shaped lake—which has an average depth of 4.24 m and a maximum depth of 12 m—is strewn with islands and, in some areas, navigable only by small vessels.

7.2.1 Winds and Waves

Over the most northerly region of the lake, winds from the northwest and southeast have the greatest fetch; over the central and southern parts, this holds true for winds from the north to northeast and south to southwest. In a few locations, winds along these axes have long fetches that allow for the development of wind set-ups and large waves, which are amplified by the effects of shoaling. There are, however, numerous small bays on the lake in which to hide from high winds and waves. Shallow waters exist just offshore along the south end of the lake, creating ideal conditions for shoaling and refraction.

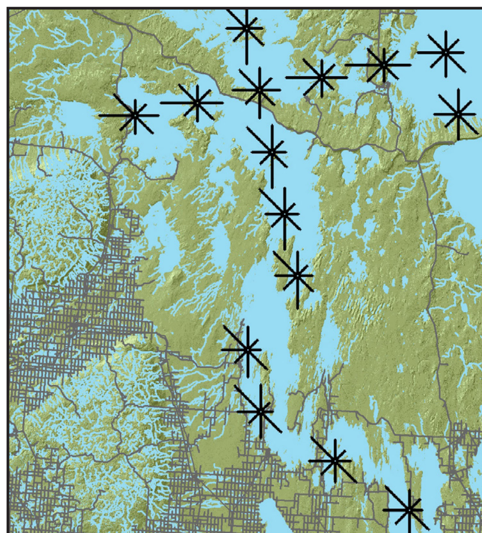
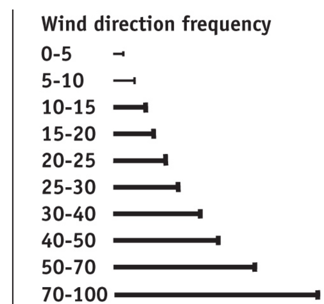


Figure 4: RADAR SAT derived wind roses June, July and August: Lake Winnipegosis.



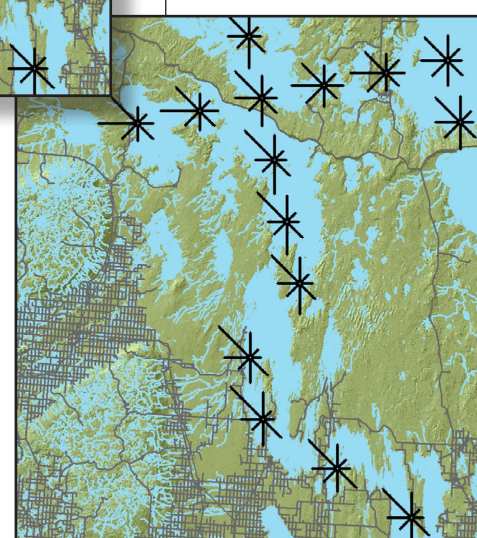


Figure 5: RADAR SAT derived wind roses September, October and November: Lake Winnipegosis.

7.2.2 Local Effects

This section describes local effects for the west and east shores of Lake Winnipegosis.

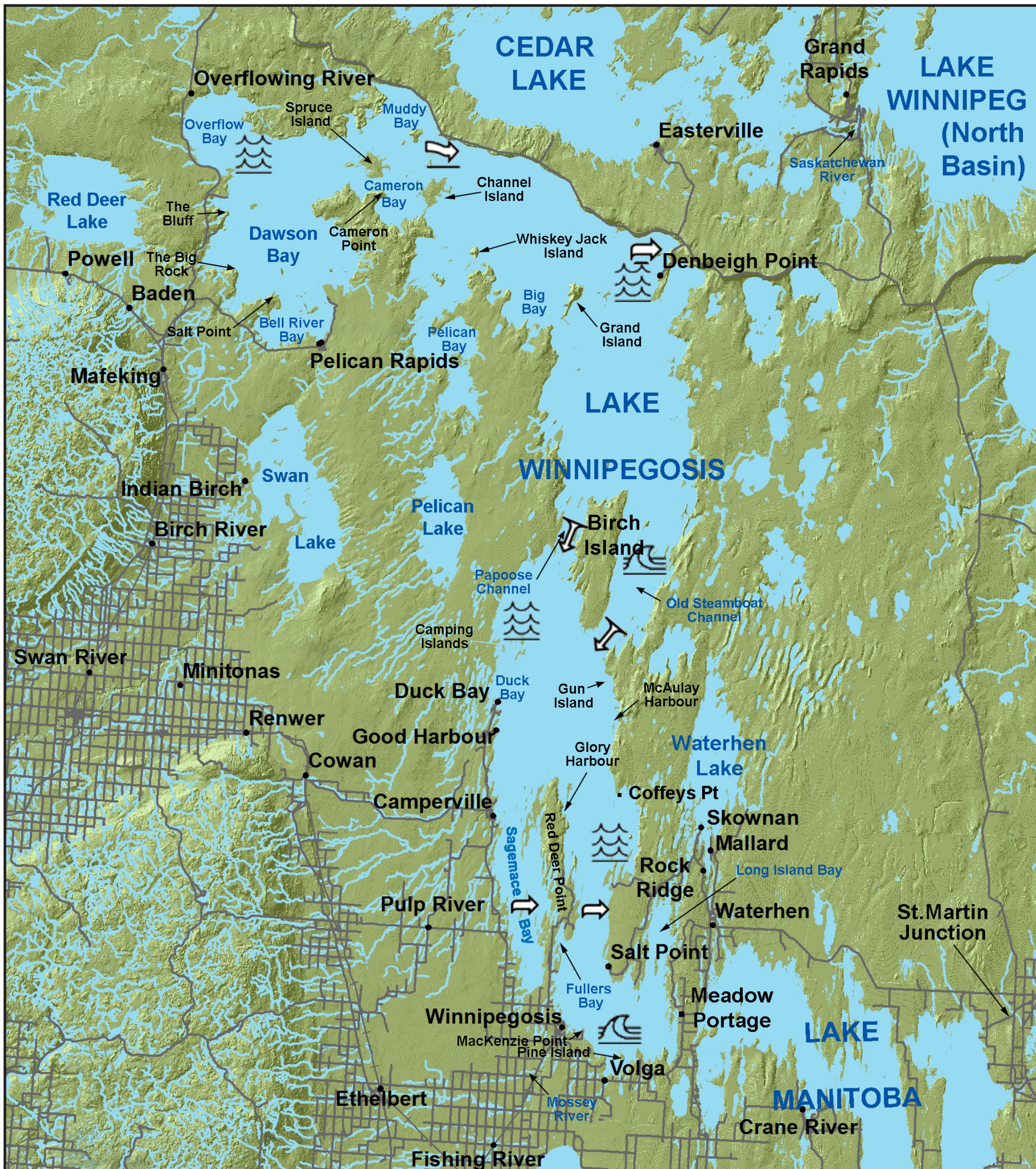


Figure 6: Known and inferred local effects for Lake Winnipegosis.

West Shore

- **Overflow Bay:** Strong northwest winds combined with the shoreline topography can create choppy confused seas in this bay, located near Overflowing River.
- **Cameron Bay:** East winds cause a barrier jet, creating confused seas between Cameron Point and Spruce Island. Channeling also occurs between these two points in east

or west winds, with east winds giving rise to confused seas because they blow in opposition to the current.

- **Birch Island:** Located in the center of the lake this large, marshy island has many fingers jutting out from its south and southwest end. The funneling of north and northeast winds through Old Steamboat Channel and Papoose Channel (on either side of the island) can create large seas in these areas and confused seas to the lee of the island.

- **Duck Bay Harbour:** Confused seas can occur at the entrance to the bay in north winds, due to the Camping Islands north of the bay.

- **Red Deer Point:** Channeling between this point and Salt Point (on the opposite shore) can increase north or south winds and waves.

- **Sagemace Bay:** The long fetch available to winds from the north and northeast can create large waves. Channeling of north winds between the mainland and Red Deer Point can increase wave heights toward the south end of the bay.

- **Mossey River/Winnipegosis:** Prolonged north and east winds can create waves 1 to 2 m in height at the mouth of the river. Shoals from Farmers Point to MacKenzie Point can also create steep, heavy seas offshore.

East Shore

- **Denbeigh Point:** This fishing harbour is exposed to winds and waves from northwest to southwest that can be strengthened by the barrier effect, causing heavy seas along the north coast of the lake from this point to Muddy Bay.

- **Old Steamboat Channel to Coffeys Point:** Reefs to the south of Gun Island can cause confused seas from the channel's exit to Coffeys Point.

- **Salt Point:** Channeling between this point and Red Deer Point (on the opposite shore) can increase north or south winds and waves.

- **Volga:** Located at the southern end of the lake, this area has many small inlets, bays, and headlands that offer all-weather protection from winds and waves from all directions except north. Confused seas can develop at the headlands due to refraction and in the lee of Pine Island, just north of Volga.

7.3 Lake Manitoba

Lake Manitoba is the smallest of the three lakes covered in this regional guide, with a length of approximately 225 km (oriented north-south), a surface area of 4,624 km^2, a maximum width of 45 km, and a maximum depth of 7 m. It has two distinct parts: a smaller, irregularly shaped north basin with numerous islands, peninsulas, and straits; and a larger, rounder south basin with a flat, featureless bottom, and steeply sloping sides. The average depth of the north basin is 3.1 m; the south basin, 4.5 m. Communities on the lake include Fairford, Steep Rock, St. Laurent, Oak Point, and Sandy Bay. Delta Marsh, at its southernmost end, lies just 24 km north of Portage la Prairie.

7.3.1 Winds and Waves

Strong northerly winds have a long fetch over the lake, with waves of 1.2 to 1.5 m possible downwind in extreme conditions. Its open, obstruction-free conditions make these effects more pronounced in the south basin, where large waves can develop in any wind direction. In the north basin, while large waves are also possible in north winds, the irregularly shaped shoreline shortens the fetch and generally limits the size of the waves.

In the south basin, depths of 1 to 2 m can extend to over a kilometre offshore in some places, creating ideal conditions for shoaling and refraction. Large, closely spaced, and breaking waves and confused seas are common and can create hazardous conditions for small craft.

In the south basin, large set-ups and storm surges can occur, with the biggest wind set-up observed at its south end being 1 m at Delta Marsh in 1944. When there is a strong wind from the north, the combination of large waves and strong set-ups can drive seas up to 2.5 m in height onto the south shore.

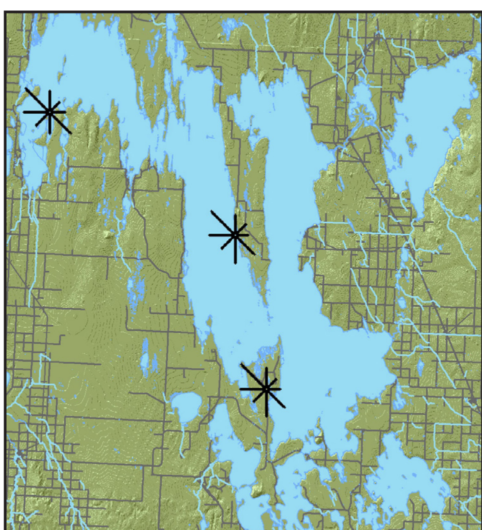
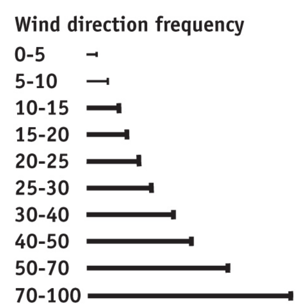


Figure 7: RADAR SAT derived wind roses June, July and August: Lake Manitoba (north basin).

Figure 8: RADAR SAT derived wind roses June, July and August: Lake Manitoba (south basin).



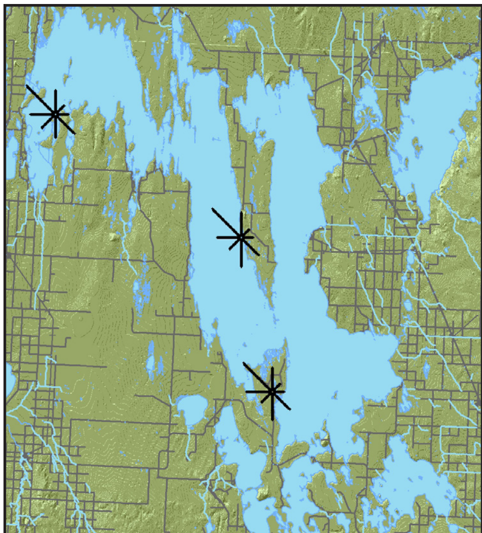
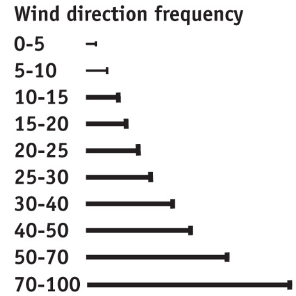
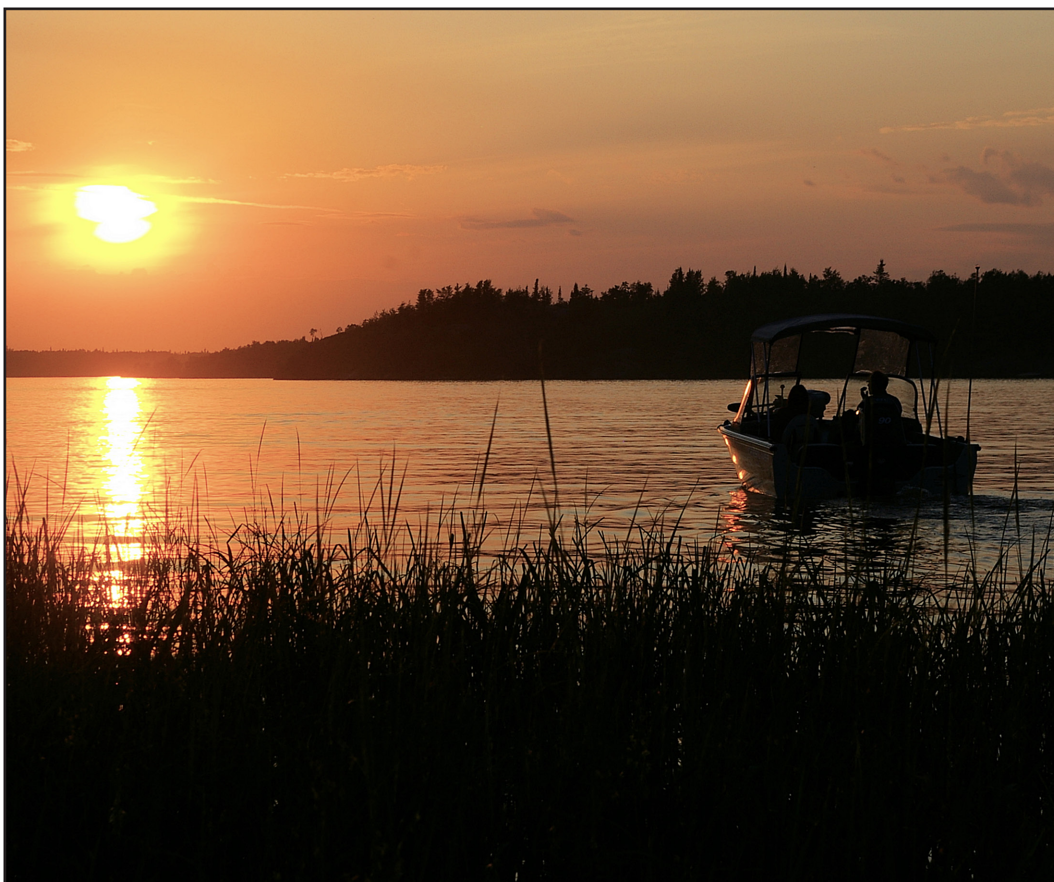


Figure 9: RADAR SAT derived wind roses
September, October and November:
Lake Manitoba (north basin).

Figure 10: RADAR SAT derived wind roses
September, October and November:
Lake Manitoba (south basin).





Lac du Bonnet, Manitoba. Photo: Patrick McCarthy

7.3.2 Local Effects

This section describes local weather effects for the north and south basins of Lake Manitoba.

7.3.2.1 North Basin

This section describes local effects on the west and east shores of the north basin.

Figure 11: Known and inferred local effects for Lake Manitoba, north basin.

West Shore

- **Wauhkonens Bay:** Northeast and east winds can cause large waves at the mouth of the bay, with confused waves in the lee of the Twin islands.

- **Waterhen River:** Crossing seas can be expected at the mouth of the river when waves generated by strong easterly winds interact with its exiting current.

- **Crane Narrows:** The funneling of northwest or east winds through the narrows can create large waves downwind. A chain of flat islands and reefs oriented north-south across the middle of the channel also partially blocks waves, creating confused seas in the lee of the islands.

- **Ashams Point:** The bay to the west of the point can provide protection from winds and waves; however, north to northeast winds cause large seas at its entrance.

- **Reykjavik Narrows:** Crossing seas can occur at the east end of the narrows when waves interact with the south-north current coming up the east side of Lake Manitoba. Confused seas are also possible with east or west winds in the lee of Peonan Point, Cherry Island, and the reefs south of the latter.

- **The Bluff Harbour:** Moderate to strong winds cause large seas outside the harbour due to the long fetch in north, east, and south directions.

East Shore

- **Portage Bay:** Confused seas are possible with north and east winds between Pine Island and Sandy Point, as two areas of refraction collide. North and south winds can cause large seas over the entire bay, while winds from the southwest to northwest can create high waves at the mouth of the Fairford River, due to the long fetch, and cornering to the northeast of Birch Point.

- **Watchorn Beach:** Strong west to southwest winds drive large waves onto the shore.

- **Moosehorn Bay:** Steep, rough seas can be expected with strong west to northwest winds due to shoaling and when winds blow counter to the prevailing current.

- **Sigurdson Point:** In northwest, north, and northeast winds, waves can occur at the entrance to this breakwater-protected harbour, which is located southeast of the point.

7.3.2.2 South Basin

This section describes local effects on the west and east shores of the south basin.

Figure 12: Local effects for Lake Manitoba, south basin.

West Shore

There are a few small harbours along the shoreline, which is generally featureless and devoid of islands, except between Stony Point and Sandy Point. Prolonged north, northeast, and southeast winds, although not as common as northwesterlies, can produce large seas due to the long fetch. Shoaling occurs near shore due to the shallow nature of the lake, steepening the waves and causing breakers. Prolonged northwest winds produce set-down along this shore.

- **Big Sandy Point:** This lagoon, although not a harbour, has beaches nearby where small craft can land.
- **Amaranth Harbour:** The entrance to this fishing harbour, located approximately 12 km north of the town of Amaranth, can experience large seas when winds are from the west through southeast.
- **Sandy Bay:** Located within a lagoon, this natural harbour offers all-weather protection from winds and waves. North to southeast winds will produce large seas at the entrance of the bay due to the long fetch.
- **Big Point:** The point is exposed to northwest, north, northeast, east, and southeast winds and waves. Refraction can cause steep, confused seas in the vicinity of the shoreline.
- **Lynchs Point:** This point is located within a large embayment at the entrance to the Whitemud River, where seas can be rough in east and northeast winds. River currents are generally weak, except during the spring run-off.
- **Delta Marsh:** This extensive, open marsh extends for nearly 30 km along the south shore of the lake and is only about 1 m in depth. Wave-current interaction can occur as the strong current from the Assiniboine River (Portage Diversion) interact with the lake's natural west-to-east current and moderate to strong northwest winds, especially during the spring run-off.

East Shore

This is a busy recreational boating area lined with several beaches but few harbours. Although strong west and southwest winds can produce large waves along the eastern shores, prolonged, brisk northwest winds can produce especially large seas and strong gusty winds over the south and southeast ends of the lake. The prevailing northwesterly winds are also counter-current and, combined with shoaling, produce large, rough seas along the eastern shores. This shoreline is generally devoid of islands, except near Marshy Point and in the far north.

- **The Narrows:** North or south winds are often strengthened by funneling through this narrow channel; however, the numerous islands and inlets usually prevent the waves from getting too large. Northerly winds create confused seas as they blow against the current. There are very few places to hide north of Manitou Island, which protects the exit of the Narrows from north and northeast winds and waves.

- **Dog Creek:** The many islands beyond the mouth of the creek not only provide protection from winds and waves but also produce many nearshore effects. Winds from the south or southwest can produce waves 1 to 2 m in height and choppy seas. Confused seas can occur in the lee side of the islands.
- **Lundar Beach:** This recreational beach is exposed to winds and waves from southeast to northwest. Sigfussons Beach, to the south, is protected from winds and waves from the south to northwest by Sugar Point. Lily Bay, to the north, provides protection from west and northwest winds and waves. Prolonged northwesterly winds create large waves due to the long fetch and shoaling.
- **Oak Point:** Several areas north of the point offer protection for small craft, including two harbours north of the beach, Bluebill Lake (a lagoon north of the point that provides shelter from the prevailing northwesterlies), the area between Channel Creek and Channel Lake, Morris Lake, and (further north) the Hatchery and Fox Islands. Use caution near shore, as the Marshy Point headland can cause refraction near the beach area.
- **St. Laurent/Laurentia Beach:** Prevailing northwesterlies and shallow waters create large waves offshore.
- **Twin Lakes Beach:** Just northeast of this beach is the small, protected harbour of Rocky Point, the entrance to which is exposed to winds and waves from south to north.
- **St. Ambroise:** Shallow waters and sandbars make this area a natural playground for recreational (especially non-motorized) watercraft; however, prevailing northwesterlies create large, steep seas due to shoaling.

7.4 Lake Winnipeg

Lake Winnipeg has a surface area of 24,514 km^2 and is the tenth-largest freshwater lake in the world. It extends 436 km from north to south and is divided into north and south basins by a channel called the Narrows, which is 0.5 to 2.5 km in width. The north basin makes up approximately 75 percent of the lake's surface area and has a maximum width of 111 km, while the smaller south basin is 46 km across at its widest point. The lake is shallow, with a mean depth of 12 m in the north basin and 9 m in the south. The deepest areas are found in the Narrows (average depth 36 m) and northeast of Black Island (maximum depth 60 m).

The west shore of the lake boasts a generally uniform prairie landscape with large bays and the occasional limestone cliff. Since it lies on the Canadian Shield, the east shore features numerous islands and outcroppings of bedrock, interspersed with marshland.

7.4.1 Waves

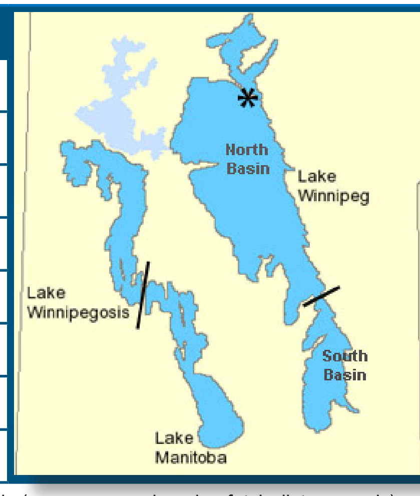
Lake Winnipeg is known for its rough seas and choppy waves. Because of the lake's shallow bathymetry and large size, winds can quickly and unexpectedly generate waves large enough to threaten small boats. Large, open expanses of relatively shallow water (characteristic of most of the south basin) also provide ideal conditions for shoaling and refraction, causing large, closely spaced, and breaking waves and confused seas.

7.4.2 Seiches

Because of its orientation, shape, and depth, Lake Winnipeg is prone to storm surges and seiches. These can occur in winds of any direction but are highest when the winds blow from the north and south, as the length of the lake allows for a fetch of more than 400 km. As such, wind set-up or storm surges may raise the water level by 0.6 to 1.2 m, especially in the fall and early winter.

In addition to affecting water levels at wharfs and launching ramps, seiches can cause currents that have a significant impact on the circulation in the lake. These currents are usually strongest during and after north or south winds have been blowing for some time. Strong currents are often observed at and near the Narrows because the flow of the high volume of water being pushed through the channel is constricted and, therefore, speeds up. With a seiche, the currents in the Narrows can reverse many times. Since wave action is affected by the strength and direction of the wind in relation to the current, a combination of weather patterns can create confused seas and potentially hazardous conditions for small craft.

Wind	20 knots	30 knots	40 knots	50 knots
N				
NE				
E	0.6 m	1.2 m	1.6 m	2.0 m
SE	0.9 m	1.4 m	1.9 m	2.4 m
S	2.0 m	3.3 m	4.7 m	6.2 m
SW	1.6 m	2.8 m	3.9 m	5.1 m
W	1.4 m	2.8 m	3.2 m	4.3 m
NW				



Estimated significant wave heights with 20-, 30-, 40-, and 50-kt sustained winds (per wave graph, using fetch distance only) for Lake Winnipeg, North Basin, Nelson River entrance.

Wind	20 knots	30 knots	40 knots	50 knots
N	1.6 m	2.8 m	3.9 m	5.1 m
NE	1.3 m	1.9 m	2.6 m	3.5 m
E	1.3 m	1.9 m	2.6 m	3.5 m
SE	1.5 m	2.3 m	3.0 m	4.7 m
S	1.7 m	2.8 m	4.0 m	5.3 m
SW	1.3 m	1.7 m	2.9 m	4.0 m
W	1.4 m	1.8 m	3.0 m	4.1 m
NW	1.6 m	2.8 m	3.7 m	5.0 m

Estimated significant wave heights with 20-, 30-, 40-, and 50-kt sustained winds (per wave graph, using fetch distance only) for Lake Winnipeg, North Basin, centre of lake.

Wind	20 knots	30 knots	40 knots	50 knots
N	1.4 m	2.3 m	4.0 m	5.0 m
NE	1.4 m	2.3 m	3.1 m	4.3 m
E				
SE				
S				
SW				
W				
NW	0.9 m	1.4 m	2.0 m	2.6 m

Estimated significant wave heights with 20-, 30-, 40-, and 50-kt sustained winds (per wave graph, using fetch distance only) for Lake Winnipeg, South Basin, mouth of Red River.

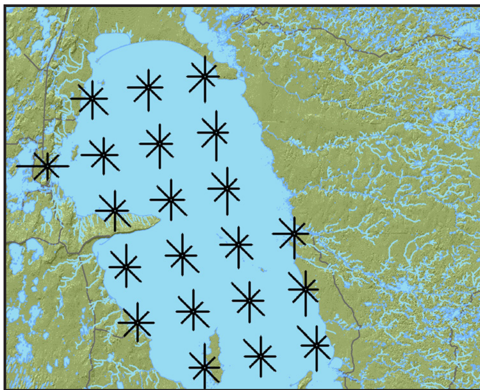
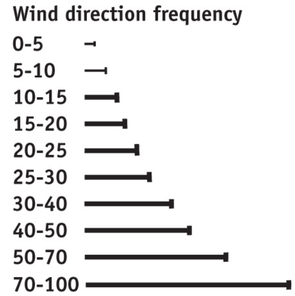


Figure 13: RADAR SAT derived wind roses June, July and August: Lake Winnipeg (north basin).



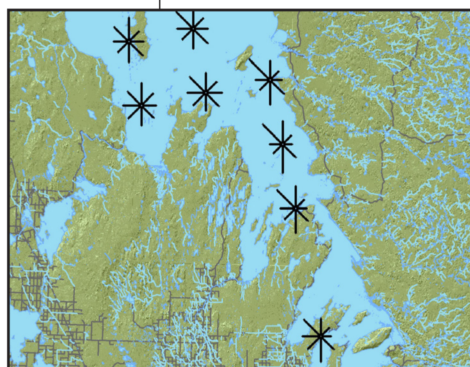


Figure 14: RADAR SAT derived wind roses June, July and August: Lake Winnipeg (the Narrows).

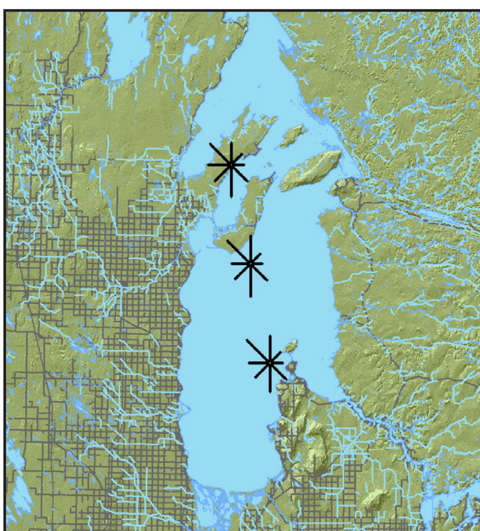
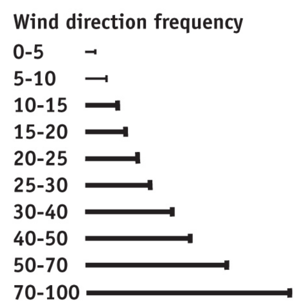


Figure 15: RADAR SAT derived wind roses June, July and August: Lake Winnipeg (south basin).



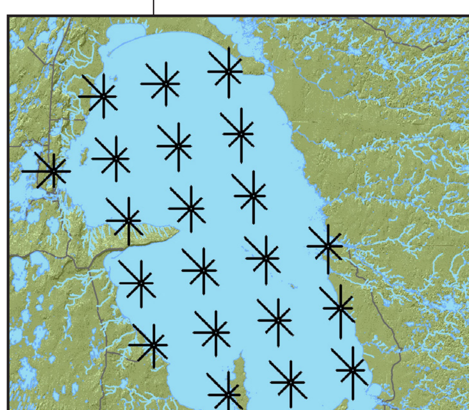


Figure 16: RADAR SAT derived wind roses September, October and November: Lake Winnipeg (north basin).

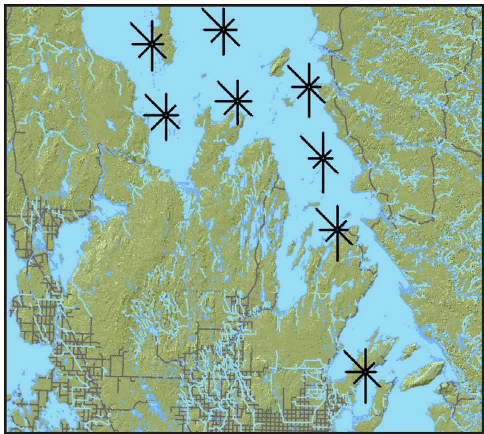
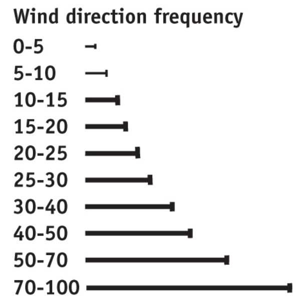


Figure 17: RADAR SAT derived wind roses September, October and November: Lake Winnipeg (the Narrows).



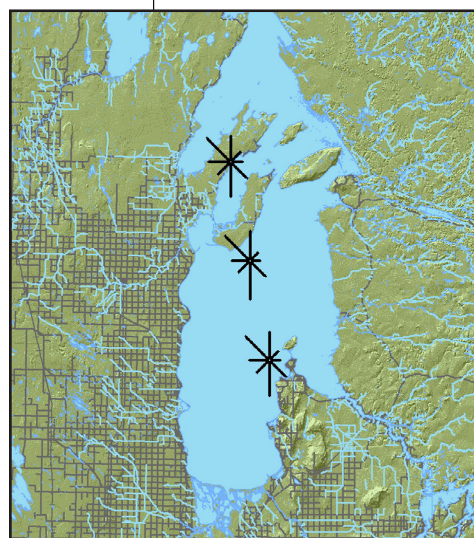


Figure 18: RADAR SAT derived wind roses September, October and November: Lake Winnipeg (south basin).

7.4.3 Freeze-up and Break-up

There are approximately 180 to 195 days of open water on the south basin of Lake Winnipeg, with the lake being ice-covered for the remainder of the year. The earliest and latest recorded dates for spring break-up are May 1 and May 25; for freeze-up, November 5 and December 1.

7.4.4 Local Effects

Although the forecasts for Lake Winnipeg separate the north and south basins at East and West Doghead Points, the local effects section for Lake Winnipeg has been divided into three sections: the north basin, the narrows, and the south basin.

7.4.4.1 North Basin

The north basin has a long fetch for winds from any direction; however, it is particularly long for those from the north-northwest and south-southeast. From calculations, waves of close to 5 m in height are possible with 40 kt winds on the downwind side of the lake. The added effects of shoaling and refraction caused by the shallow waters along the shoreline can cause waves on the basin to become very dangerous. This section examines local effects on the west and east shores of the basin.

Figure 19: Known and inferred local effects for Lake Winnipeg's north basin.

West Shore

- **Grand Rapids:** North to east winds create large waves at the mouth of the Saskatchewan River, with crossing seas possible during the spring run-off. Shoaling is possible between Grand Rapids and Horse Island.
- **Long Point:** Relatively steep shorelines to the south of the point can create barrier winds when the prevailing winds are from the south southeast or southwest. In northwest and west winds, coastal convergence and funnelling create stronger winds along the northern shore and at the tip of the peninsula. Offshore reefs to the north cause confused seas due to shoaling.
- **Reindeer Island:** Shoaling and refraction are possible to the south and southeast of the island and west of the island between Dancing Point and Morass Point due to shallow waters.

East Shore

- **Warren Landing:** South to southwest winds create large steep waves at the mouth of Nelson River due to the long fetch and shoaling.
- **Big Black River:** Strong south to northwest winds create large, confused seas.
- **Poplar River:** Southwest to northwest winds create large waves and confused seas due to shoaling at the entrance of the river. Crossing seas can be encountered at the mouth of the river as the lake current meets the east-west current of Poplar River.
- **Poplar Point to Marchand Point:** Numerous reefs starts north of Marchand Point, extending to approximately 15 km northwest of Poplar Point and continuing northeast toward the mouth of the Poplar River.
- **George Island:** A chain of small islands and reefs extends northwest of this island, sometimes creating confused seas.

7.4.4.2 The Narrows

Its long, narrow shape, north-south alignment, and deeper waters reduce the frequency of large waves in the Narrows—although they are still possible, especially in winds from the north/northwest or south/southeast. There are, however, many sheltered bays along the shoreline where vessels can hide. Funneling of the prevailing winds, especially if they are from the northwest or southeast, will strengthen wind speeds through the Narrows, especially in the middle, where it is narrowest.

Figure 20: Known and inferred local effects for the Narrows, Lake Winnipeg.

- **Dauphin River:** Strong currents from the river (which enters Lake Winnipeg at Anama Bay) can cause crossing seas at its mouth when winds blow from the north or northeast.

- **Sturgeon Bay:** Northwest and north winds create large waves in the bay, with confused seas at the entrance to the bay and in the far south due to shoaling.

- **Lynx Bay:** Strong north to northeast winds create large waves, with shoaling steepening the waves at the mouth of the bay.

- **Kinwow Bay:** North, northeast, and southwest winds are channeled within the bay, creating large waves downstream.

- **Black Bear Island:** Located northwest of the Narrows, the waters near the island are prone to large waves in prolonged northwest winds, with shoaling creating steep, rough waves to its west.
- **Matheson Island:** Very shallow waters to the west and north of the island create choppy seas due to shoaling.
- **Berens River:** Southeast winds channeled along the river create stronger winds and larger waves at its mouth. West to north winds can also cause confused seas due to wave-current interaction, especially during the spring run-off.
- **Berens Island:** Shallow depths and reefs between Berens Island and Commissioner Island and Wicked Point can steepen waves. The island can also have a cornering effect on the winds around it.
- **Rabbit Point:** North of the point (Princess Harbour and to the southeast), there are many small islands along the shore.
- **East Doghead Point to McLeods Island:** Many islands and reefs are found up to 2 km offshore from the point to the island.

7.4.4.3 South Basin

The south basin is a large, open, and exposed expanse of relatively shallow water that is particularly shallow along its shores and southern perimeter. This creates ideal conditions for shoaling and refraction, causing large, closely spaced, and breaking waves and confused seas. Because of this, severe wave conditions are common and can create hazardous conditions for small watercraft. This section looks at local effects along the north end, west, east, and south shores of the basin.

Figure 21: Known and inferred local effects for Lake Winnipeg's south basin.

North End

There are many large islands around the Hecla and Black islands that can be used as protection from winds and waves. The area north of Grindstone Peninsula and Deer Island is susceptible to large seas due to long fetches from the north. As such, mariners moving into the area from the more sheltered areas to the south may be surprised by these rougher conditions.

- **Hecla, Black, and Deer Islands:** These islands can create a cornering effect on the winds around them and also experience gusty lee winds due to the high limestone cliffs on their south side.
- **Deer Island:** Confused seas can develop southeast of the island due to the interaction of winds, seiches, and currents.
- **Black Island:** Steep shores could cause barrier winds near the island when the prevailing winds are from the south.
- **Hecla Island:** Shoaling and refraction of waves can occur in the shallow waters around the island, including the west shore (which is marshy and only 4.6 m deep), north of Sandy Point (where depths drop to between 1.3 and 2.7 m), and at the reefs near its southwest end. Northerly winds cause gusty lee eddies south of Hecla Island and are enhanced by funneling between it and Black Island, creating stronger winds and larger waves offshore.

Waterspout over Lake Winnipeg's south basin, July 1998.

West Shore

The west shore of the basin is shallow, making it prone to choppy waves that build up on shoals and refract around bends and points. A number of rigid structures (groynes and abutments) run perpendicular to the shoreline, serving as a break for incoming waves. Seiche events can be as high as 1 to 2 m. Strong northwest winds can cause water levels to drop along this area, while northeast to southeast winds can cause rough seas.

- **Riverton Harbour:** This commercial fishing wharf, located in the town of Riverton on the north side of the Icelandic River, provides excellent protection from winds and waves. North to southeast winds can cause large waves and choppy seas at the mouth of the river due to shoaling.
- **Hnausa Harbour:** Located 0.8 km northeast of Hnausa, this harbour is exposed to northeast, east, southeast, and south winds. When winds from these directions are strong, they can cause high waves that break onto the wharf and make entry to the harbour difficult.
- **Silver Harbour Marina Resort/Arnes Harbour:** This recreational and commercial fishing harbour is located approximately 1.2 km northeast of Arnes, on the south side of Drunken Point and adjacent to a large lagoon. Waves can be driven onto the wharf in northeast to southeast winds.
- **Gimli Harbour:** Located in a lagoon south of the town of Gimli, this recreational harbour offers excellent all-weather protection within its breakwaters. Its entrance is susceptible to rough seas with strong north to southeast winds: south and southeast storms send large rollers along the inside of the breakwater; strong north, northeast, and east winds, onto its outside.
- **Boundary Creek Marina/Winnipeg Beach Harbour:** This recreational harbour is well-protected, with a slight exposure to southeast winds. Strong winds from the northeast to south can create choppy seas at its entrance.

East Shore

This is a busy recreational area for watercraft of all types, especially from Elk Island to the Netley-Libau Marsh. The prevailing northwest winds, combined with the shallowness of the lake, cause high waves and choppy seas along the shore and wind set-up can cause dramatic rises in water levels. Currents are stronger than on the west shore, so wave-current interactions play an important role.

- **Traverse Bay:** Strong currents from the Winnipeg River, combined with the prevailing northwest winds, can create confused seas where the river enters the bay. Wave-current interaction can be dangerous in this area and is made worse with shoaling in the bay and increased flow during the spring run-off. With southeast winds, funneling down the river valley increases wind speeds relative to the surrounding area.

- **Pine Falls Harbour:** Located in Powerview-Pine Falls, on a small embayment on the south shore of the Winnipeg River, this harbour offers excellent protection from winds and waves, with limited wave activity from north winds.

- **Albert Beach Harbour/Dockside Marina:** Located 4.8 km south of Victoria Beach, on the south shore of Traverse Bay and facing Elk Island, this harbour is exposed to north to southeast winds and waves. Large seas occur outside the harbour in strong north winds and choppy seas to the southeast, due to shoaling between the beach and the mouth of the Winnipeg River.

- **Elk Island:** There are two safe anchorages along the south shore of the island, with sheltered coves facing southeast and southwest. A strong southerly current, combined with shoaling and refraction, can create choppy water conditions and gusty lee eddies, especially with north winds. Southeast winds cause cornering effects due to the island's steep cliffs.

- **Victoria Beach Harbour:** This exposed harbour is protected from north and northeast winds inside the approach wharf, which is open to winds and waves from the west, southwest, south, and southeast. Strong winds from these directions can make entry into the harbour difficult. Southwest winds can create rough seas along the outside of wharf due to reflection. Strong southerly currents are nearby, so northwesterly winds can cause confused or crossing seas outside the harbour due to wave-current interaction.

- **Hillside Beach Harbour:** This recreational harbour is a large lagoon fronted by a stable pressure ridge and backed by marsh and lowland. The entrance is exposed to northwest winds and waves.

- **Grand Beach Harbour:** Strong west to northeast winds in the bay cause large seas due to shoaling. Dangerous currents exist in the channel as water flows back and forth between the lake and lagoon. The area is often adversely affected by strong winds and large waves.

- **Beaconia/Balsam Bay Harbour:** This recreational harbour provides excellent protection from winds and waves behind the breakwater, but shoaling can cause rough seas outside the harbour entrance.

South Shore

North winds can create very large seas and dramatic rises in water level at the south end of the lake, with calculations indicating that a 40-kt wind could build waves up to 4 m in height.

- **Netley-Libau Marsh:** This complex of shallow lakes, lagoons, and channels (which range up to 3 m in depth) commonly experiences breaker action due to its shallow offshore slopes. Strong northerly winds can cause large waves to the area due to the long fetch and shoaling effects.