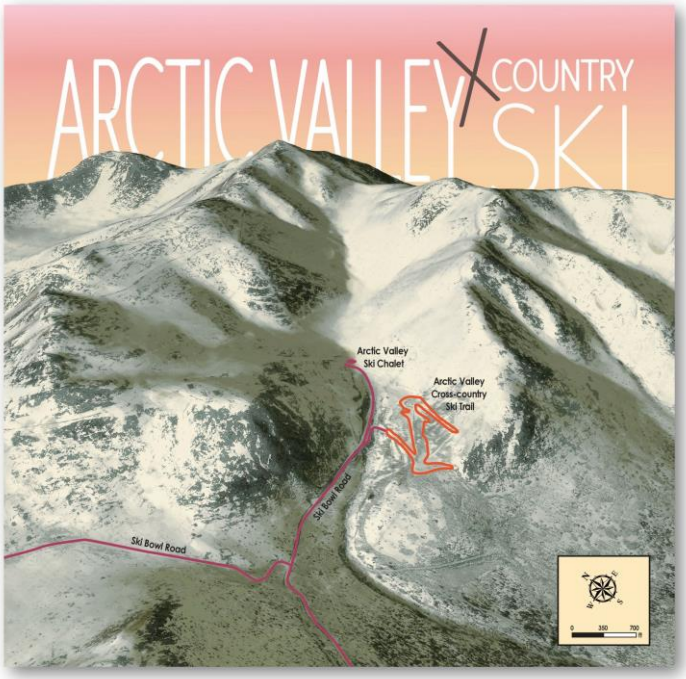
NORTHERN ENGINEERING, INC.



DESIGN STUDY REPORT

Arctic Valley Cross-Country Ski Trail

Project No. 2019.01
Spring 2019

Tanner Stephens
Rostislav Martynyuk

TABLE OF CONTENTS

1. Description of Project

1.1) Location of Project

This project is located at the base of the Arctic Valley Ski area which is accessed by Ski Bowl road, off of the Glenn Highway. See vicinity maps of the recreational area and access roads.

The Arctic valley recreational area currently consists of a chalet, multiple parking lots, trailheads, restrooms, ski lifts, and available utilities.

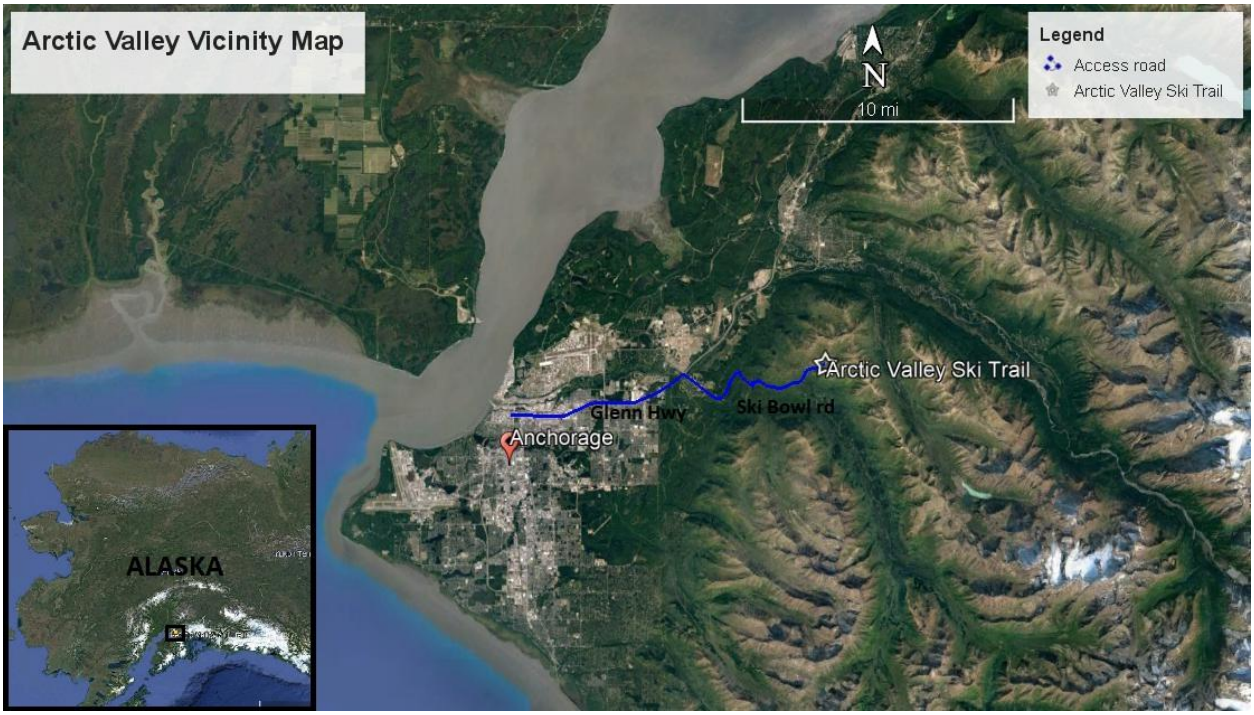


FIGURE 1

1.2) Project History

Arctic Valley Ski Area has a long history of usage since it was created by the oldest ski club in Anchorage. A ski area was first developed in 1941 by the US army. Although in 2003, this older ski area was decommissioned and the area is left undeveloped. The modern Arctic Valley Ski area, formerly called “Alpenglow Ski Area”, was created in the 1940’s by the Anchorage Ski Club immediately to the north of the military ski area. This recreational area is non-profit. It was developed and maintained through volunteer and community efforts, slowly developing through time.

A project proposal was created by the UAA ski team coach in 2018 and the project was reviewed by the Joint Base Elmendorf-Richardson (JBER) Community Planning Section. In the summer of 2018 some preliminary labour was conducted where trees were cleared from projected course. Further development of the project requires approval.

1.3) Purpose and Need

The main purpose of this project is to develop the Arctic Valley area, to realize it's recreational potential, and to utilize the natural terrain to create an elite level cross-country ski course.

The Arctic Valley area has a long history of recreational use, but it poses great potential for additional activities. Arctic Valley is a scenic location nestled back in the mountains, far from the warm ocean winds. This allows for longer winters and cooler temperatures which is an ideal environment for a cross-country ski trail. The existing trails in the area allow for a cost effective design using previously cleared areas, saving costs on both clearing the land and earthwork.

Additionally, due to the large population in the Anchorage area, larger volumes of skiers require additional ski areas to be developed. There is also a need for additional International Ski Federation (FIS) qualified trails to be used for elite level races. Arctic Valley is an optimal location for this particular use. It has a variety of natural slopes that can be used to create a dynamic race trail. The location offers beautiful scenery and a viewpoint over Anchorage and the Chugach mountains which is great for skiers visiting Alaska.

1.4) Project Challenges

The location of the proposed trail falls on JBER territory and is near the Nike Historic District. This means that there is limited access to the location and need for special permits for development on these grounds. Future closures due to military training exercises may occur and disrupt activity in Arctic Valley. There is permitting required for easement which is foreseen as difficult to receive. In order receive approval a cultural resources survey must be conducted on the historic district.

The mountainous region in which the trail is located has a dynamic and rugged terrain. Although the natural slopes are great for downhill skiers, a cross country trail must have appropriate percentage of level terrain. These requirements are outlined in the FIS manual. A major challenge for this project is in creating a 3 k trail loop while meeting these slope requirement and also avoiding large volumes of cut terrain.

The development of a cross-country trail in Arctic Valley will increase the amount of visitors and this would increase the traffic volumes on the access road. The traffic may exceed the volumes designed for the road. Increased volumes of visitors also require shelter, access to bathrooms, and a place to wax skis. The existing chalet in Arctic Valley will be used as shelter but the increased amounts of visitors may exceed the capacity. Construction of new bathrooms and a

waxing building will be necessary. The issue of parking must be considered in the case of increased traffic volumes.

2. Design Standards

The design of this project was governed by the FIS standards. The manual details the specific requirements for a ski trail in order to qualify for FIS sanctioned races. This manual is located in Appendix 1.
Two main items truly governed our design. The allowable grades throughout the course, and the number of specific hill types a course is permitted to have. FIS breaks down hills into three categories: A-climbs, B-climbs, and C-climbs. The table depicting each hill type is given below.

Length of Loop	Major Uphills (A)		Short Uphills (B)	Steep Up-hills (C)
	Gradient 9 - 18 %		Gradient 9 - 18 %	≥ 18 %;
	Average 6 - 12 %		10m<PHD<29m	4 m<10 m< PHD
	Qty	**PHD (m)**	**Qty**	**Qty**
Sprint Classic			1 - 2	0
2.5 km	1	30 - 50	1 - 3	0 – 2

TABLE 1

3. Design Alternatives

Alternative A - Trail on Chugach State Park land only
This alternative proposes a 3 km ski loop in the Arctic Valley area based exclusively on Chugach State Park land. It's location is moved to the south than that of the clients desired trail placement. This option is attractive because it avoids the military JBER land and the subsequent land use rights requirements. The area has a varied terrain with large sloped and large amounts of undulating terrain. There is a large degree of cut/fill which would have to be performed in this location.

Cost estimate: $300,000.00

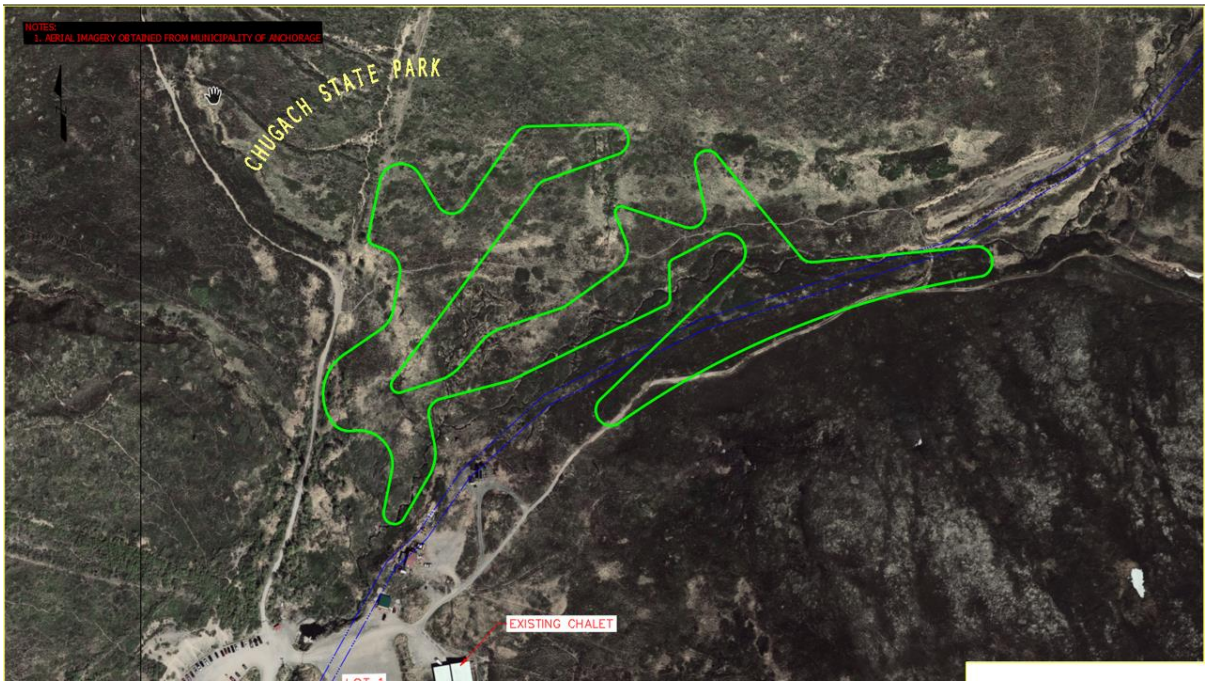


FIGURE 2

Alternative B - Trail on Chugach State Park and JBER land

This alternative proposes a 2.5 km ski loop located on both Chugach State Park and JBER. The location was recommended by the client due to the existing trail segments in the vicinity. This area is adjacent to the Arctic Valley Ski area and the starting location is close to a chair lift. This location offers easy access to facilities, parking lots, and existing warming chalet. The terrain is fairly level and requires minimal cut/fill volumes. Since this alternative is located on split territories, Licensing has to be obtained from multiple entities.

Cost estimate: $100,000.00

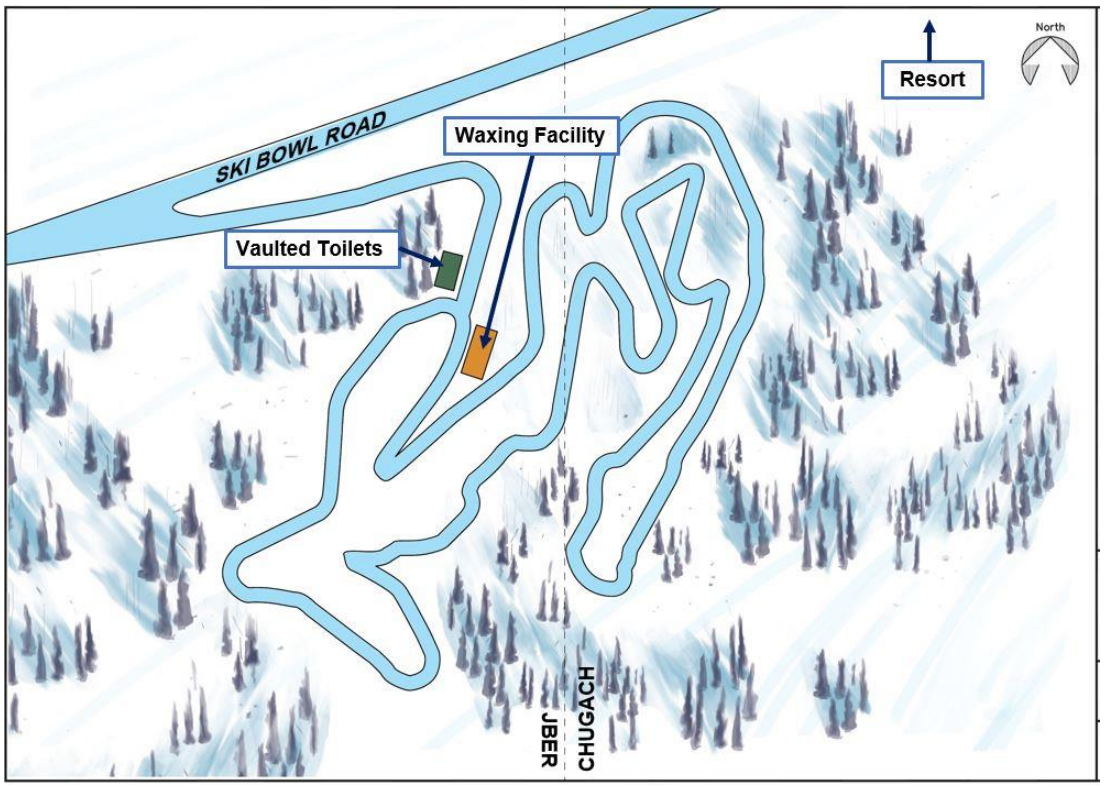


FIGURE 3

4) Preferred Alternative

Alternative B is preferred because it requires less earthwork, has generally more level terrain, and is closer to the Arctic Valley Ski facilities and parking lots. The existing trail segments can be used and costs can be kept down. In terms of permitting and land use rights, this option poses more limitations.

5) Typical trail sections

The trail typical section ranges anywhere between 3 and 9 meters in width depending on the race type being held and permitting terrain. There must be adequate width on both sides for competitors in especially tricky areas such as sharp corners. Below is the typical section for the trail. Appendix 2 gives the AutoCAD generated typical section.

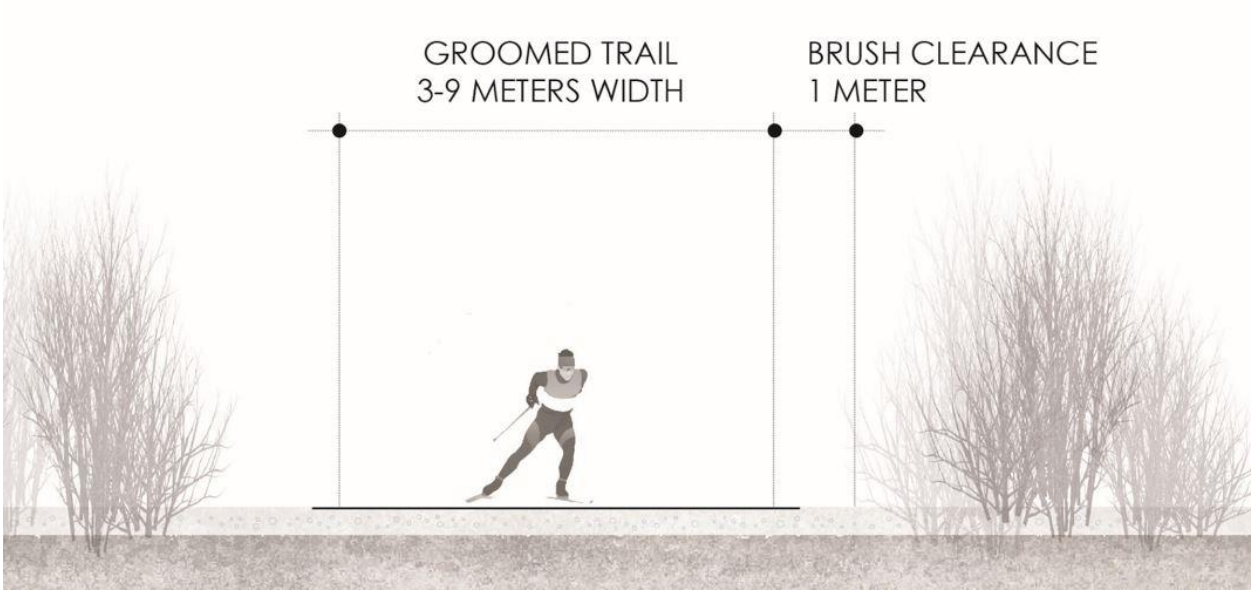


FIGURE 4

6) Trail Alignment

The horizontal alignment of the trail is designed around existing trail segments and natural flat sections to reduce labor requirements. Due to the small level area, the horizontal alignment had to be winding to increase the trail length. The vertical alignment is designed around FIS requirements. There is a specified amount on flat, undulating, and sloped terrain that the trail must have. Other design specifications such as maximum slopes, amount of hills, and the acceptable change in elevation from the highest and lowest point along trail govern the design of the vertical alignment. Since there is a relationship between the horizontal and vertical alignment, the horizontal alignment must be placed so the result will be the best fit vertical alignment. The horizontal and vertical alignments 65% design drawings are located in Appendix 3 and 4, respectively.

7) Erosion and Sediment Control

Erosion and sediment control will be required in order to prevent the infiltration of sediments generated by construction activity. Detailed instruction are located is the specifications

APPENDIX 1 - FIS Manual

APPENDIX 2 - Typical Section

APPENDIX 3 - Horizontal Alignment

APPENDIX 4 - Vertical Alignment

CROSS-COUNTRY
HOMOLOGATION MANUAL

6th EDITION June 2012

FÉDÉRATION INTERNATIONALE DE SKI
INTERNATIONAL SKI FEDERATION
INTERNATIONALER SKI VERBAND

CONTENTS

1 Introduction

1.1 Preface

This Homologation Manual is now in its sixth edition with adjusted content regarding the fluid modern race formats and the new techniques and tactics they bring forward. The experiences over the past years have proven that this manual and the Homologation process have become valuable assets that support the development of the sport. The standards that are described in this manual are now widely recognized by coaches, athletes and organizers. Their feedback has been very positive.

However, in order to get the best possible courses the involvement, the knowhow and the quality of the work performed by the Homologation Inspectors is of paramount importance. There are unfortunate examples showing that not all organizers take this work seriously enough. Therefore, the FIS appointed Homologation Inspectors are carrying a special responsibility for taking care of the best traditions in Cross-Country course design, and at the same time develop courses that are well suited for all competition formats.

As before this manual is intended to be a useful resource for the work of the Homologation Inspectors, Cross-Country course designers and the organizers of National and FIS events. The content of the manual combined with the process of homologation should help to formulate a better and correct understanding of the FIS International Competition Rules (ICR) norms for course design, and thus provide the best possible courses for all levels of skiers.

The ICR articles 311and 312, represent the basis for the discussion in the manual. Section 14 in this manual includes these ICR articles.

The development of this manual represents the collective experiences of many homologation inspectors, other experts, competitors and coaches. The development of the standards has systematically been ongoing since the Nordic World Ski Championships in Oberstdorf, 1987. Future challenges for the Homologation process will be still to address the needs of all competition formats and the increased emphasis on TV production and promotion of our sport, and at the same time use as long courses as necessary in order to maintain the soul of the sport.

Many thanks to the working group:

Hermod Bjørkestøl,	John Aalberg	Uros Ponikvar
NOR	USA	SLO

I trust that the National Ski Federations will continue to promote the Homologation process in order to further improve the sport of Cross-Country skiing.

FIS Cross-Country Committee
Vegard Ulvang
Chairman

1.2 Responsibility

For the highest level competitions, level 1, the Olympic Winter Games (OWG), World Ski Championships (WSC), World Cup (WC) and Junior World Ski Championships (JWSC) competitions, the FIS is responsible for the execution of the Homologation process. That includes the appointment of the Homologation Inspectors (HI), the review of the homologation reports and the final acceptance of the courses. A second level of inspection is additionally implemented for the final approval of the Olympic and World Championship courses.

For level 2, Continental Cup- and FIS competitions, the National Ski Association (NSA) is responsible for the appointment of the HI, and that reports are being provided to the FIS office. To be able to have an even quality of the Cross Country courses around the World, FIS-certified regional Homologation Inspectors should provide support to the NSA and inspect and approve the courses in their region before FIS certificates are issued (see paragraph 8.2.3).

The FIS Nordic Office is responsible for:

- Receiving and filing the documentation for each homologated course
- Issuing a certificate for each homologated course.
- Keeping an updated record of all homologated courses. There has to be separate overviews and numbering for level 1 and level 2 competition courses

2 Philosophy of Homologation

2.1 Description of the Homologation Process

Homologation represents a “system of evaluation” that is designed to guide the development and upgrade of Cross-Country competition courses. It is not just a set of numbers and standards, but is a process for certification that provides a forum for constructive discussion between Organizers, FIS and Inspectors.

The homologation evaluation includes more than just the course design. The stadium layout and the infrastructure installations are also part of the overall evaluation. The resulting certification represents a FIS stamp of approval indicating that the site is physically capable of accommodating international FIS competitions.

The controller of a new course is usually the FIS-appointed inspector, and this is believed to be a good opportunity for courses to be designed from scratch with Homologation Standards in mind. Existing courses that are evaluated for homologation certification will usually undergo some design changes in order to adapt to new competition formats.

When an organizer applies or prepares for an international championship the courses, stadium and other facilities will normally need to be improved. These improvements should take place under supervision of a FIS appointed homologation inspector/expert.

The end result of the process is expected to provide varied and challenging courses that require competent skiing abilities, as well as stadiums that meet the requirements of the new competition formats.

It has to be emphasized that homologation should not be carried out in such a way that the courses marginally fit the rules. Some of the Cross-Country Ski Centres will not be capable of having a homologated course if the physical characteristics of the terrain are below the required height difference (HD) limits.

2.2 Preserving Cross Country Heritage

In the beginning of the ski history the trails that were used for cross country skiing were the same trails used for transportation in summer time, with limited grooming and no mechanical influence. The Cross Country skiing was the mean of transportation in the wintertime. The layouts of the first competition courses were made in the same way; “The best possible trails given the possibilities of the terrain”. Some competitions were also conducted on normal daily used trails. With the increased use of heavy construction machinery there is a considerable risk that we will lose a “feeling for the natural terrain” that is in the soul of the Cross-Country skier. Even though we are designing courses for competition it is extremely important that we take every opportunity to preserve the athlete’s contact with the natural undulations of the terrain. This implies that course designers and inspectors have a responsibility to minimize the need to modify the terrain with machinery, but instead must find ways of using the natural terrain whenever possible. There have unfortunately been examples where a bulldozer has been sent into the terrain to construct an artificial track when the natural terrain was capable of providing a better skiing experience. The joy of skiing should be the ultimate goal.

2.3 Environmental Aspects

Society expects Cross-Country skiers to be close to nature and as such we have an inherent responsibility to protect the natural resources. In order to preserve the relationship with nature, course designers must be aware of environmental factors and set a positive example in their work. This includes the need to work with a variety of environmental organizations and landscape architects. The following lists some key areas of concern:

- Avoiding excessive side cuts
- Managing water flow and drainage
- Employing materials and finishing that blend into the natural surroundings
- Rehabilitation/reforestation of the site, pre and post event
- Avoiding bridges where possible. They are expensive, have an impact on the nature, can be future obstacles, and make future changes more difficult.

2.4 Legal Aspects

It is the responsibility of the Organizer to perform the necessary research into any legal aspects that impact on the proposed site selection and its development; for example

- Land ownership
- Government authority regulations
- Environmental regulations

2.5 Course safety

The safety of the athletes under difficult snow conditions has to be considered when the technical challenges on the course are determined. Areas that need special

protection should be mentioned in the Homologation Documents. Course protection during competitions must be emphasized. Spectators' and officials' access to and along the course also have to be considered. Special measures that the organiser must take in certain course conditions should be mentioned in the Homologation report.

2.6 Course grooming

The courses have to be constructed to a quality that allows for grooming and skiing the courses in wintertime with approximately 25 -30 cm of snow.

2.7 Visibility

Over the past years new race formats have been developed. Sprint-, team sprint -, mass start-, and skiathlon competitions have been included in the FIS Calendar. The big challenge for the organizers will be to design venues that display the cross-country sport as modern events that attract spectators, TV-viewers and other media-people, and will ensure and even increase the interest for the sport. This means a course layout where major parts of the course are visible for spectators. To provide for fair conditions the courses must be wide enough for the new formats, and the transitions between down hills into up hills must be laid out so congestion is avoided. However the technical challenges still must be considered as most important.

2.8 Cooperation with TV

Sport is now a huge entertainment industry. In order to maintain and even improve the position of the Cross Country sport, cooperation with TV is of paramount importance.
Before any construction work on new (level 1) courses is started all aspects related to TV-transmission from future competitions has to be reviewed. This includes camera positions in the stadium and on the courses, as well as cable paths, areas for production busses etc. For WSC, OWG and on classical WC sites the cooperation starts when the Homologation planning process starts. The detailed course layout has to be discussed with the responsible TV-producer, or a person with similar knowledge of TV requirements. Important aspects are;
The objective is to create interesting TV-pictures showing all techniques of Cross Country skiing at the appropriate distances along the competition courses, and pictures of spectators enjoying themselves ("folk-fest") without disturbing the focus of the competitors. Even coaches should co-operate with TV and "no-coaching" zones should be planned to avoid blocking of the camera shots. Such zones should be displayed on the course maps, and reviewed at the Team Captains' Meetings.
Other important aspects are:

- Unique motives from the nature, old buildings or other interesting objects that makes the TV-picture more interesting
- Something special about a venue that gives it identity, for instance the church in Seefeld, and the jumping tower in Holmenkollen.
- The camera-positions have to be located at specific distances along the courses. Thus the course layout has to meet these criteria.
- For mass start competitions the whole course must be laid out so TV can cover it continuously.

Costs saving considerations mentioned in paragraph 3.3 are important. As mentioned above, an increasingly important goal for course design (especially for level1 competitions) is to provide the opportunity for the exciting and entertaining TV transmission that our sport can give.

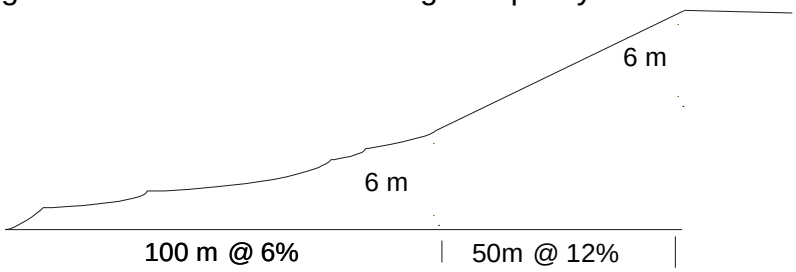
3 Course Design Criteria

3.1 Terms

In this manual and in the International Competition Rulebook (ICR) the following terms are used. The definition and understanding of these rules should be as follows.

3.1.1 A-climbs definitions:
A= Major uphills = PHD $\geq$ 30 m, gradient 9 - 18 %, normally broken with some short undulating sections less than 200 meters in length or a down hill that does not exceed 10 m, PHD. Normally the maximum PHD should not exceed 80 m.

3.1.2 B-climb definitions:
B = Short uphills 10 m $\leq$ PHD $\leq$ 29 m, gradient 9 - 18 %
B-climbs can also permit sections with gradients of less than 9% providing that the B-climb includes some sections with a gradient $\geq$ 9% and the average gradient is > 6%. The following will qualify as a B-climb.



This is the way that the software in the EIBL program works.

3.1.3 C-climb definitions:
C = Steep uphills 4m < PHD < 10m, gradient > 18%. Climbs with < 4 m PHD will be included as undulating terrain or as part of an A- or B-climb.

3.1.4 Maximum Climb (MC)
MC is the climb with the highest PTC, in other terms, the biggest uphill.

3.1.5 Total Climb (TC)
TC is the sum of all climbs on the course.

3.1.6 Height Difference (HD)
HD is the vertical distance from the highest to the lowest point on a cross-country course.

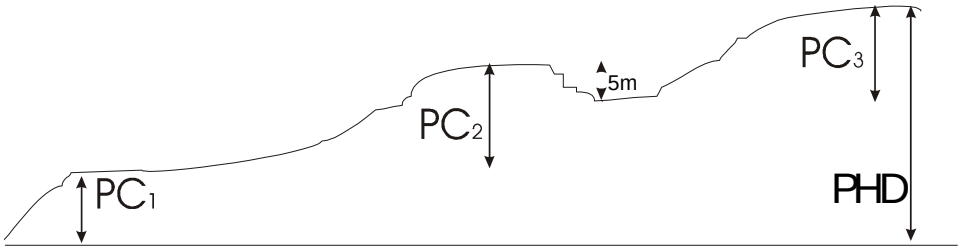
3.1.7 Partial Height Difference (PHD)
See figure below (paragraph 3.1.9)
PHD is used to calculate the average gradient of the climb.

3.1.8 Partial Total Climb (PTC)

PTC (Partial Total Climb) = PC1 + PC2 + PC3, for any A or B climb that has some varied gradients in sections. If the A or B uphill has no downhill parts then the PTC = PHD.

3.1.9 Partial Climb (PC)

See figure below.



$$PTC = PC_1 + PC_2 + PC_3$$

$$PHD = PTC - 5m$$

PHD is used when calculating the average gradient of the climb (PHD x 100/distance), while PTC is used to calculate the terrain distribution

3.2 General Characteristics

The course should be laid out as naturally as possible to avoid any monotony, with rolling undulated sections, climbs and downhill sections. Where possible, the course should be laid out through a woodland area, however the spectators' visibility aspect has to be considered.

The specifications listed in the ICR have been thoroughly discussed with the best athletes, and represent the range and limits within which the different kinds of terrain should be selected.

ICR Rule 311.1.1 - 1.2 and 1.3 represents the inclusion of the main course design criteria in the FIS Rules that provide a general framework which the Homologation Inspector should consider when evaluating the suitability of any particular racecourse. They should be interpreted as follows:

The course must:

- Test the skier in a technical, tactical and physical manner
- Provide a degree of difficulty that matches the level of competition
- Be laid out as naturally as possible using the terrain in a balanced manner according to the rules in paragraph 311.
- Be located to avoid wind exposed areas, woodland areas are preferred, however the visibility aspect should be emphasized
- Be laid out in such a way that impact on the nature is minimized
- Provide smooth transitions between the varying techniques of the skier
- Remain safe in marginal snow or icy conditions
- Have a distribution of the terrain of approximately
    - 1/3 uphills
    - 1/3 downhills and
    - 1/3 undulating terrain

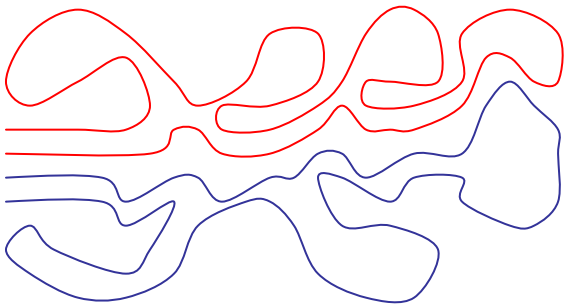
The remaining sections of the ICR 311 – 312 represent strongly recommended guidelines and standards to which the overall race site design should adhere. It is expected that some deviations may be necessary. However the Homologation Inspector has to make sure that the physical, technical and tactical demands on the racer provided by the overall course design are met. Where it is necessary to go below the standards on one part of the course, this should be compensated on another part.

In particular, courses for mass start competitions should avoid narrow uphill or finish sections in order to provide for fair competitions. This would also minimise skiers obstructing each other.

3.3 Resource saving Considerations

The layout of a Cross-Country course should provide:

- Minimum of impact on the nature, bridges should be avoided where possible.
- Cost saving construction for the Organizer, that means short wiring distances for timing, electrical power supply etc.
- Optimal and cost efficient TV-production – one bus can cover several positions on the course.
- Easy access to different parts of the course for
    - Spectators
    - Media
    - Athletes
    - Team support personnel
    - Organizer's officials



This is a principle layout of a course system that can accommodate all competition formats. It consists of two separate courses, one for each technique in the skiathlon competition and each 5 km long. Cut-offs can make courses of 2.5, 3.3 and 3-75 km. Also sprint courses can be laid out inside this system. These two courses can be considered as one 10 km course, Another option is a transition from the red to the blue course outside the stadium in order to make a 7.5 km loop more suitable for interval start formats.

4 Homologation Categories for Courses

Course width requirements – see section 14 paragarph 311.2.6

The requirement for width is based on measurements when the course is prepared for skiing and fenced off for the competition.

5 Course requirements for different race formats

5.1 General

The race formats are; Interval start, Mass Start, Sprint and Team sprint, Relay and Skiathlon.
The width requirements mentioned in section 4 are required mainly for up hills. For the Classical technique mass start/skiathlon competitions with large fields it is necessary that 4 tracks be set throughout the course, while the requirement for free technique (sprint, mass start) is that 3 athletes can ski side by side without interfering with each other. The HI has to consider that.

5.2 Relay

Relay competitions in both techniques can be carried out both on Category D and E courses. Two different 2.5 courses can be considered as one 5 km course, two 5 km courses can be considered as one 10 km course provided that athletes can ski at the same time on all parts of the course without interference. For relay competitions with many spectators, it is preferable that all legs of the relay are held on the same course (this course must be category D or E).

5.3 Interval start competitions

If the rules and recommendations are followed, the most important thing to consider for the HI is that overtaking and passing can take place.

5.4 Mass start competitions

The start area must be wide and long enough to allow for starting up to 100 athletes at the same time. After the start and for the next 500 – 1000 m, depending on the terrain, climbing, flat or even downhill, 3 or more skiers should be easily able to ski side by side. Congestions have to be avoided, such as in

- Transitions from down hills into up hills.
- Long and steep C-climbs.

In downhill sections the following has to be taken into considerations:

- Avoid sections of high speed compression followed by a curve or corner
- Avoid “blind corners” where skiers can not see the bottom of the hill etc.

Approaching the finish, the course layout should focus on allowing for overtaking and passing. If possible a final climb with opportunities for overtaking and passing should be located in view from the spectator stands. This is important in order to promote the excitement of these race formats that is so important for the future of the Cross-Country sport. The last 150 m before the finish the course must be wide enough to allow for four corridors to the finish line.

Narrow passages should be avoided on mass start courses. However if a bridge or a tunnel has to be constructed, they could be narrower than the other part of the course provided that this section is not located at a decisive part of the course. Decisive parts can be immediate after start; just before finish and other parts where one athlete can block for the others and affect the outcome of the race in an unfair

way. Such considerations should be given special attention by the HI, and given comments in the Homologation report.

Extra space for feeding stations is an element affiliated with mass starts that should be given special attention. The HI should look for appropriate locations around the course that are extra wide to accommodate a large group of coaches. The feeding locations are best located during undulating terrain, and on a straight section followed by a slight downhill. Optimally an extra 6 meters in width (30 meters long) is needed for a feeding station (feeding on both sides).

5.5 Skiathlon

In addition to the requirements mentioned above, special attention must be given to the area for equipment change, which has to take place in the stadium. In order to show the excitement of this race format, the athletes should come through the stadium as a minimum every 2.5/3.75/5 km. That means for the ladies 7.5 km + 7.5 km, the laps could be 2.5 or 3.75 km. For the men's 15 km + 15 km, a 3.75 km or 5 km course could be used the same way.

5.6 Sprint Classical technique

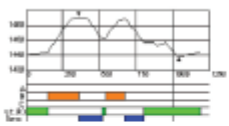
The overall goal when designing a classical sprint course is to make sure that the diagonal technique is used, which means hilly enough such that the skiers are applying kick wax under the skis.

The data below is for the men's classical sprint course. Ladies courses can be easier.

- Include minimum two uphills
- Gradient 12 – 18 %
- HD of one of the uphills should be minimum 20 m
- HD of the second uphill should be minimum 15 m.
- Both flat and up hill sections should include straight sections that allow for overtaking and passing. Too many curves on flat parts give advantages to those athletes using skating skies.
- A slight gradient uphill towards the finish should be applied.
- Down hills with curves where several technical and tactical choices of best line is possible, is recommended.

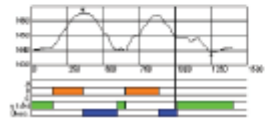
Examples:

1,2 km sprint
1,2 км спринт

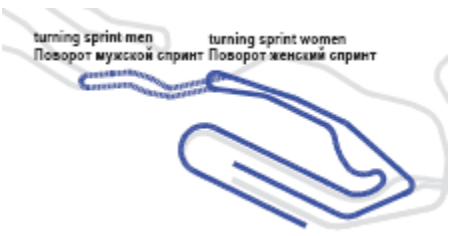


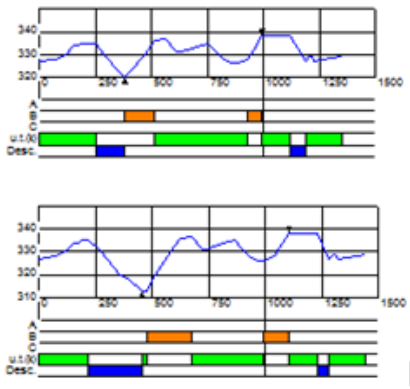
TC 43 m (0 – 60 m)
MC 23 m (0 – 30 m)
HD 26 m (< 30 m)
HP 1468 m asl (< 1800 m)

1,5 km sprint
1,5 км спринт



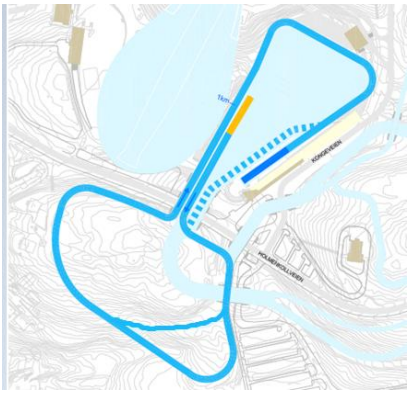
TC 55 m (0 – 60 m)
MC 24 m (0 – 30 m)
HD 26 m (< 30 m)
HP 1468 m asl (< 1800 m)





TC 45 m
MC 16 m
HD 18 m

TC 52 m
MC 24 m
HD 25 m



5.7 Sprint Free technique

Normally sprint competitions in Free Technique should meet the same requirements as for Classical courses. However they can be held on flatter courses (such as city sprints, track and field stadiums etc)

6 Design of Courses

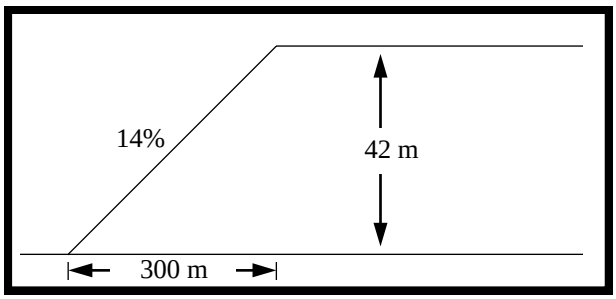
6.1 Uphill Terrain

Course designers and homologation inspectors must appreciate that there are many factors that can contribute to the difficulty of a climb. In designing a course the possibilities for various kinds of climbs should be emphasized.

The steepest up hills are not necessarily the ones that best separate the best skiers from the others, since the steepness often limits the speed regardless of technique and athlete's capacity. The best courses are those that include all kinds of uphills, with a variety of lengths and gradients. The ideal solution is for example one major uphill with an average gradient of 6%, another with 12%, and a third with 9%.

A few examples may help out some considerations in how to design different climbs.

This example will normally not homologate (over this specific interval)



Specific climb gradient = 14%

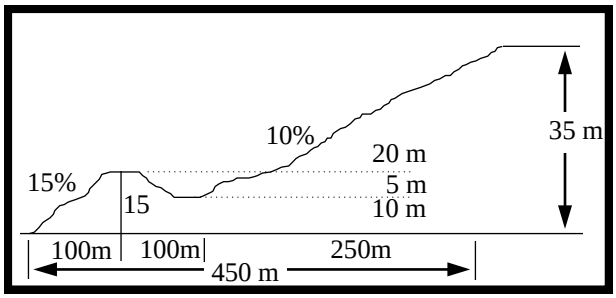
Average gradient of climb = 14%

Overall HD of climb = 42m

Added to TC from this climb = 42m

This will fail as a good design for a major climb since it has an average gradient greater than the 6% - 12% (ICR para 313.1.3). Design changes should extend the length of this climb using short breaks, thus lowering the average.

This example will homologate as a major climb.



Specific climb gradient = 15% & 10%

Average gradient of climb = 7,8%

Overall HD of climb = 35m

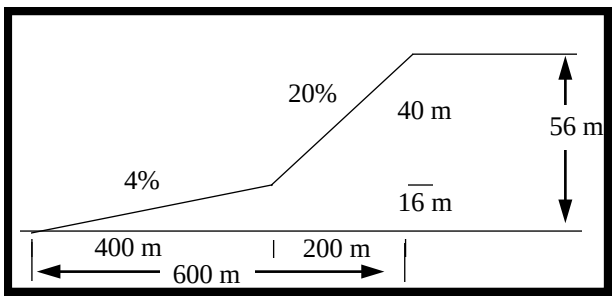
Added to TC from this climb = 40m.

(15 + 25m)

*Note: TC is the sum of all individual positive HDs.

The interruption consists of undulating terrain. Thus a small downhill with HD < 10m can be included.

This example will not homologate as a major climb.



Specific climb gradient = 4% & 20%

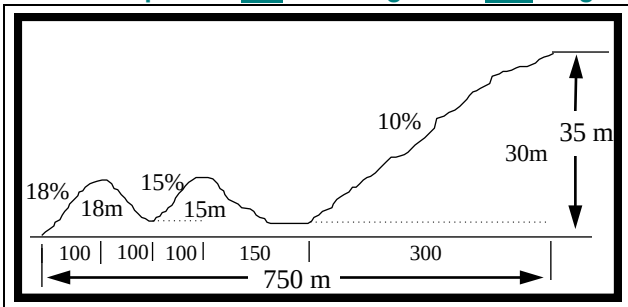
Average gradient of climb = 9,3%

Overall HD of climb = 56m

Added to TC from this climb = 56m (16 + 40m)

This example illustrates why the majority of the sections of climb in a major uphill belong in the range of 9 - 18% (ICR paragraph 313.1.2). Both these gradients of 4% and 20% are outside the range even though the average gradient is in the range of 6 - 12%. This would represent a poorly constructed uphill due to the long section at 20% for 200m. This is unacceptably long and must be broken up into shorter sections of varying slopes or eliminated altogether. Steep up hills, type "C" with gradient > 18% are not recommended to exceed 30m in length, with a single maximum HD of 10m. It is necessary to stress that these "C" climbs are kept short and not too steep so that the rhythm and tempo can be maintained while providing some technical and tactical features to the course. For mass start competitions in Classical technique any C climbs should be avoided.

This example will not homologate as one single major climb.



Specific climb gradient = 18%, 15% and 10%

Average gradient of climb = 4,6%

Overall HD of climb = 33m

Added to TC from this climb = 63m (18 + 15 + 30m)

This is an example of two individual "B" climbs and one "A"climb. Lesser HD's(<10m) in this situation would return the B climbs to undulating terrain.

Undulating Terrain (Gradient < 9%) As Part of A Major Climb

Major up hills are defined with a gradient of between 9% - 18%. The average gradient in a major uphill should be between 6% - 12%, thus an uphill can include undulating terrain. In fact undulating terrain shall normally be parts of a major uphill. Such undulating sections can occur at the beginning, in the middle section or at the end of the major climb.

The acceptance of undulating sections within a major climb is based on their location and length. If an undulating section is accepted as part of a climb it counts to the up hills in the overall calculation of the terrain distribution.

When they occur in the middle of the climb it is a fairly simple solution. If they are less than 200m in length or include a downhill of less than 10 m HD, the climb is not broken and the overall HD is used to determine the climb's average gradient. When they occur at the beginning or end of the climb, then the decision to allow them will depend on three basic principles:

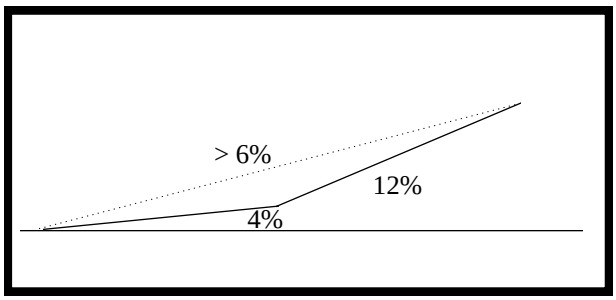
a) is the average gradient between 6% - 12% when they are included

b) sections of uniform gradient must either be completely included or excluded

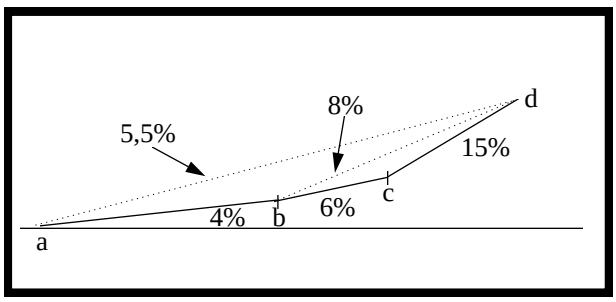
c) does the undulating section add sufficient physical demand to the skier

The last point is intended to be a judgement call on the part of the inspector in cases where the average gradient borders on the limits of 6% or 12%.

Sample profiles



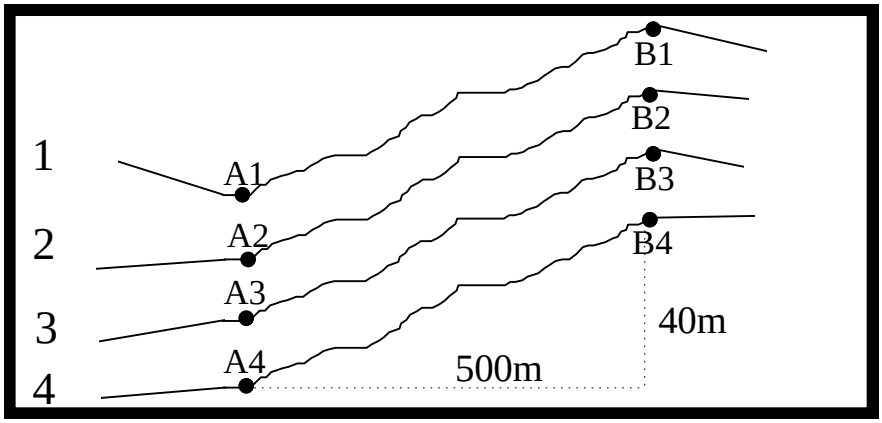
Normally accepted providing the 4% section is not excessively long.



Major climb is from B to D only. The HD from A to B is not included as part of this major climb. AB is an undulating part of the course, and the TC from this section is added to the TC of the course.

Effects of Surrounding Terrain on the Uphill

For course designers it must be appreciated that the following 4 examples represent sections that get progressively more difficult for the skier to ski, yet our homologation system would rate them all with average gradient of 8% with HD of 40m from A to B.



They would all be included as a good A climb in any course. The nature of terrain before and after the climb can add substantial physical demand without affecting the definition of the climb itself. One main purpose of Cross-Country course design is to create courses that separate the good skier from the less skilled one. A major climb like example 4 should be a part of every well designed course. Even though the specifications are the same for all of the above examples it should be recognized that hill no. 4 is much more demanding to ski than the others because of the characteristics of the terrain before and after the uphill section.

6.2 Requirement for the number of A- and B-climbs

Length of Loop	Major Uphills (A)		Short Uphills (B)	Steep Up-hills (C)
	Gradient 9 - 18 %		Gradient 9 - 18 %	≥ 18 %;
	Average 6 - 12 %		10m<PHD<29m	4 m<10 m< PHD
	Qty	**PHD (m)**	**Qty**	**Qty**
Sprint Classic			1 - 2	0
2.5 km	1	30 - 50	1 - 3	0 – 2
3.3 km	1	30 - 50	2 - 3	0 – 2
3.75 km	1	30 - 80	3 - 4	0 – 2
5 km	1 - 2	30 - 80	3 - 5	0 – 3
7.5 km	2 - 3	30 - 80	4 - 6	0 - 4
8.4 km	3 - 4	30 - 80	4 - 7	0 - 4
10 km	3 - 4	30 - 80	5 - 7	0- 4
12.5 km	1 - 2	51 - 80	6 - 9	0 - 5
	2 - 3	30 - 50		
15 km and 16,7 km	1 - 2	51 - 80	≥ 8	0 - 8
	3 - 5	30 - 50		

6.3 Location of Climbs

The location of the climbs along the course is as critical as their total climb or elevation values, and together these factors determine the flow and balance of technique as well as when the maximum physical demands are placed on the skier.

The table above gives recommendations to the location of the major climbs. These "location ranges" can be slightly modified to suit the given terrain and minimize the environmental impact.

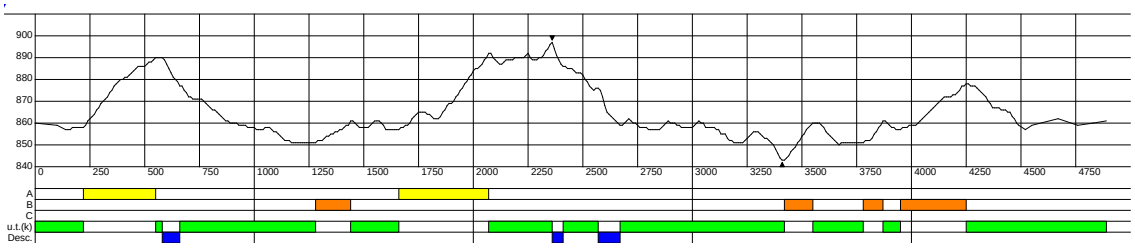
The location of major climbs in the terrain must be a primary influence on where the stadium should be placed so that there is good access to the best terrain at appropriate distances along the course. If possible the ideal solution is to place the stadium close to the middle between the highest and lowest point. The reason for this is that it gives flexibility for course design.

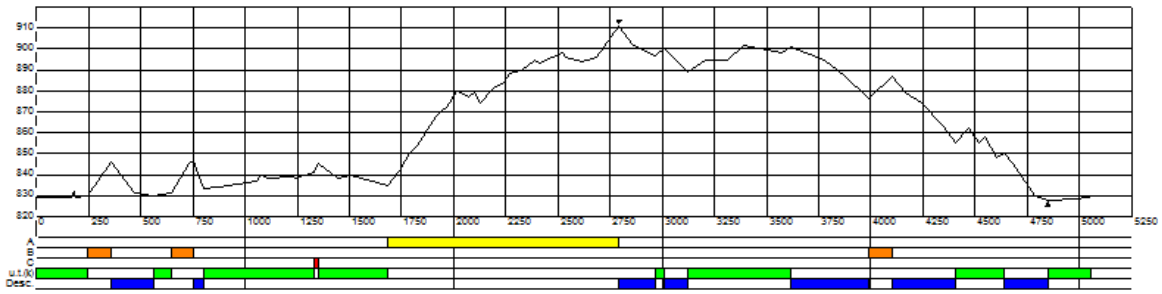
The “A”climbs should represent between 25% - 55% of the total climb (TC). Also the “B”climbs should represent between 25% - 55 % of the TC, while undulating terrain should provide for 15% - 35%.

For example, if a reasonably difficult 5 km loop (World Cup level) is to be designed the TC should exceed 180 m. This will require two major uphills of a total of 80 – 90 m climbs. This could be a combination of a 60 m hill and a 25 m hill, or a combination of a 50 m hill and a 30 m hill. This situation suggests terrain requirements with HD of 80 m to add flexibility in laying out the course.

In order to preserve cross country course traditions while at the same time using shorter loops, a 5 km loop could include one or two A-climbs (see first example below). If there is only one A-climb the PHD should exceed 45 m and could be up to the maximum of 80 m (see second example below). Another solution could be that the two A climbs follow each other (see third example below).

6.4 Examples of homologated Championships courses





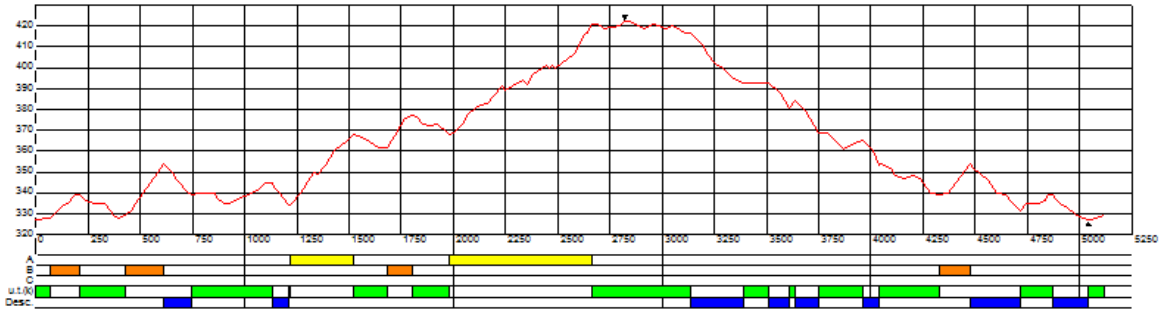


Table for Heighth Difference (HD), Maximum Climb (MC) and Total Climb (TC) in the design

See section 14, ICR Paragraph 311.2.5

6.5 Design of Undulating Terrain

Its definition is found in ICR 313.1.4 and is best summed up with words "rolling terrain" including short ups and downs interspersed with flat sections.
Rising terrain with less than 9% gradient will be considered undulating terrain. Short climbs (9 – 18% with HD less than 10m PHD, or >18% and less than 4 m PHD) are also included in the definition of undulating terrain. Short down hills with HD < 10m are parts of the undulating terrain as well. As indicated earlier in this manual undulating terrain should be included as parts of a major climb.
The TC of a course includes all positive elevation changes found in undulating terrain.

6.6 Design of downhills

Safety together with technical and tactical challenges to the skier should be taken into consideration when a downhill is to be designed. A good Cross-Country course includes various kinds of down hills, long and short, steep and slowly falling terrain. In downhill curves the need for slight banking or super-elevation must be emphasized.

Short down hills have an HD between 10m and 29m. Long downhills have an HD >30m. Safety and the technical challenges need to be taken into consideration when the steepness is evaluated.

Undulating terrain can be included in a downhill. If those sections also include small up hills, the elevation of these up hills also counts to the TC of the course.

6.7 Homologation of Multiple Lap Courses

The data from the table in 6.9 is designed to represent single loop distances. Sprint competitions should be carried out on single loop courses. Other competitions such as relay-, mass start- and skiathlon competitions should be carried out on multiple lap courses.

It is important to note that loops which will serve several racing distances should have climbs designed so that the major climbs could be increased or decreased through the use of cut offs or similar alternate routes.

The rules and guidelines give many possibilities for variations in course design. The solution will be a judgement call on the part of the designer and the inspector.

When planning a competition course, the Total Climb (TC) for the **whole** competition distance has to be taken into account when TC for shorter loops are considered.

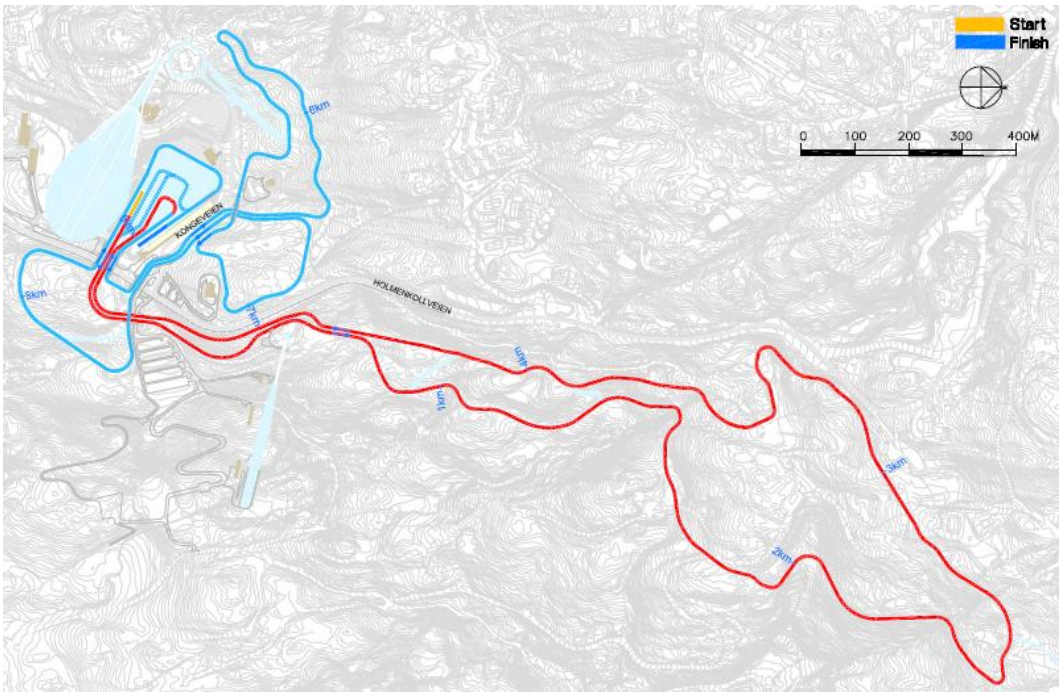
For example, a 5 km loop with a TC of 180 m is in the middle of the suggested range for a 5 km course, while the TC for a 50 km competition on the same loop (10 laps) will be 1800 m, which is at the *upper* level. A challenging course that tests the skier's ability does not need to be at the maximum in order to be a good course. There are many combinations of factors that make the course a good one.

6.8 Standard marking of courses

Skiathlon competitions are the most demanding formats that will normally require two different courses. In order to better inform athletes and coaches about the course system the Classical course should be marked red and the Free Technique course marked blue. The courses could then be named:

Red	Blue
1.4 km or	1.4 km
2.5 km	2.5 km
3.3 km	3.3 km
3.75 km	3.75 km
5 km	5 km

The longer courses (7.5 km, 8.4 km and 10 km) will then be a combination of the shorter red and blue courses. See example below.



8,3 km course WSC 2011, Holmenkollen, Oslo, Norway

6.9 Guidelines on Course Distances used in different Competition Formats:

Competition courses WC, WSC and Olympic Broadcast requirements			
Event	Minimum loop	Optimal loop	Comments
Interval start 10 km	3,3 km*	5 km	
Interval start 15 km	5 km	7,5 km or 10 + 5 km	
Interval start 30 km	5 km	7,5 km or 10 km	
Interval start 50 km	10 km*	12,5 km or 16,7 km	
Mass start 10 km	2,5 km	2,5 km or 3,3 km	
Mass start 15 km	2,5 km*	3,75 km or 5 km	
Mass start 30 km	3,75 km*	5 km, 7,5 km or 10 km	
Mass start 50 km	7,5 km	8,3 km or 10 km	Can use two different shorter loops if separate through stadium for example two different 5 km courses or a 3,3 km + 5 km
Skiathlon 5+5 km	2,5 km	2,5 km	Can use same course for both techniques if it is wide enough (12 m)
Skiathlon 7,5 + 7,5 km	2,5 km	2,5 km or 3,75 km	Can use same course for both techniques if it is wide enough (12 m)
Skiathlon 10 + 10 km	2,5 km	2,5 km or 3,3 km	Can use same course for both techniques if it is wide enough (12 m)
Skiathlon 15 + 15 km	3,75 km	3,75 km or 5 km	Can use same course for both techniques if it is wide enough (12 m)
Prologue 2,5 km, 3,3 km or 3,75 km	2,5 km	2,5 km, 3,3 km or 3,75 km	
Relay 4 x 5 km	2,5 km	2,5 km or 5 km	Can use same course for both techniques if it is wide enough (9 m)
Relay 4 x 10 km	2,5 km*	2,5 km, 3,3 km or 5 km	Can use same course for both techniques if it is wide enough (9 m)
Individual sprint	0,4 km	0,8 km up to 1,8 km	
Team sprint	0,4 km	0,8 km up to 1,8 km	Two laps on a short loop can be used.
Special cases			Popular competitions or Example Alpe Cermis - to be dealt with individually.
1. The minimum loops marked with an asterisk * - especially for interval start competitions – must only be used in unique sitations. For example no 10 km interval start competition should be planned to be held on a 3.3 km long course. Only in lack of snow should the shorter loop be an option.			
2. In all competitions the TV Director must be involved at the earliest possible moment to evaluate which course would be best for TV for this particular event. The overall scheduling of the event (budgeting, other factors) might have an influence on this. For example, sometimes – for practical reasons – it is better to do a skiathlon on the shorter loop even if the longer loop would give better TV pictures. This could be the case, especially in WC events, where the schedule can be very tight, and Nordic Combined or another competition needs to be taken into consideration.			
3. The stadium layouts should always be discussed with the TV director in advance. The stadium layouts should be standardised to the extent possible.			

7 Homologation of courses for skiers with disabilities.

7.1 Competitions for skiers with disabilities (governed by IPC Nordic Skiing) also take place at venues designed and homologated for FIS competitions. It is

therefore important and desirable (from a venue development and homologation perspective) to also take into consideration homologation requirements for skiers with a disability when beginning new trail design and homologation projects. This is a necessity forOlympic /Paralympic Venues.

In general, the philosophy for FIS homologation, and the requirements and recommendations for stadium and course design also apply to designing trails for skiers with disabilities. In general the standing classes of skiers can use the same courses as able bodied classes. However since certain classes and categories have clear physical limitations (such as sit skiers and visually impaired skiers), the courses must in general be made easier, with special attention to fast downhill sections, sharp curves, and steep or long up hills. With the exception of sit ski courses which generally need to be separate courses, IPC homologation requirements can normally be integrated into FIS homologated courses with the addition of cut offs (to reduce MC's or technical down hills).

Homologation standards for skiers with a disability are published in the **IPC Nordic Skiing Homologation Guide** which can be found at: http://www.ipc-nordicskiing.org/Rules/ . Designers, homologation inspectors, and venue owners should become familiar with these standards when beginning new projects.

8 The Cross-Country Stadium

see also section 14, paragraph 312.

There are normally 2 different stadium layouts

- Horseshoe layout and
- Ski out and in stadium where the horseshoe layout is the preferred one by TV.

8.1 Size, Location and Orientation

Article 312 in the ICR includes all requirements that a stadium has to meet. The main objective is to design a stadium so that an exciting atmosphere for athletes and spectators can be experienced. That means that the stadium should not be larger than absolutely necessary, approximately 50 - 60 m wide and 150-200 m long. The finishing straight should be between 130 – 150 m long with a slight gradient of 2 – 4% to the finish.

When determining the location of the stadium, the movement, functionality and flow (ingress and egress) for all categories of personnel who have access to the stadium must be considered.

Ideally the stadium should be located within the terrain somewhere in the middle between the highest and lowest point on the course. This would improve the flexibility for course design by permitting access to a greater variety of terrains. Sufficient space must be adjacent to the stadium in order to provide easy and secure access between the various services for media, team cabins, warm up, wax testing and the start. Maximizing the benefit of exposure to the sun is key to a successful atmosphere. The stadium should be oriented in such a way that the main area for

the spectators is in the sun, and that the athletes have the sun in their faces at the finish. It is usually preferable to have spectators on both sides of the stadium in-field.

8.2 Functionality

8.2.1 General

To plan for the highest level of competitions the access for all categories of people to their designated positions without interfering with each other is of paramount importance. There are several categories of traffic that have to take place during a competition. It is traffic for:

- Athletes, coaches, team leaders and service personnel
- Spectators
- Organisers' officials
- TV and Media (press, photo)
- IOC and FIS officials

All these categories of traffic have to take place at the same time without interfering each other.

8.2.2 For the athletes the most important aspects of a stadium are:

- Easy and safe (non-slip) access between wax cabin service area, warm up track and start
- Provide fair start and finish conditions for all sorts of competitions (interval start 15 or 30 sec., skiathlon, sprints, regular mass start, mass start with ski exchange and relays)
- The Finish Zone should have a slight inclination 2-4% up to a length of 150 m. This can include some small natural undulations.
- A downhill leading into the finish zone should be avoided. If this is not possible, some speed reducing measures, for example curves, should be implemented.
- Provide good conditions for clothing and feeding services.
- Sufficient space for coaches, competition equipment and final warm up.
- Good visibility of the scoreboard.
- Adequate space for lapping lane, pit stop for equipment change and relay exchange zone

The Skiathlon competition is the most demanding format for stadium design. It is because of the access to the start area, the transit for the classical course, the connections between the classical course and the ski exchange pits, the connection between the pits into the free technique course, the transit for the free technique course, and finally to the finish. This has to be laid out without course crossings that will require bridges. For mass start competitions where exchange of skis is allowed, the same considerations apply.

8.2.3 For TV and media it is very important to provide opportunities for good coverage in these locations:

- Start Line
- Finish Line

- Finish Zone
- Equipment Change Zone
- Relay Exchange Zone.

To obtain good media conditions the following has to be prepared:

- Good, unobstructed camera positions
- Facilities for photographers, writing journalists, radio and TV reporters. The detailed organization of these facilities should be done in cooperation with press people who will function in the start and finish area
- Rooms for press people and press conferences that are close to the start and finish area
- High quality and quantity of electrical power
- A parking area for TV buses
- Provide something that gives the stadium its own unique identity

8.2.4. Provide and organize space in a Mixed Zone for:

- TV Host broadcaster
- TV Rights holders
- Radio
- Electronic network gathering crew
- Photographers
- Writing press
- Service personnel (ski industry supplier representatives)
- Doping control personnel
- Ski patrol/medical (when needed)

Planning solutions for all of these different needs, while keeping the athletes as a primary focus, requires active input from all groups working in the stadium. Looking at previous models from other successful organizers is a very important first step.

Examples of mixed zones at successful venues are included in Section 15 in this manual.

9 Waxing Cabins, Ski Test area and Warm up course

9.1 Waxing cabins

For the teams the wax cabins and waiting rooms are important. They have to be located so that the access to the Start/Finish area is unobstructed, safe (non-slip) and fenced off from spectators and media. The cabins can be located in halls, tents, trailers or permanent buildings. Each participating team and FIS equipment supplier should have their own cabin that can be locked in order to store the material under safe conditions. The size of the cabins (or space) should as a minimum be in accordance with the World Cup rules (approximately 3 meter square per athlete). The FIS equipment suppliers will also have requirements for cabins.

In the cabins the installations should include

- Several electric outlets
- Adequate heating and ventilation
- Shelves
- Waste bins
- Security installations

In addition to waxing cabins separated changing rooms for women and men should be provided. In this area a sufficient number of toilets must be installed.

Several teams have their own waxing trucks, which require flat parking space as well as special power.

9.2 Ski test area

Planning of a separate ski test area and warm up course is a very important part of the Homologation process. For interval start competitions the testing has to take place outside the competition course, however if the course is wide enough warming up and can take place on a separate lane adjacent to the competition lane. For mass start competitions the testing can take place on the competition course. The SRS equipment suppliers depend heavily on this area in their testing work.

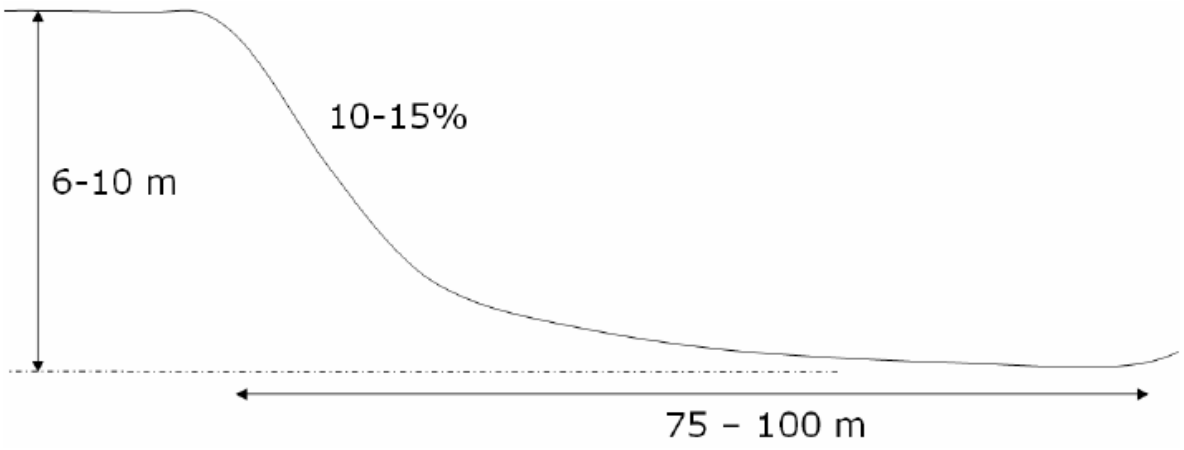
Test area should:

- Be easily accessible from the waxing cabins
- Allow unobstructed ski and wax testing for all participating teams and equipment suppliers

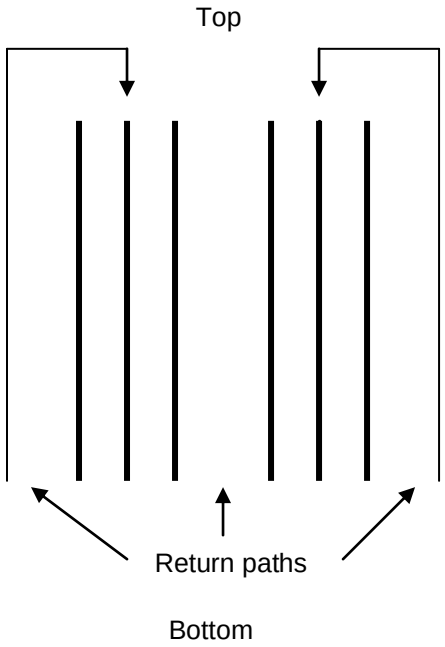
If two or more totally different snow conditions can be expected on the same course, multiple test areas should be used.

The profile of the test area should start with gradient of 10 – 15 % and then gradually flatten and should provide at least 10 seconds of skiing.

The width of the test area should allow minimum 5 parallel test tracks 1,5 m apart including return path of 4,5 m (12 m minimum). It is highly recommended to have return paths on both sides of the test area.



The ground plan of the area has to provide easy and controlled access to the top of the slope from the bottom. This could be achieved as on the figure below:



The distance between the test courses should be at least 1.5 m, the width of the return path at least 4.5 m (for skating back up the hill). For OWG, WSC, JWSC and WC competitions this will require an area of 50 – 60 m x 60 - 75 m.

Ski Depot area

In addition to using the ski test area, it is also common for teams to test skis on the course. Therefore, a ski depot area should be planned adjacent to the course where the wax technicians can store the large number of different test skis without interfering with the flow of training athletes.

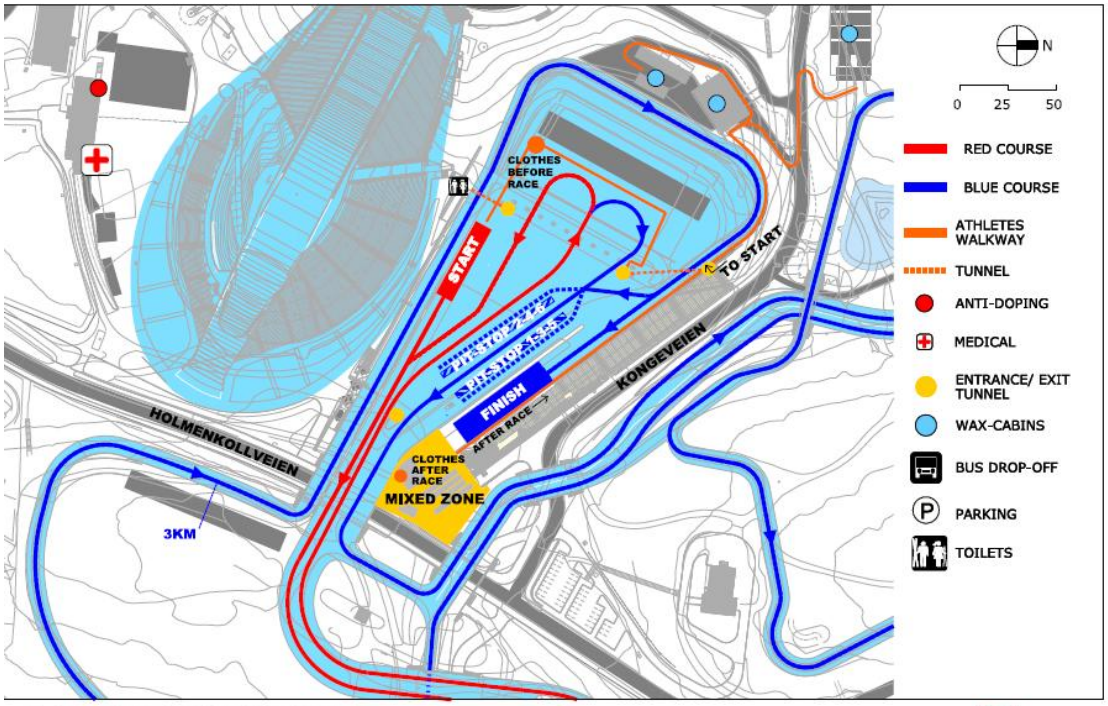
9.3 Warm up courses

The warm up courses should be designed in a way that provides use of all cross-country skiing techniques. Since many skiers are expected to be on this course at the same time, safety precautions should be considered. Blind corners, steep down hills and narrow passages should be avoided. The length of warm up courses should be approximately 1 km. This course can also be the course that provides access from the wax test area to the competition courses. Unused parts of the competition courses can be used for warm up purposes.

If a warm up course is used in both directions the course should be 10 m wide. The warm up course should provide for the same snow conditions as the competition courses, and special consideration should therefore be paid to the sun exposure. It has to be noted that for mass start competitions, where there is time for it, the warm up for the athletes can take place on the competition course.

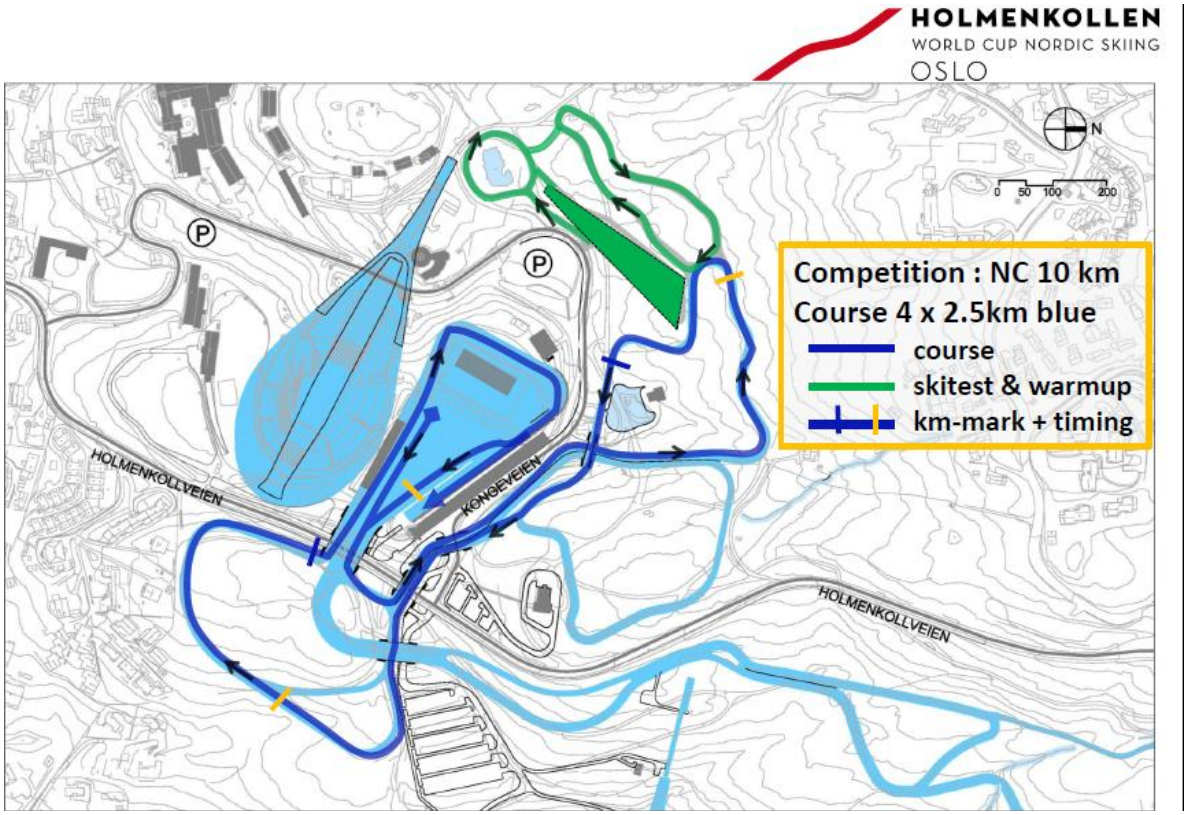
9.4 Examples of Stadium Configurations

Below see a general stadium layout, warm-up and test areas from the 2011 Nordic World Ski Championship stadium, Holmenkollen. More examples are in Section 15.



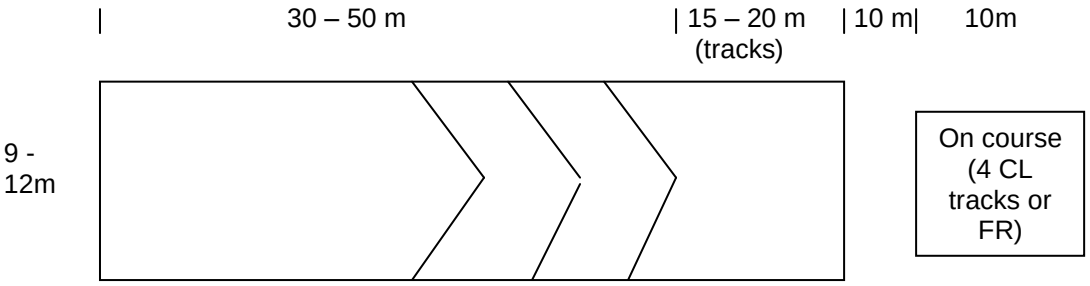
CROSS COUNTRY STADIUM LAYOUT
30KM PURSUIT M
M 1:2000 (A4)

OSL2011 Holmenkollen FIS NORDIC WORLD SKI CHAMPIONSHIPS — Statoil



9.5 Mass-start grid

Data for space requirements for mass start WC, WSC, OWG and JWSC (7 start tracks):



For competitions in Classical technique the 7 or 9 start tracks should transition into 4 tracks on the course. The start tracks should be set 1.25 – 1.5 meters apart. For competitions in Free technique the same 7 or 9 start tracks should transition into the course.

10 Practising Homologation Skills

10.1 Planning of the Cross Country venue

To begin the homologation process the Organizers must consult with the inspector in order to start the work. The following information must be made available:

- name and address of their official contact person for homologation
- the proposed competition maps and all the engineering data used to produce them
- a proposed stadium layout
- the planned infrastructure for the competition site.

After having received the appointment the Organizer and the HI make an agreement on how to complete the homologation. The HI will tell the Organizer what has to be prepared prior to their first meeting.

10.2 Purpose of the Inspection

This fieldwork by the homologation inspector is primarily a verification process to determine that the work has been carried out accurately and according to the guidelines. It is assumed that prior to this inspection there has been good consultation with the inspector during the planning and construction phases, this will support a successful project.

10.3 The Equipment Requirements for Homologation

- an inclinometer to measure gradient
- a measuring wheel with 1m circumference to determine on the ground distance between points of gradient change, or a measuring tape.
- an altimeter or GPS accurate to 1m fluctuations in altitude to determine the elevation changes between points of gradient change

- Sufficient map material, scale 1:2000 and contour interval of 1m is preferred, but other scales should be accepted. However the better the map material, the more simplified the homologation work.

The inspector has to ensure the availability of the equipment before starting the work on site. A preliminary paper-plan for the layout of the course should be done before starting the work on site.

10.4 Manual measurement and Record keeping

The method of transferring terrain data to the course profile is as follows:

1) The elevation at each point along the course where the gradient of the ground is changing noticeably has to be recorded.
2) The distance from point to point must be measured as well.
3) The gradient of each part has to be measured with the inclinometer, and the elevation change has to be confirmed by use of the altimeter or GPS.

At last the numerical description of the course will be transferred to the EIBL program which will produce the profile and the 2 sheets of paper with course specifications necessary for the production of the FIS Certificate.

Another method for course measuring is to transfer the course layout from the map into a computer that can give the data needed for the EIBL program. This service is available almost everywhere today.

11. Guidelines for the organization, education and appointment of Homologation Inspectors (HI)

11.1 For OWG, WSC and other designated competitions

the HI will serve as an expert for companies that are responsible for the total venue design.

11.2 These guidelines provide the criteria for the:

- Selection of candidates.
- Education of candidates.
- Appointment of Homologation Inspector (HI).
- Further development of the HI.
- Management of the HI.

The goal of these guidelines is to raise the standards of education and technical training to the highest level possible for all Homologation inspectors.

11.2 The authority of the Homologation Inspector

The HI is the representative of the FIS to the Organizer of the Cross-Country course homologation. He/she guarantees that the homologated course meets the standards laid down in the FIS-ICR and this manual, and that reports are being provided to the regional coordinator who sends them to the FIS office. Finally the HI must have a valid and current FIS-licence.

11.3 The Homologation Inspector Organization structure

The responsibility for all HI matters belongs to the FIS Sub-Committee for Rules and Control. A working group appointed by the Sub-Committee will prepare material and proposals on HI matters for each Sub-Committee meeting. All decisions made by the Sub-Committee for Rules and Control (SCR&C) must be approved by the Cross-Country Committee (CCC).

Regional Coordinators (RC) will be appointed by the SCR&C to oversee HI matters for their respective Region. The Regions are:

- Middle-Europe
- East-Europe
- Scandinavia with Baltikum
- North and South America
- Asia
- Australia and New Zealand

The duties of the RC include

- To promote and help to the National Associations within the region to organize and execute the Homologation Process
- For level 1 propose for HI or HI assistant
- To guide the HIs in the region in their daily work

11.4 The HI Education Process

- The Education Process provides the HI with the theoretical and practical knowledge necessary to carry out their assigned duties required to complete the Homologation Process.
- For a HI candidate to acquire and maintain a valid licence they must be selected by their NA, attend approved education seminars, pass a selection made by the SCR&C, and attend future education seminars as designated by the FIS. This selection process also includes practical homologation work under supervision.

11.5 Selection criteria for HI candidates

HI candidates should be recruited from active members of th FIS or National Ski Associations. Ideal Candidates are

- Former competitors
- Team leaders
- Former coaches
- Chiefs of Competition
- Chief of Courses

11.6 Other qualifications required are:

- To be able to communicate in English or German
- To be able to ski all types of Cross-Country courses and by that utilize the terrain possibilities in the best way.
- To be able to lead a meeting

- To be able to find solutions and make independent decisions
- To be able to understand the FIS ICR and have some experience with course design on national level.

11.7 Education requirement, timelines and content.

11.7.1 Timeline for HI education. Every two years the FIS sponsors one HI seminar. The seminar is lead by the Chairman of the SCR&C or by a member of the SCR&C responsible for HI matters. Seminar leader is responsible for

- the invitation
- seminar agenda
- lecturers
- procurement
- and distribution of educational material

11.7.2 Training period for HI

In principle the required education and training period for HI Candidates is two years. After selection by their NA the HI candidate must attend a FIS approved seminar to gain theoretical and practical knowledge, and learn the duties of the HI. After the seminar make homologation work either on national or international level under supervision of an experienced HI. The conclusion of the work has to be documented by the Homologation Report filled in by the candidate and approved by his Supervisor.

11.7.3 Homologation seminars

The FIS will organize Homologation Seminars every second year in late summer or early autumn. The seminar site should have a Cross-Country course and stadium for level 1 competitions. The duration of the seminar should be two days, starting Friday after noon or Saturday morning, and conclusion Sunday after noon.

The goal for the seminar is through discussions to develop venues in order to

- Promote the Cross Country sport in the best way.
- Spread the knowledge to new countries
- Meet the needs from new competition formats.
- Meet expectations from athletes, media and spectators
- Develop HI to utilize the terrain as described in this manual

The seminar sessions should include both theoretical and practical lessons, and refer to the latest standards and most recognized venues. The lessons should include fieldwork, deskwork, organized in working groups. The seminar should aim for developing HIs to be able to understand, interpret and apply the FIS ICR, the Homologation Manual and other valid FIS-guidelines in order to develop the venues for the best promotion of the sport.

All written program and educational material prepared by the Lecturers of the Seminar should be distributed prior to the start of the seminar.

11.7.4 Selection of HI assistants

The regional HI coordinator in cooperation with the NSA should propose to the SCR&C new HI candidates. After at least two years of successful work on national level and assisting by the international level homologation work, the SCR&C can appoint the candidate as a HI.

11.7.5 All National Ski Associations should comply with the standards laid down in this Manual and ICR. To be able for the athletes to achieve FIS-points the competitions do have to take place on FIS-homologated Cross Country Courses.

11.7.6 Continuing education. All licensed HI should attend a seminar every two years. The seminars will assure that all HI are provided with the latest in new information, rule adjustments and updated guidelines. The HI should maintain his know how by continuous work with Cross Country Venue development.

11.7.7 The License. The License is the official document showing successful selection of the SCR&C, and HI activity. It is valid for four years and must be updated by the SCR&C. The FIS Nordic Office maintain records of HI license holders.

11.8 Appointment of HI

HI for OWG and WSC is proposed by the SCR&C to the CCC who will finalize the appointment.
For WC and JSWC the appointment is executed by the SCR&C.
For COC- and FIS-level competitions the Regional Coordinator in cooperation with the NSA appoints the HI, and is responsible for the supervision and completion of the work.

11.9 Compensation

The Homologation Inspector will be appointed according to article 11.8 and the compensation per working days (on site, administration, travel) will be paid according ICR 304.1.1.

For OWG and WSC venue and course design, the homologation process is more substantial than for other events and venues. It is strongly recommended that the Organiser or its design firm hires a Cross-Country course design expert for technical advice through the whole venue design process.

The FIS CC Sub-Committee for Rules and Control (SCR&C) will provide a list of such experts from which the OWG and WSC Organiser or its design firm can choose. The terms of appointment, including fees, are to be concluded between the Organiser and the expert directly.

11.10 CHECK LIST for the HOMOLOGATION INSPECTOR

11.10.1 Homologation Inspectors' sequential check-list

11.10.2 1st step:

For sites with existing courses the Organizing Committee (OC) provides the inspector with the following documents:

- map, scale 1: 2 000, with 1 m contour interval and courses traced
- written description of the longitudinal section
- graphic description of the longitudinal section, scale 1:10, with the characteristics of the course profile made by the EIBL program.
- plan of the stadium, scale 1:500, and a functional description

For sites that are developing new courses or making major upgrades to existing facilities these steps should follow some collaborative design work with the inspector and the on-site designers so that homologation requirements can be incorporated in the design phase. This usually requires at least one preliminary visit to the site.

11.10.3 2nd step:

The inspector makes a preliminary inspection of the papers and asks the OC to provide him with any missing documents or unclear/inaccurate data. If the course cannot be homologated based on the documents he has received, the inspector informs the OC in writing, thereby stating clearly the premises that have not been fulfilled.

11.10.4 3rd step:

The OC sends the corrected documents to the inspector and they agree upon a date for the homologation.

11.10.5 4th step:

The homologation is done on the spot.

1. The written description of the course profile is inspected through a complete re-measuring of the terrain. Corrections are done in agreement with the applicant.
2. The graphic description of the course profile is adjusted to the new measurements.
3. The plan views of the course are inspected and adjusted if necessary.
4. The plan of the stadium is inspected by measuring in the terrain, and corrected if necessary.
5. The functioning of the whole competition area concept is evaluated.
6. For level 1 venues a TV expert should be involved at this stage in order to make sure that the TV requirements are met.

11.10.6 5th step:

The inspector writes a provisional report on the relevant form and delivers it to the OC. He makes all the adjustments and changes necessary for the preparation of the final application for homologation, which is to be sent to the responsible member of the Sub-committee, Cross-Country Rules and Control of FIS.

11.10.7 6th step:
The OC makes the changes and adjustments agreed upon, establish the final version of the documents listed below and sends three copies of each to the inspector.

- Written description of the course profile, made by the EIBL program
- Graphic description of the course profile, made by the EIBL program
- Plan of courses, electronic document
- Plan of stadium, scale 1:500
- Course profiles, plan of course and plan of stadium as they are going to be presented to the teams.

11.10.8 7th step:
The inspector writes out the final homologation report and sends it electronically to the responsible homologation coordinator of the Sub-committee Rules and Control, together with the following documents:

- a list of the changes made during the homologation
- the final descriptions, plans and profiles mentioned in step 6.

NOTE: When a FIS inspector is nominated, the FIS Nordic Office informs him/her accordingly. The applicant (OC) contacts the inspector. If the inspector is to be involved in the establishment of a new CC area, a first visit to the site for a thorough evaluation of the terrain precedes Step 1.

12 PROCEDURE FOR CROSS-COUNTRY COURSE HOMOLOGATION

12.1 Request for homologation of Cross-Country courses from the National Ski Association to FIS Office. In the request it has to be stated for which level of competition the courses should be homologated: Olympic Winter Games (OWG), World Ski Championships (WSC), World Cup (WC), Junior World Ski Championships (JWSC), Continental Cup (COC) or FIS competitions.

12.2.1 FIS Office forwards all requests to the Chairman of the Sub-Committee for Rules and Control (R&C), for OWG, WSC, WC and JWSC competitions, copies of the requests to the person responsible for homologation of the specific course, and for COC and FIS competitions, copies of the requests to the persons that are responsible in the different regions.

12.3 For the time being these persons have the responsibility as follows:

Hermod Bjørkestøl, NOR	Final acceptance of all courses, issuing FIS certificates
John Aalberg, USA	for COC and FIS competitions USA/CAN
Akira Wada, JPN	for COC and FIS competitions Asia
Christian Egli, SUI	for COC and FIS competitions Central Europe
Jakub Vodrážka, CZE	for COC and FIS competitions Eastern Europe
Finn Marsland, AUS	for COC and FIS competitions Australia and New

	Zealand
Hermod Björkestöl, NOR	for COC and FIS competitions Scandinavia,

12.4 Nomination of Homologation Inspectors (HI) should be made at the meeting of the R&C Sub-Committee, after proposals from the persons mentioned above. If necessary for an immediate homologation, nomination could be made by the Chairman of the R&C Sub-Committee in cooperation with the person responsible.

12.5 FIS-Office announces the nomination of HI to:

- National Ski Association
- Organizer
- Homologation Inspector

and asks the Organizers to make the first contact with the HI. The HI then follows the procedure in accordance with section 11 “CHECKLIST for the HOMOLOGATION INSPECTOR“ in the manual.

12.6 When the inspector has accepted the courses and stadium, and is finishing his work, he sends the report for:

OWG, WSC, WC and JWSC competitions	to the person responsible for homologation on that level (special appointment)
COC and FIS competitions	to the regional coordinator (see above) who can proceed the signed report for final acceptance to the person responsible, or return it back to HI for further improvements of the courses

12.7 The Homologation Coordinator (or appointed person for OWC, WSC, WC, JWSC) is responsible for controlling the quality of the report. If accepted, the material is forwarded to FIS for preparation and issuing of the certificate. If not accepted, the HI is contacted regarding required improvement or changes

12.8 For OWG, WSC, WC and JWSC the map material for the certificate should be in colour.

12.9 When finished, the FIS Office sends the signed certificate to the National Ski Association (NSA).

12.10 The National Ski Association is charged the cost of the certificate, and must itself invoice the OC if applicable.

12.11 For courses that have not been homologated for five years or more, the FIS Office sends a letter to the National Ski Association with information that the course should be recertificated. If FIS Office does not get a request for recertification from the NSA within three months, the course automatically looses the certificate.

12.12 The R&C Sub-Committee will make decision about recertification for the next five years, or if new homologation is required. For World Cup courses the decision is based on proposal from the WC Race Director and the TD-reports

from the last season. For COC and FIS courses the regional controllers make the decision. In the case of extension (recertification) of the homologation, a confirmation must be issued by the FIS office.

12.13 In case of new homologation, it is possible that the course can obtain a temporary one-year permission while the work is in progress. The NSA must apply for this through the FIS office. The homologation process must otherwise follow the procedure written above.

13 Homologation Documentation Certification and Material Requirements

13.1 Eibl Programm

The FIS is using a software program for Homologation. This is made by Mr. Christian EIBL, and is therefore named the EIBL-program. When all recorded data are put into the program, all required documentation will be produced automatically. Attached are all the forms that have to be filled in, and together with course maps and stadium drawings will make a complete Homologation Report.

The EIBL-program can be purchased by the FIS- Nordic Office. The National Association can provide a copy it to their appointed Homologation Inspectors. Homologation reports

The required electronic homologation report will be automatically produced by the EIBL program after all the required data are input.

The following data must be input into the EIBL program, and can be collected in many ways (from maps, from manual measurements, etc).

13.2 Ski Langlauf - HOMOLOGATION - Cross-Country

Arbeitspapier / Workingpaper

Name der Strecke / Name of the course:
.....

Wettkampfdistanz / Competition distance: .....km

Länge der Strecke / Longitude of the course: .....km

Höhenlage in m.ü.M / Altitude:

Start/Ziel: Stadium: .....

Höchster Punkt: Highest point: .....

Tiefster Punkt: Lowest point: .....

Geschriebener Längsschnitt / Numerical Description

Standort im Gelände Position on the Course	Länge Longitude (km)	Teillänge Part longi-tude (m)	Höhe Altitude m.ü.M.	HD +/- (m)	Neigung Inclination (%)	MT (m)
	0,000					

13.3 Examples of course data (created by EIBL program)

Data of the course profile

	Data						Remarks of the inspector
Name of the course	Holmenkollen 8,3 km Red						
Competition distance	8810 m						
Number and length of the laps							
Height difference (HD)	109 m						
Maximum climb (MC)	59 m						
Total climb (TC)	333 m						
Lowest point	313 m						
Highest point	422 m						
A		at m	PHD	PTC	gradient	average gradient	Remarks of the inspector
major uphills with:	1.	1200	37	38	5.00-17.50	12.33	
and Ø	2.	2050	53	59	3.33-17.65	7.52	
6.00 - 12.00% gradient	3.	5625	34	35	2.86-16.67	7.91	
in accordance to ICR 313.1							
total							39.64% part of TC
B	1.	70	11	11	0.00-10.00	7.86	
shorter uphills with:	2.	400	26	26	3.33-16.00	12.38	
10 m - 29 m MP	3.	1750	15	15	15.69-17.50	16.48	
and Ø	4.	4395	12	12	5.00-14.29	12.00	
<18.00% gradient	5.	6760	23	24	2.86-14.81	7.80	
in accordance to ICR 313.1	6.	7840	24	24	2.00-17.50	12.00	
	7.	8360	12	12	4.44-16.00	10.91	
total							37.24% part of TC
C							
steep uphills with							
Dist. <= 30 m							
and Ø							
> 18.00% gradient							
in accordance to ICR 313.1							
undulated terrain				77			
total				77			23.12% part of TC
total climb							100.00 0

13.4 DOCUMENTATION OF HOMOLOGATED CROSS-COUNTRY COURSES (Example)

FIS CROSS COUNTRY COMMITTEE
Subcommittee for Rules and Control

DOCUMENTATION OF HOMOLOGATED CROSS COUNTRY COURSES

(1) Registration Number:
(2) Location of the competition site: Holmenkollen, Oslo
(3) Organizer: Oslo 2011
(4) National Ski Association: Norwegian Ski Federation
(5) Contact person in the organizing committee: Bente Skari
(6) Homologation inspector: Karl-Heinz Lickert/Jakub Vodrazka
(7) Name of course: Holmenkollen 8,3 km Red
(8) Description of course:

Course length:	8810m	Height Difference (HD):	109m	Lowest point:	313m
Category:	D	Maximum Climb (MC):	59m	Highest point:	422m
Competition Level:	WSC	Total Climb (TC):	333m		

(9) Overview of the uphills

	No.	PTC	% of TC
- major uphills	3	132	39.64
- shorter uphills	7	124	37.24
- undulated terrain	u.t.	77	23.12

(10) Stadium area

- fixed stadium	☑	indoor working room for	
- fixed building	☑	- timekeeping	☑
- temporary stadium	☐	- calculation	☑
- temporary building	☐	- announcer	☑
- good infrastructure (access, parking, media, etc.)	☑	- media	☑
- skitesting area near the stadium	☑	- jury	☑
- warm up track near the stadium	☑	- others	☑

(11) Category for the stadium and course layout

	Individual	Sprint	Pursuit	Relay	Masstart
Stadium: suitable for following starting procedures	☑	☑	☑	☑	☑
Course: suitable for following competition formats with					
a) classical technique	☑	☐	☐	☐	☑
b) free technique	☑	☐	☐	☐	☑
suitable for mixed relay and pursuit competition					
a) on the same course					☐
b) combined with a separat course					☐

Category: D

(12) Possibility of snow making
Stadium area ☑ Course ☑

(13) Substitute course avaliable ☐

(14) Map material in accordance to art 313.4.3 ICR
very good ☐ sufficient ☑

(15) Date of the final inspection: 05.11.2010

(16) Closing of the homologation procedure:

(17) Date of the FIS-License:

13.5 FIS Certificate

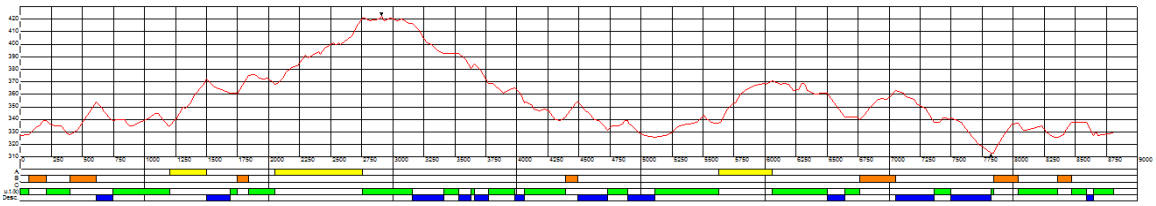
CERTIFICATE

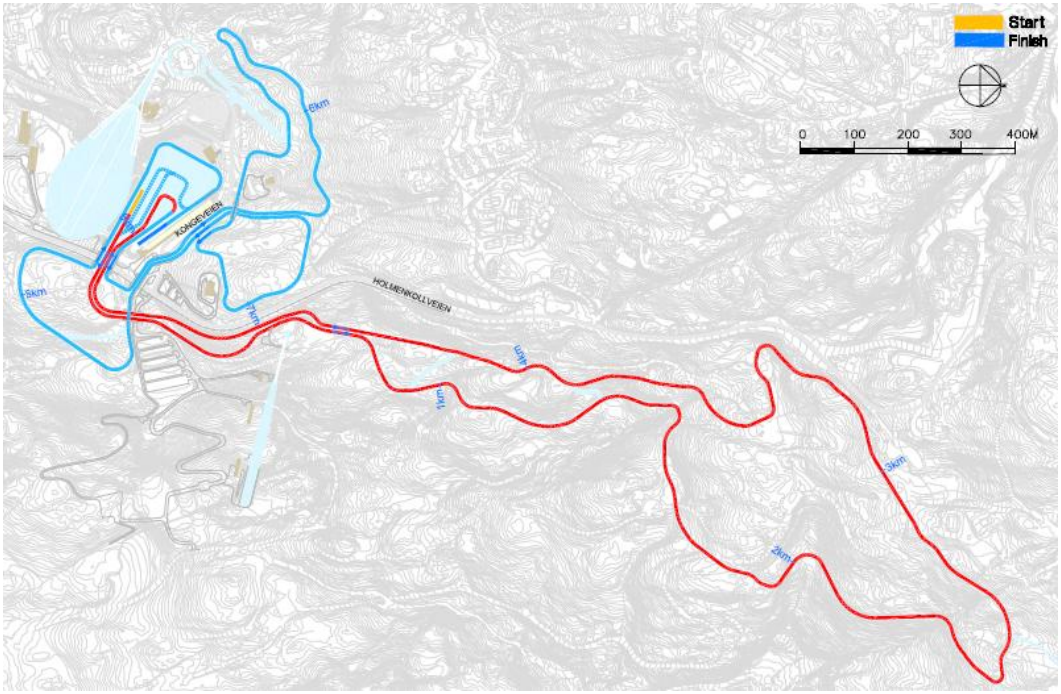
OF FIS HOMOLOGATED CROSS-COUNTRY COURSE

FIS CROSS-COUNTRY COMMITTEE

(1) Registration Number:	WC 10/07.09/8,3
(2) Location of the competition site:	Holmenkollen, Oslo
(3) Organizer:	Foreningen til Skiidrettens Fremme
(4) National Ski Association:	Norwegian Ski Federation
(5) Contact person in the organizing committee:	Bente Skari
(6) Homologation inspector:	Karl-Heinz Lickert/Jakub Vodrazka
(7) Name of course:	Holmenkollen 8,3 km
(8) Description of course:	

Course length:	8810 m	Height Difference (HD):	109 m	Lowest point:	313 m
Category:	D	Maximum Climb (MC):	59 m	Highest point	422 m
Competition Level:	WSC	Total Climb (TC):	333 m		





FIS Office	FIS Stamp	FIS Homologation Responsible	Date of Issue
Jürg Capol		Hermod Bjørkestøl	23.11.2010 Valid until 30.06.2015

14 ICR 311 Cross-Country Competition Courses

311.1 Fundamental Characteristics

311.1.1 Cross-Country courses must be laid out so that they provide a technical, tactical and physical test of the competitors' qualifications. The degree of difficulty should be in accordance with the level of the competition. The course should be laid out as naturally as possible to avoid any monotony, with rolling undulating sections, climbs, and downhill sections.

Rhythm should not be broken by too many sharp changes in direction or steep climbs. The downhill sections must be laid out so that they create a challenge to the competitors. At the same time it should be possible to ski the course even under fast conditions.

311.1.2 In principle, the Cross-Country course should consist of

- One third up hills defined as climbs with a gradient between 9% (1:11) and 18% (1:5.5) with height differences over 10 meters plus some short climbs steeper than 18%.
- One third undulating, rolling terrain, utilizing all terrain features with short climbs and downhills (with height differences of 1-9 meters).
- One third varied downhills, demanding versatile downhill techniques.

311.1.3 At OWG, WSC, JWSC, WC and COC Cross-Country competitions the courses may only be used in the direction established in the homologation certificates.

311.1.4 A ski glide testing area with testing tracks for all participating teams must be located close to the stadium. It should be close to the team wax cabins and warm up track. The testing tracks must be prepared to the same standard as the competition tracks.

311.1.5 Warm up courses should be prepared as close as possible to the stadium.

311.2 The Homologation

311.2.1 All FIS Cross-Country competitions should be carried out on homologated courses. The details on homologation procedure are described in FIS Cross Country homologation manual.

311.2.2 In competitions designed for CC sport promotion it is possible to use courses outside of the homologation standards providing they have been approved by the Sub-Committee for Rules and Control.

311.2.3 The Organizer must supply copies of the approved course maps and the homologation certificate to its TD. A graduated scale and a north direction arrow must be included.

311.2.4 Definitions

311.2.4.1 HD (height difference) is the difference in height between the lowest and highest points of a competition course.

311.2.4.2 MC (Maximum climb) is the climb with the highest partial height difference, in other terms, the biggest uphill. The uphill can be interrupted by a section of undulating terrain that does not exceed 200 m in length or a downhill that does not exceed 10 m PHD.

311.2.4.3 TC (Total climb) represents a total of all climbs on the course.

311.2.5 Norms for Cross-Country courses.

The HD, TC and MC of the homologated competition courses should be within the following norms:

Course distance	HD	MC	TC
Sprint F	max. 50m	0 – 30 m	0 – 60 m
Sprint C	max. 50m	10 – 30 m	20 – 60 m
2.5 km	max. 50m	30 – 50 m	75 – 105 m
3.3 km	max. 65m	30 – 65 m	100 – 135 m
3.75 km	max. 80m	30 – 80 m	100 – 150 m
5 km	max. 100m	30 – 80 m	150 – 210 m
7.5 km	max. 125m	30 – 80 m	200 – 300 m
8.3 km	max. 125m	30 – 80 m	210 – 350 m
10 km	max. 125m	30 – 80 m	250 – 420 m
15 km and over	max. 150m	30 – 80 m	400 – 600 m

311.2.6 Course width categories

Course widths for particular race formats should follow the following table:

Category	**Minimum course width**			**Used for**
	Uphills	**Undulated terrain**	**Downhills**	
A	3 m	3 m	3 m	Interval start C
B	4 m	4 m	4 m	Interval start F Relay C
C	6 m	6 m	6 m	Mass start C Skiathlon C part Pursuit C Relay F Sprint C Team sprint C
D	9 m	9 m	6 m	Mass start F Skiathlon F part Pursuit F

Category	Minimum course width			Used for
	Uphills	Undulated terrain	Downhills	
				Sprint F Team sprint F
E	12 m	9 m	9 m	Skiathlon (both techniques on the same course)

311.2.7 At OWG, WSC, JWSC and WC competitions, the highest point of a CrossCountry course should not exceed 1800 m.

311.2.8 For COC and FIS level competitions, courses with a minimum MC of 25 m and/or highest point above 1800 m can be homologated.

311.3 Preparation of the Course

311.3.1 Pre-Season Preparation

Rocks, stones, roots, stumps, brush and similar obstacles should be re-moved. The courses must be prepared before the winter so that they can be raced even with very little snow. Sections of the course that have drai-nage problems must be corrected. The summer preparations should be of a standard which allows for carrying out of competitions with approxima-tely 30 cm of snow. Special attention must be given to downhill sections and the need for banking the curves.

311.3.2 General Preparation for the competition

311.3.2.1 The course should be completely prepared with mechanical equipment. If heavy machines are used, they should follow the original configuration of the ground as much as possible in order to preserve the undulations of the terrain.

311.3.2.2 The course must be prepared to the recommended width according to the Homologation Manual and the competition format (see ICR articles section C). The course must be prepared so that competitors can ski and pass unobstructed. On slopes where the courses traverse, they must be wide enough to allow for good preparation.

311.3.2.3 The courses and the warm up tracks must be completely prepared before the official training, correctly marked and with the kilometer signs in place. The testing tracks should have the same preparation as the competition course.

311.3.2.4 The same conditions must be ensured for all competitors during the competition. If it is snowing or blowing hard, a sufficient number of qualified forerunners and/or especially equipped patrols must be available and utilized in order to maintain constant conditions. An action plan has to be prepared in cooperation with the Jury.

311.3.2.5 All use of artificial means in order to improve the glide on the snow are forbidden. In special cases use of chemicals to prevent a soft surface is allowed.

311.3.3 Preparation for Classical Technique

311.3.3.1 The number of tracks will be decided by the jury according to the length, the width, the profile of the course to the competition format (see ICR articles section C).

311.3.3.2 The tracks should be in general set along the ideal skiing line of the competition course. The track is normally set in the middle of the course except through curves.

311.3.3.3 In curves there should only be set track where the skis can glide unrestrained in the set track. Where the curves are too sharp and the speed is considered to be too high for the skier to stay in the track, the track should be removed. In curves the track is to be set close to the fence to avoid the possibility to ski between the track and the fence.

311.3.3.4 To decide the proper course preparation and track setting, the best competitors and highest possible speed must be taken into consideration.

311.3.3.5 The ski tracks must be prepared so that ski control and gliding are possible without a lateral braking effect by any parts of the bindings. The two tracks should be set 17-30 cm apart, measured from the middle of each track. The depth of the track should be 2-5 cm, even in hard or frozen snow.

311.3.3.6 Where two or more tracks are used, they should be a minimum 1.20 meter apart measured from the middle of each pair of tracks.

311.3.4 Preparation for Free Technique

311.3.4.1 The course must be well-packed the entire width. The width of the course should be suitable with the competition format (see ICR articles section C)

311.3.4.2 The jury determines where and how tracks will be set in the downhills.

311.4 Marking the Course

311.4.1 The marking of the course must be so clear that the competitor is never in doubt where the course goes. At OWG and WSC the colors of the markings have to be determined and described in the course descriptions.

311.4.2 Kilometer signs should mark the accumulated distance skied along the course.

311.4.3 Forks and intersections on the course must be clearly marked by visible signage, and fences or V-boards must be placed across unused parts of the course.

311.5 Refreshment Stations

311.5.1 The OC must at a minimum provide a refreshment station (in the finish area).

311.5.2 The jury decides on positions or limitations on feeding stations on the competition course.

311.6 Course Protection

311.6.1 At OWG, WSC, JWSC and WC competitions the courses should be fenced along both sides at all places where spectators can potentially interfere with the competitors.

311.7 Training and Inspection of the Course

311.7.1 Competitors and team officials must be given the opportunity to train and inspect the course in competition conditions. When possible, the course should be open two days before the competition. The Jury may close the course or limit the use of the course to certain sections or hours.

312 The Cross-Country Stadium

312.1 Stadium Area

312.1.1 A Cross-Country stadium has to be prepared with a well-designed start/finish area.

312.1.2 The stadium arrangement should provide a functional entity divided and controlled as necessary by gates, fences and marked zones. It must be prepared in such a way that

- the competitors may pass through it several times,
- competitors, officials, media, service people and spectators may reach their respective areas easily,
- there is enough space to carry out all competition formats.

312.2 Start Zone

312.2.1 The first 50 m will be the start zone. This zone may be separated into corridors and classical tracks may be set. The number, width and length of corridors will be determined by the jury according to the competition formats (see ICR articles section C) and the stadium layout.

312.2.2 The starting positions will be set according to the competition formats (see ICR articles section C).

312.3 Finish Zone

312.3.1 The last straight 50 to 100 m will be the finish zone. This zone is normally separa-ted into corridors. They must be clearly marked and high-ly visible but not interfering with the skis. The number, width and length of corridors will be determined by the jury according to the competition formats (see ICR articles section C) and the stadium layout.

312.3.2 The finish line must be clearly marked with a colored line. The width of the finish line is maximum 10 cm.

312.3.3 A control line is marked 10-15 meters after the finish line. Competitors are not allowed to take off their skis until after the control line (article 206.5). Violations will be reported to the Jury.

312.4 Exchange zone

312.4.1 In team events, the exchange zone should be sufficiently wide and long, clearly marked and located on flat or smoothly rising ground in the stadium.

312.4.2 The size (length and width) should be adapted to the competition formats (see also ICR articles section C) and the available space in the stadium.

312.5 Pit boxes

312.5.1 When ski exchange is allowed, the pit box area must be designed so that each competitor has a designated box marked by his/her bib number and an exit is provided that minimizes any chance for interference. A bypass corridor must be provided so that any competitors who do not enter their pit boxes will have the shortest skiing distance past this ski exchange area.

312.6 Working Conditions

312.6.1 Competition officials, Jury members, Coaches, media and service people must have proper working zones within the stadium area so that they can work without disturbing the process of start and finish. The access of these persons to the stadium area must be controlled.

312.6.2 Timekeeping and calculation should be located in a building with a good view of the start and finish.

312.6.3 At OWG, WSC, JWSC, WC and COC competitions, FIS officials and Jury mem-bers must be provided a working room with a good view of the stadium, and in the immediate vicinity of the stadium.

312.6.4 A heated room must be provided for the medical office near the stadium.

312.7 Additional Facilities

312.7.1 In the immediate vicinity of the stadium at OWG, WSC, JWSC and WC a controlled (with fences or manual control) team preparation area with wax cabins and space for wax trucks must be installed. The cabins must be heated and well ventilated using forced air exchangers. Additional rules may apply for OWG, WSC, JWSC, WC.

312.7.2 Toilets and wash rooms must be installed for competitors near the stadium. They must be easily reached from the start area.

312.8 Current Information Facilities

312.8.1 A notice board showing results, important information from the OC and the Jury, and the air and snow temperature should be located close to the wax cabins and the stadium. The temperatures must be displayed for the following times: two hours before the start, one hour before the start, one-half hour before the start, at the start, one-half hour after the start, one hour after the start.

312.8.2 Temperature measurements must be taken in the stadium area and at places where extreme temperatures (low point, high point) can be expected.

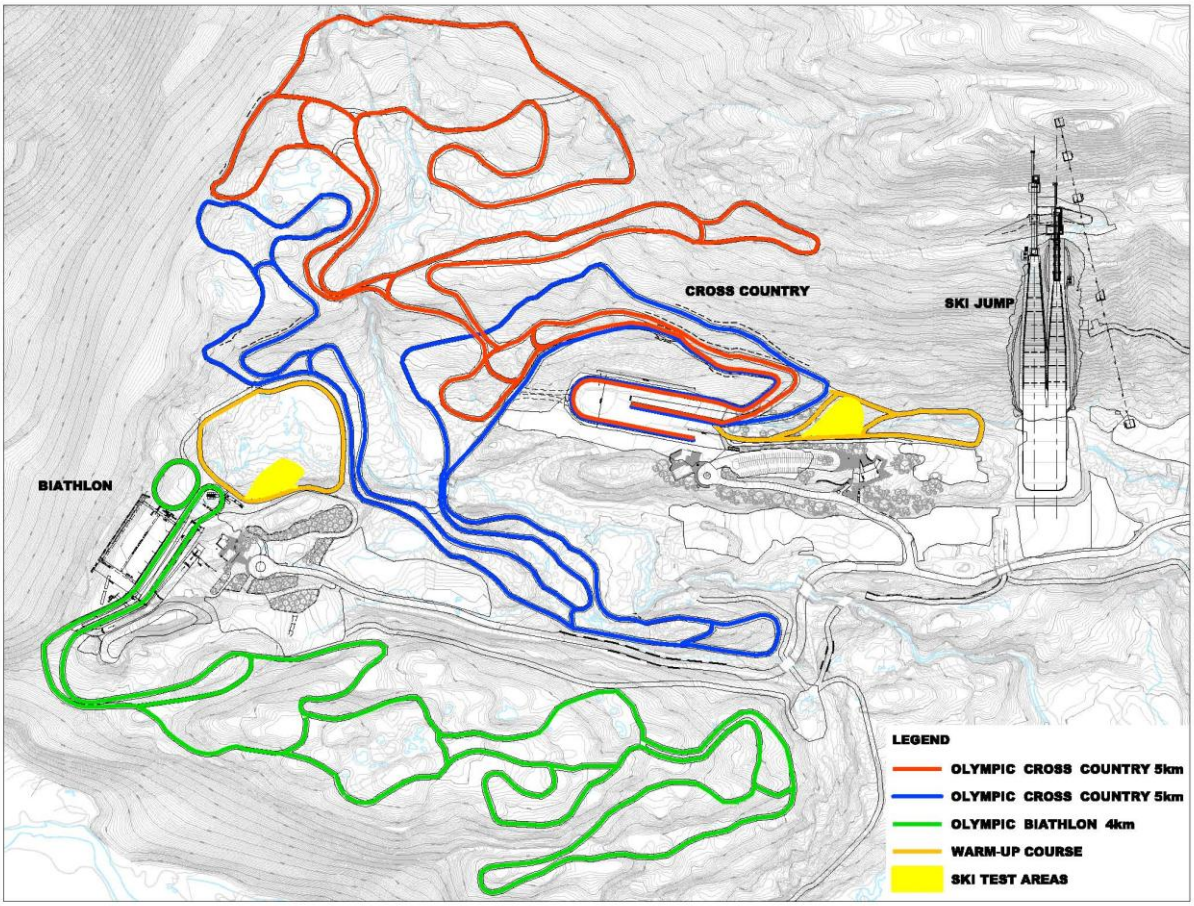
312.8.3 Loudspeakers must be used for announcing the competition and important information.

312.8.4 In order to inform international competitors, trainers, spectators, English language must be used.

15. Venue layouts

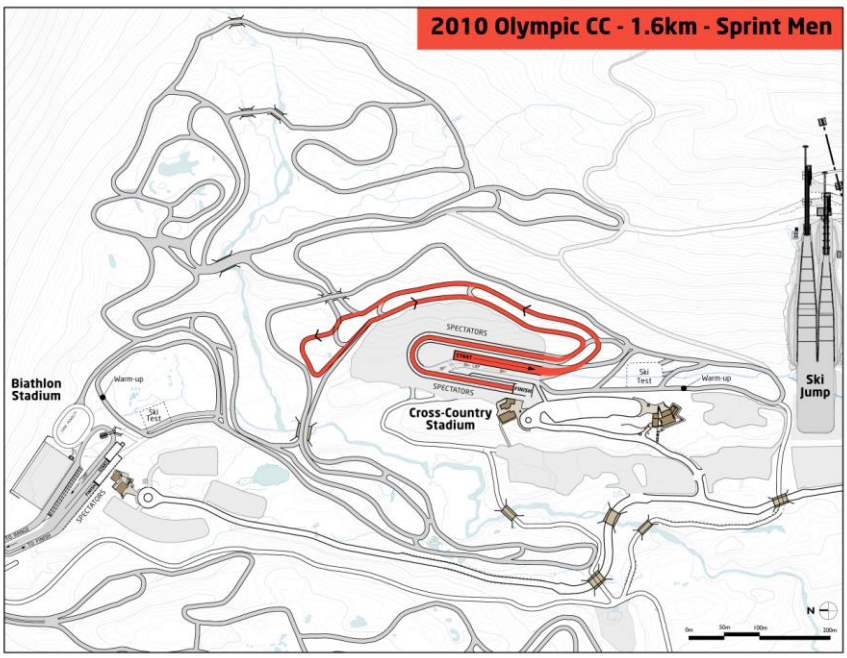
COURSE PLANS, PROFILES AND STADIUM LAYOUTS – OWG 2010, WHISTLER OLYMPIC PARK, CALLAGHAN VALLEY

OVERALL VENUE VIEW

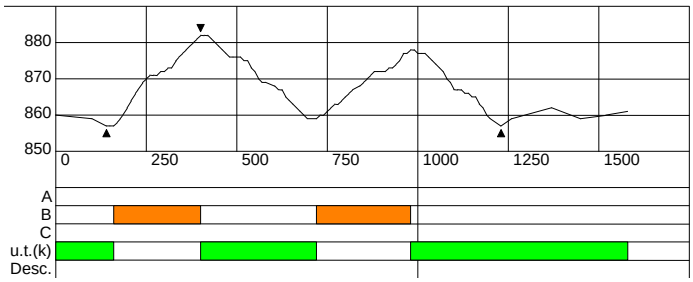


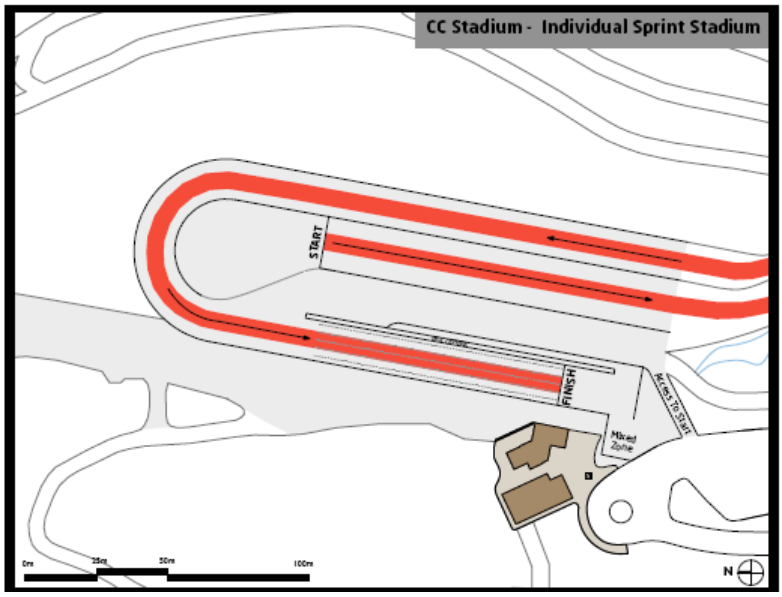
Course layout, course profiles and stadium configurations adapted to competition formats.

Individual sprint, men

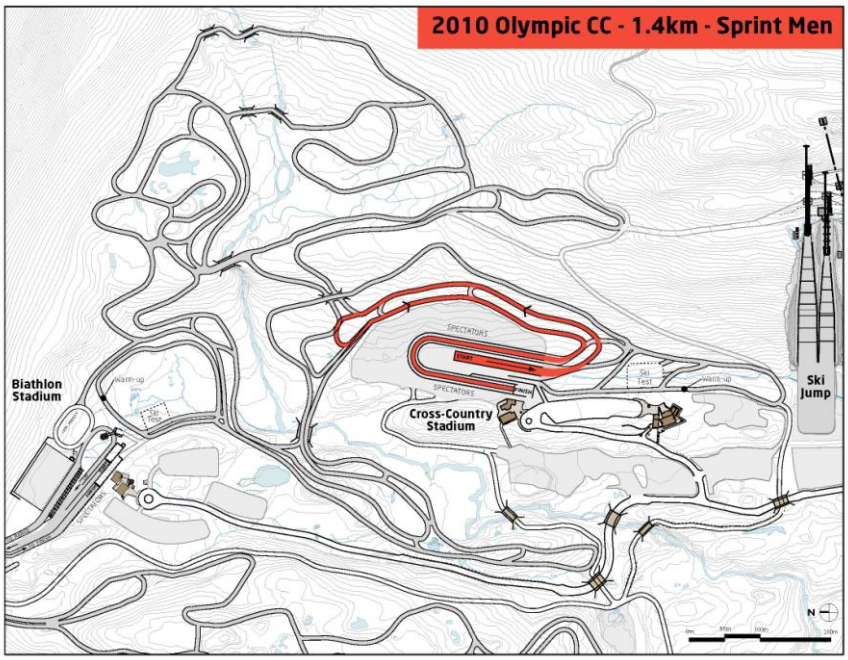


HD: 25 m MC: 25 m TC: 51 m LP: 857 m asl HP 882 m asl

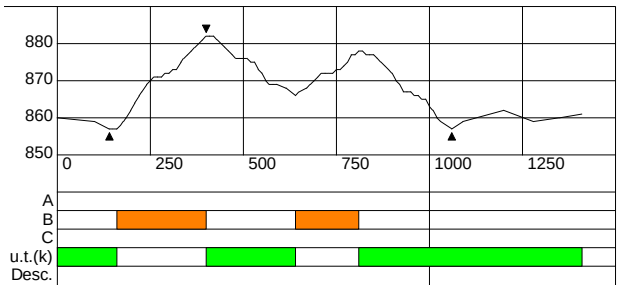


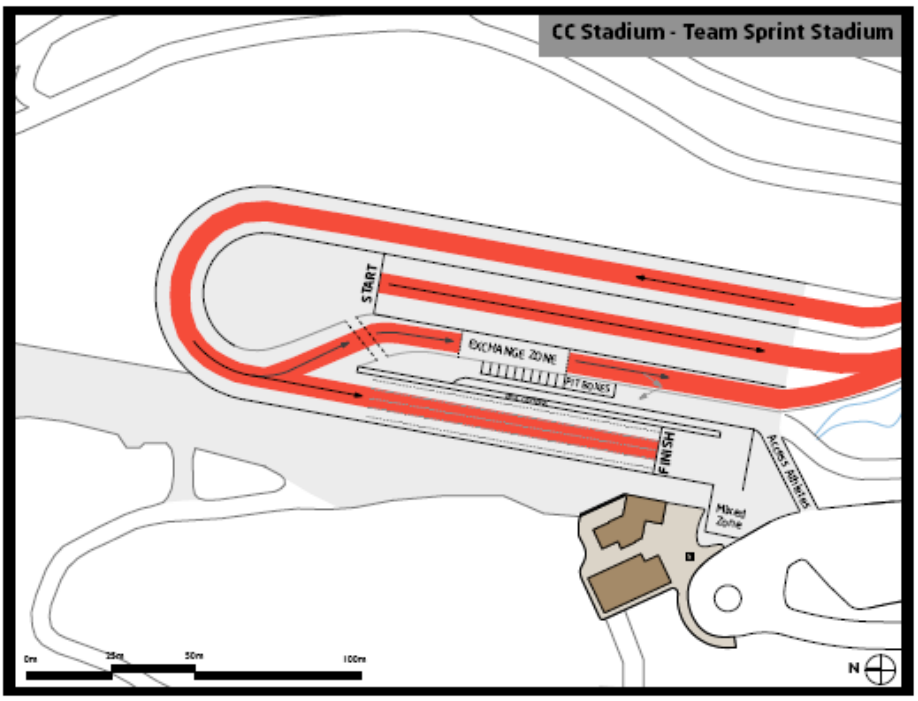


Team sprint women

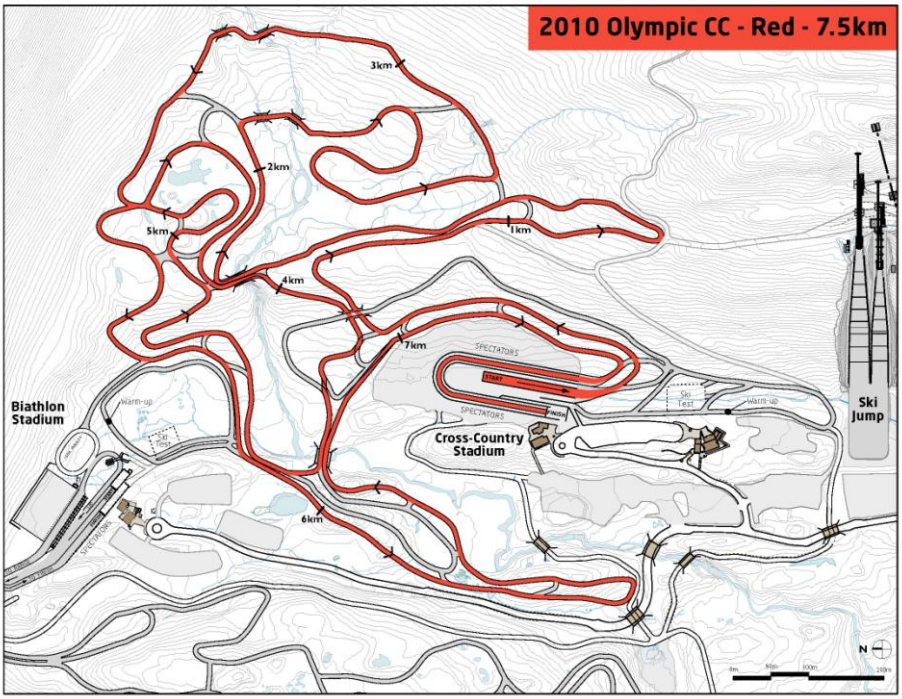


HD: 25 m MC: 25 m TC: 44 m LP: 857 m asl HP 882 m asl

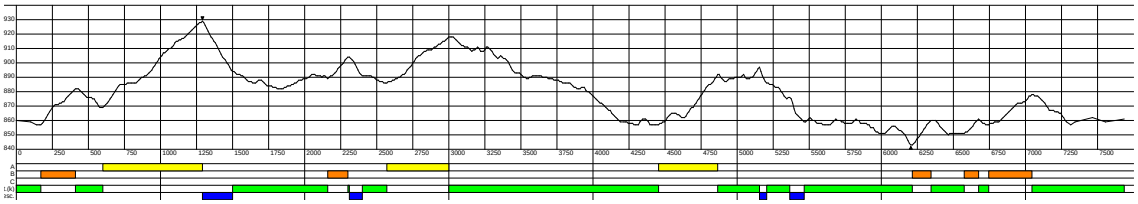


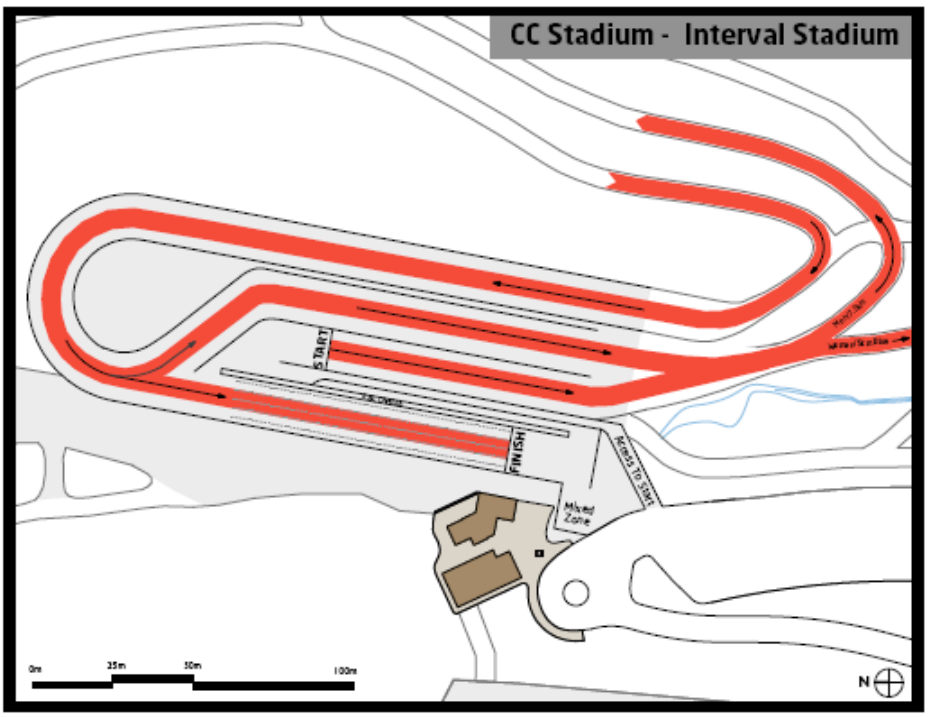


15 km interval start men

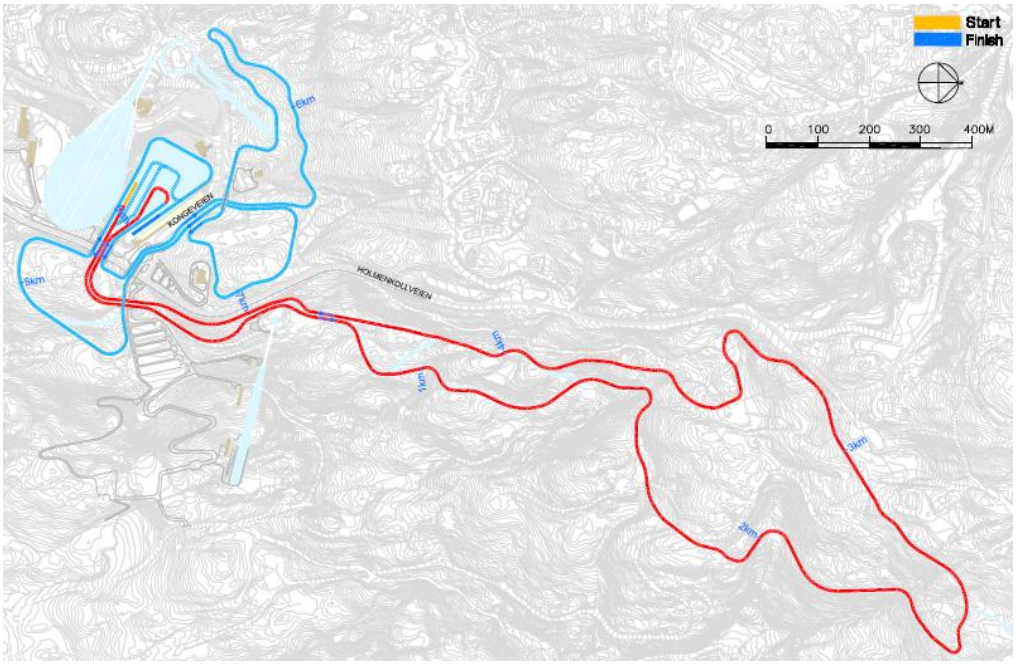


HD: 86 m MC: 60 m TC: 566 m LP: 843 m asl HP 929 m asl

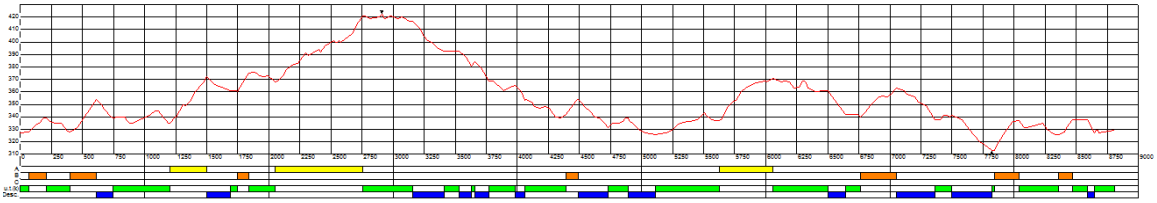


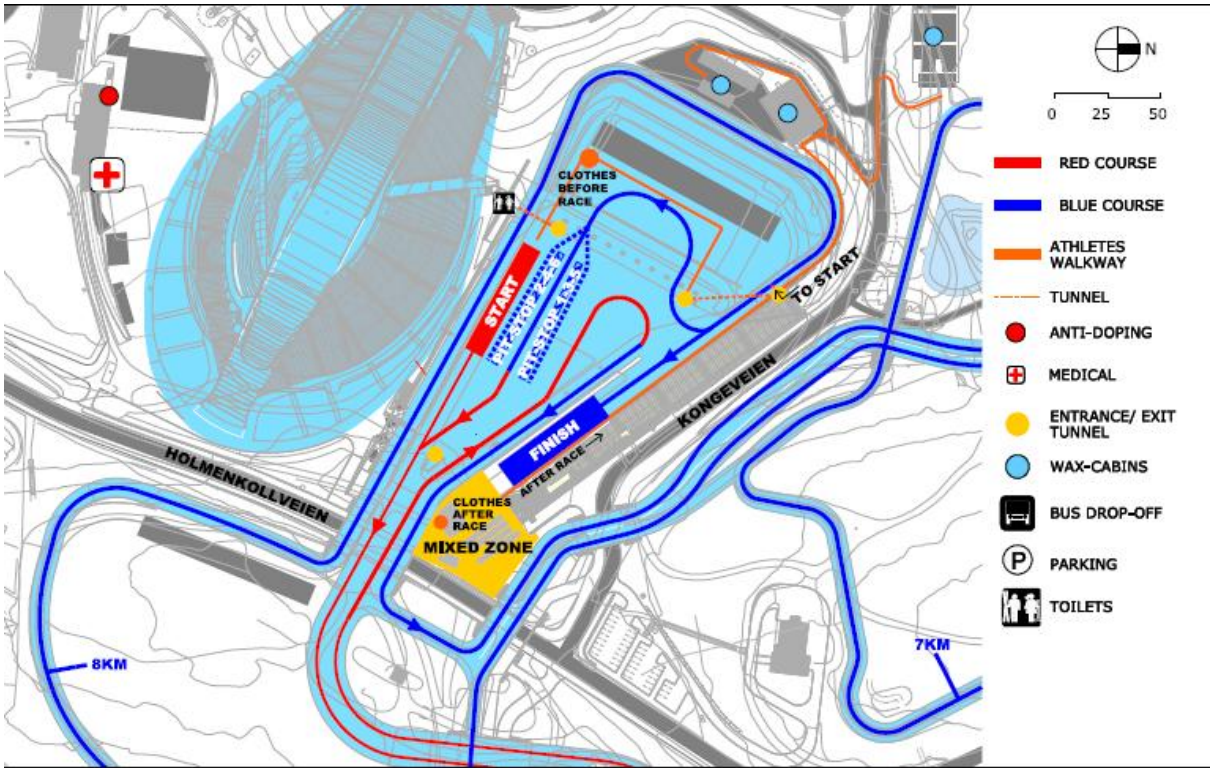


30 km mass start WSC 2011 Holmenkollen



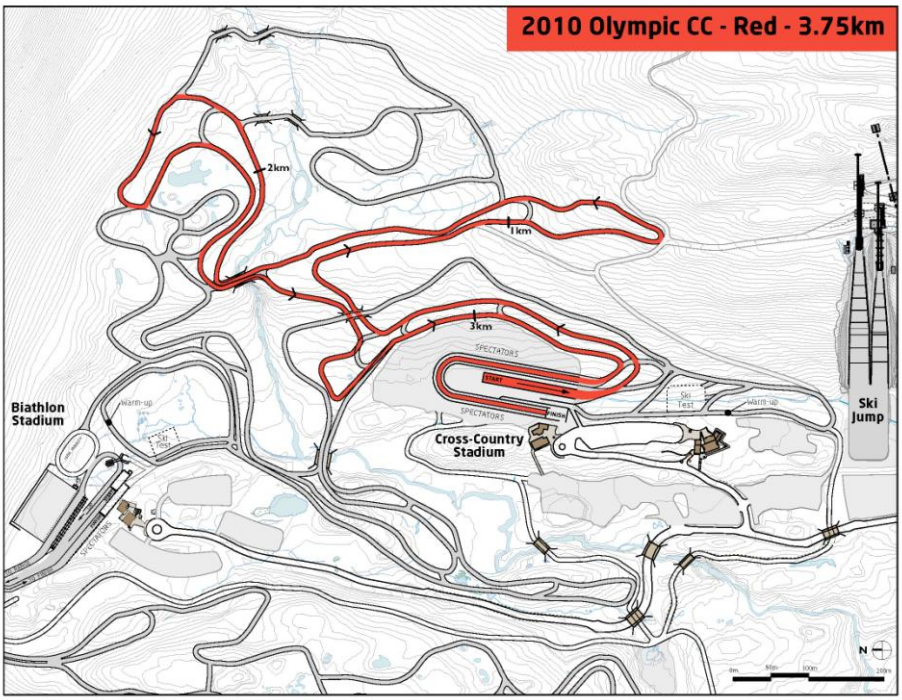
HD: 109 m MC: 59 m TC: 333 m LP: 313 m asl HP 422 m asl



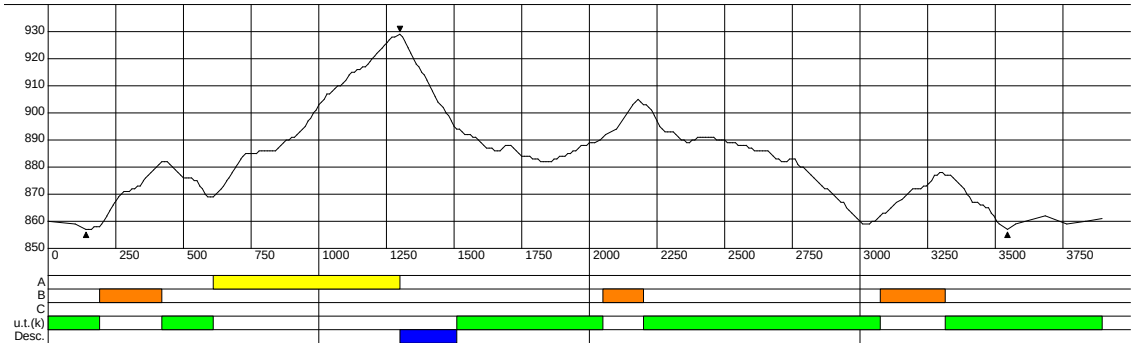


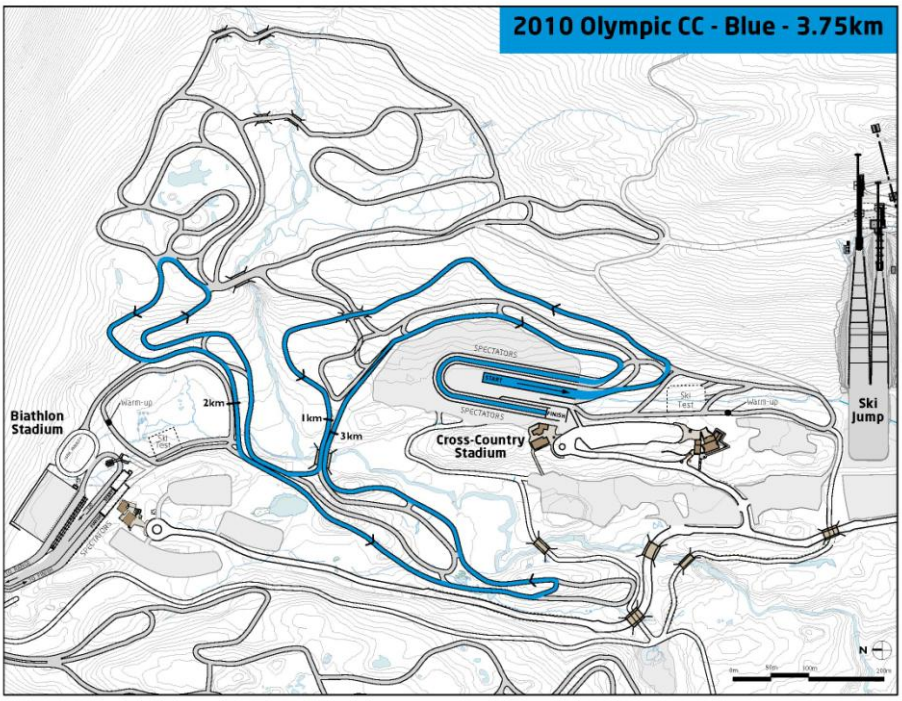
Skiathlon

15 km Skiathlon competitions women (2 x 3,75 km Cl + 2 x 3,75 km F)

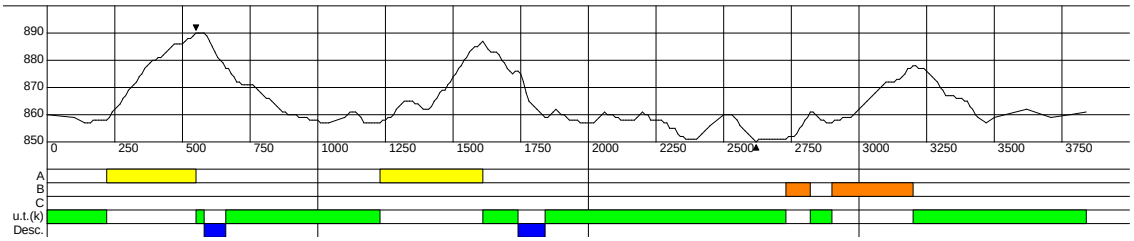


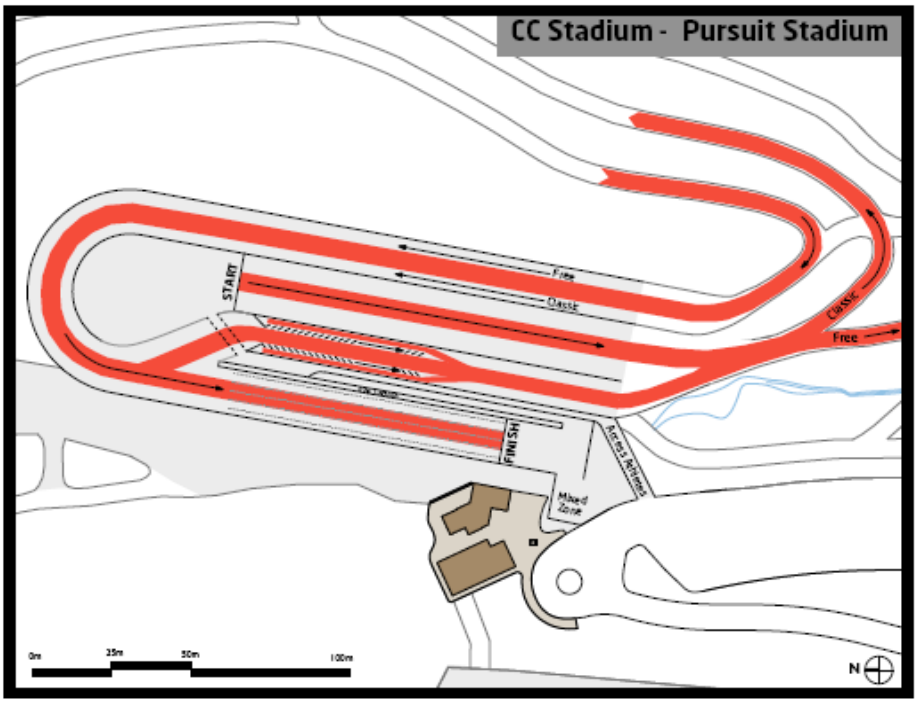
HD: 72 m MC: 60 m TC: 139 m LP: 857 m asl HP 929 m asl





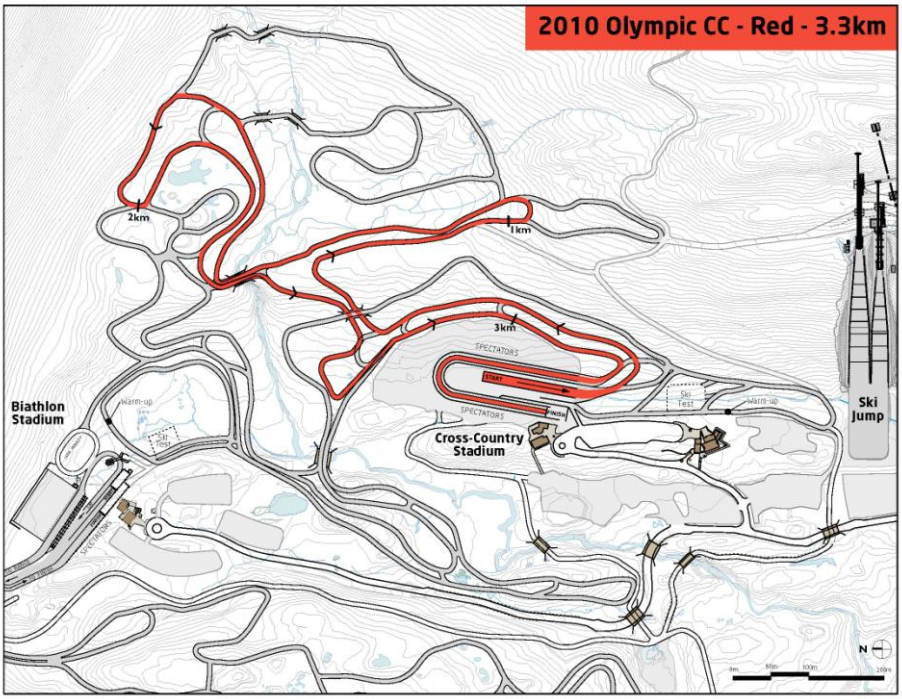
HD: 40 m MC: 33 m TC: 129 m LP: 850 m asl HP 890 m asl



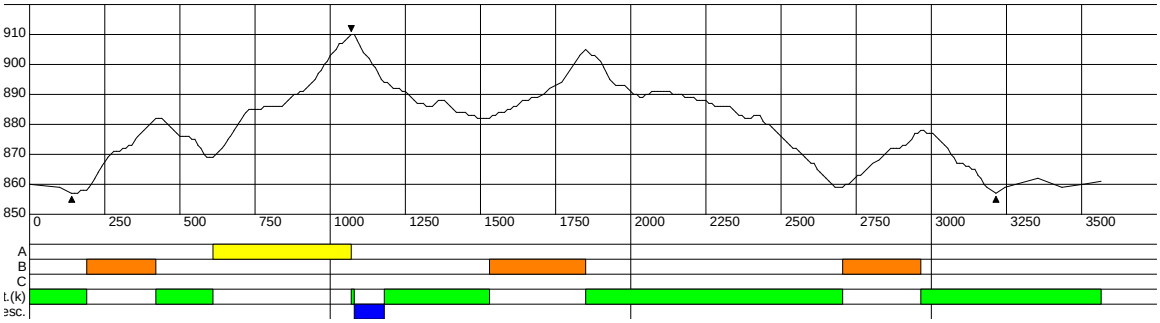


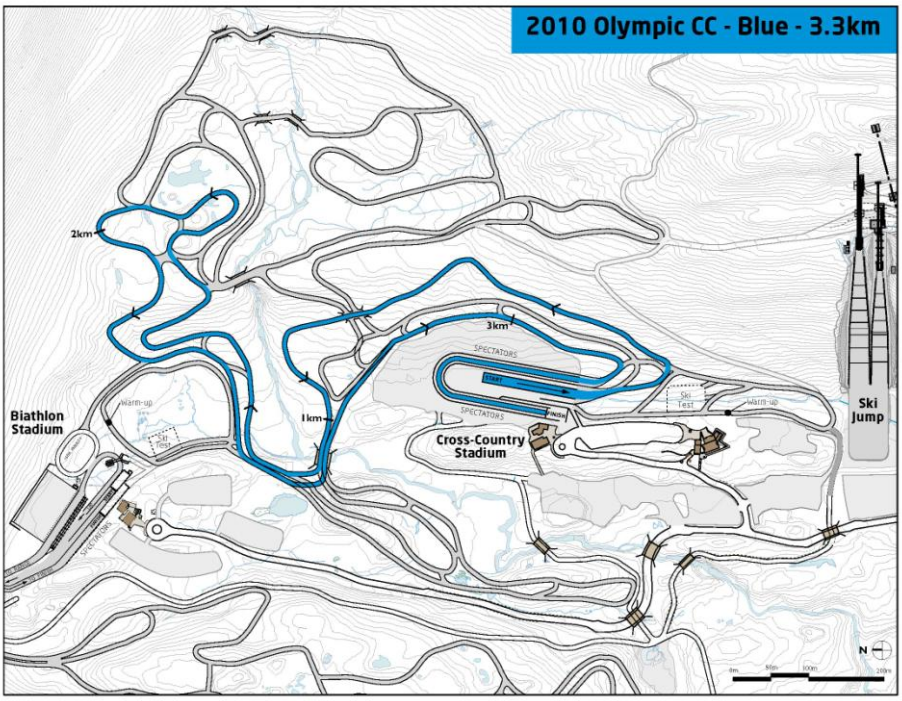
4x10 km relay – two different courses

4 x 10 km relay men 2 x (3 x 3,3 km Cl) + 2 x (3 x 3,3 km F)

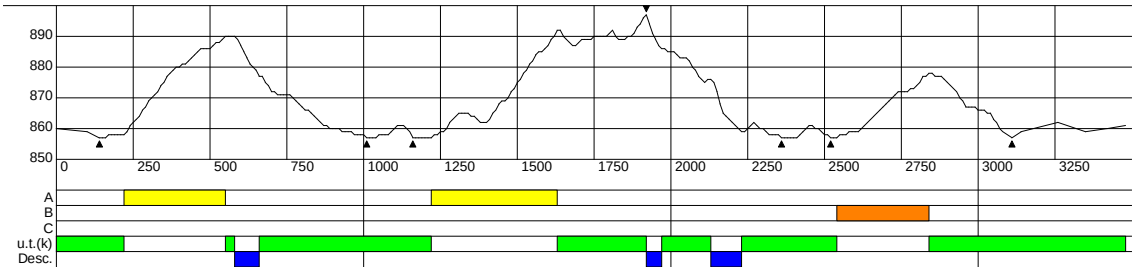


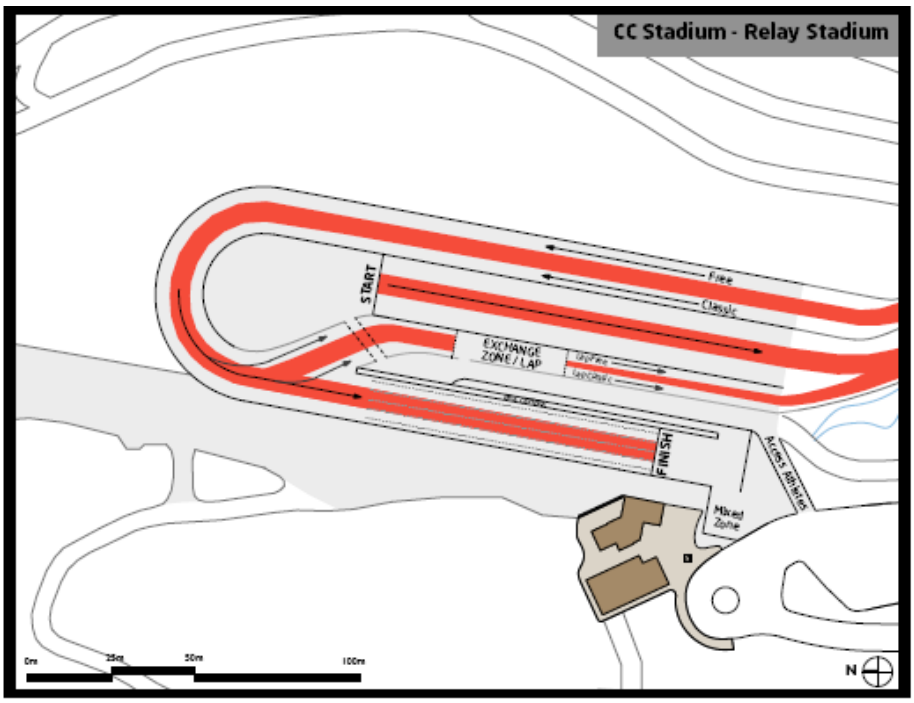
HD: 53 m MC: 41 m TC: 120 m LP: 857 m asl HP 910 m asl



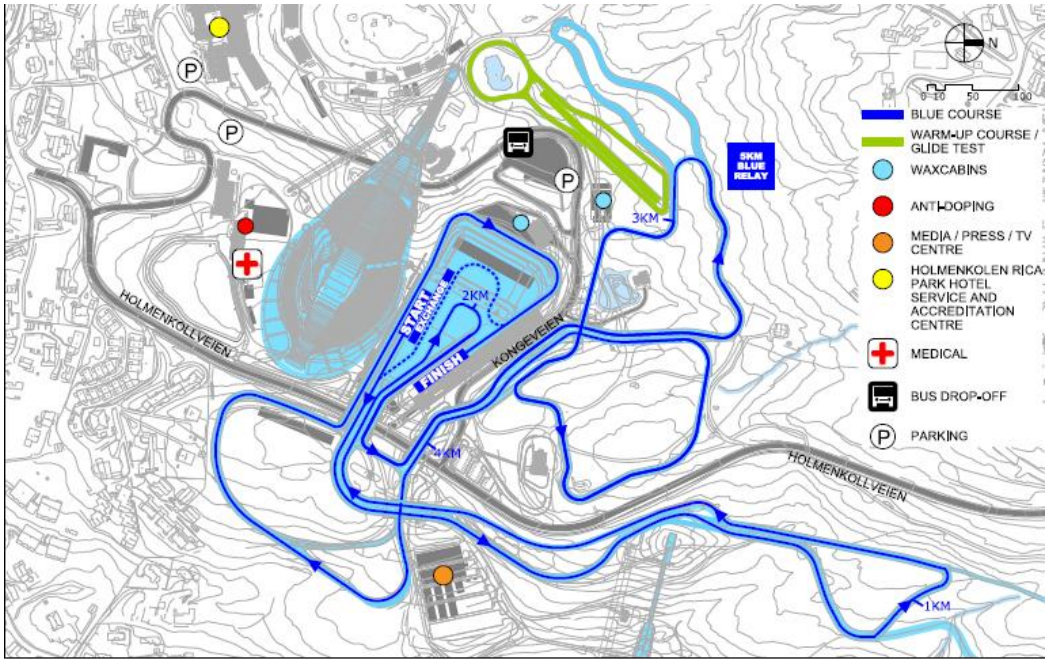


HD: 40 m MC: 38 m TC: 124 m LP: 857 m asl HP 897 m asl

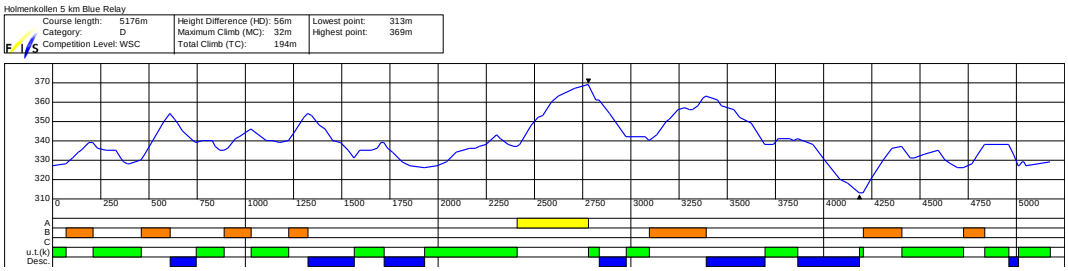


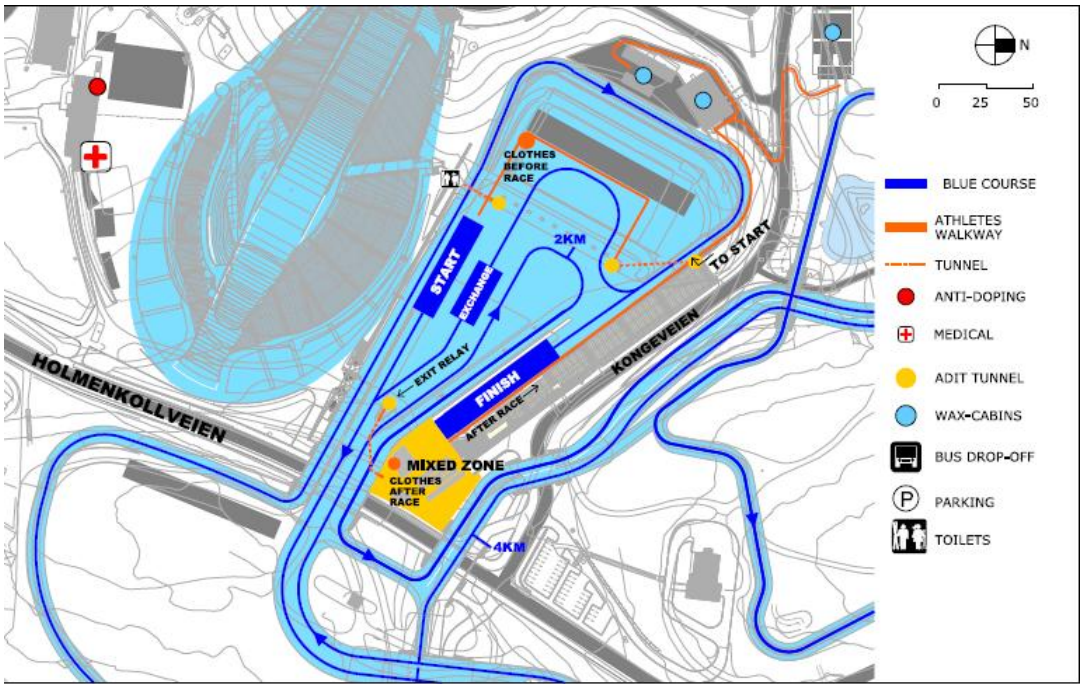


4x10 km relay – on same course

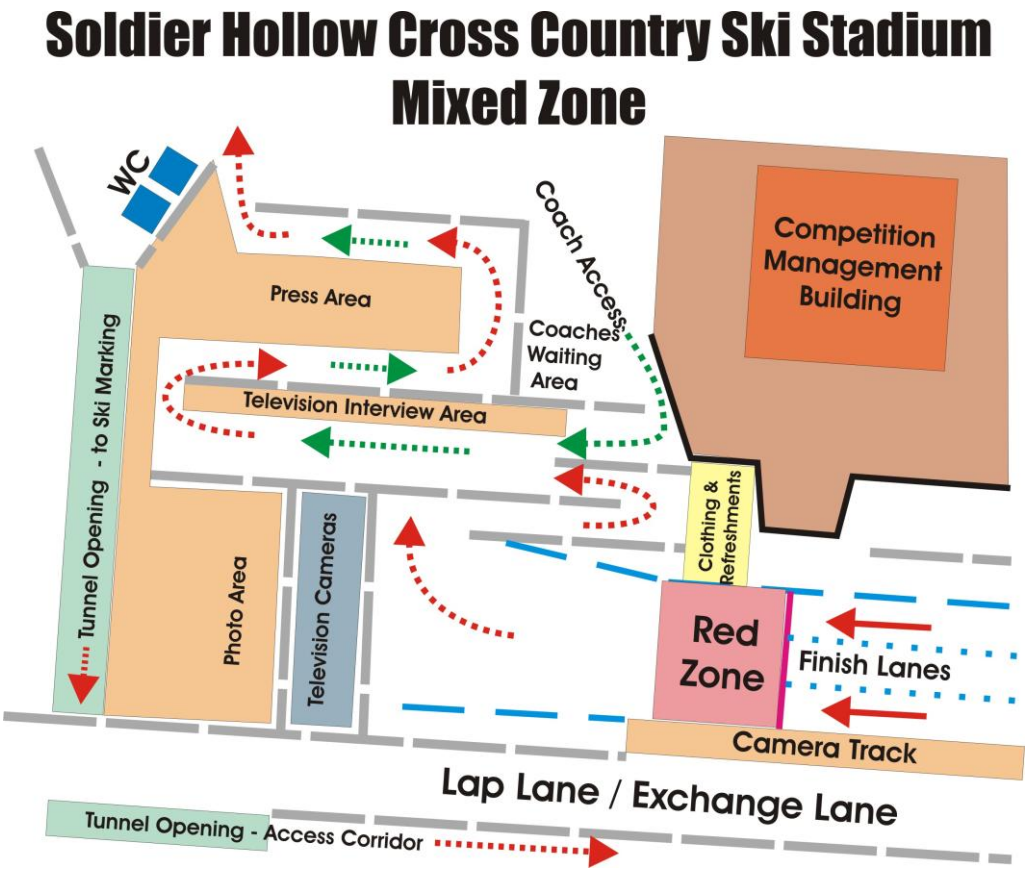


HD: 56 m MC: 32 m TC: 194 m LP: 313 m asl HP 369 m asl

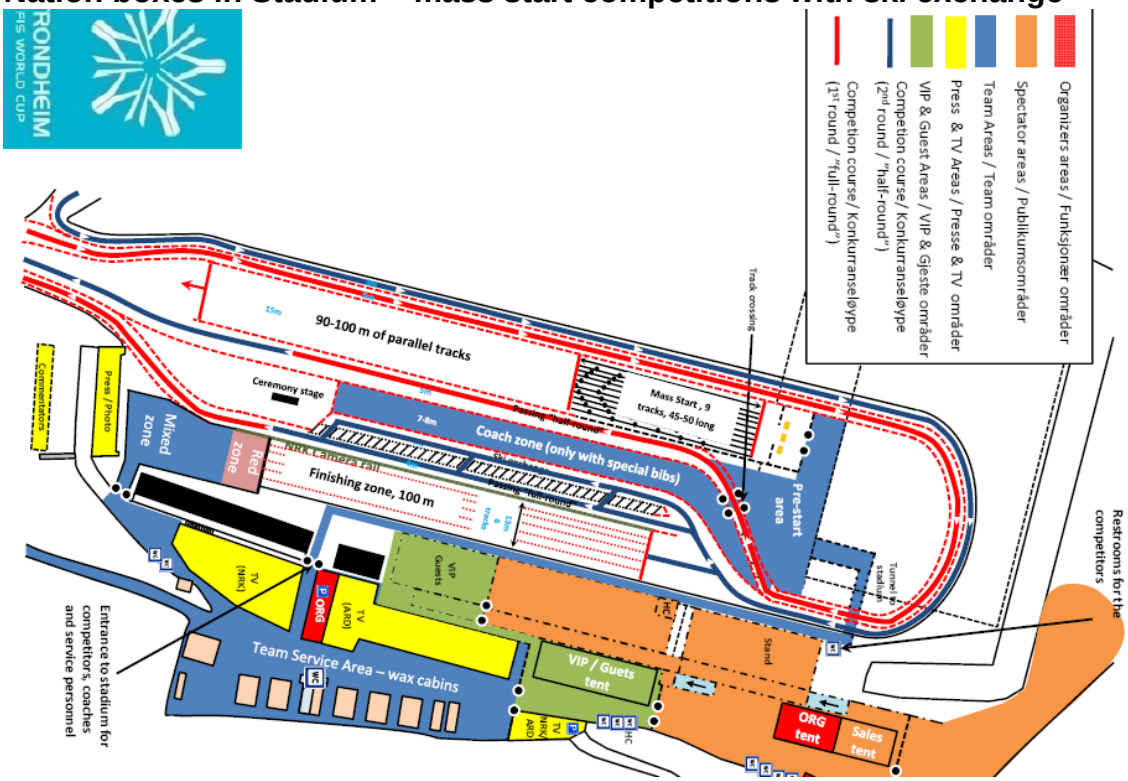




Mixed zone



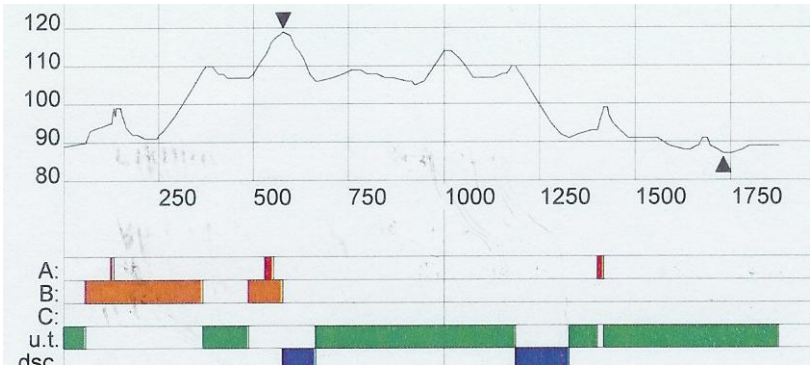
Nation boxes in Stadium – mass start competitions with ski exchange



16 Experiences

16.1 2005 Homologation seminar

Example 1.

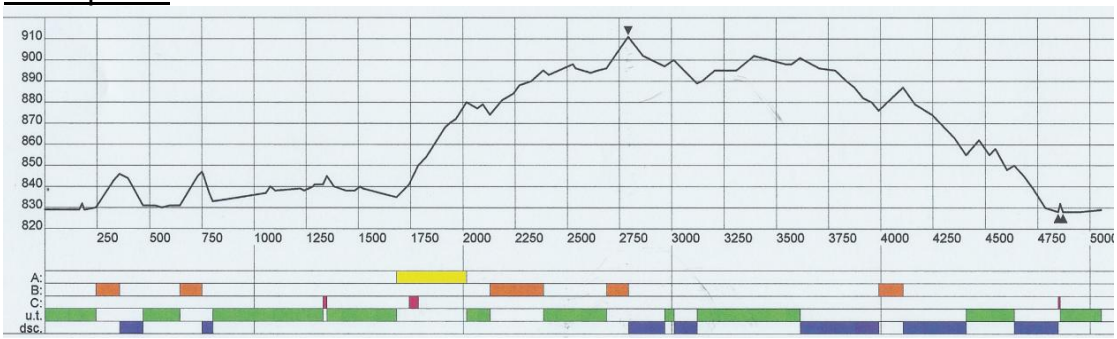


Task: Make analyse of the up hills on this course.

The judgement of the inspector, or maybe the software of the EIBL program gave the result shown on the figure above, 2 B-climbs. That is what was reported to me. If there are two B-climbs, the first should not start as shown on the figure, but after approximately 250 m. The first 250 m of the course is undulating terrain, and if the PHD of the steep part is 4 m or more we also have a C-climb included.
On the distance from 250 to 580 m there are two climbs with a part of undulating terrain in between. The undulating part is approximately 125 m long, and falls 3 m. If there is a break, and thus make to B-climbs, the undulating part should be 200 m or more, or the downhill should fall 10 m or more. That is according to our rules. The conclusion is therefore that on this course there is only one B-climb, starting at 250 m and ends at 580 m with PHD 28 m and average gradient

$$\frac{28 \text{ m} \times 100}{580 \text{ m} - 250 \text{ m}} = 8{,}5\ \%$$

Example 2.



1. 2. 3. 4.5.6. 7.

Distance and elevation of the positions showed on the profile:

1. 1683/835	4. 2526/898	7. 2793/911
2. 2019/880	5. 2613/894	
3. 2131/874	6. 2688/896	

Task: Is the judgement of this course in accordance with our rules?

The two first and the last B-climbs are OK, but we should take a closer look at the distance from 1683 m to 2793 m.

Let us first look at the distance from 1683 m to 2019 m, which is considered as one A-climb by the Homologation Inspector.

Average climb $\frac{(880\ m - 835\ m) \times 100}{2019\ m - 1683\ m} = 13{,}4\%$

13,4 % gradient is outside our rules, which says that maximum average gradient in an A-climb should not exceed 12 %.

If skiing the distance from 1683 m to 2793 m, I think that everybody will consider the whole part as one continuous climb. Let us look how that fits into our rules.

Average climb $\frac{(911\ m - 835m) \times 100}{2793\ m - 1683m} = 6{,}85\ \%$

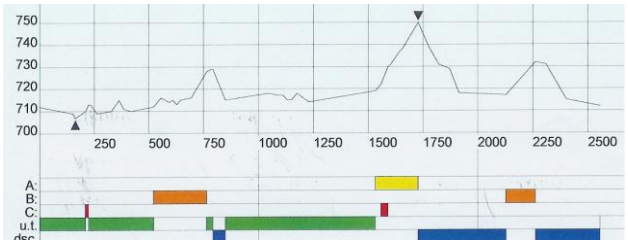
6,85 % gradient is within our rules (6 % – 12 %), so we have one A-climb with PHD 76 m, and gradient 6,85 %. MC in this climb is approximately 88 m because we have some small down hills included in the climb.

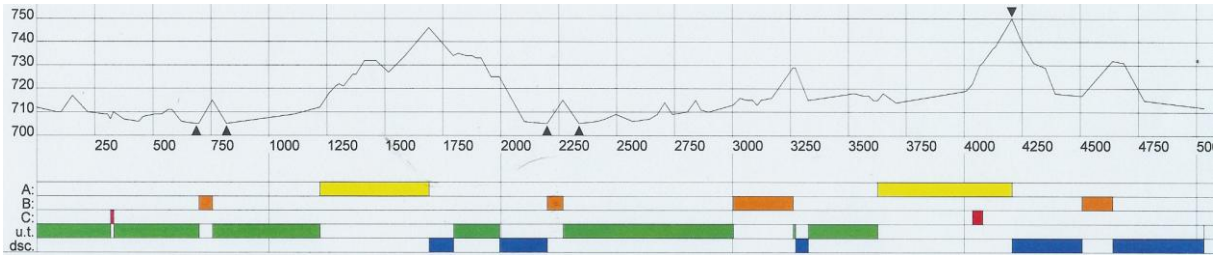
This course cannot be accepted for competitions of 5 km. There are two reasons for that.

1. We have said that in a 5 km competition course 2 A- climbs with PHD 30 m – 50 m, and 3 – 5 B-climbs with PHD 10m – 29 m should be included. On this course we have only one A-climb.
2. On a 5 km competition course no A-climb should exceed 50 m in PHD. On this course the A-climb we have has a PHD of 76 m. If one of the B-climbs has a PHD close to 30 m we could accept the course, but that is not the case here.

But for competitions of 10 km or more, multiple lap competitions, the course can be accepted, but with the data as described above.

Example 3.



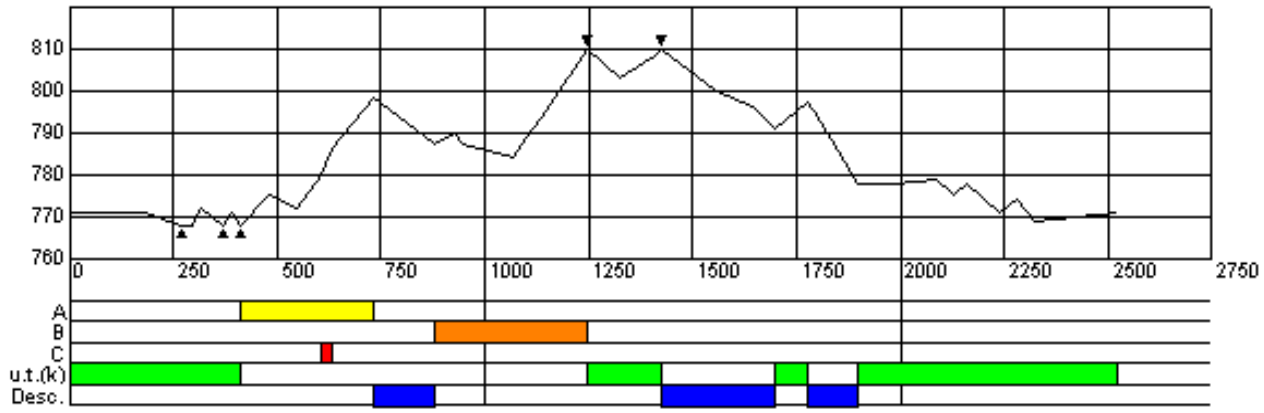


On these two courses we have the same a-climb, but two different A-climb judgements. What should be correct?

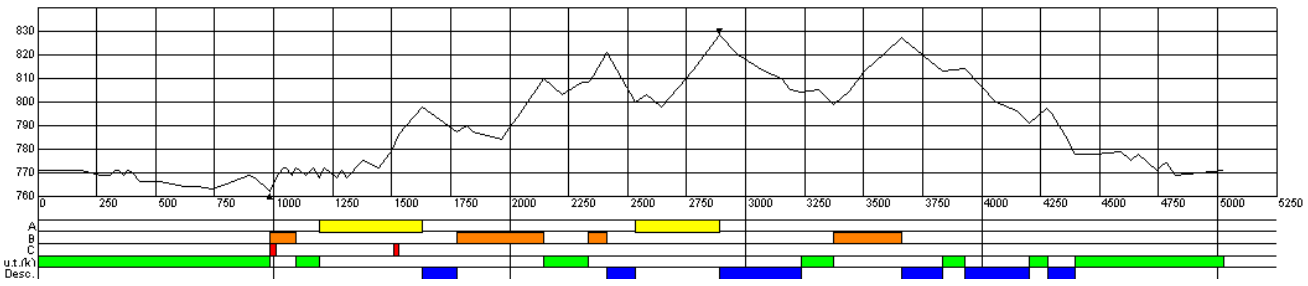
From the profiles above we can see that the 2,5 km course, upper profile, is the same course as the last part of the 5 km course, lower profile.

The A-climb on the 2,5 km course is approximately 240 m long with PHD 30 m. On the 5 km course, where we have the same uphill, there the judgement is that the same A-climb is now 585m long with a PHD of 35 m. Again if we ski the course most people will consider the climb to be in accordance with judgement for the 2,5 km course. That was also agreed on the seminar.

Example 4.



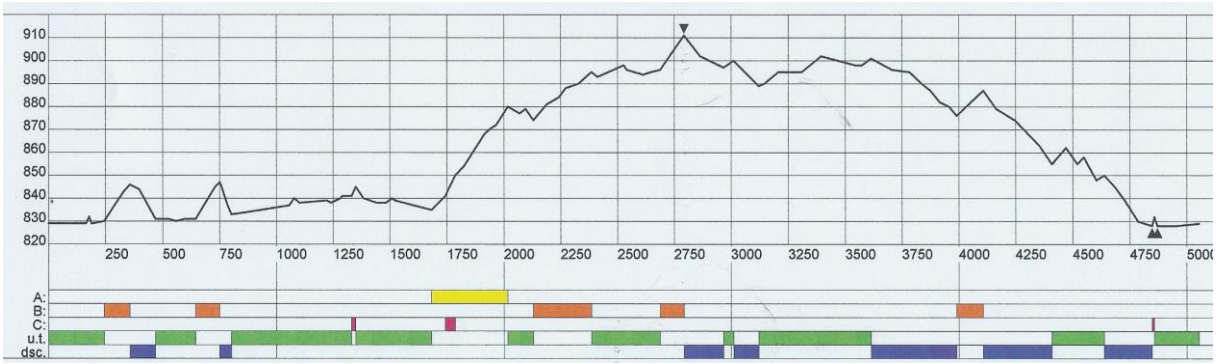
B- climb, where does it start?



Where do the climbs start?

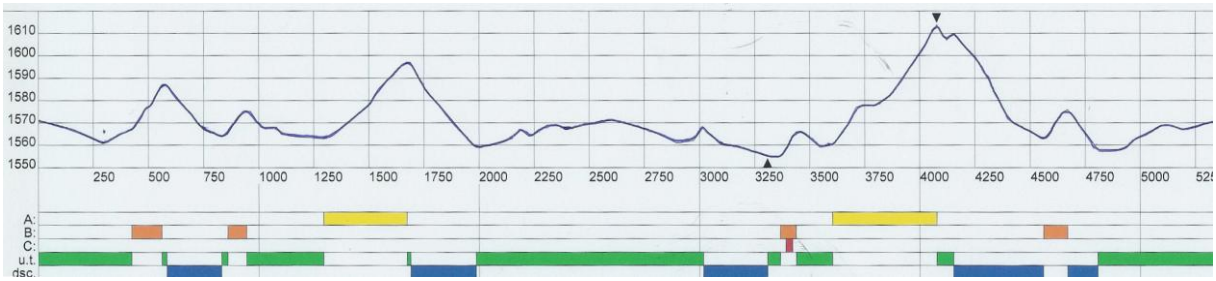
Example 5

Course 1.



TC 191 m, MC 45 m, HD 83 m, A-climbs 23,6%, B-climbs 41,3%, und terrain 35,1%

Course 2.



TC 192 m, MC 54 m, HD 59 m, A-climbs 45,8%, B-climbs 28,1% Und terrain 26,1%

Make an analyse of these two courses, both for single and multiple lap competitions. How do they fit to our rules regarding

	Course 1	Course 2	ICR	Judgement
TC,	191 m	192 m	150 – 210 m	Both OK
MC	45 m	54 m	30 – 50 single lap	Course 1 OK
			50 – 80 multiple lap	Course 2 OK
HD	83 m	59 m	Not over 100 m	Both OK
A-climbs % of TC	23,6 %	45,8 %	35 – 55 %	Course 2 OK
B-climbs % of TC	41,3 %	28,1 %	25 – 35 %	Course 2 OK
Und terrain % of TC	35,1 %	26,1 %	15 – 35 %	Both OK

Look at example 2 and the course judgement made there. The data for course 1 should be changed in accordance with the judgement there.

An A-climb with PHD close to 50 m covers both a 5 km competition course and longer courses. Therefore with the new competition formats with more use of the same course several times, an A-climb with PHD at approximately 50 m serves all distances.

2 Terrain distribution

Course 1, last 2,2 km almost only downhill.

Course 2, first half of the course includes one A- climb and two B-climbs. Also the last half includes one A- climb and two B-climbs. Terrain distribution is OK.

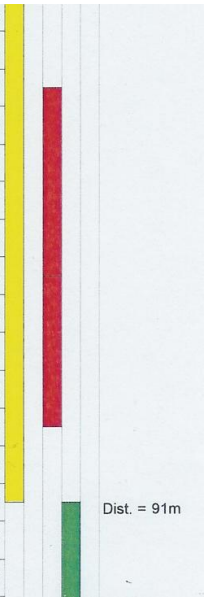
Exciting finish

Course 1. Mainly downhill on the last part. The most interesting aspect is if the skis are fast or not.

Course 2. Also in this course fast skis are of interest. But in addition if an athlete is fit there are some climbs on the last part of the course, and also climbing into the finish. That should provide for an exciting finish of a competition.

Example 6.

55		28	1616	96	7.14	2	52
56		6	1622	97	16.67	1	53
57		41	1663	103	14.63	6	59
58		8	1671	104	12.50	1	60
59		13	1684	106	15.38	2	62
60		15	1699	109	20.00	3	65
61		4	1703	112	75.00	3	68
62		2	1705	113	50.00	1	69
63		2	1707	114	50.00	1	70
64		2	1709	115	50.00	1	71
65		4	1713	116	25.00	1	72
66		2	1715	117	50.00	1	73
67		19	1734	117	0.00	0	73
68		16	1750	120	18.75	3	76
69		26	1776	117	-11.54	-3	76
70		26	1802	116	-3.85	-1	76



Look at the c-climb, red vertical. Are the data for this climb correct in accordance with climb gradient in the terrain?

Are the measurements in rows 61 – 66 reliable?

This is a result of a GPS measurement, and transferred directly into the EIBL program. If you walk out in the terrain on a Cross Country course, you rarely find up hills steeper than 30 %. Gradient of 50 % and 75 % are wrong. Therefore when this occurs the Homologation Inspector has to go out to the place and measure the correct gradient with an Inclinometer.

Conclusion.

The reason for showing these examples at the seminar is that we should have a common understanding of the rules. Our experience is that if we should get a “feeling” with the course, we should make our own judgement. We should not leave the course judgement to the EIBL software.

Measuring a course with GPS equipment is OK. But if we see figures as shown on example 5, it tells us that we have to go out to measure the real gradient with an inclinometer. Again human considerations cannot be left over to software solutions.

At the end it is the feeling of the skier when skiing the course that is important. That should therefore be the basis for our judgement. It is wrong to try to show data that fits into our rules, if our feeling when skiing the course does not match the data.

On some reports the Course Category is not written there. If not it is hard for others to find out what competition formats can be conducted on the course/stadium. If I lack this information the FIS cannot give the Organiser a certificate.

Homologation Philosophy – Manual – Rules

- Experiences so far regarding
  - Course layout
  - Course width
  - Transition from downhills into uphills
  - Courses for Classic sprint
  - Cooperation with TV

There is still some work to do to get courses that suit specially pursuit - and mass start competitions. There are mainly 4 reasons for that:

<u>Too narrow courses.</u>
I have observed that even if the course is 9 m wide, when fences are set up, the whole course width is not utilized and we can loose a couple of meters. This is a task for the Technical Delegates to observe and correct.

<u>Too curved courses.</u>
If an uphill is too steep one way to make it less steep is to make a curved course. The problem that then arises is that it is almost impossible to overtake and pass. All athletes try to ski the ideal line, that means the shortest distance, and the athlete(s) in front always head for the inner curve. In the long up hills there should therefore be long and straight course sections.

<u>Too narrow transitions from down hills into up hills.</u>
When coming down a hill and then go directly into a steep uphill we have really created a problem for the athletes if there is a mass start. We studied videotape from a mass start competition in Ramsau. The athletes at the rear end of the pack had to plough, and stop to wait until the athletes in front started to move again. This does not feel fair, and we have to design courses where congestions are avoided.

<u>Not possible to maintain the gap opened in an uphill.</u>
If possible we should look for the possibility to have a section with undulating terrain after a major climb in order to increase or at least maintain the gap. Now

nobody tries to push in up hills because athletes behind will close the gap if an uphill immediately turns into a downhill.

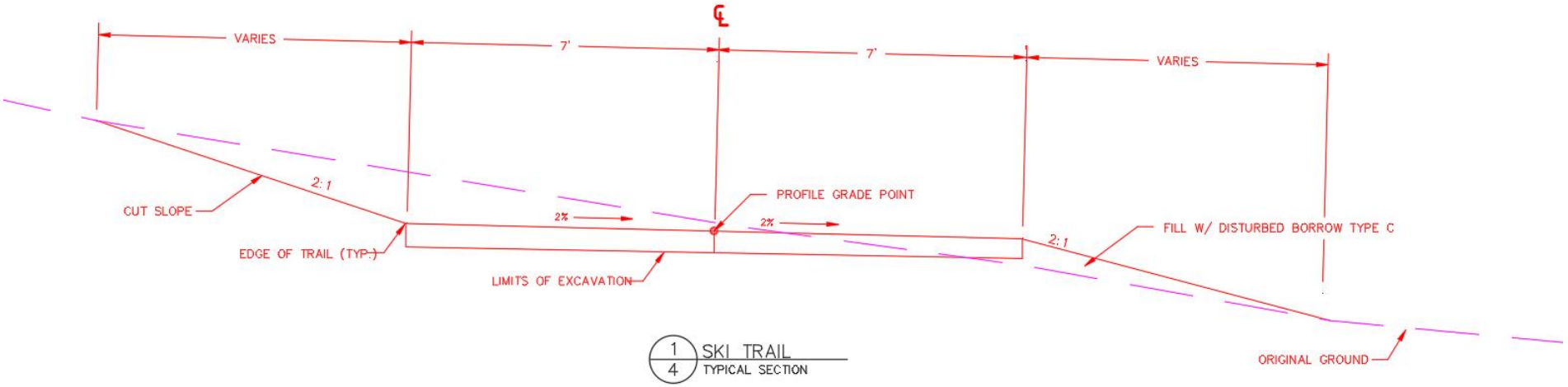
Courses for sprint in Classic technique.
Sprint competitions in Classical technique should be executed in diagonal technique and with kickwax under the skis. It should not be beneficial just to doublepole through the course. We have to make more clear specifications for such courses.

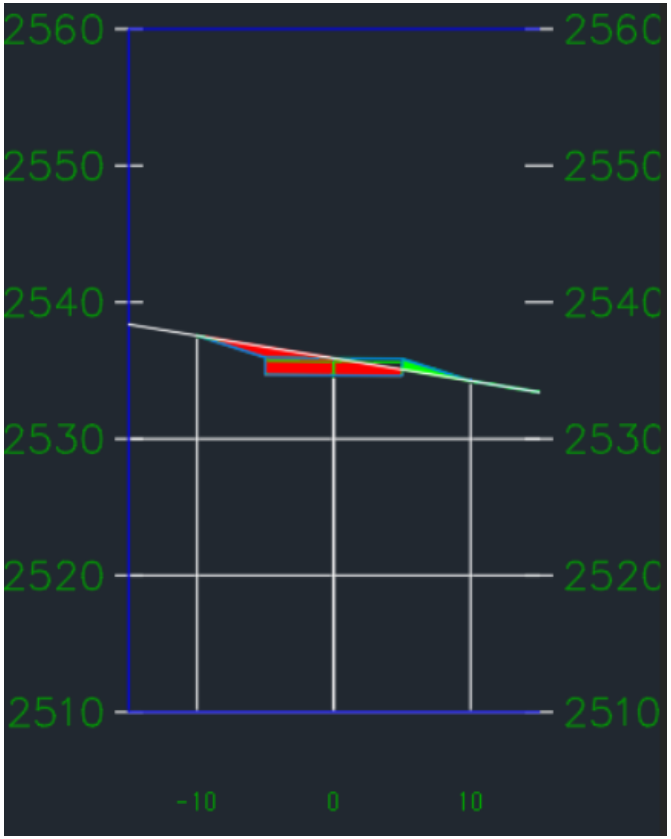
Cooperation with TV.
When starting to design a Cross Country venue a TV expert should be involved as early as possible. The success of the Cross Country sport depends heavily on the quality of the TV transmission. The FIS should hire a TV consultant in order to define standards that ensure the quality we want, and also control that the standards are met

Snow making and salting.
Marco Mapelli, ITA and John Aalberg USA/NOR, can be consulted in this question.

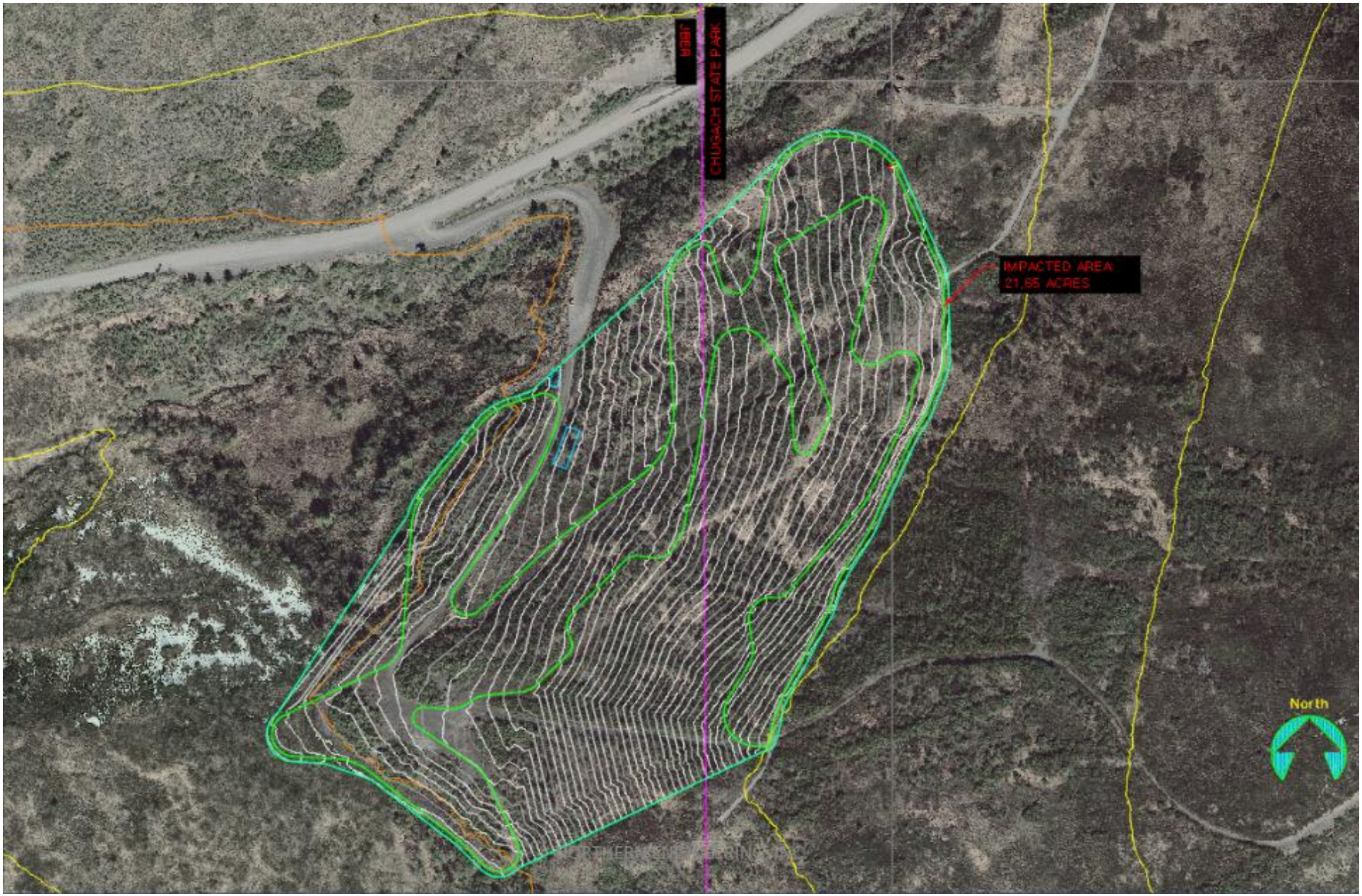
GPS equipment, experiences
Tomas Jons, Sweden and Janne Pylväs, Finland, can be consulted in this question.

APPENDIX 2

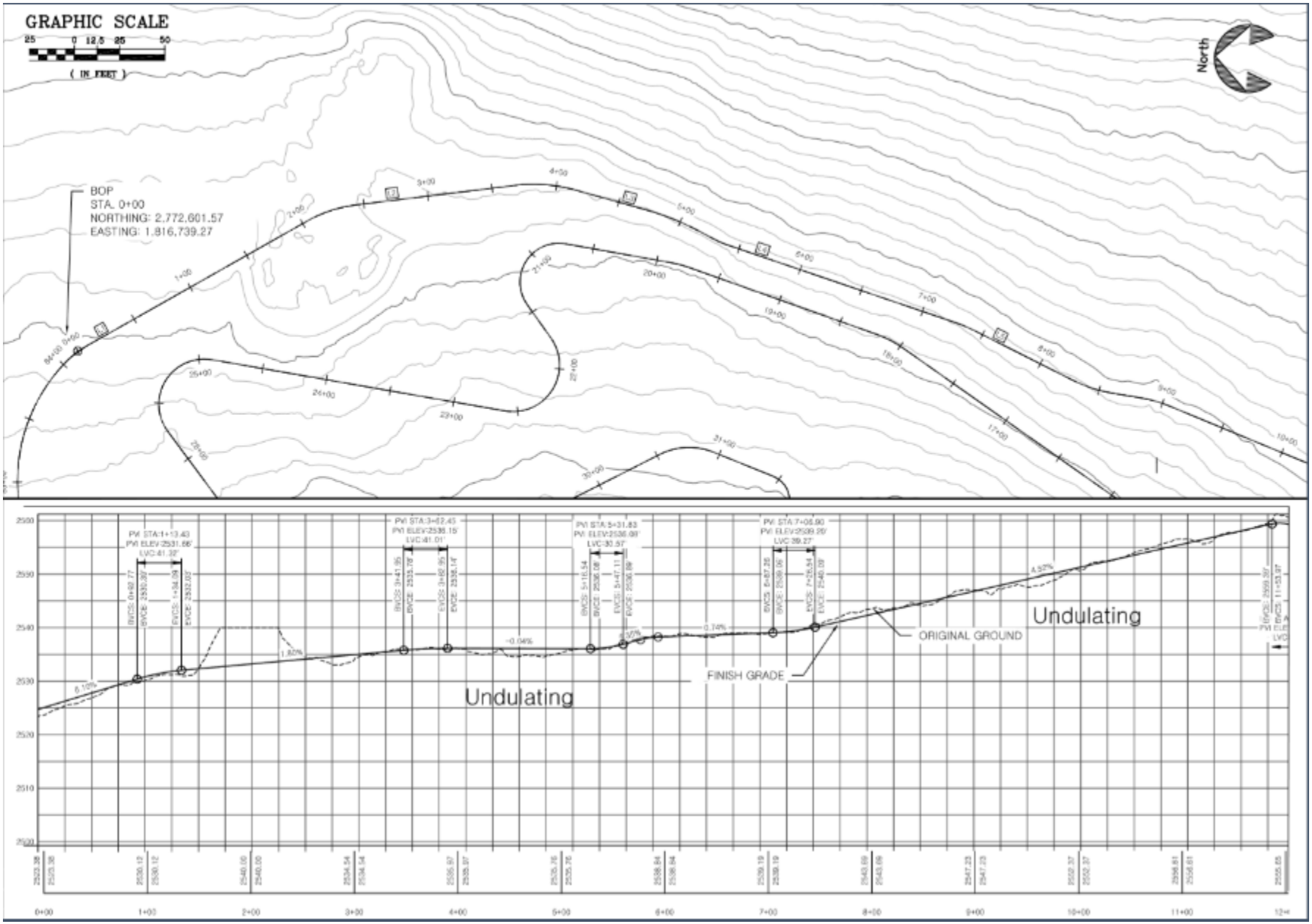

VARIES
7'
7'
VARIES
2:1
CUT SLOPE
EDGE OF TRAIL (TYP.)
2%
PROFILE GRADE POINT
2%
LIMITS OF EXCAVATION
2:1
FILL W/ DISTURBED BORROW TYPE C
ORIGINAL GROUND
1/4 SKI TRAIL
TYPICAL SECTION

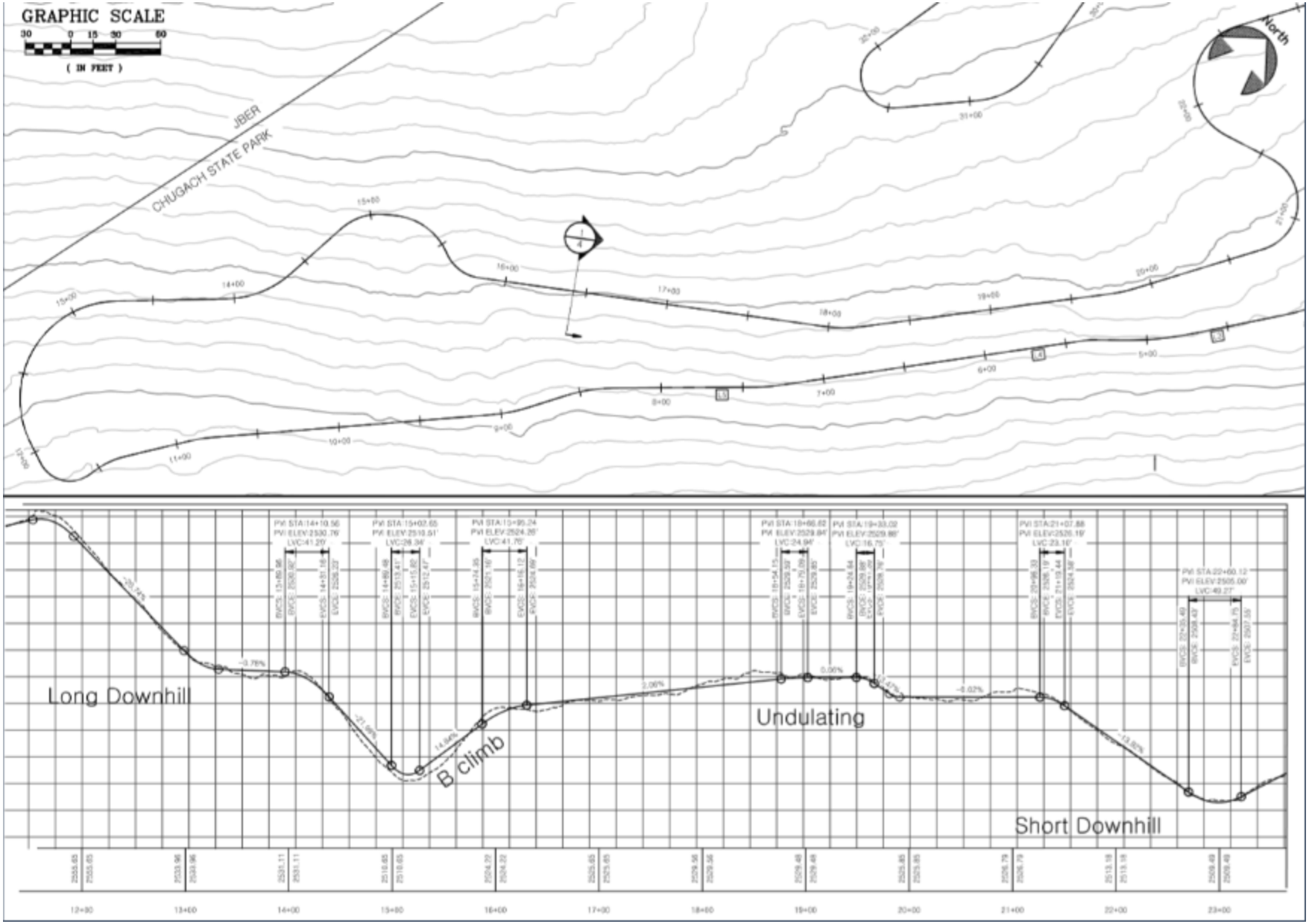

2560
2550
2540
2530
2520
2510
256C
255C
254C
253C
252C
2510
-10
0
10

APPENDIX 3



APPENDIX 4


GRAPHIC SCALE
25 0 12.5 25 50
(IN FEET)
North
BOP
STA. 0+00
NORTHING: 2,772,601.57
EASTING: 1,816,739.27
ORIGINAL GROUND
FINISH GRADE
Undulating
Undulating


GRAPHIC SCALE
30 0 15 30 60
(IN FEET)
JBER
CHUGACH STATE PARK
North
Long Downhill
B climb
Undulating
Short Downhill
-20.42%
-3.78%
-21.48%
14.84%
2.06%
0.06%
1.47%
-0.02%
13.92%
PVI STA:14+10.56
PVI ELEV:2530.76'
LVC:41.25'
PVI STA:15+02.65
PVI ELEV:2510.51'
LVC:26.34'
PVI STA:15+99.24
PVI ELEV:2524.26'
LVC:41.75'
PVI STA:18+66.62
PVI ELEV:2529.84'
LVC:24.94'
PVI STA:19+33.02
PVI ELEV:2529.88'
LVC:16.75'
PVI STA:21+07.88
PVI ELEV:2525.19'
LVC:23.16'
PVI STA:22+60.12
PVI ELEV:2505.00'
LVC:49.27'
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00
20+00
21+00
22+00
23+00