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# Initial Environmental Evaluation

# JASE

**Swedish Antarctic Research Programme**
SWEDISH POLAR RESEARCH SECRETARIAT
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# CONTENTS



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# 1. NON-TECHNICAL SUMMARY

**The initial environmental evaluation (IEE) indicates that environmental impacts from the planned activities most likely will be small. *Minor or transitory* environmental impact is expected from the logistic activities. Therefore, from an environmental point of view, there is no reason not to carry out the planned activities.**

The Japanese-Swedish Antarctic Expedition (JASE) is a Japanese-Swedish contribution to the International Polar Year. Scientists will carry out research during a 3000 km tracked vehicle traverse. The expedition makes use of two start points, the Japanese station Syowa and the Swedish Wasa station. Four Japanese and four Swedish tracked vehicles will start the journey from respective station in late November 2007, in order to meet on the Polar plateau in end of December for joint scientific efforts and exchange crew members. In January 2008 the two field parties will head back to the coastal stations and in early February the crew will leave Antarctica. A summary of the identified activities that will result in environmental impacts are presented below in table 1.

***Table 1.*** *Summary of the activities identified that can have an impact on the environment.*

| Activity | Less than minor Or transitory impact | Minor or transitory impact | More than minor or transitory impact |
|---|---|---|---|
| **Logistics DML 06/07** | | | |
| Ground transportation | X | | |
| Fuel management | | X | |
| Chemical management | X | | |
| Waste and sewage | | X | |
| **Science Programme** | | | |
| Radar measurements | X | | |
| Shallow & medium coring | X | | |
| Pit studies, snow sampling | X | | |
| Aerosol measurements | X | | |
| GPS-survey | X | | |

## Summary of identified environmental impacts

JASE is considered to have at most a minor or transitory impact on the environment as a consequence of:

***Emissions to air*** of exhaust fumes and particles from combustion engines. The associated impacts are increased concentrations of greenhouse gases and aerosols in the atmosphere, contributing to human induced climate change as well as altering the physical and chemical properties of the local environment. However, emissions to air from JASE are expected to be small and dissipate as negligible concentrations in the ice and snow along the route.

***Accidental spills*** may be expected when handling fuel and chemicals resulting in contamination of ice and snow. Monitoring shows that main source of spills at from human activities around Wasa is from fuel. Spills have so far been small and are very locally defined. Quantity of accidental spills is likely to be very limited and locally defined, impacts are therefore considered to be minor.

## Mitigations used to reduce environmental impacts

SWEDARP act simultaneously as developer, planner, operator and manager of the Swedish part of the expedition. This creates good opportunities to minimise the environmental impact of the expedition throughout the entire chain. Swedish Polar Research Secretariat has always have had a high environmental profile, and based on earlier expeditions, environmental management has been integrated in the regular work during expeditions.

The stage for a high quality environmental performance is well functioning operational practices and routines. Actions that will be taken to mitigate impacts from this expedition are described in the "*Field Course Handbook*" as well as the "*Nordic Environmental Handbook – Antarctic operations*" (NEH). See Appendix 1 for SWEDARP's environmental code and mitigation measures.

## What alternatives are there to the expedition that can give the same result but a reduced environmental impact?

The largest contribution to environmental outputs and associated impacts are related to the physical presence in Antarctica. If researchers participated in other national expeditions, associated logistic and scientific impacts would basically be shunted to those programmes. Also, technology and working conditions in Antarctica are limited due to the extreme conditions. Highest priority is given to safety and reliability. Thus, it is difficult to come up with a realistic alternative that might give the same result but with a reduced impact.

# 2. DESCRIPTION OF THE EXPEDITION

## 2.1 JASE

The traverse is planned to go between the Japanese station Syowa and the Swedish station Wasa, via the deep ice core drilling sites Dome Fuji and EPICA-DML. The scientific programme is linked to the International Trans Antarctic Scientific Expeditions (ITASE), the Japanese deep ice core drilling programme Dome F (NIPR) and the European Project for Ice Coring in Antarctica (EPICA). The ITASE-programme is aiming at determining the *spatial* variability of the Antarctic climate and environment over the last 200 years, and where data are available, the last 1000 years. The deep ice core drilling programmes are aiming at determining the *temporal* variability of climate and environment over several glacial cycles (hundred thousands of years). Because the remoteness of the continent, Antarctica is an ideal location to study local-to-global scale changes in climate and biogeochemical cycles. ITASE will produce continental scale "environmental maps"; elucidate processes of atmosphere and snow/ice interactions; verify atmospheric models; and interpolate spatial time-series determined from satellite remote sensing. The identification of spatial gradients in ice core properties will be linked to the interpretation of deep ice core records (e.g. Vostok, Dome F, EPICA-DC and EPICA –DML).

## 2.2 Organisation and legal framework

Tomas Karlberg, chief technician at the Swedish Polar Research Secretariat, is expedition leader for JASE. The expedition leader has the overall responsibility to coordinate the expedition, ensuring that the expedition and related activities are in compliance with the *Antarctic Treaty System.* The legal framework is presented in the "*Nordic Environmental Handbook – Antarctic operations*" (NEH). All expedition- and project leaders must be familiar with the contents of NEH, and all expeditioners must be aware of existing station routines and guidelines presented in the "*Field course handbook*" and NEH.

The expedition is approximately 65 days. There will be nine participants, five researchers, three technicians and one medical doctor. The time plan presented below is based on the conditions given by access to four tracked vehicles, practical issues and access to fuel depot. The time plan is subject to change.

**Coarse time schedule for JASE**

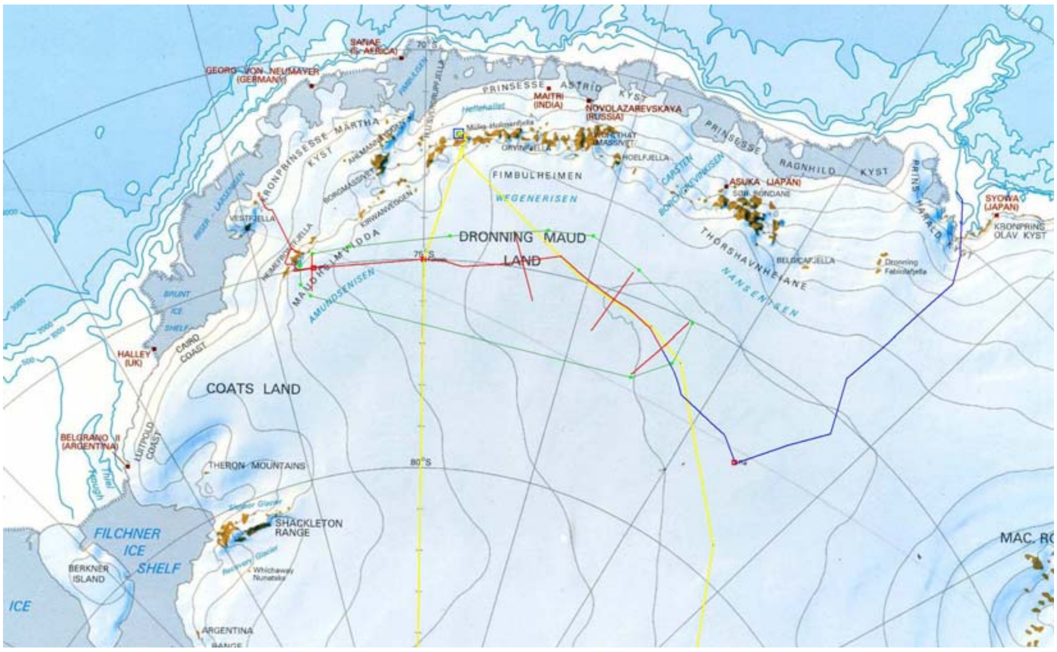
| | |
|---|---|
| Nov.20 | Personnel fly to the Wasa station |
| Dec 1 | Departure from Wasa station |
| Dec 20 | Departure from Dome Fuji |
| Jan 5-12 | Meeting at Polar plateau (SJ04), exchange of crew |
| Feb 5 | Arrival at Wasa and Syowa stations |
| Feb 5-15 | Exchange of personnel and equipment |

## 2.3 Education and training

All Swedish expedition participants will take part in preparations during workshops in Sweden and Italy (high altitude training and safety). Expeditioners get a basic environmental introduction based upon the contents of the NEH and the "*Field Course Handbook*". At the beginning of the season the expedition leader organizes in-site training on safety, contingency plans and environmental management e.g. waste handling and fuel management.

## 2.4 Areas visited

The Swedish part of the traverse starts at the Wasa station (73°S, 13°W) and goes to a fuel depot at 75°S,10°W. From the depot the traverse continuous to the Kohnen station at 75°S, 0°E. Then the route goes along 75°S to 15°E (end point of the 1996/97 Nordic traverse). From this point the traverse plan to follow the ice divide towards Dome Fuji and the traverse ends on the plateau in a joint meeting somewhere between Kohnen and Fuji. The return route will then follow the track back to the depot at 75°S, 10°W, see picture 1 below.




Picture 1: Planned route.

## 3. ENVIRONMENTAL IMPACT ASSESSMENT FOR JASE

Sweden is responsible for the environmental impact assessment for the Swedish activites during JASE. The procedure follows to a large extent COMNAP's "*Guidelines for Environmental Impact Assessment in Antarctica*". The process of impact identification and evaluation is not presented in this document, but can be obtained upon request from the environmental officer at the Swedish Polar Research Secretariat.

## 3.1 Impacts identification from JASE logistic activities

The logistic issues cover ground transport, accommodation at the station and in the field, storage of fuel and hazardous substances, maintenance of equipments, supply of power and water etc. The basic information below is collected from personnel at the Logistics Centre at the Swedish Polar Research Secretariat.

### 3.1.1 Ground transportation

Three Hägglunds TL-4 and one TL-6 will be used by the Swedish party for the traverse. They consume about 2-3 litre per kilometres dependent on the payload and terrain. Snowmobiles will also be used during the traverse, either Yamaha Viking I or II. The snowmobiles run on unleaded petrol and consume about 4 litre per 10 km. Ground transport will generate exhaust fumes that contributes to air pollution.

Air in the local area around combustion engines will be exposed to exhaust emission. The emissions to air are expected to be transitory but eventually will dissipate in small concentrations along the traverse route. Monitoring of pollutants in snow and ice (in 1991/92 and 1993/94) in the vicinity of Wasa show that human impact from exhaust fumes is low and very local. Hence, exhaust emissions from combustion of fuel during JASE 2007/08 are not expected to adversely impact the environment on a regional level in Dronning Maud Land.

However, the release of greenhouse gases and aerosols to the atmosphere from usage of fossil fuels is one of the main environmental impacts resulting from the Swedish Polar Research Secretariat activities. In this context, releases of air emissions from combusting engines are considered to have a minor impact on the environment.

Vehicular transport will produce noise as well as tracks in snow and on bare ground. Driving on bare ground is banned, with the possible exception of vital logistical transports at the Wasa station "court yard". Tracks impact snow/ice surface temporarily, although due to the low level of activity and the type of disturbance, environmental impact from vehicle noise and tracks are considered to be insignificant.

### 3.1.2 Fuel management

During operations every effort is made to prevent accidental oil spills through careful attention to fuel management and transfer operations, and by maintaining storage facilities to a high standard. Emphasis on prevention of any spills or leaks is given in all operations. The Oil Spill Contingency Plan describes procedures to be used in the event of oil spills. Any spill that might occur is considered as serious and every effort will be done in order to minimise the environmental impact as far as possible.

Refuelling of vehicles will be performed according to the guidelines in the NEH. Some emission to ground from small fuel-spills might be expected. An investigation was made in 2001/02 regarding contamination of heavy metals and petroleum hydrocarbons in soil and grey water. Results showed that the levels of soil contamination are comparable to other Antarctic research stations. The spills were in a few relatively small and rather well defined areas. Impacts from fuel spillage are considered to have a minor environmental impact.

Estimated fuel consumption for the expedition is presented in table 2. Resulting $CO_2$-emission is estimated[1] to 85 tons. As a comparison, a return flight with a Boeing 737-800 between Stockholm-Las Palmas results in 119 tons of $CO_2$-emission. Hence, $CO_2$-emission from JASE are considered to have a minor environmental impact.

***Table 2.*** *Estimated fuel consumption for ground transportation during JASE*

| Type of fuel and usage | Estimated fuel consumption | Maximum estimated $CO_2$ emissions |
|---|---|---|
| **Jet A1** | | |
| Tracked vehicles | 158 drums (31 600 l) | 74.6 tons |
| Genertors | 16 drums (3 200 l) | 7.6 tons |
| **Petrol (unleaded)** | | |
| Snow mobiles, generators | 6 drums (1 200 l) | 2.8 tons |

### 3.1.3 Waste and sewage management

The NEH includes guidelines for waste management plans for Nordic expeditions in Antarctica and is thus also used as a basis planning individual expeditions and operations organised by SWEDARP.

The key element of the waste management policy is to minimize generation of waste. The chain of order for the material brought to Antarctica is; reduce, reuse, recycle and return. Expedition members receive instruction in waste management during their induction training. Waste, sewage and spilled fuel and oil are to be separated and collected in empty fuel drums. Waste from the traverse will be brought back to Wasa. The waste will be safely stored and retrograded at a later time.

Materials and paint e.g. used as site markers in the scientific programmes, or other material that cannot be practically retrieved may result in an impact on the ice or ground surface. Such markers will result in a minor, temporary alteration of the environment and their impact is expected to be negligible.

Minor releases of other materials to the environment are expected to happen occasionally. Some littering may be expected due to extreme weather conditions. These kinds of accidental releases, as well as the unrecoverable loss of equipment, or the dispersal and loss of materials and wastes due to high winds are not planned, their frequency, magnitude, and composition can therefore not be projected in advance.

[1] One liter Jet Gasoline and petrol equals to 2,36 kg of $CO_2$ (Source: EPA, Sweden)

## 3.2 Impact identification and evaluation from scientific activities

The assessment is based on information obtained from chief investigators (CI).

### 3.2.1 JASE Science plan

*Highly resolved physico-chemical characterization of the Antarctic air snow interface: understanding the present to learn about the past for assessing the future*

The scientific planning is a collaborative effort of Stockholm University in Sweden, National Institute of Polar Research in Japan and the international network of ITASE. The principal investigators are Prof. Yoshiyuki Fujii (NIPR) and Prof. Per Holmlund (S.U.). The ITASE science plan is outlined on the web site http://www.ume.maine.edu/itase.

Some specific scientific aims for this traverse are:
-Produce a "steady state EPICA-DML deep ice core record" based on surface measurements along the flow line.
-Determine variability of accumulation rate of snow.
-Model backscatter from ENVISAT ASAR (satellite sensor) over Antarctic firn/snow.
-Characterize the atmospheric aerosol.
-Study air-snow transfer processes by simultaneous measurements in air and snow.
-Study changes in position of ice divide and basal processes.
-Mapping surface and bedrock topography along the ice divide

The science plan consists of different modules of measurements. One overall aim is to make a highly resolved physico-chemical characterization of the Antarctic air snow interface. The different modules are outlined briefly below indicating contact persons.

<u>A "steady state EPICA-DML deep ice core record"</u>
The EPICA-DML deep ice core reflects climate and environmental variability over time. The planned route for the traverse follows more or less the flow-line upstream the drill site (the ice in the deepest part of the ice core have travelled a distance of 150 km) giving the opportunity for us to study spatial variability of parameters at present conditions. The aim with this study is to develop a synthetic ice core record describing a steady state system based on the present climate and atmospheric circulation. We may thus be able to exclude non-climatic variables from the real climate variables in the core data.

Different kinds of data to be compiled originate from:
-Snow radar measurements
-Ice depth soundings
-Shallow coring and pit studies of snow and temperatures
-GPS-survey of surface topography
-Continuous measurements of air temperature, humidity and air pressure

Accumulation rate variability

The goal is to study accumulation rate variability and mega dunes in East Antarctica and relations to surface topography and surface winds. By studying snow/firn layering in nets at various scales at drill sites the stratigraphy will be described in 3-D in great detail. A 2-D description will be obtained from the transports between drill sites.

Furthermore we will model backscatter from ENVISAT ASAR (satellite sensor) over Antarctic snow/firn, with the aim to increase our understanding of spatial variability in accumulation rate. The backscatter is dependent on several conditions, and we are primarily interested in components related to layering in shallow snow/firn. Ground based radar surveys of shallow snow/firn and snow measurements will be developed to constrain and refine a backscatter model. ASAR imagery will be acquired coincident with the ground traverse.

Measurements/activities to be carried out in the field:
-Ground-Penetrating Radar measurements (shallow 0-20 m, medium depth; down to1000 m)
-GPS-measurements
-Shallow and medium coring
-Corner reflectors will be put out for rectifying ASAR imagery

Radar soundings of deep ice layers and bed topography

The aim is to study changes in the position of the ice divide, to study the glacial influence on the bed topography and to study basal processes. Internal structures give information on different kind of perturbation in the ice sheet such as irregularities in accumulation pattern with time, influence of bed topography and basal melting. In some areas along the route the subglacial landscape will be mapped in detail in order to study the landscape evolution and tracers of the initiation phase of the glaciation. The basal ice in the center part of the ridge shows a strange lack of radar reflections. It may indicate a type of internal shearing which is very difficult to explain physically. The extent and setting of this type of ice will be mapped. The surveys will be carried out along the ridge and in transects in connection to drilling sites. The equipment is a Japanese monopulse radar operating at 60 and 179 MHz and to a minor extent the Swedish multi frequency radar operated at 155 MHz.

Three different types of measurements will be carried out:
-Bed topography mapping
-Structures of basal ice
-GPS-measurements

Characterization of the atmospheric aerosol

The goals are to provide information about the aerosol physio-chemical properties and study their spatial variability. Both goals are aimed to better understanding of observations of particles and solute in ice cores and snow samples. Proposed observations offer the necessary tools that make it possible to understand how variations in the particle properties and chemistry observed in ice cores and snow samples relates to the properties of the atmospheric aerosol.

Activities in the field:
-Real time observations of particle number, density and size distribution
-The mixing state of aerosol
-Single particle analysis
-Light absorbing properties of the aerosol
-Organic to elemental carbon fractionation in air and snow

Detailed snow chemistry
Detailed sampling for chemical analysis to reveal spatial variability and to study deposition and post-depositional processes. The aim is to increase our knowledge about air-snow-ice transfer processes which are essential for the interpretation of deep ice core records into atmospheric concentrations. The snow chemistry investigations are tightly linked to the aerosol measurements, the meteorological observations and the determination of accumulation rate variability. In contrast to pervious studies, focussed on detail temporal and process oriented investigations at one site, approach proposed here is based on covering large area to understand a spatial variability and general trends in aerosol chemistry and links to composition of the most upper part of snow/ice cover

Activities in the field:
- Pit studies and surface snow sampling, shallow and medium long coring
Planned analyses:
-Ion chromatography (IC)
-ICPMS
-Isotope studies ($\delta^{18}O$, $\delta D$, $\delta^{34}S$, Sr/Nd)

Monitoring
Along the route information on ice depth and snow layering will be sampled at close spacing. It will be 1-5 metres between each measurement. The surface topography will be mapped by using GPS receivers. Some weather parameters such as temperature, air pressure and humidity will be measured continuously while driving.

**Rationale**
The sampling procedure will be both continuous (radar surveys, GPS and aerosol measurements), semi-continuous (surface snow and filter sampling) and by point measurements (snow pits, shallow and medium long coring).
Two different radar systems will be used; one Japanese mono pulse radar for depth soundings (60-179 MHz), and one Swedish continuous wave radar for snow surveys (1-6 GHz and 155MHz). Both systems will be mounted into two separate tracked vehicles. In addition to these systems antennae must be mounted outside the tracked vehicles.

The GPS surveys will be performed from different vehicles. In order to increase the spatial information skidoos may be used in combination with the tracked vehicles. The GPS-information will also be used to provide geodetic information to various continuous measurements that will be carried out along the route.

The design of the payload for the aerosol measurements will be developed on the concept used for airborne operations. Complementing observations of meteorological parameters (pressure, temperature, relative humidity, and wind properties) and some trace gases (CO and/or $O_3$) would significantly increase the scientific output of the proposed arrangement. Snow and firn sampling will be carried out using three different methods; pit studies, shallow coring and medium long coring. The pit studies means clean sampling to 1-2 m depth giving detailed quantitative information of parameters of the last decade. Shallow coring means 10-20 m covering the last 100-200 years and medium long coring (50-80 m) covering the last millennium.

**Environmental impact**

The measurements collected from the scientific instruments are not expected to result in any direct environmental impact in Antarctica besides that from the power usage. Power will be supplied from the tracked vehicles when the engine is running and from usage of generators during field stops. The additional consumption of diesel will results in emissions to air and noise generation from generators. The amount of diesel used is negligible compared to the amounts used for transportation. Environmental impacts from power generation for the instruments are considered to be less than minor.

Shallow and medium coring and pit studies will be required to allow sampling of snow and study temperature. When excavations and cores are carefully closed, they should cause minimal environmental disturbance. Impacts are considered to be less than minor.

> As a conclusion, negative environmental impacts from the scientific programmes are likely to be less than minor or transitory. Indirectly, the scientific projects participating in JASE will increase general understanding of certain parameters important for the global change processes. This will eventually have a positive impact on the environment by scientifically documenting the changes in environment and making scenarios for the likely future impacts on a larger scale for the global environment.

# 4. Cumulative impacts

The area visited is a pristine and untouched area, with the exception of the impact created in vicinity of research stations and field depots. These areas show minor impact from human activities due to sporadic visits since the 1980s. Sine the route is in an remote are that rarely have been visited before, cumulative effects due to other research expeditions are considered to be less than minor.

## 4.1 Prevention of introduction of non-native species

Humans have introduced a wide range of alien, and in many cases invasive, species to Antarctica and the sub-Antarctic islands. These include microbes, algae, fungi, bryophytes, vascular plants, invertebrates, fish, birds and mammals.

These species have come to survive, and in some cases dominate, terrestrial, freshwater, and marine habitats, and in the sub-Antarctic are causing considerable damage by way of local species extinctions and wholesale alteration of ecosystems. Alien species arrive in a multitude of ways: in clothing and personal baggage, attached to fresh vegetables, in vehicles, affixed to the hulls of ships and inflatable rubber boats, and as unwanted passengers on anchor chains, in sea chests and in ballast water.

In order to prevent the accidental introduction and spread through human activity of any alien organism or substance that may have an unwanted impact on Antarctic species or ecosystems, SPRS has endorsed SCAR's "Code of Conduct for Field Work: Transfer of Alien Species to Antarctica and sub-Antarctic Islands and Between Location Transfer of Species", see Annex 2.

## 4.2 Alternative areas

There are no relevant alternatives to the chosen areas.

## 4.3 The zero alternative

The zero alternatives imply that no activities will be carried out. It is considered to entail no additional consequences for the environment, as opposed to a situation when the areas are visited. This situation, however, will deprive scientist of an important logistical framework, which is necessary in order for them to carry out their research.

## 4.4 Emergency preparedness and response

A risk analyse have identified the following threats and hazards that might lead to a significant environmental impact in case of an emergency:

- Fire
- Oil/chemical spill

Response strategies have been identified and documented in contingency plans, fuel/oil spill has been incorporated in the NEH guidelines, see Appendix 1, and protection against fire is found in Chapter 6 in SPRS "*Field course handbook*".

## 4.5 Gaps of information and other uncertainties

Current understanding of many aspects of Antarctic biology and ecology is poor. The identification and classification of Antarctic species, especially invertebrates and micro-organisms, is at a rudimentary stage. Ecological processes that govern life in Antarctic soils, in the Southern Ocean, and at the ice edge are only beginning to be understood. Information on the status and trends of Antarctic fauna and flora is fragmentary at best. More research and monitoring are required to track trends in basic environmental parameters in the Antarctic. Access to and logistics in remote Antarctic areas are a major challenge to researchers. New techniques, including remote sensing, and further studies will shed light on these critical areas.

The limits of current knowledge and methodology of evaluation process must be recognized before potentially harmful development is undertaken. Knowledge of the synergies and interlinkages present in the natural environment will never be sufficient to accurately predict the exact impacts of a project. This circumstance contributes to uncertainties regarding the environmental assessment process. We must tread carefully where the consequences of our actions cannot be foreseen.

## 4.6 Conclusion

The initial environmental evaluation indicates that environmental impacts from JASE are considered to be at most minor or transitory impact, resulting from the logistic activities.

From an environmental point of view there are no reasons not to perform JASE, assuming that the expedition is conducted within the framework described in this IEE.

# APPENDIX 1 – NEH ENVIRONMENTAL GUIDELINES

## - Environmental Code of Conduct

**Vegetation** (Appendix II of the Protocol refers)
*Vegetation is scarce and sensitive. Do not collect or interfere without a permit.*
- Avoid trampling
- Do not collect plants or harmfully interfere without a permit
- Be aware of the risk of introducing non-native species

**Birds and mammals** (Appendix II of the Protocol refers)
*Birds and mammals are more stressed than they appear. Taking or interference is not allowed without a permit.*
- Keep your distance (do not approach) and be quiet and calm in presence of seabirds and seals.
- Do not use motorized vehicles closer than 200 meters from bird colonies (and be aware that pilots have been advised to keep helicopters/aircraft at a distance of at least 2000 meters from bird colonies)
- Do not handle animals without a permit
- Be aware of the risk of introducing diseases to Antarctic wildlife

**Site Management** (Appendix III and V of the Protocol refers)
*A site should always be left in its natural condition.*
- Always bring with you all garbage and other material when you leave a site
- Do not collect fossils and rocks, or in other manners deface the surface, unless for authorized research purposes
- Do not damage or remove historic remains

**Waste and Pollutants** (Appendix III and IV of the Protocol refers)
*No waste is to be left in Antarctica and pollutants are not to be released into the environment*
- Minimize waste before you leave for Antarctica by removing unnecessary packaging material
- Separate metal and glass from the waste stream, and dispose of all waste in appropriate designated containers.
- Avoid fuel spills by utilizing absorbents when handling fuel.
- Clean up all fuel spills

**Protected Areas** (Appendix V of the Protocol refers)
*Some sites have been designated as Protected Areas. Do not enter without a permit.*
- Protected Areas are protected for a purpose, e.g. for physical/ biological occurrences, scientific value, etc. You should respect this designation.
- Do not enter a protected area without a permit.
- If you have a permit, be sure to adhere to the permit conditions and be sure to bring the permit with you in the field

## - Flora, Fauna and the Natural Environment

*Human activity can have a large impact on the vulnerable natural environment in Antarctica. Show respect, and do your utmost to ensure that your presence does not harm the environment unnecessarily*

**Plants**

- Plants in Antarctica are rare, fragile and grow slowly. Therefore you should avoid areas where mosses and lichens grow. Use established paths and trails where these exist.
- Establish camps in non-sensitive areas
- It is prohibited to collect plants without a special permit.
- It is prohibited to bring plants to Antarctica except in accordance with a permit.

**Animals**

- Keep distance to animals, and be quiet and calm in their presence. Be especially alert in periods when animals breed. Do not walk through bird and seal colonies unless you are conducting approved research in the area. Avoid use of motorised vehicles closer than 200 meters from any animal.
- Do not feed, touch or handle birds or seals, or approach or photograph them in ways that cause them to alter their behaviour.
- It is prohibited to collect animals without a special permit
- It is prohibited to bring animals to Antarctica

**Natural environment**

- Do not paint on rocks or boulders, or in any other manner deface these.
- Avoid collecting or taking away geological specimens as a souvenir, including rocks, bones, fossils.
- When leaving a site it should be left in a natural state. Go thoroughly through the area before you leave, and remove waste and other left behind effects.

**Protected areas**

- Always check whether there are Antarctic Specially Protected Areas (ASPA), Antarctic Specially Managed Areas (ASMA), or registered historic sites and monuments in the vicinity.
- Special permits are required for entering or engage in activity in ASPAs. The permit must be with you in the field.
- ASMA and ASPA have management plans. It is your responsibility to familiarise yourself with and adhere to existing requirements and rules for these management plans.
- Cultural remains shall not be damaged, destroyed or removed.

## - Waste Management

**Waste Minimization**

- Minimize purchase of products with plastic, glass or other bulky packaging material.
- Buy durable products instead of disposable products.
- Get rid of unnecessary packaging material (especially plastic) before leaving
- Substitute shredded paper, polystyrene chips, beads and other similar loose packaging material with bubble wrap, cardboard or paper.
- Buy products that easily can be re-used for other purposes.
- Use packaging material that can be re-used.
- Re-use products/material whenever this is practicable.

**Environmentally harmful products**

- Polychlorinated biphenyls (PCB), non-sterile soil, polystyrene chips/beads and similar forms of packaging material, pesticides are not allowed.
- The use of polyvinylchloride (PVC) products is highly discouraged.
- The introduction of non-native species of animals and plants (including seeds, viruses, bacteria, parasites, fungi and yeast) requires a special permit.
- Hazardous chemicals and products should be treated with special attention so that no emission and dispersal occur.

**Waste Removal**

- No waste is to be disposed of in Antarctica unless special permission has been granted.
- No open burning of waste is allowed.

**Separation of waste**

Waste is to be separated into the following categories:

| | |
|---|---|
| BLUE | Metal waste |
| GREEN | Glass waste |
| ORANGE | Mixed combustible solid wastes |
| BLACK | Sewage and food waste |

**Sewage**

- Discharge of sewage is prohibited under all circumstances unless the project has been granted exemption.
- Under no circumstances must sewage or domestic liquid waste be disposed of in vegetated areas or in areas with discharge to fresh water.

**Hazardous waste**

- Different categories of hazardous wastes should never be mixed together in the same drum or crate
- Oil-contaminated soil/water/fabric is to be stored in separate containers
- Solids to be combusted
- No burning is allowed
- Radioactive waste
- For both liquid and solid radioactive waste it is essential that the correct information is provided in the labelling of the containers.

## - Fuel Management

*Fuel spills in Antarctica can cause long-lasting environmental damage. Any person handling fuel therefore has a certain responsibility to ensure that spills do not occur. All expedition members shall be aware of the guidelines outlined below and act accordingly.*

### Fuel Storage

- Fuel must not be stored in the vicinity of environmentally sensitive areas, i.e. vegetated areas, fresh water, bird colonies, etc.
- Store all containers, drums, etc. in such a way that any drips, leaks and spills will not enter into the environment. An accumulation of such minor releases can easily add up to unnecessary contamination.
- Fuel shall only be stored in containers specifically designed for the products being stored, and suitable for the prevailing climatic conditions.
- Containers must not leak, and must be sealed with a proper fitting lid or cap.
- Keep lids, valves, etc. tightly closed except during transfer of fuel.

### Transport of fuel

- During transport all drums must be transported upright and properly secured with adjustable straps to the vehicle to prevent shifting or swaying in any manner.
- Containers of 20 litres or less should be stored in leak proof storage box during transport. This will keep the containers from bouncing out of the vehicle and will contain any spillage that may occur from small leaks.
- Maintain appropriate spill handling equipment with the transport vehicle. If leaks and spills are noticed, these should be stopped and contained immediately. Fuel from leaky or damaged containers should be transferred to un-damaged containers or to a safety drum.

### Handling & Transfer of fuel

- Re-fuelling should as far as possible occur sheltered from the wind.
- During fuel transfer absorbent material should always be available. Fuel spills and leaks shall be removed with the aid of absorbents and disposed of in an approved manner.
- During fuel transfer operations absorbent mats should as far as practicable be used to avoid accidental spills to the ground.
- All spills and leaks must immediately be contained, cleaned and disposed of in an approved manner according to procedures described in the Oil Spill Contingency Plan (OSCP).
- Ensure that all spills are to be reported according to the procedures described in OSCP. Spills larger than 200 litres are to be reported to expedition leader immediately.
- All sources of ignition must be eliminated or removed while refuelling.

### Maintenance & Inspection

- Fuel containers should be visually checked for leaks and spills by any person having errands in the fuel storage area.
- All fuel storage drums are to be thoroughly inspected on a weekly basis, and as soon as possible following adverse weather. The storage drums and storage area should be checked for leaks, spills, and deformed drums, etc.

## - Fuel Spill Response

*The physical conditions in Antarctica retard the decomposition of the fuel products, and clean-up efforts are made difficult by the conditions as well. The best strategy is to prevent spills from happening in the first place. If a spill occurs, persons involved shall act according to the guidelines below.*

**Initial assessment**

The observer of the spill must carry out an initial assessment of the situation. He/she must check the:

1) Probable quantity of fuel spilled
2) Type of fuel
3) Location of the spill
4) Probable source and cause
5) Risk of fire or harm to human health

**Initial notification**

If spill is assessed to be larger than 200 litres the observer of the spill must notify expedition leader and communicate the information obtained in the initial assessment.

**Response team**

If spill is assessed to be less than 200 litres, observer initiates further response alone or with present personnel. Observer should request additional personnel if deemed necessary. If spill is assessed to be larger than 200 litres, the Expedition Leader must decide on the most appropriate response strategy and ensure the presence of adequate personnel to take care of the spill. It is the duty of the selected personnel to protect:

A) *Health and safety* B) *Station facilities* C) *Threatened resources*

**General clean-up procedures**

Although each oil spill is different, general common procedures are outlined below:

- Ensure oil spill equipment is in a known and accessible location.
- If a spill occurs, stop or minimise any further spillage. Ensure safety of all personnel. Check for fire and explosion risk. Ensure safety equipment is worn.
- For all spills, deploy absorbents to contain fuel if possible. It may be possible to hold fuel in depressions by using absorbent materials, or by building small dams.
- If possible use pump to remove fuel from ground straight into 200-litre drums. Ensure that sufficient good quality empty drums are available near the spill site.
- Put absorbent pads on any remaining fuel or oil outside which cannot be pumped or manually removed. Oil soaked absorbents must be picked up and put into plastic bags and/or empty 200-litre drums.
- Contaminated snow can be stored in 200-litre drums that have had their tops removed. Allow the snow to melt and decant off fuel.
- Any waste drums containing a mixture of fuel and snow or water are likely to freeze. To prevent drums from splitting, use only those in good conditions. Do not fill completely.
- Drums of recovered fuel/water, oil soaked absorbents and contaminated clothing must be sent for disposal outside Antarctica. Follow the disposal instructions given in the Nordic Waste Management Handbook.

# APPENDIX 2 – SCAR Code of Conduct for field work:

## Transfer of alien species to Antarctica and Sub-antarctic Islands and between location transfers of species

### Risk assessment

*As part of the field work planning process the following simple risk assessment is conducted.*

Risk assessment questions*:*

1. Has any equipment/ equipment cases/ field clothing/ boots, planned for use in the subantarctic/Antarctica been used in other natural environments, particularly alpine or polar environments?
2. What are the means needed to clean this equipment/ equipment cases/ clothing/boots?
3. Will the field party be visiting more than one major locality?
4. If yes, how will the field party ensure that equipment/ equipment cases/ clothing/boots do not carry diaspores between sites?

### Field work

*The following recommendations are made with regard to field work.*

Field planning
If field work requires moving between major ice-free localities, aim to conduct field work in low diversity localities before high diversity localities.

Equipment

1. When designing field equipment, reduce the capacity of the equipment to carry additional material and make the equipment easy to clean and sterilise.
2. If equipment can not be cleaned effectively, do not use this equipment between major localities but take multiple sets of equipment (eg planktonic nets).
3. Be aware of where equipment cases are stored and that these cases do not accumulate dust or invertebrate infestations.
4. When cleaning items be particularly vigilant in removing soil, seeds and bryophyte propagules (including leaves).