SECTION 7

Winter-Use Trails



Winter trail activities have a long history in Minnesota. The extensive winter trail systems across the state allow outdoor enthusiasts ample opportunity to pursue their interests.

Overview

Winter-use trails serve a wide array of users. Although there are some common features, each trail has unique design and grooming requirements that greatly affect the user's experience.

Winter Trail Classifications

As defined in Section 4 – Trail Classifications and General Characteristics, a number of classifications fall under winter use trails, including:

- Cross-County Ski Trail
- Snowshoeing Trail
- Winter Hiking Trail
- Dogsledding Trail
- Skijoring Trail
- Snowmobile Trail

The following considers each of these in greater detail.

Cross-Country Ski Trail

The following provides general design and grooming guidelines for cross-country ski trails. As with other types of trails, the guidelines are not intended to be a substitute for site-specific design that responds to local conditions, development requirements, and safety concerns.

Cross-Country Skiing Styles

Groomed cross-country ski trails typically accommodate two distinct skiing styles: Traditional/classic and skating style. Each of these styles has specific trail width and grooming requirements, as the following photos illustrate.

In traditional/classic style cross-country skiing the skier uses a kick and gliding motion to move forward within a set track – which in most park settings is machine set, as shown in this photo. In wilderness settings, the track is most often set by the lead skier "breaking" trail.





Skate skiers use a skating motion to move forward following a groomed trail surface without a track. Skating trails are almost always machine groomed, as shown in this photo (to the right of the set traditional track).

Trail Tread Widths and Configurations

The physical space required for the two styles of skiers provides the base-line for determining the optional width for cross-country trails. The configuration of trails also affects the width of the trail, as the following graphic illustrates.

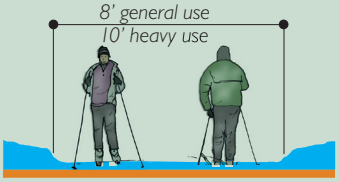
Typical Trail Widths For Cross-Country Ski Trails

Trail widths vary considerably to accommodate the two styles of skiing. The following defines the basic trail widths and directional configurations for each type of cross-country ski trail commonly found in Minnesota. (These correspond with the cross-country ski trail configurations defined in Section 4 – Trail Classifications and General Characteristics.)



Generally used in a casual park setting or trails in less frequently used county, regional, and state parks. Grooming is limited and trails are often tracked by local users. One direction is used where use levels are higher, otherwise direction of use is often informal and two way.

Traditional (Classic) Style - One Track Set/One or Two Direction



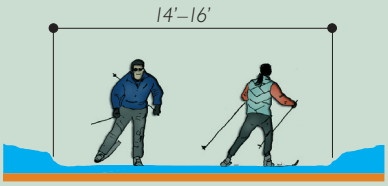
The most common type of groomed trail in many state parks and less frequently used regional or county parks. Routinely groomed, especially after a snowfall of a couple inches or more. One direction is used on busy and/or more challenging trails. Otherwise, two-way trail is most common.

Traditional (Classic) Style - Two Track Set/One or Two Directions



Occasionally used in county, regional, or state parks where use pressures are high and/or where separation of skiing styles is preferred. Also occasionally used as a connector trail from one loop to the next.

Skate Style - Single Width/One Direction



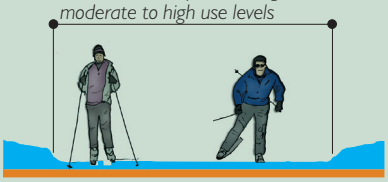
Occasionally used in county, regional, or state parks where use pressures are high and/or where separation of skiing styles is preferred.

Not as common as combination trails due to increased kilometers of trails needed to accommodate separated uses, and the additional time needed to groom the trails.

Skate Style - Double Width/One or Two Directions

(Note: 8'–10' is sometimes used with low use levels or in a more remote lodge-to-lodge setting)

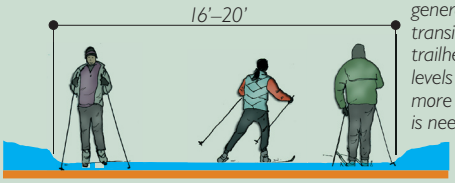
12'–14' in most park setting with moderate to high use levels



The most common trail configuration in county, regional, and state parks where both styles of skiing are accommodated. Suitable for moderate to high use levels.

One directional use helps avoid confusion and conflict and keeps overall tread width a bit narrower.

Combination Traditional and Skate Style - One Direction



This trail width is generally used in transition areas, near a trailhead, and where use levels are very high and more maneuvering space is needed for skiers.

Also used as a linear connector between loops where two-direction use must be accommodated.

Combination Traditional and Skate Style - One or Two Directions

The trail widths as shown in the graphic are general and are often modified to accommodate site-specific conditions. For example, trail widths are often increased on steep hills to allow skiers to herringbone up or snowplow down, or to provide adequate space at the bottom of a slope for run-outs. Long uphills may also require extra width to allow moving skiers to pass resting ones. Trailhead areas and trail intersections and transition zones where skiers often congregate often warrant wider trails to avoid congestion. At busier trails, consider providing a wider trail for the first 1/4 to 1/2 kilometer from the trailhead to allow skiers to spread out and let faster skiers get past slower ones. The following photos illustrate a variety of situations where widening the trail has merit.



This short but steep hill climb has been widened by grooming equipment (and use) to allow faster skiers to pass slower ones without crossing skis. Notice how the track on the right ceases to exist since traditional style skiers tend to use a herringbone stride to get up the hill. Too narrow of a trail up a hill this steep can be very annoying to skiers. This segment is about 16 feet wide.



This longer hill "grind" forces many skiers to take a break part way up. Without some extra width, a hill like this can become congested quickly as resting, traditional, and skate skiers all jockey for position to avoid losing momentum. In these cases, the groomed part of the trail should be wide enough for a skate skier to pass another skier doing a herringbone maneuver. This segment is about 16 feet wide.



This uphill section does not require much trail widening since it is gentle and short enough for either style of skier to maintain form and make it up with relative ease. This segment retains the recommended 12- to 14-foot width.



Although not excessively steep, this downhill run warrants a slightly wider run-out area on the right side since it transitions quickly into a sharp curve with trees on the outside of it. Note the loss of the track as skiers break their speed using a snowplow maneuver. It only takes one snowplower to wipe out the track, forcing all that follow to also snowplow, thereby compounding the problem.



Trails are commonly widened at intersections since it is common for skiers to stop and decide on which direction to go and/or catch their breath. These areas should be wide enough to allow through-skiers to continue on unimpeded.



On this steeper uphill section, this two-track traditional trail only widens a foot or two to accommodate herringbone or snowplowing skiers. With light levels of use, there is no reason to make the trail wider on a hill.

Make sure clearance of brush takes snow load into consideration!

Brushy material that might hang into the trail once it gets loaded with snow should also be removed when the trail is being prepared for the ski season.

Trail Clearance Zones

The clearance zone is defined as the physical space above and on either side of the trail that is free from obstructions. A 10-foot vertical clear area is recommended for all ski trails. This clear zone is especially important and may have to be enlarged when larger grooming equipment is used. The vertical clearance zone should also take into consideration the depth of the snow since the grooming equipment will sit on top of it.

The horizontal clearance zone should extend a minimum of 24 inches on either side of the groomed area to provide enough extra space for a skier's pole or ski to occasionally flail out and not catch on brush and tree limbs. It also provides more space for the grooming equipment to maneuver. The horizontal clearance zone should also increase around corners at the base of a hill where skiers are most likely to fall or go off the trail and catch a ski on brush or run into a tree. The extent to which this should occur is a matter of site-specific evaluation. The following photos illustrate common clearance zones adjacent to ski trails.



This is a common example of a comfortable clearance zone adjacent to a groomed and tracked trail. The clearance zone is especially important where trees and brush are present on downhill runs.



In grassy areas, the clearance zone is less obvious and less important since this type of vegetation is less likely to catch a pole or ski and skiers are less likely to be injured if they ski off the trail.



This two-track traditional trail through the woods is nicely groomed and has appropriate clearance zones for a pleasant experience.

Trail Grades, Curves, and Sight Distances

Cross-country ski trails should provide a variety of terrain consistent with the desired difficulty level. As a general rule, one-third of a given trail should be uphill, one-third should be downhill, and one-third should be undulating or rolling grade. The height and steepness of uphills and downhills should be consistent with the trail difficulty rating as described in Section 4 – Trail Classifications and General Characteristics and the guidelines in the following table.

Cross-Country Trail Grade Guidelines

The table provides general guidelines for trail grades relative to trail difficulty ratings associated with general use cross-country ski trails.

Aspect	Easy	Intermediate	Expert/Advanced
Avg. trail grade	4%–10%	6%–12%	> 12% (most challenging loops)
Max. hill grade	10%–12%	12%–18%	>18, with 40% max. for short distance
Avg. total climb per km	10–15 m/30–50 ft	15–25 m/50–80 ft	25–35 m/80–115 ft
Max. hill height	10–30 m/30–100 ft	30–50 m/100–165 ft	50–80 m/165–260 ft

Combining easier and more difficult trails!

Note that a trail cutoff can be used to bypass challenging hill climbs or descents. This allows an otherwise expert trail to be used as part of an easier or intermediate trail loop.

The maximum hill height and grade are important considerations in trail design in that most skiers are not experts and can become frustrated (and less likely to return) if the trails are consistently too difficult. As defined in Section 4, easy to intermediate trails should make up the core system of trails, with expert level trails being "stacked" onto these trails. For beginning skiers, an average gradient of 4 percent is preferred across a pleasant, undulating terrain. Climbs should be less than 10 meters in height at a maximum grade of 9 percent.

Even on more difficult trails, steeper and longer climbs should be broken up with short, level sections for brief resting areas. This is especially the case on easy trails, where anything above 10 percent can be too challenging to negotiate for recreational skiers. As common practice, steep uphills should be kept to a minimum on all but advanced trails since relatively few skiers have the skills and stamina to really enjoy them.

Downhills



This long downhill is made easier by having open sightlines and enough undulations to slow skiers and help them avoid excessive speeds and loss of control.

The design of downhill runs is especially important with cross-country ski trails. In general, the longer and steeper the run, the straighter and longer the run-out area needs to be at the bottom of the hill. As a general guideline, the run-out should be at least as long as the slope in order to dissipate speed and allow a skier to regain any loss of control before a sharp curve or another downhill section. If space is limited, a rise in grade at the bottom of the slope can be used to offset the loss of run-out distance. Also, the clearance zone along and at the bottom of a downhill run should be ample enough to allow a skier to fall and slide off-trail several feet without running into a tree or heavy brush. Long downhills should also be avoided on most trails since the average skier is not comfortable with excessive speed.

On two-direction trails, the trail should be wide enough to completely separate uphill and downhill skiers when trail grades exceed 8 to 10 percent. This can be accomplished by widening the trail or by providing separate trails for uphill and downhill skiers.

Curves



The gentle curve of this trail controls sightlines and piques skiers' interest about what is around the corner. Juxtaposition of longer sightlines with intimate spacing using curves is appealing to skiers.

Since most skiers are not experts and are likely to lose control from time to time, sharp curves at the bottom of a hill should simply be avoided. "Sharp" is defined as any curve radius that is tight enough where the average skier can be thrown off-balance. As a general guideline, a radius of 100 feet or more is preferred, with 50 feet being the minimum on non-hill sections of the trail. For tracked trails, average skiers should be able to stay in the groomed track as they proceed down the slope. Average skiers should not have to rely upon a snowplowing technique to proceed down a slope on a recreational-level ski trail.

If a curve is needed through a downhill section, it should be as long and gentle as possible to avoid throwing the skier off balance. Widening the trail and adding additional clearance on the outside of the curve should also be considered to provide enough space for out-of-control skiers to regain their stride, or to fall and slide a few feet outside the groomed trail. A widened trail also provides more space for advanced skiers to pass slower ones through these sections with greater ease. In situations where a curve at the end of a downhill cannot be avoided, a warning sign at the top of the slope should be provided, typically about 100 feet before the beginning of the slope.

Although curves through downhills should be carefully considered, taking all of the challenge out of a ski trail by making it too straight, uninteresting, and less challenging should also be avoided. For high-level trails, curves through a downhill can be part of the desired experience as long as reasonable precautions are taken with run-out area and clear zones. An alternative approach is to provide a bypass around a more difficult section that allows skiers to choose the level of challenge best suited to their skill level. A well-placed bypass could be a de facto run-out that allows even more advanced skiers to "bail out" if they misjudge the curve. Signage is recommended in these instances to alert skiers to the options.

Where curves are provided through or at the base of a downhill, a modest superelevation may have merit to keep skiers in the set track. Since this often allows skiers to go faster, providing an adequate run-out and clearance area on the outside of the curve remains an important safety consideration. A maximum superelevation of 4 or 5 percent is recommended.

Sight Distances

Although not as critical as some types of trails, reasonable sight distances should still be provided along a ski trail. As a general guideline, a site distance of 100 feet is optimal, especially through sharp curves or downhill sections. The recommended minimum is 50 feet to ensure that skiers can see and react to approaching trail conditions.

The following photos illustrate a variety of trail grades, curve situations, and sightlines encountered on cross-country ski trails.



This gentle curve through a long but not too steep downhill is fun and skiers can stay in control. The long run-out at the bottom provides a nice, slightly uphill transition into another downhill segment.



The approach to this short but steep hill section is long and straight, allowing a skier to build momentum for the climb.



Skiers can readily see the trail ahead as they descend along this modest downhill. The curvilinear character of this trail through the woods adds to it appeal.



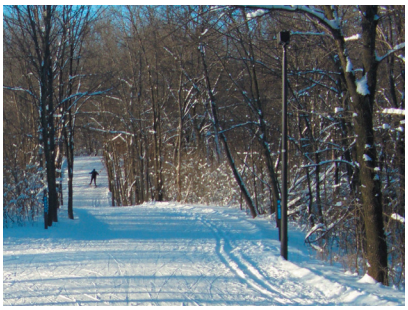
Managing sightlines can add excitement to a ski trail experience. In this photo, skiers get a hint of what is to come, yet the full scene is not exposed until they reach the corner and the view of a riverway is framed by the rock outcrops.

Tread Preparation

The tread refers to the underlying trail beneath the compacted and groomed snow. Proper off-season evaluation of trail alignments and tread surface preparation and maintenance is critical to setting the stage for quality cross-country ski trails. The following considers the most important aspects of preparing the tread for winter use.

Trail Alignment

Section 4 – Trail Classifications and General Characteristics, considered cross-country trail alignment in terms of laying out a system of trails with varying levels of difficulty. In the context of the tread surface, alignment refers to locating trails where snow will remain the longest and be most stable. One of the biggest factors in this regard is sun intensity, especially later in the season when the sun begins to build strength and more quickly melts the snow surface in exposed areas.



Hardwood forests help shield the trail from sun, which helps extend the season. The only downside is that maintaining a grass ground cover can be more challenging in the summer for the same reason – especially if the trail is also used for summer hiking. Limiting summer access or using an alternative surface, such as woodchips, are possible solutions.



Excessive pine needles dropping on the trail can be very annoying to skiers. Where this is a persistent problem, the trail corridor may have to be selectively opened up or the trail rerouted to a less problematic corridor.

Hardwood forests are usually well suited for ski trails because the sun is less intense and the air temperature is slightly colder than open areas. Using changes in topography to reduce the extent of direct sun on the trail can also be an effective strategy. This is especially the case along the base of north-facing slopes where the sun is usually less intense relative to wide-open flat areas. Avoid locating ski trails along the base of south facing slopes whenever possible since the sun tends to be the most intense in these areas, especially in open settings.

Running a trail through a coniferous forest also poses some problems with pine needles and cones dropping on to the trail and sticking to the skis, thereby slowing down the skier. Where this situation cannot be avoided, the clearance zone may have to be widened to prevent excessive needle accumulation on the trail.

In open, shortgrass prairie areas, wind can strip snow from or deposit drifting snow on the trail, both of which make for poorer skiing conditions and require more frequent grooming. Before a trail is permanently established, potential alignments in wind-swept areas should be field tested over one or two seasons to determine seasonal wind effects and snow displacement patterns. Even relatively minor shifts in the location of a ski trail can make a dramatic difference in the impact wind will have on it.

In tallgrass prairies, wind and sun are less of a concern since the grasses are high enough to shade the trail and reduce sun exposure. As with shortgrass prairies, field testing the alignment of a trail over one or two seasons can be beneficial to determining the most advantageous location to hold snow.

Tread Characteristics

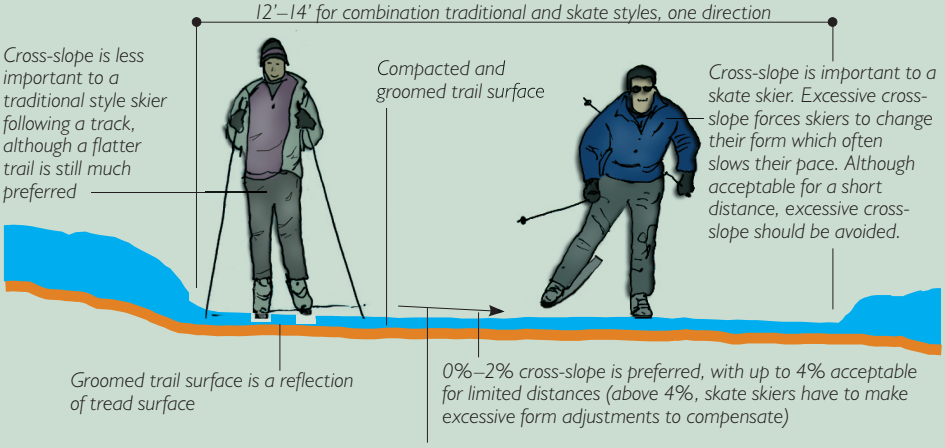
The trail tread is another major consideration in the development of quality ski trails. The cross-section, trail surface, summer uses, and erosion are all reflected in the groomed surface of the trail and factor into overall trail quality.

Trail Cross Grades

The optimal ski trail cross-section is of a consistent, even grade with a 0 to 2 percent cross-slope, as illustrated in the following graphic.

Optimal Cross-Country Ski Trail Cross-Grade Characteristics

The cross-slope of a ski trail is an important factor in creating a quality trail. Since the groomed trail surface tends to reflect what is underneath, the ground surface is worthy of due consideration as ski trails are laid out during the off-season.

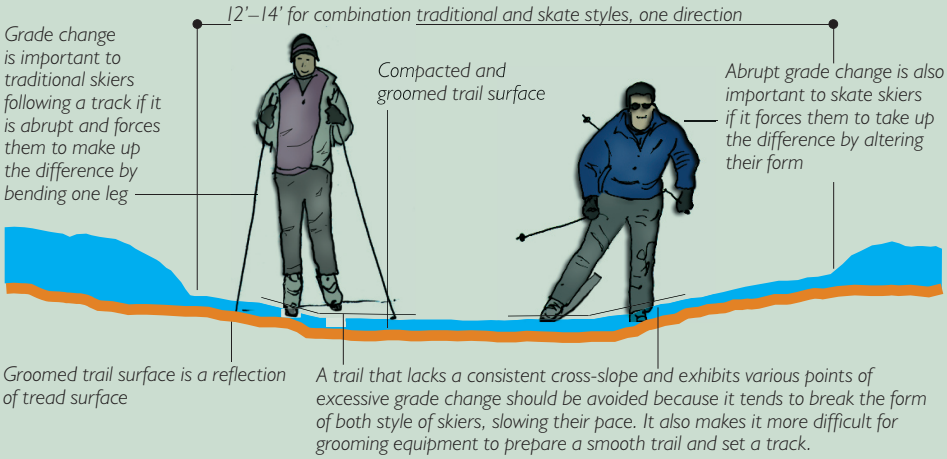


The direction of the cross-slope on a trail should be balanced along the length of the trail so skiers are not constantly leaning or changing form in one direction. If the cross-slope exceeds 2%, it should be tilted to the inside of the curve, like a superelevation on a roadway or trail. It should also be tilted away from the direction of the sun, especially in the spring.

As illustrated, an evenly sloped grade across the trail is important to both styles of skiers in order to maintain an optimal skiing form. Abrupt grade changes or general unevenness across a trail should be also avoided to make trails easier to groom and more enjoyable to ski on. The following two graphics illustrate these conditions.

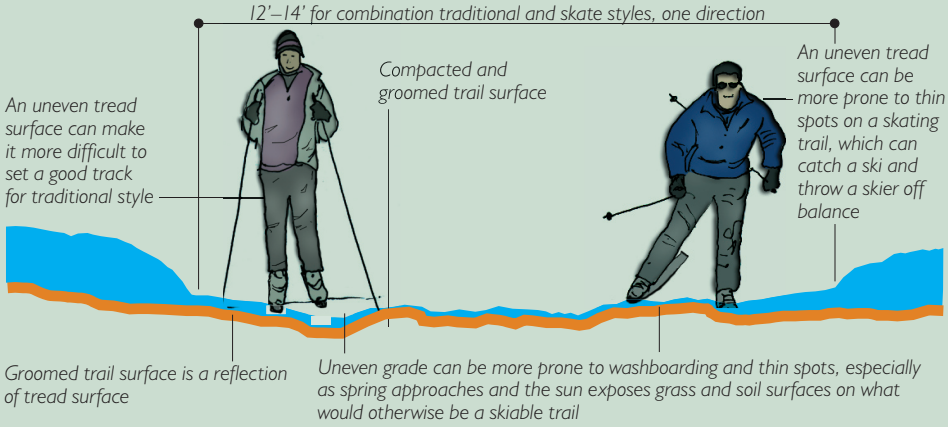
Abrupt Tread Cross Grades

Abrupt trail cross grades negatively affect the form of both styles of skiers, depending on the degree to which it occurs and the skill of the skier. While more advanced skiers can more easily compensate for grade changes in their form, novice and recreational skiers can find it frustrating.



Excessive Trail Unevenness

Excessive trail unevenness negatively affects the form of both styles of skiers. It also requires more snow to establish a base. Although good grooming technique can smooth out some of the rough spots on the tread surface, excessively uneven areas should be avoided because they can be more prone to washboarding and thin spots.



The following photos illustrate some of the previously described cross-section conditions.



The nice even trail tread with a slight cross-slope is well suited for a two-track set through the woods, making for easy grooming and fun skiing.



The cross-slope on this trail (arrow) is greater than desired but is not a major issue because it is only for a short distance. If this went on for a distance, skiers would find it annoying.



Even these simple ruts unintentionally caused by maintenance vehicles can cause an uneven surface that may be reflected in the ski trail, annoying both groomers and skiers.

A level, smooth trail with short grass cover is optimal!

This combination provides the nicest cross-country skiing and should be the standard wherever possible.

Tread Surface Conditions

The tread surface is an important trail preparation and grooming consideration. A uniform, short-mowed grass surface is preferred across the entire width of the trail for a couple of reasons: 1) grass holds snow better than bare ground or paved surfaces, and 2) grass helps prevent off-season foot traffic and erosion from creating an uneven surface.

Optimally, grass should be mowed to a length of 3 or 4 inches. For trails in nonecologically sensitive areas, a park turf grass mix is often used to create a uniform surface that will consistently hold snow. This type of trail is often mowed once a month or every other month to maintain the turf during the off-season. Regular mowing also keeps woody plant growth under control and reduces the need for brush trimming in the fall. Routine trimming of the woody material on the edge of the clearance zone is also important to maintaining the tread surface.

In natural areas where native plant species are preferred and grasses are higher and thicker, a two-step approach to mowing is often used. The first mowing is undertaken in late September after the nesting season and used to cut the grass to the desired length. The second mowing a few weeks later is used to more finely mulch the debris left from the first pass. All protruding rocks, logs, and other woody debris should also be removed from the trail shortly before the season.

Although a grass surface is much preferred, other surfaces may also be used for ski trails, albeit with certain limitations as the following considers:

- Woodchip surfaces – are not as good as grass since chips can be dislodged during grooming and skiing and stick to skies or otherwise affect skiers' stride. Once established, woodchips hold snow better than bare ground or paved surfaces and are therefore considered the next best surface after grass.
- Bare ground and aggregate surfacing – are better than asphalt and concrete, but not as good as woodchips and far behind grass. Aggregate can also pose the same problems as woodchips and scratch skies once exposed or dislodged.

Surfaces that are least desirable include asphalt and concrete, because snow does not as readily stick to them and they absorb more sun energy and lose the snow earlier. These surfaces are also harder on certain types of ski poles and skis if snow cover is thin. Limiting sun exposure is very important if paved trails are used for ski trails.

As with summer-use natural surface trails, tread drainage and erosion are important considerations for cross-country ski trails. If drainage is poor and erosion pervasive, the tread surface will be compromised and be harder to groom. The most important factor in preventing erosion is making sure the trail is covered with a stabilizing ground cover during the off-season. Ski trails that follow the fall line of a slope should also not be used for summer uses to avoid creating a single track that exposes the soils to erosion.

Wetland areas should also be avoided when aligning ski trails since these surfaces are too inconsistent and unpredictable. Potential ecological impacts are another reason to avoid wetland areas. Lakes pose numerous safety issues and surface quality uncertainties, and should be avoided whenever possible. If a lake is crossed, vigilance is required to monitor the lake surface and provide adequate signage to warn skiers of poor ice conditions and trail closures. For this reason, many park districts simply do not place ski trails on lakes.

The following photos illustrate various tread surface conditions.



This maintained trail corridor with a grass surface is well suited for a cross-country ski trail. Although used in the summer for hiking, the use levels are not high enough to cause a major problem with depressions.



Although ground cover is sparser along this trail, summer use levels are light enough and the ground hard enough to limit depressions and erosion, making for a very suitable trail surface.



Paved trails are the least desirable because they do not hold snow nearly as well as grass surfaces. They also are harder on equipment when a bare spot is encountered or the base is too thin.





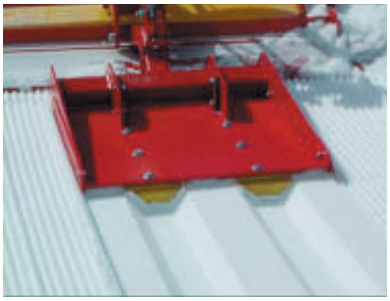
On this level trail corridor through the woods (left), shredded woodchips that bind together work reasonably well for multiseason use. However, even on a modest grade (middle), woodchips can pose problems because runoff dislodges them relatively easily and erosion occurs as if the ground were bare. The key is to align trails to avoid these situations in the first place, rather than dealing with ongoing problems during each season of use.



Trails through open prairies must be mowed a couple times prior to the ski season to create an acceptable surface. In sensitive areas, this should occur late in the season to avoid disrupting nesting birds.

Trail Grooming

Grooming is a very important aspect of creating quality cross-country ski trails. Often considered as much art as technique, good grooming is a result of both specialized equipment and skilled operators. Whereas the following conveys some of the essential elements of trail grooming, there is no substitute for operator training and the experience gained from working with skiers to perfect grooming techniques.



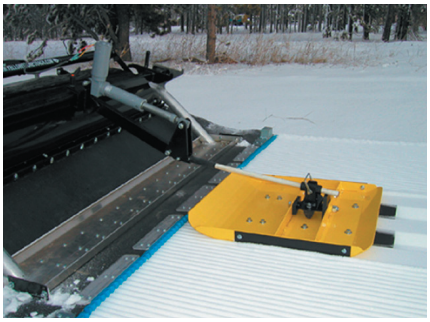
Grooming Equipment

Cross-country ski trail grooming equipment is very specialized, yet readily available. The most effective and economical system consists of a snowmobile and a tow-behind packer and track setter. This system works especially well when the snow base is limited and saving snow is critical to keeping the trails open. The most common pieces of grooming equipment are Tidd Tech and Ginzu Groomers, manufactured by different companies. The following photos illustrate each of these pieces of equipment and a few other pieces of equipment commonly used for grooming.



The Tidd Tech groomer (bottom photo) includes a flat pan with a grooved edge to create the desired trail texture for skate-style skiing. The pan can be tilted forward to till or peel up a layer of snow and grind it for repacking. The track setter (top photo) is the last grooming step and sets the track for traditional skiing. It is simply an attachment to the groomer that is lowered to set the track.





The Ginzu groomer has much in common with the Tidd Tech, with personal preference being the discerning factor on which groomer to use. A combination of weights, springs, and hydraulics are used to increase the level of compaction on the snow surface. One of the Ginzu's strengths is it ability to level out humps and cut hard pack snow.



A plastic roller is often used in warmer temperatures and for early season use to pack and settle snow by taking the air out of it.



A pan is used to compact and smooth a trail under various conditions. Weights can be added as needed to achieve the desired level of compactness.

Creating the "best line" is an important grooming consideration!

Groomers will sometimes set tracks as a separate operation from packing the trail to allow them to pick the "best line" for the skier to follow, especially through a curve.

For more specialized trail grooming, larger (and significantly more expensive) equipment is available. The most common machine is a tracked Piston Bully, which has all of the same capabilities as the previously defined equipment along with a variety of other attachments. Most notable of these is its front blade for moving snow around and a hydraulic grinder and packer for renovating hard-packed or crusted snow. This piece of equipment is best suited for grooming trails with artificial snow where the volume, depth, and texture of the snow warrant a bigger piece of equipment with greater snow moving capabilities. This type of equipment is not necessary for most applications and is only used when the snowmobile and tow-behind packer and track setter combination proves to be inadequate. The following photos illustrate this type of equipment.





The Piston Bully is an impressive piece of equipment that can be effective for certain types of conditions, especially moving around artificial snow, which is often heavier and deeper than natural snow. But for most applications, the more economical snowmobile and tow-behind packer and track setter produces excellent results under an experienced operator, especially when snow depths are limited and a larger piece of equipment is excessive.

Basic Grooming Techniques

Grooming ski trails starts with packing the first appreciable snowfall to establish a base. For skating trails, a minimum of 3 inches is typically needed to get started, assuming that the tread surface is level and covered with short grass. The flat pan on the grooming equipment is used to pack the snow, with the trailing edge corrugated to create a textured surface. With each new snowfall of 1-inch or more, the trail is again packed and textured for skate skiing. Once there is an adequate depth to the base, the traditional track can be set.

As the season progresses, trail groomers use a variety of techniques to keep the trail fresh. If there is adequate depth, teeth or spikes on the front edge of the groomer are lowered to fluff up the snow for repacking and texturing. For the avid skate skier, daily reworking the trail is especially desirable to get the right "bite" with the ski edge. Having a well-set track is also important to traditional skiers.

During seasons of limited snowfall, saving snow is one of the main challenges. This requires an intimate understanding of snow conditions and grooming when temperatures are just right to reshape the snow without losing it.

"Snowball-technique!

Some groomers will not groom if a snowball can be readily made, which usually means that there is too much moisture in the snow and grooming at that time would result in icy tracks or skating trails.

The ideal grooming time depends on the snow conditions and user expectations. Dry snow is best groomed during the day so the sun and increased temperature can help bind the snow once it is stirred up and compacted. Real fluffy and dry snow also takes some time to set up into a desirable consistency for skiing. Wet snow grooms better at night when temperatures are cooler.

User expectations can also be key factor in the ideal time for grooming. Grooming in the early morning is common to prepare trails for peak hours of use, with most skiers tending to get out between 10:00 A.M. and 3:00 P.M.

If moguls (snow bumps) appear on the trail, they should be cut out near or at their bases and the snow spread into a uniform layer and packed. Higher cuts will tend to leave the snow density uneven and moguls will simply reappear.

Hard-packed and icy trail conditions (especially with a thin base) are some of the most difficult trail conditions to groom. If the base is deep enough, a set of knives, tiller, or renovator is used to literally peel up a layer of snow and grind it up. A snowmobile with a tow-behind groomer can work up to a point, but harsh conditions sometimes require heavier equipment such as a Piston Bully to break up the surface, bring up the snow, and level it. The downside of the latter is that the heavier equipment requires a deeper base, which is usually not the case if the trail is icy and hard since the warmer weather likely melted some of it away.

Under harsh trail conditions, some groomers focus on maintaining a shorter loop to a higher standard than attempting to groom an entire system to what will inevitably be a lower standard given groomer limitations. This is especially the case where skier expectations for trail grooming are high and quality is preferred over quantity. In general, a 5 kilometer loop is typically the minimum desired loop length.

Most experienced groomers at high-use facilities also make an extra effort to prevent ice or hard-packed conditions from getting established. For example, on warm days some groomers will groom the trail smooth, including the classical tracks, just as the temperatures begin to drop below freezing. If the trail is groomed too early it becomes very hard. If groomed too late it becomes rutted.

Under wet snow conditions, some groomers will wait until the day after the snow to give it some time to set up and become better suited for grooming and less prone to becoming hard pack. To preserve at least some trails during spells of warmer weather, some trail managers will rotate the use of trail loops to prevent overcompaction and icing. The following photos illustrate grooming at under various conditions.



New snow cover waiting to be groomed. Depending on the moisture level in the snow, groomers will select equipment best suited to the conditions.



Grooming underway on this trail, with the left side packed under the first pass. Grooming technique is as much art as science, and "time on the machine" is the best training.



This perfectly set dual track is ready for skiers. Although the base in this case is quite thin, proper grooming technique maximizes the snow and allows for quality skiing.





(Left) This nicely groomed trail exhibits the optimal condition for skate skiers. The grooves provide perfect conditions for a ski edge to bite into the snow.

(Right) Even small amounts of debris, such as pine needles, can annoy the groomer and skier alike. Proper trail alignment and tread surface preparation before the season are critical to minimizing the likelihood of debris on the trail during the ski season.

Levels of Trail Grooming

In most cross-country ski trail systems, the level of grooming varies depending on the venue and user expectations. State, regional, county, and local parks each provide different venues offering contrasting experiences. Trail users seek out the venue that appeals to them on a given day, bringing with them certain expectations for the quality of the trail grooming.

Notably, most skiers do not expect all venues to have the same level of grooming. For example, skiers have different grooming expectations for back-country trails in remote areas (which usually means no grooming) than they do for two-track traditional trails in state parks or combination trails in regional parks. What is most important is maintaining a consistent level of grooming relative to the venue so that skiers know what to expect when selecting a trail.

A Tiered Cross-Country Ski Trail System

To stay within their working budgets, many park districts establish a tiered cross-country ski trail system based on the park setting, anticipated levels of use, and the skiing styles being accommodated. Typically, a limited number of "primary" venues are provided that target skiers with high expectations for trail-grooming quality. Most skate skiers and advanced traditional skiers seek out these venues because well-groomed trails are faster and more enjoyable to ski on. Grooming at these venues is often on a daily basis.

"Secondary" venues under a tiered system target the more casual or recreational skier where grooming is still important but less of a factor relative to other reasons for skiing, such as the experience of being in an outdoor setting. Grooming at these venues is often on a once-a-week or as-needed basis after a significant snowfall.

Trail Grooming Reports

Trail grooming reports are an important aspect of managing user expectations and keeping skiers coming back. At primary facilities, *daily* reporting through official websites, voice recordings, and notice boards is recommended. Secondary facilities require weekly updates at a minimum, preferably on a Thursday or Friday for those that might want to travel for a weekend of skiing.

Venues that do a poor job of reporting are often less frequently used even if the grooming is known to be good. Given the irregularity of snow conditions, skiers are much more likely to go where ski conditions are routinely and accurately reported and they have a sense of what to expect. The accuracy of trail conditions is also important to skiers. To improve accuracy, some venues enlist skiers to report on trail conditions, rather than rely on nonskier attendants to describe the conditions.

Lighted Cross-Country Ski Trails

With the short winter days in Minnesota, the idea of lighting ski trails has been around for many decades. Starting with candle or lantern trails (which continue to be used), trail lighting has progressed to more sophisticated electrical systems now found in larger regional and state parks. Although formal engineering is required, the basics of these lighting systems are fairly straightforward, as the following describes.

Lighted Trail Loop Length

A lighted ski trail must be long enough to attract enough skiers to the venue to justify the investment. As a general guideline, established ski venues have found a 5-kilometer loop to be reasonable for a lighted cross-country ski trail. This provides adequate length to incorporate a variety of terrain and challenge into the trail to be of interest to the skier, while still being economical enough to afford. Anything less than 5 kilometers is probably too short and skiers will lose interest if they have to make too many loops to get in a good workout.

Although a trail that is too short may not attract enough skiers, the costs and benefits of lighted trails longer than 5 kilometers should also be carefully scrutinized to avoid over-investment. Any lighting beyond 5 kilometers is recommended only when there is adequate evidence that skier satisfaction and use levels would go up enough to justify the additional costs for development and maintenance.

Technical Requirements for Lighted Trails

Lighting systems for ski trails either use pole-mounted fixtures or lighted bollards that provide enough light for skiers to see the trail without unduly detracting from the experience of skiing at night. For pole-mounted systems, light standards are commonly spaced about every 100 feet or so, with additional lighting strategically placed adjacent to challenging areas. For example, increasing the level of lighting along a steeper downhill section or on the inside of tight curve at the base of a downhill is common practice. For lighted bollards, light spacing averages about every 80 feet. The spacing around sharp corners and along downhills is reduced to around 40 feet. Light spacing in prairie areas can be expanded to 200 feet.

Since there are no established standards for ski trail lighting per se, it is recommended that new systems be based on the existing systems to take advantage of actual field experience. Providing one-half foot candle of light along the trail is a common starting point for designing a system, although actual field conditions should dictate lighting levels needed to ensure skier safety. Fixtures should be shrouded to limit light spill into the ski and away from the trail. (Light pollution is an increasing important issue to park users.)

One of the major cost and technical considerations associated with lighting trails is the efficient use of transformers, power sources, and wiring. These are major considerations in determining which trail should be lit and the overall kilometers of lighted trails than can be afforded. Also, buried wire is preferred over above-ground lines for aesthetics and maintenance purposes. This is especially important in a natural park setting where above-ground wires would detract from the setting and also be subject to being taken out by falling trees and limbs.

The following photos illustrate a variety of trail lighting options found in parks across Minnesota.



The common pole-mounted high-pressure sodium fixture faces down the trail in the direction of travel to avoid putting light in the face of the skier and night ski. With buried wire, a natural-colored pole, and a small fixture, the light serves it purpose with minimal visual intrusion.



A down-facing box light is also occasionally used on ski trails, although the lighting is more apparent. This type of fixture is more commonly used at trailheads, where a larger pool of light is desired.



This bollard-mounted light is made of PVC and inserts into a ground socket. It is removed during the off-season.

Snow Making for Cross-Country Ski Trails

Although in its relative infancy and still uncommon, snow making for cross-country ski trails is being tested at a limited number of high-use venues where there is adequate demand to justify the investment in utilities, equipment, and maintenance. Typically, snow making occurs on lighted trails to maximize the hours of use during the course of a week, especially weekday evenings.

Although no standard has been established, a 5-kilometer loop coinciding with a lighted trail is probably the practical limit for snow making. Some venues have found that 2.5 kilometer is the minimum needed to make it worthwhile. Anything less will not likely attract enough skiers to justify the investment even when no other venues are open due to lack of snow.

The utilities needed to support snow making are extensive and consist of underground electrical and water supplies that connect to portable snow-making equipment. Water service and electrical pedestals are spaced approximately 300 feet apart, which makes it reasonably convenient to hook up the hoses and cords to the portable snow-making machines. The water supply system must self-drain to avoid freeze-up.

Artificial snow is often heavier than natural snow and snow-making machines are not overly accurate or uniform in laying it down on the trail. Moving snow-making equipment around and grooming the trail under these conditions requires heavier pieces of equipment with more attachments, such as the Piston Bully. This issue alone can be a significant consideration in the cost-benefit analysis for making snow for cross-country ski trails.

The following photos illustrate some of the infrastructure and specialized equipment needed to make snow for ski trails.



Snow-making equipment is typically portable and is moved along the trail from station to station. Wind and air temperature can greatly affect the quality and placement of the snow as it is created.



Water service and electrical pedestals are spaced along the trail at roughly 300-foot intervals. This makes the length of hose and electrical cord from the machines less cumbersome. Water is supplied from a pond or high-capacity well.



The end result of snow making can be well-groomed trails that extend the skiing season in years in which natural snow is limited.

Shared and Summer Uses of Cross-Country Ski Trails

During the winter season, most cross-country ski trails are designated for skiing only to prevent nonskiers from displacing the groomed trail and set track. At popular, higher level venues, skiers are very intolerant about others being on the trail. In more remote or less frequented parks, snowshoeing is sometimes allowed on dual track trails as long as the snowshoer stays out of the traditional tracks. As a general practice, separating uses is recommended in most situations.

Always be aware of the potential for erosion!

Although ski trails sometimes follow the fall line to add interest, this should only be done when there is relative assurance that erosion will not be an issue. This requires careful consideration of soil conditions and how likelihood of maintaining an adequate ground cover to prevent erosion from occurring.

The compatibility of cross-country ski trails and summer natural surface trails following the same corridor should not be assumed. From an alignment standpoint, ski trails sometimes follow the fall line of a slope for challenge and excitement. In the winter, erosion on this type of trail is not an issue. In contrast, erosion is a serious consideration with summer-use natural surface trails and following the fall line is typically avoided. Also, hikers following a trail often prefer a more gradual and interesting route around a landform, rather than scurrying directly up a fall-line.

With respect to the trail tread, the bare ground and depressions associated with single- or dual-track summer use trails often make grooming more of a challenge in the winter. Summer users often find that the mowed width of the ski trail takes away some of the intimacy of the natural setting they are seeking.

For these reasons, using a common tread for summer hiking and winter cross-country ski trails has its limitations and requires careful consideration to avoid compromising both users. Some park districts simply keep the two separate, closing off the winter ski trails during the summer. Others take a modified, or hybrid, approach, whereby some sections of trail are common and others are not. In all cases, forcing incompatible uses onto the same tread should be avoided since it diminishes the value of each trail use. This is especially the case with OHV trails, where inevitable rutting and loss of vegetative cover caused by summer use greater impacts the grooming operation and the quality of the ski trail. These uses are generally considered incompatible.

An example of a hybrid approach is using an undulating trail through a prairie for hiking in the summer and skiing in the winter, assuming that grades are suitable for both uses and a grass tread can be reasonably maintained. When the trails traverse terrain where they are not compatible, they separate and each follows a suitable alignment. Given the smaller footprint than two entirely separate trails, the hybrid approach has particular application in settings where space is limited or where minimizing ecological impacts is a major consideration.

The following photos illustrate some of the issues associated with shared and summer uses of cross-country ski trails.



Use of cross-country ski trail corridors for motorized summer activities is generally to be avoided. The heavy machines simply compact the trail too much and cause dual tracks that make trails very hard to groom in the winter.



This wide corridor suits skiers well, but in the summer its width can make the trail less intimate and interesting to a summer hiker.



This steeper fall-line ski trail might be stable in the winter, but it could be susceptible to erosion in the summer if bare ground is exposed through use.

Trailhead Facilities

There are no set standards for trailheads for cross-country ski venues, with each facility providing the level of service consistent with local expectations. In larger park settings at the county, regional, or state level, it is common for the main trailhead to be located adjacent to a visitor center or contact station. Equipment rental, ski passes, restrooms, warming area, and vending are provided to varying degrees in these situations. At the local level, it is much more common for a trailhead to consist of a parking area, self-registration station, and portable restroom. The following photos illustrate the varying approaches to trailheads, each of which meet the needs and expectations of local skiers.



Larger regional and state parks often combine the ski trail trailhead with a visitor center to gain needed efficiencies and control costs while providing a needed service. These facilities often rent equipment and provide restrooms and concessions.



At smaller venues, trailhead facilities are fairly basic and meet the need.



Providing ski trail information is one of the most important trailhead functions. This kiosk covers all of the information needed by a skier at a state park.

Trail Signage

The signage for cross-country ski trails should be generally consistent with the types and placement of signs for natural trails as defined in *Section 6 – Sustainable Natural Trails*. DNR's *Sign Manual* should also be referenced for ski trail signage and should be referred to for in-depth information. The manual includes requirements and recommendations for regulatory, warning, trailhead, orientation, and directional signs and route guides. With cross-country ski trails, orientation (mapping) and trail distance, and difficulty level and warning signs are the most important signs.

Trail orientation signs should be placed at all trailheads and trail intersections. These should include a map illustrating the layout, distance, and difficulty level of each trail loop. Along the trail, distance markers, difficulty level, and hazard warning signs should be placed as needed to keep the skier informed. The following photos illustrate common approaches to signing cross-country ski trails.



Traihead signs can be very simple and give skiers only the information necessary for them to select the type of trail and distance they want to ski.



Signage along the trail should clearly illustrate which uses are allowed and not allowed on a given trail. This is especially important with cross-country ski trails, where skiers are very intolerant of nonskiers' impact on groomed trails.



Safety signage is very important and should be provided wherever necessary to highlight a hazard.



Route maps with clearly understandable "you are here" information is very important to skiers. Signage should also clearly illustrate the level of difficulty and length of trails to allow skiers to make informed decisions.





Clearly marking the trail name and level of difficulty is an important signage issue and should not be overlooked, since most skiers are not experts and do not want to get onto trails that are above their level of ability.

Snowshoeing, Winter Hiking, Dogsledding, and Skijoring Trails

The following provides general design and grooming guidelines for a variety of nonmotorized winter trail activities. Although each of these activities has grown in popularity over the years, the relative demand for specialized trails remains less than for cross-country skiing and snowmobiling.

The design and grooming standards for snowshoeing, winter hiking, dogsledding, and skijoring trails are generally consistent with those defined for cross-country ski trails. For each of these uses, trail grades should be consistent with "easy" or "intermediate" cross-country ski trail difficulty levels. This is especially the case with skijoring and dogsledding trails, where the dogs can gain considerable speed on a steep downhill when the person behind is trying to maintain control or slow down.

Work closely with user groups!

For emerging users such as these, the best approach is to work closely with organized groups to ensure that their trail needs are understood and met.

Trail widths are commonly based on the level of use that is anticipated and users' input. A 6 to 8 foot wide groomed tread is typically sufficient to accommodate one- or two-way snowshoeing and winter hiking. One-way skijoring and dog-sledding groomed trails are 8 to 10 feet wide since the pace is much quicker and the dogs are not always under perfect control. For dogsledding events, trail widths can match those of wider ski or snowmobile trails, reaching 16 feet in some cases.

Snowshoeing

Snowshoers either follow groomed trails or go cross country, depending on the setting and the type of snowshoes they use. Groomed trails are packed similar to those for cross-country skate skiing, albeit there is less of a demand for daily grooming since snowshoes easily accommodate loose or uncompacted snow on the trail. Grooming trails once a week or after a significant snow fall is common. Typically, several loops totaling 3 to 5 miles is adequate to accommodate this use. Most often, existing summer-use natural surface trail corridors are used since snowshoers can tolerate some unevenness.

For ungroomed snowshoeing, park districts either designate a route or allow snowshoers to go cross-country in a defined area. With the former, following existing summer trail corridors is common practice. Another approach gaining in popularity is to mark a varying route using simple tree markers and trail blazes that can be readily relocated each season or several times during the season. This approach provides variety while still controlling the activity and making sure people do not get lost. For cross-country travel, maps are typically provided highlighting the areas open to snowshoeing.

Winter Hiking

Winter hiking is either on a groomed trail similar to a cross-country ski or snowshoeing trail or following a plowed paved trail. Typically, a single or several loops totaling 3 to 5 miles is adequate to accommodate this use. It is also common in lower-use areas to allow snowshoers and hikers on the same trail.

Dogsledding and Skijoring

Specialized trails for dogsledding and skijoring are only infrequently provided in parks in Minnesota due to the limited demand. Often, formal trails are established only for special events. Where these trails are provided on a seasonal basis, grooming standards are consistent with those for cross-country ski trails for skate skiing or snowmobile trails, although some skijorers will use set tracks if available. Skijoring distances are consistent with those for cross-country skiing, although the pace can be much quicker with a fast dog. Dogsledding trails can be anywhere from 4 to 15 miles for sprint racing, even longer for mid-distance racing.

Time Slotting

In some areas there is adequate demand to make provisions for accommodating dogsledding or skijoring on a more routine basis. In these instances, time slotting is a common approach, whereby a given time slot on a cross-country ski or snowmobile trail is set aside for dogsledding or skijoring, or both. This approach seems to have gained some popularity because it allows parks to accommodate these activities without creating specialized trails or substantially increasing grooming costs.

Snowmobile Trails

The following guidelines provide general design and grooming parameters for snowmobile trails. As with other types of trails, the guidelines are not intended to be a substitute for site-specific design that responds to local conditions, development requirements, and safety concerns.

Trail Tread Widths and Configurations

The physical space required for the one- and two-way trails provides the base-line for determining the optional width for snowmobile trails, as the following graphic illustrates.

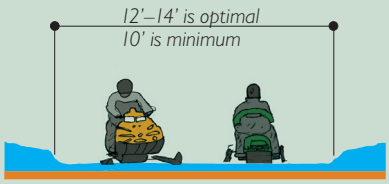
Typical Trail Widths For Snowmobile Trails

The following defines the basic trail widths and directional configurations for snowmobile trails. (These correspond with the snowmobile trail configurations defined in Section 4 – Trail Classifications and General Characteristics.)



One-way trails are occasionally used in a snowmobile trail system where a moderate length loop is provided or the corridor is particularly narrow.

One-Way Snowmobile Trail



Two-way trails are often the most practical and thus common type of snowmobile trail. These are well suited for longer, integrated trail systems with moderate to high use levels.

Two-Way Snowmobile Trail

The trail widths shown in the graphic are general and are often modified to accommodate site-specific conditions. A 12- to 14-foot wide snowmobile trail is considered optimal to allow for ease of passing oncoming traffic. Going any wider is not always desirable since it requires more grooming and takes away from the setting and experience of being close to nature.

Trails wider than the optimal width are typically only provided where traffic is especially heavy, such as near a trailhead or between popular destinations. The need for a wider trail in these situations is field determined by the local trail sponsors. At busy trailheads and trail intersections, the first 200 to 300 feet of trail is sometimes a couple of feet wider to allow snowmobilers to wait along one side for their riding group to assemble and still allow for two-way traffic on the trail. The following photos illustrate common trail widths for snowmobile trails.





These classic two-way snowmobile trails are groomed to between 12 and 14 feet wide. The trail on the left runs through a northern forest where sightlines are more limited, which helps keep riding speeds lower. In the middle photo, the long abandoned rail-grade trail is very flat with long sightlines. Here, too, 12 to 14 feet is adequate to accommodate two-way traffic.



Near trailheads, the trail is sometimes groomed a few feet wider to accommodate riders grouping up alongside the trail.

Trail Clearance Zones

The clearance zone is defined as the physical space above and on either side of the trail that is free from obstructions. A 12-foot minimum vertical clear area above the snow surface is recommended for all snowmobiles trails, with 14 feet being required when larger grooming equipment is used.

The horizontal clearance zone should extend a minimum of 24 inches on either side of the groomed area. The horizontal clearance zone should increase at trail or roadway crossings to at least double the width of the trail and standard clearance zone – 32 to 36 feet for a two-way snowmobile trail. The clearance width should also be enlarged near a hazard, such as a bridge or culvert. The extent to which it is enlarged should be determined in the field based on site-specific conditions, taking into consideration sightlines and anticipated speeds. The following photos illustrate common clearance zones adjacent to snowmobile trails.



This is a common example of a comfortable clearance zone adjacent to a groomed and tracked trail. The clearance zone is especially important where trees and brush are present on downhills. Note that by limiting the clearance zone, trail "creep" can be controlled, as can cross-country travel.



The clearance zone should take into consideration the terrain and sightlines. Even with rolling terrain, a couple of feet of clearance on either side of the trail is usually enough for a safe experience. However, the clearance zone should be widened whenever a rider's view is obstructed at normal riding speeds for the trail.



It is common and recommended that the clearance zone be widened at bridge approaches, hazards, and roadway crossings to give riders ample opportunity to react to trail conditions.

Trail Grades, Curves, and Sight Distances

Snowmobile trails should provide a variety of terrain consistent with the setting. An important distinguishing aspect of snowmobile trails is that they should cross contours at right angles to prevent the snowmobile from rolling over or sliding sideways and tearing up the trail.

As a general guideline, snowmobile trails should incorporate a variety of hills and undulating terrain to add interest. On hilly sections, grades between 10 and 25 percent are acceptable, although 10 percent or less is preferred for safety reasons and sightlines. (The grade percentage of a slope can be measured with a clinometer or calculated using the following formula: percent of grade = rise/run x 100.)

Steeper grades require adequate approaches and run-outs at least as long as the slope itself to give riders ample space to control their machines prior to entering a curve. It is important to maintain vegetation on trails traversing steeper slopes to prevent off-season erosion, which could cause a rough trail and hence grooming and snowmobile handling problems.

On grades of 8 percent or greater, consider separating the trail into uphill and downhill sections to avoid conflicts.



Longer, flowing curves with adequate sightlines are preferred for snowmobile trails. Sightlines should be long enough for the rider to react to oncoming conditions but not so long as to entice excessive speeds.

Curves

Curves should be as gentle as possible and well signed. Longer curves enhance rider safety and also make trail maintenance easier since snow is not as easily pushed to the edge as can be the case with a sharper turn. As a general guideline, a 100-foot or longer radius is recommended, with 50 feet being the minimum if adequate run-out space and sightlines are provided. Typically, a minimum of 15 feet of clearance zone on the outside of sharp curves is needed to allow riders to regain control if they enter the turn too fast. Warning signs should be provided up to 300 feet ahead of any sharp turn, especially those that require a change in speed.

Sight Distances

Sight distances are important on snowmobile trails, with final determinations dependent on the character of the trail and anticipated speeds. As a base-line, sightlines should generally be at least 100 feet and increase from there depending on site conditions and expected travel speeds. At 50 mph, a sightline of 300 feet or more is necessary, especially if a trail is icy. Where sightlines are compromised, warning signs should be provided at least 100 feet and up to 300 feet prior to a hazard. Hazards include roadway crossings, trail intersections, steep drop-offs, and sharp curves.

The following photos illustrate a variety of trail grades, curve situations, and sightlines encountered on snowmobile trails.



The wide-open sightlines of this trail encourage riders to go faster. The lack of a clearly defined corridor also temps riders to wander off trail onto adjoining private property, which can lead to trail restrictions. Where the corridor is not obvious, blazes along the trail are recommended to keep riders on the approved trail tread – and remind them of the consequences of not staying on the trail.



Approaching hills at a right angle is important with snowmobile trails to prevent rollovers. On steep slopes on two-way trails, separating the uphill and downhill sections is sometimes used to increase safety and reduce the potential for conflict. With the open sightlines and modest grade of this hill, two-way traffic on a single 12- to 14-foot tread works well.



Provide adequate visual cues of an approaching tight curve to enhance trail safety. From this direction, the gate and other signs at the trailhead alert the rider of the approaching curve. From the other direction, a warning sign is provided about 100 feet prior to the curve to alert riders to slow down and approach with caution.

Tread Preparation

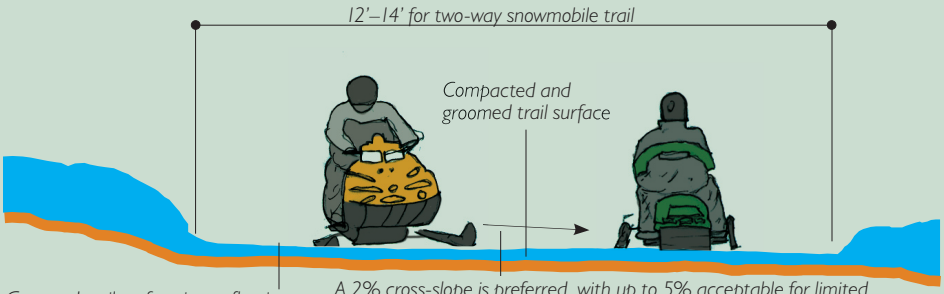
The tread refers to the underlying trail beneath the compacted and groomed snow. Proper off-season evaluation of trail alignments and tread surface preparation and maintenance is critical to setting the stage for quality snowmobile trails. The following considers the most important aspects of preparing the tread for winter use.

Trail Cross Grades

The optimal snowmobile trail cross-section is of a consistent, even grade with a 2 percent cross-slope, as illustrated in the following graphic.

Optimal Snowmobile Trail Cross-Section Characteristics

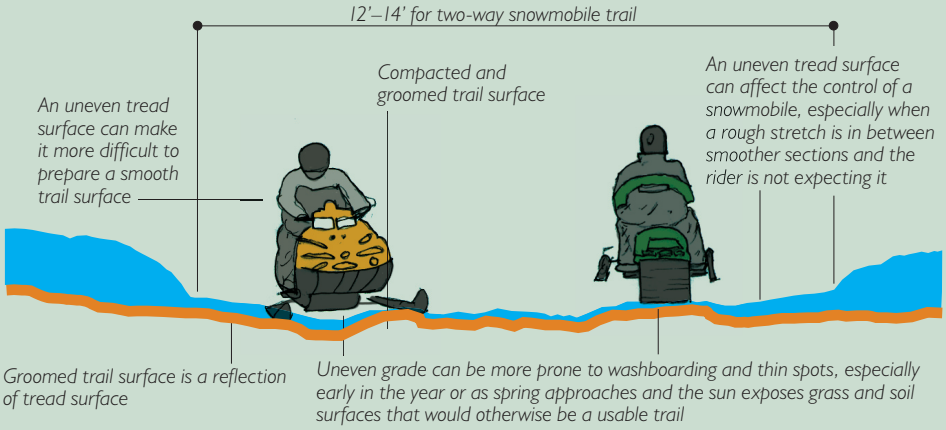
The cross-slope of a snowmobile trail is an important factor in creating a quality trail. Since the groomed trail surface tends to reflect what is underneath, the ground surface is worthy of due consideration as snowmobile trails are laid out during the off-season.



As illustrated, an evenly sloped grade across the trail is optimal for snowmobiling. Abrupt grade changes or general unevenness should be avoided to make trails easier to groom and more enjoyable to snowmobile on. The following graphic illustrates these conditions.

Excessive Trail Unevenness

Excessive trail unevenness negatively affects the ultimate smoothness of a snowmobile trail. It also requires more snow to establish a base and makes the trail more prone to washboarding.



The following photos illustrate some of the previously described cross-section conditions.



This even and smooth grade with vegetation and a slight cross-slope is ideal for a snowmobile trail.



This hard-packed, graveled route through the forest makes for a pleasant snowmobile trail in the winter as long as its use is in sync with forest access rules.



The lack of ground cover on this steeper hill is allowing erosion to take hold, making the trail unsustainable for summer use and increasingly rough for winter use.

Tread Surface Conditions



If not mowed, the longer grasses along this corridor require significantly more snow to create a usable base. Whereas mowing the trail just before the season has considerable merit, that has to be balanced against ecological and wildlife impacts, such as disturbing nesting birds. When trails traverse sensitive natural areas, the principles of ecological sustainability (as defined in Section 3) should be given due consideration. One important factor in this regard is waiting until as late in the season as possible before mowing to avoid disrupting nesting birds and bedded animals.

The tread surface is an important trail preparation and grooming consideration. A uniform grass surface is preferred across the entire width of the trail for a couple of reasons: 1) grass holds snow better than bare ground or paved surfaces and 2) grass helps prevent off-season use and erosion from creating an uneven surface.

The longer and heavier the grass, the more snow it will take to establish a base. Where feasible, mow the trail just before the season to prepare the tread and reduce the depth of base needed to create a usable trail. Under most conditions, a 6- to 12-inch snowfall is optimal to establish a base over a relatively short grassy ground cover.

Routine brushing/trimming of the woody material across the trail and on the edge of the clearance zone is also very important to maintaining the tread surface. All protruding rocks, logs, and other woody debris that would interfere with trail grooming and rider safety should be removed from the trail shortly before the season.

Although not as desirable as a natural or aggregate surface, asphalt is an acceptable surface when snowfall is sufficient. Laws pertaining to the use of studs should be considered when establishing a trail on an asphalt surface. Also, it should be expected that the snow cover will not last as long in the spring as it would on a grass-surfaced trail.

Tread drainage and erosion are important considerations for snowmobile trails. If drainage is poor and erosion pervasive, the tread surface will be compromised and become uneven, making it harder to groom and ride on. The most important factor in preventing erosion is making sure the trail is covered with a stabilizing ground cover during the off-season. Snowmobile trails that follow the fall line of a slope should also generally not be used for summer uses to avoid creating a single track that exposes the soils to erosion. In some cases, off-season grading and revegetation is necessary to fill in ruts, maintain drainage, and correct erosion problems.

Wetland and Water Crossings

Wetland areas should be avoided when aligning snowmobile trails because the tread surface is often uneven, inconsistent, and unpredictable. Potential ecological impacts are another reason to generally avoid wetland areas. If a trail does cross a wetland, select the location carefully to minimize these impacts.

Lakes and rivers inherently pose safety issues and surface quality uncertainties and should therefore be avoided for formal trails.



Designated use of lakes for snowmobile trails should be avoided given the many safety concerns, such as slush, thin spots, and unknown surface irregularities. There is also a temptation for riders to wander far and wide and also "skip" across open water.

When water drainage crossings are necessary, culverts, boardwalks, or bridges should be used. Approaches to these structures should be smooth and level (up to a 5 percent grade) and with a clear sight distance of at least 100 feet. Bridge and boardwalk decks should be flush with the trail surface with narrow or no gaps between decking boards (to allow snow to accumulate and compact). A 10-foot-wide bridge or boardwalk is optimal, with 8 feet being the minimum acceptable. Each should have a weight capacity of 10 tons or more to accommodate maintenance equipment. All bridges must be designed to meet applicable DNR bridge standards (determined on a site-by-site basis). The following photos illustrate various tread surface and bridge conditions.



A level, grass-surfaced corridor is optimal for snowmobile trails. Mowing the trail just before the season can reduce the amount of snow needed to create a usable base.



Approaches to culverts crossing drainages should be smooth and level. If the trail narrows or the shoulder is steep, place a warning sign at least 100 feet prior to the hazard.



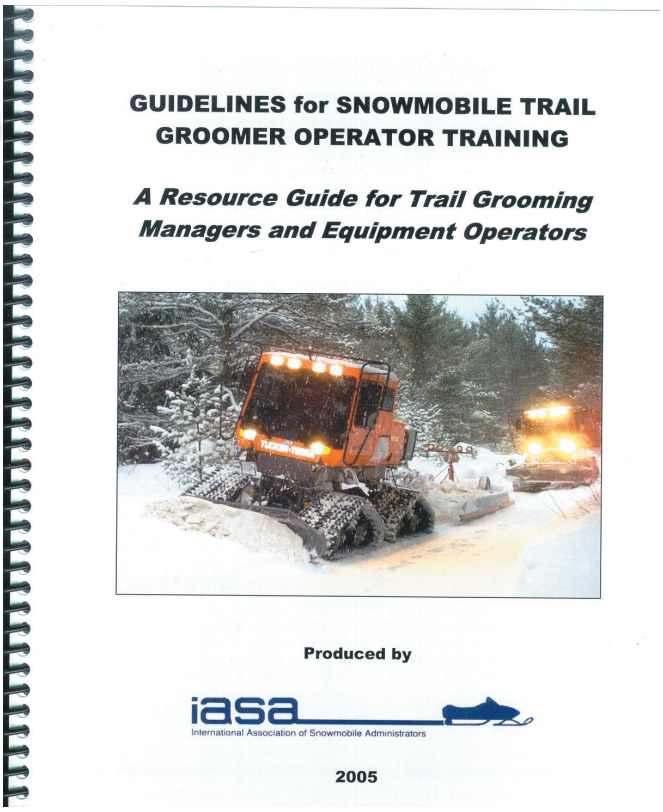
If a summer-use bridge is used for a snowmobile trail, the surface of the trail and deck should be smooth and flush. The deck boards should have minimal gaps to hold snow. Railings are also required.

Trail Grooming

Grooming snowmobile trails is a specialized activity that is part art and part technique. The International Association of Snowmobile Administrators (IASA) has done considerable research on this subject and has developed a resource guide for trail grooming entitled *Guidelines for Snowmobile Trail Groomer Operator Training.* The guide covers all of the fundamental aspects of trail grooming and is a highly recommended reference.

For more information!

The grooming guidelines can be found on the IASA website (www.snowmobilers.org/groomer_guide/GroomerGuidecomplete.pdf



Roadway Crossings



A gateway at this midblock crossing helps snowmobilers and motorists more easily recognize the crossing. The level grade on both sides of the road (similar to a farm field access drive) also improves sightlines and allows the rider to more easily position for the crossing.

Roadway crossings are an important safety concern for snowmobilers and motorists. All crossings should be well marked with signs, including Stop Ahead signs at least 100 feet prior to a stop sign. Snowbanks should be kept low at all crossings, with ample sightlines from both the trail and the roadway.

Where feasible, roadway crossings should be at intersections where motorists are expecting traffic from the side and thus more likely to recognize a snowmobile trail crossing. If midblock crossings are required, approaches should be as level as possible and sightlines extra long. To be level during the snow season, the approach should be designed to be 3 to 6 inches lower than the road during the none-snow season, where feasible. This will allow groomers to remove the extra snow dragged across the road by snowmobiles and to avoid creating a hump right before the crossing point.

Gateways on each side of the road can also remind riders that they are about to make a crossing and extra attention is warranted. All roadway crossings should be consistent with any applicable laws and ordinances. The optimal location for all crossings should be field determined by experienced trail designers and tested during the day and at night to ensure that they are clearly visible and as safe as possible. The following photos illustrate a number of roadway crossing considerations.



Although this crossing is well marked from both sides, it is not optimal due to the guy wire from an adjoining utility pole. During the day, riders are likely to see it, but at night it poses more of a risk. Careful attention to detail is essential at all crossings given the distractions that are inherent in these situations.



A narrow tread caused by snowbanks poses two concerns: 1) it reduces the sightlines from the trail and roadway and 2) it squeezes riders into a single path just when they are about to make a crossing. On designated trails, avoid this whenever possible.



Along with proper signage, a light is added at this trail crossing to improve safety. The flatness and straightness of this rail conversion reduced the visual cues associated with identifying this intersection, warranting the addition of the light.

Trail Signage

Consistent with the grant-in-aid program administered by DNR, signage should be provided for direction, information, and enhancing the safety of trail users. Major signing areas include trailheads, trail junctions, and areas where the safety of the user is of particular concern. The primary reference for snowmobile trail signage is the *MN DNR's Sign Manual,* which provides reference numbers and in-depth information for each type of sign used along a snowmobile trail. The instructions manual for the snowmobile grant program administered by the DNR Division of Trails and Waterways also has an extensive listing of signing recommendations. The following provides a brief overview of signage that complements these resources.

Trailhead and trail junction signs provide maps showing route designations, distances, traffic flow direction, and the location of support facilities. Safety signs are used to caution users of steep slopes, bridges, highway crossings, or other trail hazards.

Signs on trails should be kept to the minimum necessary and be well placed to serve their purpose. Signs placed along the trail should include reassuring blazers along with Caution, Do Not Enter, Stop Ahead, Stop, and other related signs.

Placement of most signs is consistent with the guidelines for natural trails as defined in Section 6 – Sustainable Natural Surface Trails. Signs should be placed on the right side of the trail and set back from the main tread, but within the clearing limits. Signs should be attached to posts offset 2 feet (minimum) to 3 feet (preferred) from the edge of the groomed treadway. The signs should be placed 3 feet (minimum) to 4 feet (maximum) above the expected snow depth. Setting the signs 4 feet above the bare ground typically ensures the sign will be the desired height. Posts may be wood or plastic, depending on location and availability.

Directional signs used along the trail should include trail junction blazes, directional blazes, and reassuring blazes. These signs should be placed in open areas or in other areas where a trail user might become confused. If uncertain about the effectiveness of signing, invite a nonlocal snowmobiler to identify deficiencies.

Trailheads and Support Facilities

Trailheads typically consist of a parking area and trailhead kiosk with trail maps and related information. The parking area for trails varies considerably depending on its popularity and the number of access points. As a general guideline, parking areas should be designed to accommodate a minimum of 10 vehicles, with room for expansion. Each space should be 10 feet wide by 45 feet long. Drive lanes should be 24 feet wide with adequate turning radii. An aggregate surface is sufficient for parking areas if used primarily for snowmobile trail use. Snowbanks from plowing should also be used as the primary means to define the parking area. Posts or other barriers can also be used on the periphery of the parking area to prevent vehicles from leaving the designated area.

Given the maintenance and cost, providing portable or permanent restroom facilities should be carefully considered. If private services are available near the trailhead, providing these facilities is generally not recommended. In select locations, snowmobile trailheads take advantage of support facilities, including restrooms, at summer-use state or county trails and parks

In addition to trailheads, support facilities that should be identified on trail maps include services such as gas, repair shops, food, lodging, medical facilities, and law enforcement offices (911 or Zenith). The nearest DNR office should also be identified, along with any other helpful information. Trailheads that are in conjunction with or near gas stations and convenience stores can be especially successful.

Summer Uses of Snowmobile Trails

The compatibility of snowmobile and summer-use trails following the same corridor should not be assumed and requires site-specific evaluation. This is especially the case where snowmobile trails travel through areas of unstable or hydric soils that can support snowmobile use when frozen conditions but become unstable in summer. Summer use of these corridors should be precluded. The following photos illustrate some of these conditions.



This otherwise sustainable snowmobile corridor is not well suited to summer ATV use, as the photo clearly illustrates. An ongoing occurrence of this type of impact only leads to more restrict uses, sometimes even for those the trail was designed to accommodate.



Even seemingly stable soil conditions can be susceptible to erosion when a snowmobile trail corridor becomes a de facto ATV trail. The key point is that all trails must be designed for their purpose. It should never be assumed that a trail corridor for one purpose will be suitable for another until it is assessed for that purpose.