Nord Stream
The new gas supply route for Europe

Environmental monitoring in B_l ish waters 2010

Nord Stream Project

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APPENDICES

Abbreviations and definitions

ADCP	Acoustic Doppler Current Profiler
ADF	Admiral Danish Fleet
AFDW	Ash Free Dry Weight
AIS	Automatic Identification System
A&R	Abandonment and Recovery
Bcm	Billion cubic metres
BHM	Bornholm Marine District
CTD	Conductivity, Temperature and Depth
CTDO	Conductivity, Temperature, Depth and Oxygen
CMP	Construction Management Plan
CWA	Chemical Warfare Agents
D_{50}	Median grain size of the sediment
DCC	Distance of Cross Course
DEMA	Danish Emergency Management Agency
DGPS	Differential Global Positioning System
DM	Dry Matter
DW	Dry Weight
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EOD	Explosive Ordnance Disposal
ES	Environmental Study
GVI	General Video Inspection
H_2S	Hydrogen sulphide
HELCOM	The Helsinki Commission
HSE	Health, Safety and Environment
ESMS	Environmental and Social Management System
IMR	Inspection, Maintenance and Repair
IWs	Intervention Works
KP	Kilometre Point (starting with KP 0 km at Russian landfall)
LOI	Loss On Ignition
m^3	Cubic meter
MBES	Multi Beam Echo Sounder
MMT	Marin Mätteknik AB
Natura 2000	An ecological network of protected areas in the territory of the European Union
OBS	Optical Back-Scatter
PAM	Passive Acoustic Monitor
psu	practical salinity units
ROV	Remotely Operated Vehicle
SMHI	The Swedish Meteorological and Hydrological Institute
SSC	Suspended Sediment Concentration

Thermocline	A thin but distinct layer in which temperature changes rapidly with depth
TOC	Total Organic Carbon
TW	Territorial Water
USBL	Ultra-Short Baseline
VERIFIN	Finnish Institute for Verification of the Chemical Weapons Convention

1 Summary

The construction of two offshore natural gas pipelines from Russia to Germany (the Nord Stream Pipeline) commenced in spring 2010. The pipelines shall connect the large natural gas resources of Russia with the European natural gas pipeline network.

As part of the permit requirements for construction of the pipelines, an environmental monitoring programme covering activities in the period 2010-2016 within the Danish territorial water (TW) and exclusive economic zone (EEZ) was formulated by Nord Stream in collaboration with the Danish authorities.

The monitoring programme covers the following environmental and socioeconomic parameters:

Environmental parameters:

- Monitoring of fish along pipeline
- Monitoring of benthic fauna
- Monitoring of water quality
- Monitoring of hydrographic conditions in the Bornholm Basin

Socioeconomic monitoring parameters:

- Monitoring of cultural heritage
- Monitoring of munitions
- Monitoring of chemical warfare agents (CWA) in the sediment
- Monitoring at national and international monitoring stations
- Monitoring of maritime traffic

This document provides an overview of all environmental monitoring activities carried out by Nord Stream in 2010 within Danish waters. The document explains the status of monitoring in general terms in addition to the overall results. Detailed descriptions of monitoring activities and results are presented in specific monitoring reports, one for each monitoring module.

This document is the first of seven planned annual reports, the purpose of which is to document the status and the results of the monitoring activities in the Danish waters and if necessary recommend appropriate adjustments to the monitoring scope.

The focus of the monitoring in 2010 has generally been on baseline monitoring. The monitoring of potential impacts of the pipelines is not undertaken until 2011, after the first pipeline has been laid.

1.1 Construction activities 2010

Construction commenced in Danish waters on 22 July 2010 with the installation of cable crossing mattresses. It was followed by pipe-laying and trenching of the laid pipeline. On 16 October 2010 the vessel Castoro Sei (C6) started laying the first (northwest) pipeline in Danish waters south of

Bornholm at KP (kilometre point) 1142 (coming from Germany). It continued to KP 1004, where it left Danish waters and entered Swedish waters on 30 December 2010.

Construction of the pipelines necessitates the crossing of several cables. These cables are used mainly for telecommunications and electric power transmission. In Danish waters three existing cables were crossed and mattresses were installed. The design of each crossing takes into consideration the specific locations of the cables including the crossing angle and cable burial depth. The data is based on collated data from the side-scan sonar, towed magnetometer, sub-bottom profile and gradiometer surveys conducted within the installation corridor.

The work performance of the pipe-lay activities was satisfactory and in accordance with expectations. The pipe-lay from KP 1142 to KP 1004 was successfully completed on 30 December 2010 and the operations continued into Swedish EEZ. During the execution of pipe-lay in Danish waters, the pipeline had to be laid down and picked up again several times due to rough weather. This operation is called “Abandonment and Recovery (A&R)".

The Nord Stream Pipeline was trenched in two sections in Danish waters. The trenching took place between 8 and 17 February 2011. Lowering of the pipeline into the seabed using a plough ensures that the pipeline will remain stable in its position throughout its lifetime. Subsea ploughs work much in the same way as their land-based farming equivalents, except in this case the pipeline is passed through a pair of roller boxes in the body of the plough whilst the seabed is excavated as the plough advances. Natural sediment movements from waves and currents will gradually backfill the ploughed trench. The plough (PL3) used for the Nord Stream Pipeline was towed by the purpose-built vessel Far Samson.

Upon specific request, Bornholm Marine District (BHM) agreed to assist Nord Stream during critical operations in the vicinity of the known chemical munitions areas. As a preventive measure, BHM mobilised its munitions team and brought it on board Nord Stream’s operative units with the aim of assisting Nord Stream with visual inspection, consultancy and tracing of chemical munitions. No chemical warfare agents were detected under any of the construction works performed in Danish waters.

1.2 Monitoring of fish along the pipeline

Field investigations were conducted during the period October-November 2010. The monitoring has established a baseline for similar surveys planned in 2011-2014 with the overall objective to describe the qualitative and if possible the quantitative changes in the fish community in the immediate vicinity of the Nord Stream Pipeline and to compare the findings with the fish community of the surrounding seabed. The aim of the monitoring is to investigate whether the pipelines lead to a so-called reef effect and to determine the extent of changes in fish abundance.

The overall objective of fish monitoring is to measure impacts where the pipelines are established directly on the seabed and where trenching has been carried out. The monitoring of fish directly at and in the immediate vicinity of the pipelines is focused on demersal fish species, as no effects from the presence of the pipelines on the seabed are expected to occur for pelagic fish species. To obtain detailed information on species composition, and to estimate quantitative changes due to a potential

reef effect, information is gathered through survey trawling and gill net fishery. Additionally, echo-sounder surveys, and visual inspections with a remotely operated vehicle (ROV) are carried out.

Investigations are undertaken at nine locations along the pipeline and at four reference stations (>1 km west of the pipeline). Five of these fish monitoring stations are so-called “hotspots” identified by Danish fishermen as particularly important for fishery along the Danish section of the Nord Stream Pipeline.

The data from the 2010 survey shows that Cod, Herring, Flounder and Plaice dominate the catches in the surveyed areas, with Cod being the dominating species. Other species represented in the catches include Haddock, Shorthorn sculpin, Smelt, Sprat, Three-bearded rockling, Three-spined stickleback, Turbot, Whiting and Atlantic horse mackerel.

The statistical analysis for catches in bottom trawl showed no significant differences in fish assemblages for biomass or abundance between impact and reference stations. However, the analysis of the results showed significant spatial differences in fish assemblages between the analysed stations. Results from the five stations which do not have a reference station will be included in the statistical analysis of the coming year.

The statistical analysis for catches in gill nets showed no significant spatial differences in abundance and composition of fish within in the studied area, indicating homogenous fish assemblages at the impact and reference stations.

1.3 Monitoring of benthic fauna

The field surveys were carried out in the period 19-26 July 2010. The monitoring has established a baseline for similar surveys planned for 2011-2013 with the overall objective to enable assessments of impacts on the benthic infauna and seabed due to construction works. A survey regarding epifauna establishment and growth on the pipeline is due to start in 2011 and results will be included in subsequent reports.

The purpose of the monitoring programme for benthic fauna is to evaluate and document re-colonisation and recovery of the infauna changes around the pipelines due to establishment of the Nord Stream Pipeline, and to evaluate and document the establishment and growth of epifauna on the pipelines. Since monitoring of the establishment and growth of epifauna on the pipelines begin in 2011 it shall not be explained further in this report.

The benthic infauna stations are located in areas where trenching is planned, and where the most pronounced effects from sediment dispersion and re-sedimentation may be expected. Two benthic infauna transects (B10 and B11) are located perpendicular to the Nord Stream Pipeline. There are 15 stations at each transect. At each station, three Van Veen grab samples have been collected, along with one core sample for analysis of physical and chemical properties of the seabed sediment.

The results of the surveys showed that there were no spatial gradient in abundance and biomass along the two surveyed transects. The results of classification and ordination based on abundance and biomass were basically identical and showed that the benthic community along transect B10 and transect B11 was dominated by the same species. However, the benthic communities were

significantly different along the two transects due to differences in abundance and biomass of the dominant species. The main differences were a dominance of the bivalve *Astarte borealis* along the deeper transect B10 and a dominance of the bivalve *Macoma balthica* and the polychaete *Pygospio elegans* along the shallower transect B11. Other characteristic species along the transects were the polychaetes *Scoloplos armiger* and *Bylgides sarsi*, the common mussel *Mytilus edulis*, the crustaceans *Diastylis rathkei* and *Diastylis lucifera* and the pripulid *Halicryptus spinulosus*.

Comparison of the average data from transect B10 and transect B11, respectively, with data from the stations closest to the area where the survey was conducted, revealed large spatial and inter-annual variations in species composition, abundance and biomass even within the same area.

1.4 Monitoring of water quality

No monitoring of water quality took place in Danish waters as part of the Nord Stream monitoring programme in 2010. Monitoring of sediment spreading was carried out in February 2011 in connection with post-lay trenching. The data is currently being analysed and will be presented in a separate report in summer 2011.

1.5 Monitoring of hydrographic conditions in the Bornholm Basin

Monitoring of hydrographic conditions in the Bornholm Basin was undertaken in January 2010 and ended in January 2011. The purpose of the hydrographic monitoring programme in Danish and Swedish waters is to establish documentation for the theoretical analysis of the possible blocking of the water inflow to the Baltic Sea caused by the presence of the Nord Stream Pipeline.

The monitoring aims to provide descriptions of the bottom currents, interfacial friction and dissipation of inflow waters. Inflow events are expected to occur near the seabed (mainly during winter) and below the halocline (mainly during summer). Oceanographic measurements (velocity, temperature, salinity) were initially carried out during a nine month period (including a down period of approximately 1 month) by a fixed monitoring station at KP 1036 in Danish waters northeast of Bornholm at a water depth of approximately 90 m. In autumn 2010 the monitoring station was moved to KP 966 in Swedish water, to also record measurements from shallower water depths (approximately 68 m).

In addition to the fixed station, line transects of currents have been carried out by ADCP. The line transects were carried out along the pipeline route between KP 1030 and KP 1070. A total of seven transects were planned in relation to each service inspection (incl. mobilisation and demobilisation). This has been reduced due to existing weather conditions. By the end of 2010, four successful line transects had been carried out.

The results of the monitoring shall be submitted to the authorities in summer 2011 in a separate report when the data has been analysed.

1.6 Monitoring of cultural heritage

Detailed surveys have led to the discovery of a number of wrecks and cultural heritage sites east and south of Bornholm. The on behalf of the Heritage Agency of Denmark the Viking Ship Museum have assessed these cultural heritage sites and it has been agreed with the Heritage Agency that 27

protection zones of 200 m radius are established around these cultural heritage locations during pipeline installation in Danish waters. These zones shall ensure that no impacts from pipeline installation and anchor handling occur at the cultural heritage sites.

Monitoring of two wrecks located within 50 meters of the Nord Stream Pipeline is part of the environmental monitoring programme. The wreck monitoring is carried out as visual inspection with ROV before and after pipeline installation. The purpose of the monitoring programme for cultural heritage is to document that cultural heritage sites under protection are not damaged or disturbed during the construction of the Nord Stream Pipeline and that the presence of the pipelines does not cause any erosion around protected wrecks.

The pre-lay monitoring wreck inspections were performed on 21 and 25-26 October 2010 and the post-lay monitoring was carried out on 2 November 2010 and 14 January 2011. The result of the monitoring was that no damage to the two wrecks was recorded during installation of the first pipeline.

The wreck monitoring is planned to be repeated before and after installation of the second pipeline in 2011-2012. Monitoring will be carried out again in 2014 and in 2016 to ensure that no erosion has taken place around the wrecks as a result of the pipelines' presence on the seabed.

1.7 Monitoring of munitions

Detailed munitions surveys have led to the discovery of five chemical munitions objects east of Bornholm. The Admiral Danish Fleet have assessed these objects and it has been agreed with the Admiral Danish Fleet that the chemical munitions are to be left on the seabed and not disturbed during installation of the Nord Stream Pipeline. This will be achieved by using a controlled lay with ROV monitoring during installation.

As part of the environmental monitoring programme, monitoring of the five chemical munitions has been included. The munitions monitoring is being carried out by visual inspection using an ROV before and after pipeline installation. The inspections serve to enable an evaluation of any disturbance, which may have occurred to the chemical munitions objects during pipeline installation.

Monitoring of munitions before and after installation of the first pipeline was conducted in autumn/winter 2010/2011. The result of the monitoring is that no disturbance of the chemical munitions objects has taken place during pipeline installation. One object (R-DK1-2-33-3995) has been covered with sediment, due to disturbance of the seabed from either pipeline installation or e.g. trawling, but the inspection indicates that no direct contact with the object has taken place.

In compliance with the Danish permit requirements safety precautions and emergency plans for handling of chemical munitions have been followed during installation of the first pipeline in Danish waters. Accordingly, on behalf of the Admiral Danish Fleet, Bornholm Marine District have been onboard the lay vessel during cable crossings and recoveries of the pipeline on occasions where pipe-lay had to be stopped due to rough weather.

The munitions monitoring is planned to be repeated again before and after installation of the second pipeline in 2011 and 2012.

1.8 Monitoring of chemical warfare agents (CWA) in sediment

The field surveys were carried out in the period 19 to 26 July 2010 to establish a baseline for similar surveys planned in 2011 and 2012. The overall objective of these surveys is to enable assessment of the impacts on changes in risk due to CWA in the seabed caused by construction of the Nord Stream Pipeline.

The monitoring focuses on impacts from trenching as this is the activity which is deemed to have the greatest impact on the seabed environment and thereby the greatest potential for disturbing buried CWA residues.

The survey in 2010 was confined to 23 stations distributed over the total length of the pipelines and six transects, each with 15 sampling locations covering an additional 90 stations. The transects were located perpendicular to the pipelines, three of them on sections where the pipelines are trenched into the seabed. Measurements could only be performed at 5 of the 6 transects due to a hard and stony seabed. The actual sampling programme ended up covering 98 sample stations.

No intact warfare agents, i.e. sulphur mustard (H), Adamsite (DM), Clark I (DA), á-chloroacetophenone (CN), Tabun (GA), Triphenylarsine (TPA), were found in any of the samples analysed.

A degradation product of phenyldichloroarsine (PDCA [SPr]) and a degradation product of lewisite (L2[ox]) were detected in two out of 98 samples.

The total CWA related exposure to the marine environment is estimated to be 0.8 µg/l, and the total fish community risk quotient (RQ) for the two degradation products PDCA [SPr] + L2[ox] is 0.026, indicating a negligible risk to fish living at the seabed with exposure to the CWA agents. An RQ value of >1.0 indicates that 5% of the fish community which is exposed to the CWA agents may be affected.

1.9 Monitoring of other parameters

National and international monitoring stations
All national and international monitoring stations inside Danish waters are located relatively far from the Nord Stream Pipeline. The distance to the monitoring station closest to the Nord stream Pipeline is a HELCOM station located at the northern section of the pipeline route in the Bornholm Basin 3.2 km from the pipelines. Due to the large distance from the pipelines it is assessed that there will be no impacts to the HELCOM station, or to other monitoring stations inside Danish waters, during construction and operation of the Nord Stream Pipeline.

Maritime traffic
The purpose of Nord Stream's control and monitoring in relation to maritime traffic is to minimise the risk of collisions or other accidents involving commercial ship traffic and/or vessels performing construction activities for the project. Safety zones of varying sizes are established around all vessels performing underwater construction work and vessel management systems (such as Automatic Identification System (AIS) for identification and locating of vessels) are used. Information on upcoming and ongoing construction activities is provided to the relevant authorities, who in turn

inform the ship traffic. Information designated for the fishing communities is being produced and delivered both to individual fishermen and fishing organisations on a regular basis.

During the construction in Danish waters, Nord Stream and its construction vessels have followed the communication and reporting procedures which have been agreed with Danish authorities and organisations. Nord Stream has provided the relevant authorities with e.g. daily updates from the construction vessels as well as weekly forecasts. Regular information to the fishing community has been provided from the time construction activities started and shall continue throughout the construction period.

Almost all types of construction activities which are planned within the Nord Stream Project in Danish waters have already been carried out several times during the last year, i.e. survey activities, mattress installation and pipe-laying. Precautionary safety measures were successfully implemented and the construction activities have all been performed without any accidents with third party vessels.

2 Introduction

Nord Stream is an offshore natural gas pipeline from Russia to Germany. The Nord Stream Pipeline will connect the large natural gas resources of Russia with the European natural gas pipeline network. At full capacity, it will provide 55 billion cubic metres (bcm) of natural gas per year to European consumers.

The length of the entire two-pipeline system ('the Nord Stream Pipeline') is approximately 1,220 km. The pipeline crosses the exclusive economic zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany, and territorial waters (TW) of Russia, Denmark and Germany. The construction of the first pipeline commenced in April 2010, and will be completed in 2011. The second pipeline is planned to be completed in 2012. The Nord Stream Pipeline is designed to operate for 50 years.

2.1 Construction permit and conditions for environmental monitoring

Nord Stream AG has by letter of 3 March 2009 to the Danish Energy Agency (DEA) applied for permission to construct two parallel natural gas pipelines in Danish sea area in the Baltic Sea east and south of Bornholm.

The permit for construction including installation of the natural gas pipelines in Danish sea area was given by DEA on 27 October 2009. The permit is issued in accordance with the Continental Shelf Act, cf. Consolidated Act no. 1101 of 18 November 2005, as amended by Act no. 548 of 6 June 2007 and Act no. 1400 of 27 December 2008, the State Sovereignty over territorial waters, as well as Executive Order no. 361 of 25 April 2006 on certain pipeline installations for transport of hydrocarbons in territorial waters and on the continental shelf.

The permit is based on the following conditions regarding monitoring which are stated in the permit /1/ conditions nos. 4-6:

4. *Nord Stream AG must prepare a monitoring programme for the construction phase, including pipeline installation on the seabed. The monitoring programme must encompass environmental conditions and be approved by the authorities before pipeline installation on the seabed.*
5. *Nord Stream AG must prepare a monitoring programme for the operational phase. The monitoring programme must encompass the environmental conditions and be approved by the authorities before pipeline commissioning.*
6. *Nord Stream AG must prepare a monitoring programme for the operational phase. The monitoring programme must encompass the safety conditions. The monitoring programme must be approved by the Danish Energy Agency before pipeline commissioning.*

The environmental monitoring programme for both the construction and the operational phase, referred to in permit conditions 4 and 5, was discussed and agreed with Danish authorities ahead of commencement of construction works. This report includes the initial results from those agreed monitoring activities. The monitoring referred to in permit condition 6 relates to operational control

and maintenance during the operational phase. These topics are not addressed in this report, but they are important parts of the application for the operation permit which Nord Stream has filed to the Danish Energy Agency.

Nord Stream AG must apply to DEA for an operation permit before the pipelines are taken into operation, ref § 2 of Executive Order no. 361 of 25 April 2006 on certain pipeline installations for transport of hydrocarbons in territorial waters and on the continental shelf.

2.2 Environmental monitoring within the Danish territorial water and EEZ

To accommodate the conditions laid out in the construction permit, a programme for environmental monitoring within Danish waters was compiled by Nord Stream in collaboration with the Danish authorities. The environmental monitoring programme was presented to, and discussed with the Danish authorities at a meeting held on 9 February 2010.

The environmental monitoring programme comprises the following documents:

- Ramboll O&G/Nord Stream. Environmental Monitoring Programme Denmark. G-PE-EMS-MON-100-05110000-C /2/.
- Ramboll O&G/Nord Stream. Scope of Work for Monitoring of Mobilised Sediments during Construction in Danish waters. G-PE-EMS-MON-100-05120000-C /3/
- Ramboll O&G/Nord Stream. Scope of Work for Visual Monitoring of Munitions and Cultural Heritage in Danish waters. G-PE-EMS-MON-100-05130000-C /4/
- Ramboll O&G/Nord Stream. Scope of Work for Monitoring of Seabed Sediments, Benthic Fauna and Demersal Fish in Danish waters. G-PE-EMS-MON-100-05140000-C /5/
- Ramboll O&G/Nord Stream. Hydrographic Effects: Deep Water Inflow in the Bornholm Basin (Danish EEZ). 15.03.2010. G-PE-PER-REP-000-HydrogSE-B /6/.
- Ramboll O&G/Nord Stream. Monitoring Stations in Danish Waters. G-PE-EMS-MON-100-05160000-C /7/.

In the Danish Environmental Impact Assessment /8/ all potential impacts from construction and operation of the Nord Stream Pipeline were assessed to be minor. Consequently, monitoring would not necessarily be required, but it is considered important to employ additional effort to validate the accuracy of the impact assessment on certain fit-for-purpose activities and to achieve the main monitoring objectives for the project.

In order to measure the effectiveness of the monitoring and mitigation measures, relevant receptors and indicators identified within the monitoring programme are characterised by the following:

- Low natural variability and broad applicability;
- Measurable; and

- Appropriate to the scale of impact, the impact mechanism as well as to temporal and spatial dynamics.

Monitoring of potential environmental factors and related impacts considers:

- Emission intensity; and
- Sensitivity of the receptor and conservation value.

A project-based concept in relation to overall oceanography follows the evaluation of potential environmental impacts with consideration to the following:

- Focus on shallow waters providing habitats for conservation objectives;
- A general approach to potential impact areas for waters between 80 m and 30 m water depth; and
- No biological investigations below the halocline at 80 m water depth if alternative options are available, in view of the anoxic conditions at these depths.

Nord Stream's environmental monitoring in Danish waters therefore varies in spatial range, temporal frequency and duration, depending on the nature of the parameters monitored and in accordance with the potential impacts predicted and in relation to potential receptors. According to local variations in environment and construction works, certain investigations are conducted only at selected sites.

The environmental and socioeconomic monitoring comprises the following main objectives:

Change monitoring: to detect environmental changes that may have occurred as a result of project implementation. This includes monitoring undertaken before construction (baseline monitoring), during construction (not necessarily in direct connection to construction activities in a specific area) and during the first years of operation (post-construction).

Compliance monitoring: periodic sampling or continuous recording of specific environmental and social quality indicators for a defined purpose to ensure project compliance.

Pro-active monitoring: timely routine and periodic checks by observation, measurement and evaluation for a defined purpose, which includes corrective action.

2.2.1 Construction and environmental control

Besides the additional environmental monitoring, which comes as a result of permit conditions and authority discussions, and which is the focus of this report, Nord Stream also has its own overall system in place to manage and control all aspects of environmental relevance of the project. This control structure is called the Environmental and Social Management System (ESMS). To a large extent, the ESMS is guided by the findings and recommendations of the National Environmental Impact Assessments (EIAs), Environmental Studies (ESs), and the Espoo Report, as well as EU EIA directive requirements, lenders' requirements and requirements of the relevant authorities. The purpose of the ESMS is as follows:

- Establish a framework for implementation of mitigation and management measures and to monitor the effectiveness of those measures
- Provide assurance to authorities and other stakeholders that their requirements will be met, with respect to environmental and social performance
- Provide for the implementation of corrective measures where required
- Establish a framework for performance monitoring to enable Nord Stream to ensure that its commitments and policies are met, with respect to environmental and social performance

A number of management plans have been designed to structure the requirements for the different construction activities and/or areas. Each management plan provides detailed information, requirements and minimum environmental standards relating to either a specific construction activity (e.g. seabed intervention) or an environmental/social issue (e.g. waste management). Thus the environmental and social management as well as mitigation and monitoring actions to be undertaken by Nord Stream and its contractors are clearly stated, the roles defined and adherence easily ensured. Nord Stream has also prepared bridging documentation to align the contractor's management system with that of Nord Stream.

Contractor compliance, of both documentation and the work itself, is further controlled and supervised by a number of internationally renowned independent environmental and technical consultants (such as Det Norske Veritas, Global Maritime and Environ). These companies have provided support in ensuring that the contractors have followed and implemented Nord Stream's obligations and commitments as appropriate, and as described in the management plans, during the first year of construction. The contractor's compliance with the defined procedures has been carefully monitored through offshore inspections and reporting throughout the construction phase, for example through vessel safety audits by a marine warranty surveyor prior to mobilisation and periodical on-site environmental and safety inspections by an environment, health and safety representative.

2.3 Purpose of the document and reading instructions

This document provides an overview of all environmental and socioeconomic monitoring activities carried out by Nord Stream in 2010 in Danish TW and EEZ. It is the first of seven planned annual reports the purpose of which is to document the status and the results of the monitoring activities in Danish waters and if necessary recommend appropriate adjustments to the monitoring scope. The reports will be submitted each year and cover all activities undertaken the previous year. The monitoring programme for the Danish EEZ covers activities from 2010-2016.

The document starts with a description in Chapter 3 of all construction activities undertaken in 2010. In Chapter 4, the status of the monitoring of the environmental parameters is described followed by status of the monitoring of socioeconomic parameters in Chapter 5. A comparison with the results of the monitoring and the assessments made in the Environmental Impact Assessment is presented in Chapter 6, followed by conclusions and recommendations in Chapter 7.

The monitoring activities that have required more detailed studies and/or field studies have been divided into seven different modules:

- Monitoring of fish along the pipeline (reef effect)
- Monitoring of benthic fauna
- Monitoring of water quality
- Monitoring of hydrographic conditions in the Bornholm Basin
- Monitoring of cultural heritage
- Monitoring of munitions
- Monitoring of chemical warfare agents (CWA) in the sediment

A brief presentation of the status of each module is given in this main report along with the overall results in Chapter 4 and 5. The module reports are based on reports elaborated by the companies that have undertaken the actual monitoring tasks. Each task has been tendered in fair competition among the most respected and competent specialist companies in the region with in-depth knowledge of the specific conditions governing the natural environment in the Baltic Sea.

It should be noted that due to the timing of the monitoring of water quality and hydrographic conditions in the Bornholm Basin, detailed reporting of these modules will not be presented until summer 2011.

It should also be noted that the focus of the above-mentioned monitoring modules is baseline monitoring. The monitoring of potential effects of the pipeline is not undertaken until 2011.

3 Construction activities in 2010

Construction commenced in Danish waters on 22 July 2010 with the installation of cable crossing mattresses and was followed by pipe-laying and trenching of the laid pipeline. On 16 October 2010 the vessel Castoro Sei (C6) started laying the first (northwest) pipeline in Danish waters south of Bornholm at KP (kilometre point[1]) 1142 (coming from Germany). It continued to KP 1004 where it left Danish waters and entered Swedish waters on 30 December 2010.

The following chapters provide further information on the completed construction activities during 2010 in the Danish EEZ which included:

- Cable crossing (mattress installations)
- Pipeline installation, KP 1142 to KP 1004
- Post-lay trenching

3.1 Cable crossing (mattress installation)

Construction of the pipelines necessitates the crossing of several cables. These cables are used mainly for telecommunications and electric power transmission.

Prior to construction, Nord Stream AG approached the owners of the active cables in order to reach mutual agreements concerning rights and obligations, crossing procedures etc. Prior to concluding the agreements, Nord Stream AG provided crossing designs and installation procedure information.

The design of each crossing takes into consideration the specific locations of the cables including crossing angle and cable burial depth. The data is based on collated data from the side-scan sonar, towed magnetometer, sub-bottom profile and gradiometer surveys conducted within the installation corridor.

Flexible concrete mattresses have been selected for placement over the cables at the crossing locations to increase the bending radius imposed on the cables and to ensure a permanent vertical separation between the pipeline and the cables. In cases where the cables have been buried at a lesser depth, neoprene pads have been added to the lower surface of the mattresses. For some crossings, concrete beam mattresses have been selected for placement under the pipelines at locations adjacent to the crossing locations to provide additional bearing support thereby reducing the load on the cables at the crossing locations.

Monitoring of the existing cables and the constructed crossings during 2010 was done by visual inspection using an ROV (remotely operated vehicle) to identify the target position and condition immediately prior to and after crossing installation. In doings so, the crossing point and the intended position of the mattresses were already verified during the mattress installation. After the installation, a general video inspection (GVI) was made of the crossing structure. In addition, the as-left crossing survey was done to confirm the position, alignment and status of the pipeline in relation to the cable crossing and mattresses.

[1] Kilometre points are counted from the start of the pipeline in Russia, at Portovaya Bay (KP 0) to Germany, Lubmin (KP 1,224).

In Danish waters three existing cables were crossed and mattresses where installed (Figure 3.1):

- Baltica Seg 1: Mattress installation on 19 July 2010 (crossed: 7 November 2010)
- DK-RU1: Mattress installation on 22 to 23 July 2010 (crossed: 7 November 2010)
- DK-PL2: Mattress installation on 23 to 26 July 2010 (crossed: 19 December 2010)

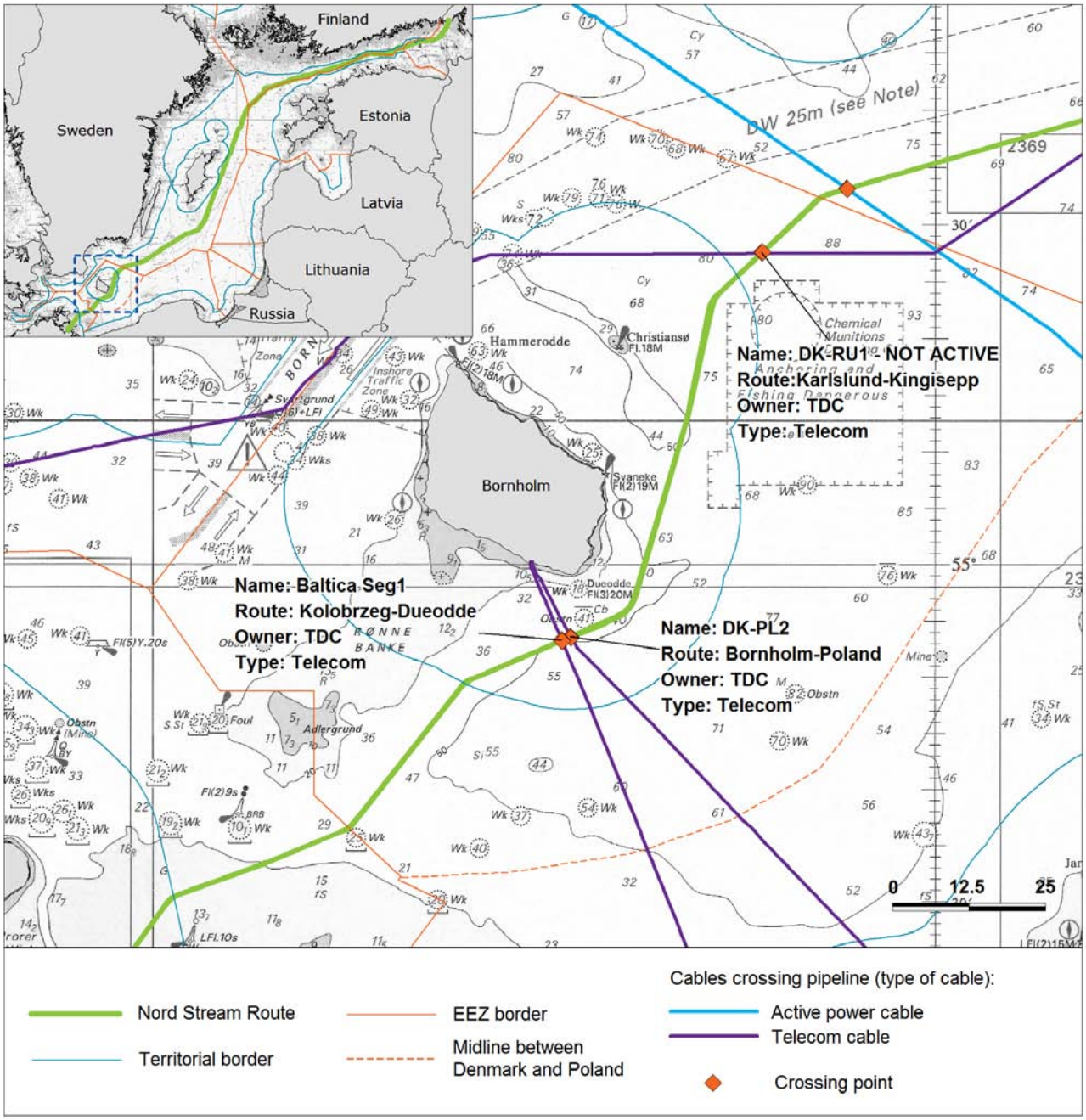

Figure 3.1 Three cable crossings in Danish waters.

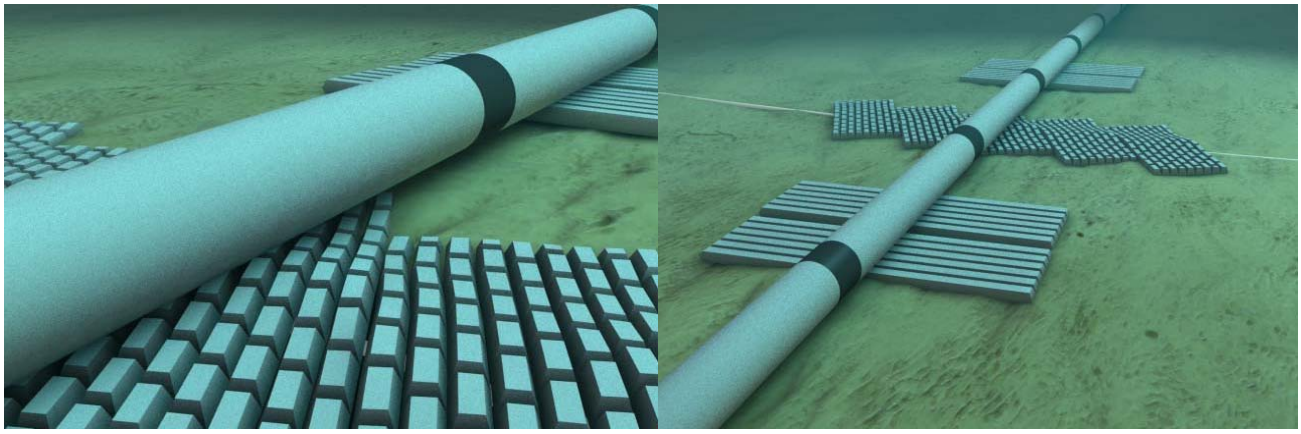

Figure 3.2 Typical use of concrete mattresses in relation to cable crossings.

The number of mattresses to be used for the cable crossings has been defined on the basis of detailed engineering performed by Saipem Energy Services, previously Snamprogetti. Criteria for defining the initial crossing design were governed by the crossing angle and specific survey results detailing installed cable state of burial.

3.1.1 Baltica Seg 1 cable monitoring

After pipeline installation, an as-left survey of the Baltica Seg 1 cable route was conducted to confirm the position, alignment and status of the cable, mattresses and pipeline. Visibility was hampered by the very soft sediment stirred up by the ROV. All mattresses at the Baltica Seg 1 crossing location appear to have settled into the sediment to varying degrees. Both the East and West mattress arrangements had settled slightly more into the seabed and sediment had built up along the mattress edges.

The pipeline was found to be well aligned on the mattresses over the crossing and it was possible to confirm that there had been no movement in the positions of the mattresses.

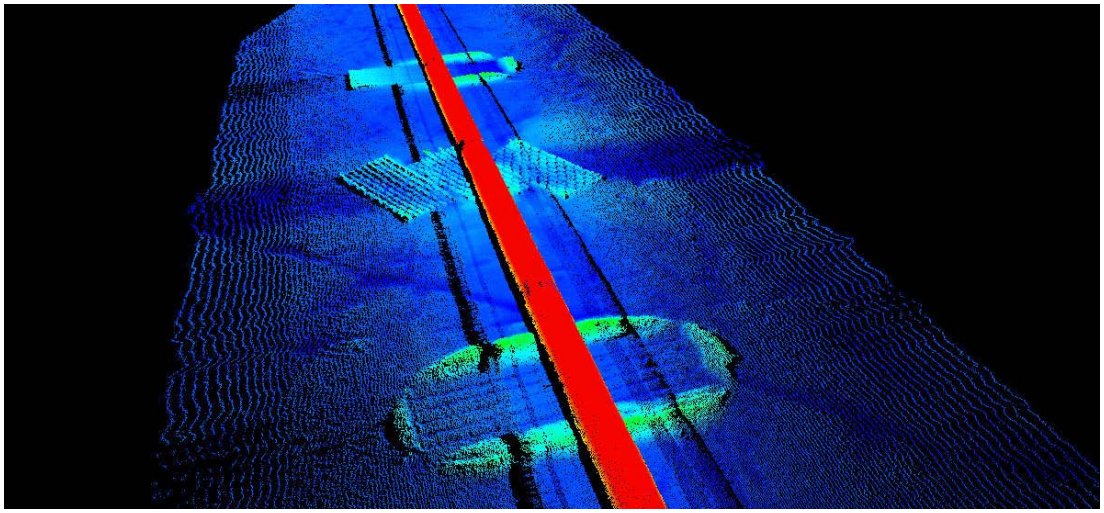

Figure 3.3 Baltica Seg 1 cable crossing viewed from west.

3.1.2 DK-PL2 cable monitoring

An as-left survey of the DK-PL2 cable route was conducted after pipe-laying to cover the extent of the anchor corridor, to confirm that there had not been any interaction between anchors and the cable.

At the crossing location the pipeline was found to be crossing almost centrally over the mattresses. The pipeline was observed to be in contact with the seabed and the mattresses throughout. All three mattresses at the DK-Poland 2 crossing location exhibited negligible settlement into the seabed. The pipeline was observed to be lying on the mattresses with no visible free-spans between the mattress arrangement and the seabed.

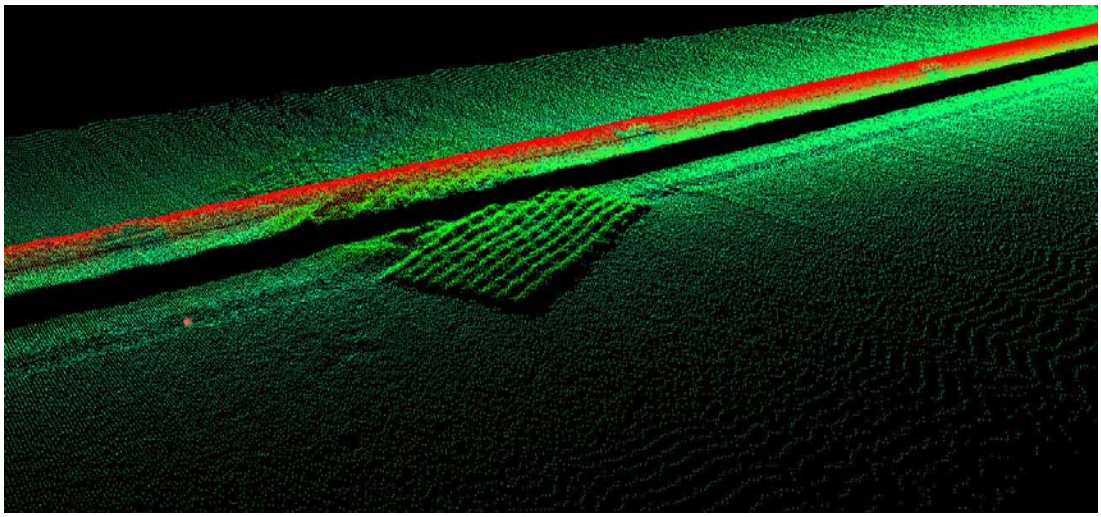

Figure 3.4 DK-Poland 2 cable crossing viewed from south.

3.1.3 DK-RU1 cable monitoring

An as-left survey of the DK-RU1 cable route was conducted after pipe-laying to cover the extent of the anchor corridor to confirm that there had not been any interaction between anchors and the cable.

The DK-RU1 crossing position was installed in accordance with the design. There was substantial embedment of the mattresses at the crossing location due to soft seabed conditions. All five mattresses at the DK-RU1 crossing location appeared to have settled into the very soft seabed with sediment covering many of the concrete blocks. Furthermore, sediment partially covered the mattresses after the installation.

The pipeline was observed to be lying on the mattresses with no visible free-spans between the mattress arrangement and the seabed. The weight of the pipeline also appeared to have contributed to the central mattress settling into the soft seabed displacing seabed material around it. No movement in the mattress positions and no visible evidence of seabed disturbances or anchor cable scars were found throughout the survey.

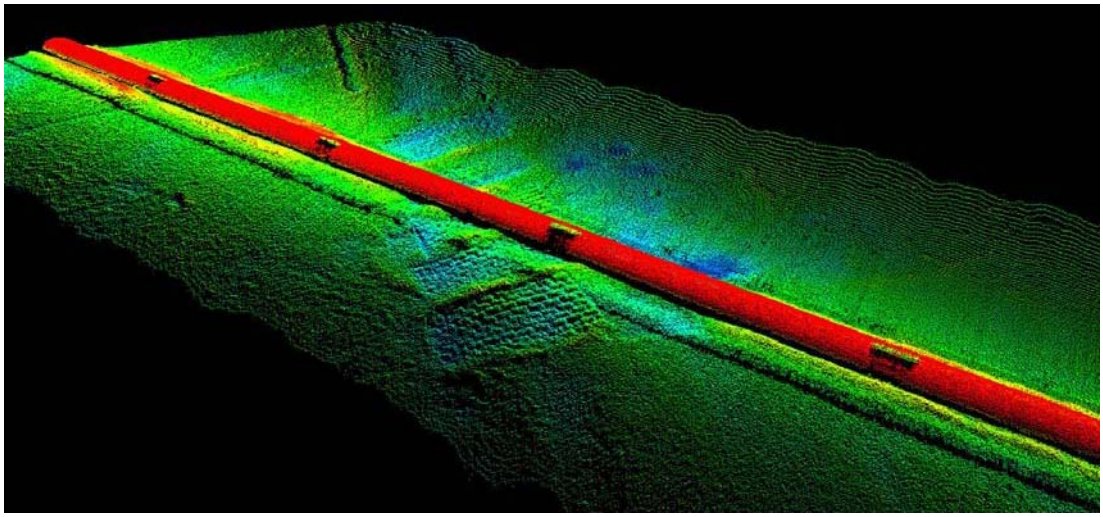

Figure 3.5 DK-RU1 cable crossing viewed from east.

3.2 Pipe-lay, KP 1142 to KP 1004

Pipe-lay activities commenced in Danish waters on 16 October 2010. The work performance was satisfactory and in accordance with expectations. The pipe-lay from KP 1142 to KP 1004 was successfully completed on 30 December 2010 and the operations continued into Swedish EEZ.

The Castoro Sei pipe-lay vessel and its support vessels, namely the survey vessel, anchor handling tugs and supply vessel, are manned and equipped to lay pipe 24 hours a day, seven days a week. The operation on the pipe-lay vessel comprises several steps from loading the pipes onto the pipe-lay vessel to lowering the pipeline onto the seabed. There are exact procedures defined for each process to ensure consistent quality and compliance with health and safety regulations. On the Castoro Sei pipe-lay vessel, the process on board includes the following steps:

- Single pipe joint supply
- Single pipe joint storage on deck
- Activities in the double-joint Plant
    - Pipe joint bevelling
    - Double-joint welding
    - Double-joint inspection (non-destructive testing (NDT))
- Double-joint cleaning, pre-heating, and transfer to the firing line (main production line)
- Activities in the firing line
    - Double-joint alignment and welding to mainline
    - Field joint inspection (non-destructive testing (NDT))
    - Field joint coating (main line and double joint)
    - Field joint inspection
- Lay vessel move-up
- Pipeline advance to seabed.

During the performance of pipe-lay in Danish waters, the pipeline had to be laid and picked up again several times due to rough weather. This operation is called “Abandonment and Recovery” (A&R).

To enable the laying of the pipeline it has to be sealed watertight. This is achieved by welding a lay down head to the end of the pipe string in the firing line. This lay down head will be attached to the A&R wire and connected to the A&R winch at the top of the firing line. Then, the vessel will slowly move up while paying out A&R wire, thus allowing the pipe end to move through the firing line and down the stinger. The operation is monitored by ROV and tension is reduced until the A&R head touches down on the seabed. During recovery, the pipeline is pulled up on the wire, over the stinger, and into the firing line. Once it has moved past the first tensioner, all tensioners will be closed, and the tension will be transferred from the A&R cable to the tensioners. The A&R head and wire will be removed and normal pipe-laying continues.

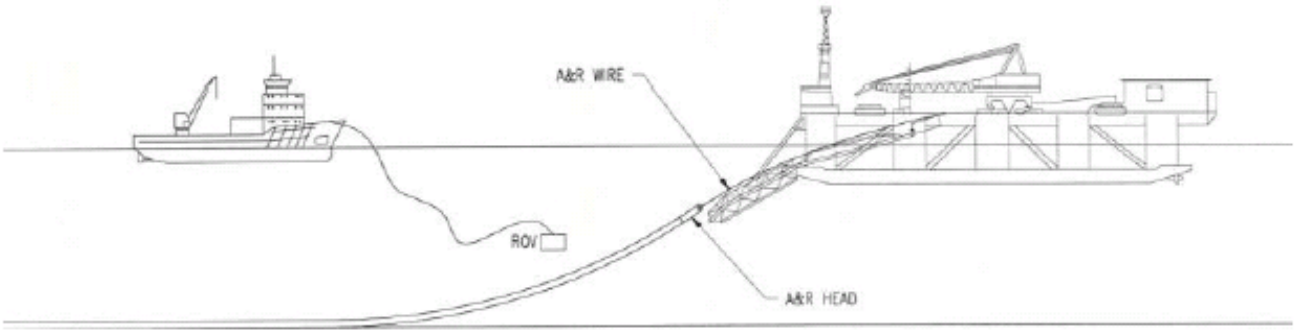

Figure 3.6 Pipe-laying.

During pipe-lay Castoro Sei used 10-12 anchors to ensure the correct position of the barge. The anchors, which are moved by designated anchor-handling vessels, are placed up to approximately 1000 metres from the pipeline alignment. A typical anchor pattern is outlined in Figure 3.7. Three anchor-handling vessels supported Castoro Sei during the construction works in Danish waters.
Additionally, four pipe carriers provided the pipes for the lay vessel. Pipes were supplied from the stockyard at Mukran in Germany to the lay barge. Supplies to the Castoro Sei were shipped from the supply base in Norrköping in Sweden.

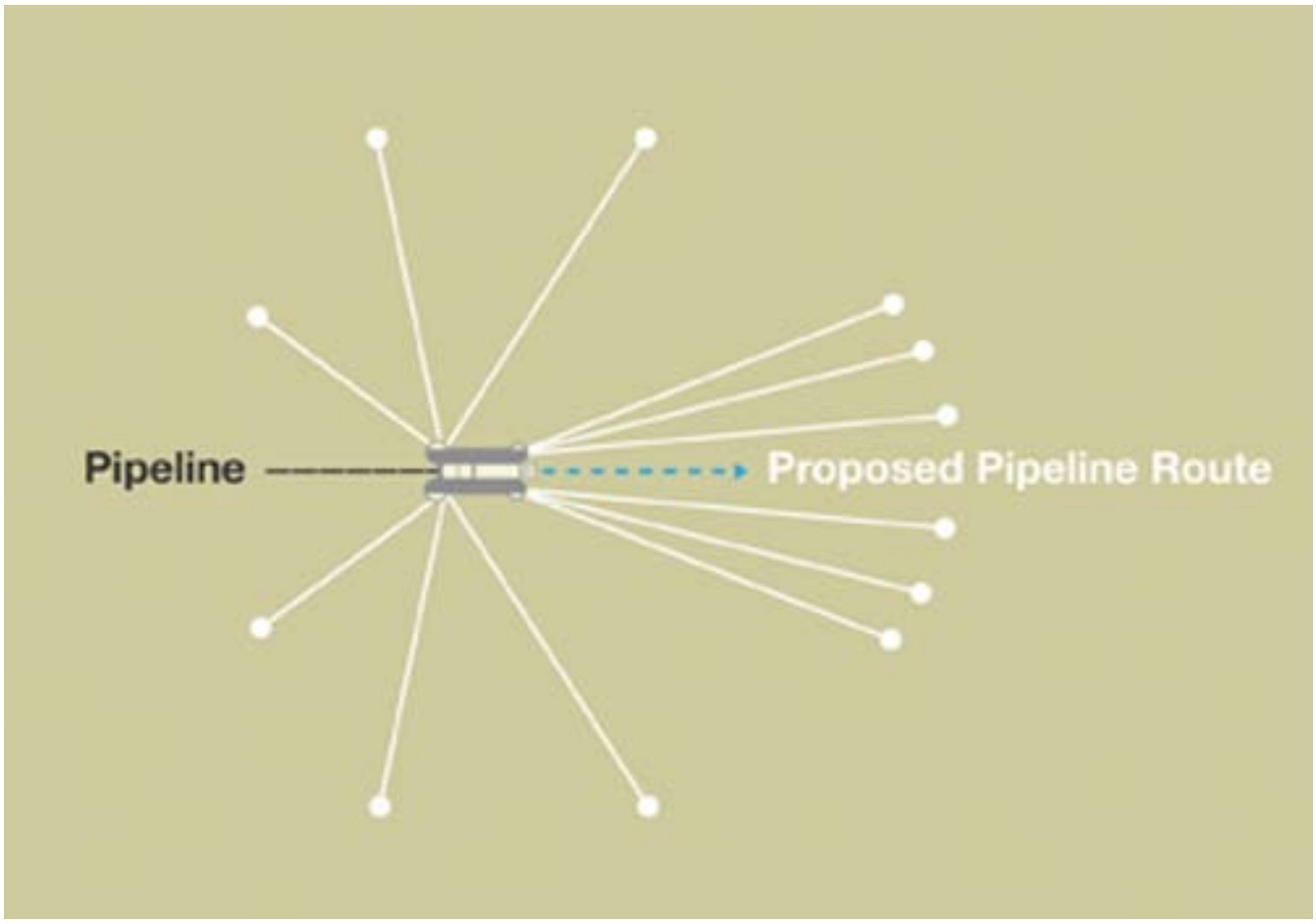

Figure 3.7 The Castoro Sei 12-point mooring system.

During construction the Castoro Sei is normally positioned by means of a 12-point mooring system. This system enables it to maintain accurate positioning. Each of the 12 mooring lines, or anchor lines, is controlled by a tension winch weighing 124 tonnes. The vessel also features thrusters to further ensure precise positioning.

3.3 Post-lay trenching

In accordance with the Danish Construction permit (1110/8609-0002/003/004, 20 October 2009) and the Technical Update document (G-PE-PER-REP-100-05150000, 23 June 2010) the Nord Stream Pipeline was trenched in two sections in Danish waters.

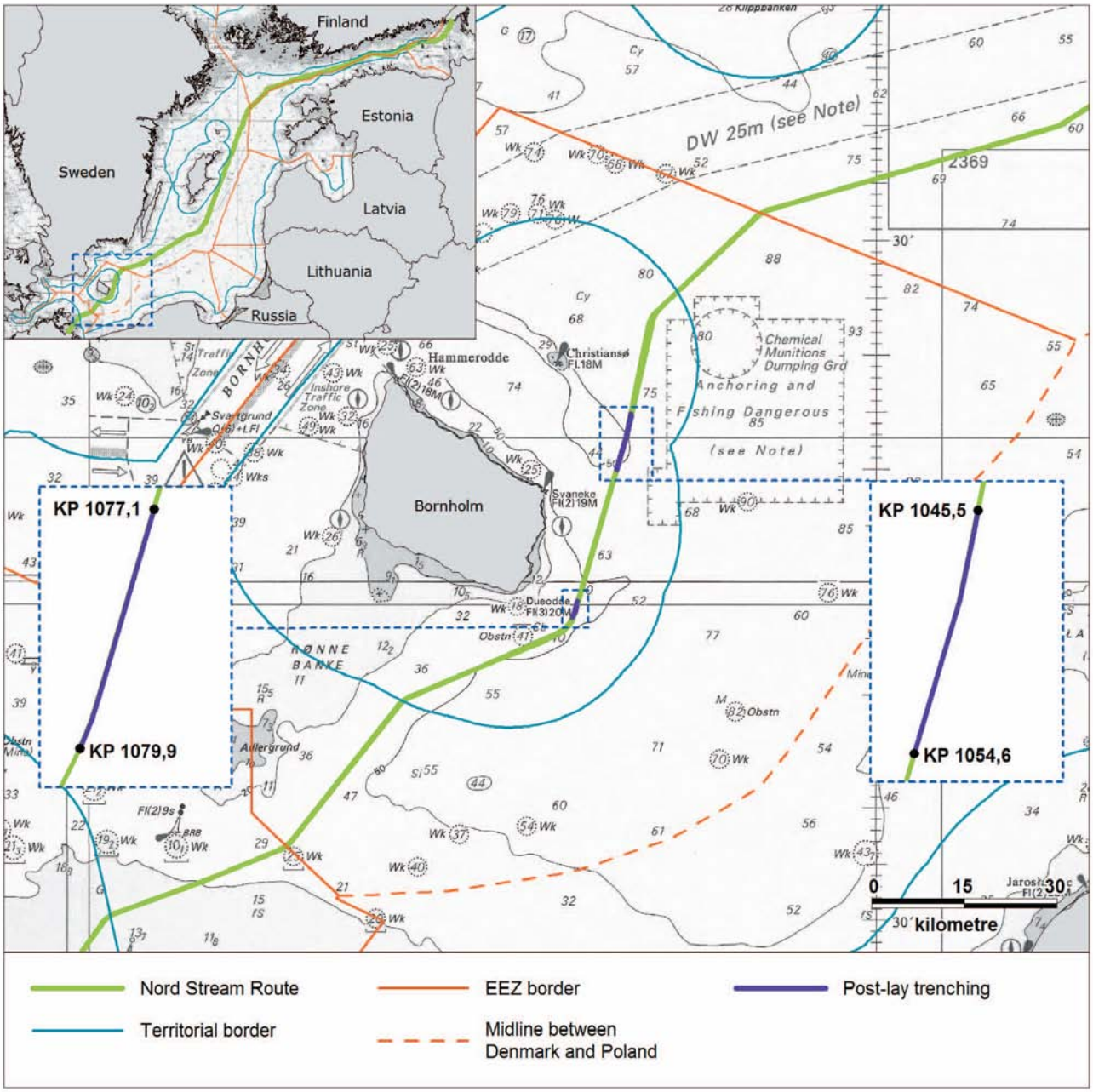

Figure 3.8 Sections with post-lay trenching in Denmark.

Trenching took place between 8 and 17 February 2011. Lowering of the pipeline onto the seabed using a plough ensures that the pipeline will remain stable in its position throughout its lifetime. Subsea ploughs work much in the same way as their land-based farming equivalents, except in this case the pipeline is passed through a pair of roller boxes in the body of the plough whilst the seabed is excavated as the plough advances. The PL3 plough raises the pipeline into its roller boxes using

hydraulic grabs, and is then towed by the vessel Far Samson, creating a trench of pre-determined length, depth and width into which the pipeline is laid as the plough progresses. Natural sediment movements from waves and currents will gradually backfill the ploughed trench. The PL3 plough used for the Nord Stream pipeline was towed by purpose-built vessel Far Samson. The Far Samson has a hybrid propulsion system and is extremely fuel efficient; its generator engines are equipped with catalytic converters which result in 95 percent NOx reduction.

3.4 Assistance from ADF/Bornholm Marine District and DEMA

Bornholm Marine District (BHM) is responsible for two main areas: Ship traffic surveillance and EOD (Explosive Ordnance Disposal) tasks. The EOD team comprises nine people and is the unit handling chemical warfare agents (CWA) finds in the Baltic Sea. They have a 24-hour call service, with three people on duty, ready to act in case of an emergency related to CWA chance finds.

Upon specific request, BHM agreed to assist Nord Stream during critical operations in the vicinity of the known chemical munitions areas. As a preventive measure BHM mobilised its munitions team and brought the team on board Nord Stream's operative units with the aim of assisting Nord Stream with visual inspection, consultancy and tracing of chemical munitions.

BHM assisted Nord Stream during the following events:

- Pipe Installation at Cable Crossing Locations
    - Three cables where crossed in the Danish section. Nord Stream considered it necessary to have BHM onboard the anchor handling tugs for the lifting of the anchors to deck, since they have been in contact with the seabed. The anchors are brought on deck when a cable is crossed to avoid potential damage of the cable by anchor-cable interaction.

    - Procedures for detection and cleaning of CWA were for a BHM team member to be placed on each of the three anchor handling tugs. The anchors were washed before brought to deck; hereafter BHM were able to detect potential warfare agents with a detection powder or paper.

- Abandonment & Recovery
    - The pipe had to be "abandoned" on the seabed several times (due to rough weather) and then had to be recovered back onto the vessel from the seabed. Nord Stream considered it necessary to have BHM onboard for the recovery operations, since the pipe head had been in contact with the seabed.

    - The procedures for detection and cleaning were to wash down the pipe head and stinger thoroughly and check for traces of warfare agents with detection powder or paper.

- Seabed intervention work (ploughing)
    - Two sections of the pipeline were ploughed in Danish waters. The ploughing sections are approximately 3 km and 9 km. Nord Stream considered it necessary to have BHM onboard the lay vessel during these operations as the plough is brought up onto the vessel's deck after each section is ploughed, thus having been in contact with the seabed.

- The following procedure was taken in action for cleaning of the plough: after ploughing of the first section (southern section) was completed the plough was recovered and washed thoroughly. When ploughing of the second section was completed the plough was brought to a sheltered place where DEMA (Danish Emergency Management Agency) performed a full cleaning of the plough before it left Danish waters for further work in Sweden.

No chemical warfare agents were detected under any of the construction works performed in Danish waters.

4 Environmental monitoring within the Danish territorial water and EEZ

This chapter briefly presents the environmental monitoring programme in Danish water and lists the monitoring activities undertaken in 2010.

4.1 Monitoring of fish along pipeline

4.1.1 Monitoring programme, purpose and period of monitoring

The monitoring programme for fish along the pipeline is described in /2/ and /5/, and is designed in alignment with a similar programme for the Swedish sector. The programme will be carried out before and after the establishment of the Nord Stream Pipeline.

The purpose of the monitoring module of fish along the pipelines is:

- To evaluate and document the qualitative and if possible the quantitative changes in the demersal fish communities in the area adjacent to the Nord Stream Pipeline, compared to the fish community of the surrounding seabed.

The aim of the monitoring programme is to investigate whether the presence of the pipelines lead to a so-called "reef effect"[2] and to determine the extent of changes in fish abundance and composition of species.

Fish monitoring is carried out at the following types of locations:

- Where the pipelines are established directly on the seabed
- Where trenching is carried out
- In five hotspot areas (identified by Danish fishermen)
- At four reference locations ≥1 km from the pipelines

Table 4.1 and Figure 4.1 show the locations of the fish monitoring areas. Investigations are undertaken in 9 areas (including reference areas/stations). Monitoring of fish along the pipeline will be undertaken once per year in September/October in the years 2010-2014.

Table 4.1 Monitoring areas for monitoring of fish along the pipeline in Denmark. The hotspot zones refer to areas of intensive bottom trawling.

Areas investigated	KP points
Pipelines laid directly on seabed	1010, 1120
Pipelines laid directly on seabed (hotspot)	1046, 1056, 1070, 1100, 1106
Pipelines trenched into the seabed by post-lay trenching	1050, 1078
Reference stations	1 km to the west of: KP 1010, KP 1120, KP 1050, KP 1078

[2] The hard structure of the pipeline creating new reef-like habitats.

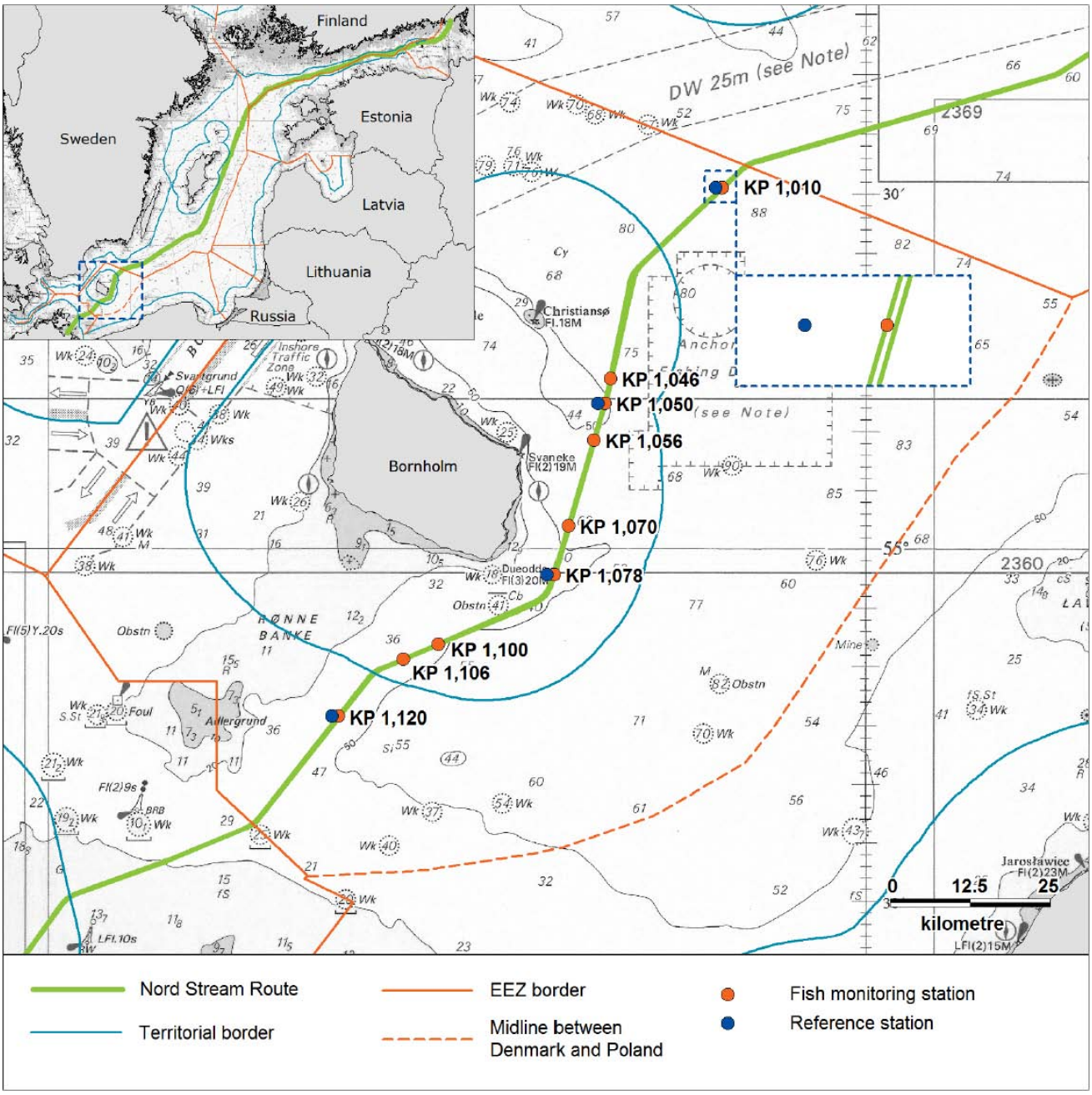

Figure 4.1 Areas for monitoring of fish along the pipeline in Denmark.

The monitoring of fish at and in the immediate vicinity of the pipelines is focused on demersal fish species, as no effects from the presence of the pipelines on the seabed are expected for pelagic fish species. In addition to survey trawl fishery (TV3-520 trawl) and gill net fishery (gill net type K072), echo-sounder measurements and visual inspections with a remotely operated vehicle (ROV) will also be carried out.

A summary of the monitoring programme for fish in Denmark is presented in Table 4.2.

Table 4.2 Summary of the monitoring programme for fish fauna along the pipeline in Denmark.

Fish in Denmark	
Monitoring of fish fauna along the pipeline	
Purpose	To evaluate and document the qualitative and if possible the quantitative changes in the fish community in the area adjacent to the Nord Stream Pipeline
Area to be monitored	At nine locations plus four reference locations along the pipeline inside the Danish sector
Activity to be monitored	Two stations at trenched section, two stations at section with pipeline on seabed, five stations at section with intense trawling activity and four reference stations
Method to be used	Fish investigations by survey trawl (TV-3 trawl) and echosounder. Video recordings of seabed and CTDO profiles inside trawled sections
Period of monitoring	September 2010-2014. If the preliminary results from the monitoring show that the impact is insignificant or negligible, suggested changes for subsequent monitoring activities are reported to the relevant authorities
Results	Documentation of changes in fish fauna along the pipelines compared with seabed without pipelines

4.1.2 Monitoring and results for 2010

Seven stations and two reference stations were sampled with bottom trawl and two stations and two reference stations were sampled with gill nets due to uneven seabed conditions and rocks, which made trawling difficult. Areas where the pipeline is established on the seabed were therefore surveyed with trawl and areas where the pipeline is trenched were surveyed with gill net.

Areas where the pipeline is established on the seabed (survey conducted with trawl)
The fish assemblages, based on catches in bottom trawl were strongly dominated by Cod and Herring. The statistical analysis showed no significant differences in fish assemblages for biomass or abundance between impact and reference stations at KP 1010 or between impact and reference stations at KP 1120. However, the analysis of the results showed significant spatial differences in fish assemblages between KP 1010 and KP 1120. Especially significant were differences in catches of Cod, Herring and Flounder between these two locations. Moreover, at KP 1010 only three different fish species were caught, whereas a total of twelve different fish species were registered at KP 1120. This variation could be due to differences in the marine environment. The bottom substrates at KP 1010 is made up by very soft clay and the water depth ranges between 69 and 83 m whilst at KP 1120 the bottom substrates is made up by silt and fine sand with water depths varying from 42 to 45 m. This is an important aspect since presence of many fish species is known to be influenced by bottom substrates. Moreover, the presence of demersal fishes is determined by the abiotic factors in the water body. At KP 1010 the oxygen concentrations in the bottom water were below 2 ml/l, hence at levels of hypoxia. This could have caused avoidance of fish from the area resulting in low catches compared with catches of fish at KP 1120, which had bottom water with oxygen levels above hypoxia.

The length distribution for Cod at KP 1010 differed slightly at impact and reference stations. The share of small Cod individuals below commercial fishing size (38 cm) was 55% at impact stations compared to 40% at reference stations. However, at KP 1010 measurements of abiotic factors

showed similar results at impact and reference stations. Hence, the observed difference in size of Cod between reference and impact stations may be due to a random variation in population distribution. At KP 1120 the Cod population was mainly made up by individuals below the size limit for commercial fishing. The length distribution was similar at impact and reference stations. Small individuals of Cod also dominated the catches at KP 1046, KP 1056, KP 1070 and KP 1100. The length distributions for Herring were similar at impact and reference stations at KP 1010 and KP 1120. Noticeably, the amount of individuals of Cod and Herring at KP 1010 are low, making a comparison between impact and reference stations uncertain.

Regarding length distribution and weight-length relationships for Cod and Herring at KP 1010, the amounts of individuals caught were low making comparison between reference and impact stations uncertain. Hence, comparisons between impact and reference stations should be done with caution in subsequent years of sampling. The length distribution and weight-length relationships for Cod and Herring at KP 1120 reference stations are considered reliable references for KP 1120 impact stations in subsequent years of sampling.

Results from the five stations which do not have a reference station will be included in the statistical analysis of the coming year.

Areas where the pipeline is trenched (survey conducted with gill net)
The fish assemblages based upon catches in gill nets at KP 1050 and KP 1078 impact and reference stations were strongly dominated by Cod, followed by Plaice, Flounder, Three-bearded rockling and Herring. The results showed no significant spatial differences in composition of fish within the studied area, indicating homogenous fish assemblages at KP 1050 and KP 1078 impact and reference stations.

The marine environments at KP 1050 and KP 1078 are very similar. The bottom substrates consist of similar coarse sediments at both KP 1050 and KP 1078. The abiotic factors measured at the two locations were also identical, with the exception of salinity levels close to the bottom, which was somewhat higher at KP 1078 compared to KP 1050. Nonetheless, the difference in salinity was not so evident that it would affect the fish assemblage in a significant way between stations at KP 1050 and KP 1078. Levels of hypoxia (O_2<2ml/l), which can affect the distribution of fish populations, were not observed at this location.

The length distributions and individual weight-length relationships of Cod were similar at KP 1050 impact and reference stations. Length distribution was characterised by a majority of Cod below the size limit for commercial Cod fishing in the Baltic Sea. At KP 1078 impact stations the majority of Cod was commercially adequate, while at KP 1078 reference stations the population was more evenly distributed between individuals with commercially adequate (45%) and none adequate (55%) body length, respectively. The weight-length relationship of Cod was also generally steeper at KP 1078 impact stations, compared to KP 1078 reference stations.

The differences between impact and reference stations at KP 1078, regarding individual size of Cod, may be due to a spatial effect in the sampled area. However, the measurements of abiotic factors (e.g. bottom substrates, depth, temperature etc.) showed similar results at impact and reference stations and do not indicate that a spatial effect on fish assemblage would exist. Hence, differences

in Cod size between KP 1078 impact and reference stations could be due to a random variation in population distribution.

The results from the gill net fishing show that KP 1050 and KP 1078 reference stations are representative references for both KP 1050 and KP 1078 impact stations in terms of fish assemblage. Concerning individual length distribution and weight-length relationships, KP 1050 reference stations are assessed to be reliable references for KP 1050 impact stations. However, differences between KP 1078 impact and reference stations for Cod length distribution and individual weight-length relationship has to be taken into account in the impact assessments made in the coming years.

4.2 Monitoring of benthic fauna

4.2.1 Monitoring programme, purpose and period of monitoring

The monitoring programme for benthic fauna to be undertaken once every year is described in /2/, /5/ and /9/. Monitoring of infauna will be carried out before and after establishment of the Nord Stream Pipeline on the seabed, while monitoring of epifauna will start after the first pipeline has been installed on the seabed. Monitoring of the benthic fauna includes:

- Infauna investigations: Once per year in June/July from 2010-2013
- Epifauna investigations: Once per year in September/October from 2011-2014

The purpose of the monitoring programme for benthic fauna is:

- To evaluate and document re-colonization and recovery of the infauna changes around the pipelines after their installation
- To evaluate and document the establishment and growth of epifauna on the pipelines

Infauna
The monitoring areas for benthic infauna are shown in Figure 4.2. The benthic infauna stations are located in areas where trenching is planned, and where the most pronounced effects from sediment dispersion and re-sedimentation due to trenching can be expected. The three planned benthic infauna transects (B10, B11, B29) are located perpendicular to the Nord Stream Pipeline. There are 15 stations at each transect. At each station three Van Veen grab samples are collected along with one core sample for analysis of physical and chemical properties of the seabed sediment.

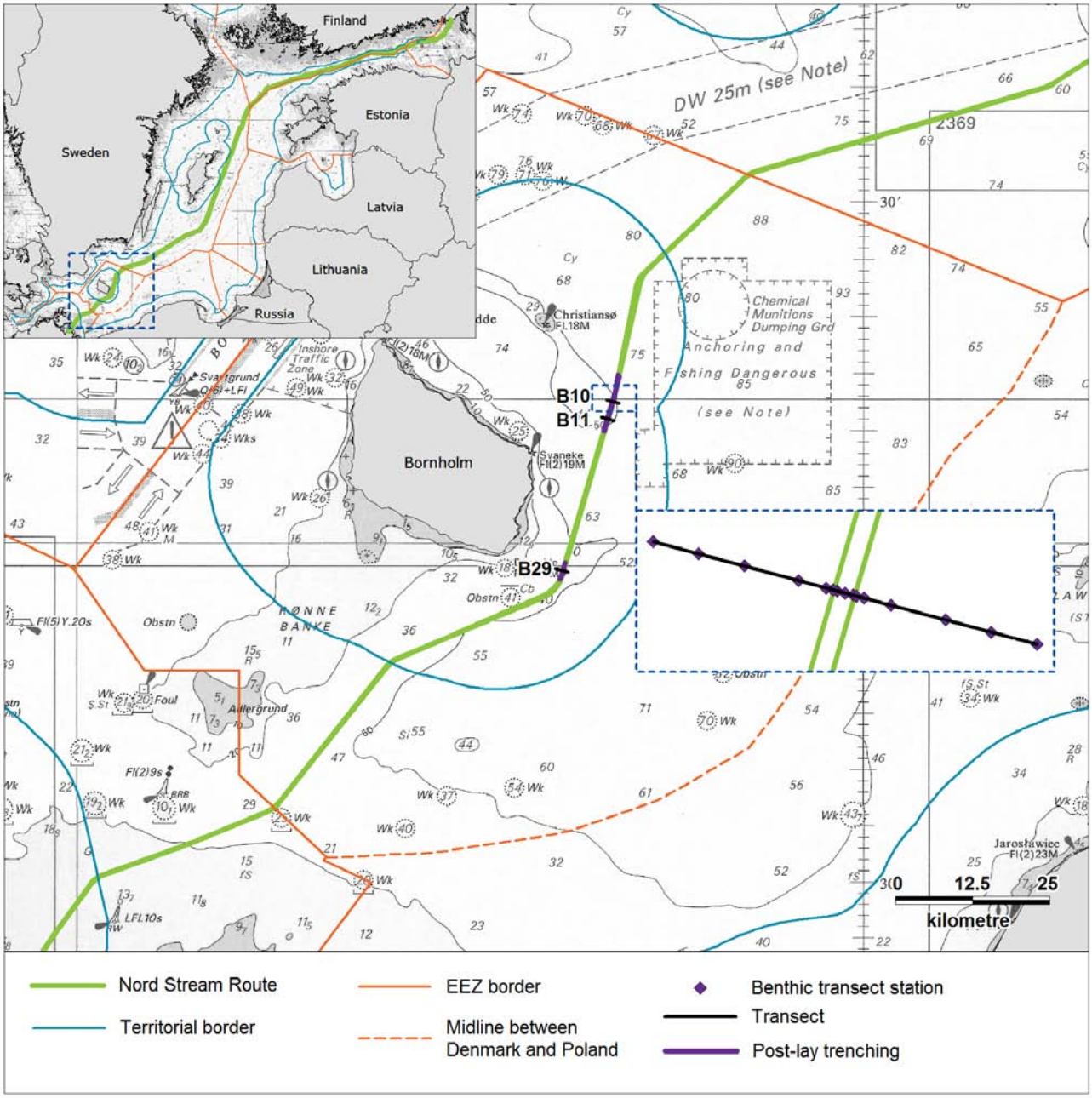

Figure 4.2 Monitoring stations for infauna in Denmark. Sampling along transect B29 proved to be impossible due to a hard and stony seabed.

A summary of the monitoring programme for infauna in Denmark is presented in Table 4.3.

Table 4.3 Summary of the monitoring programme for infauna in Denmark.

Benthic fauna in Denmark	
Monitoring of infauna	
Purpose	To evaluate and document effects on and recovery of the infauna
Area to be monitored	Three transects where post-lay trenching is carried out
Activity to be monitored	Trenching
Method to be used	Infauna investigations by Van Veen grab sampler. Sediment analyses: grain size, dry matter, loss of ignition, total organic carbon at all stations. Water measurements: CTDO profiles at all stations. Visual inspections by video mounted on ROV at all stations
Period of monitoring	June/July 2010-2013
Results	Description of re-colonisation/recovery of infauna

Epifauna

Inspection of colonisation and growth of epifauna on the pipelines will be undertaken by visual inspections of the pipeline structures in areas with relatively shallow depths. Visual inspections are planned at nine locations as shown in Figure 4.3, in which the growth of benthic epifauna will be described and evaluated.

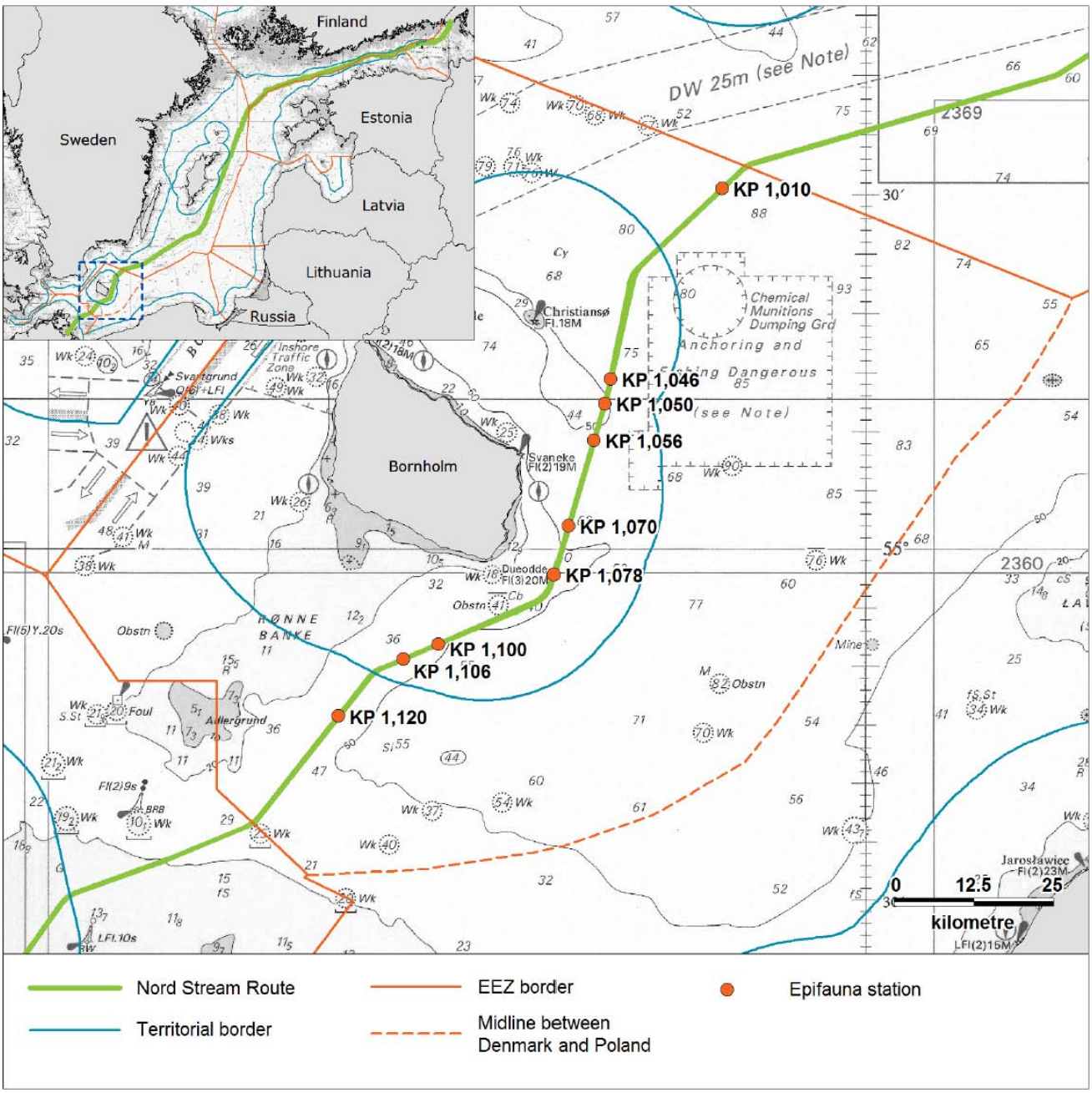

Figure 4.3 Areas for monitoring of benthic epifauna in Danish waters.

A summary of the monitoring programme for epifauna in Denmark is presented in Table 4.4.

Table 4.4 Summary of the monitoring programme for establishment and growth of epifauna on pipelines in Denmark.

Benthic flora and fauna in Denmark	
Monitoring of establishment and growth of epifauna on the pipelines	
Purpose	To evaluate and document the establishment and growth of epifauna on the pipelines
Area to be monitored	At nine stations along the pipeline inside the Danish sector
Activity to be monitored	Two stations at trenched sections, one section where the pipeline is on the seabed and six stations in areas where intense bottom trawling takes place
Method to be used	Monitoring along the pipeline by a video mounted on ROV
Period of monitoring	September/October 2011-2014
Results	Description of establishment and growth of epifauna on pipelines

Since monitoring of the establishment and growth of epifauna on the pipeline only begins in 2011 it shall not be explained further in this report.

4.2.2 Monitoring and results for 2010

The field surveys were carried out in the period 19 to 26 July 2010. The monitoring has established a baseline for similar surveys planned in 2011-2013 with the overall objective to enable assessments of impacts on the benthic infauna and the seabed due to the construction of the pipelines.

The results of the surveys showed that there were no spatial gradient in abundance and biomass along the two surveyed transects. The results of classification and ordination based on abundance and biomass were fundamentally the same and showed that the benthic community along transect B10 and transect B11 was dominated by the same species. However, a comparison of the benthic community showed significant dissimilarities along the two transects due to differences in abundance and biomass of the dominant species. The main differences were a dominance of the bivalve[3] *Astarte borealis* along the deeper transect B10 and a dominance of the bivalve *Macoma balthica* and the polychaete[4] *Pygospio elegans* along the shallower transect B11. Other characteristic species along the transects were the polychaetes *Scoloplos armiger* and *Bylgides sarsi*, the common mussel *Mytilus edulis*, the crustaceans[5] *Diastylis rathkei* and *Diastylis lucifera* and the pripulid *Halicryptus spinulosus*.

Comparison of the average data from transect B10 and transect B11, respectively, with data from the stations closest to the area where the survey was conducted in 2008 (station B10 and station B11, respectively) revealed large spatial and inter-annual variations in species composition, abundance and biomass even within the same area.

[3] Clams
[4] Bristleworms
[5] Including e.g. crabs, lobsters, crayfish, shrimp, krill and barnacles

A short summary of the results from the two surveyed transects is given below. For more details on the expected effects of construction and operation, the monitoring programme, materials and methods used during the survey and the results please refer to /5/.

Sampling along transect B29 proved to be impossible due to hard and stony seabed conditions. Nord Stream therefore suggest to cancel transect B29 for future monitoring.

Transect B10

Twenty species and two higher taxa (Oligochaeta and Nemertina) were recorded in the 45 samples taken along transect B10. The sampling program is regarded as being adequate to represent most of the species present in this rather low diversity benthic community east of Bornholm. The average number of species at the stations was 8 per 0.1 m^2 and the range at the stations was between 6 and 10 species per 0.1 m^2. There was no obvious spatial gradient in the number of species along the transect. In rounded values, the average abundance of the benthic fauna at the monitoring stations was 780 individuals per m^2 and the average biomass was 4.3 g ash free dry weight (g AFDW) per m^2. The range in average abundance was between 250 and 1510 individuals per m^2. The abundance was highest and above 800 to 1000 individuals per m^2 at a number of stations in the middle of transect B10, but a pronounced spatial gradient was not observed. There was a pronounced range in benthic biomass between 0.32 and 8.07 g AFDW per m^2 but there was no systematic spatial change in benthic biomass from west to east.

Four species of bivalves (*Astarte borealis, Astarte montagui, Mytilus edulis* and *Macoma balthica*) accounted for 66% of the benthic abundance and 96% of the biomass. *Astarte borealis* was by far the most common species and accounted for 32% of the abundance and 89% of the benthic biomass. The population of *Astarte borealis* was dominated by individuals with a shell length around 10 mm. Both smaller and younger and larger and older bivalves were less common. *Astarte montagui* was scarce and the abundance and biomass was low. The shell length of most individuals was between 10 mm and 13 mm. The common mussel (*Mytilus edulis*) was the most abundant species and accounted for 32% of the benthic abundance. However, most of the mussels were young recruits with a shell length below 5 mm and the species contributed only 4% to the benthic biomass. The Baltic Tellin *Macoma balthica* was rather abundant (between 35 and 40 individuals per m^2) at the two most western stations, but the abundance was low or the species was absent at the remaining stations. The species contributed 1-2% to the benthic abundance and biomass. The population consisted both of young recruits and older bivalves.

The polychaetes accounted for 24% of the benthic abundance and 1.9% of the biomass. *Scoloplos armiger* was the most abundant species. The abundance was between 60 and 183 individuals per m^2. The semi-pelagic *Bylgides sarsi* was also present at all stations. The abundance was below 40 individuals per m^2 at most stations and highest (133 individuals per m^2) at the station in the middle of the transect. The distribution of the sedentary tube building *Pygospio elegans* was patchy with a relatively high abundance (approximately 70 individuals per m^2 and 100 individuals per m^2) at two stations. The species was absent at four stations including the three easternmost stations and the abundance was low at the remaining stations.

Crustacean was the most diverse taxonomic group with 9 species, but it only contributed 5.6% to the benthic abundance and 0.78% of the biomass. The most common and abundant species were the

cumaceans *Diastylis rathkei* and *Diastylis lucifera*. The large isopod *Saduria entomon* was recorded at a few stations, but the abundance and biomass was low.

Unidentified species of Nemertina were recorded at all stations, but in low abundance and the taxonomic group contributed less than 1% to the biomass. The Pripulid *Halicryptus spinulosus* was recorded at all stations and mostly in abundances above 10 individuals per m^2. No spatial gradient in abundance or biomass was observed.

Transect B11
Eighteen species and two higher taxa (Oligochaeta and Nemertina) were recorded in the 45 samples along transect B11 and the sampling program is regarded as adequate to represent most of the species present in this rather low diversity benthic community east of Bornholm.

The average number of species at the stations was eight species per 0.1 m^2 and the range was between seven and 16 species per 0.1 m^2. Generally, the number of species was highest at stations in the central part of transect B11. In rounded values, the average abundance and biomass of benthic fauna at the monitoring stations was 570 individuals per m^2 and 1.0 g AFDW per m^2, respectively. The range in average abundance was between 330 and 960 individuals per m^2. The abundance appears to be highest at the central stations. The range in benthic biomass was between 0.5 g and 2.6 g AFDW per m^2 and the biomass was lowest at the central stations. The spatial trend in biomass seems to be the opposite of the spatial changes in number of species and benthic abundance, which generally were highest at the central stations.

Four species of bivalves (*Macoma balthica, Mytilus edulis, Astarte borealis* and *Astarte montagui*) accounted for 34% of the benthic abundance and 82% of the biomass. The Baltic Tellin *Macoma balthica* was present at all stations and accounted for 48% of the benthic biomass. Generally, the abundance was highest at the western stations and the density appeared to decrease from west to east. The population consisted both of young recruits (<5 mm) and older bivalves with a shell length around 13 mm. The common mussel (*Mytilus edulis*) was the most abundant species and accounted for 26% of the benthic abundance. However, most of the mussels were young recruits with a shell length below 5 mm and the species contributed with just 4% to the benthic biomass. Common mussels were most abundant in the western and eastern part of the transect. *Astarte borealis* was only recorded at the four eastern stations. The species, which only accounted for less than 3% of the abundance, contributed 25% to the biomass due to the size of the species. The population was dominated by individuals around 11 mm and young recruits below 5 mm were scarce. Only two specimens of *Astarte montagui* were recorded.

The polychaetes accounted for 52% of the benthic abundance and 11% of the biomass. *Scoloplos armiger* was the most abundant species. The abundance was between 30 and 240 individuals per m^2. The sedentary tube building *Pygospio elegans* was recorded at all stations but the abundance was mostly below 100 individuals per m^2. Other species of polychaetes were scarce and the abundance was mostly low. Only one individual of the newly introduced species *Marenzelleria viridis* was recorded. Unidentified species of oligochaetes were only recorded at five stations and in very low numbers.

The crustacean accounted for 8% of the benthic abundance and 3.1% of the biomass. The most common and abundant species were the cumacean *Diastylis rathkei* and *Diastylis lucifera*. The two species were present at most stations but the abundance and especially the biomass of *Diastylis rathkei* was much larger than the biomass of *Diastylis lucifera*. The other species of crustaceans including the large isopod *Saduria entomon* were scarce and the abundance was low.

Unidentified species of Nemertina were recorded at all stations, except one. However, the abundance was low and the species contributed less than 2% to the abundance and biomass of the benthic fauna. The Pripulid *Halicryptus spinulosus* was recorded at all stations and the species accounted for 5% of the abundance and 3% of the biomass. No spatial gradient in abundance and biomass was observed.

4.3 Monitoring of water quality

4.3.1 Monitoring programme, purpose and period of monitoring

During trenching, sediments will be mobilised as suspended sediments and these will subsequently settle to the seabed. As shown in /3/, the sediments are only expected to impact the area close to the trenching location, and only during a short period of time. Thus, no significant environmental impact (except in the construction area) is expected from this activity.

Ship-based monitoring will be carried out as campaigns during the periods of trenching of the first pipeline (see Table 4.5). The purpose of the monitoring is to verify the modelling results with respect to the order of magnitude of the concentration of suspended sediments caused by the trenching activities.

During up to 4 days of trenching (depending on the speed of progress), profiles of turbidity, salinity, water temperature and currents will be measured from a vessel. The profiles will be measured downstream of the trenching activities, aiming at determining the maximum sediment concentrations downstream of the work area. Measurements will also be carried out upstream of the work area, in order to establish the natural background sediment concentration, which should be subtracted from the measured concentrations downstream of the trenching area to establish the contribution of the trenching works.

Water samples for subsequent laboratory analysis will be collected during the monitoring campaign in order to make it possible to convert the measured turbidity values to mass concentration of suspended sediments.

The monitoring of suspended sediment during construction is detailed in /3/.

Table 4.5 Monitoring programme for mobilised sediments.

Monitoring of spilled sediment					
Activity	**Parameter**	**Unit**	**Method**	**Location**	**Timing**
Trenching	Concentration of suspended sediment	mg/l	Water sampling, turbidity meter. CTD-probe[1] ADCP[2]	At transects along trenching sections of the pipeline route	3-4 days during trenching
	Turbidity	NTU			
	Water temperature	^{0}C			
	Salinity	‰			
	Current velocity	m/s			
	Current direction	degrees			
1: Conductivity, Temperature and Depth. 2: Acoustic Doppler Current Profiler.					

4.3.2 Monitoring and results for 2010

No monitoring of water quality took place in Danish waters as part of the Nord Stream monitoring programme in 2010, as trenching of the first pipeline was not conducted until early 2011.

4.4 Monitoring of hydrographic conditions in the Bornholm Basin

4.4.1 Monitoring programme, purpose and period of monitoring

The purpose of the hydrographic monitoring programme in Danish and Swedish waters is:

- To establish documentation for the theoretical analysis of the possible blocking of the water inflow to the Baltic Sea caused by the presence of the Nord Stream Pipeline as reported in /10/.

The saltwater inflows from the Kattegat are sporadic and ecologically important. Concerns have been raised in relation to the influence of the pipelines on the inflow of high-salinity bottom water through the Bornholm Basin. In response, Nord Stream carried out an extensive study to address the issue /10/. The study concluded that the impact of the pipelines on the inflow of high-saline bottom water in the Baltic Proper will be negligible.

During the Swedish public consultation process, questions were raised as to whether existing knowledge and data would be sufficient for an exhaustive description of the problem. Consequently, Nord Stream decided to establish a hydrographic monitoring programme in collaboration with the relevant authorities.

The purpose of the hydrographic monitoring programme is to investigate the influence of the pipelines on the inflowing, high-saline deepwater in the Bornholm Basin. It was assessed that it is impossible to directly monitor the effect of the presence of the pipelines, due to the natural variability being several orders of magnitude higher than a possible local effect. The scope, therefore, is

focused on verifying the assumptions for the previous investigations by SMHI in their consulting report /10/.

Hydrographic measurements were planned in 2010 and 2013 respectively. Field investigations before construction lasted approximately one year (commenced 21 January 2010 and ended 11 January 2011). The measurements aim to describe the bottom currents, interfacial friction and dissipation of inflow waters. Oceanographic measurements (velocity, temperature, salinity) were carried out initially during a period of 9 months (including an approx. 1 month down period) at KP 1036 northeast of Bornholm at a water depth of approximately 90 m. The location was selected in mutual understanding with SMHI and the fishermen's organisation on Bornholm. In autumn 2010 the measuring station was moved to KP 966 in Swedish waters in order to also obtain measurements from the halocline level at shallower water depths (approximately 68 m). The two locations of the monitoring station are presented in Figure 4.4.

In addition to the fixed station, line transects of currents have been carried out by ADCP. The line transects done in 2010 were carried out along the pipeline route between KP 1030 and KP 1070. A total of 7 transects were planned in relation to each service inspection (incl. mobilisation and demobilization). By the end of 2010 four successful line transects had been carried out. The reduction in the number of transects is mainly due to the weather conditions during the service cruises.

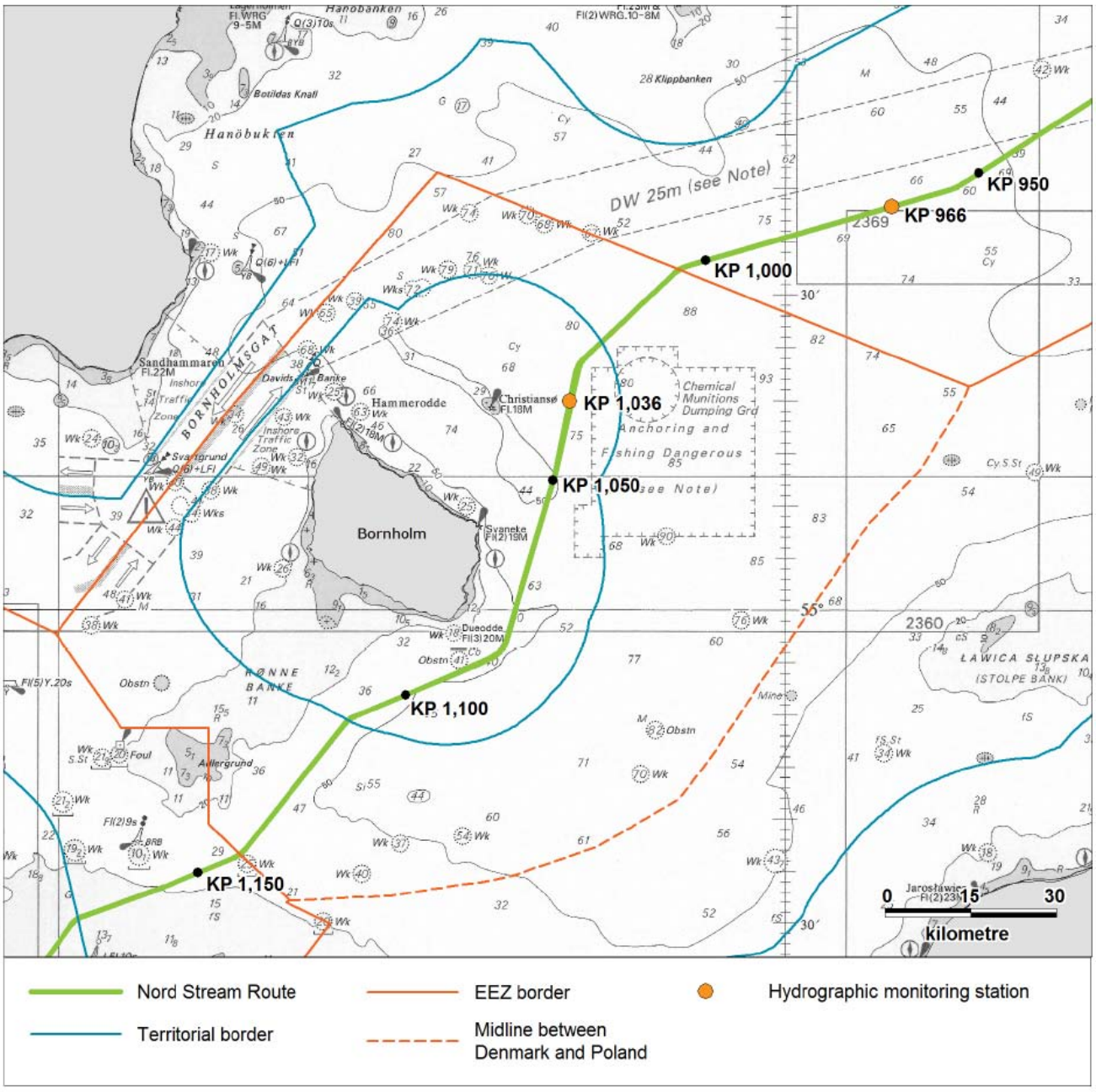

Figure 4.4 Location of the hydrographic monitoring station in Denmark and Sweden. The station was originally deployed near KP 1036. In November 2010 it was moved to shallower water at KP 966.

Table 4.6 Summary of the hydrographic monitoring programme in Denmark and Sweden.

Hydrography in Denmark/Sweden	
Monitoring of water inflow	
Purpose	Description of bottom currents, interfacial friction and dissipation of inflow waters. Evaluation of changes caused by the Nord Stream Pipeline
Area to be monitored	Transects at the pipeline route between KP 1030 and KP 1070 in the Bornholm Basin. The measuring station was positioned at KP 1036 in Danish water and at KP 966 in Swedish water
Activity to be monitored	Presence of the pipelines on the seabed
Method to be used	ADCP, CTD (fixed station). Ship mounted ADCP (line transects)
Period of monitoring	Continuous measurement for one year (2010) before construction and after the pipelines have entered into operation (2013)
Results	Documentation of effects from the pipeline on inflowing saline/oxygenated bottom water from the Danish straits

4.4.2 Monitoring and results for 2010

Fixed monitoring station

The fixed monitoring station was installed at KP 1036 on 21 January 2010. The station was retrieved from this location on 11 October 2010. It was trawled up on 7 March 2010 and redeployed on 8 April 2010. No data was consequently compiled during this period. The equipment was moved to a new position at KP 966 on 5 November 2010 and retrieved on 11 January 2011.

Table 4.7 Monitoring activity and data availability for fixed stations of the 2010 hydrographic monitoring campaign.

Date	Activity	Monitoring location	Data available
22.01.2010 – 07.03.2010	Measuring	KP 1036	Yes
07.03.2010 – 08.04.2010	Trawled up	KP 1036	-
08.04.2010 – 11.10.2010	Measuring	KP 1036	Yes
11.10.2010	Retrieved	KP 1036	-
05.11.2010 – 11.01.2011	Measuring	KP 966	Yes
11.01.2011	Retrieved	KP 966	-

Data from the ADCP instrument (Aquadopp) from 12 m depth to the bottom is absent in the following three periods: 30.04.2010-16.06.2010, 22.08.2010-31.08.2010 and 17.09.2010-11.10.2010. In the first case it appears to be due to unstable power supply since internal cabling has been changed in

the subsequent service. In the second case data is classified as “unvalidated”, and in the latter case, it is due to battery failure.

Salinity and temperature data from the mooring and from CTD sections are generally of a very high quality. In the ADCP data from the mooring, some levels have excessive noise levels and have been disregarded. This is mostly due to known effects, such as reflection from the bottom, blanking distance from the instrument and disturbances from sharp interfaces (the density interface above the mixed bottom layer).

Line transects
Line transects for monitoring of currents with ADCP have been carried out. Each line transect is carried out at the pipeline route over a 40 km distance between KP 1030 to KP 1070. By the end of 2010 the following 4 line transects have been carried out as summarised in Table 4.8.

Table 4.8 Monitoring activity and data availability for line transects of the 2010 hydrographic monitoring campaign.

Date	Transect ID	Data
16.02.2010	T1	Yes, but noisy
17.03.2010	T2	Yes
16.06.2010	T3	Yes
01.09.2010	T4	Yes

Transect T1 is of lower quality, in part due to cold water and low particle content, a known problem for acoustic instruments.

An extra fifth line transect is planned to be carried out during April 2011. This line transect will be extended towards the northeast to cover the fixed monitoring position at KP 966. The length of the line transect will be 130 km from KP 1070 to KP 940 to ensure coverage of both positions.

Preliminary results
CTD stations show a 40-45 m mixed surface layer. Beneath the pycnocline (45-70 m depth), one or two relatively well-defined layers may be found. Temperature gradients form in the surface layer during spring and summer.

In the beginning of 2010, temperature at the surface was colder than at the bottom. Events where colder water penetrated from mid- to deeper layers occurred from mid-February, and in April, May and to a lesser extent also in the beginning of June. Most of these events resulted in a lowering of salinity. Stable conditions lasted throughout summer. On 5-6 October, warmer and saltier water penetrated all the way to the bottom and 15 m above the seabed. This is in accordance with observations of higher oxygen levels at the bottom at the monitoring station BY4 in the beginning of October.

Current velocities at the bottom vary between 0-0.2 m/s and between 0-0.5 m/s 30-50 m above the seabed. Some of the cold water penetrating downward can be associated with higher velocities. There is no obvious pattern with respect to the direction of the current.

Unfortunately, the bottom ADCP data is absent during the period of saline inflow. No signal is found in the AWAC data facing up, however, this instrument was situated above the inflow. Figure 4.5 shows a current rose from the bottom cell (2 m above the seabed) based on all data between January and October 2010. Data have been averaged to remove noise.

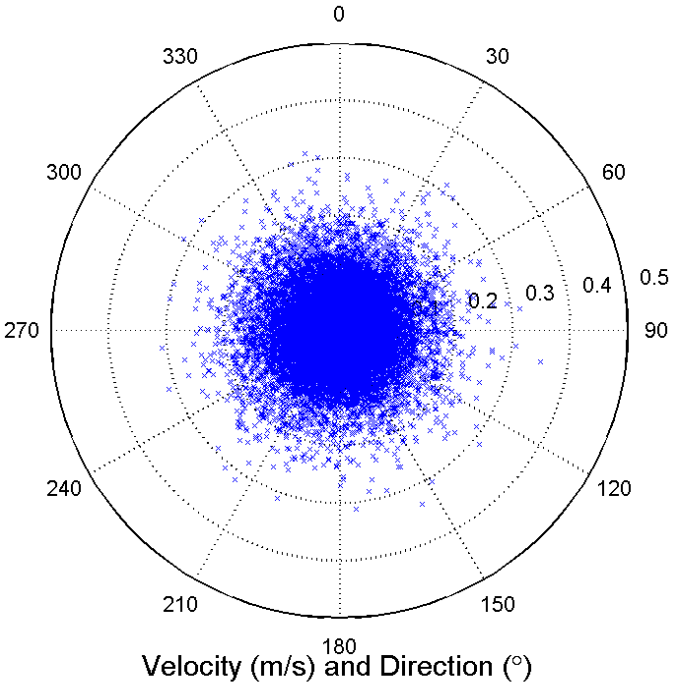

Figure 4.5 Current rose diagram, January to October 2010, 2 m above seabed at the fixed monitoring station, KP 1036.

Post-processing of data was initiated end of 2010. Current data were filtered using a Butterworth filter of the same length as the inertial frequency (>14 h) to remove noise. Certain data displayed very high noise levels, some of which are related to bottom effects or the presence of a sharp density interface. To avoid confusion, these data are removed from the data set before plotting.

Since the last raw data was retrieved in January 2011 the post-processing is still ongoing. The data will form the source for evaluation of the basis for /10/. The evaluation will include an assessment of the validity of the conclusion in /10/.

The results of the monitoring will be documented in a separate report, when the data has been analysed.

5 Socio-economic monitoring within the Danish territorial water and EEZ

5.1 Monitoring of cultural heritage

5.1.1 Monitoring programme, purpose and period of monitoring

The purpose of the cultural heritage monitoring programme in Denmark is:

- To verify that construction in the vicinity of wrecks of cultural heritage significance has proceeded as planned

Verification that the construction has proceeded as planned
In Denmark, the detailed surveys that Nord Stream conducted prior to installation have led to the discovery of a number of wrecks and cultural heritage sites east and south of Bornholm. On behalf of the Heritage Agency of Denmark, the Viking Ship Museum assessed these cultural heritage sites and it was agreed that 27 protection zones of a 200 m radius were established around cultural heritage locations during pipeline installation in Danish waters for the first pipeline. These zones ensured that the cultural heritage objects were not affected by pipeline installation and anchor handling.

In collaboration with the Danish authorities, Nord Stream has agreed on an environmental monitoring programme for Denmark. As a part of the programme, monitoring of the two wrecks located closest to the Nord Stream Pipeline has been included (see Figure 5.1).

The wrecks have been designated as:

- S-DK1-2-36-4472 – Wooden wreck, collapsed. The debris area is approximately 28 m long. The wreck is situated closest to the northwest pipeline.
- S-S33-3802 – Iron wreck, approximately 42 m long. The wreck is situated closest to the southeast pipeline.

The wreck monitoring is carried out as visual inspection using an ROV before and after pipeline installation. The inspections serve to evaluate whether damage has occurred to the wrecks during pipeline installation and whether the presence of the pipelines causes enhanced erosion around the wrecks. The pre-lay monitoring wreck inspections were performed 21 and 25-26 October 2010 and the post-lay monitoring was carried out 2 November 2010 and 14 January 2011.

The wreck monitoring is planned to be repeated before and after installation of the second pipeline in 2011-2012. Monitoring will be carried out again in 2014 and 2016 to verify that no erosion has taken place around the wrecks as a result of the pipelines being present on the seabed. Erosion patterns may be altered slightly due to local changes in the current in the areas where the pipelines are placed directly on the seabed. If no erosion can be detected after three inspections, the inspections will be suspended.

It has been agreed that if other cultural heritage objects are identified during the pipe-laying and anchor-handling operations, the Heritage Agency of Denmark will be notified immediately.

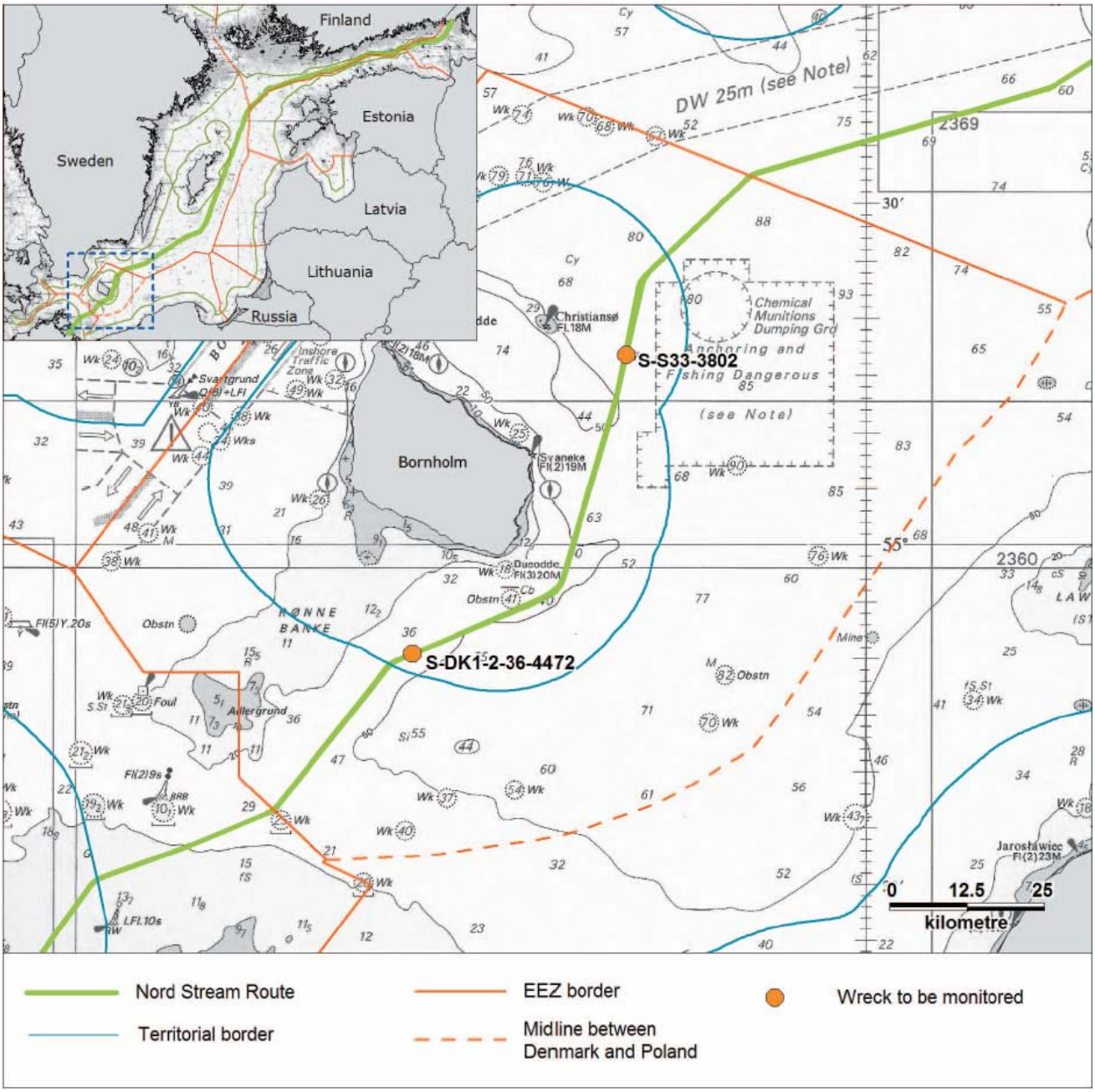

Figure 5.1 Cultural heritage monitored in Denmark.

Table 5.1 Summary of the monitoring programme for cultural heritage in Denmark.

Cultural heritage in Denmark	
Monitoring of cultural heritage objects	
Purpose	To evaluate and document that the identified wrecks have not been damaged, and that the presence of the pipelines does not cause enhanced erosion around the wrecks
Area to be monitored	Selected wrecks of cultural heritage
Activity to be monitored	Construction of the pipeline
Method to be used	Visual inspection by ROV
Period of monitoring	Inspections carried out before and after completion of the pipelines. Further inspections carried out in 2014 and in 2016. If no erosion is detected after three inspections, the inspections will be suspended
Results	Video recordings

5.1.2 Monitoring and results for 2010

In accordance with the construction permit requirements for cultural heritage, the safety zone restrictions around the 27 cultural heritage locations were established and respected during installation of the first pipeline in Danish waters during October-December 2010. When the pipeline was installed next to the wooden wreck S-DK 1-2-36-4472, two representatives from the Viking Ship Museum were onboard the lay vessel to control, that laying procedures around the wreck were followed. The pipeline was installed successfully without any interference with the wreck.

Wreck monitoring before and after installation of the first pipeline was conducted in autumn/winter 2010/2011. The results of the surveys showed that no damage or disturbance had occurred to cultural heritage sites during construction activities of the first pipeline.

Installation of Line 2 shall commence in the last quarter of 2011. Before and after installation of Line 2, pre- and post-lay monitoring of cultural heritage shall be conducted in Denmark. Additionally monitoring shall be repeated in 2014 and 2016 to verify that no erosion has taken place around the wrecks as a result of the pipelines being present on the seabed.

5.2 Monitoring of munitions

5.2.1 Monitoring programme, purpose and period of monitoring

The purpose of the chemical munitions monitoring programme in Denmark is:

- To validate the integrity of the five chemical munitions objects identified before the start of construction

The Nord Stream Pipeline passes close to the chemical dumpsite east of Bornholm in Denmark and there has therefore been a special focus on this area related to the EIA process. Five chemical munitions objects were identified in Danish waters during munitions screening surveys, see Figure 5.2. The munitions are located at a distance of 7.1-17.1 m from the pipelines. The integrity of the five munitions objects is documented before and upon completion of the construction works by visual inspection of the objects.

A summary of the monitoring programme for validation of the integrity of the five chemical munitions objects identified in Denmark is presented in Table 5.2.

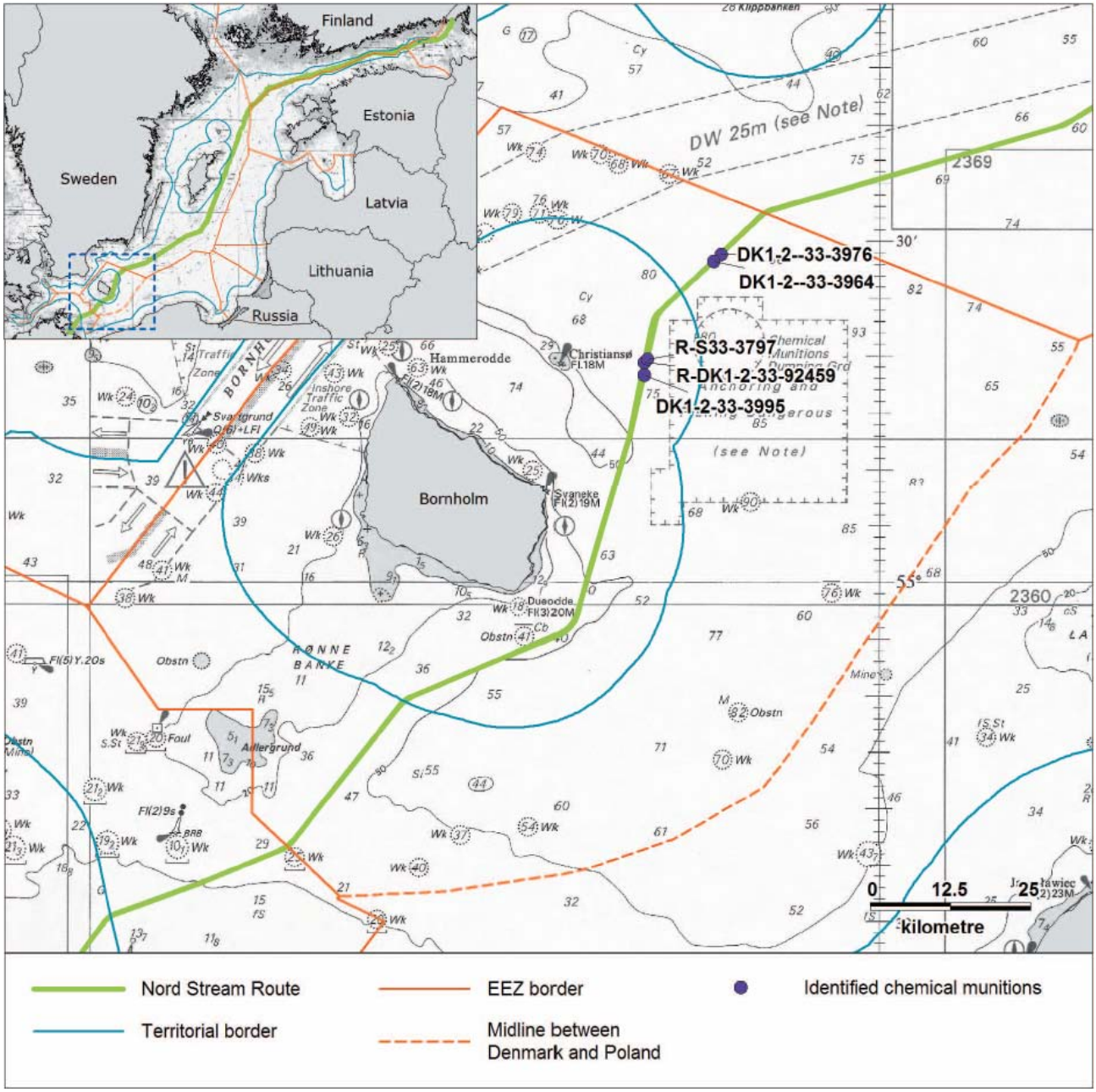

Figure 5.2 Chemical munitions identified during the munitions screening survey in Danish waters. The munitions are located at a distance of 7.1-17.1 m from the pipelines.

Table 5.2 Summary of the monitoring programme for chemical munitions in Denmark.

Chemical munitions in Denmark	
Documenting integrity of identified munitions objects	
Purpose	To evaluate and document the integrity of five identified munitions objects
Area to be monitored	Chemical munitions objects
Activity to be monitored	Effects from pipe-laying
Method to be used	Video inspection
Period of monitoring	Before and after construction: 2010, 2011 and 2012
Results	A video recording of the munitions objects

5.2.2 Monitoring and results for 2010

The pre-lay monitoring of munitions was carried out on 26 and 27 October 2010 and the post-lay monitoring on 15 January 2011. The monitoring was carried out as a 360 degree inspection around the objects, to make sure that the chemical munitions objects were fully investigated.

The results from the munitions monitoring showed that no damage occurred to the five chemical munitions objects during construction of the first pipeline. One of the objects; DK1-2-33-3995 has been covered with sediment, due to disturbance of the seabed from either pipeline installation or e.g. trawling. However the monitoring indicates that no direct contact has taken place with the object.

In compliance with the Danish permit requirements, safety precautions and emergency plans for handling of chemical munitions have been followed during installation in Danish waters. Accordingly, the Admiral Danish Fleet/Bornholm Marine District have been onboard the lay vessel during cable crossings and recoveries of the pipeline on occasions where pipe-lay had to be suspended due to rough weather.

Installation of the second pipeline shall commence in the last quarter of 2011. Before and after installation of the second pipeline, pre- and post-lay monitoring of munitions will be conducted in Denmark.

5.3 Monitoring of Chemical Warfare Agents (CWA) in the sediment

5.3.1 Monitoring programme

The purpose of the CWA monitoring programme in Denmark is:

- To document changes of levels of chemical warfare agents in the sediment due to project activities resulting in the disturbance of contaminated sediment originating from disposed chemical munitions

With the monitoring programme, Nord Stream shall document any changes in the level of chemical warfare agents in the sediment due to project activities resulting in the disturbance of contaminated sediments originating from dumped chemical munitions. Hence, before and after pipe-laying, seabed sampling, laboratory analyses and environmental assessments are conducted.

Figure 5.3 shows the locations for seabed sampling. Sampling is conducted at 29 stations along the midline of the pipelines. At six of these stations, a transect consisting of 15 stations is planned to be sampled /5/. The sampling programme is aligned with the baseline investigations conducted in 2008. Sampling and analysis for CWAs is conducted in June/July 2010 before installation of the first pipeline, in June/July of 2011 after installation of the first pipeline, and in June/July 2012 after installation of the second pipeline.

A summary of the CWA monitoring programme in Denmark is presented in Table 5.3.

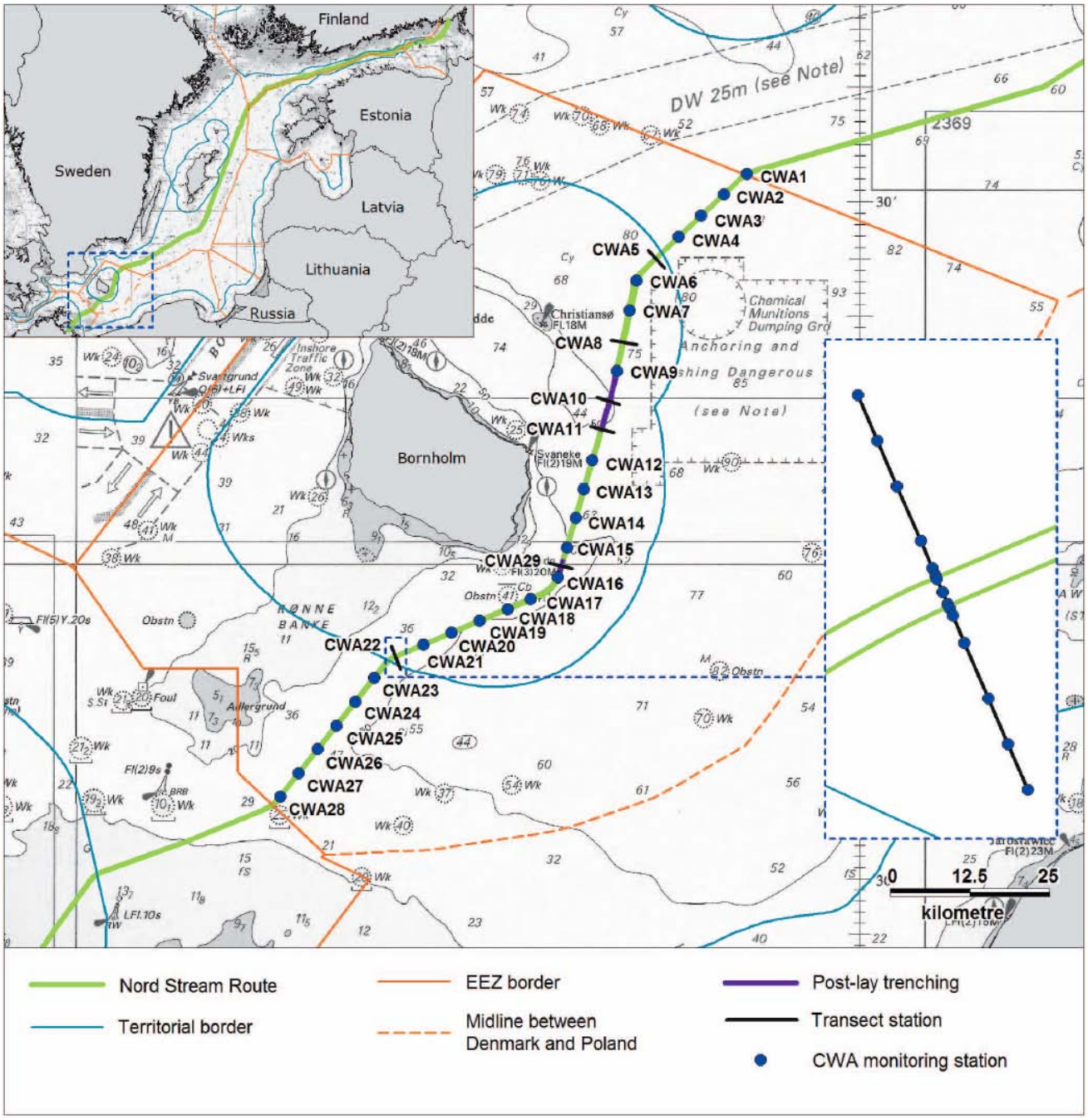

Figure 5.3 Sediment sampling stations for chemical warfare agents comprising 29 stations along the midline of the pipelines. Six stations are transects stations with 15 stations in each /5/.

Table 5.3 Summary of the monitoring programme for concentrations of chemical warfare agents in the seabed sediment in Denmark.

Seabed sediment in Denmark	
Monitoring of chemical warfare agents	
Purpose	To evaluate and document the changes in concentrations of chemical warfare agents in the seabed sediment
Area to be monitored	29 pipeline route sampling locations and six transect sampling locations
Activity to be monitored	Construction of the pipeline
Method to be used	Seabed sampling (with subsequent laboratory analysis)
Period of monitoring	Before and after construction: 2010, 2011 and 2012. Baseline investigations conducted in 2008
Results	Changes in the concentration of chemical warfare agents in the seabed

5.3.2 Monitoring and results for 2010

The field surveys were carried out in the period 19 to 26 July 2010 to establish a baseline for similar surveys planned in 2011 and 2012. The overall objective of the surveys was to enable assessments of impacts on changes in risk due to CWA in the seabed due to the construction of the Nord Stream Pipeline. Monitoring focuses on impacts from trenching as this is the activity which is assessed to have the greatest impact on the seabed environment and thereby the greatest potential for disturbing buried CWA residues.

The survey in 2010 was confined to 23 stations distributed over the total length of the pipelines and six transects each with 15 sampling locations covering an additional 90 stations. The transects were located perpendicular to the pipelines, three of them on sections where the pipelines are trenched into the seabed. Measurements could not be performed at transects CWA29 due to hard and stony seabed conditions. Nord Stream therefore suggest to cancel transect CWA29 for future monitoring. The actual sampling programme ended up covering 98 sample stations.

No intact warfare agents, i.e. sulphur mustard (H), Adamsite (DM), Clark I (DA), á-chloroacetophenone (CN), Tabun (GA), Triphenylarsine (TPA), were found in any of the samples analysed.

A degradation product of phenyldichloroarsine (PDCA [SPr]) and a degradation product of lewisite (L2[ox]) were detected in two out of 98 samples.

PDCA [SPr] was as the only compound detected in both 2008 and 2010 as seen in Figure 5.4. In 2010 PDCA was found at the northern location CWA5 (5.14). Similar concentrations were not found close to CWA5 in 2008. The highest concentration found in 2008 was near CWA11, where no PDCA was detected in 2010.

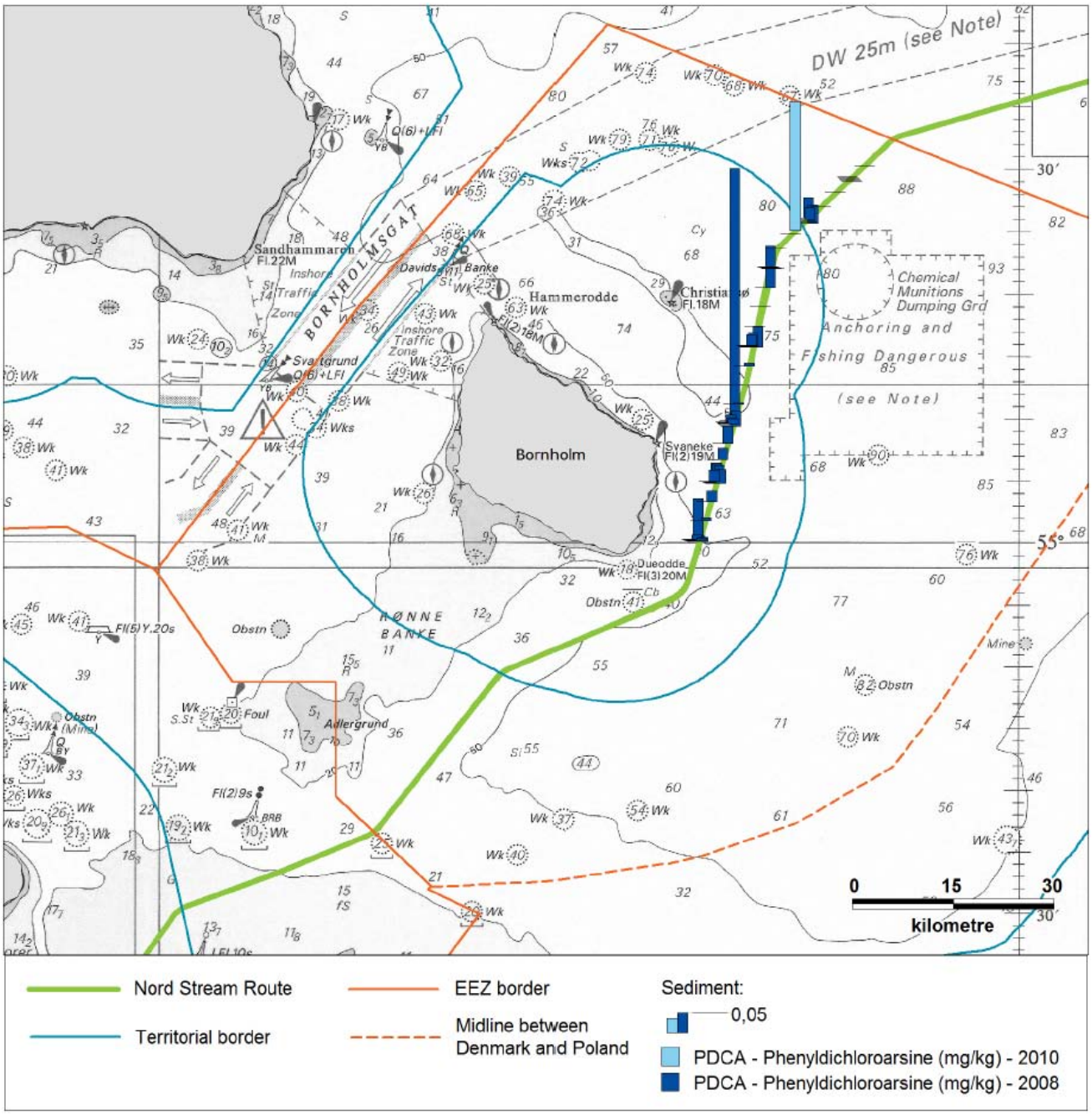

Figure 5.4 Phenyldichloroarsine (PDCA) detected in 2008 and 2010.

A low concentration of the degradation product of Lewisite (L2[ox]) was found in a sample from CWA5.1 as seen in Figure 5.5.

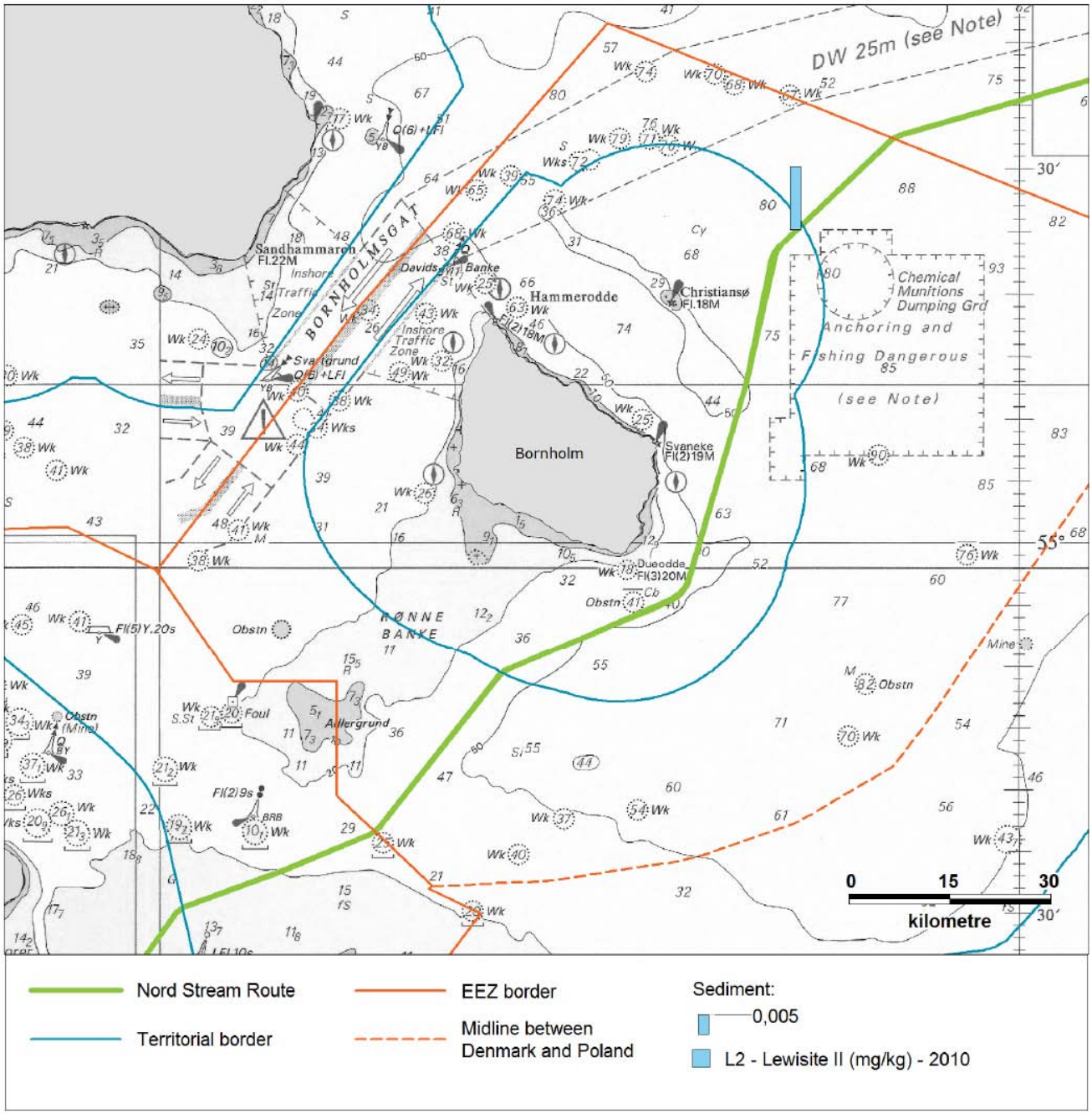

Figure 5.5 Lewisite II (L2) detected in 2010.

The Limit of Quantification (LOQ) was higher in 2010 than at the baseline investigations carried out during the spring of 2008. The main difference between the methods was the handling of the sediment. In 2008, the pore water was centrifuged away from the sediment, which was subsequently extracted. In the more recent study, both sediment and the contained pore water were freeze dried.

In some samples, a white substance – probably sodium chloride – was visible in the dried sediment. The presence of this salt has an effect on the sample preparation and instrumental analysis, thereby affecting the LOQ. In early 2011 VERIFIN (Finnish Institute for Verification of the Chemical Weapons Convention) shall conduct freeze drying tests to evaluate whether improved CWA detection could be achieved in future CWA sampling campaigns.

The exposure levels are comparable between the 2008 and 2010. The total CWA related exposure is estimated to 0.8 µg/L, and the total fish community risk quotient (RQ) is 0.026, indicating a negligible risk. The added exposure contributed by the trenching alone is 0.039 and 0.0019 µg/L for PDCA[SPr] and L2[ox], respectively. These exposures represent an added CWA related RQ for the fish community from installation of the pipelines of 0.00107. This is evaluated as being an insignificant risk.

It was not possible to directly compare the CWA related risks to the analysis of the benthic life analysis since benthic life was not sampled in the two locations where CWA residues were detected. However, the habitat and the dissolved oxygen (DO) conditions at these two locations suggest that benthic life would be limited due to these factors rather than due to the CWA residue exposure.

5.4 Monitoring/mitigation measures at national and international monitoring stations

5.4.1 Monitoring programme, purpose and period of monitoring

The need of monitoring and mitigation measures at national and international monitoring stations due to the construction and operation of the Nord Stream Pipeline has been investigated and described in /7/.

In order to determine whether the establishment of the Nord Stream Pipeline affects governmental or international monitoring programs, the locations of the monitoring stations have been identified in relation to the pipeline route and related construction and operation activities. Coordinates of both national and international monitoring stations have been investigated, and information concerning location and measured parameters has been compiled. An assessment of impacts has been conducted and mitigation measures have been recommended.

Potential impacts on environmental monitoring stations could be caused, if:

- Monitoring activities coincide in time with construction work
- Monitoring stations are located inside the anchor corridor for the lay vessel (approximately 1.5 km to each side of the pipeline).
- Monitoring stations are located close to areas with trenching, hence potentially being affected by re-sedimentation of sediment that has been brought in suspension during construction
- Monitoring stations are very close to the pipelines therefore potentially affected by local changes in erosion/sedimentation patterns around the pipelines during pipeline operation

Figure 5.6 shows the locations of the national and international monitoring stations in Danish waters.

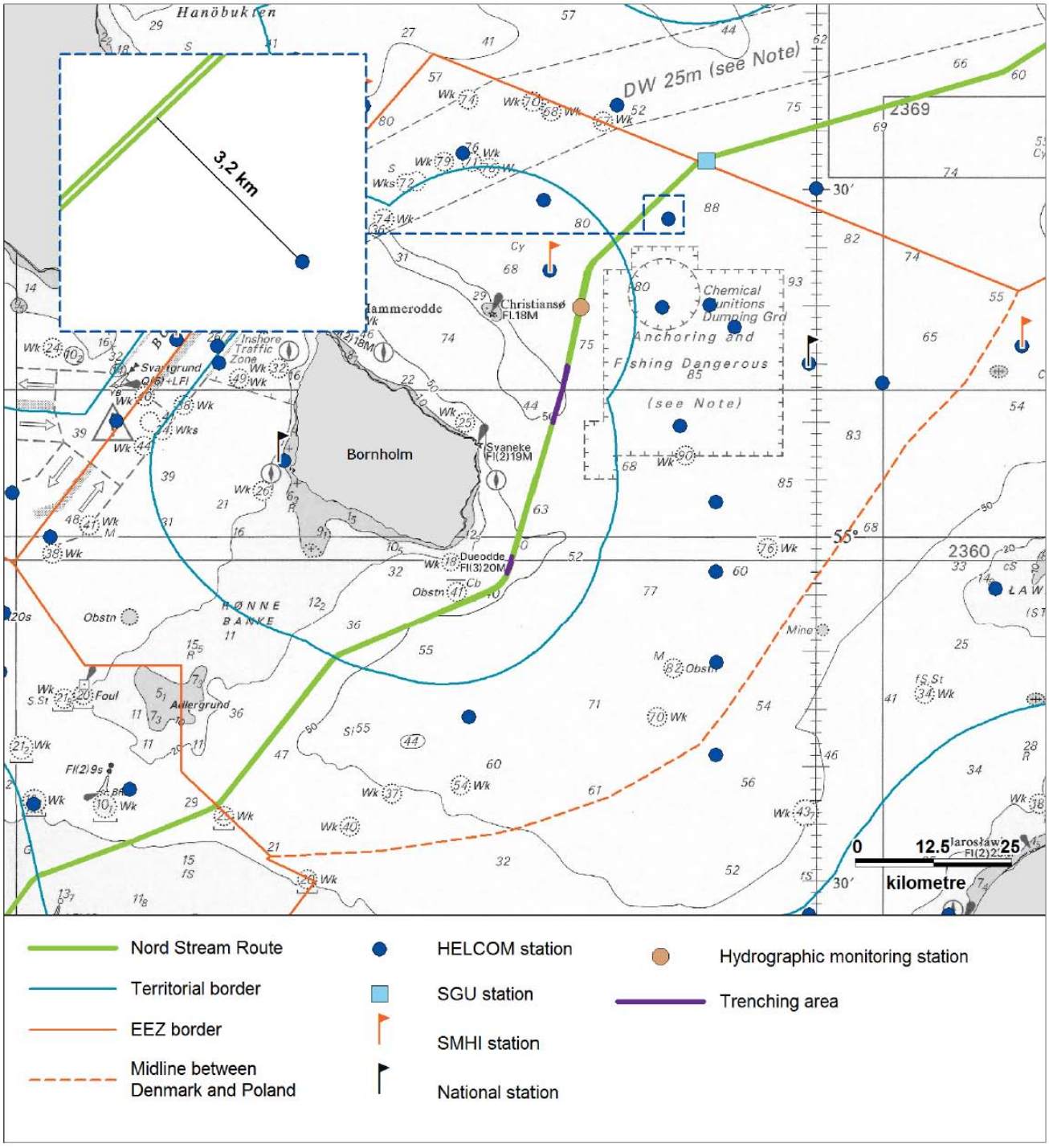

Figure 5.6 National and international monitoring stations in Danish waters.

5.4.2 Monitoring and results for 2010

As shown in Figure 5.6, the distance to the station closest to the pipeline route in Danish waters, is 3.2 km. Due to the large distance from the pipeline route to any of the monitoring stations, none of the impacts described above are relevant to neither national nor international monitoring stations located within Danish waters.

5.5 Monitoring of maritime traffic

5.5.1 Monitoring programme, purpose and period of monitoring

The purpose of Nord Stream's control and monitoring in relation to maritime traffic is to minimise the risk of collisions or other accidents involving commercial ship traffic and/or vessels performing construction activities for the project. A number of activities have been, or are being, performed in order to achieve this goal. Mitigation and risk reducing measures have been analyzed and discussed in risk assessments and have been included and implemented in ship traffic management procedures (or plans). Safety zones of varying sizes are established around all vessels performing underwater construction work. Vessels within the construction spread, or additional vessels, can serve as guard vessels during certain construction activities or in particularly sensitive areas such as shipping lanes. Information on upcoming and ongoing construction activities is provided to the relevant authorities. Dedicated information for the fishing communities is being produced and delivered both to individual fishermen and fishing organisations on an ongoing basis.

The ship traffic management procedures are developed by the contractors before the start of the construction activities to ensure the safety of both third party shipping and the vessels involved in the construction works. These procedures include e.g. normal and emergency communication lines and flowcharts, safety measures and responsibilities, required safety zones and vessel management systems (such as Automatic Identification System (AIS) for identification and locating of vessels).

Safety zones of varying sizes are established in agreement with the Danish authorities around all vessels performing underwater construction work. No other vessels are allowed to enter this zone without permission from the working vessel's captain. In line with the watch keeping procedures the traffic is regularly monitored visually and by radar. The track and speed of any vessel approaching the safety zone is monitored and any vessel on course to enter the safety zone is contacted and requested to change course. Vessels within the construction spread (or additional vessels) can also act as guard vessels during certain construction activities or in particularly sensitive areas such as shipping lanes. In case radio contact with a vessel is not established, the guard vessels are able to intervene and potentially intercept an approaching vessel.

When operating in Danish waters a daily report is transmitted from the vessels of all construction activities. These reports include e.g. the vessel name, call sign, present position and plan for the next 24 hours. Before and during construction the locations of the construction vessels are announced in 'Notices to Mariners' by the Danish Maritime Safety Administration in order to increase the awareness of project generated ship traffic.

Prior to the commencement of construction activities Nord Stream has informed the fishing associations about the planned activities and safety zones of various construction works.

Throughout the construction period regular information is made available (e.g. weekly newsletter) addressing construction vessels, work scopes and potential safety concerns.

The control and monitoring of marine traffic is of high importance during the whole construction phase of the project.

5.5.2 Monitoring and results for 2010

During the construction in Danish waters, Nord Stream and its construction vessels have followed the communication and reporting procedures that were agreed with Danish authorities and organisations. Nord Stream has provided the relevant authorities with notifications prior to commencement of new construction activities and daily updates from the construction vessels as well as weekly forecasts. Regular information to the fishing community has been provided from the time when the construction activities started and will continue throughout the construction period.

Almost all types of construction activities which are planned within the Nord Stream Project in Danish waters have already been carried out several times during the last year, i.e. survey activities, mattress installation and pipe-laying. Precautionary safety measures were successfully implemented and the construction activities have all been performed without any accidents or significant incidents involving third party vessels. On few occasions, other vessels entered into the requested safety zones around the construction vessels. The monitoring and communication procedures onboard the construction vessels were then followed successfully and none of these safety zone intrusions resulted in any risk-related situations or incidents.

6 Comparison of monitoring results from 2010 with assessment in the Danish EIA

A comparison of the monitoring results at the specific monitoring locations with the description of the existing environmental conditions (baseline) in the Danish Environmental Impacts Assessment (EIA) shows that the findings from monitoring in 2010 are in accordance with the description in the Danish EIA.

The comparison of the monitoring results with the assessment of effects and impacts in the Danish EIA is possible only for monitoring programmes that have been fully finalised. For 2010 this includes monitoring in connection with cable crossings for the first pipeline.

The results from the cable crossings show that impacts on the environment have been restricted to the immediate vicinity of areas where these activities have been carried out. This is in line with the assessment in the Danish EIA, where it is stated that the overall impact on the environment from cable crossings would be insignificant as effects are local.

The main part of the evaluation of effects and impacts from the Nord Stream Pipeline will only be achievable when results from monitoring surveys carried out after construction of the first pipeline are available. Results from the monitoring in 2010 have established a baseline for similar surveys planned for the coming years, with the overall objective to enable assessments of possible effects and impacts on the environmental parameters which are monitored.

For the following monitoring modules a comparison with the assessment in the Danish EIA can only be undertaken from 2011 and onwards:

- Monitoring of fish along the pipeline (reef effect)
- Monitoring of benthic fauna
- Monitoring of chemical warfare agents (CWA) in the sediment.
- Monitoring of water quality
- Monitoring of hydrographic conditions in the Bornholm Basin

Furthermore, environmental monitoring is carried out for:

- National and international monitoring stations close to/relatively close to the Nord Stream Pipeline
- Maritime traffic

Monitoring/evaluation of effects on national and international monitoring stations in the Baltic Sea have shown that no effects on monitoring stations inside Danish waters shall occur.

During the construction in Danish waters, Nord Stream and its construction vessels have followed the communication and reporting procedures that were agreed with Danish authorities and organisations. Nord Stream has provided the relevant authorities with notifications prior to commencement of new construction activities and daily updates from the construction vessels as well as weekly forecasts. Regular information to the fishing community has been provided from the time when the construction activities started and will continue throughout the construction period.

There have been no accident or near misses in relation to maritime traffic involving fishing vessels in 2010, and the impacts on maritime traffic have been found to be minor, local and short-term. This is in accordance with the assessment stated in the Danish EIA.

7 Conclusion and recommendations

Based on the results from the Nord Stream monitoring for 2010, it is concluded that effects and impacts on the marine environment have been limited to areas in the immediate vicinity of the pipelines. This is in accordance with assessments in the Danish EIA. Furthermore, impacts have been assessed to be local and of minor to insignificant effect.

Monitoring in relation to cable crossings for the first pipeline was finalised in 2010 and impacts were registered to be local and assessed to be insignificant.

The monitoring of benthic fauna at the two transects showed a fauna community that was in accordance with the results from earlier monitoring undertaken by Nord Stream and with information from HELCOM.

Monitoring of fish along the pipeline was carried out at nine areas along the pipeline route inside Danish waters. The results indicated a large spatial difference between the areas in terms of abundance and composition of fish, but no statistically significant difference between impact and reference stations within the same area was found.

Monitoring of chemical warfare agents in the sediment showed no content of intact warfare agents, i.e. sulphur mustard (H), Adamsite (DM), Clark I (DA), α-chloroacetophenone (CN), Tabun (GA), Triphenylarsine (TPA). In two samples out of 98 samples a degradation product of phenyldichloroarsine (PDCA [SPr]) and a degradation product of lewisite (L2[ox]) were detected with low concentration.

Monitoring of cultural heritage has led to the discovery of a number of wrecks and cultural heritage sites east and south of Bornholm. As part of the monitoring programme, monitoring of two wrecks located within 50 meters of the Nord Stream Pipeline has been carried out. The results from the pre-lay monitoring wreck inspections in October 2010 and the post-lay monitoring in November 2010 and January 2011, showed that no damage had occurred to the two wrecks, or other wrecks, during pipeline installation.

Monitoring of munitions before and after installation of the first Nord Stream Pipeline was conducted in autumn/winter 2010/2011. The result of the monitoring was that no disturbance of the chemical munitions objects had taken place during pipeline installation. Due to disturbance of the seabed from either pipeline installation or e.g. trawling, one object (R-DK1-2-33-3995) has been covered with sediment, but the inspection indicates that there has been no direct contact with the object.

The results from the above-mentioned monitoring surveys for infauna, fish along the pipeline, and chemical warfare agents, shall function as baseline for future monitoring activities. Therefore, an evaluation of the impact from construction and operation of the pipelines will be achievable only after results from surveys carried out after construction of the first pipeline have been retrieved.

Results from the other monitoring programmes, such as monitoring of water quality, and monitoring at the hydrographical station in the Bornholm Basin started end of 2010 and will be finalised and reported to the authorities in 2011.

Separate reports have been elaborated for the 2010 annual reporting for the following monitoring parameters:

- Monitoring of fish along the pipeline, Denmark 2010
- Monitoring of benthic fauna, Denmark 2010
- Monitoring of cultural heritage, Denmark 2010
- Monitoring of munitions, Denmark 2010
- Monitoring of chemical warfare agents (CWA), Denmark 2010

The annual monitoring report for 2011: “Environmental monitoring in Danish waters 2011” shall include the same monitoring parameters as the 2010 report. Furthermore, separate reports for the following monitoring parameters will be prepared for the 2011 annual reporting:

- Monitoring of water quality, Denmark 2011
- Monitoring of hydrographic conditions in Bornholm Basin, Denmark 2011

The 2010 monitoring surveys have been undertaken as planned, and procedures used in the 2010 survey will be updated for the 2011 survey based on findings and recommendations. Based on the execution and the results from monitoring in 2010, it is concluded that generally there will be no need for changes of the monitoring programme for 2011. However, Nord Stream suggest to cancel transect B29/CWA29 for future monitoring of benthic infauna and chemical warfare agents as sampling along these transects proved to be impossible due to hard and stony bottom.

8 References

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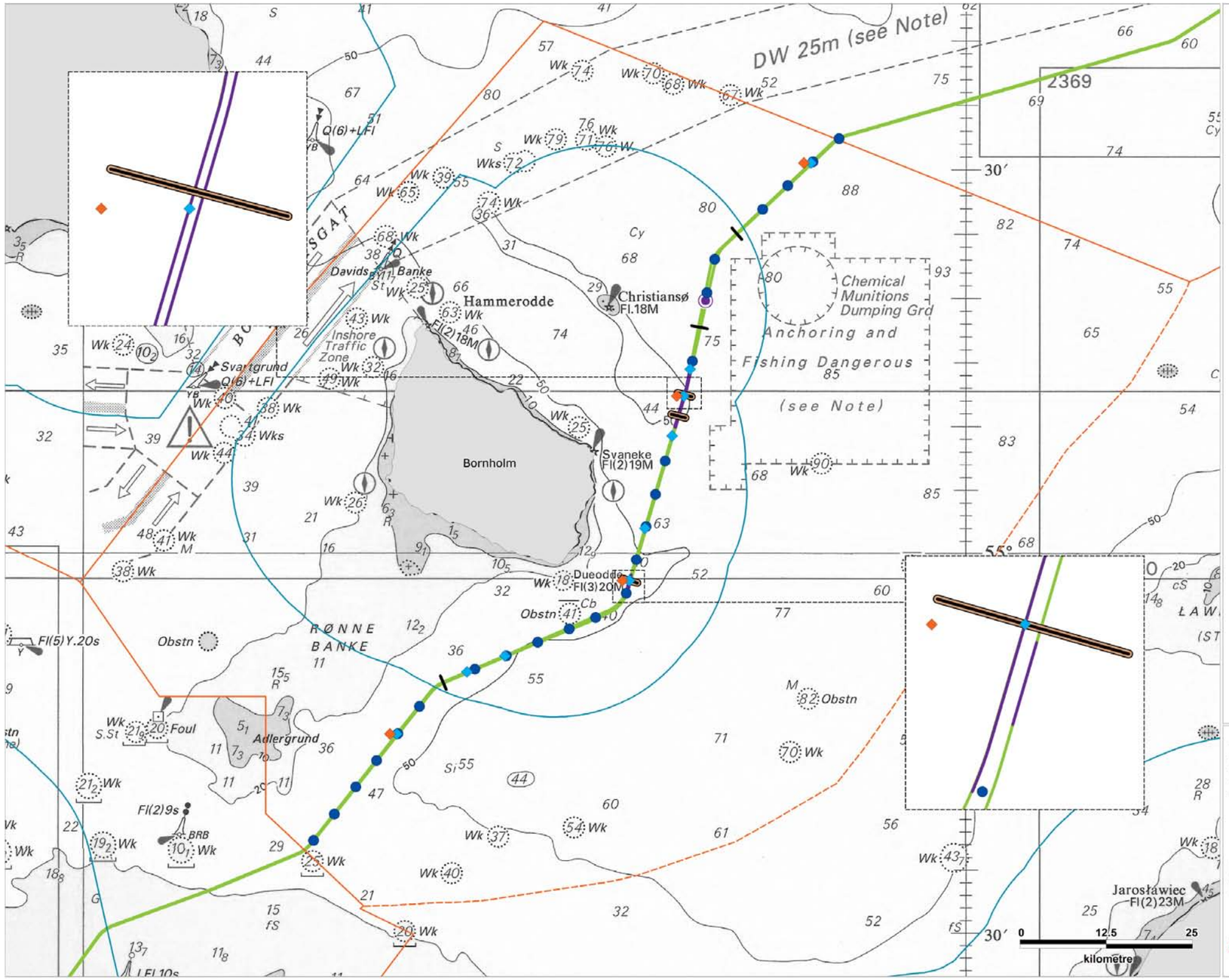
/10/ SMHI, **2009**, "Possible hydrographical effects upon inflowing deep water of a pipeline crossing the flow route in the Bornholm Proper", SMHI and University of Gothenburg, 23 September 2009. Scientific review by Jacob Steen Møller, Danish Technical University.

APPENDIX A

Map of Nord Stream monitoring stations in the Danish EEZ



Legend :

- Nord Stream Route
- Territorial border
- EEZ border
- Midline between Denmark and Poland

Water monitoring:

- Trenching

Sediment sampling:

- CWA monitoring station
- Transect

Monitoring of fish and epifauna:

- Fish monitoring station/ Epifauna monitoring station
- Reference station

Monitoring of infauna:

- Benthic transect

Monitoring of the hydrography:

- Hydrographic monitoring station

General references:
- Pipeline rev. C.16.5 (May 2009).
- Limits of Exclusive Economic Zones and Territorial Waters: IBRU January 2010.
- Background sea charts are "Not to be used for navigation".
- Background sea chart, © Crown Copyright. Reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk).

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Map MON-02

Monitoring stations in Danish waters

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