



**Saskatchewan  
Ministry of  
Highways and  
Infrastructure**

# **Winter Roads Handbook**



**December 2010**

Developed by the Safe Operating Procedures for Winter Roads Committee

Produced by the Ministry of Highways and Infrastructure  
Engineering Standards Branch  
350 Third Ave. N.  
Saskatoon, Sask. S7K 2H6

Field Handbook version of the *Winter Roads Manual December 2010*



# 1 INTRODUCTION

## PURPOSE

The material in this manual has been compiled by a joint committee of winter road contractors and Ministry of Highways and Infrastructure staff. The purpose of the manual is to minimize the risk of accidents occurring due to ice failure. The manual provides guidelines for safe working practices on ice roads.

These guidelines are intended for use on winter road alignments built in the same general vicinity each year. Experience and historical data are very important when working with inexact foundations and materials. Extra precautions must be taken when there is a new, unfamiliar alignment.

## DISCLAIMER

**Note: Information presented has been compiled from sources believed to be current and reliable; however, it cannot be assumed that all acceptable safety measures are contained in this Manual or that other additional measures may not be required under particular or exceptional circumstances. Contractors, employers and workers are responsible to familiarize themselves and comply with all legislation and safe work practices applicable to the work being performed.**

**Sections of this manual are not to be used or distributed without the remainder. Combined knowledge from all sections of the Manual along with using staff experienced in the business of ice road construction will provide a good basis for development of Safe Operating Procedures.**

## OTHER RESOURCES

Material for this manual was compiled from a variety of sources. Major sources of information include the following documents:

“Construction and Maintenance of Winter Roads”, Manitoba Transportation and Government Services

“Environmental Guidelines for the Construction, Maintenance and Closure of Winter Roads in the Northwest Territories”, Northwest Territories Transportation

INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

# 900-00 MONITORING CONSTRUCTION CONDITIONS

Construction of ice roads involves many variables that do not remain constant. Never take for granted any single variable. Daily decisions should be based on knowledge of:

- Ice thickness
- Ice quality
- New route vs. known route
- Road use and duration
- Temperature fluctuations and daily mean temperature
- Length of daylight per day
- Wind velocity and direction
- Type and amount of staff and equipment
- Presence and type of cracking
- Pressure ridge location, size and movement
- Amount and type of snow cover
- Fluctuating vs. stable water levels
- Presence and strength of water currents
- Presence of slush

**Remember**, you are constructing a road that is entirely subject to the fluctuations and unpredictability of the weather!

## 900 ICE ROADS

### 900-01 ICE STRENGTHENING

#### Locating Ice Roads

If water levels remain constant it is advisable to construct ice roads in the same location every year. If this is a new route or one unfamiliar to you or the contractor, consult locals or previous builders to determine routes and danger areas.

Sharp curves on ice roads should be avoided, as they are difficult for drivers to navigate when visibility is reduced.

#### Ice Formation

The first phase of ice road construction is monitoring during freeze up. Watch how the freezeup is occurring in order to identify possible trouble spots or sections that will require pre-packing, flooding or possible route alteration. In the north most of this can be observed from the air during routine air travel.



**Figure 1: Natural Ice Formation**

Lake ice may form more slowly along sections near islands, sand bars or points of land. The energy from water currents in these areas prevents ice from forming as quickly as in other locations without water currents.

Lakes that are shallow or ice roads that approach shore lines must be constructed and tested with care as there could be muskeg producing gases that slow natural ice formation.

Ice on rivers will begin to form on the banks where the velocity of the water is lower. Gradually the ice thickens and forms outward from the banks to midstream. Clusters of ice also form in the open water areas and grow into ice pans which slide into the border ice. Eventually the river becomes ice covered.

In general there are two types of ice that form. They are blue ice and white ice.

**Blue ice** forms as water freezes on the bottom of the ice cover. The heat released during freezing is conducted upward through the ice and snow into the atmosphere. The colder the atmospheric temperature, the quicker blue ice forms.

Blue ice is clear and transmits light to the water below. Often the ice appears blue or black in color from the coloration of the water below.

**White ice** forms when the snow on top of the ice becomes heavy enough to push the ice down. Water flows through cracks in the ice, wetting the snow layer above. The water then freezes creating white ice. White ice is made up of densely packed air bubbles and small ice crystals. White ice will also form when the snow melts and then refreezes.



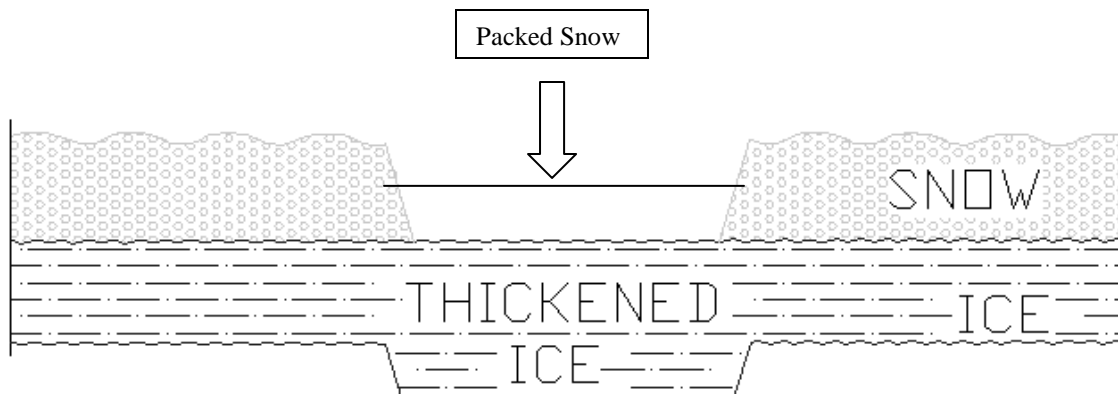
**Figure 2: Ice core with White Ice on top and Blue Ice below**

As freeze up and natural ice formation progresses the early construction phase begins. This phase starts with careful testing using light equipment to ensure the natural thickness of the ice is sufficient to support ice strengthening equipment. Ice testing is discussed in detail in the next section.

Most ice road construction on lakes in Saskatchewan does not start until there is 48 cm. (19 inches) of blue ice. Construction of ice pads for bridge construction or ice roads across rivers or reservoirs may start with a relatively thin ice cover of 15 to 25 cm (6 to 10 in.) and a light cover of snow.

### Ice Strengthening

Ice strengthening is accomplished using two methods. Snow clearing will allow the water under the ice to freeze faster. Ice strengthening is also accomplished by flooding the cleared area or packing and flooding the snow cover to build ice thickness above the naturally formed ice. This is depicted in the figure below.



Ice strengthening can not begin until there is adequate ice to carry the construction equipment. Snowmobiles, bombardiers or other light-tracked vehicles can be used to compact the snow cover if there is less than the safe amount of blue ice required for clearing equipment. The compacted snow cover causes the ice to thicken under the packed portion of the ice road.

### Construction Width and Length

The Ministry of Highways and Infrastructure standard cleared width on large lakes is forty-five (45) meters. In areas where ground drift is prevalent, extra clearing width may help reduce snow accumulation as the wind has a tendency to blow the ice road clean. Extra clearing width also allows for snow storage. Windrows of snow should be flattened as much as possible.

The Ministry of Highways and Infrastructure standard cleared width on rivers, streams and smaller lakes is thirty (30) to forty five (45) meters. Wider areas should be cleared on longer crossings and for roads that will be operated for longer durations.

Safety of an ice road is largely derived from the buoyancy of the ice. The importance of maintaining the proper ice road width is vital.

### THE WIDER THE SNOW IS CLEARED - THE BETTER!!

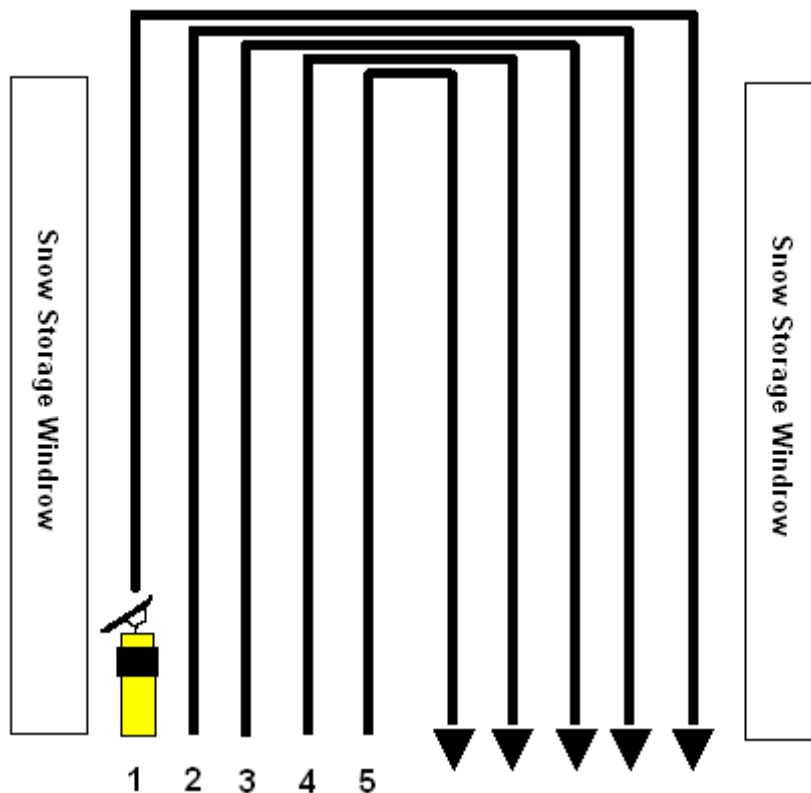


Figure 4: Snow Clearing Process

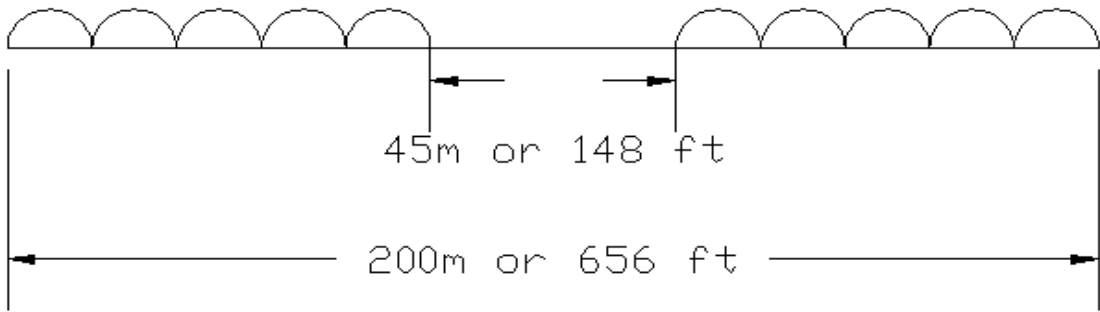
INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

Clearing should start on the outside edges and continue towards the centre if the snow is heavy. The equipment should only move as much snow as it can safely handle. The outside limits of the ice road should be marked in advance so the operators know the exact location that was checked and remains to be cleared.

Once you are ready to start clearing ensure that only as much road is opened as can be completed within that shift. You should never attempt to move a windrow that has sat in place overnight. In the rare case where a windrow must be moved or crossed, retesting of ice and extreme care must be used, as a stress crack under the windrow is “normal”, creating an additional hazard for heavy equipment and operator.

If there is limited snow cover, clearing operations can start at the center and move to the outside clearing limits. Ensure that the resulting windrow is flattened out so that excess weight is not put on the ice.

If there is heavy snow cover on the ice, additional ice checking for width may have to be done so that clearing can commence past the outside limits and work toward the center. This results in a slower clearing process, but it does allow for moving smaller windrows of snow larger distances. It also allows for more area for snow storage. Again, ensure that the resulting windrow is flattened out so that excess weight is not put on the ice.



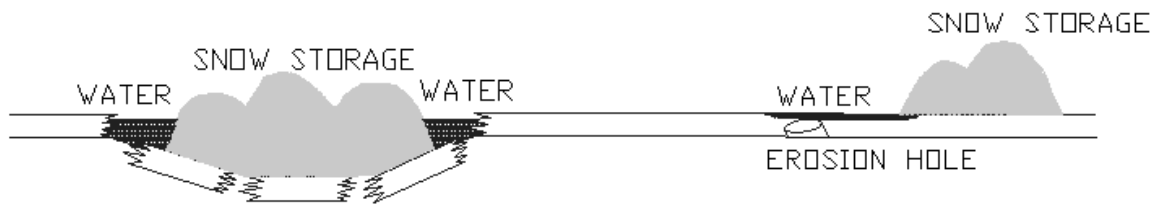
**Figure 5: Windrows**

Only open as much length of road that can be cleared in the same shift.

Care must be taken not to leave large windrows in the area to be cleared. Slushing could occur making it impossible to move the windrows safely. Slushing occurs when the weight of snow on the ice overcomes the natural buoyancy of the ice. This forces the ice down and water comes up through the cracks. It is because of this that you should not attempt to move a windrow after it has been there for a time. If the water is forced up quickly it could erode the ice forming air holes under the banks or along the edge of the banks.

Construction equipment and the public should not be allowed to work or travel in areas where slushing has occurred.





**Figure 6: Ice Failure**

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

Air holes, drill holes, or erosion holes can cause slushing along the snow storage banks. These areas should be blocked off to prevent access.

## **Flooding**

Once the full width of the ice road has been cleared or packed, flooding can commence using sleigh augers or a 12" auger attached to the rear of a snowmobile. Care should be taken to "plug" or bank snow around each hole after flooding is completed to prevent water from flowing back into the hole.

The first flood should not exceed 25 mm (1") in depth. If there is packed snow on the surface the first flood should bind the snow together. Subsequent floods should not exceed 50 mm (2") in depth. Each flood must be frozen solid before the next flood is applied.

Flooding on unpacked snow will form slush that is insulated and will not readily freeze. Using snowmobiles to pack slush would be extremely difficult as the slush will freeze and plug up the track.

If you encounter an area with slush or the ice forms and there is a deep snow accumulation, flotation tank equipped units should be used for compaction. Equipment should have low ground pressure and be as light as possible. It must be suitable for the capacity of the ice. Outriggers are also advised. **Extreme caution must be exercised in these situations.**

In some cases flooding can cause the natural blue ice on the bottom to erode. Accurate ice testing will determine if erosion is occurring.

## **Beaver Dam Removal**

Beaver dams are hazardous to cross as they could drain and collapse when the road is being used. They should be removed and drained during the first stages of construction to allow for removal of hanging ice and penetration of frost in the ground.

## **Ice Road Structure**

With continuous freezing, the compacted section of the ice road develops a shape as shown in the diagram below. This occurs because the outside snow banks act as an insulator. This insulation slows formation of ice under the extreme edges of the road.

INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

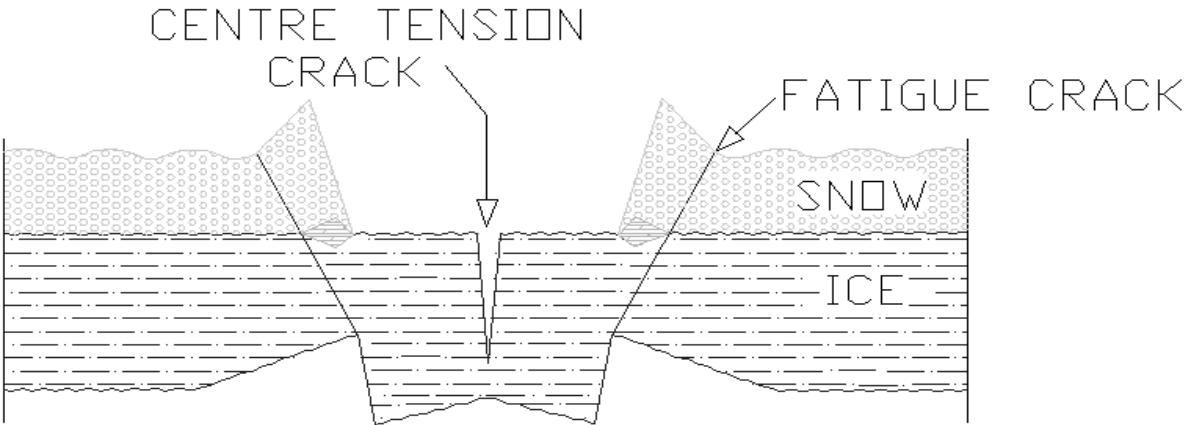


Figure 7: Typical Substructure on an Ice Road

900-02 ICE TESTING

INTRODUCTION

Construction of ice bridges and ice roads has unique safety hazards because of the ever-present danger of an ice failure. To reduce this risk for those working on the road as well as for the traveling public, strict attention must be paid to testing of the ice to ensure that it is capable of supporting the loads to which it is subjected.

Ice is generally unpredictable and thickness or consistency should never be taken for granted. Air temperature, currents, snow cover, traffic volumes and uneven flooding may cause variables in thickness. Test holes only 5 m apart have had a 60 cm difference in thickness.

TYPES OF ICE

**Blue Ice** Blue ice forms as water freezes on the bottom of the ice cover. The heat released during freezing is conducted upward through the ice and snow into the atmosphere. The colder the atmospheric temperature, the quicker blue ice forms.

Blue ice thickness can be induced by keeping the road surface clear of snow and allowing light traffic (ice thickness permitting) to pass over the ice road.

Blue ice is clear and transmits light to the water below. Often the ice appears blue or black in color from the coloration of the water below. Blue ice has a solid, clear texture.

Blue ice has the highest allowable bearing capacity of all ice.

**White Ice** White ice is made up of densely packed air bubbles and small ice crystals. It is less dense and therefore weaker than clear blue ice. White ice is considered to have only 50% of the load bearing capacity of natural blue ice. Several different types of white ice can be formed:

**Flood Ice** White ice that is produced by flooding with augering or pumping. Flood ice may also occur naturally or from wave action near dams on lakes, rivers, and creeks.

<b>Set Slush Ice</b>	White ice that forms when the snow on the ice surface melts and freezes. This occurs on the surface of traveled portions of the ice roads and under the banks created when cleared snow is deposited.
<b>Grey Ice</b>	Grey crystallized or honeycomb ice forms from thawing and indicates the presence of water running through the ice. Grey Ice should not be trusted as a load bearing surface.

**If any doubt exists as to whether the ice should be considered blue or white ice, always assume it is white ice for increased safety.**

## **TEST METHODS**

To determine the safe bearing capacity of ice it is to be tested manually by drilling boreholes and examining the thickness and type of ice present. Hand, electric or gas augers are used to drill boreholes. Another method is use of an electronic profiler or Ground Penetrating Radar (GPR), which provides a continuous readout indicating ice thickness and presence of cracks. GPR profilers are often used for ice roads that are too long to test manually or areas where there are fluctuations in the ice thickness are expected such as river crossings. Manual borehole testing is still required to determine the ice texture and the thickness of the blue vs. white ice layers.

## **MANUAL TESTING PROCEDURE**

**Ice Thickness Required For Testing** Be sure you know the weight of the equipment you are using and do not proceed if the ice is not thick enough to support the combined weight of both you and your equipment. Workers on foot are not to proceed onto ice which is less than 10 centimeters thick for any reason. Snowmobiles must have a minimum of 15 centimeters of ice before proceeding. If during testing, the measured ice thickness is less than that required to support the equipment you are using, back off slowly and suspend further testing. Report to your work crew supervisor.

If thin ice is found but conditions are still safe, drill additional holes to determine the extent of the weak area. The thinnest ice measurements will govern the allowable loading. For example, if nine test holes read 25 centimeters and one reads 12 centimeters, the critical ice thickness will be 12 centimeters. Subsequent testing will start at the 12-centimeter test hole location.

Ice thickness can be increased by flooding. Alternatively, construction activities can be postponed until the ice thickens naturally.

**Ice Thickness Required for Equipment** Prior to moving equipment on to any proposed ice road, the Contractor or the Ministry supervisor shall ensure that testing is done for ice thickness and ice bearing capacity. Each piece of equipment will be weighed to ensure that it is under the maximum gross vehicle weight allowable for the ice. The data will be recorded on the Winter Road Ice Thickness Report and copies of the information will be provided to the Saskatchewan Ministry of Highways and Infrastructure Representative.

INTRODUCTION	<p><b>Test Holes</b></p> <p>The work crew supervisor is responsible for supervising/measuring ice thickness at the test holes. A needle bar may be used to test ice up to 15 centimeters thick. An auger should be used for ice more than 15 centimeters thick.</p> <p>Use a small diameter (4" or 6" recommended) gas or electric ice auger to drill the test hole partially into the ice. Remove the auger and loose snow. Visually inspect the hole so you can locate the depth where white ice changes to blue ice. The smaller the auger is, the easier the hole will be to plug.</p>
900 ICE ROADS	<p><b>Bore Hole Drilling</b></p> <p>Take care to make sure the auger does not jam on the sides of the hole. Stop the auger before breaking through in order to assess the amount of white ice. Once you have measured the white ice, bore the hole all the way through the ice.</p>
901 SIGNING	<p>Measure and document the depth of any flood, slush or white ice. Measurements should be taken using an ice measuring stick which has a foot to hook the underside of the ice. Use your thumb to mark the top of the ice location then lift the measure clear of the hole to read. This eliminates visibility problems caused by poor light or loose ice obstructing the view of the hole while trying to read the measurement</p>
902 WINTER ROADS AND THE ENVIRONMENT	<p>As soon as your auger reaches water continue augering until all the loose ice has been removed from the hole. The hole is now full of water so the only depth you can measure and document is the total depth of the ice. The measuring stick should start at zero from a bolt extended out of the stick at the bottom. The extended bolt allows you to place the measuring stick on the side of the hole and find the bottom of the ice. Record the total depth of the ice.</p> <p>Calculate the blue ice thickness by subtracting the measured white ice thickness from the total depth of the ice. Now calculate the bearing ice thickness by dividing the white ice thickness by 2 and adding the blue ice thickness to it.</p>
903 WINTER ROAD SAFETY	<p><b>Sample Calculation of Bearing Ice Thickness:</b></p> <p>Measured Total Depth of Ice = 32"</p> <p>Measured White Ice Thickness = 8"</p> <p>Calculated Blue Ice Thickness = <math>32'' - 8'' = 24''</math></p> <p><b>Total Bearing Ice Thickness = <math>(8''/2) + 24'' = 28''</math></b></p>
904 MANAGEMENT OF WINTER ROADS	<p>Once you have completed your drilling, measuring, and documentation, plug the hole with snow to prevent any flooding.</p>

**Minimum Testing for Bearing Capacity**

Prior to opening the road or when testing for a specific load bearing capacity a full set of ice readings with 3 bore holes at each location should be taken and recorded until the ice tests pass for a specific load bearing capacity.

In general, the most frequent and intensive testing will take place early in the construction season. As ice thickness increases and crews become more confident that all thin areas have been identified, testing may be reduced.

**Minimum Testing for Lakes**

Manual testing on large lakes should consist of three boreholes (i.e. left, centre and right) taken at a minimum of one km intervals. At any point where the road passes within 500 meters of shoreline then testing intervals should be shortened to 100 meter intervals or less. Testing at fixed distances will enable subsequent retesting, in the event of low ice readings, to be taken at the same locations. If an area of low ice readings is encountered, test intervals should be shortened to 100 meters or less depending on the total length of the area involved.

**Random Testing**

Random ice testing can take place prior to ice testing for specific weights. Random testing would involve a minimum of one borehole at each location varying from left, center and right. Random ice testing would allow for projections on anticipated opening dates and should not be used to determine the maximum load bearing capacity of ice.

**Minimum Testing for Rivers**

Manual testing on streams and rivers should consist of three boreholes; (left, center and right) taken a maximum of 30 meters apart. Since the currents in rivers and streams are greater on curved sections, they should be crossed on straight sections where the current is reduced. Any type of blockage in the flow also produces a stronger current and should be avoided.

INTRODUCTION	900 ICE ROADS	Road Stage	Testing Frequency	Rivers	Lakes	
					Within 500m of Shore	Greater than 500m from Shore
		Pre Construction: Initial Test Run	Repeat as required until sufficient ice has formed to allow the start of construction	30 m between test holes along center line. Look for thin areas caused by river current.	50 m between test holes along center line.	250 m between test holes along center line.
		Construction: From start of Construction until the Road is Open to Traffic	Testing will be carried out until required thickness is obtained	30 m between test holes along both edges.	50 m between test holes along both edges and center	250 m between test holes along both edges and center.
901 SIGNING		Operation: This may overlap with Construction Activities on Roads with Lower Loads	Test entire route prior to raising load limits or spot test known thin areas as directed by the Supervisor.	30 m between test holes along both edges.	250 m between test holes along alternate edges.	
<b>Note: If GPR is used test holes are only required for calibration and mapping thin areas</b>						
<b>Note: The above table indicates normal test frequency and hole spacing. Good judgment based on field experience must be used when varying from the table. In thin areas the suggested spacing must be reduced to determine their extent and severity.</b>						

Table 1: Summary of Frequency and Distribution of Test Holes for Ice Roads

### RECORD KEEPING

Test hole frequency, location and ice thickness measurements must be recorded on the Thickness Report form. These records will be filed as part of the permanent record. It is important that the ice thickness report is filled out accurately and is written clearly. In addition to the location and thickness, the following information must also be recorded:

- Date
- Location
- Kilometer of test hole
- Under Comments record:
  - Names of testing crew,
  - Presence of wide cracks, wet cracks and other significant cracks
  - Details of load reductions and/or traffic detours

It is very important to **document all ice readings** carried out on the project.

12

# INTRODUCTION


# 900 ICE ROADS

## 901 SIGNING

## 902 WINTER ROADS AND THE ENVIRONMENT

**903 WINTER ROAD  
SAFETY**

## 904 MANAGEMENT OF WINTER ROADS

INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

## GPR TEST PROCEDURE

If available, Ground Penetrating Radar (GPR) may be used in conjunction with manual borehole testing. This is particularly useful in identifying air bubbles, cracks and other anomalies, which might be missed by the test holes. The GPR unit takes a reading at regular intervals normally one meter. The GPR unit must be calibrated to ensure its accuracy at the start of each day, after four hours of use and whenever erratic or questionable readings are obtained.

If a GPS unit is attached to the Ground Penetrating Radar, location stamps are put right on the read-out, allowing easy location identification of problem areas.

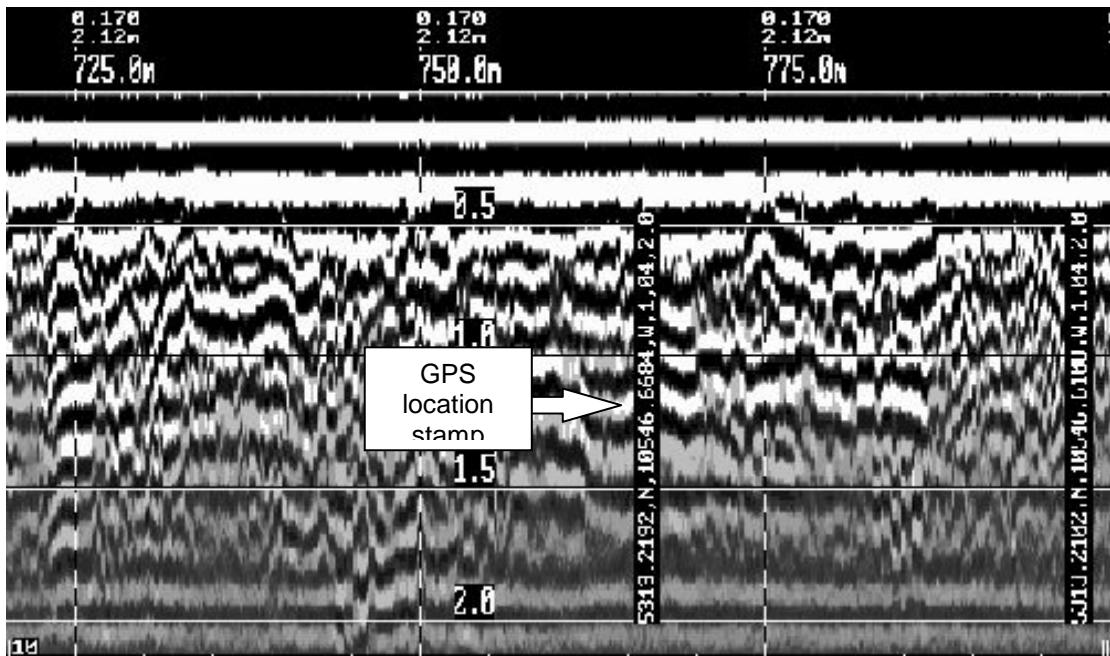


Figure 8: Sample of GPR Readout with GPS Location Stamp

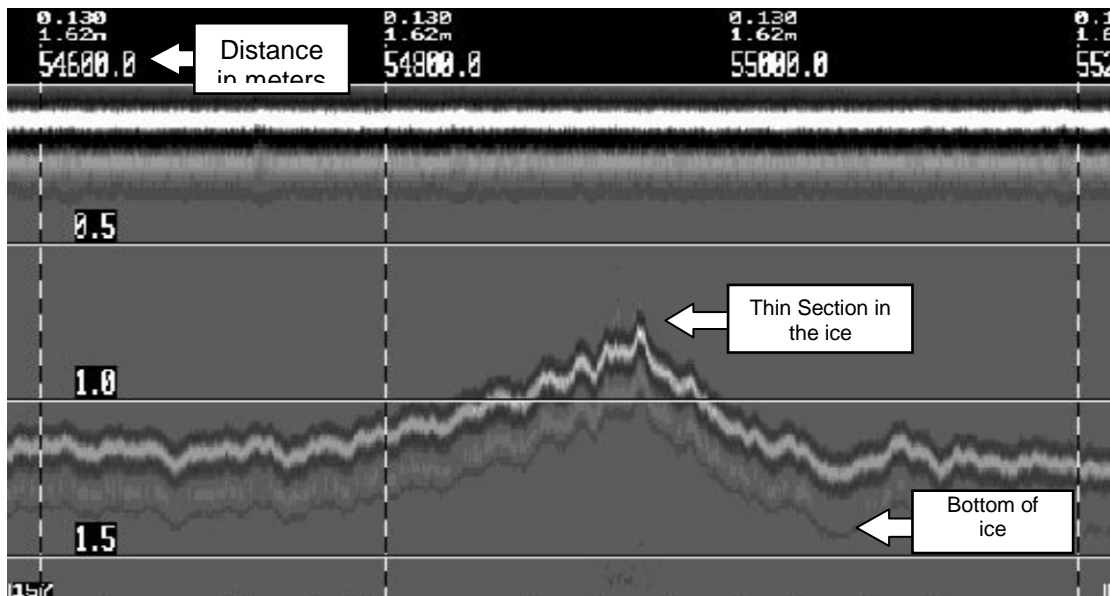


Figure 9: Sample GPR readout



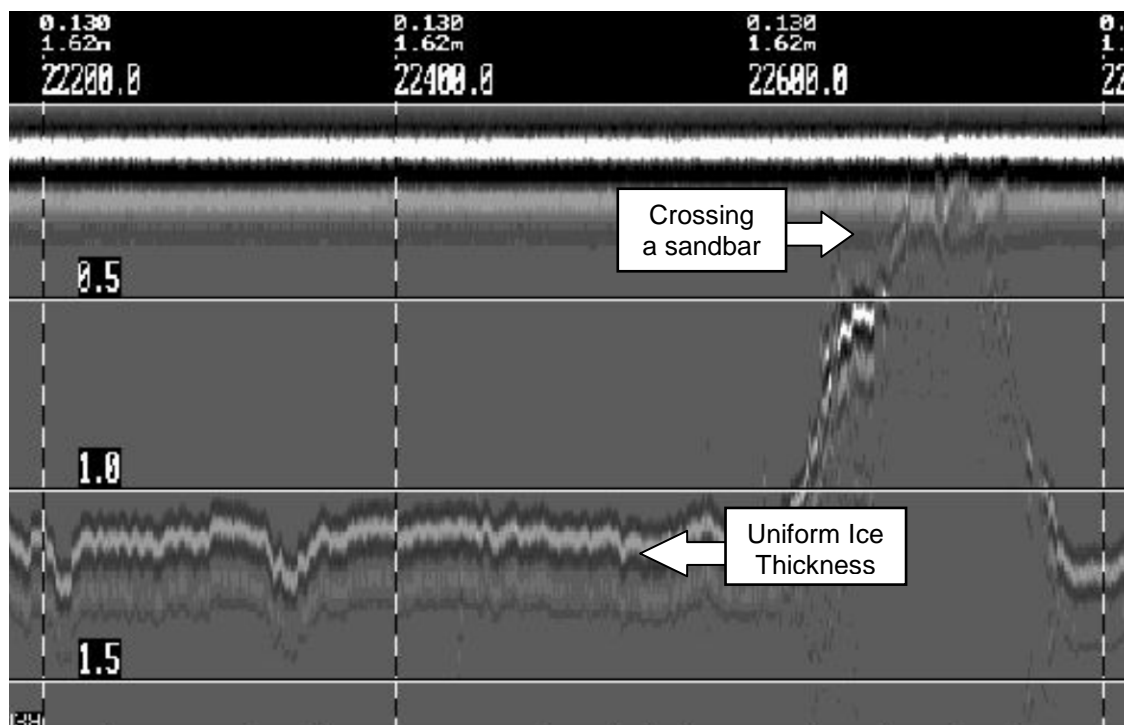


Figure 10: Sample GPR readout

## 900-03 ICE CAPACITY

### INTRODUCTION

The ability of ice to support a load is dependent on a number of factors including ice thickness, the pressure of the water below the ice as deflection develops, the way the ice formed initially, snow cover, vehicle speed and the kinds of load placed on the ice cover. The strength is different for sea and freshwater ice and is affected by the presence of cracks and sudden or extreme temperature changes. It should also be remembered that ice thickness can vary considerably from place to place and until a margin of safety is achieved, extreme caution must be exercised.

### GOLD'S FORMULA

The Ministry of Highways and Infrastructure and most other agencies who construct ice roads use the Gold Formula to determine the bearing capacity of ice. Gold's Formula is used as a guide for establishing the thickness of ice necessary to support a given load. The Gold's Formula provides an estimate of the load limit for a particular thickness of ice, below which the failure of an ice sheet is unlikely. Thickness is not an infallible measure of the bearing capacity of an ice sheet and must be combined with field observations of other factors affecting ice strength when actual load limits are determined. Use of this formula allows for a number of safety factors for an ice sheet under less-than-ideal conditions. As such, practical use of this formula may be made with reasonable safety.

INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

**Gold Formula**

$P = 6.0 \times h^2$      or      $P = 6.0 (h + 1/2W)^2$

where,     **P** = Allowable Load Capacity of the Ice (kg)  
**h** = Blue or Natural ice thickness (cm)  
**w** = Thickness of White ice (cm)

**Imperial to Metric Conversions:**

- in x 2.54 = cm
- lbs x 0.4535 = kg
- cm x 0.3937 = in
- kg x 2.205 = lbs

Blue Ice Thickness (cm)	Allowable Load (lbs)	Allowable Load (kg)
2	53	24
4	212	96
6	476	216
8	847	384
10	1,323	600
12	1,905	864
14	2,593	1,176
16	3,386	1,536
18	4,286	1,944
20	5,291	2,400
22	6,402	2,904
24	7,619	3,456
26	8,942	4,056
28	10,371	4,704
30	11,905	5,400
32	13,545	6,144
34	15,291	6,936
36	17,143	7,776
38	19,101	8,664
40	21,164	9,600
42	23,334	10,584
44	25,609	11,616
46	27,990	12,696
48	30,477	13,824
50	33,069	15,000
55	40,014	18,150
60	47,620	21,600
65	55,887	25,350
70	64,816	29,400
75	74,406	33,750
80	84,657	38,400
85	95,570	43,350
90	107,145	48,600
95	119,380	54,150
100	132,277	60,000
105	145,836	66,150

**Table 2: Metric Blue Ice Bearing Capacity**

**FACTORS INFLUENCING ICE CAPACITY:** Ice thickness is only one of the factors that determine the safe operating conditions on ice. Weather, traveling speed, water currents, temperature fluctuations or other traffic actions may make any depth of ice unsafe.

INTRODUCTION	2	341	155
	3	768	348
	4	1,366	620
	5	2,134	968
	6	3,073	1,394
	7	4,182	1,897
	8	5,463	2,478
	9	6,914	3,136
900 ICE ROADS	10	8,535	3,871
	11	10,328	4,685
	12	12,291	5,575
	13	14,425	6,543
	14	16,730	7,589
	15	19,205	8,711
	16	21,851	9,911
	17	24,667	11,189
901 SIGNING	18	27,655	12,544
	19	30,813	13,977
	20	34,142	15,487
	21	37,641	17,074
	22	41,312	18,739
	23	45,153	20,481
	24	49,164	22,300
	25	53,347	24,198
902 WINTER ROADS AND THE ENVIRONMENT	27	62,224	28,224
	29	71,783	32,560
	31	82,026	37,206
	33	92,951	42,162
	35	104,559	47,427
	37	116,851	53,003
	39	129,824	58,887
	41	143,481	65,082
903 WINTER ROAD SAFETY	43	157,821	71,586
	45	172,843	78,400
	47	188,548	85,524
904 MANAGEMENT OF WINTER ROADS			

Table 3: Imperial Blue Ice Bearing Capacity

**FACTORS INFLUENCING ICE CAPACITY:** Ice thickness is only one of the factors that determine the safe operating conditions on ice. Weather, traveling speed, water currents, temperature fluctuations or other traffic actions may make any depth of ice unsafe.

**Sudden and Extreme Temperature Changes** A temperature fluctuation of more than 18° Celsius over a 24 hour period will produce severe thermal stressing and cracking of the ice. If this occurs the road should be checked for cracks which may compromise the load capacity. If you are in the Construction phase, all work with heavy equipment should STOP until the temperatures have stabilized.

**Presence of Cracks** Any ice cover will have cracks caused by thermal contraction or movements in the ice cover. Except during spring thaw or in areas subject to fatigue, cracks do not necessarily indicate a loss in the load bearing capacity of the ice.

Where there is an indication that a wet crack penetrates right through the ice cover, a reduction in the allowable load limit is advisable. Once a wet crack refreezes, the new ice is as strong as the original. A healed wet crack should be tested with an ice drill or a chain saw to gauge the depth of healing.

Where a dry crack over 10 centimeters wide is observed, a reduction in the maximum load limit should be considered. The decision to reduce the load limit will be based on the frequency, width, depth and intersection of the cracks. Dry cracks can be repaired by filling them with water or slush.

Type of Crack	Modification of Ice Loads	Remedial Action
Hair Cracks	None	None
Refrozen Cracks	None	None
Dry Cracks: Intersecting and Non-Intersecting	Weight reduction to 90% of allowable should be considered based on frequency, width and intersection of cracks	Fill cracks, and/or detour around the affected area and/or spray or flood the affected area, and/or abandon the existing alignment.
Wet Cracks: Non-Intersecting	Weight reduction to 75% of allowable should be considered based on frequency, width and intersection of cracks	Fill cracks, and/or detour around the affected area and/or spray or flood the affected area, and/or abandon the existing alignment.
Wet Cracks: Intersecting	Weight reduction to 50% of allowable should be considered based on frequency, width and intersection of cracks	Fill cracks, and/or detour around the affected area and/or spray or flood the affected area, and/or abandon the existing alignment.

**Table 4: Modification of Ice Loading and Remedial Action for Various Types of Cracks**

As a result of normal thermal contraction, cracks sometimes form in the middle of a road across the direction of travel or along the direction of travel. If they remain dry they do not seriously reduce the bearing capacity of the ice. Cracks at the sides of the road and running parallel to the direction of travel indicate over-stressing; perhaps by the weight of snow deposits from clearing operations or possible fatigue from excessive traffic. If such cracks develop, particularly if they are wet, traffic should be diverted away from the crack and, in more extreme

INTRODUCTION		cases, road use should be suspended until the cracks have healed.
900 ICE ROADS	<b>Presence of Cracks</b>	Fluctuating water levels may produce cracks near and generally parallel to the shoreline. This can create hanging ice or pressure ridges. These cracks are often accompanied by a difference in the levels of the floating and the grounded ice. If these cracks are wet, loads should be reduced accordingly. With extreme differences in the level, bridging repair or flooding may be necessary.
901 SIGNING	<b>Moving Loads</b>	<p>Deflection of ice by a moving vehicle creates stresses which fatigue the ice when frequently repeated and in extreme cases may result in a sudden failure. The speed of the vehicle is a key factor. An empty truck traveling between 25 and 35 kilometers per hour will often cause more audible cracking in the ice cover than a fully loaded truck traveling at 8 kilometers per hour or less. Some freighting companies recognize the velocity effect; they restrict the speed of trucks to 8 kilometers per hour on ice of marginal strength.</p> <p>Moving loads deflect the ice sheet and create a wave in the water beneath the ice. The speed of the wave is dependent on the depth of the water, the thickness of the ice cover and the strength of the ice. The greatest deflection and the most severe stresses occur when the vehicle on top of the ice and the wave below it are traveling at the same speed.</p> <p>The moving deflection effect is critical when the water depth is less than 50 times the thickness of the ice. The critical velocity increases with water depth. Consequently, over very deep water, the deflection wave travels through the ice at a much higher velocity than a vehicle would normally achieve. Although the speed of a vehicle is not significant over deep water it becomes critical near the shore.</p> <p>When a vehicle is traveling parallel to a shoreline, resonant waves reflect back through the ice. The wave pattern is critical when the vehicle weight is close to the load-bearing limit of the ice. Reflected waves are greatest when a vehicle approaches a shoreline at a right angle. If possible, roads and vehicles should meet the shoreline at a 45° angle. It is important that drivers obey the posted speed limit when a road meets the shoreline at a 90° angle and when a vehicle's weight is close to the maximum load limit for the ice.</p>
902 WINTER ROADS AND THE ENVIRONMENT		
903 WINTER ROAD SAFETY	<b>Multiple Loads</b>	Two or more moving vehicles increase deflection and stress as they approach or travel close together. Therefore drivers should decrease speed when approaching another vehicle and should not follow other vehicles too closely. When two vehicles meet head-on, they should both stay as close to the center of the road as possible when passing each other. Heavy and/or tracked equipment such as a D8 crawler tractor can also cause vibrations in the ice, which adds to the deflection effect.
904 MANAGEMENT OF WINTER ROADS	<b>Frequently Repeated Loads</b>	Frequently repeated loadings will cause ruts, holes, and dry and wet cracks to form in the ice. The weakened condition of the ice may be grounds to reduce the allowable load limit. If cracks or potholes appear in the ice, the travel route may be detoured, loads reduced, the area flooded or the road closed temporarily to allow for the recovery of the damaged areas.

**Long-Term Loads** Long-term loads are those imposed by vehicles parked for more than a few minutes. Over a period of time the ice begins to show signs of creeping failure. The ice bearing capacity will be reduced permanently by long term loads, even if those loads are within the allowable weight range for the ice. Parking of vehicles or equipment on ice that is at or near its load limits should be avoided.

## 900-04 CRACKS & PRESSURE RIDGES

### CRACK FORMATION

Cracks may form in the ice as a result of rising or falling water levels, temperature variations, or frequent heavy loading. Surface cracks a few inches deep (several cm.) are not considered serious, but cracks that pass completely through the ice sheet permitting water to rise to the surface usually require load reductions on the road.

**Identifying Cracks** It may be difficult at times to identify cracks especially if there is snow cover. During the initial stage of clearing, cracks may be located in areas where the snow is depressed or cracks are visible in the snow.

**Ice Failures & Pop Outs** Overweight loads that exceed the speed limit can cause a wave movement in the ice that can rebound or cause the ice to flex and produce a complete failure. Vehicles over 7,000 Kg maximum Gross Vehicle Weight that exceed the 15-km/h speed limit could also cause ice pop-outs. These are pieces of surface ice located at the junction of two cracks that come loose from the vibration on the surface. They can be repaired by chopping up the pop-out, adding snow and re-filling the hole. The typical weight of a loaded 3-ton truck is 7,000 Kg.

**Load Restrictions** The following load reductions are suggested for cracked ice:

- For cracks running across the direction of travel, reduce load limit to one-half of that for uncracked ice.
- For cracks running in the same direction as travel, reduce load limit to one-quarter of that for uncracked ice.

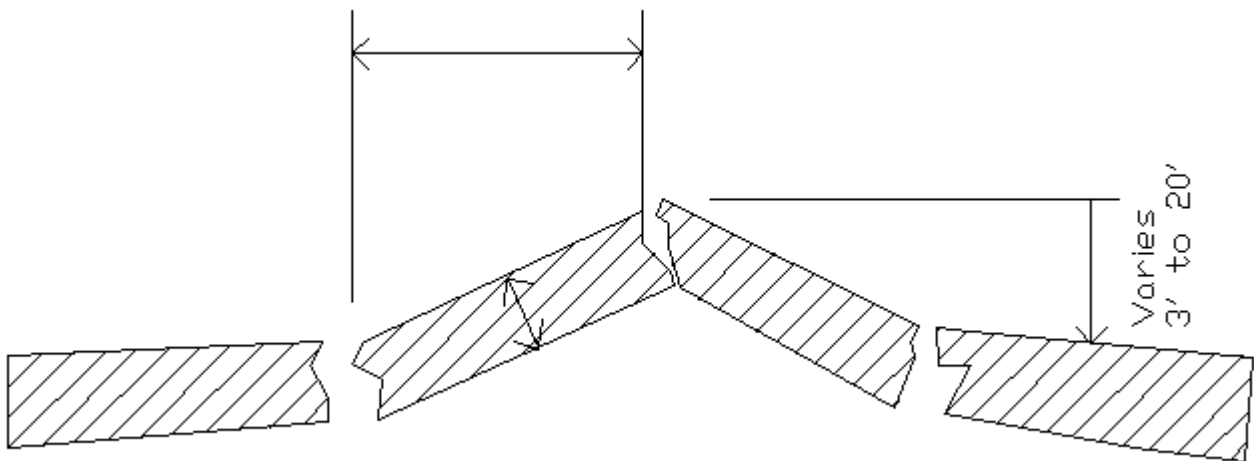
In time, cracks in the ice usually refreeze and load limits may be raised to normal after a thorough inspection to determine if travel is safe.

**Table 5: Crack Monitoring, Repair and Load Restrictions**

Wet Cracks	Dry Cracks
<b>Active:</b> Repair as soon as possible Reduce load by one-half If crack does not heal it must be bridged Look for intersecting wet cracks, if they exist <b>suspend operation</b> until repaired	<b>Less than 1/8" wide:</b> Not a concern but should be watched
<b>Re-Frozen:</b> Drill to determine thickness Assign appropriate safe load	<b>Greater than 1/8" wide:</b> Should be repaired with water or slush as soon as possible

## PRESSURE RIDGE FORMATION

Pressure ridges are upheavals or downheavals of the ice. They can occur on a small or large scale. If it is possible these areas should be avoided due to their unpredictable nature. Pressure ridges may occur in the same general location every year and should be anticipated when deciding the ice road route.



**Figure 11: Up Heave Pressure Ridge**

While it is preferable to avoid ice road locations that are historically prone to developing bad cracks or pressure ridges, this is not always possible. Large lakes often develop pressure ridges during sudden temperature changes, and re-routing the road may not be feasible or cost effective.

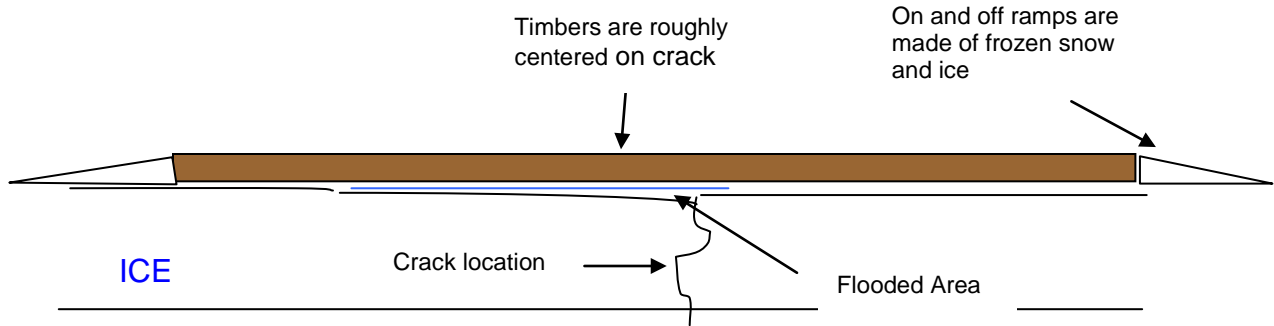
## BRIDGING PRESSURE RIDGES & CRACKS

Bridging cracks or pressure ridges requires the same type of solution. The idea is to put a bridge across the weak area, in order to allow safe passage of traffic.

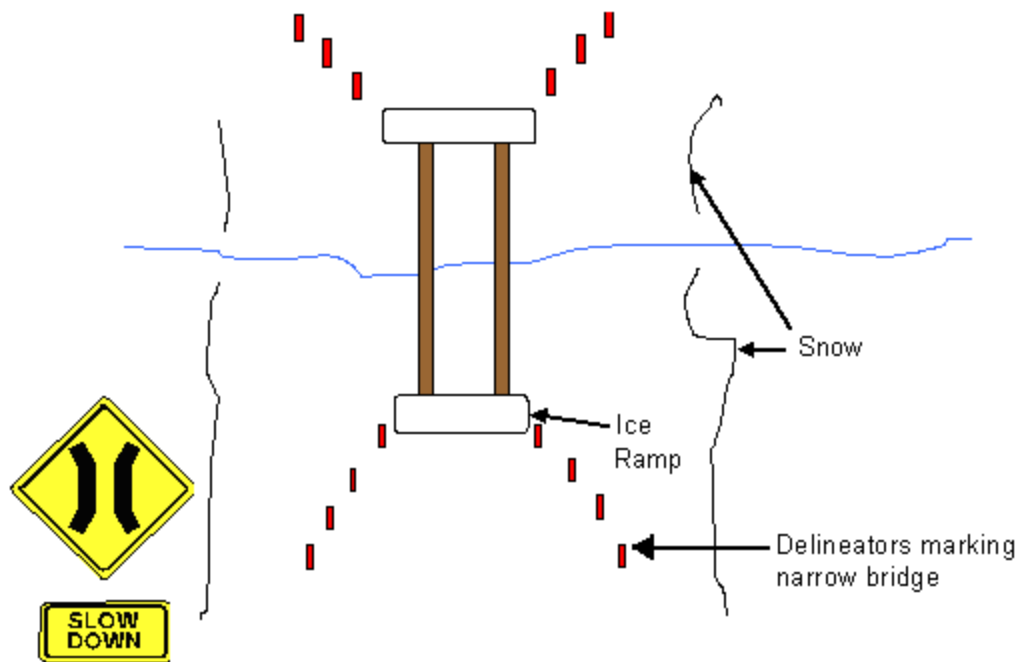
Safety of the winter road user is of prime importance when crossing a pressure ridge. They should be well marked and have adequate signing so traffic can funnel into the crossing site.



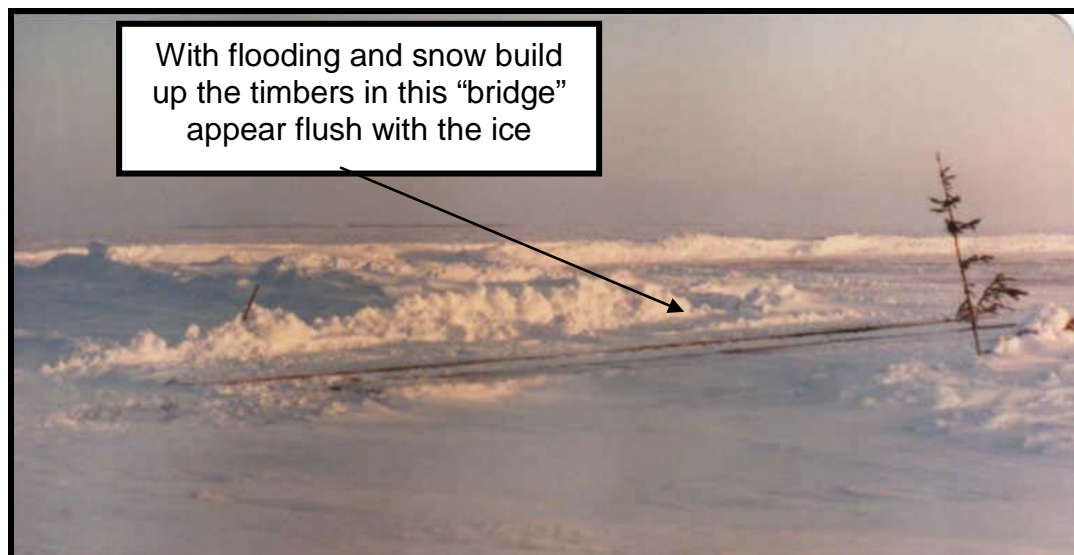
Construction of a crossing consists of cutting out and leveling the actual pressure ridge so twin timber or steel ramps can be pulled in. If the ramps lift in the air there should be no attempt to cross until they have been re-leveled. Any attempt to access the ramps if they are unstable could injure the occupants of the vehicle and damage the vehicle or ramps. Extra caution shall always be used around open cracks or pressure ridges. During the process of testing the ice and bridging the pressure ridge, workers must be equipped with safety lines and some method of warming up or drying if they get wet.



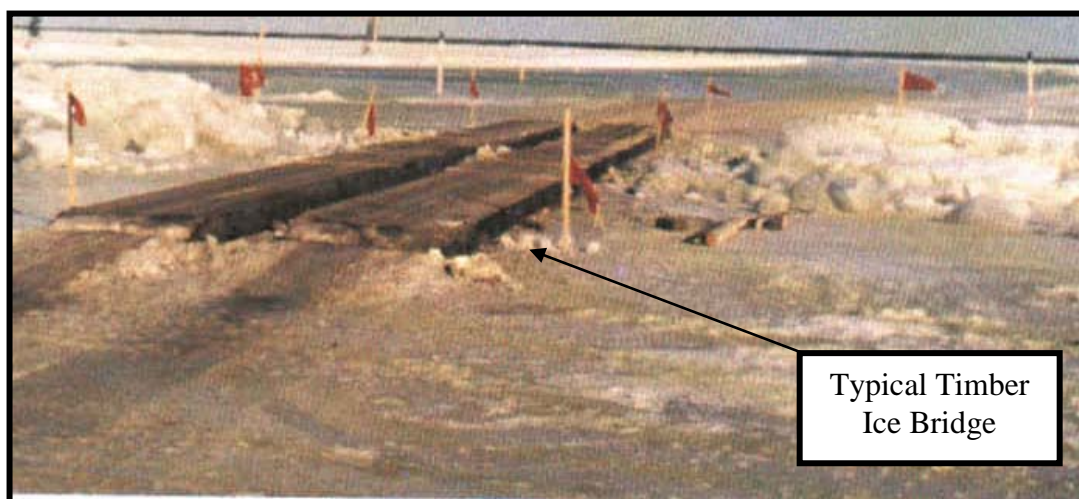
**Figure 12: Bridging Crack**



**Figure 13: Plan View of a Crossing**



**Figure 14: Iced-in Bridge**



**Figure 15: Typical Timber Crossing**

## 900-05 ICE ROAD RESTRICTIONS

### Travel Lane

**It is recommended that equipment and trucks travel near the center of the ice road. Do not travel or park close to the snow storage banks. This is the weakest area of the ice road due to the weight of the banks.**

### Maximum Speed Limit

The maximum speed limit on all ice roads for vehicles weighing over 7,000 kg GVW is 15 km/h. This speed should be reduced when approaching land or meeting other vehicles. The stopping ability of all vehicles is dramatically reduced on ice roads especially if there is no snow cover. Due to this variable in the surface, all users should drive with extreme caution.

## Maximum Weight

The maximum weight allowed when opening a Saskatchewan Highways and Infrastructure ice road is 32,000 lbs or 14,800 kg providing the blue ice thickness is 18" (46 cm). Under these conditions the road is opened to "Light Traffic Only". The maximum allowable weight is increased to 76,000 lbs or 34,500 kg when the blue ice thickness on all ice roads increases to 29" (74 cm).

## Over Dimension Loads

Over dimension loads require approval from Saskatchewan Highways and Infrastructure so all users can be notified in advance that a wide load is anticipated. Permits are required so the width can be checked, as some ice bridges, rivers and streams have restricted widths due to bridge and corduroy construction. Some sections have tight corners and steep grades that could affect an over width move.

## Over Weight Loads

Over weight loads require approval from Saskatchewan Highways and Infrastructure. The normal over weight permitting procedures are followed. Depending on the winter road conditions a permit may not be issued.

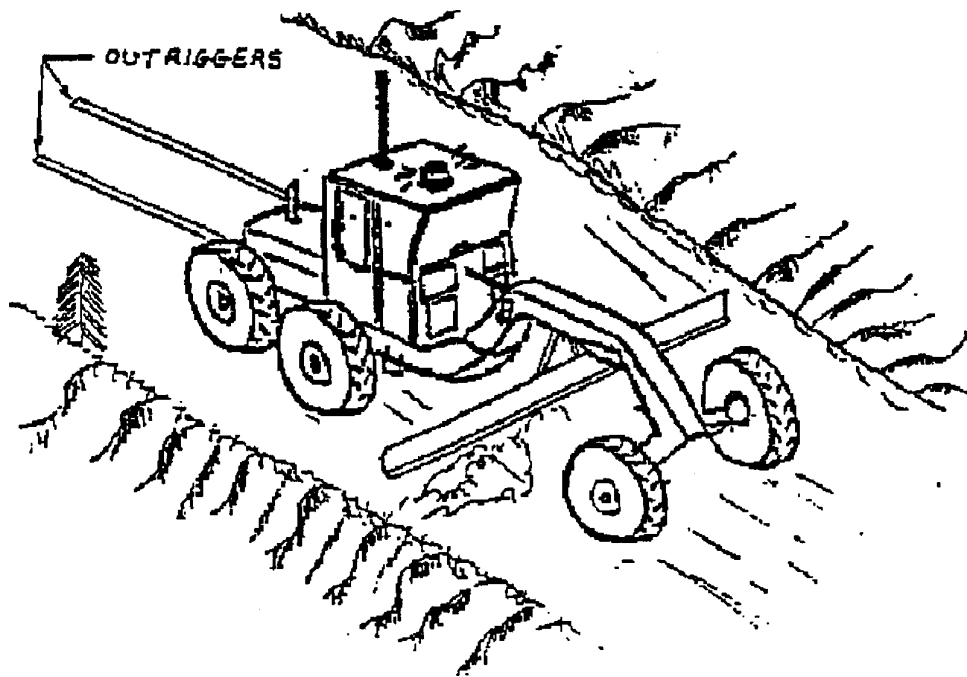
## Loads Over 7,000kg GVW

All loads over 7,000 kg GVW should follow each other at a minimum of 1 km apart. They should not pass each other when traveling in the same direction. When meeting head-on, both vehicles should decrease their speed and move to the right to pass each other, while staying as close as possible to the center of the road to avoid the weaker area close to the windrows.

## Parking

Stopping or parking loaded trucks on the ice is not recommended at any time due to the concentrated pressure it causes. One truck parked on the ice could lead to other trucks stopping, adding to the concentrated pressure.

INTRODUCTION	<p>900-06 EQUIPMENT</p> <p><b>INTRODUCTION</b></p> <p>Construction and maintenance of ice roads requires special consideration of the types of equipment used and the operating techniques. Precautions need to be taken to avoid creating ice failures and to ensure operators can escape from the equipment if it breaks through the ice.</p> <p>It is important to make use of all available equipment as ice thickness permits, so the ice roads can be cleared quickly and natural ice formation can take place.</p> <p><b>SPECIAL EQUIPMENT CONSIDERATIONS</b></p> <div> <p><b><i>ESCAPE HATCHES – An alternate means to allow for the escape of an operator in the event of an ice failure resulting in equipment rapidly sinking into the lake or river.</i></b></p> </div>
900 ICE ROADS	
901 SIGNING	<p><b>Escape Hatches</b></p> <p>When the equipment has an enclosed cab an alternate means of escape is strongly recommended. This could mean a specially designed "pop-out" window or a spring-loaded door in the top of the equipment. If canopies are required on the equipment for other safety reasons (i.e. clearing, etc.), additional equipment without canopies is recommended when working on ice. The minimum allowable practice is to have a specifically designed punch for breaking glass mounted in open sight in any equipment not equipped with an alternate escape route. Any vehicle with power windows will not be used for snow removal on an ice road.</p> <p>Most crawlers are equipped with ROPS canopies. These canopies are heavy and to maintain the integrity of the protection provided, cannot be tampered with. Cutting escape hatches through the roof is not permitted by law. Older models may allow escape hatches built into the roof.</p>
902 WINTER ROADS AND THE ENVIRONMENT	
903 WINTER ROAD SAFETY	<div> <p><b>SLIDE-OPENING BACK WINDOWS</b></p> <p><b><i>Can be obtained from dealer or from glass shops I.E. Alternate to making an escape hatch in the roof.</i></b></p> </div>
904 MANAGEMENT OF WINTER ROADS	



**Figure 16: Grader with Outriggers Attached**

### **Outriggers**

Outriggers are projecting supports extending from the main structure of the machine to provide additional stability and can be in the form of heavy timbers, logs, steel beams or other approved devices. The purpose of outriggers is to allow time for the operator to escape from equipment breaking through the ice. Outriggers should be used on ice road construction or maintenance equipment where the depth of water is deeper than the equipment's seat.

Graders with blade and wing and equipped with outriggers can also be used for initial ice road construction, providing the ice thickness is adequate to carry the weight of the grader and equipment. V plows are not recommended due to their extra weight and limited use.

**Recommended Outrigger Dimensions** -- steel post - 4 1/2" outside diameter, 1/2" walls, and 12' long.

### **Body Floatation Clothing**

The use of full body floatation clothing is required when working on ice roads during construction and maintenance. If a piece of equipment drops through the ice, the full body floatation suit would bring the operator directly back to the ice level or allow the operator to move to the edge of the hole. More information on body floatation equipment is detailed in *Section 901-02 Personal Protective Equipment*.

### **Crawler Tractors**

The majority of fatal accidents, as well as loss of equipment, occurs when using crawler tractors for constructing winter roads. This is due to the equipment's concentrated weight distribution combined with considerable vibration. There is often damage done to the ice road surface by the tractors' cleats.

Crawler tractors are generally **not recommended** for working on lake and river crossings. If crawler tractors are the only available equipment, the recommended Maximum GVW is 20,000 lbs. (9,000 kg), roughly equivalent to a Cat D-4 in size.

INTRODUCTION	<p><b>Truck Mounted Plows</b> Truck Mounted Plows with wing and <b><u>floatation tank</u></b> are recommended for the initial ice road construction, providing the ice thickness is adequate to carry the combined weight of the truck with mounted plow.</p> <p><b>Loaders &amp; Skidders</b> Unless specially equipped with dozer blades, etc. loaders and skidders should see limited use due to limited snow removal capability. This equipment can be used to move snow banks that do not have slush, to make the initial pass down the ice road or to clear short ice roads.</p>
900 ICE ROADS	<p><b>Cleats &amp; Tire Chains</b> Cleats and tire chains are not recommended for use on lake or river crossings. These cause damage to the road surface.</p>
EQUIPMENT OPERATING PRECAUTIONS	
	<p><b>Speed</b> During the initial stages of construction speed should be reduced. As ice thickness increases operating speeds can be increased slightly to allow for efficient snow removal.</p>
901 SIGNING	<p><b>Heavy Snow</b> If equipment is moving a heavy concentrated snow load extra ice thickness is needed to support movement of the snow.</p>
	<p><b>Loading &amp; Unloading</b> The loading and unloading of all trucks and storage of material is not approved on ice. Loading and unloading should only occur on land.</p>
902 WINTER ROADS AND THE ENVIRONMENT	<p><b>Hydraulic Attachments</b> Equipment that has hydraulic blades and buckets (e.g. graders, truck plows, loaders, backhoes, skidders) should not drop their attachments onto the ice in a sudden motion. This action creates pressure under the ice and could create an ice failure.</p>
903 WINTER ROAD SAFETY	
904 MANAGEMENT OF WINTER ROADS	

## 901 SIGNING

### 901-00 SIGNING

**INTRODUCTION** Signs are an important part of safety. Winter road traffic signs are used to declare the road open or closed, to direct traffic to destinations along the road, to post load limits and to warn motorists of potential hazards. The standards of signing are somewhat different from those on permanent all-weather roads because conditions on seasonal roads are more subject to change. Traffic signs must be adjusted to meet these changing road conditions.

### PROCEDURES

**Signing During Construction** While the winter road is under construction and not yet open to the public, barricades and signs will be posted at the entrance to the winter road stating that it is closed. Regular checks and patrols will be conducted to ensure that all barricades are in place at all times. If barricades have been moved or vandalized, the R.C.M.P. having jurisdiction in the area will be notified.

**Entry Signs** Signs will be posted at each major river crossing and at the entrance to all winter roads on the Saskatchewan Highway System. These signs will indicate the loading and speed which must not be exceeded when traveling or hauling freight across ice roads over frozen lakes, rivers, and streams. Entry signs will clearly indicate whether the road or crossing is open or closed and the phone number to call for road information. Signs advising motorists that there are no services available or the distance to the next community should also be posted.

**Speed Limit** Speed limit signs should be posted as required, taking into account the type of road surface.

**Weight Advisory** The maximum weight sign should not be placed until there is adequate ice thickness to support the indicated weight. Minimum ice thickness is recorded in “**Blue Ice**” equivalency.

**End of Season** At the end of the season the signs and barricades must be reinstalled and inspected. Typically these signs should be left up for two to three weeks after the season ends.

The following entry signs will be used:



SUGGESTED SAFE MAXIMUM WEIGHTS FOR GOOD BLUE ICE			
Safety of ice is not guaranteed Crossings are made at your own risk			
ICE THICKNESS		MAXIMUM GVW WEIGHT	
CM's	INCHES	KG's	LB's
40	16		
45	18		
50	20		
55	22		
75	30		



ATTENTION: WHEN CROSSING WITH HEAVY LOADS			
1.	Maximum speed 15 km/h		
2.	Do not pass other loaded vehicles		
3.	Vehicles to travel at least 1 km apart		
4.	Max 8 km/h within 1 km of shore to minimize wave action under the ice approaching shore		
FOR MORE INFORMATION PLEASE CALL :			
1-306-953-3262 – ATHABASCA AREA OFFICE			
1-888-335-7623 – HIGHWAY HOTLINE			

Figure 17: Entry Signs

#### Roadway Markers

Where possible, markers such as flagging and trees will be installed on ice roads to delineate the edge of the roadway. Additional traffic control devices such as flags and barricades can be used to direct the flow of traffic.

#### Warning Signs

Standard warning signs should be posted where required. On short detours, traffic cones or drums may be sufficient.

#### Barricades

Barricade lights may be installed in an emergency to attract attention to a sign message or to identify a particular hazard or obstruction. Lighting devices should be positioned so as not to blind traffic with their glare. Flashing devices do not provide good illumination and should not be used by themselves to channel traffic.

#### Information Signs & Km Markers

Signs on winter roads inform users of the **distance and route to the next community where fuel, accommodation and food are available**. Km markers are placed every 10 km to indicate the distance from the start of the winter road. Each vehicle traveling on the winter road should be equipped with **survival equipment** as described in Winter Roads Section 903-02: Personal Protective Equipment.

#### Hazard Signs

Signs/markers are used to identify and mark hazards on the winter road location. When a hazard cannot be removed, road users should be alert to bump markers or red flags. Signs with messages such as steep hills, sharp curve, severe bump, boulders, rough hummocky area or narrow area are very beneficial in assisting to identify hazards and danger areas. Often these signs are home made.



## Road Closures

Section 10 of *The Highways and Transportation Act, 1997* authorizes the closure of portions of a highway for the purpose of construction or maintenance. The Department routinely closes sections of highway if snowstorms or drifting snow reduce visibility to the extent that travel is hazardous.

It is the responsibility of the Ministry of Highways and Infrastructure or delegate to close a winter road when an emergency situation requires such action. Winter roads may have to be temporarily closed due to early thaws, severe snowstorms, or excessive snowfall. Pressure ridges may develop on a location across a lake, river or creek crossing causing it to become unserviceable. The Ministry will provide signs and barricades to alert travelers to this condition. The public should be notified of a road closure with as much advance notice as possible as there is no inspection or maintenance provided when a road is closed.

When a road is closed, proper signs must be installed to inform the public. The same standards apply to temporary and permanent road closures. In addition, it is important to notify the local radio stations so that public service announcements advising of the closure can be made.

The Ministry of Highways and Infrastructure officials set the permanent closing date for a winter road based on the date indicated in the winter road contracts. The following signs are recommended at the beginning or end of the system and on either side of any community on the winter road when the winter road is officially closed.

For easy placement the sign could be mounted on permanent posts and the sign could be hinged in the center allowing the bottom portion to be flipped up covering the sign during the period the winter road is not in use.



**For Overland Roads**



**For Ice Roads**

**Figure 18: Winter Road Closure Signs**

The public will also be notified of any temporary or permanent winter road closures through the media, newspaper, radio, TV (Local band channel) and bulletin boards.

INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

## 901-01    SIGNING PRIVATE WINTER ROADS

### INTRODUCTION

Where private winter roads are constructed for specific use, safety is of fundamental importance. Often the public cannot be stopped from using these roads, which makes it very important to post appropriate signs to inform the users and public of the serviceability of the road, possible dangers and hazards. Signs providing information regarding the use of the road are an important part of the safety program.

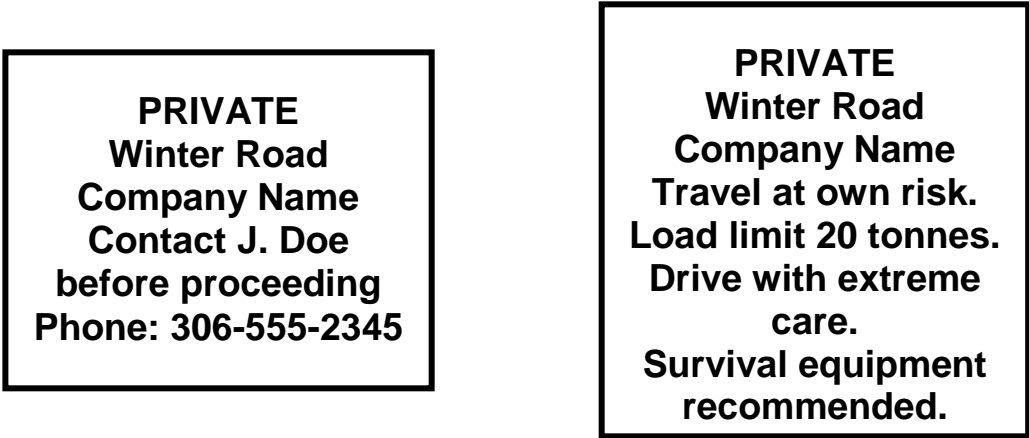


Figure 19: Private Winter Road Advisory Signs

## 902 WINTER ROADS AND THE ENVIRONMENT

### INTRODUCTION

Damage to the environment caused by the construction, maintenance or use of winter roads is considered extremely serious. Prevention is very important and a prompt response is essential to limit adverse effects on the public and the environment.

### PROCEDURES

<b>Environmental Assessment</b>	An <b>Environmental Assessment Approval</b> must be obtained before any construction is started on any new overland road locations.
<b>Camps</b>	Construction camps should not be situated on the ice, and fuel and oil contamination should not be allowed.
<b>Abandoned Vehicles</b>	The RCMP must be notified if vehicles are abandoned on the ice. They will notify the registered owner and arrange to have the vehicles removed.
<b>Spill Management</b>	<p>The Federal Transportation of Dangerous Goods Act requires anyone responsible for the custody and control of any contaminant involved in a transport-related environmental accident to immediately report the accident. All environmental accidents occurring in Saskatchewan should be reported immediately to the <b>Spill Control Center</b> at <b>1-800-667-7525</b>. This is the Canadian Transport Emergency Center (CANUTEC).</p> <p>Types of spills that should be reported:</p> <ul style="list-style-type: none"><li>• Spills, leaks or fires involving chemicals such as pesticides or fertilizers;</li><li>• Accidents involving hazardous wastes or radioactive materials, and;</li><li>• Any other uncontrolled chemical or petroleum spill.</li><li>• Petroleum spills over 100 liters (22 gallons) must be reported. This is a requirement under Saskatchewan law.</li></ul>

INTRODUCTION	<p><b>Spill Management</b></p> <p>When reporting a spill to the Spill Control Center, the following information should be provided:</p> <ul style="list-style-type: none"> <li>• Your name</li> <li>• Telephone number</li> <li>• Exact location of the accident</li> <li>• Type of accident (spill, leak, fire, etc.)</li> <li>• Name and spelling of the product or products involved, and estimate of the quantity involved</li> </ul> <p>The person in charge of the dangerous goods at the time of an accident should also <b>immediately notify</b>:</p> <ul style="list-style-type: none"> <li>• The local police</li> <li>• Their employer</li> <li>• The owner, lessee or charterer of the vehicle</li> <li>• The shipper or owner of the dangerous goods</li> </ul>
900 ICE ROADS	
901 SIGNING	
902 WINTER ROADS AND THE ENVIRONMENT	
903 WINTER ROAD SAFETY	
904 MANAGEMENT OF WINTER ROADS	

## 903 WINTER ROAD SAFETY

### 903-01 TRAINING

**PURPOSE** All winter maintenance personnel working on ice roads should have a minimum level of training to minimize the risk of accidents occurring and ensure appropriate training is in place to effectively handle accidents that do occur.

**TRAINING STANDARDS** Anyone working on ice roads should have successfully completed the following training courses and maintain associated certification:

- First Aid and CPR (St. John's Ambulance or Red Cross)
- Ice Rescue – courses are available that meet the National Fire Protection Association standards for emergency response ice rescue training
- Winter Survival for Remote Locations
- Equipment Certification - appropriate for equipment being operated
- Transportation of Dangerous Goods - if required
- Workplace Hazardous Material Identification System (WHMIS) – if required
- Occupational Health Committee (OHC) Level 1 and 2 – if OHC member

### 903-02 PERSONAL PROTECTIVE EQUIPMENT

**PURPOSE** All winter maintenance personnel working on ice roads should wear a minimum level of personal protective equipment (PPE) to minimize the risk of accidents and injury occurring

**PPE STANDARDS** Anyone working on ice roads should be meeting the following PPE guidelines, as well as possessing the appropriate training that corresponds to each piece of equipment. All personal safety equipment must be inspected daily.

**Floataction Clothing** **Full body floatation clothing must be worn during all construction and maintenance activities on ice roads.**

**ALL WORKERS** on the ice during construction must wear a Canadian Coast Guard (CCG) approved flotation suit (Northwest Territories has specified the Mustang Survival, Anti-Exposure Coverall and Worksuit model MS2176 and Mustang Survival Coverall model MS-185 as an acceptable flotation suit for their workers).

**Life Line** Within 500 m of shore and within known danger areas a lifeline **MUST** be used by workers who are doing the initial testing of an area or suspect that they may be near the load limits given the equipment they are using. Common

INTRODUCTION		<p>equipment used for initial testing includes snowmobile or pickup with trailer mounted auger. Know the weight of your equipment. The life line should be 15 millimeter or ½” thick nylon rope and at least 30 meters or 100 feet in length. The life line should be held by another worker rather than attached to a piece of equipment.</p> <p>The line must be inspected for damage before and after each use. During ice testing the lead worker must wear a CSA approved harness to which the lifeline is secured.</p>
900 ICE ROADS	<p><b>Hard Hats</b></p> <p><b>Footwear</b></p>	<p>Hard hats in fluorescent orange or other high visibility color should be worn to prevent head injury and provide visibility to other workers, vehicles, and equipment.</p> <p>Safety footwear which is CSA (Green Triangle) approved with a safety toe, puncture resistant soles, and boot height appropriate to the work being performed should be worn to prevent foot injury.</p>
901 SIGNING	<p><b>Eyewear</b></p> <p><b>Ear Protection</b></p>	<p>Safety eyewear and/or face protection should be worn if a person is conducting a task where there is a risk of eye injury.</p> <p>Approved hearing protection should be worn when working in environments or in the vicinity of equipment where the noise levels may exceed 80 dBA, or when one has daily exposure to noise levels greater than 85 dBA over an 8-hour period.</p> <p>Workers should consult their safety coordinators to determine which type of hearing protection should be used. There are many different types available.</p>
902 WINTER ROADS AND THE ENVIRONMENT	<p><b>Visibility</b></p> <p><b>Winter Apparel</b></p>	<p>High visibility apparel should be worn to prevent accidents when working around heavy equipment and/or vehicular traffic are operating. This type of clothing includes reflective stripping which is intended to provide a high contrast between the clothing and the ambient background against which it is seen during both daytime and night-time usage. The clothing should also, where possible, be fluorescent orange or another high visibility color.</p> <p>Winter protective apparel should be worn to protect workers from cold temperatures and wind. It is recommended that appropriate hand, head, face and foot wear be worn suitable to the weather conditions. Workers should wear outdoor clothing that is rated correctly for the weather that they are working in.</p>
903 WINTER ROAD SAFETY	<p><b>Warning Devices</b></p>	<p><b>Fire extinguishers, first aid kits, and warning devices such as flares, reflectors and flags are mandatory</b> on all vehicles used on winter road construction and maintenance.</p>
904 MANAGEMENT OF WINTER ROADS	<p><b>Emergency Kit</b></p>	<p>If operating a vehicle, obtain an emergency kit as described on the following page. Store it securely in the vehicle to protect it from damage, theft and direct sunlight. If items from the kit are used, they should be replaced or the kit exchanged for a fully serviced one at the end of the shift.</p>

An **emergency kit** should include all of the following:

CLOTHING	FOOD
<ul style="list-style-type: none"> <li>• Winter socks</li> <li>• Winter pants</li> <li>• Two piece thermal underwear</li> <li>• Parka or snowmobile suit</li> <li>• Mitts</li> <li>• Toque or warm cap</li> <li>• Extra set of clothing</li> </ul>	<ul style="list-style-type: none"> <li>• Chocolate</li> <li>• Freeze dried food</li> <li>• Nuts or granola bars</li> <li>• Salt</li> <li>• Sugar</li> <li>• Tea bags, soup, and hot chocolate</li> <li>• Raisins</li> <li>• K Rations</li> <li>• Hot pac meals</li> <li>• Water purification tablets</li> </ul>
SURVIVAL EQUIPMENT	
<ul style="list-style-type: none"> <li>• Always carry any <b>PERSONAL MEDICATION</b> with you at all times</li> <li>• Blankets and/or sleeping bag rated for the weather</li> <li>• First Aid Kit</li> <li>• Map and compass</li> <li>• Flashlight and candle</li> <li>• Zippo-type lighter and lighter fluid</li> <li>• Matches (strike anywhere, waterproof)</li> <li>• Knife with straight and serrated edge</li> <li>• Rope and wire</li> <li>• Hatchet or axe <u>and</u> saw (bow saw)</li> <li>• Newspaper for fire starting and reading</li> <li>• Watch</li> <li>• Small metal can or jug</li> <li>• Toilet paper and paper towels</li> <li>• Sunglasses</li> <li>• <b>Survival book</b></li> </ul>	

**Table 6: Emergency Kit and Survival Equipment List**

Every vehicle should also have **emergency supplies** which should include the following:

VEHICLE EMERGENCY EQUIPMENT	
<ul style="list-style-type: none"> <li>• Extra belts</li> <li>• Fuel filter</li> <li>• Booster cables</li> <li>• Ice scraper</li> <li>• Methyl hydrate</li> <li>• Anti-freeze</li> <li>• Shovel</li> </ul>	<ul style="list-style-type: none"> <li>• Canned Heat</li> <li>• Snow tires</li> <li>• Jack</li> <li>• Tools</li> <li>• Come-along</li> <li>• Tow chain or nylon rope</li> <li>• Extension cord</li> </ul>

**Table 7: Vehicle Emergency Equipment List**

Always make sure you have enough **fuel** to reach your final destination, as there are no service stops.

For **first aid minimum requirements**, please see the *Saskatchewan OH&S Act and Regulations*, page 235, Table 9: Summary of First Aid Requirements.

### 903-03 COMMUNICATIONS

Emergency communication equipment is recommended when traveling on winter roads in Saskatchewan. You may require communication equipment if you happen to come upon an accident site, or if your vehicle has a mechanical break down. Injured persons from an accident may be beyond your first aid abilities, and you may need to summon medical aid or even extraction equipment. With the CB or FM communication equipment that most truckers have, the range is usually limited to a few miles. To directly contact emergency personnel, a satellite phone or mobile radiotelephone is recommended.

For information on current telephone use in remote, isolated areas contact Sask-Tel or another service provider.



## 903-04 WORKING ALONE

### DEFINITIONS

**Working Alone** to work at a work site as the only worker, or when not in the presence of another person directly associated with the work

**Isolated** a place of employment or work site that is more than two hours travel time from a hospital or medical facility under normal travel conditions using the available means of surface transportation or for which transport by aircraft is the normal mode of transport

### STANDARD

Working or traveling alone on the winter road system increases the inherent risks. OHC Regulation 35(1-4) requires that employers and workers cooperatively develop a **Working Alone Plan** in situations where workers are required to work or travel alone. The intent of "the plan" is to identify and minimize the hazards of the work or activity being performed by a lone worker.

**It is required that, other than for surveillance, the labour force and equipment work in pairs. This will allow for immediate assistance and communication in the event of an injury, accident or ice failure.**

For further information refer to *Saskatchewan Occupational Health and Safety Regulations 1996, Section 35* or contact the Saskatchewan Occupational Health and Safety Branch at 1-800-667-5023 (Saskatoon) or 1-800-567-7233 (Regina).

INTRODUCTION	903-05 WORKER SAFETY
	<b>INTRODUCTION</b> <p>Working on ice is inherently dangerous. Failure can occur so quickly that rescue is impossible. It is therefore imperative that all workers are aware of the potential danger and take the necessary steps to protect themselves. Workers should observe all Occupational Health and Safety Regulations as well as other standards, procedures and practices relating to their work.</p>
900 ICE ROADS	<b>WORK CONDITION GUIDELINES</b>  <b>Ice Conditions</b> Seek approval from the work crew supervisor before going on any winter road or ice road.  <p>The ice must be a minimum of 15 centimeters thick before a snowmobile or 20 centimeters thick before a car or light truck may travel on the ice.</p>
901 SIGNING	<b>Weather Conditions</b> Evaluate weather and ice conditions, prior to venturing onto the winter road and follow OHC Guidelines for Working in a Cold Environment.  <p>Cancel or postpone travel on a winter road if the weather is unsuitable or if deterioration in the ice is apparent.</p>
	<b>PROCEDURES</b>  <b>Buddy System</b> On winter road construction, a "buddy system" will be used. This means that a person working on winter roads will be able to contact another person by radio or telephone on an open channel at all times. Wherever possible, workers should not be alone.
902 WINTER ROADS AND THE ENVIRONMENT	<b>Working Alone</b> If machine operators are working alone, they will radio the work crew supervisor at the beginning of each shift and give their location and direction of travel. During the shift, they are required to call in as directed by the Work Supervisor.
	<b>Report Conditions</b> Observe and report hazardous conditions.
903 WINTER ROAD SAFETY	<b>Vehicles and Equipment</b> Supervisors and/or Equipment operators will decide whether the doors and/or hatches on equipment working on ice will be removed or lashed open during the construction phase. Wherever practical, canopies will be removed and panic bars or hatches will be installed on equipment doors so that operators can quickly exit in case of breakthrough. At the first sign of break-through the operator is to abandon the vehicle immediately.
904 MANAGEMENT OF WINTER ROADS	<p>Use of seat belts is optional when traveling on ice during the construction phase.</p> <p>Tools, equipment and materials must be stowed neatly in the vehicle.</p> <p>Visibility from the vehicle should be unobstructed (i.e. clean windshield).</p>

<p>No equipment will be used on winter roads if it is not in proper running order.</p> <p>Vehicles operating close to the load bearing capacity of the ice during construction must not exceed 15 kilometers per hour.</p>	INTRODUCTION
<p>Each piece of equipment will be weighed and the minimum ice thickness necessary to support it will be calculated according to the formula presented on the Ice Load Bearing Capacity Chart. In those communities without permanent weigh scales, equipment will be weighed with portable scales.</p> <p>Operators will be responsible for the care of their equipment and for reporting any equipment problem to their work crew supervisor. The work crew supervisor will arrange for repairs.</p>	900 ICE ROADS
<p>An operational check of all equipment will be done and proper training for all personnel carried out.</p>	901 SIGNING
<p><b>903-06 PUBLIC SAFETY</b></p> <p><b>INTRODUCTION</b></p>	
<p>All Ministry contractor employees, in addition to their regular duties, are responsible for monitoring road conditions. If an employee sees a situation which is a danger to the public, they have the authority and responsibility to take immediate action to protect the traveling public. For example, if wet cracks and overflow conditions are observed at a stream crossing, an employee has the authority to temporarily close the road.</p> <p>Winter roads are somewhat unique in that even minor accidents or delays have the potential to create a life threatening situation. Anything therefore that interferes with the steady flow of traffic is a public safety concern.</p>	902 WINTER ROADS AND THE ENVIRONMENT
<p><b>PROCEDURES</b></p> <p><b>Winter Road Inspections</b></p> <p>While all personnel have a responsibility to identify potential hazards, this is a major part of the activities of both foremen and superintendents. Regular road patrols are carried out during both the construction and maintenance phases of the winter road season. Once identified, problems must either be corrected or isolated from the traffic. The traveling public must also be promptly advised of changes to road conditions which might affect their ability to complete a trip.</p>	903 WINTER ROAD SAFETY
<p>When conducting road inspections:</p> <ul style="list-style-type: none"> <li>Look for snow drifting, overflow, wet or dry cracks and icing. If a hazard is discovered, place warning devices such as flags, delineators, or flares. If possible, remedial action should begin at once. Warning signs must be set if the repair will take some time to complete.</li> </ul>	904 MANAGEMENT OF WINTER ROADS

INTRODUCTION	<ul style="list-style-type: none"> <li>• Check for missing or damaged traffic signs and make immediate repairs or replacements.</li> <li>• Check for and remove debris or dead animals from the roadway.</li> <li>• Report the unauthorized erection of signs or the construction of accesses to the Ministry of Highways and Infrastructure Area Manager.</li> </ul>
900 ICE ROADS	<ul style="list-style-type: none"> <li>• Report abandoned vehicles to the RCMP or the Highway Transport Compliance Officer.</li> <li>• Check and report spills of dangerous goods.</li> </ul> <p>Inspections should be done a minimum of once a week on snow roads, twice a week on ice roads and daily on ice bridges.</p>
901 SIGNING	<p><b>Hazard Repair</b></p> <p>Hazards created by drifting snow can be reduced by blading out snow guards approximately 30 meters 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. When constructing the road, a narrow lane may be initially compacted to allow the movement of equipment to locations within the limits of the project. Wherever possible, however, the full width of the road should be cleared in order to reduce the possibility of thermal cracks and the development of pressure ridges.</p>
902 WINTER ROADS AND THE ENVIRONMENT	<p><b>Highway Transport Compliance Patrols</b></p> <p>Highway Transport Compliance Officers are responsible for ensuring that commercial vehicles comply with the Motor Vehicles Act and its regulations. Inspections of transport trucks are especially important when the load limits on the ice roads are not yet up to those set for the all-weather highway system. A truck that is legally loaded for the primary highway system may exceed the load limit for an ice road or crossing and cause an ice failure.</p>
903 WINTER ROAD SAFETY	<p>If construction/maintenance personnel believe that trucks are operating in excess of an ice crossing load limit, they should notify Ministry of Highways personnel of the need for spot inspections. The Officer assigned to enforcement duty on a winter road will be equipped with portable scales to weigh the truck traffic.</p>
904 MANAGEMENT OF WINTER ROADS	<p><b>Highway Hotline</b></p> <p>The Ministry provides information on current road conditions on the website, on local radio stations, messages on a toll free telephone line (Hotline) and communication with major transportation companies. Any changes in road conditions must be promptly communicated to the Ministry to ensure that information provided to the public is up to date and accurate.</p>

## INTRODUCTION

In spite of taking all reasonable safety precautions, accidents will continue to occur. Whether such accidents involve the public, government employees or private contractors, it is likely that those involved with highway construction and maintenance will be among the first on site and will be required to respond.

Similarly, regardless of who is involved in the accident or its severity, it is important to report it to the correct individuals so that follow-up action can be taken and so that information and statistics are available to those with responsibility for establishing design/construction standards and operational guidelines. It is through this process that ongoing problems are identified and corrected.

## PROCEDURES

### Accident Scene Assessment

In the event of an accident the first priority is to secure the site to ensure that no one, including you, is in danger from further accidents. For example, in the case of an ice failure, warning signs, flares or barriers must be used to warn others away from the hole. In an area where visibility is poor and traffic is likely, warnings must again be provided to ensure that those working at the accident scene are not endangered by approaching vehicles.

In the case of an ice failure, approach with extreme caution. **No attempt at rescue must be made if it puts the rescuer at risk.**

### Think before you act.

Determine if anyone is in immediate danger. A rescue effort may be required if a person is trapped in a vehicle and the vehicle is in an unstable position. Similarly, an injured person may be in need of immediate medical attention. Deal with life threatening situations or injuries immediately.

### Call for Help

**At the first opportunity, call for assistance. A satellite phone will directly contact emergency staff. Provide the following information:**

- Location
- Brief description of the accident
- Description of injuries
- Assistance required such as:
  - Air evacuation
  - Ambulance
  - Road closure
  - Additional personnel or equipment
- Request that the RCMP be notified
- Request that the Ministry of Highways and Infrastructure Area Manager be notified

INTRODUCTION	<p><b>Waiting for Assistance</b></p> <p><b>After you radio for assistance:</b></p> <p>Stabilize casualties being sure to provide as much warmth and shelter as possible.</p> <p>Maintain security of the site and stability of casualties until assistance arrives.</p>
900 ICE ROADS	<p><b>Transporting</b></p> <p>Transport victims to the nearest facility where medical assistance or <b>Victims</b> transportation is available.</p> <p><b><i>Important - There is always a danger in moving an accident victim. This danger must be weighed against the danger associated with the delay in receiving professional medical treatment and the lack of adequate warmth and shelter. Whenever possible, use your radio to seek professional medical advice before making the decision to move the casualty.</i></b></p>
901 SIGNING	<p><b>Accident Report</b></p> <p><b>In the event of death, serious injury or major equipment loss:</b></p> <ul style="list-style-type: none"> <li>• Prevent the destruction or removal of evidence at the accident scene if possible. The site should remain secured until the Area Manager authorizes restoration of the site and recovery of the equipment.</li> <li>• If there are witnesses to the accident, they should be interviewed while events are still fresh in their minds. Written statements should be obtained.</li> <li>• Try to establish the cause of the accident.</li> <li>• Take photos and make a sketch complete with measurements of the accident site.</li> </ul> <p><b>Within 24 hours, provide a written accident report to the Ministry of Highways and Infrastructure Area Manager which includes:</b></p> <ul style="list-style-type: none"> <li>• Date and time of accident</li> <li>• Persons involved</li> <li>• Vehicles or equipment involved</li> <li>• Description of accident</li> <li>• Weather conditions at the time of the accident</li> <li>• Road conditions at the time of the accident</li> <li>• Action(s) taken</li> </ul>
902 WINTER ROADS AND THE ENVIRONMENT	
903 WINTER ROAD SAFETY	
904 MANAGEMENT OF WINTER ROADS	<p><b>Minor Injury Or Equipment Damage</b></p> <p><b>In the event of minor injury or equipment damage:</b></p> <p>Minor injuries to employees/contractors are to be reported to the appropriate Administrative Officer within 24 hours. The injured person and their supervisor are responsible for filing reports with the Workers' Compensation Board.</p>

**Sask  
Highway's  
Responsibility**

Minor equipment accidents are to be reported to the appropriate Administrative Officer within 24 hours.

It is the responsibility of the Area Manager to immediately report accidents involving death or serious injury of the general public to:

- Regional Executive Director
- Regional Coordinator
- Assistant Deputy Minister
- Deputy Minister
- Communications Branch
- Regional Design and Operations Engineer

Ministry procedures related to accident reporting requirements are found in *Section 2300 of the DHT Safety Manual*.

INTRODUCTION

900 ICE ROADS

901 SIGNING

902 WINTER ROADS AND  
THE ENVIRONMENT

903 WINTER ROAD  
SAFETY

904 MANAGEMENT OF  
WINTER ROADS

INTRODUCTION	<h2>903-08 SURVIVAL INFORMATION</h2> <h3>GENERAL SAFETY INFORMATION &amp; KEYS TO SURVIVAL</h3> <p>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 you will have the confidence to cope with any situation should the need arise.</p>
900 ICE ROADS	<p>Safety is of fundamental importance when using Saskatchewan's winter roads system. 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 basic information regarding safety, first aid, survival equipment and basic information on how to cope with an emergency situation.</p>
901 SIGNING	<p>You should never travel on the winter road system without survival equipment. No one ever plans on going through the ice or becoming stranded. However, if you do go through the ice or become stranded, an extra set of dry clothing and a survival kit could be the best friend you have. Always carry any <b>PERSONAL MEDICATION</b> with you.</p> <p>One of the most important factors in outdoor survival is the ability to recognize an emergency and to react appropriately. It is dangerous to have the "IT CAN'T HAPPEN TO ME" attitude. Realizing that "IT CAN HAPPEN TO ME" prepares you for survival.</p>
902 WINTER ROADS AND THE ENVIRONMENT	<p>Your ability to survive may depend more on your attitude and personality than on other factors such as the weather and terrain. You must be able to make a decision, improvise and adapt, have patience and keep calm. Confidence in your own ability is your strongest ally.</p> <p>There are other factors that will threaten your ability or will to survive. You must recognize these enemies, the effects they can have on you, and be prepared to cope with them. Above all, you must believe you can survive. The human body is a marvelous machine and can adapt to deal with almost any situation. Don't panic or feel sorry for yourself -- Be Positive!</p>
903 WINTER ROAD SAFETY	<p>Fear can affect your ability to survive. Fear is normal. Only a fool is never afraid. The energy that fear generates can make you more alert and can be turned into a positive asset. Recognize your fears and deal with them using common sense. Make a plan of action and stick to it. Emotional reactions spurred by fear can lead to disaster.</p> <p>Fear of the unknown is our most common fear, not only in a survival situation, but throughout our everyday lives. You may worry about your fate, whether or not you can make it, or if someone will find you. You can control your anxiety. Think Positive! Someone will be along to help. Until then, make yourself comfortable and wait.</p>
904 MANAGEMENT OF WINTER ROADS	<p>The fear of death may enter your mind. There's no reason to believe you cannot survive, if you have the knowledge, the ability and the resources to meet the problem head-on. Make a plan and approach it methodically in a step-by-step manner.</p> <p>Other fears may include: darkness, animals, and ridicule. Animals such as wolves will avoid you and pose little, if any, threat to you. Look at smaller animals positively, as company or as a food source if necessary. Your companions will likely admire your ability to survive, even if outwardly they joke with you a little.</p>



Pain may go unnoticed if you are busy. But once you sit down to relax or study the situation, it becomes apparent. Treat all wounds immediately but do not dwell on them. Even minor pain can weaken your will to carry on if you let it get the best of you. Keep busy making plans and carrying them out to take your mind off your pain.

Avoid overexertion and exposure. Exertion from attempting to push your vehicle, shoveling heavy drifts or performing other difficult chores during strong winds, blinding snow and bitter cold of a blizzard may cause hypothermia or a heart attack. These conditions may occur even for persons in apparently good physical condition.

**Stay in your vehicle.** Do not attempt to walk out of a blizzard. Disorientation comes quickly in blowing and drifting snow. Being lost in open country during a blizzard is almost certain death. You are more likely to be found, and more likely to be sheltered in your vehicle.

Engine failure could be caused by gas line freeze-up. Pour the gas-line anti-freeze in your fuel tank, wait 10 minutes and try your engine again.

If your engine still works, run it for short periods just to keep warm. Crack a window open to avoid carbon monoxide poisoning. Make sure your exhaust pipe is free of obstruction. Clear outside heater vents. (Clean the grill under the windshield.) Pay attention to the wind direction as the exhaust should be blown away from the vehicle if possible, not towards the open window or heater venting.

Keep fresh air in your vehicle. Freezing wet snow and wind-driven snow can completely seal the passenger compartment.

Use a candle to keep warm if your engine does not work.

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, to maintain circulation.

Do not consume alcohol. It lowers body temperature and will cause you to become drowsy.

Turn on dome lights at night, to make the vehicle visible to other vehicles.

Signal other vehicles that you are stranded by using flares, flashlights or by tying a brightly coloured cloth to the antenna or door handle.

Keep watch. Do not permit all occupants of the vehicle to sleep at once. If it becomes necessary, open your survival kit and follow instructions carefully.

INTRODUCTION
900 ICE ROADS
901 SIGNING
902 WINTER ROADS AND THE ENVIRONMENT
903 WINTER ROAD SAFETY
904 MANAGEMENT OF WINTER ROADS

## 904 MANAGEMENT OF WINTER ROADS

### 904-01 SUMMARY OF ICE ROAD PROCESSES

#### WINTER ROAD CONSTRUCTION & MAINTENANCE CHECKLIST

##### Preparation

- Through the fall and early winter:
  - Training of staff and orientation of any new staff or contractors
  - Inspect and repair all equipment to ensure that it is mechanically ready for the season
  - Install Outriggers, Floatation tanks etc. (See Section 900-05 Equipment)
  - Weigh and record all equipment that will be used on ice road construction.
  - Check all spill kits, first aid kits, survival kits, and safety supplies for repair and completeness
  - Check all winter road signs for amount and condition. Order as required.
  - Check all communications equipment
  - Monitor freezeup to identify possible trouble spots or locations that will require pre-packing, flooding or route alteration. In the north most of this can be observed from the air during routine air travel.
  - If this is a new route or one unfamiliar to you or the contractor, consult locals or previous builders to determine routes and danger areas.

##### Early Construction (See Section 900-02 Ice Testing)

- As soon as you have confirmed by careful testing on foot near shore that there is sufficient ice to support early testing, testing should be started. Use the lightest equipment available to identify possible trouble spots or sections that will require pre-packing or flooding. Mark test locations using flourescent ribbon on lath. Document the route and ice thickness in each location. Ensure that the outside limits of tested areas are clearly marked.
- Once it has been determined by careful testing that sufficient ice exists to support the clearing equipment that is available, give notifications to Supervisors and the Ministry so that they can authorize proceeding.
- Once you are ready to start clearing:
  - Ensure that Road Closed signs/barricades are in place at both ends
  - Ensure that only as much road is opened as can be completed within that shift. You should never attempt to move a windrow that has sat in place overnight. In the rare case where a windrow must be moved or crossed, retesting of ice and extreme care must be used, as a stress crack under the windrow is “normal”, creating an additional hazard for heavy equipment and operator. (See Section 900-01 Figure 4: Ice Failure)
  - If there is limited snow cover, clearing operations can start at the center and move to the outside clearing limits. Ensure that the resulting windrow is flattened out so that excess weight is not put on the ice. (See Section 900-01 Ice Strengthening)
  - If there is heavy snow cover on the ice, additional ice checking for width may have to be done so that clearing can commence past the outside limits and work toward the center. This results in a slower clearing process, but it does allow for moving smaller windrows of snow larger

distances. It also allows for more area for snow storage. Again, ensure that resulting windrow is flattened out so that excess weight is not put on the ice.	INTRODUCTION
<ul style="list-style-type: none"> <li>○ Once all clearing has been completed: <ul style="list-style-type: none"> <li>• Install all required signs and kilometer markers (See Section 901 Signing)</li> <li>• Notify Supervisor and the Ministry of the open status, the lowest ice reading and when that test was done.</li> <li>• Monitor ice thicknesses until the desired bearing strength is reached.</li> <li>• Notify the Ministry and ice thicknesses may be verified by GPR. (See Section 900-02 Ice Testing Ground Penetrating Radar)</li> <li>• Inspect road for drifting and snow buildup. Clear as required, allowing the road to narrow slightly with each clearing, to allow safe snow storage without getting too close to previous windrow.</li> <li>• Notify Supervisor and the Ministry of any change in status of the road i.e. blocked, heavy snow, cracks, pressure ridges, “bridges” installed and location, the current lowest ice reading and any other pertinent information affecting road safety.</li> <li>• Ensure that all danger areas are appropriately marked.</li> </ul> </li> </ul>	900 ICE ROADS
<b>When the road is to be closed:</b>	901 SIGNING
<ul style="list-style-type: none"> <li>○ Temporary closure: <ul style="list-style-type: none"> <li>• Erect the road closed signs and barricades at all accesses.</li> <li>• Notify Supervisor and the Ministry of the closure, reason for it and the estimated time of re-opening.</li> <li>• Monitor the road closed signs and barricades to ensure that they remain in place.</li> </ul> </li> <li>○ Closed for the season: <ul style="list-style-type: none"> <li>• Erect the road closed signs and barricades at all accesses.</li> <li>• Remove all temporary bridges</li> <li>• Remove all signs</li> <li>• Monitor the road closed signs and barricades to ensure that they remain in place.</li> </ul> </li> </ul>	902 WINTER ROADS AND THE ENVIRONMENT
<b>904-02 GENERAL CONTRACTOR DUTIES</b>	903 WINTER ROAD SAFETY
<b>The General Contractor or the Ministry of Highways and Infrastructure are typically responsible for the following:</b>	904 MANAGEMENT OF WINTER ROADS
<ul style="list-style-type: none"> <li>• Coordinating the duties of the winter road inspection staff.</li> <li>• Submitting progress payments as the contractor constructs and maintains each section of the project.</li> <li>• Monitoring contract construction and maintenance standards and ensuring that all sections of the winter roads are safe for public use.</li> <li>• Opening and closing each section on the winter road. Must evaluate ice readings to ensure there is adequate ice to support specific loads.</li> <li>• All traffic signing on the project.</li> <li>• Addressing environmental concerns and complying with any Permits.</li> </ul>	

INTRODUCTION	<ul style="list-style-type: none"> <li>Organizing a pre-construction meeting with the subcontractors or Ministry staff before any work commences.</li> <li>Providing adequate communication equipment, survival equipment, first aid equipment and vehicle equipment for all winter road inspectors on the project.</li> <li>Ensuring that all winter road inspectors are trained and knowledgeable in the use of equipment provided.</li> <li>Ensuring that all personnel working on the ice roads have proper safety training.</li> <li>The completion of operator's proficiency verification forms by road Work Supervisor.</li> <li>Preparing and submitting a detailed project safety plan.</li> <li>Ensuring all contractors and sub contractors' equipment, labourers and operators on the project are covered by a current worker's compensation policy and have adequate insurance.</li> <li>Participating in a joint Winter Roads Manual Committee to ensure that the data in the manual is correct, current, and accurately reflects our best practice.</li> </ul>
900 ICE ROADS	
901 SIGNING	<p><b>904-03 WORK SUPERVISOR DUTIES</b></p> <p><b>The Work Supervisor is typically responsible for:</b></p> <ul style="list-style-type: none"> <li>Informing the Ministry\General Contractor of the current winter road status and conditions.</li> <li>The documentation of any event that may be pertinent to the project.</li> <li>Informing the Ministry of work progress in a weekly written report.</li> <li>Testing and recording the ice thickness for Public use of all ice roads on the project.</li> <li>The evaluation of white and blue ice depths when checking ice thickness for all construction and maintenance equipment. All ice checks must be documented on the ice thickness reports.</li> <li>Ensuring that the ice conditions are safe for all equipment, labourers and operators. Ice thickness reports must be filled out and submitted when completed.</li> <li>The supervision of all flooding procedures.</li> <li>Maintaining the daily record of all contractor's\subcontractor's equipment working on the project.</li> <li>Ensuring that the same ice road route is used every year, with all ice conditions permitting.</li> <li>The initiation of corrective action if the road becomes impassable.</li> <li>Reporting any change in road conditions to the Ministry.</li> <li>Assisting with any accidents that occur on the project within your capability as required.</li> <li>Assisting with any fuel spills on the project.</li> <li>Ensure that any known incidents are responded to in a reasonable manner.</li> <li>The documentation of any important incident that occurs on the project.</li> <li>The documentation of all conversations relevant to the project.</li> <li>Dealing with subcontractors if any work is to be carried out.</li> <li>Knowing the signing and placards required for vehicles Transporting Dangerous Goods.</li> <li>Identifying and installing directional and hazard traffic control signing.</li> <li>Monitoring subcontractor's progress, ensuring that the winter road is constructed and maintained to the standards set out in the agreement.</li> <li>Knowledgeable in the use of all communication equipment, vehicle equipment,</li> </ul>
902 WINTER ROADS AND THE ENVIRONMENT	
903 WINTER ROAD SAFETY	
904 MANAGEMENT OF WINTER ROADS	

<p>first aid equipment and survival equipment provided.</p> <ul style="list-style-type: none"> <li>• Ensuring the winter road is built to the construction and maintenance standards set out in this manual or in negotiated agreements.</li> <li>• The scheduling of all work.</li> <li>• Completing weekly/daily reports.</li> </ul>	INTRODUCTION
<h2>904-04 SUBCONTRACTOR DUTIES</h2>	
<p><b>The Subcontractor is typically responsible for:</b></p>	900 ICE ROADS
<ul style="list-style-type: none"> <li>• All maintenance of equipment working on the project. Only equipment that has been shown to be safe and effective is to be used.</li> <li>• Ensuring that all employees operating equipment on ice during the construction and maintenance phases of the winter road operation are properly equipped and trained.</li> <li>• Informing all staff of work to be conducted.</li> <li>• Inspecting any problem areas on their assigned project.</li> </ul>	901 SIGNING
<ul style="list-style-type: none"> <li>• Ensuring that adequate compaction has been carried out on the land portions before heavy equipment is used.</li> <li>• Ensuring an adequate winter road communication system is available for labourers and operators working in remote areas.</li> <li>• The training of all staff so they are aware of all winter roads safety procedures. Recommended training should include TDG, WHMIS, First Aid, Survival, Rescue Procedures and Equipment, Working Alone Plan.</li> <li>• Ensuring that all equipment is supplied with adequate tools, first aid and survival kits.</li> </ul>	902 WINTER ROADS AND THE ENVIRONMENT
<ul style="list-style-type: none"> <li>• Being aware of hazardous areas on the project and notifying all staff of the consequence of traveling in these locations. This is essential, especially with new employees.</li> <li>• Providing and documenting operator training before the employees' use any type of equipment. This will provide the contractor with a record of the equipment each operator is capable of running safely.</li> <li>• Knowing the signing and placarding requirements for vehicles transporting dangerous goods. Need to make up a list of training requirements for subcontractors and employees of the sub contractors.</li> <li>• Removing abandoned vehicles from hazardous locations and the project, when required. (After consultation with RCMP or Owner).</li> <li>• Removing garbage from the project when required or as directed. Ensuring that the headquarter sites are kept in a neat appearance.</li> <li>• Ensuring that any fuel or oil spills are cleaned up immediately, whether they are caused by their own equipment or other vehicles.</li> </ul>	903 WINTER ROAD SAFETY
	904 MANAGEMENT OF WINTER ROADS