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First Nations Guidelines for the Construction and Maintenance of Existing Winter Roads

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First Nations
Guidelines for the Construction and Maintenance of Existing Winter Roads

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1.0 Preface

This information is intended as guidelines only for the construction and maintenance of winter roads in Ontario's Far North. These guidelines highlight some concerns/issues when constructing and maintaining winter roads. Included are safe working practices on ice roads.

It is the responsibility of each First Nation community or winter road corporation to develop their own specific document and policies related to winter road construction and maintenance.

See Appendix A for a list of all communities involved in the development of the winter road systems.

See Appendix C for a list of the Winter Roads Technical Working Group members involved in the development of the winter roads' guidelines.

Disclaimer: *Information presented in this guideline are believed to be current and reliable; however, it cannot be assumed that all acceptable safety measures are contained in this document or that other additional measures may not be required under particular or exceptional circumstances.*

It is the responsibility of the road user to verify the ice thickness for their own use of the winter road. All Northern Ontario Winter Roads are "Use At Your Own Risk".

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2.0 Introduction

The objective of this section is to provide information so that winter ice and land roads can be safely constructed and maintained. Construction methods are different for construction over land and water. All roads must be constructed to support vehicles up to 37,500 kg (80,000 lbs) (gross vehicle weight) both over land and over water. **The wider the snow is cleared – the better.**

The following provides guidelines on the minimum snow clearance widths based on the type of terrain.

Terrain Type	Road Width	
	(meters)	(feet)
Land	12	40
Lakes and channel crossings	45 to 60	150 to 200
Open muskeg, swamp and sloughs	18	60
Rivers and streams etc	30-60	100 to 200

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3.0 Construction and Maintenance of Winter Land Roads

3.1 Construction Guidelines over Land

The winter road should be constructed so that it can withstand constant hauling by normal highway type vehicles of up to 37,500 kg (80,000 lbs) gross weight. The road surface should be constructed to a standard that will allow trucks to travel safely at an average speed of not less than 35 km/ hr. and a lower speed where severe ground conditions prohibit faster travel.

The suggested width for the section of the winter road overland is 12 meters (40 feet).

Overland construction consists of three stages:

1. Compacting - to drive frost into the ground.
2. Shaping- to remove hazards and construct a base for a level road surface.
3. Blading and Dragging - to create a smooth level driving surface.

3.1.1 Compacting

It is recommended that initial compacting for frost penetration should start as soon as the bearing capacity of the terrain permits with the use of lightweight equipment; building to heavy equipment.

Table 2.1 – Steps to Achieve Compaction

Light compaction	snowshoes; then, snowmobiles
Moderate compaction	small groomer
Heavy compaction	bulldozer, with or without drag, etc.

The objective is to achieve compaction to the full road width.

3.1.2 Ramp and Snow Bridge Construction

As an option, a second crossing can be constructed close by so 1 lane can be open while the other is being constructed/maintained.

As a note: south facing river/lake banks see the most sunshine; therefore, snow is stockpiled nearby this bank in shade (if possible) utilizing front-end loaders. When gathering this snow, be careful not to include vegetation.

3.1.2.1 Creek Crossings

- Pile snow; then flood and leave at least overnight; repeat. Continue until shape is developed for ramp from water to land surface.

3.1.2.2 River Crossings

- Check ice depth across the width of the river before equipment proceeds.
- Ensure there is no hanging ice at the shoreline. Remove (knock down) hanging ice, fill area with snow, flood, and freeze.
- Build ramp from land to water by filling with snow, flooding, and freezing.
- If pressure ridges are available close by, cut the pressure ridge and haul to the land/water ramp location to use as fill or ice blocks can be used.

3.1.2.3 Lake Crossings

- Check ice depth across the width of the lake before equipment proceeds.
- Ensure there is no hanging ice at the shoreline. Remove (knock down) hanging ice, fill area with snow, flood, and freeze.
- Build ramp from land to water by filling with snow, flooding, and freezing.

3.1.3 Shaping

Shaping the winter road should start as soon as the frost has penetrated sufficiently to permit the use of heavier equipment and motor graders. Snow, debris, and surface vegetation should be bladed to the tree line. Preliminary leveling should also be performed at this time. Fresh fallen snow should be bladed and compacted to create a reasonably level and smooth road surface.

Care must be taken to make sure snow banks are pushed as far as possible from the cleared right-of-way. On corners, remove snow banks when possible.

In open areas, hazards created by drifting snow can be reduced by blading snow guards approximately 30 metres (100 feet) from each side of the road. The guards will trap blowing snow before it reaches the road surface. This will keep the road open longer during drifting conditions and also reduce maintenance costs. *Care must be taken to ensure that the ice beyond the edge of the cleared road surface is sufficient to support the equipment being used to maintain these guards.*

3.1.4 Blading and Dragging

At this stage, heavy equipment is used to blade and drag the road driving in frost, shaping and smoothing the road. The equipment should only move as much snow as it, and the road foundation, can safely handle.

3.1.5 Push-out Areas

Push-out areas are used to allow the driver to check equipment and secure loads. Push-outs should be constructed and maintained to the same level as the actual winter road.

All push-out areas should be cleared of snow, compacted, and large enough for a grader unit to make a safe u-turn and/or to park without getting in the way of traffic.

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4.0 Construction and Maintenance of Winter Roads Ice Crossings

4.1 Introduction

Never assume anything; as ice is unpredictable. Ice crossings can be constructed across rivers, streams and lakes. If water levels remain the same, it is advisable to construct the ice crossings in the same location every year. Some sections may form ice slower if they are near islands, sand bars, or points of land. These areas produce currents that prevent ice from forming naturally. Tidal areas can cause ice to rise and fall with the tide.

Lakes that are shallow or ice crossings that approach shore lines must be constructed and tested with care as there could be muskeg producing gases that slow natural ice formation. To prevent ice failure and wave action, the clearing equipment should follow each other and clear in the same direction. Sharp curves on ice should be avoided as they are hard to locate if visibility is reduced.

The natural sequence of construction of the winter crossing starts with determining the ice thickness, removal of snow cover to allow for freezing, and flooding if required. The initial step is to check ice to ensure there is adequate good quality solid ice to carry the equipment being used.

Remove any cover of snow. The snow cover acts as an insulator slowing the formation of ice.

Mark the outside limits of the ice crossing right-of-way so the operators know the exact location that was checked. The outside limits should be identified with markers approximately two meters (6 feet) high. Once the road is established, intermittently place markers. The markers act as a guide to prevent any traffic hitting the banks when visibility is reduced. Colouring on markers is suggested for improved night visibility. The importance of maintaining the proper ice crossing width is vital.

Maintain a distance of approximately 500 metres (1,650 feet) between equipment.

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The suggested ice crossing widths are:

Terrain Type	Road Width (meters)	(feet)
Large Lakes	60	200
rivers, streams and smaller lakes where drifting is not a problem	30 to 60	100 to 200
Open muskeg, swamp and sloughs (small wet depressions)	18	60

The wider the snow is cleared the better. Clearing on ice should start on the outside edges and continue toward the center if the snow is heavy. To prevent ice failure and wave action the clearing equipment should follow each other in the same direction. Care must be taken **not** to create large snow banks on the ice.

Precautions must be taken to prevent slushing from occurring. Slushing occurs when the weight of snow banks force the ice down and water comes up through cracks. If the water is forced up quickly, it could erode the ice; forming air holes under the snow banks or along the edge of the traveled surface. Leaving large windrows in the areas to be cleared can also create slush and make moving snow banks very difficult.

Once the full width of the ice crossing has been cleared, the contractor has the option of flooding or waiting for the ice thickness to increase naturally. Care should be taken to plug or bank snow around each hole created to draw water for water trucks and flooding once flooding is completed. The first flood should not exceed 25 mm (1 inch) in depth. Subsequent floods should not exceed 50 mm (2 inches). **Each flood must be frozen solid before the next flood.**

4.2 Ice Testing

4.2.1 Manual Testing

4.2.1.1 Testing During Construction

At freeze up, employ, when possible, local persons who are familiar with each water crossing and its characteristics. *Ensure the buddy system is used for personal safety.* Two people proceed to check ice with one person measuring and the other at a safe distance for backup. Mark the outline of the ice crossing alignment.

A good method to determine the safe allowable load capacity of ice and ensure all layers of ice are solid is to test it manually, using hand, electric, gas augers or an ice power saw. Cut the ice such that the thickness of each type of ice can be measured.

Check ice along crown, right-hand-side, and left-hand-side at 30 m (100 feet) intervals. Measure thickness of ice at each cut and record.

If the ice is not thick enough for safe operation of equipment; but, the contractor has walked across the water way, pack the road alignment right-of-way with a snow machine and continue to measure the ice thickness. Depth of ice can be identified using colour coding on a map. Record ice thickness on the log and/or map.

Note: the lowest ice thickness reading determines the weight of equipment (gross vehicle weight + weight of operator + weight of fuel) that can be used considering the load distribution of the particular equipment. Groomers are the best equipment to use across water as they are light weight and have a wide weight distribution. Constructors need to know the weight of each of their pieces of equipment. See Appendix B for ice bearing guidelines.

When the ice is thick enough for the safe operation of equipment, begin by removing snow from ice surface. Flood if needed (see Section 3.1).

The ice testing intervals should be decreased until the tests provide a level of comfort for all staff working on the ice crossing. Use a cutting tool to cut partially into the ice. Remove the cutting tool and loose snow. Visually inspect the hole so you can locate the depth where white changes to blue ice and ensure all layers of ice are solid and bonded together. Measure and document the depth of white ice. Continue checking in this manner until you reach water. As soon as water is reached, continue cutting until all the loose ice has been removed from the hole. The hole is now full of water so now you can measure using a measuring stick. When you have finished measuring, plug the hole with snow to prevent any flooding.

- Half loads can be hauled once the equivalent of blue (black) ice thickness reaches a minimum of 66 cm (26 inches). See Appendix B for ice bearing guidelines.

- Road construction is considered to be complete (full loads) once the equivalent of blue (black) ice thickness reaches a minimum of 76 cm (30 inches). See Appendix B for ice bearing guidelines.

4.2.1.2 Testing During Maintenance

Visual inspections take place regularly.

Given a concern during a regular visual inspection, ice testing may occur. Monitoring of this concern continues until it resolves itself or repairs take place. For ice crack details, see Section 4.3.2.

Ice thickness report sheets should be maintained.

4.3 Ice Crossing Restrictions

The maximum recommended speed limit on all ice crossings for vehicles weighing over 7,000 kg (15,500 lb) ***gross vehicle* weight** (G.V.W.) is **15 km/h.** (The typical weight of a loaded 3 ton truck is 7,000 kg). This speed should be reduced when approaching land or meeting other trucks. The stopping ability of all vehicles is dramatically reduced on ice crossings especially if there is no snow cover. Due to this variable in the surface, all users should drive with extreme caution.

Overweight loads that exceed the speed limit can cause a wave movement under the ice that can rebound or cause the ice to flex and cause a complete failure.

It is advisable to travel the centre portion of the ice crossing. Fully loaded semi trucks should allow a minimum of 500 m (1,600 feet) distance between following trucks. Loaded trucks should not pass each other when traveling in the same direction. When meeting, the empty vehicle moves over and both should decrease speed.

Do not travel nor park close to the snow storage banks as this is the weakest area of the ice road due to the additional weight of the snow banks.

Stopping or parking on the ice is not recommended at any time due to the concentrated pressure it causes. The sight of one truck parked on the ice could lead to others stopping. The weight of one or two trucks stopped on the ice could create ice failure. Loaded trucks should never stop on the ice road.

Ice behaves elastically under moving loads; that is, the ice is depressed while loaded but recovers its original position after the load has passed.

A stationary load will cause the ice to sag continuously and may fail. The safe bearing capability for stationary loads should be considered to be half that for moving loads.

The sequence of failure for stationary loads is:

i) radiating cracks form at the bottom of the cover immediately beneath the load (and ultimately propagate through the cover);

ii) circular cracks form at the upper surface of the cover at some distance from the load (noticeable sagging of the ice may occur);

iii) The ice shears in a circle immediately adjacent to the loaded surface (failure may be imminent).

Stationary load should be moved under any of the following conditions:

i) when radial cracks develop;

ii) if noticeable sagging is observed;

iii) if rate of sagging increases;

iv) if continuous cracking is heard or observed;

v) if water appears on the surface of the ice.

4.3.1 Pressure Ridges

Pressure ridges are upheavals or down-heavals of the ice. They can be small to large in size.

Upheavel ridges should be avoided due to their unpredictable nature. Re-route the alignment whenever possible. Pressure ridges should be well marked if in vicinity of ice crossing alignment.

4.3.2 Ice Cracks

Cracks can be a result of rising or falling water levels, temperature variations, frequent heavy loading, vehicles travelling too closely together, or speeding. Surface cracks, a few inches deep, are not considered serious; however, they should be monitored for movement. Cracks that pass completely through the ice sheet permitting water to rise to the surface usually require load reductions on the ice crossing.

Ice can crack and fail from weight of the snow and slush along the snow storage banks. If the ice cracks and drops a lot on the traveled surface the road should be closed.

When an ice crack extends to a minimum width of (100 mm) 4 inches repairs are to be made.

4.3.2.1 Ice Crack Repair

Fill ice crack with packed snow and flood to freeze.

4.3.3 Load Reductions Due to Ice Cracking Recommendations

If significant cracks occur at the crown, left-hand-side and right-hand-side, it is highly recommended the road be closed.

4.3.4 Tidal Effects at River Crossings

Tidal effects can occur twice in a day. When 'tidal effect' is active, the ice sheet is unsupported. There is a physical separation between the ice road and ground. Currently during low tide the roads are considered to be very high risk and closed during these times.

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5.0 Signage on Winter Roads

NO FUEL OR LODGING AVAILABLE BETWEEN DESTINATIONS

Signs are an important part of safety. Signs for winter roads are to inform users of road openings and closures, the distance to the nearest community where fuel, accommodations and food are available, etc.

WINTER ROAD CLOSED ROAD NOT MAINTAINED

Winter roads may need to be temporarily closed and signage should be placed at the start of the winter road system. The public should be notified of road closures. The following sign is recommended at the beginning or end of the system and on either side of any community on the winter road when the season is officially closed.

WARNING WINTER SURVIVAL AND COMMUNICATION EQUIPMENT ARE RECOMMENDED

Those who use ice crossings for transportation are cautioned that the bearing capacity of ice depends on the quality of the ice, the presence of cracks and other properties.

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MAXIMUM SPEED ON LAKE 15 KM/HR

Signs placed at the approaches to the ice crossings will indicate the speed which must not be exceeded

MAXIMUM SPEED ON LAND 25 KM/HR

North Spirit Lake	115 km
Deer Lake	203 km

The signs are used to identify river and stream crossings and distances to the next communities. Kilometer markers are placed every 5 km to indicate the distance from start of the winter road to the next destination.

Markers are used to identify potential hazards on the winter road location.

WINTER ROAD NARROW WINDING ROADWAY SLIPPERY SURFACE SHARP CURVES AND HILLS DRIVE WITH EXTREME CARE

Signs with messages such as steep hill, sharp curve, severe bump, boulders or narrow area are very beneficial in assisting to identify hazards and danger areas.

6.0 General Safety Information

Each vehicle travelling on the winter road should be equipped with survival equipment. (See Appendix D.) ***The traveler should notify someone of their departure, expected arrival time, destination, and emergency plan.*** In the event of unforeseen circumstances, appropriate measures can be taken. Dress for the weather conditions.

This information has been gathered with the hope that you will never have to use it in a survival or emergency situation. However, by having the equipment and knowledge of its use, you will be confident to cope with any situation. This is not a comprehensive discussion of the safety measures that can be taken.

The remoteness of the roads the possibility of severe weather and the danger of ice failure must be accounted for at all times. It is the intention of this section to provide you with the basic information respecting safety, first aid, survival equipment and common sense information on how to cope with an emergency situation.

All vehicles should travel down the centre of the road, when it is safe to do so. Do not travel or park close to the snow banks as this is the weakest area of the winter road.

In the event of unforeseen circumstances, avoid overexertion and exposure. Exertion from attempting to push your vehicle, shovel heavy snow, or perform other difficult chores may cause hypothermia or a heart attack.

Stay in your vehicle. Do not try to walk out of a blizzard. Disorientation comes quickly in blowing snow and bitter cold. Being lost in open country during a storm is almost certain death.

Engine failure could be caused by gas line freeze up. Pour gas antifreeze in your fuel tank, wait ten minutes and try your engine again.

If your engine still works run it for short periods to stay warm. Make sure your exhaust pipe is free of obstruction. Slightly open a window to keep fresh air in your vehicle and avoid carbon monoxide poisoning. For clean air circulation, keep vents clear.

Freezing snow and wind driven snow can completely seal the passenger compartment. Use a candle to keep you and the interior of the car warm. Use a coffee tin and a candle to melt snow to drink. Do not eat snow as it lowers your body temperature when you need to conserve heat. Do not stay motionless for long periods of time; clap your hands, wiggle your toes, etc. Turn on dome lights at night to make the vehicle visible to passing traffic. Keep watch.

Use common sense while travelling winter roads.

Appendix A PARTICIPATING COMMUNITIES OF THE WINTER ROAD SYSTEM FOR ONTARIO

Communities of the Winter Road System for Ontario

Asheweig Winter Road Corp., P.O. Box 81, Kingfisher Lake ON P0V 1Z0
Contact: Phone (807) 532-9952; Fax (807) 532-9954

Bearskin Lake First Nation, P.O. Box 25, Bearskin Lake ON P0V 1E0
Contact: Phone (807) 363-2518; Fax: (807) 363-1066

Cat Lake First Nation, Box 81, Cat Lake ON P0V 1J0
Contact: (807) 347-2100; Fax: (807) 347-2116

Deer Lake First Nation, General Delivery, Deer Lake ON P0V 1N0
Contact: Phone (807) 775-2141; Fax: (807) 775-2220

Eabametoong First Nation, P.O. Box 298, Eabamet Lake ON P0T 1L0
Contact: Phone (807) 242-7221; Fax: (807) 242-1440

Fort Severn First Nation, Box 149, Fort Severn ON P0V 1W0
Contact: Phone (807) 478-2572; Fax: (807) 478-1103

Kasabonika First Nation, Box 124, Kasabonika Lake ON P0V 1Y0
Contact: Phone (807) 535-2547; Fax: (807) 535-1152

Keewaywin First Nation, Box 90, 202 Band Office Road, Keewaywin ON P0V 3G0
Contact: Phone (807) 771-1210; Fax: (807) 771-1053

Kimesskanamenow Corporation, c/o McLeod Wood Associates Inc. 465 A St. Patrick St. W., Fergus ON N1M 1M2
Contact: Phone (519) 820-9130; Fax: (519) 787-5120

Kitchenuhmaykoosib Inninuwug, P.O. Box 329, Big Trout Lake ON P0V 1G0
Contact: Phone (807) 537-2263; Fax: (807) 537-2574

Kingfisher Lake First Nation, P.O. Box 57, Kingfisher Lake ON P0V 1Z0
Contact: Phone (807) 532-2067; Fax: (807) 532-2063

Koocheching First Nation, Box 32, Sandy Lake ON P0V 1V0
Contact: Phone (807) 774-1576

Marten Falls First Nation, General Delivery, Ogoki ON P0T 2L0
Contact: Phone (807) 349-2509; Fax: (807) 349-2411

Moose Cree First Nation, P.O. Box 190, 25 Jonathan Cheechoo Drive, Moose Factory Island, ON P0L 1W0
Contact: Phone (705) 658-4619; Fax: (705) 658-6770

The Corporation of the Town of Moosonee, P.O. Box 727, Moosonee ON P0L 1Y0
Contact: Phone (705) 336-2993; Fax (705) 336-2426

Muskrat Dam First Nation, P.O. Box 140, Muskrat Dam ON P0V 3B0
Contact: Phone (807) 471-2573; Fax: (807) 471-2699

Communities of the Winter Road System for Ontario

Neskantaga First Nation, P.O. Box 105, Lansdowne House, ON P0T 1Z0
Contact: Phone (807) 479-2570; Fax: (807) 479-1138

Nibinamik First Nation, General Delivery, Summer Beaver ON P0T 3B0
Contact: Phone (807) 593-2131; Fax: (807) 593-2270

North Caribou Lake First Nation, General Delivery, Weagamow Lake ON P0V 2Y0
Contact: Phone (807) 469-5191; Fax: (807) 469-1315

North Spirit Lake First Nation, General Delivery, North Spirit Lake ON P0V 2G0
Contact: Phone (807) 776-0021; Fax: (807) 776-0026

Northwest Angle #37, P.O. Box 267, Sioux Narrows ON P0X 1N0
Contact: Phone (807) 226-5353; Fax: (807) 226-1164

Pikangikum First Nation, P.O. Box 323, Pikangikum ON P0V 2L0
Contact: Phone (807) 773-5578; Fax: (807) 773-5536

Poplar Hill First Nation, P.O. Box #01, Poplar Hill ON P0V 3E0
Contact: Phone (807) 772-8838; Fax: (807) 772-8876

Sachigo Lake First Nation, Box 5, Sachigo Lake ON P0V 2P0
Contact: Phone (807) 595-2527; Fax: (807) 595-1119

Sandy Lake First Nation, P.O. Box 248, Sandy Lake ON P0V 1V0
Contact: Phone (807) 774-1564; Fax: (807) 774-1082

Temagami First Nation, General Delivery, Bear Island ON P0H 1C0
Contact: Phone (705) 237-8631; Fax: (705) 237-8959

Wapekeka First Nation, P.O. Box 2, Wapekeka ON P0V 1B0
Contact: Phone (807) 537-2315; Fax: (807) 537-2336

Wawakapewin First Nation, c/o Shibogama First Nations Council, 81 King Street, P.O. Box 449, Sioux Lookout ON P8T 1A5
Contact: Phone (807) 737-2662; Fax: (807) 737-4226

Webequie First Nation, P.O. Box 268, Webequie ON P0T 3A0
Contact: Phone (807) 353-6531; Fax: (807) 353-1218

Weenusk First Nation, P.O. Box 1, Peawanuck ON P0L 2H0
Contact: Phone (705) 473-2554; Fax: (705) 473-2503

Appendix B BEARING CAPACITY OF BLUE ICE CHART

Bearing Capacity of Blue Ice Chart

Metric Gold Formula

The formula below provides information on one system used to determine the allowable load capacity of ice for construction. The system is known as Metric Gold Formula. The Metric Gold Formula has been developed for a ***moving*** load at the approved ice crossing speed limit.

The Allowable Load Capacity of Ice Chart is not for the use of stationary equipment, storing material or under the following conditions: snow cover, slush, water on ice crossings, abnormal cracking, travelling close to large snow banks and equipment weight that exceeds the approved ice thickness.

The Metric Gold Formula is: $P = A \times h^2$ where:

- P = Allowable Load Capacity of the ice (kg)
- A = Gold Formula "A" Value
- h = Total Solid Ice Thickness (cm)

When the ***solid white ice*** is less than 50% of the total solid ice thickness, A = 4.

When the ***solid white ice*** is greater than 50% of the total solid ice thickness, A = 7.

"A" values between 5 and 7 have been used throughout Ontario.

The Metric Gold Formula used for computing the allowable load capacity of ice sheet is not meant to give the true measure of the allowable load capacity of ice sheet. Rather it provides the load limit below which failure of any ice sheet is likely, and it takes into account many of the variables which may exist in ice.

If any doubt exists as to whether ice should be considered 'Blue' or 'White', assume 'White' for increased safety.

Imperial			Metric	
1 inch	100 lbs.		2 cm	28 kg
2 inches	400 lbs.		4 cm	112 kg
3 inches	900 lbs.		6 cm	253 kg
4 inches	1,600 lbs.		8 cm	450 kg
5 inches	2,500 lbs.		10 cm	703 kg
6 inches	3,600 lbs.		12 cm	1,012 kg
7 inches	4,900 lbs.		14 cm	1,378 kg
8 inches	6,400 lbs.		16 cm	1,780 kg
9 inches	8,100 lbs.		18 cm	2,278 kg
10 inches	10,000 lbs.		20 cm	2,812 kg
11 inches	12,100 lbs.		22 cm	3,403 kg
12 inches	14,401 lbs.		24 cm	4,049 kg
13inches	16,901 lbs.		26 cm	4,752 kg
14 inches	19,601 lbs.		28 cm	5,512 kg
15 inches	22,501 lbs.		30 cm	6,327 kg

16 inches	25,601 lbs.		32 cm	7,199 kg
17 inches	28,902 lbs.		34 cm	8,127 kg
18 inches	32,402 lbs.		36 cm	9,111 kg
19 inches	36,102 lbs.		38 cm	10,151 kg
20 inches	40,002 lbs.		40 cm	11,248 kg
21 inches	44,103 lbs.		42 cm	12,401 kg
22 inches	48,403 lbs.		44 cm	13,610 kg
23 inches	52,903 lbs.		46 cm	14,876 kg
24 inches	57,604 lbs.		48 cm	16,197 kg
25 inches	62,504 lbs.		50 cm	17,575 kg
26 inches	67,604 lbs.		52 cm	19,009 kg
27 inches	72,905 lbs.		54 cm	20,499 kg
28 inches	78,405 lbs.		56 cm	22,046 kg
29 inches	84,106 lbs.		58 cm	23,649 kg
30 inches	90,006 lbs.		60 cm	25,308 kg
31 inches	95,106 lbs.		62 cm	27,023 kg

32 inches	102,407 lbs.		64 cm	28,795 kg
33 inches	108,907 lbs.		66 cm	30,623 kg
34 inches	115,608 lbs.		68 cm	32,507 kg
35 inches	122,508 lbs.		70 cm	34,447 kg
36 inches	129,609 lbs.		72 cm	36,443 kg
37 inches	136,909 lbs.		74 cm	38,496 kg
38 inches	144,410 lbs.		76 cm	40,605 kg
39 inches	152,110 lbs.		78 cm	42,771 kg
40 inches	160,011 lbs.		80 cm	44,992 kg
			82 cm	47,270 kg
			84 cm	49,604 kg
			86 cm	51,994 kg
			88 cm	54,440 kg
			90 cm	56,943 kg
			92 cm	59,502 kg
			94 cm	62,117 kg

			96 cm	64,788 kg
			98 cm	67,516 kg
			100 cm	70,300 kg

Imperial and Metric Conversions

Inches *x* 2.54 = cm

cm *x* 0.3937 = inches

lbs. *x* 0.4535 = kg

kg *x* 2.205 = lbs

Appendix C WINTER ROADS TECHNICAL WORKING GROUP

Winter Roads Technical Working Group (2009/2010)

The Winter Road Technical Working Group (WRTWG), coordinated by NADF, is to explore options for, and make recommendations with respect to, the establishment of a Northern Ontario Winter Road Authority (NOWRA). NOWRA is to represent First Nations and other Aboriginal communities in the north in planning, seeking funding for, and developing a winter road system in northern Ontario. The WRTWG is comprised of twelve members with one representative from MNDMF, one from INAC and ten representatives from First Nation communities and Tribal Councils in the areas that rely upon winter roads for transportation. All decisions made will be by consensus.

The WRTWG commissioned the report titled Northern Ontario Winter Roads Transportation Agency (ies) Feasibility Study and have presented it to the Winter Roads Chiefs at meeting in Thunder Bay on March 29, 2010 along with a draft First Nations Guidelines for the Construction and Maintenance of Existing Winter Roads document.

Appendix D SAFETY EQUIPMENT WINTER ROAD CONSTRUCTION AND TRAVEL

Safety Equipment for Winter Road Construction and Maintenance

The following provides a suggestion of equipment to keep in the vehicle during travel on winter roads. This is not an exhaustive list.

- Thermometer to monitor temperature
- First Aid Kit
- Fire Extinguisher
- Warning device (pylons, reflectors, flags etc)
- Waterproof matches
- Candles
- Sleeping bag or blankets
- Backup cold weather clothes
- Flashlight
- Snow shovel
- Two way radio, cell phone or satellite phone
- Tin can for melting snow to drink
- Emergency rations, food (energy bars) and beverage mixes instant coffee, tea
- Axe, hatchet, or chisel
- Floatation suit
- Ice rescue picks
- Whistle
- Insulated gloves, waterproof
- Rubber soled felt pack boots
- Sunglasses
- Extra belts and fuel filter
- Booster cables
- Gasoline antifreeze
- Spare gasoline
- Radiator antifreeze

List of Supplies for Safe Travel for the General Public

The following provides a suggestion of supplies to keep in the vehicle during travel on winter roads. This is not an exhaustive list.

Clothing:

- Winter footwear
- Winter pants
- Parka or snowmobile suit
- Mitts
- Two piece underwear
- Toque or warm cap
- Winter socks
- Extra set of clothing

Food

- Chocolate
- Nuts or granola bars
- Freeze dried food
- Salt
- Tea bags, soup, hot chocolate
- Water purification tablets
- Hot pack meals
- Sugar
- Raisins

Survival Equipment

Always carry PERSONAL MEDICATION with you

- Blankets, or sleeping bags
- First aid kit, map
- Flashlight, candle
- Knife, rope, wire
- Hatchet, axe or saw
- Mirror, newspaper, watch
- Matches (strike anywhere)
- Small metal can, jug
- Sun glasses, survival book
- Toilet paper, paper towels

Appendix E FOUR TYPES OF ICE

Four Types of Ice

1. Solid Blue (kichi-micum) ice is the natural thickening of ice through a normal freezing process. Solid blue ice thickness can be encouraged by keeping the road surface clear of snow. Solid blue ice is clear in texture.

   Solid blue (kichi-micum) ice has the highest allowable bearing capacity of all ice.

2. Solid Flood Ice or Solid White Ice occurs naturally and is produced by pumping water over the ice surface.

   Solid flood ice is white in texture.

   Solid flood ice/white ice is considered to have only 50% of the load bearing capacity of natural blue ice.

3. Solid Slush Ice forms when the snow on the ice surface melts and freezes. This occurs on the travelled portion and under the banks where the cleared snow is deposited.

   Solid slush ice is white in texture.

4. ***Opaque Ice or Grey Ice*** forms from wet snow and has a higher air content. It is less dense then solid blue ice or solid white ice.

   Grey, crystallized or honeycomb ice forms from thawing and indicates the pressure of water running through the ice.

Opaque or grey ice shall NOT be considered as a load bearing surface.