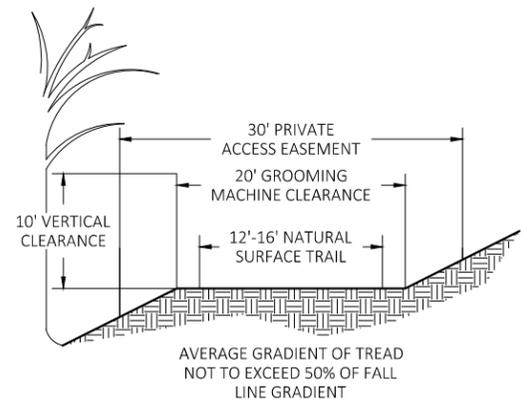
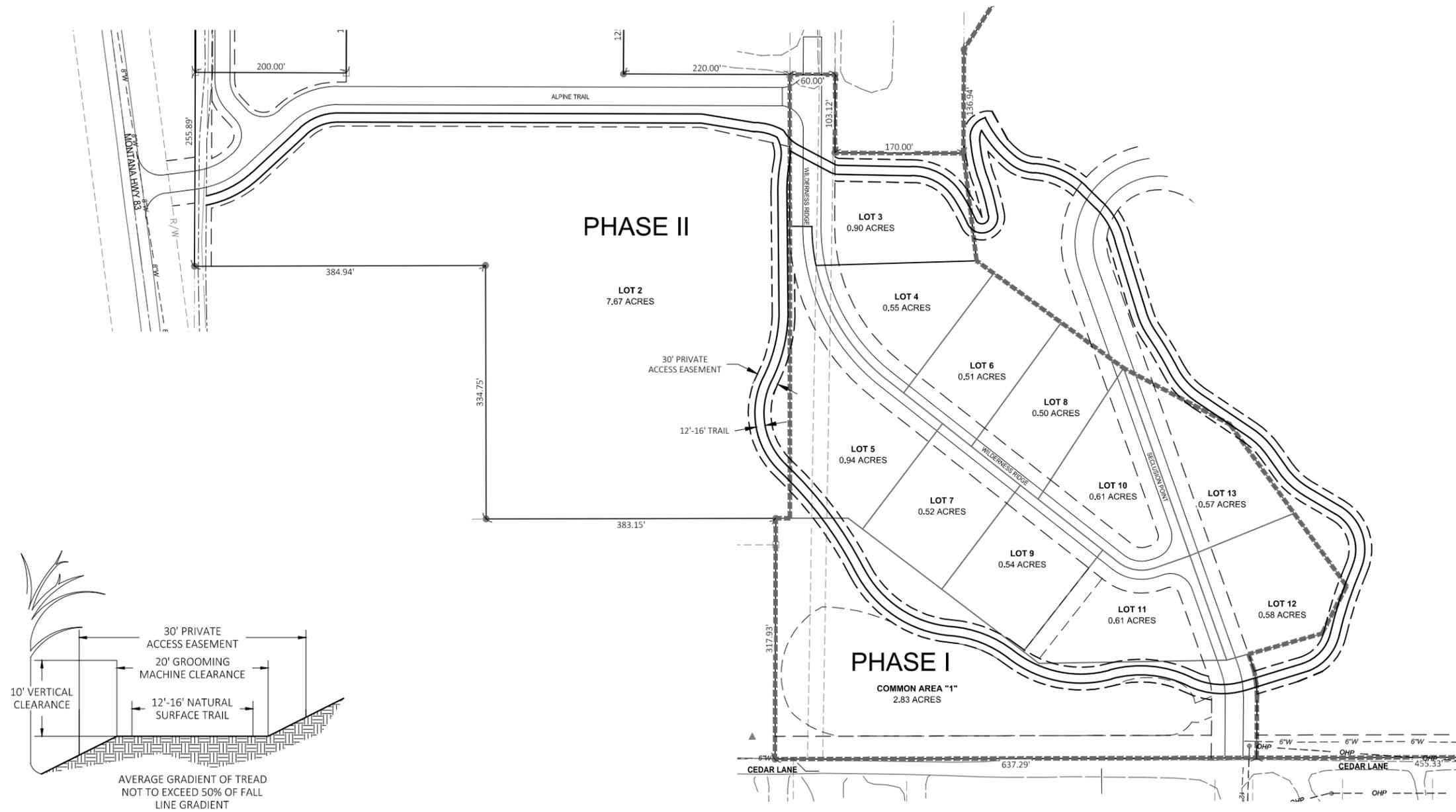
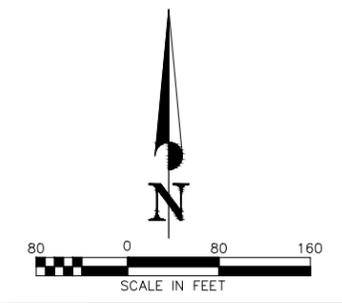


***ALPINE TRAILS
SUBDIVISION***

TRAIL INFORMATION



TYPICAL TRAIL SECTION



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 Engineers, Surveyors, Planners, Mappers
 3115 RUSSELL ST. PO BOX 1750 MISSOULA, MONTANA 59801
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PROJECT #:	7395-05
DRAWN:	DM
CHECKED:	DM
DATE:	8-31-13
REVISION:	10-31-15 ELEMENT REVIEW REVISIONS
REVISION:	1-15-16 2ND ELEMENT REVIEW REVISIONS
REVISION:	11-20-16 SUFFICIENCY REVIEW REVISIONS
REVISION:	4-10-17 2ND SUFFICIENCY REVIEW REVISIONS
REVISION:	
REVISION:	

ALPINE TRAILS SUBDIVISION
 TRAIL PLAN - PHASE 1 - TO BE CONSTRUCTED WITH SUBDIVISION PHASE I
 SEC. 35, T.17 N., R.15 W., P.M.M.,
 MISSOULA COUNTY, MONTANA

MORTON TRAILS COMMENTS ON TRAIL DESIGN

1. Trail width: this depends on a number of factors, including how high trail usage will be, if traffic is bi-directional or one-directional, and the type of grooming machine. For a trail like yours, we generally recommend 14'-16' width, with an up to 16' opening to allow for classic and skating technique, 12' is a little narrow if the trail is meant for both techniques. For winter grooming, you want to make sure that your trail opening is at least a couple of feet wider than the grooming machine!
2. Trail surfacing: we are generally proponents of natural surface trails, and this would definitely be my recommendation here. Once the trail is built and graded, you can lay down some top soil and seed with a local grass mix – we use a “conservation mix” back east that works really well. If people are using the trail for biking and running, you will often see a single track of dirt develop during the summer. This is fine, and you can even let the grass grow up on either side to make it feel more like a single-track “experience” for people seeking that.
3. Trail sustainability: this is of particular importance on your site, since part of the trail runs right down a drainage. It is important to try to keep the average gradient of the trail less than half of the fall-line gradient on a hillside. It is also important to build in rolling dips, or grade reversals on sections of trail that might channel water (such as the section going down the drainage). This will shunt water off of the trail and keep it from channelizing and eroding the trail surface.

[Here](#) is a link to a great presentation of trail designing and building from the Minnesota DNR. There are also plenty of USFS resources on the web, and The International Mountain Bike Association (IMBA) has a great recourse called “Trail Solutions” that discusses sustainable building practices in depth.



Observations and Suggestions for the Construction of Nordic Ski Trails

After a couple of decades of designing and consulting on the construction of Nordic ski trails throughout the northern United States and beyond, we have gathered some observations which may

Unlike other athletic or recreational facilities, (tennis courts, baseball diamonds, etc.) all cross country ski trails are unique, which is an important part of their appeal. They vary significantly in length, in width and in technical difficulty. Nordic skiing originated in the Scandinavian countries of Europe, therefore trails are typically measured in kilometers. A popular distance for a school or a community trail is 5 kilometers (3.1 miles). Prior to the 1980's, cross-country ski trails could be quite narrow, 4' or so, threaded through the trees. Three factors have dramatically influenced the width of trails since then.

1. The evolution of the skating technique has required much wider trails so that competitors don't interfere with each other. The International Ski Federation (the FIS) has established competition course guidelines so that top level Nordic skiers have some idea of what they will encounter no matter where in the world they are racing. The most expansive of these standards, for race trails hosting mass start skating events, require a trail width of 6 meters (nearly 20') on the descents and 9 meters (nearly 30') on the climbs and rolling terrain.
2. Climate change has made natural snow cover precious enough that Nordic ski areas are opening the tree canopy above their trails so that the snow which falls, actually reaches the ground.
3. Wider trails are most efficiently built by sizable excavators and groomed with sno-cat type machines, which require an opening between the trees bordering the trail of at least 12'-16' in which to operate effectively.

Trails designed and constructed for cross-country skiing are also suitable for a number of other non-motorized outdoor activities, including: running, walking, hiking, orienteering, mountain biking, snowshoeing, horseback riding and fat tire biking.

Trail Planning and Design

Many recreational trail networks simply evolve over time, often following the path of least resistance. It is very common for Nordic ski trails to make use of existing logging roads or skid trails, power line easements, as well as pastures and natural openings in the forest. This makes sense if the existing route (whatever its original purpose) serves the objective of the trail, but far too often the experience of the recreational trail user is compromised by the questionable convenience of following an abandoned logging road that is already there.

It is important to understand the intended uses anticipated for the finished trail network. Most contemporary trails are designed for shared, year-round use. For example, a trail may be intended for cross country skiing and snowshoeing in winter, but also for walking, running, mountain biking and perhaps even horseback riding in the summer months. It is not uncommon for trails to serve both as a location for passive, community recreation as well as a venue for organized, competitive events. Both activities, casual recreation and organized events, have specific trail design requirements which should be addressed. Trail design projects can be as simple as retired landowners wanting a safe, enjoyable route to get out into their wood lot, or as complex as an international competition venue, meeting FIS standards for world caliber competitions. Typically, the planning and design aspect of a trail project ranges from 10% to 20% of the total cost of the project.

Community Approval, Permitting and Engineering

Most trails for private landowners are relatively straightforward and uncomplicated. Once the objectives of the trail have been determined, the trail designers configure a route, being mindful of sensitive natural features like wetlands, wildlife habitats, etc. The logging contractor and excavator operator then cut, clear and build the trail adhering to the “Best Practices” guidelines for forestry operations in the state in which the project is located.

Trail projects for public entities (municipalities, state parks, U.S. Forest Service land, etc.) quickly become more complicated and more expensive. Trail projects on public land often require public hearings, information sessions, feasibility studies, etc. Even after a project gains local support, it is likely that a series of studies and permits will be required. Finally, if any bridges are included in the trail project, those structures will probably have to be designed by engineers. Because communities vary so much across the country, it is impossible to accurately estimate the cost added to a typical, public trail project by developing community approval, navigating the permitting process and paying to have critical features of the project designed by engineers. However, for planning purposes, it is probably not unrealistic to anticipate, in a municipal setting that up to 30% of the cost of a comprehensive, recreational trail project could go to these “soft costs.”

Cutting and Clearing the Trail Route

While Nordic ski trails can be designed and built almost anywhere there is snow in winter, typically, trails are predominantly cut through woodlands. If a commercial logging contractor is cutting and clearing the trail, it often involves a feller-buncher (a large machine that grasps the trees, shears them off and lays them in bunches on the ground) which cuts the trail corridor, and a grapple-skidder which pulls bunches of full-length trees to a central log yard to be processed. A more labor intensive, but satisfactory alternative, is for loggers with chainsaws, accompanied by a tractor equipped with a wood chipper, to cut and clear the trail route, putting the saplings directly into the chipper and stacking any salvageable timber to the side of the trail to be eventually skidded out.

Cutting and clearing a Nordic ski trail differs from a conventional logging operation in a couple of significant ways:

- Once the desired configuration and general route of the trail has been determined the final refinement is established by marking the trees to be harvested for the trail with forestry paint. Achieving the desired width and direction of the trail will be accomplished by harvesting predominately damaged, diseased or immature trees, while leaving healthy, strong, mature trees to border, and to help define the finished trail. Special care must be taken to protect the trees that will be bordering the finished trail from being scared by the equipment during construction. Leaving bumper trees during the cutting and clearing phase will help protect the mature trees left to define the finished route. In addition to the trees marked for the trail route itself, occasionally damaged, dead, dying or uprooted trees adjacent to the trail may also be marked when it appears that they might eventually fall into the trail or that their absence will improve the appearance of the finished trail.
- While skid trails, for obvious reasons, tend to be relatively straight to establish a direct route to the log yard, in contrast, a well designed, Nordic ski trail is typically quite convoluted, incorporating frequent, and sometimes dramatic changes in direction. During the cutting and clearing phase, it is preferable to link useful sections of the ski trail route to be used as skid trails, rather than creating a separate network of skid trails generally parallel to the proposed ski trails.
- The goal is to leave a route relatively free of underbrush, saplings, mature trees and fallen logs so that the excavator operator deals mainly with rocks, stumps and earth. Although it requires extra time and effort, any clearing of brush, dead trees, overhanging branches, tops and debris from the borders of the trail route will greatly enhance the appearance of the finished trail.

Generally, clearing a trail corridor through forest land generates four categories of wood:

1. Saw logs - of sufficient quality, size and number to merit hauling to a lumber mill
2. Firewood - typically, hardwood saplings, tops and branches too small of quality too poor for saw logs
3. Soft wood - tops, branches and slash to be feed through a chipper or stacked off the trail route
4. Dead or rotten logs - windfalls and brush unfit for firewood or chipping

The cost of cutting and clearing a trail varies dramatically depending upon a number of factors. Three important issues are:

1. The quality of the timber to be removed to open the trail corridor
2. The difficulty of getting the timber (length of the skid) out to the log yard
3. The current market for the harvested wood and the location of the mill

There have been Nordic ski trail projects which generated enough revenue from the harvested timber (and associated wood products, like chips) to pay for the entire trail project, but that is rare. There have been other projects where there is very little, if any value, in the trees and saplings cut for the trail, and the loggers have to be paid by the hour, often costing tens of thousands of dollars to cut and clear the entire trail route. Although there is no “typical” scenario, if a logging contractor cuts and clears a trail corridor, including chipping or removing the tops, brush and slash from the edges of the trail corridor, in exchange for the firewood and saw logs harvested from clearing the trail, the client is probably doing quite well. More often, a client might expect to pay a logging contractor a few thousand dollars to cut and clear a trail route.

Building the Trail

Although some contractors prefer to rough out a trail with an excavator and finish it with a bulldozer, excellent results have been achieved with an excavator alone. A skilled operator with decent soils to work with can produce a surface suitable for mulching and seeding. In less desirable soil conditions, a finished grade can be achieved with a tractor equipped with a PTO-driven Harley Rake to dislodge small roots and kick small rocks to the edge of the trail. The loose, tilled earth left by the Harley Rake leaves an excellent surface for maximum seed germination of Vermont Conservation Mix or similar product.

A world class, Nordic ski trail is roughly the width of a typical woods road (about 20'). Unlike a woods road or skid trail where the effort is to minimize unnecessary turns or changes in elevation, a Nordic ski trail emphasizes interesting terrain changes. Extended straight, flat sections should be avoided in ski trail construction, with the exception of the start/finish area. In fact, in ski trail construction it is not uncommon to actually build rolls or dips to add interest in an otherwise flat, boring section. This approach is an advantage when large boulders or ledge outcroppings are encountered, because a perfectly suitable option is to mound up over the obstruction. Just keep in mind that any elevation changes should not be too abrupt, (could you comfortably drive your four-wheel-drive, pick-up truck over it?). It is fine to place large boulders off to the side of the trail, but avoid placing them on the outside of descending turns.

Roughing in the trail will involve the removal of stumps and boulders. While the boulders can be used to build up banked turns, etc., the stumps are often buried adjacent to the trail (where permitted by state regulations). Typically, the excavator operator will be looking for locations near the trail where he can mine material to fill in low sections, etc. These “soil mines” then become suitable locations to bury the unsightly stumps, skimming the filled hole over with a layer of dirt.

Another alternative for stumps is to place them, roots down, out in the woods as far as the excavator can reach from the trail. In this way they appear to be natural stumps, and are eventually obscured from the trail in summertime by ferns and undergrowth.

It is a good investment of time and expense to remove major stumps and boulders that slightly encroach on the finished trail. Although they may appear to be on the edge of the trail in summer, it is almost certain that in winter, under a foot of snow, they will become concealed obstacles for the grooming equipment, eventually causing costly damage to the groomer.

It is helpful to keep in mind the intended direction of travel for the skiers. Climbs should be relatively level across the trail (although a slight cant of the trail surface-5% or less- to shed water is fine), while descending turns should be banked like the turns on a NASCAR track. There is debate at the World Cup level as to how much, if at all, to bank descending turns. Our view is, if the trail is to be used by the general public as well as by elite racers, the turns must be banked to help keep the less-able skiers from blowing out of the turns. While the aggressiveness of the banking depends upon the anticipated speed of the skier entering the turn, a reasonable guideline, in terms of the extent of the banking might be, "would you feel comfortable driving your four-wheel-drive pick-up truck around the course after you finish building it."

Much of the joy of Nordic skiing is a result of elevation changes. This means if you have to install a culvert in a drainage between two ridges or shoulders, don't feel that you have to knock down the ridges to fill in over the culvert, leveling out the route as you would a driveway. Regarding culverts, the environmental folks would prefer it if you oversize them, install them deeper in the crossing than necessary with the idea that they will eventually, partially fill with silt so that the wetland critters can waddle their way up stream through the mud. If possible, the outlet of the culverts should be at ground level, avoiding the creation of waterfalls (which the small, wetland critters cannot negotiate).

As with most excavator work, anticipating the impact of water/rain/drainage/etc. is a persistent challenge. Trails frequently traverse hillsides, from which water seeps constantly. In some instances, the trail will require a gentle ditch or swale on the uphill side, guiding water to strategically placed culverts under the trail. On longer climbs or descents, it might be necessary to create gentle rolls or swales across the trail to divert water off the trail before the water gains too much velocity or volume. These gentle rolls or swales, sculpted from earth have replaced the more abrupt water bars used in former years.

Because these trails are intended for year-round use, in all likelihood, there will be low areas prone to mud that should be built up to remain high and dry throughout the seasons.

If a Nordic ski trail has been designed to comply with FIS (International Ski Federation) homologation guidelines, the most significant issues related to trail construction typically deal with trail width. Because of the skating technique and the increased popularity of mass start events, international caliber trails are designed to be 6 meters wide (almost 20') on the descents and 9 meters wide (almost 30') on the significant climbs and rolling terrain. In our view, the 30' width can include a gentle swale alongside the trail, used to direct water to a culvert, because in all likelihood, that swale will be filled with snow, and thus, part of the ski surface in the winter months. But homologation inspectors can be sticklers, especially regarding the width of important climbs on a course.

With trails required to be constructed so wide, there is a natural tendency during the cutting, clearing and construction, for the proposed route to "straighten out." An effort should be made, even with trails intended for international homologation, to preserve the gentle twists and turns dictated by the terrain. Even though it is important to build trails that can safely accommodate mass start, skating events and minimize the likelihood that athletes will obstruct each other, Nordic skiing is still a sport for the woods and fields, not interstate highways.

Like almost everything else related to the creation of first rate trails, construction costs vary dramatically. For not-for-profit, community-oriented, trail projects, it is often possible to secure “in-kind” support from local or regional excavating contractors who are willing to donate, or significantly discount the cost of their machine and skilled operator to a worthy cause. Here in New England, a skilled operator on an average-sized excavator costs about \$150 per hour. Although the time it takes to build a trail varies dramatically with soil conditions, abundance of drainages (need for culverts and even bridges), etc., a good operator in average conditions should be able to build at least a kilometer of Nordic ski trail in a five-day work week. At \$150 per hour, this translates to, plus or minus \$6,000 per kilometer. In other words, a ballpark figure for constructing a 5 kilometer Nordic ski trail would be in the range of \$30,000. While the instillation of culverts is included in that ballpark estimate, the cost of the culverts is not. New culverts can run several hundred dollars apiece, and bridges, if necessary or desired can be several thousand each.

Finishing the Trail

Recently constructed Nordic trails are typically raked to remove roots and stones, then seeded with Vermont Conservation Mix (or something comparable) and ideally, mulched with chopped hay. In sections of the trail where the forest canopy severely restricts sunlight, woodchips can provide a suitable surface. It is worth the effort to use an extended pole saw to cut overhanging branches that will bend into the trail when laden with snow. Trail marker, directional signs and enlarged trail maps will help outdoor enthusiasts from becoming disoriented, anxious or lost. Depending upon the length of the trail and the extent and quality of the informational kiosks, maps and directional signs, finishing the trail can cost several thousand dollars.

In Conclusion

There are four vital components to a memorable Nordic skiing experience:

1. A well-planned, carefully designed trail
2. A skillfully constructed trail
3. Adequate snow
4. Reliable grooming

While all four components are important, a well-constructed trail can (to some degree) compensate for shortcomings in the other three components.