Nord Stream
The new gas supply route for Europe

Nord Stream Environmental Impact Assessment
Documentation for Consultation under the Espoo Convention

Nord Stream Espoo Report: Annex
National EIA Summary - Sweden

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English version | National EIA Summary
Sweden

ENG

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1 Background

There is a high demand for natural gas in the European Union, and this demand will increase in future. According to current estimates, the EU's annual natural gas requirement of 550 billion cubic metres (bcm) in 2006 will rise by approximately 86 bcm to approximately 629 bcm per year in 2025. At the same time the production of natural gas in the EU is expected to decline to cover only 20% of the projected natural gas demand in 2025.

In order to meet the future demand for energy in the EU, the EU Commission has launched a programme called Trans-European Energy Networks (TEN-E). As part of the programme, the EU Commission specifically suggests the expansion of the EU's supply relationship with Russia.

The Nord Stream project, which consists of two gas pipelines at the bottom of the Baltic Sea connecting Russia with Germany, has been chosen as an EU priority project within the TEN-E programme.

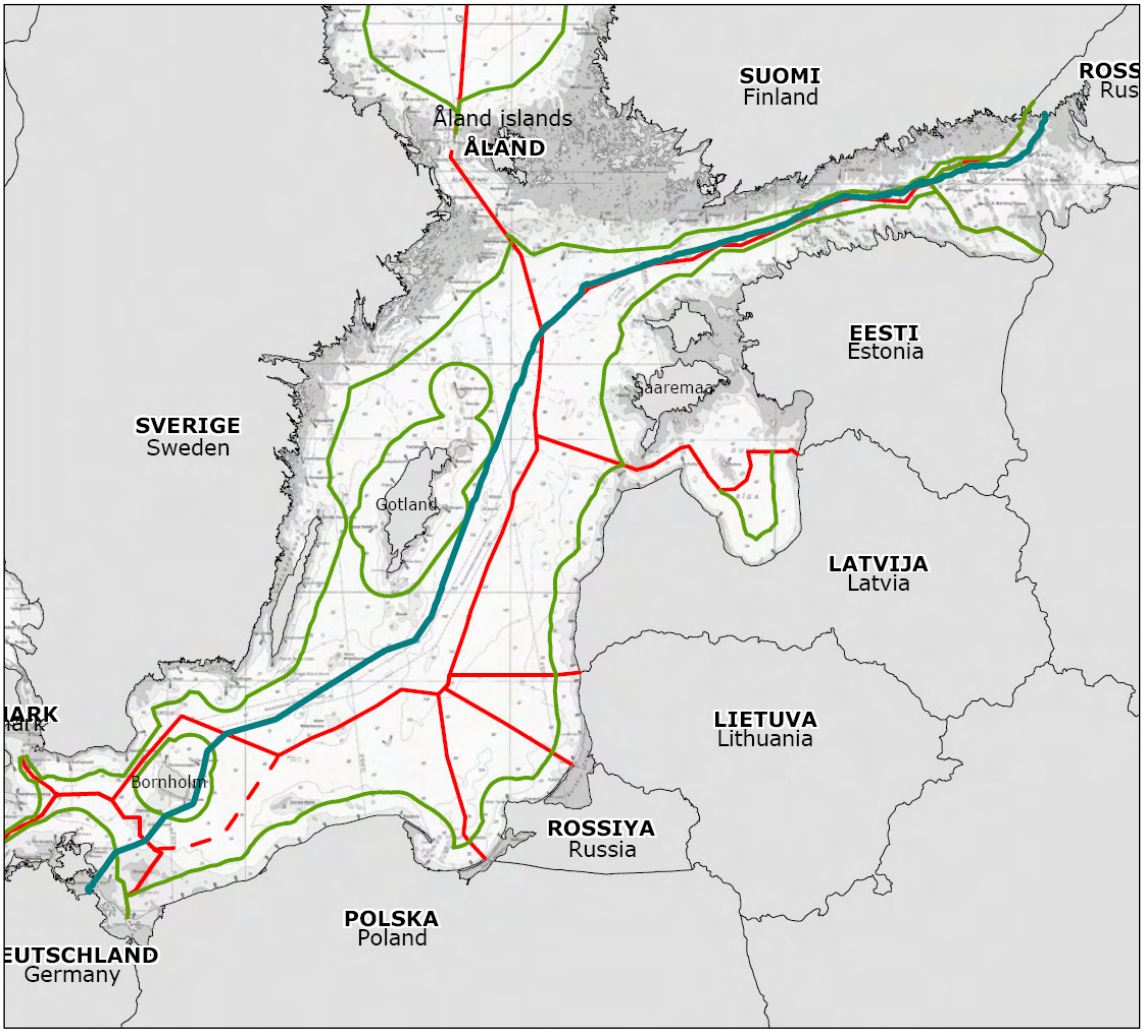

Figure 1.1 The projected pipeline route (dark green line) through the Baltic Sea. The red lines represent EEZ borders of the countries around the Baltic Sea

The two Nord Stream pipelines are planned to be constructed during 2010-2012 according to the construction schedule below. They will run from Portovaya Bay near Vyborg on Russia's Baltic coast through the Gulf of Finland and the Baltic Sea to Lubmin in the Greifswald area on the northern coast of Germany. Nord Stream will enable an annual transportation of 55 bcm of natural gas from the Russian to the European gas grid. Commissioning of the first Nord Stream pipeline leg is scheduled in 2011, providing a transport capacity of about 27.5 bcm per year of natural gas. Once the second phase of construction has been completed in late 2012, the transport capacity for natural gas will be doubled by means of the parallel pipeline leg to a total of 55 bcm per year.

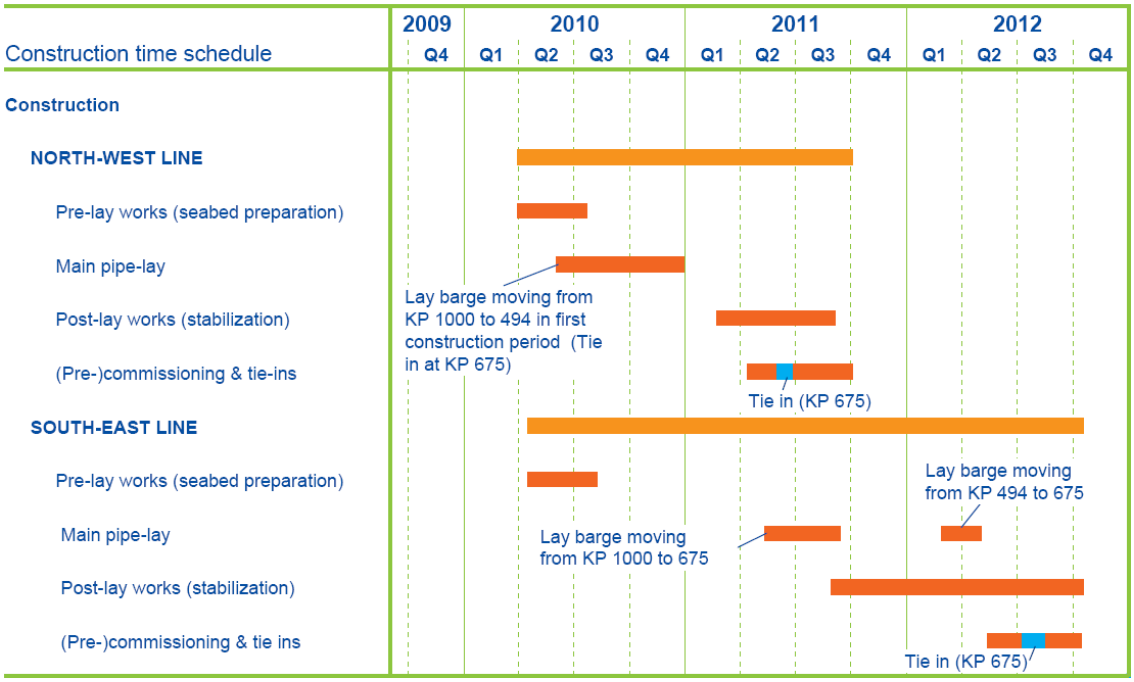

Figure 1.2 Construction time Schedule Sweden

The two pipelines will run almost parallel along the floor of the Baltic Sea, approximately 100 m apart. Each pipeline has a total offshore length of about 1,220 km, of which approximately 506 km is in the Swedish exclusive economic zone (EEZ). The pipeline alignment is shown in **Figure 1.1.**

An environmental study for the construction, operation and decommissioning of the section of the Nord Stream pipelines that runs through the Swedish EEZ has been carried out. A summary of the study follows.

2 Routing of the pipeline

2.1 General

The selection of the Nord Stream route between the appointed landfall locations was based on consideration and investigation of several different route options. The selection criteria were:

- Avoiding areas of special concern. These include nature protection areas, areas with sensitive flora and fauna, and areas with cultural heritage
- Avoiding areas where other marine activities may conflict with the installation and operation of the pipeline. These include areas for fishery, areas for extraction of raw materials, areas of military activity, areas with dumped munitions, planned offshore wind farms and designated anchoring areas
- Respecting ship traffic routes. This minimises risks from surface vessels (dropped anchors, sinking or grounding ships)
- Avoiding areas with unsuitable seabed conditions and/or bathymetry. These conditions may influence the stability of the pipeline as well as increase the need for trenching into the seabed and/or supporting the pipeline through placement of rock berms
- Respecting routing of existing cables
- Minimising overall length. This will ensure a minimised permanent occupation of the seabed and thus a minimised environmental impact during installation and operations. It furthermore maximises the overall performance of the pipeline system

2.2 Alternative routes

Base case routes were identified in order to perform geotechnical and geophysical surveys together with preliminary environmental assessments. Further adjustments of the preferred base case route have been made during the detailed development of the project from 2005 onwards.

For the section in the Swedish EEZ two different pipeline corridors were studied initially.

- A pipeline corridor west of Gotland aiming at a route for a landfall location as far west as possible on the German Baltic Sea coast, i.e., near Lübeck or Rostock

- A pipeline corridor east of Gotland aiming at a route for a landfall location on the eastern German Baltic Sea coast

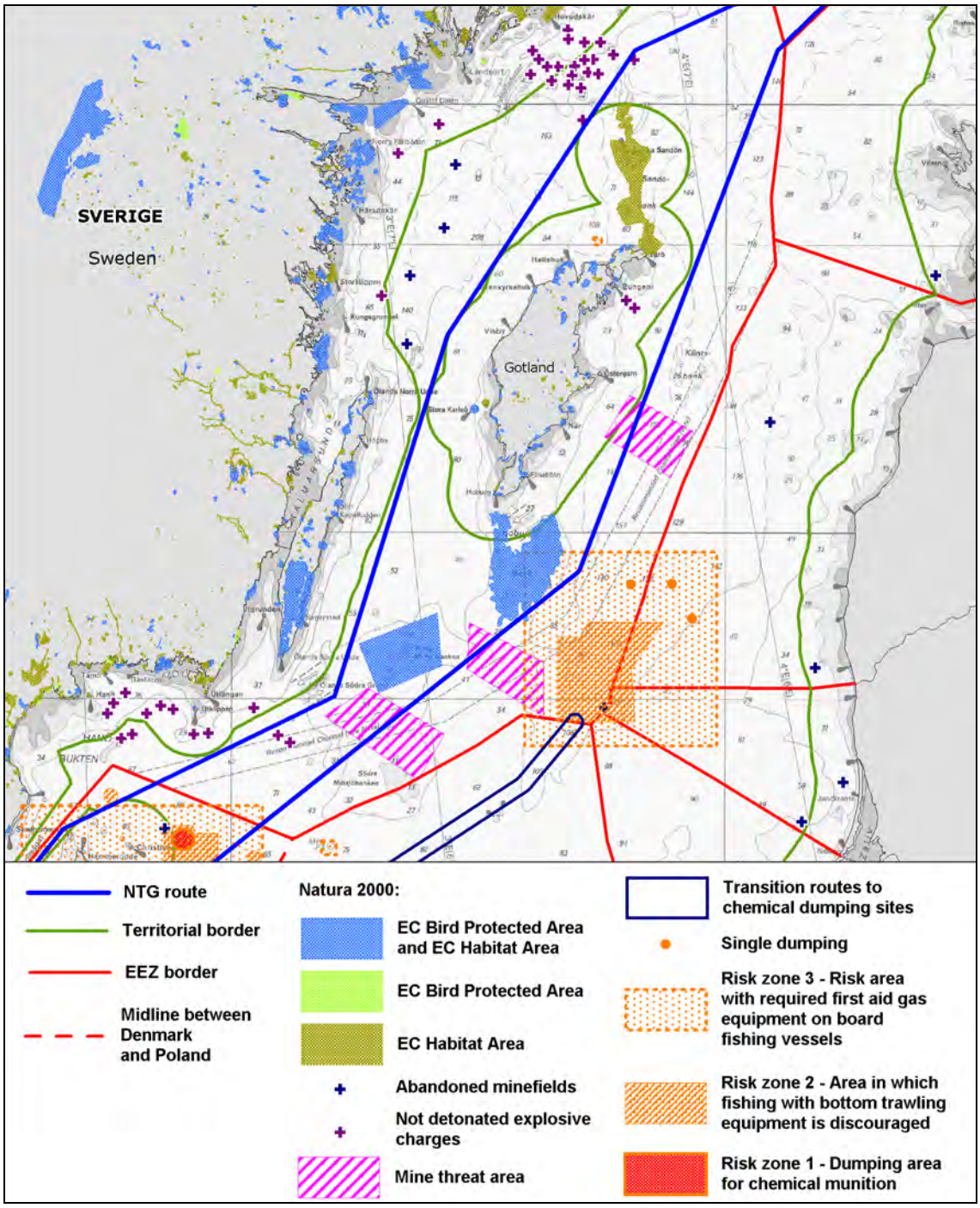

Figure 2.1 Route corridors (1997-1999) east and west of Gotland

As part of overall feasibility studies (1997-1999), both pipeline corridors were surveyed, including geophysical and geotechnical investigations and mapping of the constraints to the pipeline route, in order to assess the corridor in relation to the above route selection criteria.

The assessments of the two alternative corridors concluded that the route east of Gotland was more favourable, mainly because it avoids larger shallow-water areas (which require more seabed intervention work), a large number of cable crossings and major shipping routes. Further impacts on benthic communities will be reduced due to reduction in seabed intervention works because the benthic fauna is evaluated to be more developed in the shallow water areas east of Gotland.

As indicated in **Figure 2.1**, the selected pipeline corridor runs in the vicinity of the Natura 2000 areas Hoburgs Bank and Norra Midsjöbanken. Special precautions have been taken to ensure that the environment in these areas is not negatively impacted by the pipeline project.

Figure 2.1 also shows that the preferred pipeline route in the Swedish EEZ extends through areas classified as “Mine threat areas” and areas classified as “Risk zone 3 – Risk area with first aid gas equipment required on board fishing vessels”. Therefore, the detailed routing of the Nord Stream pipeline project has included surveys in order to safeguard the project against any interference from dumped munitions in the Baltic Sea.

In the context of the Swedish consultation process according to the Environmental Code, Swedish authorities commented on the proximity of the Nord Stream pipelines to Hoburgs Bank and Norra Midsjöbanken, both south of Gotland.

Due to this concern, a desk study for a more south-eastern route in the Swedish EEZ was carried out. The results of the study can be summarised as follows:

- A more south-eastern route would bring the pipelines to the southern side of the recommended International Maritime Organisation (IMO) shipping lane, and the crossing of the recommended shipping lane would take place further to the north
- The crossing would take place at a bend in the shipping lane
- The Denmark-Russia telecom cable would be crossed twice
- The alternative route corridor would bring the pipelines into the actual dumping area for chemical munitions at Gotland Deep
- The alternative route corridor would come very close to the shallow water at Södra Midsjöbanken; this could require the pipelines to be trenched for protection against waves and currents. This will cause disturbance of the seabed

- The alternative route corridor, depending on the exact location, could conflict with the planning objective of Södra Midsjöbanken for offshore wind energy production

A south-eastern alternative was rejected mainly due to conflicts with the recommended shipping lane and the dumping area for chemical munitions in the Gotland Deep.

2.3 Technical description

The Nord Stream pipelines will be designed and operated according to the code DNV OS-F101, Submarine Pipeline Systems, issued by Det Norske Veritas (DNV), Norway. The Italian company Snamprogetti S.p.A. of the Eni Group has been appointed engineering contractor for the detailed design. The companies DNV and SGS/TÜV have been appointed to perform independent third-party verification during the design phase, i.e., to verify the quality of engineering work. The main contractor for the installation work will be Saipem UK Ltd. of the Eni Group. Saipem will manage all sub-contractors.

The main characteristics of the pipelines are shown in **Table 2.1** below. The Swedish sector runs from approximately kilometre point (KP) 494 to KP 1000.

Table 2.1 Operating conditions

Property	Value (range)
Throughput	55 bcm/y (27.5 bcm/y per pipeline)
Gas	Dry, sweet natural gas
Design pressure	KP 0 – KP 300: 220 barg KP 300 – KP 675: 200 barg KP 675 – KP 1220: 170 barg
Design temperature	-10 – 60 °C
Operating temperature	-10 – 40 °C
Inner diameter of steel pipe	1,153 mm
Wall thickness of pipe	26.8, 30.9, 34.6 or 41.0 mm
Thickness of concrete coating	60 – 110 mm
Total length (per pipeline)	~ 1,220 km (506 km in Sweden)

The pipelines will be internally coated to increase the pipeline system's flow capacity. An external coating will be applied over the pipelines to prevent corrosion. The external anticorrosion coating will be a three-layer polyethylene coating.

The pipelines will also be coated externally with concrete. The concrete coating will be applied over the anticorrosion coating and will give the pipelines sufficient weight to remain stable on the

seabed. To ensure the integrity of the pipelines over their entire lifetime, secondary protection will be provided by sacrificial anodes of a galvanic material (cathodic protection).

The large-scale offshore construction work will require considerable support from land-based supply bases. The suggested locations of interim stockyards in Sweden are Slite (Gotland) and Karlskrona.

Pipe-laying will be performed as a conventional S-lay. The individual line pipes will be delivered to the pipe-laying vessel, where they will be assembled by welding into a continuous pipeline and lowered to the seabed.

The process onboard the lay vessel comprises the following general steps, which take place in a continuous cycle:

- Welding of pipe
- Non-destructive testing (NDT) of welds
- Field joint preparation
- Laying on seabed

Offshore pipeline installation will be conducted by lay and support vessels. One or two deep-water lay vessels (anchor-positioned, semi-submersible vessels or dynamic-positioned (DP) mono-hull vessels) will be used to lay both pipelines.

Anchor-handling vessels and survey vessels will support the pipe-laying barge. Two to six anchor-handling vessels are required per anchor-positioned lay vessel, as the vessel is kept in position by 12 anchors. Line pipe will be supplied from the supply bases.

To ensure minimum interference with pipe-laying operations from other sea traffic, an exclusion zone will be established around the lay vessel. The contractor will pay special attention to areas where shipping lanes and other areas of heavy traffic are crossed.

The offshore pipelines will be divided into major pipeline sections. The connections of these ‘tie-in’ will be carried out accordingly at two offshore, deep-water locations and at two near-shore locations. One of the two deep-water connections will be performed in the Swedish EEZ at KP 675. The sub-sea connection will be performed inside a dry welding habitat that encloses part of the pipeline on both sides of the weld.

Once the pipelines are laid, the pipe wall thickness and concrete coating will provide substantial protection of the pipelines. However, the pipelines will have varying needs for additional protection along the route to avoid:

- Stress due to free span development caused by an uneven seabed
- Excessive movement due to hydrodynamic loading
- Excessive movement due to compressive pipeline loading

In areas where one or more of these factors are possible, additional protection will be achieved through seabed intervention works. The routing of the pipelines has been carefully selected in order to minimise the need for remedial seabed works. Intervention works will be applied only where re-routing alone has not been sufficient or possible. Where required, additional protection will be achieved by trenching the pipelines into the seabed or by rock placement.

The preferred trenching method for the Nord Stream pipelines is post-trenching by ploughing, in which the pipelines are sunk into a trench made after pipe-laying. In the Swedish sector, only post-trenching is planned.

The term "rock placement" covers gravel works where coarse gravel and small stones are placed to locally reshape the seabed to ensure the long-term integrity of the pipeline. Gravel and stones are transported by ship to each position where rock placement is required. On the ship, the rock material is loaded into a pipe running through the water column. The lowest part of the pipe is equipped with nozzles to allow very precise shaping of each gravel support on the seabed. The rock-placement process is supervised by ROV (Remote Operated Vehicle).

Existing cables to be crossed by the pipelines have been identified. Only five cables will be crossed in the Swedish EEZ. The owners of active cables have been approached with the aim of reaching mutual crossing agreements covering liabilities and crossing methods. According to the agreements, Nord Stream AG will provide crossing designs and installation procedures to the satisfaction of the cable owners prior to pipeline installation. At present there are no other pipelines to be crossed. If pipelines will cross Nord Stream in future, the crossings will be designed and agreements will be reached.

After installation of the pipelines, pre-commissioning and subsequent tie-ins will be performed before the pipeline system can enter into operation.

The pre-commissioning activities include: flooding, cleaning and gauging of the pipelines and a system pressure test followed by the dewatering and drying of the pipelines. The pipelines will be flooded with seawater taken in at the Russian landfall. The water used for flooding will be sea water treated with an oxygen scavenger and with caustic soda (NaOH) to prevent oxygen corrosion and anaerobic growth in the pipeline interior. Discharge of the water will also take place at the Russian landfall.

Commissioning comprises all the activities that take place following pre-commissioning and until the pipelines are ready for natural gas transport, including filling the pipelines with natural gas.

The gas-in for each pipeline can be initiated when pre-commissioning, including dewatering, has been successfully completed and the pipeline is filled with dry air close to atmospheric pressure.

The operating philosophy and security systems have been developed to ensure the safe operation of the pipeline in any situation, which means avoiding over pressurisation, managing and monitoring potential gas leakage and ensuring material protection.

The Nord Stream pipeline control system comprises the following functions:

- Pipeline pressure regulation
- Pipeline pressure safeguarding
- Pipeline leak detection
- Pipeline parameter monitoring (including pipeline temperature safeguarding)
- Telemetry and telecommunications
- Fire and gas detection and protection
- Emergency shutdown

The landfall facilities in Russia and Germany will have local plant emergency shutdown (ESD) systems. An ESD will be triggered by events such as facilities fire detection, facilities gas detection or pipeline leak detection.

The Nord Stream pipeline system will be monitored and controlled remotely from the main control room (MCR) located at the Nord Stream AG head office in Zug, Switzerland. The MCR will be manned 24 hours per day, 365 days per year.

When the pipeline has come to the end of its operational lifetime, it will be decommissioned. The decommissioning programme of the Nord Stream pipelines has not been finally developed because technical know-how acquired over the lifetime of the pipelines as well as future regulations must be taken into account. However, decommissioning will take place in accordance with international and national legislation and regulation. From an environmental point of view, impacts will be reduced to a minimum through the fulfilment of the applicable regulations.

3 Environmental setting

The Nord Stream pipelines extend through a large proportion of the Baltic Sea, which is a quite unique environment. It is considered the world's largest estuary, that is, a partially enclosed coastal body of water with an open connection with the ocean, in which fresh water from land is mixed with salt water from the sea. The marine environment of the Baltic Sea is heavily dependent on the relatively rare, large inflows of saline water with high oxygen content from the North Sea during storms.

To analyse the impact of the Nord Stream pipelines and to plan the project in a way that minimises the impacts on the environment and on human activity in the area, the following environmental issues have been studied:

- The physical and the chemical environment
- The biological environment
- The socioeconomic environment
- Dumpsites of chemical and conventional munitions

A detailed description of the present environmental setting is provided in the report.

4 Environmental assessments

The possible impacts that may be attributed to pipe-laying and/or operation of the pipelines have been assessed. Based on analyses of the technical design and construction methods, the possible impacts on the environment have been identified. The impacts have been compared with the present environmental setting to assess the significance of the individual impacts.

Overall significance of impacts:

An overall assessment of the significance of the impacts on the environment has been divided into the following assessment categories:

: No impact

: Minor impact

: Impact

: Significant impact

- No impact: There will be no impact on structure or function in the affected area
- Minor impact: The structure or functions in the area will be partially affected, but there will be no impacts outside the affected area
- Impact: The structure or function in the area will change, but there will be no significant impacts outside the affected area
- Significant impact: The structure or function in the area will change, and the impact will have effects outside the area as well

The overall significance of an impact is the result of a detailed analysis as further described in the impact assessment section. The detailed analysis of environmental impacts in the report includes assessments of scale/intensity of effects, the geographical extent of impacts and the duration of the effects.

The scale/intensity of effects on the different environmental parameters (physical, chemical, biological and socioeconomic) of the pipelines is graded as follows:

- No effect: There will be no effects on structure or function inside the affected area

- Minor effect: There will be minor effects on structure or function inside the affected area but there will be no effects immediately after the cessation of construction activities

- Medium effect: There will be partial effects on structure or function inside the affected area, and for some time after the cessation of construction activities

- Large effect: There will be changes inside the affected area with a duration extending beyond the period of construction activities

The geographical extent is evaluated as follows:

- Local effects: There will be changes in the immediate vicinity of the pipelines/construction site. Effects are restricted to the pipeline route corridor (approximately 2 km)

- Regional effects: There will be effects outside the immediate vicinity of the pipelines (local effects), outside the pipeline corridor (approximately 2 km) and within Sweden's territorial waters and EEZ

- Global effects: There will be effects on a global scale (e.g., emissions of greenhouse gases)

Finally, whether the effects are short-term, medium-term or long-term (their temporal extent) has been assessed. The temporal extent of the effects is compared with the duration of the construction periods of the two pipelines.

- Short-term: Effects during and immediately after the construction of one pipeline. Effects end before the second pipeline is placed on the seabed

- Medium-term: Effects throughout the period of construction of both pipelines and up to around one or two years after the construction of the second pipeline

- Long-term: Effects beyond construction of the two pipelines for more than two years

A more thorough explanation of the nature and the severity of the impacts are given in the individual sections of the environmental study for the Nord Stream pipelines in the Swedish EEZ.

Projects can also cause positive impacts. Positive impacts are represented by the symbol "+" in the report's comprehensive tables for the predicted impacts.

The overall purpose of the environmental impact assessment is to carry out a description of the aspects of the environment likely to be significantly affected by the proposed project, including population, fauna, flora, sediment, water, air, climatic factors, material assets such as archaeological heritage and landscapes, and the inter-relationship between the above factors.

The environmental aspects and impacts of the Nord Stream pipelines inside the Swedish EEZ during construction, pre-commissioning, operation and decommissioning are outlined in the following section and have been summarised in **Table 5.1** – **Table 5.5**.

5 Environmental impacts

5.1 Impacts of construction

5.1.1 Impacts on the physical and chemical environment

Construction of the pipelines through the Swedish EEZ requires seabed intervention works in some areas to protect the pipelines. The seabed intervention works in the Swedish EEZ include rock placement mainly east of Gotland and Hoburgs Bank, while trenching is planned east of Gotska Sandön and in the area between Norra and Södra Midsjöbanken. The pipe-laying process and the seabed intervention works will cause mobilisation of seabed sediments. **Table 5.1** summarises the impacts related to the occupation of physical space by the pipelines and by areas of seabed intervention works.

Table 5.1 Overall significance of impact due to occupation of physical space by pipelines and by areas of seabed intervention works

EFFECT	SCALE/INTENSITY OF EFFECT	OVERALL SIGNIFICANCE OF IMPACT
OCCUPATION OF AREA BY PIPELINES AND SEABED INTERVENTION WORKS		
Area occupied by pipelines in Swedish EEZ	1.5 km^2	Minor
Section directly affected by trenching	70 km	Minor
Area of sedimentation > 1 mm following trenching	0.2 km^2	Minor
Area of suspended sediment >10 mg/l during trenching	67.6-72.6 km^2	Minor
Number of sites for rock placement	43 east/38 west	
Area of sedimentation > 1 mm following rock placement	< 0.1 km^2	Minor
Area of suspended sediment >10 mg/l during rock placement	< 0.2 km^2	Minor
Area affected by anchor-handling during construction of the pipelines	20 km^2	Minor

Table 5.2 presents the overall significance of impacts on the physical and chemical environment. Numerical modelling of the impact of the presence of the pipelines on hydraulics carried out by the Swedish Meteorological and Hydraulic Institute (SMHI) indicates that the pipelines will have no influence on the inflow of saline water to the Baltic Sea. It has thus been assessed that the pipelines will not block the inflow of deep water through the Arkona and Bornholm basins.(1) At most, bottom currents may be influenced by the pipelines, and the mixing of saline and fresh water may be slightly impacted.

Model calculations of the spreading and sedimentation of mobilised sediments indicate that the sediment spreading from construction activities will have only a local and temporary impact on the water quality in the area of construction. The Natura 2000 areas Hoburgs Bank and Norra Midsjöbanken will not be affected by the activities.

Noise emissions will not reach inhabited areas due to the distance from the Swedish coast. The noise levels are comparable to those caused by ship traffic in general, and it is assessed that noise will not cause disturbance to birds if the construction works take place outside the season when birds use the area. Noise and physical activities in general during the period when birds rest in the area may cause short-term disturbance in the immediate vicinity of construction activities. It is assessed that underwater noise may cause avoidance reactions in fish and mammals, but this is only a short-term impact.

Air emissions from the construction works contribute to the greenhouse effect. The air emissions, however, are not disproportionate to the size of the project.

(1) The assessment by SMHI has been conducted based on the discarded route alternative north of Bornholm . An update of this elaboration based on the new routing south of Bornholm will be provided. This information is an update to the text filed with the Swedish national application in October 2008.

Table 5.2 Overall significance of impact on the physical and chemical environment

EFFECT	OVERALL SIGNIFICANCE OF IMPACT
IMPACTS ON THE PHYSICAL AND CHEMICAL ENVIRONMENT	
Total amount of released nutrients and contaminants during seabed intervention works	
Spreading of sediments and contaminants from construction works on the seabed	
Suspended sediments	Minor
Sedimentation	Minor
Spreading of contaminants	Minor
Impacts on water quality	
Sediment spreading	Minor
Spreading of nutrients, inorganic and organic contaminants	Minor
Temperature difference between pipelines and marine environment	No
Contaminants from pipelines/anodes	Minor
Blocking effects of the pipeline	
Pipelines on the seabed	No
Submarine landslides	No
Impacts from noise	
Airborne noise during construction	Minor
Underwater noise during construction	Minor
Noise during operation	Minor
Impacts on air quality	
Pipeline installation and pipe supply	Minor
Seabed intervention works	Minor
Pre-commissioning	Minor
Operation	Minor

5.1.2 Impacts on the biological environment

The impacts on the biological environment are summarised in **Table 5.3**.

Impacts on the pelagic environment are closely associated with the assessed impacts on water quality. Sediment spreading from pipe-laying and anchor-handling is considered insignificant; only trenching and rock placement in shallow water are assessed to cause local sediment concentrations in the vicinity of the pipeline alignment that might influence phytoplankton or zooplankton. Rock placement that typically will be carried out in deeper water will not have any

impact on the pelagic environment. However, nutrients and contaminants may be released. Release of nutrients for the pipeline section in relative shallow water (south-east of Gotland) might marginally stimulate production of phytoplankton. The duration of these impacts, however, is very short, and no or only minor impacts on the pelagic environment are foreseen.

Table 5.3 The overall significance of impacts on the biological environmeny

EFFECT	OVERALL SIGNIFICANCE OF IMPACT
IMPACTS ON THE BIOLOGICAL ENVIRONMENT	
Impacts on the pelagic environment	
Sediment spreading	Minor
Spreading of nutrients, inorganic and organic contaminants	Minor
Difference in temperature between gas and environment	No
Contaminants from pipelines/anodes	Minor
Impacts on benthic flora and fauna	
Sediment spreading	Minor
Spreading of nutrients, inorganic and organic contaminants	Minor
Occupation of area on seabed by the pipelines	Minor/Impact
Contaminants from pipelines/anodes	No/Minor
Difference in temperature between gas and environment	No
Impacts on fish	
Sediment spreading and sedimentation	No
Physical disturbance and noise during construction	No/Minor
Occupation of seabed and changes of the bathymetry	Minor
Impacts on marine mammals	
Sediment spreading and sedimentation	Minor
Physical disturbance and noise during construction	Minor
Impacts on birds	
Sediment spreading and sedimentation	Minor
Physical disturbance and noise during construction	Minor
Impacts from non-indigenous species	
Transport with ballast water in vessels	No
Migration along the pipeline structure	No

Impacts on marine benthic fauna are assessed to be limited to areas where the pipeline is laid directly on the seabed, areas where rock berms are placed and areas in close vicinity to trenching and rock placement activities. It is evaluated that the impacts on benthic fauna in areas that are directly affected by seabed intervention works will be medium- to long-term, lasting until the fauna community is re-established. Depending on oxygen conditions, it is

assessed that benthic fauna species will begin to re-colonise areas shortly after seabed intervention works have been finished.

In general, rock placement activities will be carried out in deep water, where the oxygen conditions are poor. The field survey carried out by the Geological Survey of Sweden (SGU) showed that benthic fauna in many of these deeper water areas were absent or characterised by only a few species. Impacts on marine fauna in these areas are assessed to be limited, taking into account that sediment spreading from rock placement activities is low and limited to the lower part of the water column, near the seabed.

With respect to fish and marine mammals, it is foreseen that construction activities (locally increased water turbidity, noise, etc.) will cause avoidance reactions. However, no long-term effects are envisaged.

The ship traffic, noise and light associated with construction works may cause disturbance to birds within a short distance of the lay vessel (1 – 2 km). The duration of the disturbance will be short, as the lay vessel will move 2 – 3 km a day. Significantly reduced water transparency as a result of the increased suspended sediments will occur only at locations close to intervention works, and the duration will be very short.

It is assessed that there may be minor disturbance of birds – e.g., long-tailed ducks (Clangula hyemalis) at Hoburgs Bank – if seabed intervention works and pipe-laying are carried out during winter. However, no impact on birds is foreseen outside this season. Impacts will be short-term (days or a few weeks) and limited to the area where seabed intervention works and pipe-laying are carried out.

5.1.3 Impacts on the socioeconomic environment

Impacts on the socioeconomic environment are summarised in **Table 5.4**.

During construction there will be impacts on fisheries inside the construction area because of a protection zone around the slow-moving lay vessel and other vessels operating in the area. During construction works in the seabed (trenching and rock placement) fisheries will be affected at the construction site and in the vicinity of the construction works due to spreading of sediment. As mentioned above, this is assessed to affect fish and will likely result in avoidance reactions by fish species in the area.

Preliminary discussions with the fishermen’s associations in Sweden (as in Finland and Denmark) have taken place. Representatives from these associations recognise the necessity of a protection zone and acknowledge that a ban on all fishing activities in a specific area will most likely last for only a very short period of time (a few days). The fishermen’s associations have stated that their members would appreciate having observers who speak the local

language onboard the pipe-laying vessel for short periods in specific areas, in order to warn and support fishermen during the pipe-laying period.

In some areas where freespans will exceed the critical height, the pipelines may not be overtrawable. Therefore, permanent restrictions for fishing across/along the pipelines may be required for safety reasons in these sections.

None of the investigated seabed areas in the relatively shallow water along the planned pipeline route in the area south of Hoburgs Bank and Norra Midsjöbanken fall within the marine habitat types defined by the EU Habitats Directive. This means that no interference with protected habitat areas is expected.

Table 5.4 Overall significance of impacts on socioeconomic environment

EFFECT	OVERALL SIGNIFICANCE OF IMPACT
IMPACTS ON THE SOCIOECONOMIC ENVIRONMENT	
Impacts on fisheries	
Protection zone around the lay vessel	Minor
Sediment spreading and sedimentation	Minor
Restriction zone around pipelines	[1]
Occupation of area on the seabed	Minor
Impacts on shipping and navigation	
Physical disturbance/activities during construction	Minor
Impacts on tourism and recreational areas	
Physical disturbance and noise during construction	No
Sediment spreading and sedimentation	No
Impacts on cultural heritage	
Seabed intervention works and pipe-laying	No
Anchoring of the lay vessel	No
Changed sedimentation patterns	No
Impacts on protected areas (Natura 2000, Ramsar, BSPA areas)	
Sediment spreading and sedimentation	No
Noise during construction	No
Physical disturbance during construction	No
Impacts on infrastructure	
Impact on cables	No
Impact on wind farm areas	No
Impact on extraction areas	No
Impacts on military areas	No
Other socioeconomic aspects (job creation)	
Support during construction from land-based supply bases	Significant
IMPACTS OF DECOMMISSIONING	
Impacts of decommissioning	Minor/None[2]

1: Whether a restriction zone around the pipelines will be implemented by the Swedish authorities has not been clarified.
2: Mitigating methods and closure of the pipelines will be conducted in accordance to industry practice (legislative requirements, available technology) at the time of decommissioning.

5.1.4 Impacts from conventional munitions and dumped chemical munitions

Impacts from conventional munitions and from dumped chemical munitions are shown in **Table 5.5**.

Two munitions related objects were identified during investigations in the Swedish EEZ. One mine identified at 108 m water depth close to the Finnish EEZ border will most probably be detonated. The impacts from the detonation will be sediment spreading and dispersion of chemical compounds. However, due to water depth the impacts are considered to be limited. The other object, a bomb, was corroded and lacked explosives. (1) Munitions surveys have been carried out in a 15 m wide corridor to ensure that no munitions objects are present where the pipeline will be laid. The width of the corridor takes into account the accuracy with which the pipeline is laid.

In addition, dumped chemical munitions may be found in sections of the pipeline alignment. It is assumed that dumped chemical munitions are not armed. Chemical agents may be recovered during anchor-handling or trenching. The risk of human exposure can be eliminated by washing all equipment before it is brought on deck. The risk is comparable to risks during ongoing fishing activities.

Table 5.5 Overall significance of impacts from conventional munitions and from dumped chemical munitions

EFFECT	OVERALL SIGNIFICANCE OF IMPACT
IMPACTS FROM MUNITIONS	
Impacts from munitions clearance	1
Impacts during construction	No
Impacts during operation	No
1: If the mine identified at 108 m water depth close to the Finnish border will be detonated, Nord Stream AG will elaborate its report to include impacts from detonation of conventional munitions.	

(1) Recent updates to the project status in regard to the handling of munitions related objects in the Swedish Section have been included in this paragraph. This information is an update to the text filed with the Swedish national application in October 2008.

An environmental management system that includes specific requirements for the environmental management systems of contractors working on the project is designed to ensure that the environmental impacts of both planned and accidental discharges and emissions are minimised and controlled.

5.2 Impacts of pre-commissioning

Pre-commissioning includes pressure-testing of the pipelines. To carry out pressure-testing the pipelines will be filled with water, which will be discharged after testing. Both water intake and water discharge will occur outside the Swedish EEZ, and impact studies reveal that no impacts will occur in the Swedish EEZ.

5.3 Impacts of operation

The impact during operation of the pipeline consists of changes to the bathymetry of the seabed in locations with seabed intervention works and occupation of area from the two pipelines. In areas where trenching and rock placement are carried out, new seabed textures will be created and new fauna communities will develop depending on oxygen and salinity conditions in the area.

An overview of the impacts from the area occupied by the pipeline, including the necessary intervention works can be found in **Table 5.1**.

The sediment structure in sandy bottom areas could change to a softer seabed texture in the immediate vicinity of the pipelines because the pipelines will act as a lay belt for transverse currents and also as an artificial reef. As a consequence, the composition of the fauna could change to species that are more tolerant of occasional coverage by sediments. In the areas where the pipelines are laid on the bottom, the infauna beneath the pipelines will disappear. However, in shallower water, epifauna communities may emerge on the concrete coating of the pipelines, so the species composition will change.

The pipelines on the seabed, which can act as shelter for some fish species, may result in changes in the fish community around the pipelines, compared with the fish community of the surroundings. During operation of the two pipelines it is evaluated that there will be no effects on marine mammals or on birds.

SMHI has analysed a pipeline alignment both south and north of Bornholm. The analyses showed that the pipelines will not affect the hydraulic flow from the west through the Arkona and Bornholm basins. The increased turbulence around the pipelines might increase the mixing of inflowing saline water. The mixing of the new deep water, in the case of a northern route, was

calculated to be at most 2%, while the possible increase of mixing by a southern route would be lower. Increased mixing of new deep water means lower salinity, increased flow rate and increased transport of oxygen, which tends to improve the oxygen conditions in and below the halocline in the Baltic Proper. Just after construction, a temporary restriction zone prohibiting fishing across and along the pipelines will be required for safety reasons in areas where seabed intervention is required.The fishing ban will remain in effect until the placement of fill material and rocks has been carried out. Furthermore, there will be locations where freespans of the pipelines are of such a height that the pipelines may not be overtrawlable. Therefore, a restriction zone around the pipelines where fishing/trawling is not allowed during operation of the pipelines might be established by the Swedish authorities, which will affect fisheries in these specific areas.

The pipeline will not hinder the use or repair of existing cables.

There is no known existing or planned exploitation of natural resources on the continental shelf within the alignment of the preferred route.

5.4 Impacts of decommissioning

A separate study of options for decommissioning will be carried out in due time before decommissioning commences. The study will include a review of the technical and economic feasibility of the various options, together with an analysis of their environmental impacts.

At the time of decommissioning, experience from other projects, experience with respect to the environmental impact of the presence of the Nord Stream pipelines, industry practice and the existing legal framework will determine which decommissioning strategy should be implemented.

It is expected that best practice at that time supported by the requirements of the authority will imply an insignificant environmental impact from the decommissioning. The limited experiences available at present suggest that a decommissioning strategy implying abandonment of a pipeline as the most likely scenario with no overall significant impact. A removal of the pipeline after the end of its lifetime will most likely cause minor environmental impacts comparable to the impacts from construction of the pipeline.

6 Environmental management and monitoring

Nord Stream AG is fully committed to carrying out construction works with as minimal environmental impact as reasonably practicable. Towards that end, Nord Stream AG has established an environmental management system to ensure that the objective of minimising environmental impacts during construction is fulfilled.

This includes meeting the requirements of national and international legislation and environmental standards, including the Espoo and Helsinki Conventions.

When carrying out the environmental study for the project, a number of assumptions were made. By implementing an environmental monitoring and management programme, Nord Stream AG will ensure that the assumptions in the environmental study are valid. Another purpose is to ensure that the construction work is carried out with as minimal environmental impact as possible.

Nord Stream AG has adopted an integrated HSE (health, safety and environment) management system to ensure that health, safety, and environmental aspects are handled in a way that ensures that the activities of the company live up to the aspirations of the corporate HSE policy.

7 Risks, emergency response and mitigation measures

A risk assessment in order to identify hazards and evaluate the associated risks has been carried out for the pipeline project. The evaluation shows that the risk is minimal and internationally acceptable.

Nord Stream AG will implement mitigation measures for the pipeline project to ensure that both the known environmental impacts and the risks of unplanned events are kept as low as is reasonably practicable.

Moreover, Nord Stream AG will ensure that suitable emergency arrangements are in place to mitigate the potential impacts of an unplanned event. Contractors working for Nord Stream AG will be required to have environmental management systems in place. This will include the requirement for HSE plans that are specific to the hazards and risks associated with the contractors' scopes of work and work sites. Nord Stream AG, through audits and inspections at the contractors' worksites, will ensure that the above requirements are adhered to.

8 Priority issues identified during the consultation process

During the national process of hearings in Sweden, certain issues were identified as requiring special attention:

- Impacts on the Natura 2000 area Hoburgs Bank and on the proposed Natura 2000 area Norra Midsjöbanken
- Impacts on fish stocks and fisheries
- Release of nutrients and heavy metals/contaminants from seabed sediments
- Risks related to dumped chemical munitions
- Risks of pipeline accidents

These issues are addressed in the general assessments above. In addition, the following sections provide further information regarding these concerns, including the assessment of impacts.

8.1 Impacts on the Natura 2000 areas Hoburgs Bank, Norra Midsjöbanken and Gotska Sandön

8.1.1 Environmental issues

Hoburgs Bank, Norra Midsjöbanken and Gotska Sandön-Salvorev are designated as Natura 2000 areas. Hoburgs Bank andNorra Midsjöbanken are characterised as shallow areas with sandbanks and reef structures where mussels are abundant, providing food supply for common eider at Hoburgs Bank, and long-tailed duck and black guillemot at Hoburgs Bank and Norra Midsjöbanken. The Natura 2000 area at Norra Midsjöbanken is also a spawning area for herring and turbot. Activities that may cause a threat are exploitation of the area and increased sedimentation, possibly containing contaminants. The marine parts of Natura 2000-area of Gotska Sandön-Salvorev consist of a large shallow sea-area with sandbanks and sand reefs. Common mussel dominates the fauna. Grey seals are protected according to the habitat-directive. The area is a spawning ground of turbot and hosts a large number of wintering long-tailed duck and other sea birds. Activities that may cause a threat are exploitation of the area, eutrophication, damage from trawling and fishing.

8.1.2 Environmental aspects

The Nord Stream project has assessed whether there may be impacts to these areas due to e.g. spreading of contaminated sediments from intervention works or due to noise during pipe-laying. The spreading of sediments has been modelled, and the simulations show that suspension of sediments will not impact the Natura 2000 areas. As the seabed in this particular area is characterised by erosion due to currents and wave actions, the content of nutrients and contaminants is low. The environmental conditions of the areas, therefore, will not be influenced by pipe-laying. Noise from the lay vessel itself and from the anchor-handling vessels and supply boats will only be significant at a short distance from the work area and will not disturb bird life in the protected areas. Access to food sources in the area and visibility in the water column are similarly assessed not to be influenced by pipe-laying.

8.1.3 Environmental impacts

It is assessed that the Nord Stream pipelines will not give rise to any negative impacts in the designated Natura 2000 areas Hoburgs Bank, Norra Midsjöbanken and Gotska Sandön-Salvorev.

8.2 Impacts on fish stocks

8.2.1 Environmental issues

In the vicinity of the pipeline route there are spawning areas/nursery areas for cod and sprat and feeding areas for herring. There is also a spawning area for turbot at Norra Midsjöbanken. Eel are found along the coastal areas. Cod, turbot and eel are all threatened species according to the national Swedish inventory of species threatened with extinction.

8.2.2 Environmental aspects

The construction of the pipeline will unavoidably result in sediment spreading, underwater noise and changes to the bathymetry where the pipeline is laid. Sediment spreading and underwater noise will cause fish avoidance in the vicinity of the lay barge. Modelling of sediment spreading has revealed that turbot spawning grounds will not be affected. It is assessed that migration of eels will not be hindered because eels migrate along the coastline and swim in the open water at night. Calculations have revealed that inflow of salt water to the Baltic Sea will not be obstructed by the pipeline. This is an important issue in relation to the breeding of cod.

8.2.3 Environmental impacts

The pipe-laying activities will cause short-term disturbance to fish in the vicinity of construction works, but it is at the same time assessed that no significant or long-term impacts on fish stocks will occur.

8.3 Impacts on fisheries

8.3.1 Environmental issues

Fishing for cod, herring and sprat take place in and around the pipeline route.

8.3.2 Environmental aspects

For security reasons fishing will not be allowed in close vicinity to the lay vessel during pipe-laying operations. However, because the lay vessel moves forward several kilometres a day, disturbance to fishing during pipe-laying will be minimal. The design of the pipelines will allow trawling across the pipelines.

8.3.3 Environmental impacts

Very limited disturbance to fishing activities is foreseen during pipe-laying. Disturbance will be reduced further by the provision of information regarding pipe-laying activities to all sea traffic. Trawling across the pipeline may cause additional wear on equipment. The overall assessment is that impacts on fisheries will be limited.

8.4 Release of nutrients and heavy metals/contaminants from seabed sediments

8.4.1 Environmental issues

Nutrients such as phosphorous and heavy metals/organic contaminants are accumulated in seabed sediments in the Baltic Sea. Increased levels are observed in particular in bottom areas with accumulating conditions. The water column is characterised by a thermocline as well as a halocline. This implies that water from the lower part of the water column is exchanged with water from the upper part to only a minor extent.

8.4.2 Environmental aspects

In connection with different activities on the seabed, including trenching and rock placement, and in connection with anchor-handling of the lay vessel, sediment will be mobilised and spread.

In areas where extensive trenching is carried out, sediments contain only low contents of nutrients, heavy metals and organic contaminants, as the intervention works do not take place in bottom areas with accumulating conditions. However, anchor-handling will take place in bottom areas where accumulation conditions prevail. Because the majority of sediments that could possibly contain nutrients and contaminants are found in water areas with a halocline, which separates the lower part of the water column from the upper part, the majority of released nutrients and contaminants will resettle and not be accessible in the food chain.

8.4.3 Environmental impacts

Release of nutrients and contaminants into the biologically active upper zone of the water column is assessed to be very limited, and no impacts are foreseen.

8.5 Risks related to dumped chemical munitions

8.5.1 Environmental issues

Considerable amounts of munitions and chemical warfare agents were dumped in the Baltic Sea, especially after WWII. The pipeline will pass an area to the east of Gotland where the risk of mines must be considered. South-east of Hoburgs Bank, the pipelines will pass an area where chemical warfare agents may be found. Additionally there are two mine-risk areas where the pipeline route passes Norra Midsjöbanken. The surveys carried out by the Project have showed very few objects that may possibly be related to munitions.

8.5.2 Environmental aspects

Only two munitions that may cause impacts have been observed. One, a bomb, will be addressed by locally rerouting the pipeline, while a mine identified at 108 m water depth close to the Finnish EEZ border will most probably be detonated.

The possibility that munitions or chemical warfare agents may be encountered during pipe-laying activities cannot be ruled out. It is assessed that impacts on marine life caused by such an unlikely event can be excluded. Impacts on humans may occur if equipment that has been in contact with chemical agents is taken onboard a ship. Health risks can be avoided by implementing the appropriate safety precautions, including cleaning all equipment used in risk areas before it is taken onboard.

8.5.3 Environmental impacts

The likelihood of encountering unexploded ordnance is assessed to be very small. Implementing procedures for handling of munitions, having the necessary safety equipment onboard, together

with evacuation plans, and educating personnel will ensure that risks to personnel are limited to a minimum.

8.6 Risks of pipeline accidents

8.6.1 Environmental issues

The main risk during construction is related to the theoretical increase in the frequency of collision risks due to the increased sea traffic associated with the project, including the lay barge, pipe carriers, anchor-handling and intervention work vessels. In the case of a collision, fuel could be spilled into the environment.

A related issue is the risk related to the construction of the second line (North West line) when the south east line is already in operation.

In the operational phase rare external factors such as sinking ships or dragged anchors may result in a possible failure of the pipelines and possibly be followed by a subsea gas release.

8.6.2 Environmental aspects

A thorough analysis of the possible risks during the construction and operational phases of the Project has been carried out. It has demonstrated that the frequency of collisions and a subsequent oil spill due to the construction works is very low. The frequency of a gas release during operation due to ship traffic related interference is also assessed to be very low.

A number of risk-reduction measures will be implemented during the construction phase, including establishing a safety zone around the lay barge, closely monitoring ship traffic and maintaining contact with maritime authorities. The design of the pipeline is in accordance with the highest standards and ensures resistance against, e.g., corrosion, mechanical failure and impacts from fishing gear.

In case of a collision, fuel from the ships involved may be spilled and cause harm to the environment. A leak of natural gas from the pipeline will not, in itself, cause pollution of the sea, but a significant amount of gas would be dispersed into the atmosphere. The gas from a pipeline rupture will have an immediate lethal effect on marine animals in the close vicinity of a rupture. Natural gas exhibits negligible solubility in water and therefore will not affect water quality on a long-term basis. It will rise to the surface, from where it will be released to the atmosphere. Methane is a greenhouse gas with a global warming potential 25 times greater than carbon dioxide.

8.6.3 Environmental impacts

The unlikely event of an oil spill caused by a collision during construction works may impact on birds and marine mammals and fish, as would any other collision at sea. The impact would depend on the size of the oil spill, weather conditions, etc.

The impacts of a pipeline rupture and gas release on fish, marine mammals and birds would be limited in time and space. A major release of natural gas would impact the atmosphere due to the global warming potential of methane gas. However, it must be kept in mind that a rupture of a pipeline has been proven to be extremely unlikely.