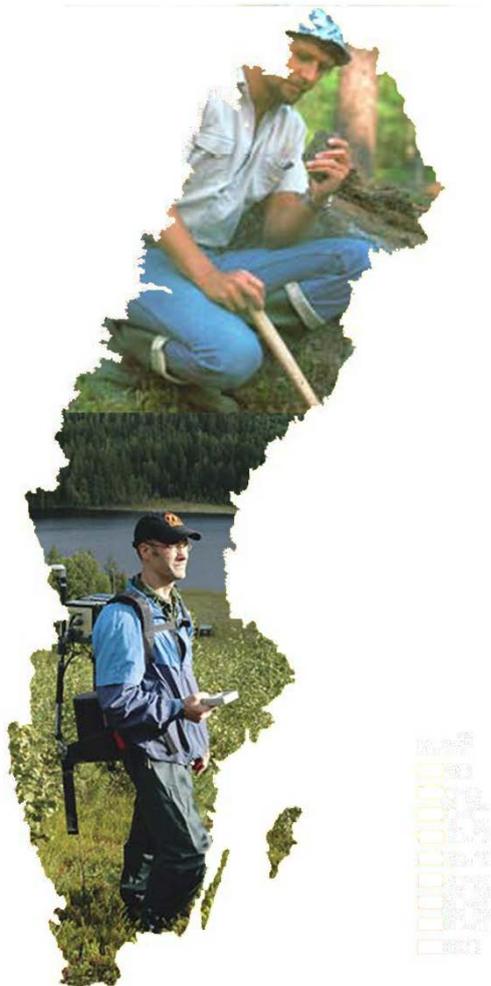


# GUIDANCE TO GOOD ENVIRONMENTAL PRACTICE FOR EXPLORATION IN PROTECTED AREAS



**SveMin**

The association for mines, mineral and metal producers in Sweden

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# TABLE OF CONTENTS

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<b>INTRODUCTION .....</b>	<b>5</b>
1. BACKGROUND .....	5
1.1 About the guidance.....	5
1.2 Reason for the guidance.....	5
1.3 Legislative framework .....	6
1.4 Protected areas .....	6
1.5 Exploration.....	7
1.6 From exploration to the start of a mine.....	8
<b>DESCRIPTION OF EXPLORATION .....</b>	<b>9</b>
2. BOULDER TRACING AND GEOLOGICAL MAPPING .....	9
2.1 General description.....	9
2.2 Consequences for the natural environment .....	9
3. GEOPHYSICAL GROUND SURVEYS.....	10
3.1 General description.....	10
3.2 Consequences for the natural environment .....	10
4. SURFACE TILL SAMPLING .....	11
4.1 General description.....	11
4.2 Consequences for the natural environment .....	11
5. DRILLING.....	12
5.1 General description.....	12
5.2 Consequences for the natural environment .....	13
<b>LEGAL FRAMEWORK FOR ACTIVITIES IN PROTECTED AREAS .....</b>	<b>14</b>
6. PROTECTED AREAS IN THE MINERALS ACT AND ITS ORDINANCES .....	14
7. PROTECTED AREAS UNDER CHAPTER 7 OF THE ENVIRONMENTAL CODE .....	16
7.1 National parks .....	16
7.2 Nature and culture reserves.....	16
7.3 Natura 2000 areas .....	18
7.4 Other area protections .....	20
7.5 Interim prohibitions .....	20
8. WORLD HERITAGE AND NATIONAL INTERESTS.....	21
8.1 World heritage .....	21
8.2 Provisions concerning land and water management .....	21
8.3 Unbroken mountains.....	21
<b>APPROVAL PROCEDURE.....</b>	<b>23</b>
9. PERMITS .....	23
9.1 Exploration permit .....	23
9.2 Permission for test mining .....	24
10. CONTENTS OF THE APPLICATIONS .....	27
10.1 Application for exploration permit.....	27
10.2 Application for permission to conduct exploration work .....	27
10.3 Application for exemption .....	27
10.4 Notification to consultation .....	28
10.5 Application for exemption from prohibition to drive in the terrain .....	28
10.6 One or several applications/notifications .....	28
11. WORK PLAN.....	29
11.1 General description .....	29
11.2 Content.....	29

12. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) .....	30
12.1 Requirement for EIA .....	30
12.2 General description .....	30
12.2 Development of a good EIA .....	30
12.3 Steps for the development of a EIA .....	31
<b>GOOD ENVIRONMENTAL PRACTICE FOR EXPLORATION.....</b>	<b>39</b>
13. START-UP.....	39
13.1 Communication planning .....	39
14. FIELD WORK.....	40
14.1 Sampling.....	40
14.2 Clearing of vegetation .....	40
14.3 Measuring .....	40
14.4 Usage of motor driven equipment .....	40
14.5 Fire prevention measures .....	40
14.6 Ancient remains.....	40
15. TRANSPORT .....	41
15.1 General.....	41
15.2 Techniques for less ground damages.....	41
15.3 Planning.....	42
15.4 Choice of vehicle.....	43
15.5 Improvement of vehicles .....	44
15.6 Protection of the ground at the crossing of sensitive areas .....	44
15.7 Use of public and existing roads .....	46
15.8 Supplementary work .....	47
16. Passage of sensitive watercourses.....	47
16.1 Choice of passage method.....	47
16.2 Snow filling .....	48
17. HANDLING OF FUELS AND FIRE PREVENTION .....	50
17.1 Fuel storage .....	50
17.2 Refuelling.....	50
17.3 Lighting of fires .....	50
17.4 Fuel storage/emergency preparedness.....	51
17.5 Measures in case of spillage/accidental spill.....	51
18. DRILLING .....	52
18.1 Planning of a drilling site .....	52
18.2 Choice of vehicle.....	52
18.3 Transport of drill machine.....	52
18.4 Routines .....	52
18.5 During the drilling operation .....	53
18.6 Handling the equipment .....	53
18.7 Handling of water .....	54
18.8 Drilling on ice and lakes.....	55
18.9 Post-drilling work.....	56
<b>GUIDELINES - COMPENSATION FOR DAMAGE AND ENCROACHMENT .....</b>	<b>57</b>
20. LEGAL FRAMEWORK.....	57
20.1 Compensation .....	57
20.2 Compensation factors.....	57
<b>APPENDICES.....</b>	<b>58</b>
EXAMPLE OF WORK PLAN.....	58

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## PREFACE

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The intention of this document is to provide guidance for good environmental practice for exploration in protected areas. The document can be used as basis for the development of national guidelines for exploration in protected areas.

The document is addressed to prospectors as well as politicians and officials within the concerned ministries, county administrative boards, municipalities and authorities. The document is developed by SveMin and applies primarily to the applicable parts of the metallic minerals covered by the Minerals Act (1991:45)<sup>1</sup>.

The SveMin Exploration Committee is commissioner of the report and has acted steering committee in the preparatory work. The following persons have been part of the working group who contributed to the work in this document:

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Fredrik Ros	Lundin Mining Exploration AB
Anders Forsgren	Boliden Mineral AB

Stockholm  
September 2007

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<sup>1</sup> Exploration and exploitation of deposits of the following mineral substances (concession minerals): antimony, arsenic, beryllium, bismuth, cesium, chromium, cobalt, copper, gold, iridium, iron occurring in the bedrock, lanthanum and lanthanide series, lead, lithium, manganese, mercury, molybdenum, nickel, niobium, osmium, palladium, platinum, rhodium, rubidium, osmium, palladium, platinum, rhodium, rubidium, ruthenium, scandium, silver, strontium, tantalum, thorium, tin, titanium, tungsten, uranium, vanadium, yttrium, zinc and zirconium, alum shale, andalusite, apatite, baryte, brucite, refractory clay or clinkering clay, coal, fluorspar, graphite, kyanite, magnesite, nepheline syenite, pyrite, pyrrhotite, rock salt or other similar salt deposits, sillimanite and wollastonite, oil, gaseous hydrocarbons and diamonds.

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# INTRODUCTION

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## 1. Background

### 1.1 About the guidance

The intention of this document is to provide guidance for how exploration work can and should be conducted in protected areas in Sweden, to comply with stipulated environment norms and regulatory requirements, and to minimise the impact on land users and the community. This is based on that a well-planned and correctly managed exploration project should have minor or no lasting impact on the environment.

Since this document provides guidance to legislative, regulatory and policy requirements, it is also subject to future changes. For that reason, this document should not be regarded as an exact opinion of the applicable law or politics. It is the responsibility of the prospector to make sure he or she is aware of what rules and regulations apply to each situation. This guidance is not only relevant to prospectors, but also to legislators and individuals and organisations that may be affected by exploration activities.

The purpose of the guidance is to:

- Describe the criteria for exploration in protected areas
- Help the industry to meet the legislative requirements
- Assist with guidance about exploration in environmentally sensitive areas, by demonstrating good practices that minimises the environmental impact and disturbance to other land users
- To be a guide for development of national guidelines for exploration in protected areas

### 1.2 Reason for the guidance

Today, there are many interests that together with the mining industry compete for the usage of land. The historical development reflects a conflict between primarily three parties: 1) *the landowner*, 2) *the government* and 3) *the finder*; that is, the prospector; all with different interests.

- The landowner may be interested in obtaining benefit for himself/herself from the mineral resources found in the ground. It is also possible that the landowner does not want to accept the land encroachment that the exploitation results in.
- The government may have several, in some cases conflicting, interests such as tax revenue, employment, and protection of other public interest, such as the natural environment and cultural heritage.
- The prospectors have an interest in obtaining benefit from the mineral resources they have found after making significant investments.

These interests have over the centuries been given varying weight, which also has been reflected in the legislation. The investigative work performed in recent years upon formation of protective areas, however, has had an imbalance in which the conservation and cultural interests not have taken the industrial interests into account. For the mining industry, this has meant that larger areas have been protected without a thorough inventory of the rock and its potential for ore findings.

The price development and the increased material needs of the society has resulted in that the ore potential in Sweden today is great, even outside areas that previously did not have any mines. Many metals that to date not have been mined, or mined in small scale (Ni, PGE, Sn, W, U, Li, etc.) have potential outside the classic ore fields.

In this context, it should be emphasised that the geology is 3-dimensional and that ore-bearing elements very well may be located under rock not associated with ore. From a national interest perspective, it is relevant to discuss the upper 2 km. A map at 2 km depth may look very different from the one we currently have over the outcrop of different geological formations.

The development in recent years, with an increasing focus on the conservation and cultural interests has created a need for the mining industry to go into protected areas to explore. Sweden's contribution to the Natura 2000 comprises approx. 14% of Sweden's area. Furthermore, many of these Natura 2000 areas include large parts of the Norrbotten county, parts of Skelleftefältet, and the Gold line, as well as large parts of Bergslagen; that is, Sweden's most important ore regions.

Technology development and increased awareness within the industry have created opportunities to act in protected areas in an efficient and environmentally acceptable way. There is thus an interest to, based on the existing legislative framework and the latest technology, provide guidance for good environmental practice for exploration in protected areas.

### **1.3 Legislative framework**

Mineral exploration in Sweden is governed under the Minerals Act (1991:45).

The purpose of the Minerals Act is to promote an economically viable mining industry, which in the best way utilises the Swedish mineral resources in a way that is consistent with Sweden's economic, social, and environmental goals.

The Minerals Act is about exploration and extraction of certain mineral deposits on land, regardless of who owns the land. The Act defines exactly which mineral substances the rules apply to, the so-called concession minerals, see Chapter 1.

§ 1. Primarily these are the traditional metals, certain industry minerals, as well as oil, gas, and diamonds. All other minerals and rocks are outside the Minerals Act. They are therefore usually called landowner minerals.

The Mining Inspectorate is the authority in Sweden that decides on authorisation for exploration – exploration permits, and for mines – exploitation concessions. An exploration permit gives exclusive right to explore, access to the land within the permit area, and preferential rights to an exploitation concession. An exploration permit does not give the right to undertake exploration work in contravention of any environmental regulations applying to the area. Applications for exemption are normally submitted to the County Administrative Board. An exploitation concession gives the holder the right to exploit a proven, extractable mineral deposit. The right is valid for 25 years and may be prolonged.

Other acts also governing exploration work include:

- Mineral Ordinance (1992:285)
- Environmental Code (1998:808)
- Off-Road Driving Act (1975:1313)
- Off-Road Driving Ordinance (1978:594)
- Forest Conservation Act (1979:429)
- Forest Conservation Ordinance (1993:1096)
- Heritage Conservation Act (1998:808)
- Heritage Conservation Ordinance (1988:1188)
- Protection of Vital Public Facilities Act (1990:217)

### **1.4 Protected areas**

The Swedish legislation allows for the protection of areas, species, and groups of organisms. The protection of area is by far the largest part of the nature preservation and implies that the nature conservation authorities with legal support establish *National parks*, *National reserves*, and *Biotope protections*. The protection means that valuable habitats and vulnerable species are protected where they remain today. The value of the areas as habitats for plants and

animals is often the main reason for the protection. A variety of cultural heritage assets as well as recreation and outdoor-life assets are also often the purpose of the protection of areas. It should be noted that all exploration activities are prohibited in national parks. The matter may, however, be considered in all other types of protected areas.

Examples of protected areas with various types of restrictions:

- National park or suggested national park
- Natura 2000 area
- Nature reserve
- Culture reserve
- Natural monument
- Biotope protection area
- Animal and Plant protection area
- Shoreline protection
- Environmental protection area
- Environmental risk area
- Water conservation area
- Protection area for wild birds
- Protection area for habitats and wild animals and plants
- Large unaffected areas
- Ecologically sensitive areas
- National interest for reindeer husbandry
- National interest for nature conservation
- National interest for cultural heritage management
- National interest for outdoor recreation
- National interest for mineral extraction
- National interest for water supply
- National interest for total defence
- Area for tourism and outdoor recreation
- Coasts where environmentally damaging facilities are prohibited
- Unbroken mountain areas
- Ancient monuments
- Embattlement area
- Cemetery, public road, church, power plant, industry
- Detailed development plan and special area regulations

### **1.5 Exploration**

Mineral exploration is defined in the Management of waste from extractive industries directive 2006/21/EG as:

*The search for mineral deposits of economic value, including sampling, bulk sampling, drilling and trenching, but excluding any work required for the development of such deposits, and any activities directly associated with an existing extractive operation.*

Mineral exploration according to the Minerals Act is the search for economical mineral deposits and may be conducted both on private and/or governmental land.

The typical activities that commonly take place during mineral exploration in Sweden are:

1. Approval procedure
2. Boulder tracing and geological mapping
3. Ground geophysical survey
4. Surface till sampling
5. Drilling
6. Evaluation of the technical feasibility and the commercial viability of extracting a mineral resource

In general, the methods used in mineral exploration have relatively minor impact on the natural environment and cultural heritage. In the initial stage, it is usually a matter of measurements of the rock properties with instruments from land or from aircraft. At a later stage, however, somewhat more intrusive investigations are

performed, for example till sampling and diamond drilling. The investigations may also include usage of other methods.

Potential consequences on the natural environment during exploration work can be:

- Felling of trees and impact on vegetation
- Impact on surface drainage
- Increase of noise, light, and dust levels
- Pollution of water and soil

### 1.6 From exploration to the start of a mine

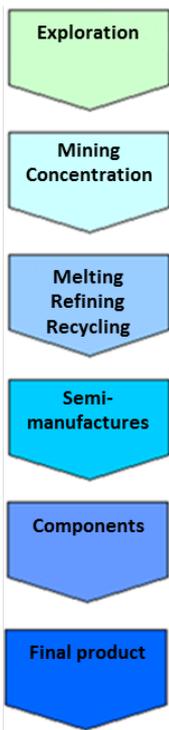
It is a governmental general interest that the extraction of ores and minerals within the country is secured. The wealth evolved during the past centuries in the western countries is to a large extent based on that a large number of metals and minerals can be extracted from the bedrock.

That exploration (prospecting) of the bedrock in accordance to the Minerals Act is conducted is thus of public interest. This is also essential for the mining industry, the metal and mineral industry, and the engineering industry; sectors of traditionally great importance for the economy of Sweden and for the employment. Mineral exploration within the country also reduces the vulnerability of the supply of raw materials for the industry. Exploration of the bedrock in order to find exploitable deposits require advanced knowledge and a major economic effort with high risk.

Exploration does not include mining. Mining is a commercial exploitation of minerals under an exploitation concession and involves refining and processing of the ore. When exploration gives a positive outcome, it is important that also a permit for mining, after thorough examination, may be granted in protected areas. Without this incitement, it will be difficult to attract capital to mineral development projects and to motivate companies to explore for new findings in Sweden.

In Europe, Sweden is the leading ore producer with almost 90% of the production of iron ore in the EU area (year 2006). Sweden's role in Europe is strengthened by the fact that EU as a whole only produces about 3 % of the world production of metallic minerals, but consumes about 20 %. The demand from the manufacturing industry and the construction sector in the EU has in recent decades steadily been increasing. Despite that a large part of the metallic minerals are exploited within the EU, the amount is relatively small compared to the global production.

The fact is, however, that the EU is geologically under-explored. Except from a number of member states which actively market the development of the mining industry (among these are Sweden and Finland, who also show the best environment results among the EU countries), most countries have ceased to support the exploration and mining sectors. In many EU countries with areas that are geologically favourable for the occurrence of metallic mineral findings, no modern exploration has ever been conducted (that is, the usage of tools such as airborne geophysics, geochemistry, etc.).



**Mineral extraction supplies the industry with important metals and minerals. The basis for the mineral supply is exploration. Without exploration, there will be no new mines, which in turn will have an impact on the supply of important raw materials to the metal and manufacturing industry.**

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# DESCRIPTION OF EXPLORATION

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## 2. Boulder tracing and geological mapping

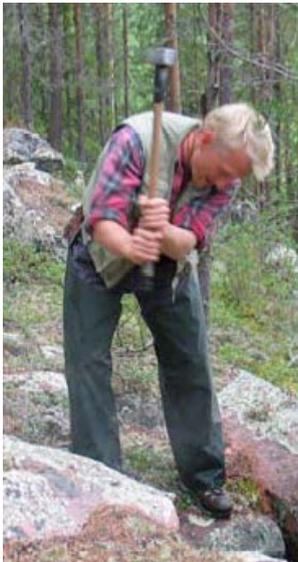


**Boulder tracing and geological mapping**

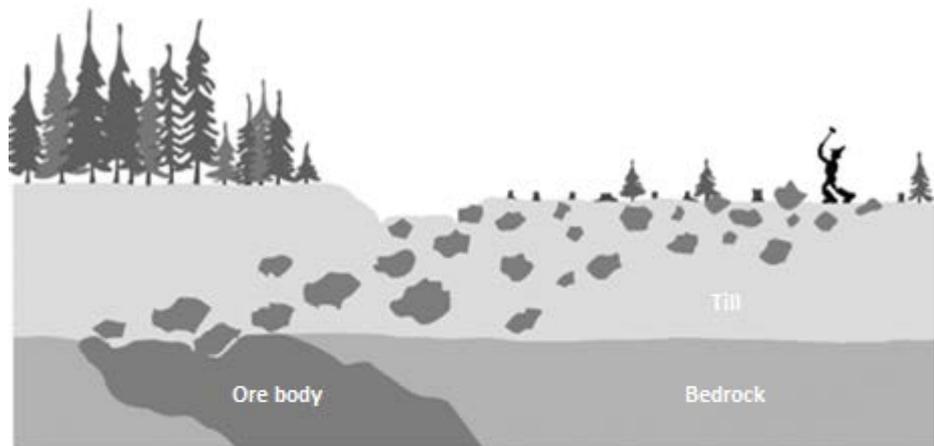
### 2.1 General description

To find mineralisations, studies of the bedrock and the rock are required. In the exploration work, boulder tracing and geological mapping are often included as a first step.

- ❑ *Boulder tracing* means searching for mineralised and geologically transformed boulders. Geologically interesting boulders are mapped and sampled with hammer. The sample is sent for analysis to determine the metal content.
- ❑ *Geological mapping* means searching for outcrops in the terrain. The outcrops are mapped and interesting outcrops are sampled for analysis of the metal content. The geological information is compiled in databases and on geological maps, together with all other available information such as geophysics and geochemistry, which provides a basis for exploration. The information is collected by geologists and geophysicists through surveys in the field.



**Sampling of rock**



*Figure 1: Boulder tracing provides great chances of finding previously undiscovered, soil-covered occurrences of ore and industry mineral. As illustrated in the upper figure, surface boulders may reveal the existence of an ore body further down in the soil layers. Also searching for outcrop may give results (lower figure). The Kiruna ore, for example, was found in this way. The chances of finding something interesting, however, is much less than with boulder tracing. Only 3% of Sweden's area consists of outcrop. (Source: Geological Survey of Sweden)*



**Boulder tracing with metal detector**

### 2.2 Consequences for the natural environment

Boulder tracing and geological mapping generally causes no land damage. For outcrop searching, however, it may be necessary to remove moss to expose the appropriate rocks and boulders.

### 3. Geophysical ground surveys

#### 3.1 General description

General geophysical surveys from airplanes or helicopters provide the basis for the mapping of the geology over large areas – often several hundred square kilometres. The results guide the prospector to places with promising geological conditions. Geophysical ground surveys are performed when a promising area for exploration has been marked off. The physical characteristics of the ground are then surveyed with different types of portable equipment.

Geophysical ground surveys are conducted throughout the year. The technicians walk or ski over the working area and measure the physical characteristics of the ground with different types of portable measurement equipment. Some of the measurement methods require that a long electrical cable is laid in the area. This is done by using a snow mobile or quad that feeds the cable from a cable drum. The technicians send the measurement results to geophysicists for interpretation.

The measurement is performed in a grid, where the distance between the survey lines generally is 100 or 200 metres and the distance between the survey points generally is 5 to 25 metres. Today, the measurements and the orientation are almost exclusively conducted with GPS (Global Position System) navigation.

#### 3.2 Consequences for the natural environment

The impact on the ground and the environment at geophysical ground surveys is non-existent or very small. In some cases, sight-clearing is done along the base line and the measurement line, but usually this is not required. The development of the GPS technology has led to that staking and clearance of staking lines is used less.



**Geophysical ground survey with snow mobile in the winter**



**Geophysical ground survey in the summer**



**Aero geophysical survey with helicopter**



**Aero geophysical survey with airplane**

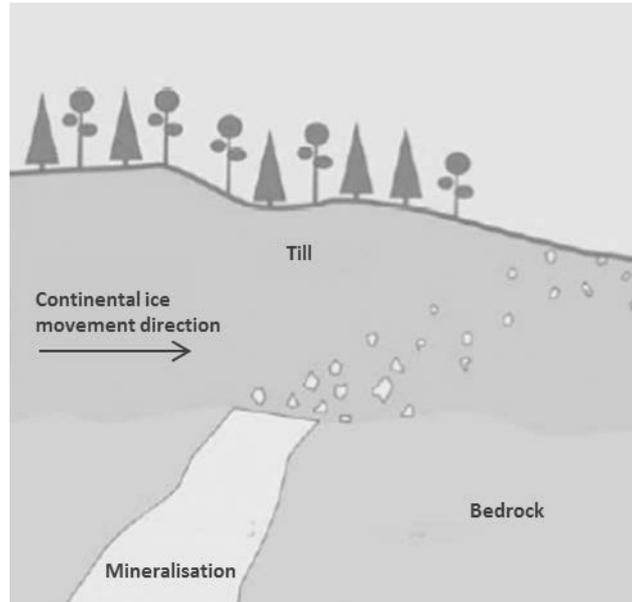
## 4. Surface till sampling



**Boulder containing nickel mineral. Locally in the proximity of Vindeln, the Västerbotten county**

### 4.1 General description

The bedrock is often overlaid with loose soil layers, usually till, which the continental ice crushed down from the bedrock and spread as the ice moved. In the till, traces of minerals and metals from the surrounding bedrock may therefore be found. Surface till sampling can be performed in different ways; with shovel and with handheld drill.



*Figure 2: The conditions for exploration in Scandinavia are special, since the region has been covered by continental ice. The ice planed the rock and brought the crushed rock and fragments of ore which is now found as traces in the soil. By studying how the continental ice has moved, it is possible to determine from where the metal fragments origin. (Source: Lappland Goldminers)*

*When sampling with a shovel*, a hole is dug in the ground until untouched mineral soil is reached, the so-called C-horizon, which is sampled. The hole is typically 0.5-1 m deep. The sample is collected in a sample bag and then the hole is backfilled with the dug-up material.

*When sampling with a handheld drill*, a small hole is drilled in the soil (approx. 5 cm in diameter) down to the desired depth, usually one to a few metres, after which the drilling is stopped and the sample is collected in a bag. The sampler, located at the bottom of the drill string, captures the sample at the depth where the drilling is stopped.

### 4.2 Consequences for the natural environment

Surface till sampling generally causes no ground damage.

## 5. Drilling



TGB drills with a 5.5" RC hammer

### 5.1 General description

When an interesting area has been identified, different types of drilling are performed to conclude the nature of the rock at depth. Since drilling is costly, careful analysis of where the drilling should be performed is required. Drilling takes place in a small and limited part of the exploration permit.

The drill rigs can vary in shape and size. Although there are a number of different sizes, manufacturers, and types of drills, there are a few simple rules that apply to most of them. The drill rigs are almost always primarily driven by a diesel motor. All drills have at least one secondary driving mechanism which is hydraulic. Typical drill rigs are small and are transported to the site with tracked vehicles or terrain vehicles.

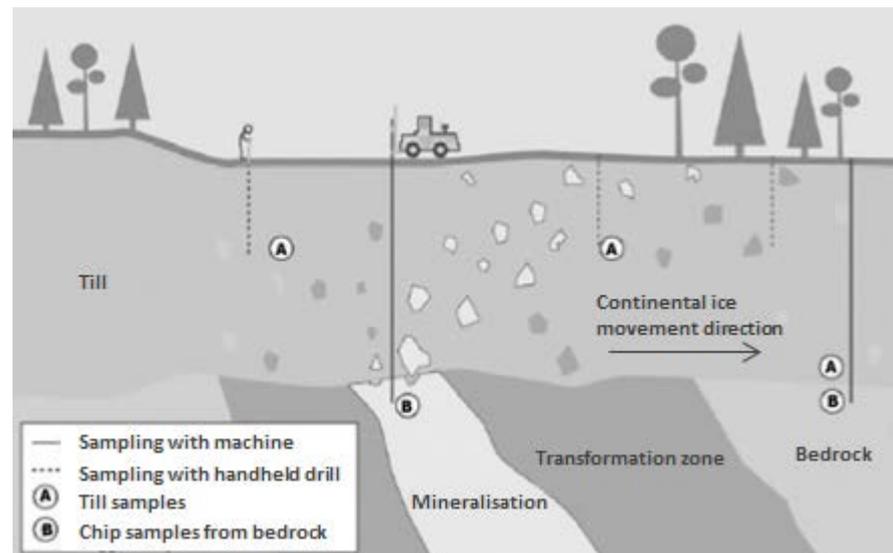


Figure 3: Different types of sampling with drill. (Source: Lapland Goldminers)

### Soil drilling

Soil drilling and surface rock sampling is performed when an interesting area has been identified by geological mapping, geophysical surveys, and/or boulder discoveries. At soil drilling, samples are taken from the soil layer, normally at a depth of 0-20 metres, above the solid rock. Normally samples are also taken from the top surface of the bedrock. The soil and rock samples are analysed. The purpose of this type of sampling is to investigate a larger area, in which there are indications of mineralisations.

Soil drilling and surface rock sampling are, like diamond drilling, relatively expensive exploration methods. Drilling usually costs SEK 200-300 per metre. The distance between the samples usually varies from 10 to 400 m. The purpose of this type of sampling is to investigate a larger area, in which there are indications of mineralisation occurrence. Increased concentrations of interesting metals can lead to the next stage in the exploration work, normally diamond drilling.

A smaller drill rig, often mounted on tracks, is driven to the drilling site. The best available route is used, preferably on hard foundation and in consultation with the landowner. For natural reasons, certain areas, such as wetlands, can only be drilled during the winter when the ground is frozen. Sometimes the snow is compacted by driving for example a snow mobile or a tractor along the transportation route before the drill rig is driven to the site. In some cases, a few trees are cut down in order to position the drill rig. The soil and rock samples are placed in packages and transported away on a snow mobile or quad and are then sent for analysis.



Examples of soil drilling



**Diamond drilling in the summer in Fäboliden, Västerbotten**



### Core drilling

Diamond drilling is often the last step in the exploration work. An interesting area has been identified through geological mapping, geophysical surveys, and/or basal till drilling and surface rock sampling and needs to be investigated more in detail. The rock is drilled with a circle shaped drill bit covered with small diamonds, which cuts out a cylindrical core of rock. When the drill tube is full, it is brought up and emptied. The drill cores are placed in special boxes and then transported on a snow mobile or quad to a drill core archive for geological mapping and sampling. Mineralised parts of the drill core are sent to a laboratory where the metal content is analysed.

Diamond drilling is often performed with a tracked machine. The best possible route to the drilling site is chosen in consultation with the landowner. For natural reasons, certain areas, such as wetlands, can only be drilled during the winter. One or several holes are usually drilled, with a diameter of approx. 5 cm and a depth of some hundreds meters. Water for cooling and transport of drill cuttings is taken from a nearby lake or a tank. This involves relatively small amounts of water, which is purified on site by sedimentation. In some cases, a few trees are cut down in order to position the drill rig.

Diamond drilling is an expensive but necessary exploration method. One drill hole generally costs between SEK 500 and 1000 per metre. The drill bit, which includes small industry diamonds, costs about 3500-4000 SEK each. Depending on the physical characteristics of the rock, the drill bit lasts for different lengths, ranging from some 10 metres to some 100 metres. This requires that the work is very well-planned and concentrated to an identified area of interest.

### RC drilling

RC drilling ("reversed circulation") is used when larger amounts of samples are desired and is most commonly used for gold exploration. The principle is that pressurised air blows rock fragments, called rock chips or drill cuttings, up from the hole while drilling. Normally, the drill cuttings are collected in large sacks for each drilled metre. These samples are recorded and a smaller but representative portion of the sample is then sent for analysis of the metal content.

The RC drilling can be compared with diamond drilling when it comes to the size of the drill rig and at what stage of the exploration it is performed. Normally, holes that are approx. 14 cm in diameter and up to 200 m deep are drilled. No water is needed for this type of drilling. In some cases, a few trees are cut down in order to position the drill rig.

The RC drilling technology is in general faster and somewhat cheaper than diamond drilling. Because of its costs, RC drilling, like diamond drilling, requires good planning to delimit an interesting area within the exploration permit.

### 5.2 Consequences for the natural environment

The impact on the environment is more limited than for example forest work. The drill rigs are in general diesel driven and mounted on a tracked vehicle or forest tractor.

Drilling itself involves a certain amount of noise from the machine. However, it can be kept relatively low with a silencer. By making the drilling staff aware of the importance of cleaning up during and after the drilling and to assemble waste and dispose it, only driveways will be visible in the terrain, as well as a sealed iron pipe at the drilling site.



**Example of RC drilling**

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## LEGAL FRAMEWORK FOR ACTIVITIES IN PROTECTED AREAS

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The Swedish legislation allows for protection of areas with special assets, species, and groups of organisms. Below are examples of protected areas with different types of restrictions:

- National park or suggested national park
- Natura 2000 area
- Nature reserve
- Culture reserve
- Natural monument
- Biotope protection areas
- Animal and Plant protection area
- Shoreline protection
- Environmental protection area
- Environmental risk area
- Water conservation area
- Protection area for wild birds
- Protection area for habitats and wild animals and plants
- Large unaffected areas
- Ecologically sensitive areas
- National interest for reindeer husbandry
- National interest for nature conservation
- National interest for cultural heritage management
- National interest for outdoor recreation
- National interest for mineral extraction
- National interest for water supply
- National interest for total defence
- Area for tourism and outdoor recreation
- Coasts where environmentally damaging facilities are prohibited
- Unbroken mountain areas
- Ancient monuments
- Embattlement area
- Cemetery, public road, church, power plant, industry
- Detailed development plan and special area regulations

Protected areas, referred to in the following sections, relates to the area protections that are regulated in chapter 7 of the Environmental Code. Also world heritage and national interests are briefly covered.

### 6. Protected areas in the Minerals Act and its ordinances

The Minerals Act includes few regulations directly applicable to protected areas. The available regulations are primarily intended to address, in connection with mineral legislation trials, the issues that may arise according to other legislation that apply in parallel with the mineral legislation. The regulations of interest in the Minerals Act and the Mineral Ordinance are in particular the following:

- ❑ According to chapter 3, section 6 of the Minerals Act, exploration work may not be undertaken *within a national park or an area which a central government authority has requested the Government to designate as a national park*. It is not required that there is a prohibition on exploration work; this regulation constitutes an independent ground against all exploration work and there is no possibility to grant exemptions.
- ❑ According to the same regulation, exploration work may not be conducted in violation of *the provisions issued for nature or culture reserves*. The purpose is primarily to ensure that possible reserve provisions are addressed early.

- ❑ In the second paragraph in the same section, there is information that permission is required for certain operations and measures according to chapter 7, sections 28a – 29b of the Environmental Code; that is, within so-called *Natura 2000 areas*.
- ❑ According to chapter 3, section 6, paragraph 3 of the Environmental Code, a permission from the County Administrative Board is required for exploration work to be conducted within an area referred to in chapter 4, section 5 of the Environmental Code; that is, *unbroken mountain area*. Permission from the County Administrative Board is also required within 200 metres from defence objects, under the Act (1990:217) on the protection of vital public facilities within military protection areas, as listed in the appendix to the regulation of the act. The same applies within churchyards and other cemeteries and finally within the rocket firing range Esrange. Permission by the Mining Inspectorate is required within 30 metres from a public road, railway, channel open for public traffic, and public airport, within 200 metres from residential building, church, community centre, education institution, hotel, guest house, health care establishment, nursing school, or other similar institution intended for more than 50 persons, electrical power station, industrial plant, and within area with a detailed development plan or special area regulations according to the Planning and Building Act. In some cases, the person affected by the works may allow them to be performed. Permissions may be conditional. Regarding unbroken mountain areas, it is provided that the conditions that are required to prevent substantial damage of the area's natural or cultural assets are stated.
- ❑ *The provisions concerning the management of land and water in chapter 3 and 4 of the Environmental Code* are to be applied in cases involving the granting of exploitation concession. If the operations later are to be examined according to other laws, the provisions shall only be examined in the concession issue. This means that the main localisation examination of a new mine takes place under the examination of the concession issue under the Minerals Act. It should also be noted that an exploitation concession cannot violate the detailed plan or special area regulations according to the Planning and Building Act.
- ❑ Section 1 of the Mineral Ordinance provides that an application for exploration permit shall include information about the areas defined in chapter 3, sections 6-7 in the Minerals Act. The assessment of an exploration permit is normally not affected by the existence of area protections, but an exploration permit can only be used for exploration work if the required permissions/exemptions are in place according to the area protections in question. By finding out in an early stage what applies within the area, the planning of the actual work is facilitated and the required applications can be prepared in time. The Mining Inspectorate always gives the County Administrative Board the possibility to give their view on the application and they usually state if there are deficiencies in the report submitted by the applicant. It is, however, always the person responsible for the exploration works that also has the responsibility to ensure that all the required permits, exemptions, and permissions are in place when the work is performed.
- ❑ An *application for exploitation concession* must include an environmental impact assessment. The requirements for the contents of the assessment is regulated in section 17 of the Mineral Ordinance, chapter 4, section 2 of the Minerals Act and chapter 6, section 7 of the Environmental Code.
- ❑ An application for exploitation concession shall, according to section 17 of the Mineral Ordinance, also include information about the areas included in chapter 3, sections 6-7 of the Minerals Act.

## 7. Protected areas under chapter 7 of the Environmental Code

Nature protection is the major part of the area protection and means that the nature conservation agencies with legal support establish *National parks*, *National reserves*, and *Biotope protection areas*. The protection implies that valuable habitats and sensitive species are protected where they remain today. The value as habitat for plants and animals of the area is often the main reason for the protection. Different cultural environmental assets and values for recreation and outdoor activities are also often included in the objective of the area protection.

The area protections under chapter 7 of the Environmental Code that are considered to have the greatest impact for the mineral sector in Sweden are:

- National parks
- Nature and culture reserves
- Natura 2000 area
- Biotope protection areas
- Unbroken mountain areas
- World heritage

### 7.1 National parks

National parks are established for the purpose of preserving a large contiguous area of a certain landscape type in its natural state or essentially unchanged. Only land belonging to the state may be covered.

Designations are made by the Government with the consent of the Parliament under chapter 7, section 2 of the Environmental Code. In the designation, the purpose of the park is included. The provisions to be applied for the park are decided by the Environmental Protection Agency (Naturvårdverket). Exemptions from the provisions may be granted by the County Administrative Board if there are special reasons.

Exploration may not be undertaken in national parks or in areas which a central government authority has requested to be designated as a national park under chapter 3, section 6 of the Minerals Act.

#### **What does this mean for me as a prospector?**

The Minerals Act prevents all exploration work. In addition, it would be very difficult or impossible to get an exemption from the provisions of a national park. This means that exploration cannot be done in a national park.

### 7.2 Nature and culture reserves

*Nature reserve* is the most common type of protection. The purpose of a nature reserve is to preserve biological diversity, protect and preserve valuable natural environments, or to satisfy the need of areas for outdoor recreation. If the area is needed to protect, restore, or establish valuable natural environments or habitats for species worthy of preservation, it can also be designated a nature reserve. The nature reserve may include both private land and publically owned land.

*Culture reserves* are designated for the purpose of preserving valuable cultural landscapes. The provisions of nature reserves are applicable also for culture reserves. Sometimes the border between culture and nature reserves is floating. A cultural environment can of course also contain a natural environment worth protection.

Decisions relating to the establishment of reserves are made by the County Administrative Board or by the municipality. The protection provisions are "tailor-made" for each reserve and are very varying depending on the motives behind the establishment of the reserve. Prohibition against land-affecting measures and damages to plant and animal life is common.

The decision establishing a nature reserve contains both a specification of the restrictions on the right to use the land and water as well as regulations as what the public has to observe in the area. The one that conducts exploration work within a nature reserve must observe all provisions. As previously indicated, the variation in regulations is very large. It is therefore always necessary to find out what is applicable to the area in which the work is going to be carried out.

### **Exemptions**

The provisions regarding restrictions on the right to use land and water are generally designed as pure *prohibitions*.

This means that the regulated measures in the normal case will not be allowed. The County Administrative Board or the municipality may, however, under chapter 7, section 7 of the Environmental Code, grant exemption from the rules it has issued. For such an exemption, special circumstances are required and that these are consistent with the purpose of the protection. An exemption may also be conditional. What may constitute special circumstances for an exemption has not been exemplified in the preparatory works to the Environmental Code. Reasonably, the more intrusive a measure is, the stronger the circumstances must be to still be allowed to perform the measure. In cases where the County Administrative Board considers that an exemption will not be granted for more extensive activities, such as for example test mining and mining in the future, this should be taken into account in the assessment of what are special circumstances.

### **Permissions**

Other provisions may instead be designed in such a way that *permission* is required to perform a measure.

As a general rule, permission for an operation or measure should only be granted if the person that intends to perform it shows that he/she intends to comply with the requirements imposed by the Environmental Code's general rules of consideration and such restrictions and other precautions that may be required to fulfil the purpose of the reserve. What this means in real terms in each single case should always be stated in the conditions that the permitting authority announces in conjunction with the permission decision.

### **Application for exemption or permission**

Section 23 of the Ordinance on protection of areas (FOM) provides that an application for permission or exemption shall be in written and accompanied by a map and, to the extent necessary in each case, an environmental impact assessment under chapter 6 of the Environmental Code.

A decision to grant an exemption ceases to apply if the work on the measure to which the exemption refers does not commence within two years or if it is not completed within five years of the date when the decision gained legal force (chapter 7, section 7 of the Environmental Code).

Further provisions concerning the consideration of exemptions and permissions are available in chapter 16 of the Environmental Code.

### **Cancelling**

The County Administrative Board or the municipality may cancel, wholly or in part, a decision it has taken pursuant to chapter 7, sections 4 to 6, if there are exceptional circumstances (chapter 7, section 7 of the Environmental Code). The provision includes the geographical extent of the reserve, the purpose, and the provisions applicable to the area under chapter 7, sections 5 and 6 of the Environmental Code. The term exceptional circumstances mean that very strong circumstances are required to cancel a reserve. According to the preparatory works, the intention of a decision on a nature reserve shall be to create a definite protection and deviations from the protection shall only exceptionally be possible to do. The requirement for exceptional circumstances may be met if a considerable change has occurred in the area. (Government bill 1997/98:45 part 2, p. 75)

Any special provision regarding cancelling of the ordinance provisions under chapter 7, section 30 does not exist. Thus, such provisions can, without any

requirements on exceptional circumstances, be withdrawn by the authority who decided on them. According to chapter 7, section 7, paragraph 4 of the Environmental Code, a decision on withdrawal according to the first paragraph may only be made if the encroachment on the natural asset is reasonable compensated. The compensation rule also applies to exemptions from the provisions.

#### **What does this mean for me as a prospector?**

That mining is a particular public interest has been expressed in several contexts, most recently in the government bill 2004/05:40, Changes in the minerals act, page 30 f. Exploration works that require exemption should, against this background, be possible to grant if they are not contrary to the purpose of the prohibition or provisions.

Most modern methods for measuring and test drilling normally only involve a minor impact on areas that are not very sensitive. Simpler exploration (such as boulder tracing and geophysical measurements) has no impact on land and can in principal always be performed, after consultation with the County Administrative Board, without a permit examination. If the test drilling is conducted with the precautions normally required by the County Administrative Boards, exemption should therefore be possible to grant under the condition that necessary safety measures are applied; such as restrictions regarding the time of the year, cutting of trees, avoidance of particularly sensitive areas, etc. (see examples); and that there are special circumstances. Such drillings are in most cases performed during the winter on frozen ground to reduce the impact. Machinery can also be flown into the area, to decrease the risk for damage. In the cases where the operator considers they cannot take into account the considerations the County Administrative Board requires, however, the operations cannot be conducted.

### **7.3 Natura 2000 areas**

Natura 2000 was established within the EU to halt the extinction of animals and plants and to prevent their habitats from being destroyed. In 1979, the Bird directive was adopted and in 1992 also the Habitat directive where the regulations applying to Natura 2000 are included. These two directives are the foundation of the nature preservation politics of the EU, which in turns has its roots in international agreements. The most important is the convention about biological diversity, adopted at the UN earth summit in Rio 1992.

The decision on a Natura 2000 area is made by the Government according to the provisions of the Habitat directive (article 4) and chapter 7, section 28 of the Environmental Code for the areas designated to birds. The Environmental Protection Agency is according to section 15 of the FOM (Ordinance on protection of areas) obligated to keep a list of these areas.

Natura 2000 implies that all EU countries shall take measures to assure that nature types and species in the network have a so-called favourable conservation status. This means that they shall remain in the long term and that preventive measures are required to secure their favourable conservation status. In Sweden this is initially done by the development of so-called conservation plans, in accordance with section 17 of the FOM. These describe what favourable conservation status is, in terms of conservation objectives. They also include descriptions of the included species and nature types, potential threats against the assets of the area and the conservation measures needed. The conservation plan is a document that forms an indicative basis for decisions on for example permission examinations under chapter 7, section 28a of the Environmental Code. Even a draft of a conservation plan is an important input.

According to the interpretation of the EU commission, there is no obvious prohibition against commercial development within areas included in Natura 2000; an assessment must be made in every single case. According to article 6 of the Habitat directive, which applies to all areas in Natura 2000, an assessment shall be made of all development plans likely to have an impact on the identified areas. The provisions are based on existing good practice for environmental impact

assessments. Even when one considers that an area is likely to be severely damaged, the directive does not exclude such development. The member states can allow development measures if there are no viable options and if it can be shown that the case is of significant public interest. In such cases, however, they have to take compensatory measures by creating or improving habitats in other locations to ensure that the completeness of the network is preserved.

### **Permissions**

Many Natura 2000 areas are protected as national parks, nature reserves or by other means. Regardless if there are other protections or not, a special permission is required for measures that in a significant way may have an impact on the environment in a Natura 2000 area. Permission is primarily applied for from the County Administrative Board, but if the examination needs to be made also according to other provisions by another authority, such as the environmental court, this authority will also examine the Natura 2000 issue after consulting the County Administrative Board. An environmental impact assessment shall be appended to the application and it shall contain the information required for the examination of the Natura 2000 permission.

In the environmental impact assessment, the operator shall identify and describe the direct and indirect effects that the operations, alone or together with other on-going or planned operations or measures, may have on the natural assets in the Natura 2000 area. The purpose is that the operator shall produce a basis for decision enabling an assessment of whether the operations can be allowed under chapter 7, section 28b; that is, if the operation alone or together with other on-going operations and measures may damage the habitat or habitats that are to be protected in the area or if it may lead to that the species to be protected are subjected to a disturbance that in a significant way may complicate the conservation of the species in the area.

The permission requirement in chapter 7, section 28 arises when an operation or a measure in a significant way may have an impact on the environment in a Natura 2000 area. The permission requirement is formulated in more general terms than the permission examination provision in chapter 7, section 28b of the Environmental Code, in order to capture operations and measures that typically may involve such an impact.

### **What does this mean for me as a prospector?**

Natura 2000 areas are entirely designated based on scientific grounds in terms of the conservation interest. At the time of the designation, no other considerations must be taken into account; any such examination shall be made at a later stage. The mineral interests are protected under chapter 3, section 7 of the Environmental Code; "Land and water areas that contain valuable substances or materials shall, to the extent possible, be protected against measures that may be prejudicial to their extraction". There is therefore nothing that prevents exploration or mining within areas where there is not sufficient knowledge about valuable substances or materials.

*During exploration work in terms of test drilling:* Most modern methods normally involve such a minor impact that a permission examination under chapter 7, section 28a of the Environmental Code not should be required in most cases, provided that necessary safety measures are applied and that the drilling is not performed in sensitive locations. Simpler exploration (such as boulder tracing and geophysical measurements) has no impact on land and can in principal always be performed, after consultation with the County Administrative Board, without permit examination.

The County Administrative Board should always be contacted before work within or in the proximity of a Natura 2000 area is performed. This is to pay attention also to indirect impact and for an overall assessment of the drilling and associated activities, such as the cutting of trees and water extraction. This is preferably handled in consultation with the County Administrative Board according to chapter 12, section 6, where issues such as time of the year, especially sensitive areas, requirements on that tress must not be cut, how waste water should be handled, etc. are addressed. Such drillings are in most cases performed during the winter on frozen ground to reduce the impact. Machinery can also be flown into the area, to decrease the risk for damage. In the cases where the operator considers that they cannot take into account the considerations required by the County Administrative Board, however, permission must be applied for. Also refer to the conservation plan of the area, which describes the purpose of the area and what is especially sensitive.

### **7.4 Other area protections**

*Biotope protection areas* are smaller land and water areas with biotopes worth preserving. Some of such areas are protected in general by FOM, for example avenues and stone walls in the farmland, while others are decided individually. Within such areas, no operations that may damage the natural environment must be performed. Exemption from the general area protections may be granted by the County Administrative Board if there are special reasons, but not from the ones that have been decided individually.

The Nature Conservation Law expired when the Environmental Code came into force on January 1, 1999. Some decisions with older forms of protection under the Nature Conservation Law are still in force. The most important are the nature preservation areas and the protection of the landscape picture. *Nature preservation areas* could not, opposed to the nature reserves, involve such restrictions in the right to use the land that requirements for compensation or redemption could occur. The nature preservation areas shall, according to the transitional provisions to the Environmental Code, when applying the code, be considered as nature reserves; that is, the legal framework for nature reserves shall apply also to these areas.

### **7.5 Interim prohibitions**

In the cases where a nature reserve has not yet been designated, but it is considered that there is a need for protection, or where a reserve needs extended protection, a County Administrative Board or municipality may make a decision on an *interim prohibition*. This means that the measures listed in the decision are prohibited for three year and that the authority during this time shall create the reserve or make a decision on the necessary protection. This is normally used in cases with acute threats against the area. The regulations for nature reserve apply also here.

## 8. World heritage and national interests

### 8.1 World heritage

The UN organisation UNESCO maintains a list of cultural and natural environments that are so unique that they shall be considered a so-called world heritage. The member countries nominate the objects themselves and shall show that they have a sufficient protection for the future. That an object/area is included on the world heritage list does not as such imply any further legal protection, but many areas have already a formal national protection, for example Laponia, which also mainly is protected as a national park and nature reserve.

### 8.2 Provisions concerning land and water management

Land and water areas shall be used for the purposes for which the areas are best suited. This is the foundation of the basic and special provisions concerning the management of land and water in chapter 3 and 4 of the Environmental Code. The provisions are of central importance for the localisation analysis that shall be performed according to the Environmental Code and many other laws. Upon examination under the Minerals Act, it is only in matters concerning exploitation concessions that these shall apply. Upon examination under the Environmental Code, the provisions concerning the management of land and water are applicable for example for assessment of issues under chapter 7; that is, in question of exemptions and permissions regarding area protection and permit examinations according to chapter 9 and 11.

Chapter 3, section 7 of the Environmental Code regulates the protection of extraction of valuable substances and materials, both by a provision concerning the management (first paragraph) and by a provision regarding the national interest for extraction (the second paragraph):

1<sup>st</sup> paragraph: *Land and water areas that contain valuable substances or materials shall, to the extent possible, be protected against measures that may be prejudicial to their extraction.*

2<sup>nd</sup> paragraph: *Areas that contain deposits of substances or materials of national interest shall be protected against measures referred to in the first paragraph.*

In chapter 3, section 10 of the Environmental Code, there is a special provision on the considerations to be made if two or more national interests are incompatible; the consideration must however not be contrary to chapter 4 of the Environmental Code. Priority shall then be given to the object or the objects that most appropriately would promote a long-term management of the land, water, and the physical environment in general. Total defence interests shall be given priority.

### 8.3 Unbroken mountains

In chapter 4 of the Environmental Code, the Parliament has directly by law stipulated that certain areas, in their entirety, shall be of national interest in view of the natural and cultural assets that exist there. These include the major part of Sweden's coastal line, the unregulated rivers, parts of the mountains and all Natura 2000 areas. Within these areas, exploitation and other environmental interventions may only be undertaken under certain circumstances specified by the law.

In chapter 4, section 1 of the Environmental Code, there is an exemption from the general rules. If there are special reasons, the provisions shall not be an obstacle for facilities for the extraction of valuable substances and minerals considered to be available within areas of national interest. As previously mentioned, a special permission by the County Administrative Board is required under chapter 3, section 7 of the Minerals Act for exploration work within unbroken mountain areas according to chapter 4, section 5 of the Environmental Code. Notification to consultation under chapter 12, section 6 of the Environmental Code shall also always be made for these works.

**What does this mean for me as a prospector?**

Within unbroken mountain areas, there is no prohibition on exploitation, since such exploitation requires plan examination. According to the Environmental Code, there is no obstacle for extraction plants within unbroken mountain areas if there are special reasons. By that, there is no obstacle for exploration within these areas, except for the general permit examination.

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# APPROVAL PROCEDURE

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## 9. Permits

### 9.1 Exploration permit

An *exploration permit* gives the holder exclusive right to exploration and a preferential right to an exploitation concession.

- ❑ The application for exploration permit is under the Minerals Act supplied to the Mining Inspectorate. Before the decision is made, the County Administrative Board shall always be given the opportunity to comment and all affected parties in the area shall be informed. If the application relates to alum shale, oil, gaseous hydrocarbons, or diamond, the application shall be proclaimed and also the municipality shall be given the opportunity to comment.
- ❑ Before the work starts, there must be a *work plan*. It is the responsibility of the prospector to establish the plan and communicate it to landowners and other holders of rights. If a landowner objects to the work plan and the prospector cannot come to an agreement with the landowner, the work plan can instead be examined by the Mining Inspectorate.

In many cases, an exploration permit and a valid work plan are sufficient to be able to start the exploration. Some actions may, however, require special permits/trials and within certain areas special regulations apply. Those who primarily may arise are:

- ❑ *Notification to consultation with the County Administrative Board according to 12:6 of the Environmental Code:* Consultation is required for activities that significantly may change the natural environment<sup>2</sup> and for which no other notification or permit is required according to the provisions of the Environmental Code. The performer of the activities is responsible for the consultation to take place (some County Administrative Boards generally require consultation for a certain type of work in certain areas). What is to be considered as a significant change of the natural environment may be difficult to determine and is not only depending on the action to be taken, but also on the sensitivity of the area. In doubtful cases, consultation should be made even if the performer believes that the change of the natural environment is of no damage. The County Administrative Board has the possibility to impose conditions for the exploration work in order to reduce the risk for damage to the natural environment. The County Administrative Board can in certain cases prohibit the entire operation. It is advisable to enclose the work plan or a draft of the work plan to the notification to consultation. The notification shall include particulars of the affected landowners and tenants.
- ❑ *Within natural reserves, Natura 2000 areas, and other areas protected under chapter 7 of the Environmental Code,* permits or exemptions may be required for the exploration activities. What is allowed or may be allowed varies a lot between the different areas. For that reason, it is necessary to check what applies to the place where the work is to be conducted. Many of these issues are to be examined by the County Administrative Board, but sometimes you should turn to the municipality instead.

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<sup>2</sup> The term natural environment is wide and includes bedrock, soil layers, air, water, lake bottoms, and all organisms both above and under the ground and the water surfaces. The term also includes the landscape picture, outdoor recreation, and the cultural heritage.

- ❑ To go by a motor driven vehicle on bare ground<sup>3</sup> or in certain cases on snow-covered ground, an application for exemption from the prohibition in the *Off-Road Driving Act* must be submitted. Such exemptions are examined by the County Administrative Board.
- ❑ To move, remove, dig out, or in other ways alter or damage ancient monuments, *permission according to chapter 2 of the Heritage Conservation Act* is required from the County Administrative Board. If an ancient monument is found during digging or other activities, the work having an impact on the ancient monument should immediately be stopped and the County Administrative Board should be notified.

### 9.2 Permission for test mining

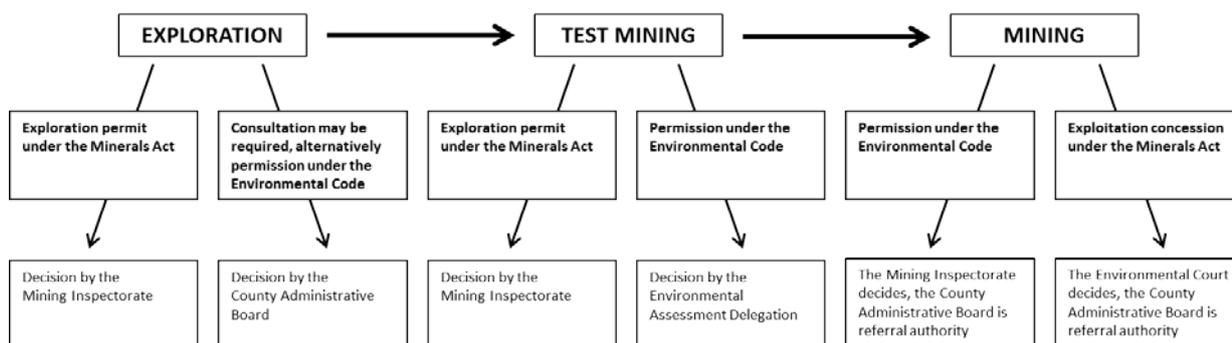
Test mining<sup>4</sup> can be considered a part of the exploration under the Minerals Act, and therefore both a valid exploration permit or exploitation concession and a work plan that includes the test mining are required.

For *test mining*, also permission according to chapter 9, and sometimes chapter 11, of the Environmental Code is required. Test mining of iron ore or test mining of non-iron ore, with the exception of uranium and thorium ore, is examined by the County Administrative Board. For uranium and thorium ore, the application is examined by the Environmental Court. In all cases, an environmental impact assessment (EIA) according to chapter 6 of the Environmental Code is required.

Chapter 6, section 7 of the Environmental Code stipulates: "For activities and measures that are likely to have an environmental impact in a nature area (Natura 2000 area), an EIA shall always contain the information that is needed for an examination under chapter 7, sections 28b and 29." The reason for this is that there should be sufficient information to examine if a permission is required and then if it can be granted.

Consultation under chapter 12, section 6 of the Environmental Code is not required for test mining, since the operation requires permission under other provisions in the Environmental Code. If it becomes necessary to take other measures that, in addition to the mining, may involve a substantial alteration of the natural environment – for example, the construction of driveways – consultation is required for that particular measure. Otherwise, the same examinations as for exploration work are required for test mining.

**Figure 4: Summary of the permission process**



<sup>3</sup> Bare ground refers to ground that is snow-free. All driving which means that the motor driven vehicle is in contact with the ground, is considered as bare ground driving. In cases where the snow depth is small or the snow so loose that the vehicle comes in contact with the ground is therefore considered as bare ground driving.

<sup>4</sup> Test mining means that the soil layer is removed and the bedrock is exposed in an area within the central parts of a near-surface deposit. A certain amount of the rock is taken for concentration tests to establish the quality of the deposit. The exploration also provides further input for assessment of the environmental factors in order to limit the environmental impact and costs of remediation and disposal of waste products.

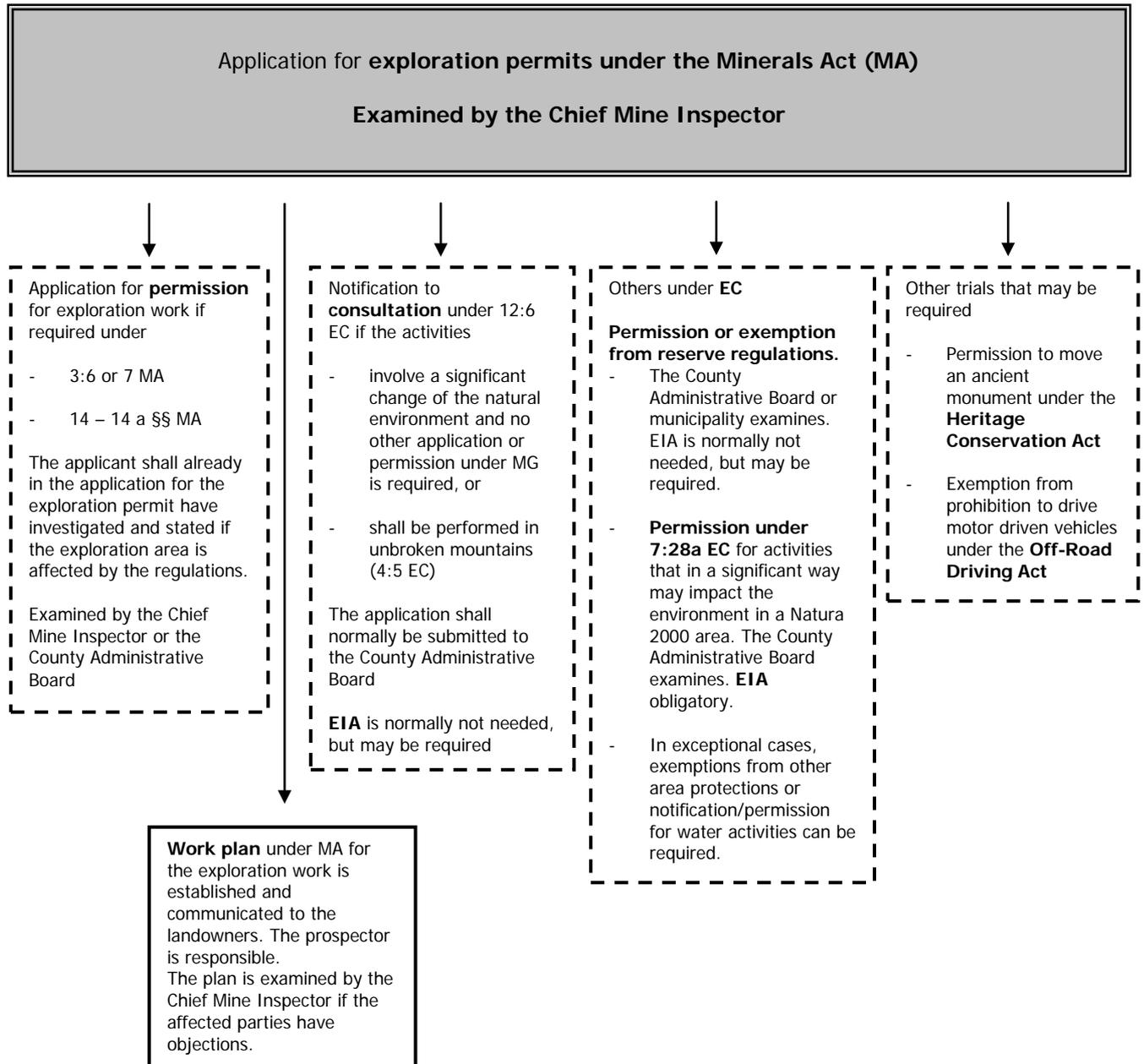
**Table 1: Summary of the permission process:**

(☒ = EIA required, ☐ = EIA normally not needed, but may be required  
 EC = Environmental Code, MA = Minerals Act)

Phase	Always required	May be required under EC/MA	Other regulations that may apply
<b>Exploration</b>	<ul style="list-style-type: none"> <li>▪ Exploration permit under MA</li> <li>▪ Work plan under MA</li> </ul>	<ul style="list-style-type: none"> <li>▪ Permission under 3:6 and 7 MA</li> <li>▪ Consultation 12:6 EC (☐)</li> <li>▪ Exemption/permission from reserve rules (☐)</li> <li>▪ Natura 2000 permission (☐)</li> <li>▪ Other area protections (☐)</li> <li>▪ Other permission applications under EC (☒☐)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Off-Road Driving Act</li> <li>▪ Heritage Conservation Act</li> </ul>
<b>Test mining</b>	<ul style="list-style-type: none"> <li>▪ Valid exploration permit under MA</li> <li>▪ Work plan under MA</li> <li>▪ Permission under chapter 9 EC (☒)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Additional permissions (☒) or notifications (☐), under chapter 9 or 11 EC, e.g. crushing plant</li> <li>▪ Exemption/permission from reserve rules (☐)</li> <li>▪ Natura 2000 permission (☒)</li> <li>▪ Other area protections (☐)</li> <li>▪ Consultation 12:6 EC is not required for test mining, but e.g. for construction of driveways to the area (☐)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Off-Road Driving Act</li> <li>▪ Heritage Conservation Act</li> <li>▪ Planning and Building Act</li> </ul>

**Table 2: Summary of the regulations (source: Geological Survey of Sweden)**

Text within solid line always applies. Text within dotted line may be relevant.



The exploration work can be started when:

- there is a valid exploration permit,
- required permissions under MA are provided,
- three weeks have passed from the date when the work plan was communicated to all the affected parties and no written objections have been made, or from the date when the decision by the Chief Mine Inspector regarding ratification of the plan became final (the Mining Inspectorate may decide that the plan shall be valid before it has become final),
- at least six weeks have passed since a complete notification to consultation under 12:6 was submitted to the County Administrative Board, if such is required,
- other permissions and exemptions required under MG have been provided AND
- permissions and exemptions required under other legislation have been provided.

## 10. Contents of the applications

### **10.1 Application for exploration permit**

What an application for an exploration permit shall contain is extensively regulated in section 1 of the Minerals Act.

The application shall among others include particulars of whether there are, within the area, areas covered by the provisions of chapter 3, sections 6–7, or chapter 17, section 3 of the Minerals Act. What is to be noted is whether such areas exist at all, not if the areas may be affected by the planned work.

### **10.2 Application for permission to conduct exploration work**

There are no provisions on application contents regarding the permission under chapter 3, sections 6 and 7 of the Minerals Act.

To facilitate the work of the examination authority, it is appropriate that the applicant specifies the basis for the request for permission. Since the permission shall refer to certain activities, these activities must also be specified in terms of place and method of execution. It is also appropriate to attach a map to the application.

### **10.3 Application for exemption**

The content of the application for permission or exemption under chapter 7 of the Minerals Act, or under provisions announced based on that, is regulated in section 23 of FOM.

The application shall according to the provisions be in written and accompanied by a map and, to the extent necessary in each case, an environmental impact assessment (EIA) under chapter 6 of the Environmental Code. According to chapter 2, section 1, the operator is also required to prove that the rules of consideration in chapter 2 are followed. These include that sufficient restrictions are planned for in order to prevent damage to the natural environment. The question whether an EIA is required, is normally assessed only after the application has been submitted. Nothing prevents, however, that contacts are made in advanced for a preliminary assessment.

If the application relates to an exemption from a prohibition, it is also important that the applicant states the reasons that would justify that the exemption is granted in the present case.

If the application relates to permission under the provisions of Natura 2000, the application shall always be accompanied by an EIA. If the EIA is established only for the permit examination under the provisions of Natura 2000, the EIA only needs to contain the particulars required for that examination.

An exemption/permission application within nature reserve/snow mobile regulated area, or notification to consultation should include the following particulars in order for the County Administrative Board to examine the case:

1. Name and number of the exploration permit
2. Municipality
3. What protected areas/regulated areas are affected?
4. General map (topographic map 1:50000 or 1:100000) with the exploration permit marked
5. Detail map (1:20000) with the exploration permit marked may be required in certain cases
6. The time period during which the exploration work will be conducted
7. Description of what will be done. What work will be executed? (For example geophysical surveys, digging, drilling, cutting, sight-clearing, etc.). How will the work be done? Manual sampling, machine work?
8. How will transports be handled? Bare ground or frozen/snow-covered ground? For heavier transports, the type of vehicle, gross weight with payload, ground pressure. Transportation route (map).

9. What environmental impact is foreseen? What measures will be taken to avoid damage?
10. What remedial measures will be taken?
11. Description of the natural conditions in the affected area.

For application relating to an exemption from natural reserve provisions, the examination fee according to the fee ordinance (1998:940) for the examination and supervision of the Environmental Code must be paid before the case is examined.

#### **10.4 Notification to consultation**

Notification to consultation shall, under section 8 of the Ordinance (1998:940) on Fees for Examination and Supervision, be in written and accompanied by a map. It shall also contain a description of the planned operation or measure. An EIA may, as for exemptions and permissions under chapter 7 of the Environmental Code, be required. Particulars of the affected landowners and tenants shall also be included. For larger work undertakings, it is important to seek prior consultation with the County Administrative Board.

#### **10.5 Application for exemption from prohibition to drive in the terrain**

Driving on bare ground terrain is forbidden in Sweden. All natural land outside roads – for example parks, fields, meadows, forests, moorlands, beaches, and bare mountains – is considered as terrain. Also paths, trails, and jogging tracks are terrain in the legal sense.

Driving in terrain is not included in the Right of public access. Terrain driving with motor driven vehicles is primarily regulated in the Off-Road Driving Act and its ordinance. A motor driven vehicle is any vehicle powered by an engine, such as car, motorcycle, scooter, quad, tracked vehicle, or snow mobile. Driving is allowed on well snow-covered or frozen ground if there is no risk for damage on land or vegetation. Note that snow mobiles are not allowed to run on:

- Bare ground
- Forest land with recently planted or young forest, if not obvious that the driving can be done without any risk for damage to the forest. The forest shall have an average height of 2 m over the snow for it to be allowed to drive there.
- Agricultural land, if not obvious that the driving can be done without any risk for damage to the land.

The County Administrative Board can approve exemption from the prohibition of driving with motor driven vehicle in terrain, if there are particular reasons and if the driving does not in a significant way affect public interests or sensitive nature. Note also that permission from the landowner always is required, even if the County Administrative Board has granted an exemption.

An application for exemption from the terrain driving prohibition shall include:

1. Purpose of the drive
2. The special reasons invoked
3. Type of vehicle
4. Time period
5. Map where the area and driveway are marked

#### **10.6 One or several applications/notifications**

In case there are several applications/notifications that are to be processed by the County Administrative Board, these can be made in one document. The applicant should, however, clearly indicate what the application concerns to avoid misunderstandings and the delay that might cause.

# 11. Work plan

## 11.1 General description

According to the Minerals Act, chapter 3, section 5, exploration work may only be carried out in accordance with the current work plan (Appendix 1). The work plan shall be established by the permit holder and contain a review of the planned exploration work, a time schedule for the work, and an evaluation of to what extent the work may affect public interests and private rights. Simpler activities that are carried out or could be carried out according to the Right of public access do not require a work plan.

The work plan shall be communicated to the owner of the land where the work will take place and to affected holders of special rights. Information to a holder of reindeer husbandry rights may be given to the Sami village that the holder belongs to. The work plan shall also be sent to the Mining Inspectorate.

Objections to the contents of the work plan shall be presented in writing to the permit holder within three weeks from the presentation of the work plan.

## 11.2 Content

The purpose of the work plan is to give landowners and other holders of rights the possibility to estimate the impacts of the planned activities and to contribute to the least possible damage and encroachment being caused. The work plan should therefore be as detailed as possible without diminishing the flexibility that is required for the planning and performance of the exploration activities.

Contents that the work plan should include:

- An introductory description of the exploration and what a work plan is, what permits the prospector holds, the rights and obligations of the individual, the procedures for objections to the work plan, and what authorities that can be contacted.
- The kind of exploration work that is planned, for example measurements, till sampling, or drilling, as well as a description of how the work is to be carried out. The location of the work area as well as planned transportation routes should be marked on an enclosed map.
- A description of what equipment and vehicles will be used.
- A description of what public interests are present in the local area and what consequences the work may have on these interests.
- A description of what consequences the work might have for private rights, for example the need to cut down trees or clear for visibility, products dropped behind such as drilling sludge, feed supply pipes, or marks, the risk of drive and road damages as well as the risk of noise and vibrations.
- A time schedule for planned activities, indicating an interval when the execution is planned. The work plan should not cover more than 1 year.
- A map with property borders and descriptions that as detailed as possible shows how the property will be affected by the exploration work and the vehicle transportation routes.
- A declaration of how compensation for utilised forest and damaged land and roads will be regulated. In connection with this, the form of security that the prospector has to fulfil the compensation payment should be specified.
- Name, phone numbers, and addresses to contact persons at the permit holder, contractor (if relevant), as well as the regulatory authority.

## 12. Environmental Impact Assessment (EIA)

### 12.1 Requirement for EIA

For simpler exploration, no environmental impact assessment is required as there is no or minor impact on the environment.

For explorations that may have a significant impact on specified/agreed protection assets in Natura 2000 areas, an EIA according to the specific protection assets of the area shall be attached. The EIA shall be designed so that it can be a separate document; that is, independent from the main application. The EIA shall provide a basis for an overall assessment of what impact the operations will have on the specified protection assets of the area. For simpler exploration in Natura 2000 areas, no EIA is required. For advanced exploration and for test mining, an EIA is required.

The EIA shall always be in proportion to the work to be performed. This is done in consultation with the County Administrative Board and is based on the unique protection assets of the area.

### 12.2 General description

It is important to note that an EIA cannot be used as is in the environmental assessment case. Some more detailed information and additions to the EIA may be required in a later stage of the examination process; that is, the document must be reviewed and revised. The EIA is made for different purposes.

Furthermore, consultation with the authorities is required several times in the different matters that area managed by the Mining Inspectorate and the Environmental Court respectively. The County Administrative Board puts a lot of work on the consultation regarding the EIA before the application can be submitted. Other areas of expertise at the County Administrative Board that are involved are nature conservation, reindeer husbandry, culture environment, fishing, and sometimes also environmental surveillance (recipient matters).

### 12.2 Development of a good EIA

- It should identify and describe the direct and indirect effects that the planned operations may have on humans, animals, plants, land, water, air, climate, landscape, and cultural environment, as well as on the management of land, water, and the physical environment in general and also on other management of materials, raw materials, and energy. It should also give an overall assessment of these effects on human health and the environment.
- It should be made early in the planning process so that experiences from the EIA work can be used to develop the project in an environmentally correct direction.
- It should be done in active consultation with the ones affected by the operations.
- It should be clearly defined, so that it shows the factors that are not addressed and why they are not addressed.
- It should have a serious description of alternative localisations or alternative technical solutions to achieve the same objective.
- It should be objective in the concerning facts.
- It should be easy to read and contain clear maps, drawings, and photographs.
- It should have a non-technical summary that can be understood by the involved individuals.

### 12.3 Steps for the development of a EIA

1. The applicant contacts the County Administrative Board (the environmental conservation function) and arranges a time for an early consultation. At the same time, brief information is sent to the County Administrative Board and to individuals especially affected by the planned operations. It should contain details about the location, scope, and setup of the planned operations, as well as its anticipated environmental impact.
2. The applicant conducts the early consultation with the County Administrative Board and affected individuals, for example neighbours. It is appropriate that the environmental administration and possibly other relevant committees from the municipality participate in the consultation. During the consultation, the affected parties shall be informed on the activities to be examined and be given the opportunity to comment. The applicant conducts the consultation with affected individuals by sending information by letter or by advertising. This can be complemented by a meeting when necessary. The letters shall include a brief summary of the background to the consultation and information on where the complete material can be obtained. If one chooses to inform only by letter, it is important to specify when and to whom any comments can be submitted.
3. The applicant compiles the results from the early consultations in the format of a consultation report, which is submitted to the County Administrative Board.
4. The County Administrative Board remits the issue to the supervisory authority, in the cases where this is not the County Administrative Board, for comments.
5. The County Administrative Board makes a decision whether the planned operations involve considerable environmental impact, if not continue to item 7.
6. The applicant conducts an extended consultation with other governmental authorities, affected municipalities, the public and other organisations that will be affected. The consultation shall cover the localisation, scope, setup, and environmental impact of the operations, as well as content and format of the environmental impact assessment. The County Administrative Board recommends that a draft of the environmental impact assessment is produced and used as basis for discussion during the consultation.
7. The applicant prepares (application documents and) EIA and submits them to the County Administrative Board (in five copies).

**Table 3: Content of EIA for application regarding advanced exploration, test mining, or mining: (X = the heading shall be included; -- = the heading is not required/is not included)**

Heading	Explanation	Heading to be included in EIA for:		
		Exploration	Test mining	Mining
1. Administrative information	The name of the applicant. Registration certificate and registration number should be specified if the applicant is a legal entity. The name and address of the applicant, and the SNI code (Swedish standard for industrial classification). Property name and property owner. Contact person for environmental issues.	X	X	X

Heading	Explanation	Heading to be included in EIA for:		
		Exploration	Test mining	Mining
2. What the application concerns	Start-up, existing operations or extended exploration.	X	X	X
3. History	Describe the history of the present project.	X	X	X
4. Deposit	Information about the deposit and what its characteristics involve from an environmental point of view.	--	X	X
5. The setup and scope of the operations	<p>Overview map showing the location of the operations in the municipality and more detailed maps showing the location of known mineralisations, the area of the operations and its surroundings.</p> <p>Description of the scope of the operations and the pollution control measures, including a general description of the exploration activities (description of tasks such as rock mapping, measurement, drilling, etc.), material, material management, and time in the field. Estimated transport volume and destinations outside the area of operations as well as to what extent the public road network will be utilised.</p>	X	X	X
6. Description of different alternatives	<p>At this stage, realistic alternatives for all plants should be described, to clarify whether the localisation matter risks being an obstacle for the exploration activities.</p> <p>The localisation of the exploration activities depends on the position of the deposit, but the alternatives should be compared here. At this stage, also different recovery methods should be discussed.</p> <p>The alternatives must be described so that the decision basis allows that the alternatives can be treated and considered on par with the main proposal of the applicant. Conclusions should be drawn as of which alternatives are realistic and how these could be further investigated. Describe the pros and cons of the alternatives. A summary of all discarded alternatives, discussed in earlier stages, shall be included, as well as explanations of why they have been discarded.</p>	--	--	X

Heading	Explanation	Heading to be included in EIA for:		
		Exploration	Test mining	Mining
7. Plan relations	Describe the current plan relations; that is, the contents of the overview maps, possible detail plans, and area regulations, as well as planned changes with explanatory text and maps.	--	--	X
8. Use of land and water	<p>For each heading below, an assessment should be made of whether chapter 3 and 4 of the Environmental Code is applicable or not.</p> <p><b>National interests</b> It can be appropriate to summarise what national interests under chapter 3 of the Environmental Code and specified national interests under chapter 4 of the Environmental Code that are concerned. Among the specified national interests are the Natura 2000 areas. A description of the core values of the national interests, how they are affected, and the proposed measures should, however, be <i>included under the respective subject area headings as per below.</i></p> <p><b>Infrastructure (roads, buildings, installations, etc.)</b> <i>Current state:</i> - Describe the current and planned buildings, other activities at the land area of the planned installations, as well as the surrounding areas that will be affected directly or indirectly.</p> <p>- The distance to and extent of the nearest buildings (including holiday homes), recreational areas, road and traffic conditions, nearby industrial and social activities, etc. should be clearly marked on a map.</p> <p><i>Environmental impact of the operations:</i> - Estimate the health and environmental effects of the operations as well as the transports to and from the operations. Describe the air pollution and road status (road surfaces, bearing strength, and access to passing places). Estimate the number of noise/vibration exposed areas as well as barrier effects due to the increased number of heavy transports.</p>	X  Adapted in consultation with the authority on the basis of the unique conservation values of the area	X  Adapted in consultation with the authority on the basis of the unique conservation values of the area	X

	<p>- If possible, specify alternative means of transport and transport routes to decrease the negative impact; preferably mark this on a map and justify the selected alternative. This includes the public road network.</p> <p>- Are new buildings needed? Describe these and what the effects are. Regarding effects for residents etc., see heading "Health and safety".</p> <p><i>Measures to decrease the negative impact:</i> Propose measures to decrease the negative impact of the operations.</p> <p><b>Reindeer husbandry</b> <i>Current state:</i> Describe how the reindeer husbandry is conducted in the present area, including the surroundings, with regards to fixed facilities, topographical and biological conditions, etc. If necessary, use a map.</p> <p><i>Environmental impact of the operations:</i> Describe the effects, negative and positive for the reindeer husbandry, of the exploitation.</p> <p><i>Measures to decrease the negative impact:</i> Possible damage reducing measures that can be taken.</p> <p><b>Fishing and hunting</b> <i>Current state:</i> Describe the current hunting and fishing activities within the area that may be affected by the planned exploration operations. If necessary, use a map. Information on fishing activities can be obtained from the County Administrative Board, municipality or, when available, the present fishing conservation area.</p> <p><i>Environmental impact of the operations:</i> What impact/disturbance may the operation have on the current hunting, professional or recreational fishing.</p> <p><i>Measures to decrease the negative impact:</i> Describe the direct measures that can be taken to reduce the negative impact and the compensatory measures that can be implemented.</p>			
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	<p><b>Forestry and agriculture</b>  <i>Current state: (preferably with a complementing map)</i>  Describe the current forestry and agriculture within the area of operation and its surroundings. Information can be obtained from the Forest Agency, County Administrative Board and municipalities.</p> <p><i>Environmental impact of the operations:</i>  Describe how the exploration operations will impact the conditions for agriculture and forestry.</p> <p><i>Measures to decrease the negative impact:</i>  Describe measures to decrease the above mentioned impact.</p> <p><b>Natural environment</b>  <i>Current state:</i>  First give a picture of the natural landscape in the surroundings. Then provide an overall description of the natural environments that will be affected directly or indirectly by the operations. The description should include hydrology, geo-scientific assets, lakes, rivers, forests, wetlands, farmlands, and the related plant and animal life. Highlight and describe more in depth the particularly sensitive areas and areas with high natural assets, for example large undisturbed areas or from an ecological point of view especially sensitive land and water areas, areas for endangered animals and plant species and habitats with large biodiversity.</p> <p>If there are areas designated as national interest, reserve, or Natura 2000 area, these shall be described separately. Describe the natural assets that are the basis for the designation. There are often large gaps in the knowledge about the natural environment in areas that have not previously been subject to inventories and the documentation must therefore be complemented by the applicant so that the impact assessments can be based on a more complete knowledge base. In the normal case, a general nature inventory is required, including a summary and evaluation of the existing material, field inventory, and a natural asset assessment to be able to make a description of the natural environment in the area. If information about the water systems is missing, it may be necessary to perform test fishing or</p>			
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	<p>electrofishing. Information about previously known natural assets can be obtained from the Forest Agency, County Administrative Board, and the municipality. Also non-profit organisations can in many cases contribute with knowledge about the natural assets. Describe the sources of water supply and water protection areas. Describe the areas where shore protection applies. Describe all specified areas on maps and feel free to use photos to illustrate.</p> <p><i>Environmental impact of the operations:</i> Describe how the operations impact the natural environment directly and indirectly, as well as temporarily and permanently. Highlight aspects such as land, ground water, surface water, air, plant and animal life, and how the types of nature and important ecological relationships in the area are affected. For areas designated as for example reserve, national interest, or Natura 2000 area, the impact shall be described separately. It shall be clearly described how the natural assets forming the basis for the designation are affected.</p> <p><i>Measures to decrease the negative impact:</i> Describe the measures that can be taken to decrease the negative impact and the compensatory measures that can be implemented. Describe the measures you have decided to take and what measures you plan to take forward.</p> <p><b>Landscape picture</b> <i>Current state:</i> Describe the current landscape picture. In the description, a wider area than the operations area itself should be studied. Sub-areas or objects of significance for the character of the landscape should be identified and described.</p> <p><i>Environmental impact of the operations:</i> The impact on the landscape picture, both during the period of operation and in the long term, should be analysed. This analysis should in addition to descriptive text include photographs, maps, and image illustrations. The current state (the zero alternative), different alternatives during the period of operation, and the long term effects should be illustrated.</p>			
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	<p><i>Measures to decrease the negative impact:</i> Measures should be proposed on how the impact on the landscape picture could be minimised.</p> <p><b>Recreation and outdoor life</b> <i>Current state:</i> Describe how the area is used for recreation and outdoor life and if the area is subject to shore protection. If necessary, illustrate on a map. Information on this can be obtained from the municipality, but should also be sought for from the local residents.</p> <p><i>Environmental impact of the operations:</i> Describe the consequences for the outdoor life and the recreation in the area and in its surroundings.</p> <p><i>Measures to decrease the negative impact:</i> Give proposals on measures to decrease the negative impact.</p> <p><b>Cultural environment</b> <i>Current state: (if necessary, with attached map)</i> Describe the character of the cultural landscape, valuable buildings, ancient monuments, cultural heritages, and cultural environments. Use a map for the description. It is the responsibility of the operator to report the cultural assets that are not included in the assemblies of the County Administrative Board. The County Administrative Board can also decide that a special archaeological investigation under chapter 2, section 11 of the Heritage Act shall be performed on the expense of the company to determine if ancient remains are affected.</p> <p><i>Environmental impact of the operations:</i> Describe how the cultural environment will be affected.</p> <p><i>Measures to decrease the negative impact:</i> Give proposals on measures to decrease the negative impact.</p> <p><b>Other</b> Other aspects under chapter 3, sections 7, 8 and 9 of the Environmental Code.</p>			
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Heading	Explanation	Heading to be included in EIA for:		
		Exploration	Test mining	Mining
9. Restoration	Different restoration alternatives and the consequences and measures for these should already at this stage be discussed.	--	X	X
10. Opposed interests	According to the management provisions in chapter 3, section 1 of the Environmental Code, the land and water areas shall be used for the purposes for which the areas are best suited in view of their nature and situation and of existing needs. Priority shall be given to such use that promotes good management from the point of view of public interest. To balance opposed interests when localising operations within especially sensitive areas, estimation and presentation of the intrusion and damage caused by the mining operation compared to the benefits of this operation may be required.	X	X	X
11. Conclusions	Conclusions should be reported here regarding the proposed alternatives and the questions that are considered to be the most important in the case. If an area is of interest for several incompatible purposes, the applicant should justify why the mining interest should take precedence over other interests.	X	X	X

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# GOOD ENVIRONMENTAL PRACTICE FOR EXPLORATION

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## 13. Start-up

### 13.1 Communication planning

An early, open, and functioning dialog between prospectors and property owners also facilitates later stages in the process. It is therefore important to conduct the operations already in the exploration stage in such a manner and with such transparency that the affected parties and others are given relevant information and good treatment.

God planning should include:

- Consultation with affected parties throughout the entire project.
- Local authorities are continuously informed about all plans.
- Within the area for the exploration permit, as early as possible clarify the legal requirements and other restrictions imposed by the affected parties.
- To have the specific characteristics and physical limitations in the landscape and environment in mind when developing the project plan.
- Systematic identification of potential environmental effects and surveying of methods and technologies that eliminate or minimise the environmental effects to acceptable levels.
- Develop project plans that minimise the ground impact and the usage of land.
- Estimate the total project cost, including any supplementary work and damage measures.
- Appoint appropriately trained staff and contractors and provide the necessary equipment.
- Ensure that the staff and contractors understand the environmental commitment and requirements regarding health and safety.
- Develop emergency plans that enable a fast and appropriate response to any environmental or health accidents.
- Develop a program for environmental surveillance, accounting, and reporting to assure and demonstrate accommodation to the regulating requirements, including the restoration of land.
- If the exploration takes place within the grassland of the reindeer husbandry, consultation with the affected Sami village should be conducted.

## 14. Field work

### 14.1 Sampling

- When it is necessary to remove moss to expose a suitable outcrop for sampling, this should be done by “cutting” the moss like a cover and then folding it. The moss layer shall be replaced immediately after the completion of the sampling.
- When sampling in a pit, the pit shall be re-filled immediately after the completion of the sampling.

### 14.2 Clearing of vegetation

- Utilise existing roads as far as possible to avoid unnecessary cleaning and cutting of vegetation and trees.
- For safety reasons, the vegetation should be cut close to the ground level to avoid dangerous “spikes” from stumps standing out. Overhanging vegetation should be trimmed to reduce the risk for protruding branches.

### 14.3 Measuring

- Global positioning systems (GPS) should be used as much as possible, to decrease the need for clearing of the vegetation (which also has an impact on the soil).
- Bio-degradable tape should be used for markings in favour of ordinary plastic tape. This tape lasts for at least two years, but degrades eventually.
- Eye-catching markings such as staking sticks and tape shall be removed after the completed exploration program.
- Measuring threads should be removed after usage, since birds can become entangled and trapped in these threads.
- Permanent staking sticks should be kept to a minimum. All temporary markings should be removed as fast as possible after the completed program.
- Staking sticks of wood shall be used instead of steel. All marking sticks shall be clearly visible.
- When free line of sight is required, this can usually be obtained by pruning trees and trample the vegetation instead of removing trees and pulling up roots.

### 14.4 Usage of motor driven equipment

- All chain oil must be of degradable oil. When purchasing equipment and consumables, eco-labelled products should be selected as far as is practically and economically viable.
- When changing oil in small, hand-operated equipment, the residual oil shall be collected and taken to an appropriate disposal site. Residual oil must not be dumped in the field.

### 14.5 Fire prevention measures

- If a portable generator is used (such as for example for UTEM measurements), be sure to keep the exhaust area clear of leaves and brushwood. After completed measurement, all cables shall be removed.

### 14.6 Ancient remains

- If ancient remains are found during the work, the work shall be stopped and a notification shall immediately be submitted to the County Administrative Board (10 law about cultural heritages etc.)

# 15. Transport

## 15.1 General

Exploration means in many cases that equipment has to be transported into the trackless terrain by motor vehicle, either on snow or on bare ground. In certain areas, terrain traffic on snow-covered ground is regulated so that traffic may only occur on certain tracks or is completely prohibited.

Transportations of heavier equipment and with heavier vehicles can cause more damage than the actual exploration work, for example pressure damages and erosion on the underlying ground when vehicles are driven in the summer. Ground pressure, the weight of the vehicle, motor power, and tire design are some of the factors that have an impact on the damages caused to the vegetation. Damages can occur even if the ground is covered with snow, especially on poorly frozen ground. Ground damages can lead to slower growth of trees, risk of leaching of environmental toxins, and spreading of sludge and sediments in waters as well as spreading of root-rot.

## 15.2 Techniques for less ground damages

Today, there are a number of techniques to reduce the ground damages when heavy machinery is used in the terrain.

- Tyre width: Studies have shown that the groove depth can be dramatically reduced by increasing the tyre width from 600 to 800 mm.
- Decreased air pressure: The groove depth can also be reduced by decreasing the air pressure in the tyres. Tests with CTI (Central Tyre Inflation) have shown that the groove depth decreases significantly if the air pressure is reduced from 380 kPa to 100 kPa. At full load, the groove depth decreases from 15 cm after 10 passes to 5 cm. Driving with low air pressure requires, however, special tyres and a system for locking the tyre to the rim, in order to prevent slippage between the tyre and the rim and that the tyre is pushed off the rim at large lateral forces.
- Tracks: On *ground with low bearing capacity*, it has also been shown that the usage of tracks instead of wheels on vehicles has had a positive effect on the groove depth. Tests show that the groove depth was the same after two passes with a wheeled machine as after eight passes with a tracked machine.  
  
*On ground with good bearing capacity*, the effect of tracks was not as large. Although machines equipped with tracks cause smaller groove depth, it has been shown that the impact on the physical characteristics of the ground is the same, since it is the machine mass that determines how large the depth becomes for changes of the physical characteristics of the ground.
- Eco-tracks: Studies of tracks have shown that the new eco-tracks would have less impact on the ground, as the link construction on these tracks is moved up onto the tyres instead of the previous position on the side of the wheel. By that, the tracks get the same rolling radius as the wheel.
- Ground-saver: To manage shorter passes on ground with poor bearing capacity, or for transports over smaller watercourses and ditches, there are several methods. The one with the longest presence on the market is the so-called ground-saver and it works as a log mat which is placed on sensitive areas to avoid wear and extension of the pressure.

Simply stated, these techniques can be divided into two groups:

- Group 1: The properties of the machine are changed and thus improve the conditions permanently
- Group 2: Actions on the ground are taken and improve the conditions intermittently in the areas.

The first group includes tracks, wider tyres, and lower air pressure (CTI). If the machines are equipped with this type of equipment, the driver can probably continue to drive as previously; that is, plan well and put as much brushwood on the driveways as is reasonable with regards to the time.

The second group includes devices such as the Weholite Bridge, the ground-saver Alf, and the post bridge from Kålarne. The Weholite Bridge is probably most suitable for crossings of ditches/smaller watercourses and paths, where it is an easy solution that is simply put over the obstacle. Log mats can also be used for crossings over sensitive areas. As long as the ground is flat, it works very well. Since it is shown that it is precisely in such areas that most of the damages are found, it should be a good solution. It is important to use the mats as an aid device in the planning of the work. The intention of the mats is to be put out before there are any damages on the ground. If a drive route close to water-saturated soil or marshy areas is selected, the mats should be put out as a preventive measure. The ground-savers can also be used to build bridges over smaller watercourses. By placing logs on either side of the watercourse, ground-savers can be put across the watercourse; this has been successfully tested.

The different types of wooden bridges/ground-savers can be said to replace the method of constructing so-called corduroy roads, where pulpwood is used to create bridges of wood on the ground. The advantage of the wooden bridges is that these are available in finished segments, which should be faster to put out.

The machinery obviously has an impact on the extension of the damages. A large part of the problem, however, lies in the planning and in the preparatory work. To minimise the number of ground damages, thorough planning of the transport routes is required. This requires a relatively good planning in advance, for example in the choice of test drilling object.

Object sensitive areas should by routine have driveways marked with strips before the work starts. Such a routine takes extra time, but if the contractors are informed about the objects in a timely manner, they should be able to plan their activities so that they do not lose money because of machinery downtime. Good planning means that the drilling is done in the right place at the right time of the year, access to quality map material, and contact with the landowner (who usually has the best information about the best driveways).

### 15.3 Planning

- Keep in mind that as terrain counts an area that is not considered a road; that is, primarily forest, mountain, marsh, but also field, meadow, pasture, park, and ice-areas. Note that tractor tracks or ruts in the terrain normally are not considered as a road.
- Plan the transport route together with the landowner and try to drive in places likely to take a minimum damage. You should avoid driving on sensitive ground, for example marshlands, since they are easily damaged by vehicle wear. In the wet ground, deep grooves are often formed, which heal slowly.
- Keep in mind that wet autumns and mild winters give a poor bearing capacity during autumn and spring.
- Vehicles that are kinder to the ground should be used and the style of driving should be adapted to the state of the ground. Avoid slipping or skidding and do not drive too fast. Especially tracked vehicles may have a tearing effect on the vegetation and cause damage during snow-free driving, in particular when turning.
- Use machines adapted to the Swedish terrain and climate conditions. Machines with too narrow tracks and stiff band bogies malfunction while driving in difficult terrain, or in winter conditions, and the driving speeds are also consistently very low.



6-wheeler



Transport with helicopter



Example of driving gear with low ground pressure

Top: Sled for transport of modules or material in the winter. Load capacity 12 tonnes.

Middle: Wide field tyres  
Bottom: Caterpillar tracks

- In the event of exploration that require snow-free driving in the mountains, the vehicle should not exceed the recommendations of the Swedish Environmental Protection Agency of a ground pressure of maximum 15 kPa and a noise level below 82 dB(A).
- There are different requirements for field vehicles and road vehicles. Therefore, different vehicles should as far as possible be used in the field and on the roads. The field vehicles should be light and have soft tyres with low ground pressure. Since the driving speed is low, the tyre pressure can be lower than when driving on roads. Road vehicles, however, must be possible to drive at high speeds and their stability and traffic safety normally require that the tyre pressure is high.
- Plan so that road accesses are not made over moist and wet areas with poor bearing capacity.
- Use temporary bridges of brushwood or pulpwood to protect sensitive areas.
- Carry mobile bridge constructions for usage in moist and heavy terrain.
- Minimise the number of crossings. The number of crossings has a great impact on the level of damage.
- During transport of heavy equipment with motor vehicles in the winter on snow-covered ground, one must ensure that the ground is well frozen. If the weather situation in the early winter has been such that the snow arrived early without any prior cold period, marshes and other wetlands may be so poorly frozen because of the insulating characteristics of the snow that the bearing capacity is very limited and ground damages may occur.
- New transport routes should not be built. For transports, the existing route paths should be used as far as possible. Primarily, forest roads and previous tractor tracks should be used.
- If driving with motor driven vehicle has to take place in marshlands/wetlands, the ground must be well frozen.
- When driving in the terrain, disturbance of wildlife should be avoided as much as possible.
- The County Administrative Board should be informed of when the first driving in the area will be made, to facilitate supervision.

#### 15.4 Choice of vehicle

- Terrain vehicles:* As far as possible, terrain vehicles with low ground pressure should be used, such as 4/6-wheeled motorcycle or snow mobile. These have the advantage that they do not leave any large grooves and only require a path to get around on.
- Helicopter:* In very hilly terrain or long transport routes through sensitive environment, helicopter may be a better alternative, both from an environmental and cost perspective. Before the flight begins, the reserve managers must be contacted to find out if there are any flight restrictions in the area that must be considered.
- With broader tyres or so-called eco-tracks, the air pressure decreases which also reduces the wear on the forest ground.
- The advantage with tracked vehicles is the low ground pressure, which gives good bearing capacity on weak ground and high traction; both effects of the large contact area of the tracks. In some cases, tracked vehicles instead of wheeled vehicles give significant reduction of the compaction. The reduction is, however, not as large as one might think, in terms of the



**Forwarder with eco-tracks**

average ground pressure under the tracks. The maximum pressure under a track is often much higher than the average pressure.

- ❑ Wide tyres or dual wheels provides a large contact area and low ground pressure and gives a significantly lower degree of compaction in the grooves than standard tyres. Such wheeled equipment will, however, provide its full potential only if the tyre pressure also is reduced.
- ❑ During all field work, as low tyre pressure as the conditions allow should be used. The pressure should therefore be varied depending on the load and driving conditions. In recent years, tyres have become available which makes it possible to use a considerable lower pressure than before. By that, the ground pressure decreases significantly and the compaction of the topsoil is reduced.
- ❑ High axle load may cause compaction at large depth in the subsoil, where the effects are very long-lasting, perhaps permanent, and very difficult to erase. To avoid permanent compaction damages, the machines must not cause pressure contribution that exceeds the bearing capacity of the soil at depths larger than 35-40 cm. This can be achieved by a limitation of the axle load and/or the ground pressure. (If the objective should be reached only by limiting the ground pressure, however, the limit must be set very low. When the ground pressure is reduced, the pressure contribution in the subsoil is much lower than in the topsoil.)<sup>5</sup>



**Example of how reduced air pressure reduces the ground pressure and the groove depth**

#### 15.5 Improvement of vehicles

- ❑ *Change to wider tyres.* With wide tyres, more passes can be made before damages to the ground occur.
- ❑ *Use eco-tracks.* Tracks have been used since long to improve the driving force. These could tear the ground. Use eco-tracks that do not tear and also reduce the ground pressure of the vehicle. To reduce the ground pressure as much as possible, it is important that the tracks have the proper tension. Too loosely tensioned tracks have almost no effect on the reduction of ground damages. Too tightly tensioned tracks may start to tear and also give high load on the transmission.
- ❑ *Use variable air pressure – CTI.* With CTI – Central Tyre Inflation, the air pressure of the tyres can be changed while driving. Reduced air pressure decreases the ground pressure and the groove depth. Tyres with low air pressure become vulnerable to puncture through the side of the tyre. Therefore, it is important to drive with high air pressure in rocky passages.



**Left: Ground-savers are laid out. Right: The forwarder drives on the ground-savers**

#### 15.6 Protection of the ground at the crossing of sensitive areas

- ❑ *Brushwood.* The bearing capacity can be improved by hauling brushwood to weak passages. If the bearing capacity is very bad, it can be reinforced with pulpwood under the brushwood. Practical length: up to 10 metres. Life-span: The brushwood wears relatively quickly, which means that the brushwood cover has to be refilled regularly.

<sup>5</sup> Studies show that when the tyre pressure on vehicles with 810 tonnes axle load is reduced from 150 to 50 kPa, the compaction at a depth of 40-50 cm is only slightly decreased, while it at a depth of 30-40 cm decreases considerably. If the ground pressure is not reduced to a very low value (below the actual pre-consolidation pressure of the subsoil), it is therefore necessary to restrict the axle load. In Sweden, the recommended axle load limit is 6 tonnes in order to prevent permanent compaction damages in the subsoil. Subsequent studies show that this limit hardly is too low, but that it should rather be set even lower if driving with high-pressure tyres on moist land. If very wide low-pressure tyres or dual wheels are used, however, the limit can be increased by a tonne.



Figure 5: Brushwooding with forwarder (Source: Fredrik Staland & Karl Larsson, SkogForsk)

- **Corduroy road.** A corduroy road is built from pieces of timber that are placed close together across passages with poor bearing capacity. To further reinforce the bridge, one can place longitudinal timber at the bottom and brushwood on top. Practical length: It is possible to build very long corduroy roads, but by experience there is a practical limit at about 40 m (about two hauling loads). Life-span: Correctly built, the corduroy road lasts for large objects and weights.



Figure 6: Laying out a corduroy road with a forwarder (Source: Fredrik Staland & Karl Larsson, SkogForsk)

- **Ground-saver.** To manage shorter passes on ground with poor bearing capacity, or for transports over smaller watercourses and ditches, there are several methods. The one with the longest presence on the market is the so-called ground-saver Alf. The ground-saver "Alf" consists of sections of timber that are laid out in pairs. Each section is 4.7 m long and 0.75 m wide. There are also other similar systems on the market. At ditch crossings etc., a basis of transverse timber is first laid out. Preparing a stream crossing takes about ten minutes. Over longer passages with poor bearing capacity, the sections are laid out after each other. It is important to place the ground-saver on as flat ground as possible, otherwise it risks being broken over for example sharp rocks. Practical length: Ditch crossing: 3 m. Poor bearing capacity: up to 30 metres.



Figure 7: Laying out a ground-saver with a forwarder (Source: Fredrik Staland & Karl Larsson, SkogForsk)

- ❑ *Arch bridge.* One type of arch bridge is the Weholite Bridge, which consists of an arch of polyethylene. The bridge is available in three different spans: 2, 2.5, and 3 metres. The width is 4 m. The bridge is transported and placed over obstacles. It requires solid ground on both sides of the obstacle to stand steady. The bridge is intended for shorter crossings, such as ditches, paths, and road accesses. It is easily placed in the terrain and no extra measures are required. The method has been developed in Canada and is successfully tested there.

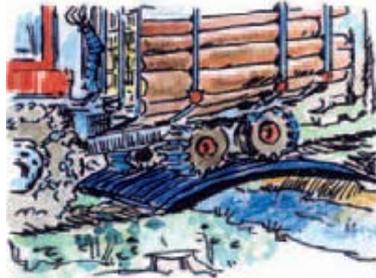


Figure 8: Crossing through an arch bridge (Source Fredrik Staland & Karl Larsson, SkogForsk)

Low profile arch

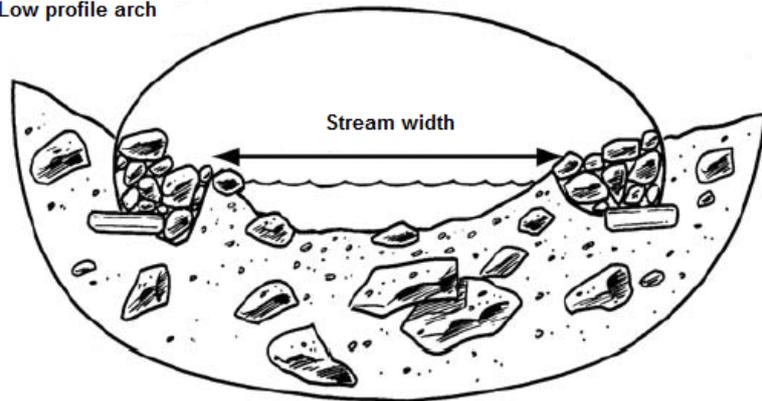


Figure 9: Principal sketch of an arch bridge

### 15.7 Use of public and existing roads

- ❑ Always use an existing road instead of building a new. This prevents duplication, avoids environmental impact, and lowers the costs.
- ❑ Ensure the ownership and obtain permission before usage of road.
- ❑ Respect the existing roads. Do not worsen the wear by excessive speed, oversized or overloaded vehicles, or usage in extreme weather conditions.
- ❑ Do not use tracked vehicles on inappropriate surfaces (such as asphalt) more than necessary.
- ❑ Different possible road routes should be identified, first by existing maps and aerial photographs, then by field inspection. Different possibilities or alternative places should be investigated for the different parts of the suggested route. Travel the entire suggested route, not only the beginning.
- ❑ An evaluation of potential visual effects should be made for the selection of different road routes, not only from maps but also from any residential areas and favourable/scenic places in the surroundings.

- To facilitate the localisation of a road route, check points should first be established between sensitive or difficult locations, such as fords and gorges, and then a direction between the check points should be determined.
- Minimise the number of fords.
- Passage over fords should be at right angle to the stream.

### 15.8 Supplementary work

- When the use of existing roads is finished, a final inspection of the road and documentation of any damages should be made. The inspection should be reported to the owner of the road. Any grooves or drainage damage should be addressed.
- Where the ground has been damaged, an excavator can be used for repair. Note that the repair most is "cosmetic". Repaired ground is susceptible to erosion over the next few years after the operation. Therefore, wait with the repair until all activities are completed.

### 16. Passage of sensitive watercourses

At the passage of sensitive watercourses (for example, waters important for spawning fish), some type of corduroy road or temporary bridge should be used. The crossing of watercourses, even temporary ones, can affect the fish stock by blocking the fish migration routes, destroy habitats in the stream and along the borders of the stream, and fill downstream watercourses with sediment and deposits. This includes small streams that supply vulnerable fish zones, such as small watercourses or wetlands. The water crossing structures should therefore maintain the existing habitat in and along the stream as far as possible. The objective is to ensure that the flow direction is not affected and that the natural characteristics of the stream are maintained or restored.

#### 16.1 Choice of passage method

- Some streams can be crossed by wading. This is, however, normally only suitable when the crossing does not take place at regular intervals. Frequent crossings require a more permanent solution. The bottom of a watercourse should as far as possible be kept untouched.
- Bridge design and crossing methods should be selected to avoid any impact on the fish passages and fish habitats in watercourses (that is, avoid selecting a bridge design with bases that narrows the stream).

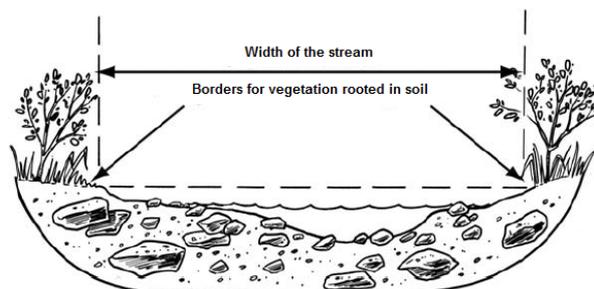


Figure 10: The width of the stream extends to the border for vegetation rooted in soil

- The crossing of larger streams and rivers usually requires a smaller structure to allow the water to pass underneath. Small crossings can be built by packing logs, where the logs are lying in the water, in parallel to each other, allowing the water to pass through the logs (so-called corduroy road). Gravel and filling materials can be placed over the logs to complement the road surface. Larger watercourses require more stable structures. The size of the structure depends on the size of the watercourse to be crossed.



Example of a mobile wooden bridge (from Martinsons, previously Svenska Träbroar), which is easy to transport, lift, and install. The wooden bridge consists of 2 supporting bridge halves, 1 mid-section, and two bases and is very environmental friendly, since there is no need to touch the stream while the bridge is installed. The wooden bridge is available in the lengths 4-12 m and the bridge width is 4 m. It is pressure treated and has a life-span of 40 years. The need for maintenance is very limited. Dimensioning and surface treatment adhere to the applicable bridge standard.



Figure 11: Example of temporary crossing where logs have been packed

- If access is only required in the summer, a temporary bridge can be lifted into place and removed again after use.
- Use of bridge bases in the stream should be avoided when possible, since they may collect raffle at flood, which results in erosion of the bridge foundation. They can also result in hydrological alterations, such as bank erosion and deposits, which may impact the habitat of the fish.
- Mobile bridges should be used for temporary crossings (in place for less than two years and are removed when the work is completed).
- For bridges with gravel covering, a geotextile filter fabric should be placed over the beams to avoid that the road material falls through the bridge and down into the stream.

### 16.2 Snow filling

Snow filling is an alternative to consider for season based usage, depending on location, time of the year, and other environmental constraints. Snow fillings are built by filling the channel with compact, clean snow (that is, clean from dust and dirt). Snow filling as a method should only be considered if the watercourse is dry or the water is frozen solid down to the bottom. Unexpected water flow due to for the season unusual wet weather can be adjusted with log bundles or culverts.

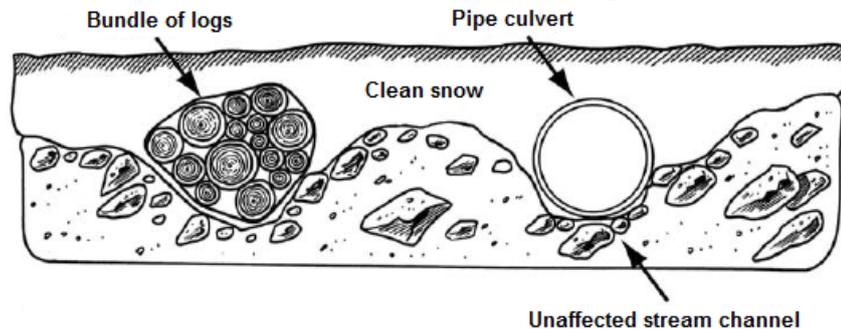


Figure 12: Principal sketch of snow construction for crossing over sensitive ground and water

- Snow fillings should only be built where there is enough amount of clean snow suitable for the construction.
- The construction should begin after the water is frozen to the bottom or has ceased running, or when there is enough ice over the water to prevent snow from damming up free water under the ice.
- Snow fillings should not be covered with soil. There may be a risk that soil takes its way down into the water during periods of mild weather.
- Snow fillings that might cause damage to the water stream during warmer weather should be removed and then re-built in colder weather.

- ❑ All snow and supporting material should be removed before the ice breakup in the spring. Removed snow should be placed above the normal flood point of the surrounding waters, to avoid that it contributes to sedimentation and erosion.

## 17. Handling of fuels and fire prevention



Fuel and oil drums etc. should be in good condition and properly stored in a closed environment.

### 17.1 Fuel storage

- Fuel storage should be arranged in such a manner that a fire hazard does not arise.
- Containers used for storage of flammable or combustible liquids (gasoline, diesel fuel, etc.) should be maintained in good condition and should not be used if damaged, rusted, or leaking.
- The containers should be properly sealed with a matching lid to prevent spills and leakages.
- The containers should be marked with a safe maximum filling level, corresponding to approximately 90% of the capacity. This also allows for the fuel to expand.
- Mark all fuel containers with a label. Store all fuels and lubricants more than 30 metres from the nearest watercourse.
- Non-smoking signs should be set up in areas close to fuel storage or where refuelling takes place.
- Storage locations and buildings with fuel should be maintained clean and well-organised.
- Containers, empty or filled, used for storage of hydrocarbons must be removed from all places, both remote and central, by the end of a field season and returned for refilling or recycling.

### 17.2 Refuelling

- Maintenance routines and operational procedures should be established to avoid spills and leaks. Ensure that the refuelling routines are well summarised and posted where all operators can see them.
- Containers should not be filled over their safe refilling level (see above).
- Use of electronic or manual fuel pump is recommended for refuelling from a barrel. Always store and secure the fuel hose above the fuel barrel to avoid any siphoning effect.
- Refuelling by gravity from a horizontal barrel increases the risk of accidental spillage. Vertical barrels should therefore be used where possible. If horizontal barrels are used, measures should be taken to prevent any contamination because of the increased risk of spillage.
- Drilling, transport of drill machine and fuel, and fuelling of equipment must be done in such a way that spillage of fuel and oil in the nature does not occur. Lubricants and other chemicals must be approved.
- If fuel handling must take place at the drilling site, double wall tanks equipped with drip protection, spill plates, or spillage collection trays should be used.
- Change of engine oil should be performed on paved ground on a road or similar and the waste oil should be collected and taken care of in accordance with the current regulations.

### 17.3 Lighting of fires

- Lighting of fires outdoors is prohibited in areas where it according to SMHI's fire risk forecast is "high risk of fire" or "very high risk of fire". Fire risk forecast refers to such forecast that SMHI normally prepares during the period March 1 – August 31. During this period, water (at least 10 litres) or powder fire extinguisher (not less than one kilogram capacity) should be

available, within reasonable distance, when all types of work that involve use of chainsaw, larger drilling equipment, or other gasoline driven equipment is performed.

#### **17.4 Fuel storage/emergency preparedness**

- In places where spillage of oil or other chemical products may occur, equipment for decontamination and absorption must be available. Oil or liquid emissions on the ground or paved surfaces should immediately be cleaned up by excavating or by other means disposing the soil or absorbent material.
- All fuel drums and other containers must be in proper condition.
- Tanks and containers for the storage of fuel and oil should be placed at a safe distance from watercourses and in a spill plate with impermeable bottom, designed to hold the contents in a tank or container in the event of a leakage or other spillage accident.
- Always keep absorbent material available, for the collection of oil on land and in water. Organic materials such as wood fibre, bark, and biodegradable absorption chemicals are products that are available for handling of spills. Used materials should be placed in containers for oil waste (hazardous waste).

#### **17.5 Measures in case of spillage/accidental spill**

- Equipment for decontamination and absorption should be available within the work area
- Any leakage of fuel or oil should immediately be cleaned up and reported to the regulatory authority
- Do not use chemicals (dispersing agents such as detergents or similar) to dissolve oil spillage. Use absorbent materials and equipment suitable for the environment for the collection of spillage.
- Petrol steam is highly flammable. If fuel is spilled, the local emergency services should be contacted. They can assist with cleaning up in a safe manner.
- Activities that can help spillage clean-up include:
  - Digging a ditch (by hand) just below the spillage and fill it with oil absorbent material, which is replaced at regular intervals.
  - Building small ponds using straw bales in affected watercourses and "socks" of oil absorbent material to collect oil/diesel. The "socks" are replaced periodically.

## 18. Drilling



Example of light caterpillar vehicle with drill equipment, with low centre of mass and a drill arm that can be folded down when moving between the drilling sites and to facilitate the transport also in the forest.

### 18.1 Planning of a drilling site

- Drill at the right object, at the right location and time. Drilling at bogs and mires should preferably be performed in the winter, when the ground is frozen and the snow can be compacted to a bearing layer for the drilling equipment.
- The drilling should be done in such a way that damage to the ground and vegetation does not occur.
- Try to avoid placing the drilling site directly under large, dead trees to avoid the danger of falling branches. If this is not possible, the work place should be made safe by sawing off hazardous branches or by felling the entire tree.
- If an area needs to be cleared to make room, there are a number of items to keep in mind to facilitate the restoration. Choice of drill rig is one factor. For rigs with caterpillar bands, it can be sufficient to remove or trample the vegetation. In wet areas and sloping slides, it may be necessary to build a drilling platform.
- When the drilling is completed, the area should be restored as soon as the drill rig has been moved, but leave the possibility for vehicles to access the borehole for future borehole surveys.

### 18.2 Choice of vehicle

- For transport of the drill rig, a terrain vehicle with low ground pressure and low noise level should be used.
- For transport of drill core boxes and rock samples, a terrain vehicle with low ground pressure such as 4/6-wheeled motorcycle or snow mobile should be used.



Drill cores in drill core boxes.

### 18.3 Transport of drill machine

- The best possible route, preferably on hard foundation, is chosen in consultation with the landowner. The drill machine should then be transported along a driveway marked with strips to the drilling site, to avoid damage to the natural environment.
- For natural reasons, certain areas, such as wetlands, can only be drilled during the winter. To protect the ground, the snow should be compacted by driving with a snow mobile along the transport route before the drill machine is transported.
- For drilling at mires, a light caterpillar vehicle with drill equipment should be used. The vehicle should have a low centre of mass and a drill arm that can be folded down when moving between the drilling sites and facilitate the transport also in the forest.

### 18.4 Routines

At the drilling site, the following should be available:

- A complete, by the client approved, chemicals list. No further chemicals must be used at the drilling site without the approval of the client.
- Safety data sheet for all chemicals.
- Equipment for handling of chemical spillage, such as oil absorbent cloth, booms, etc.
- List of contact persons at the drill contractor, client, and authorities in the event of spillage.



Investigation of drill cores in the field

- Equipment and routines for handling of waste oil and oil contaminated garbage.
- Signed protocol for conducted environmental inspections.

### 18.5 During the drilling operation

To minimise the environmental impact of drilling in the field, the drill contractor should:

- During the drilling, oil absorbent materials or jute fabrics should be used to catch grease and oil.
- During the drilling, environmental friendly and rapidly degradable oils should be used.
- Ensure that fuel tanks, waste oil tanks, and other cisterns for petroleum products are equipped with collecting vats.
- Ensure that contaminants in the drill water is minimised.
- In areas where noise can be perceived as disturbing, seek to minimise the occurrence of noise and ensure that the noise from the operations at the nearest located buildings does not exceed the guidelines of the Environmental Protection Agency (for example, the noise level can be reduced by integrating the diesel motor and generator in a separate, well sound-isolated unit).
- Follow the designated driveway to the drilling site and any water supply.
- Seek to conduct the work so that the least possible damage and intrusion are caused.
- At the risk of major damage to forests, ground, or roads promptly inform the client.
- At all field operations, complete a ground damage report in accordance with the instructions of the client.
- Keep the work places and storages in good order.
- Transport and store diesel in ADR approved tanks.
- Immediately remedy any waste and notify the client, the client should then report the incident to the regulatory authority.
- Ensure that all personnel at the drilling site are informed about the applicable regulations.
- Drill waste should not be disposed of in wetlands. During drilling operations, ensure that drilling sludge cannot run out and contaminate waterways.

### 18.6 Handling the equipment

To ensure proper handling and minimisation of the environmental impact during drilling, the following checks should regularly be conducted and documented at all exploration drilling in the field:

- All hydraulic components such as pumps, motors, couplings, hoses, etc. should be checked once a day with regards to condition and leakage. If the condition is poor, the component should be replaced and any leakage should be fixed immediately.
- Checks of that oil drums, barrels, and tanks are kept in dedicated containers should be made daily by the site responsible driller.



**Core drilling**



**Drilling operations**



**Water pump – the pump and the motor are placed in a sealed box and a tyre serves as a buffer towards the ground.**

- Checks of that there are sufficient amounts of oil absorbent materials at the drilling site should be made in conjunction with the consumption of such materials and refilling should be done to the same extent.
- Checks should be made once a day to ensure that hoses and tanks containing oil and other chemicals are not placed in such a way that they can be worn and start to leak. Should this still happen the cause must be addressed.
- Checks of generators, water pumps, and similar should be made once a day to ensure there are no leaks. Should there be any leaks, these must be addressed immediately.
- At service and oil changes, measures should be taken to ensure that no emissions are made on the ground or in the borehole. The replaced oil should be deposited in a dedicated tank.
- Generators, water pumps, and similar should be equipped with spillage and drip trays.
- Because of the proximity to watercourses, the water pumps should be placed on oil absorbent materials and regularly be checked for oil and fuel leakage.
- At the drilling site, there should be a phone list with contact persons for the client, contractor, and authorities, to be contacted in the event of any emission of hazardous substances. All personnel should be informed of when, how, and what persons to contact.
- At the drilling site, there should be a binder with product information for all chemicals used at the drilling site. It should be updated continuously if new products are added. The recommendations and instructions in the product information must be followed when handling each product.
- Good order should be kept at the drilling site and camp; garbage should be placed in appropriate containers.



Field work on a lake

### 18.7 Handling of water

- Water for rock sampling should preferably be pumped up from suitable places as close to the drilling site as possible. If a water tank is used, it is important that water is taken as close to the drilling site as possible. Water can only be taken after consultation with the reserve manager.
- A sump should be used in proximity to the drilling site, to minimise the quantity and optimise the quality of the water leaving the place, and to catch sediments from the drilling.
- Pump the water away from watercourses and drain through the vegetation where possible.
- Avoid that water from the drilling site runs directly out to nearby watercourses.
- In sensitive areas, where emission of water should be kept to a minimum, the water should be reused. If a sump cannot be dug, a tank should be brought to the drilling site where water and drill sediments can be accommodated.
- A pre-fabricated, mobile tank system is recommended. This should be sufficient in size, so that the return water from the borehole is allowed enough time to stabilise. This is sufficient for a certain percentage of the sediment to precipitate and to give the oil absorbent material sufficient chance to absorb hydrocarbons that may be present. For deeper holes and where there is sufficient space and inclination, two tanks should be set up.



Drilling on ice

## 18.8 Drilling on ice and lakes

- Ice covered waters is a form of terrain/off-road, which means that the Off-Road Driving Act in principle is applicable even when driving on ice. Ice areas are comparable to snow-covered terrain and driving on ice is thus generally permitted, unless there are other prohibitions, for example in a certain area.
- Driving on water normally means that one also has to drive on bare ground adjacent to the water. Such driving on bare ground is prohibited under the Off-Road Driving Act. Driving on water can also have an impact on shallow bottoms. In such cases, the driving shall be registered for consultation at the County Administrative Board in advance. Driving on waters can also be prohibited under local traffic regulations or regulations for water protected areas. It is advisable to ask the County Administrative Board what is applicable in the present area.
- Since the potential risk increases when drilling on ice, special attention should be paid in all the phases of the drilling, to minimise the negative impact on the environment.
- There must be ice enough to support the drill rig and the associated equipment during the transport to the drilling site and during the drilling work.
- If the ice is not sufficient, it can be built up by a series of local flooding.
- Only untreated wood should be used if the drill rig has to be supported or to distribute the weight over the ice. All wood must be removed when the drilling is completed.
- Fuel and oil products needed for maintenance and operations must not be stored on the ice, but be taken to the drilling site when needed. Fuel shall be stored on land, at least 100 metres (or according to applicable regulations for the area) from the highest water level of the lake. A limited amount of fuel may temporarily be brought to the site to facilitate the drilling. Fuel stored on land must be stored in a sealed system, such as for example a large box.
- When the drilling is completed, clean water shall be circulated through the hole to remove any drilling additives and remaining drilling sludge.
- The borehole shall be sealed in accordance to applicable regulations, to prevent that lake water accidentally reaches an aquifer and to prevent impure water (salt, mineralised) from running into the lake by underground forces.
- As far as possible, a closed system with recirculation should be used.

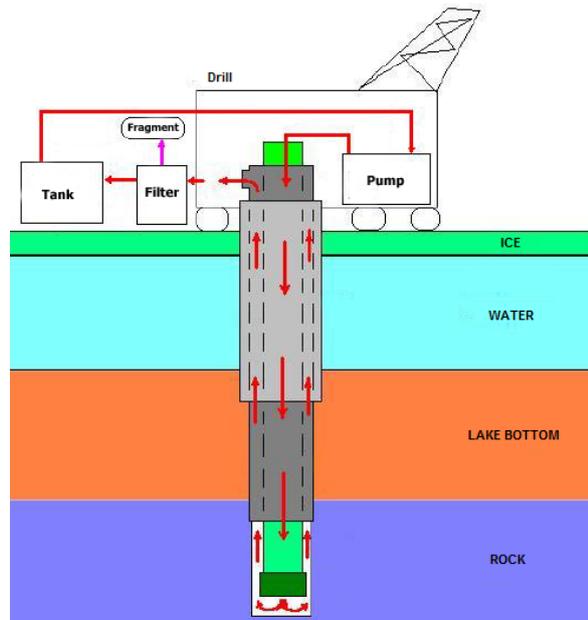


Figure 13: Recirculation of drilling fluids

- ❑ Larger amounts of drilling sludge should be collected by a filter system and be disposed of at a landfill site. Return fluids can be removed in a land based sump, placed at least 100 metres (or according to applicable regulations for the area) from the highest water level of the lake.

### 18.9 Post-drilling work

After the completion of a drill hole:

- ❑ The drill contractor shall clean up the drilling site, storage areas, and transportation routes. All rubbish, waste, waste products, and surplus working materials shall be transported away after the completion of the work.
- ❑ The drill contractor shall himself/herself or through a representative participate in an after inspection of the drilling site together with the client. The inspection shall take place on bare ground for control of cleaning, damages, and that reporting has been made.
- ❑ Left-behind casings shall at a maximum be approx. 1 dm above the surface and be provided with a firmly fit cap.
- ❑ Drill holes leaking water to the surface shall be sealed according to the client's instructions.

After the completion of a drill hole on ice or lake:

- ❑ After the completion of drilling on ice, the drill pipes should be blasted away down to 3-4 metres of depth.
- ❑ After the completion of drilling, all drilling and associated equipment shall be removed from the lake. The ice surface shall be left in the same condition as it was before the drilling started.

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# GUIDELINES - COMPENSATION FOR DAMAGE AND ENCROACHMENT

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## 20. Legal framework

### 20.1 Compensation

Damage or encroachment resulting from exploration work is regulated by the Minerals Act, chapter 7, section 1. For damage or encroachment, compensation shall be paid by the holder of the exploration permit or concession by virtue of which the work is undertaken. Compensation in connection with exploration work shall be based on the damage and the encroachment that the exploration work causes. The damages shall be compensated both for exploration work and for transport to and from the work area. No particular compensation shall be paid for the right to carry out the work

### 20.2 Compensation factors

What is legitimate compensation varies from case to case, depending on the extent of the work, type of land and forest, timing, etc. Normally, there is no such basis for compensation after boulder tracing, reconnaissance, or after measurement work carried out in the winter with snow mobile or in the summer with 4/6 wheeled motorcycle or by foot.

The factors that can give rise to compensation are listed below:

- For felled trees, the diameters should be measured, the volumes calculated, and the trees should be compensated in line with the current local price list.
- Damage of young forest (> 1.3 m). The number of damaged main stems should be noted and compensated as if they fulfilled the minimum requirement for merchantable timber, which is 8 cm at breast height.
- Damage of recently planted trees (< 1.3 metres). The area of the damaged land should be measured and compensation be paid corresponding to the regeneration cost.
- Scratch damages. Trees that have scratch damages should for spruce be compensated with the full value due to the risk of root-rot. Pine and leaf trees should be compensated with half of the timber value.
- Transport routes for heavy vehicles on bare ground. The compensation should in some form, for example based on a template, be paid for the used transport routes because of damages such as compaction of the soil and damages to root systems. 4 wheeled motorcycles, snow mobiles, etc. are not regarded as heavy vehicles.
- Extensive driving damages must be evaluated and compensated on a case-by-case basis. An alternative to compensation can be reparation using an excavator.
- Every drilling site should be compensated according to a template due to left-behind drill cuttings, left-behind casings, compaction, or driving related damage.
- Compensation for sight-clearing should be made according to a template, corresponding to the cost for reduced timber production caused by the clearing work.
- Damages on roads vary greatly and must be evaluated from case to case. An alternative to the compensation is that the damages are repaired and/or that the road is gravelled.

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# APPENDICES

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## APPENDIX 1

### Example of work plan

*Place Date*

*Name and address of the company*

*Name and address of the property owner*

#### **WORK PLAN for exploration work within the exploration permit xxxx no. 1**

*The company xxxx* has by the Mining Inspectorate of Sweden been granted an exploration permit for the area called xxx no. 1, located in *Malå* municipality, in the county of *Västerbotten*.

We plan to start exploration work in terms of *ground geophysical* measurements and core drilling within the area. Information on the exploration methods is attached.

The exploration work concerns your property *Skäppträskåheden 3:1*.

We attach a map where the exploration area is marked.

The exploration work is planned for the period *2005-07-31 to 2005-12-16*.

The exploration work is expected to affect the *area such that a few trees may need to be felled at the drilling site and along the route to the drilling site. Minor ground damage may also arise during the drilling.*

In the case the exploration work should cause any damages, compensation will be paid to the property owner. We will contact you after completion of the exploration work to settle any damages.

You have the opportunity to influence the work plan, by contacting us within three weeks after you received this information. Of course, we welcome your questions, comments, and suggestions also after that. In case you do not get in touch with us within three weeks, the exploration work will be conducted according to the work plan (unless it is cancelled). Comments should be sent to *the Company xxxx, Address xxxx*.

You can also contact the Mining Inspectorate if you have any questions. Bergsstaten, Varvsgatan 41, 972 32 Luleå, 0920-23 79 00.

*XXXX* is contact person for the exploration work.

*Phone xxxx Fax xxxx Email xxxx*

Best regards,

*Xxxx xxxx*  
*Company xxxx*

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*Guidance to good environmental practice for exploration in protected areas* is compiled by SveMin in consultation with the Exploration committee of SveMin. The work has been managed by Tomas From, SveMin; Patrik Roos, external resource; Anders Forsgren, Boliden Mineral AB; and Fredrik Ros, Lundin Mining Exploration AB

Guidelines for Exploration in Protected Areas in Sweden is available from:

**SVEMIN**  
Kungsträdgårdsgatan 10  
Box 1721  
111 87 Stockholm  
Tel: 08-762 67 35

*Disclaimer: SveMin does not guarantee the accuracy, completeness, or update of the information in the document*