



NORD STREAM 2 ANNUAL MONITORING REPORT 2018

Environmental and Technical Monitoring of the Nord Stream 2
Natural Gas Pipeline construction and operation in the Finnish EEZ

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SITOWISE

The original report is written in Finnish and has been, together with appendices, translated into Swedish and English. If there are conflicting information in the different language versions, the Finnish version prevails. Swedish version SW06 and English version EN08 are equivalent to the final Finnish version FI06.

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ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
ADD	Acoustic deterrent devices
BBC	Big bubble curtain
BQR	Biological quality ratio
DCC	Distance cross course
DP	Dynamic positioned
EEZ	Exclusive Economic Zone
EIA	Environmental impact assessment
FKP	Finnish kilometer point
FNU	Formazin nephelometric units
GKP	Global kilometre point
GOFREP	Gulf of Finland reporting system
JNCC	Great Britain's Joint Nature Conservation Committee
Leq	Equivalent continuous sound pressure level
MBES	Multi-beam echo sounder
MDS	Mine disposal system
MMO	Marine mammal observer
NEQ	Net explosive quantity
NSP2	Nord Stream 2 project
NTU	Nephelometric turbidity unit
PAM	Passive acoustic monitoring device
PSU	Practical salinity unit
PTS	Permanent threshold shift
Q	Quarter of the year
RHIB	Rigid-hulled inflatable boat
ROV	Remotely operated vehicle
SAC	Special areas of conservation
SCI	Sites of community importance
SEL	Sound exposure level
SPL	Sound pressure level
SPA	Special protection areas
t	Tonne
TTS	Temporary threshold shift
TSS	Traffic separation scheme
VHF	Very high frequency (radio waves from 30 to 300 megahertz)
WP	Water permit

SUMMARY

Monitoring and reporting of results

The Annual Monitoring report 2018 presents the results of the environmental and technical monitoring for the construction activities of the Nord Stream 2 Gas Pipelines in the Finnish Exclusive Economic Zone. Monitoring is based on the environmental monitoring programme, which was approved as part of the Water Permit decision.

This report is prepared by Sitowise Oy based on data and reports of Nord Stream 2 AG and its contractors.

This annual report includes the final results of 2018 monitoring, and comparisons to the modelling results and impact assessments presented in the EIA Report and the water permit application. Furthermore, the monitoring report includes, as applicable, a comparison to monitoring results of the Nord Stream pipeline project.

The quarterly reports, which serve as a basis for the annual report, have been submitted to the monitoring supervisory authorities at ELY Centres, and the environmental authorities of the municipalities.

Project and permits

In its decision TEM/1810/08.08.01/2017 issued on April 5, 2018, the Finnish Government granted Nord Stream 2 AG a consent to use the Finnish EEZ for construction of a natural gas pipeline system within the Finnish Exclusive Economic Zone as part of a natural gas pipeline project from Russia through the Baltic Sea to Germany.

With its decision No 53/2018/2 issued on April 12, 2018, the Regional State Administrative Agency of Southern Finland granted Nord Stream 2 AG a water permit to construct and operate two natural gas pipelines within the Finnish EEZ.

In the Finnish EEZ the route follows the existing Nord Stream pipeline route. The length of the route in the Finnish sector is approximately 374 km. All construction works in Finland are planned to be finished by the end of 2019, after which the pipelines are planned to be taken into operation.

Nord Stream 2 AG has submitted notifications to the Finnish authorities in relation to environmental and technical monitoring. In addition, Nord Stream 2 has submitted construction notifications in line with the water permit and the EEZ permit decisions.

Construction activities in the Finnish EEZ during 2018

Nord Stream 2 construction activities in 2018 covered munition clearance, rock placement, mattress installation and pipelay.

Munition clearance activities were successfully completed. In total, 74 munitions were cleared prior to all other construction works.

Rock placement works progressed as planned. All pre-lay rock berms for Lines A and B have been completed. Post-lay rock placement has commenced and will continue through 2019.

In preparation of crossings with existing cables and pipelines, 492 mattresses were installed on the seabed.

Pipelay of Line A started on September 5, 2018 and continued to the end of the year. Approximately 260 km of Line A were laid in the Finnish EEZ in 2018. Lines A and B will be completed in 2019.

No environmental incidents or adverse impact on ship traffic were caused by the NSP2 construction activities in 2018.

Environmental baseline

Baseline data for the year 2018 was collected from the observations of the NSP2 monitoring contractors and from various public sources.

The water column was clearly stratified from April to July, 2018. After the stratification break up, wind driven waves and currents were mixing the entire water column causing significant sediment resuspension during storm events.

There was no ice cover on the NSP2 corridor from Q2 to Q4 2018. The fairways to Kotka, Inkoo and Koverhar were accessible for the entire period.

Baseline description further includes description of seabed, sediments, hydrography, water quality, cultural heritage, biodiversity, ship traffic and commercial fishery as well as protected areas.

Environmental monitoring according to the monitoring programme

Environmental monitoring is most intensive in the Finnish EEZ during the construction phase from 2018 to 2019 and the majority of the monitoring activities have taken place in 2018. Most of the impacts in the environmental monitoring of the previous Nord Stream project from 2010 to 2012 were minor. Therefore, the Nord Stream 2 monitoring is concentrating on impacts of a limited number of receptors, taking into account the results of assessments and the statement of the EIA Coordinating Authority on the EIA report.

During 2018, environmental monitoring concentrated on underwater noise, water quality and currents as well as monitoring of cultural heritage.

A series of mitigation measures were successfully implemented to reduce the environmental impacts of underwater noise due to munition clearance. These included the use of bubble curtains, acoustic deterrent devices and marine mammal observers.

Underwater noise

According to the noise measurements, peak sound pressure levels were lower than predicted in the EIA report and the water permit application. Calculated permanent threshold shift zones based on measured sound levels were significantly smaller than modelled in the EIA report and the water permit application. Neither permanent threshold shift nor temporary threshold shift zones reached any Natura 2000 areas with marine mammals as a conservation objective.

Water quality and currents

The impact of rock placement on water quality in bottom close waters layers were measured at two selected sites.

Modelling results in the EIA phase estimated that elevated turbidity values are limited to a few hundred meters around the construction site. Estimated duration of impacts varied between different hydrographic conditions.

The duration of all measured impacts stayed significantly below predictions. In general, the measured values at 200–300 m offset were below the predicted winter levels as presented in the EIA report.

Measured turbidity from munitions clearance on water quality was lower and of shorter duration than assessed. Furthermore, higher turbidity levels were mainly limited to the stratified near bottom layer of the sea. Detonations from munitions clearance showed no increase in turbidity levels above the background variation, the only observable effect can be traced back to the preparation works prior to the detonation itself.

Cultural heritage

Pipeline (Line A) was laid according to plans causing no impact on the monitored cannon barge wreck. The mitigation measures for Line A were implemented - respecting the safety perimeter of 50 m. Further pipeline (Line A) was laid over the monitored World War II anti-submarine net in line with water permit provisions.

Additional monitoring

Marine mammals

The monitoring results confirm that impacts of munition clearance activities were in-line or lower than assessed in the water permit application. There is no evidence of injury to any marine mammals.

Neither the permanent threshold shift nor temporary threshold shift zones extended to any adjacent Natura 2000 areas with marine mammals as conservation object. No impact on grey seals at Kallbådan seal reserve was observed by Metsähallitus in relation to munition clearance.

The impact of suspended sediments and release of contaminants in the water column were smaller than modelled, thus their effects on all marine mammals are in-line or lower than assessed in the water permit application.

Sediment contamination study

A sediment contaminant study was performed at two munition locations to study the effect of potential toxic material release during the detonation. Based on the analysed sediment samples, no residuals of explosives were detectable. Heavy metal concentrations of sediment samples were typical to those seen in earlier baseline studies in the Gulf of Finland.

Effects on ship traffic, the objectives and initiatives set out in the Marine Strategy Framework Directive and any transboundary impacts are in-line or lower than assessed in the EIA report and the water permit application.

Conclusions

Monitoring results of the year 2018 confirm that all Nord Stream 2 related environmental impacts are in-line or lower than assessed in the EIA report and the water permit application documents.

Final monitoring results covering the entire construction phase will be presented in the annual report 2019 to be published in May 2020. Monitoring results of the operation phase will be reported annually according to the monitoring programme.

1

INTRODUCTION

1 INTRODUCTION

1.1 Project

Nord Stream 2 AG is constructing a new two-pipeline offshore natural gas system from Russia to Germany through the Baltic Sea. The length of the corridor is approximately 1,200 km. Parallel pipelines pass through the territorial waters and/or Exclusive Economic Zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany (Figure 1). In the Finnish EEZ the route follows the existing Nord Stream gas pipeline route (Figure 2). The length of the route in the Finnish sector is approximately 374 km. The pipelay of Line A started on September 5, 2018 and the pipelay of Line B is scheduled to start in 2019. All construction works in Finland are planned to be finished by the end of 2019, after which the pipelines are planned to be taken into operation.

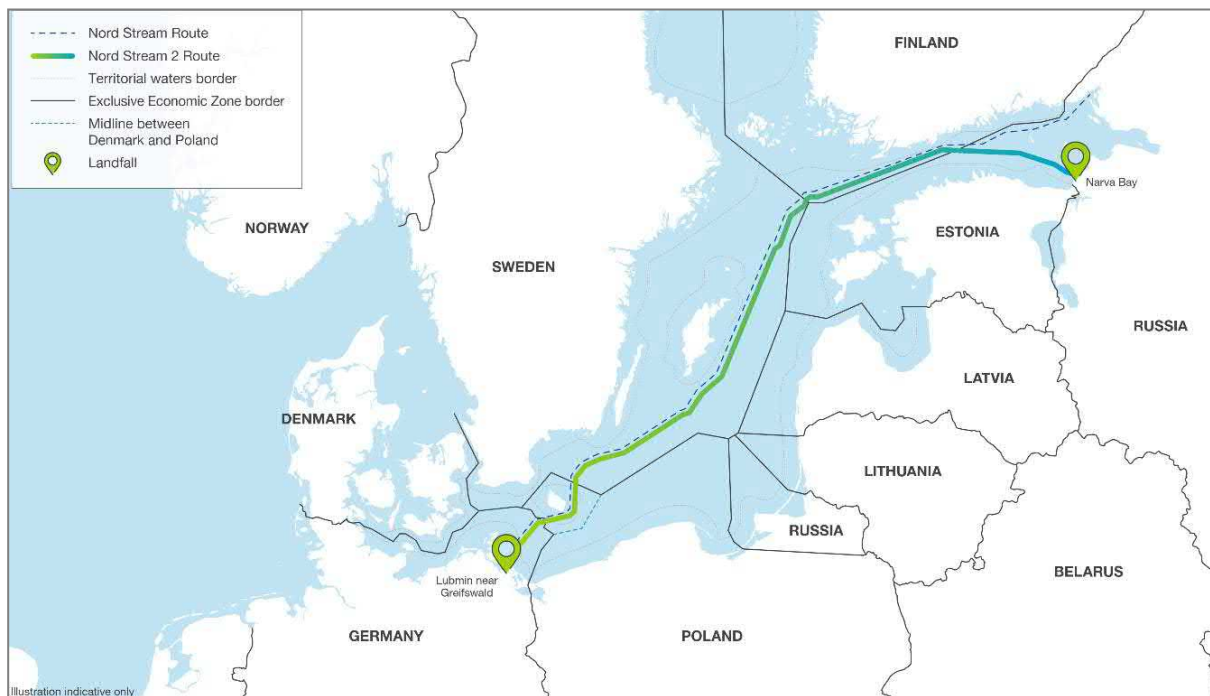


Figure 1. Nord Stream 2 pipeline base case route /1/.

The Nord Stream 2 pipeline system is planned to deliver natural gas from Russia directly to the European Union gas market. The pipeline system will have an annual capacity to supply about 55 billion cubic

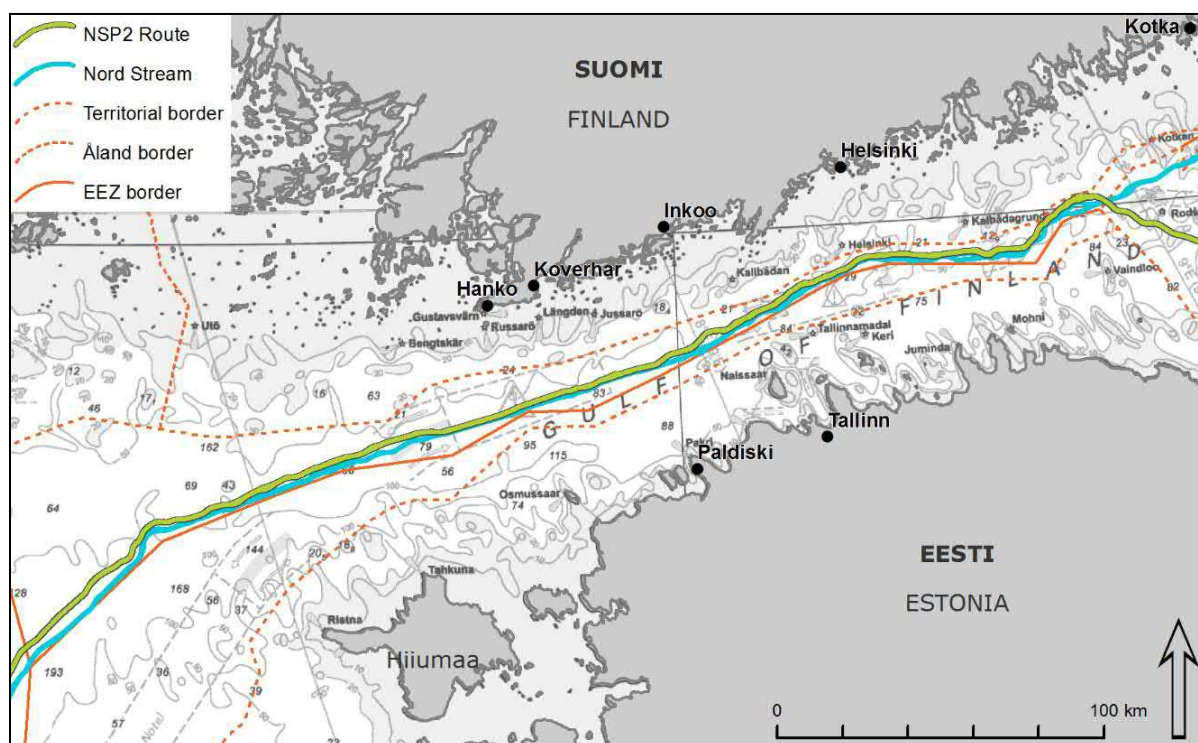


Figure 2. Nord Stream 2 pipeline route passes through the Finnish EEZ. It is situated north of the existing Nord Stream pipelines with an exception in the eastern section near Russian waters.

meters of gas per year. Nord Stream 2 project implementation is based on the successful and positive experience of the construction and operation of the existing Nord Stream Pipeline.

The Nord Stream pipelines were put into operation in 2011 and 2012. Since 2009, Nord Stream has monitored construction and operation activities in the Finnish waters. The annual monitoring report 2012 presents the results and conclusions of the environmental monitoring for the entire construction period from 2009 to 2012. One of the main conclusions from the monitoring was that the actual impacts were either lower or as predicted in the application documents /2/.

1.2 Permits

The construction and operation of the Nord Stream 2 pipelines requires two permits in Finland: Water Permit for construction and operation of the pipelines and a Government Consent to use the Finnish EEZ (Table 1). Prior to granting permits, an Environmental Impact Assessment procedure was applied to the project. The EIA procedure ended on July 26, 2017 when the EIA Authority provided its statement on the EIA report. The EIA Authority notes in its statement, that the EIA report fulfils the content criteria set out in the EIA Decree. The EIA statement was taken into account in the permit applications.

With its decision (TEM/1810/08.08.01/2017) issued on April 5, 2018, the Finnish Government granted Nord Stream 2 AG a consent to use the Finnish EEZ for construction of a natural gas pipeline system within the Finnish Exclusive Economic Zone as part of a natural gas pipeline project from Russia through the Gulf of Finland and the Baltic Sea to Germany. The permit became legally binding on July 12, 2018.

With its decision (53/2018/2) issued on April 12, 2018, the Regional State Administrative Agency of Southern Finland granted Nord Stream 2 AG a water permit to construct and operate two natural gas pipelines within the Finnish EEZ with the authorization for preparation.

Table 1. The main permits regarding construction and operation of NSP2.

Permit	Issued	Document number	Authority
Consent to use the Finnish Exclusive Economic Zone	5.4.2018	TEM/1810/08.08.01/2017	Council of State of Finland
Water permit decision	12.4.2018	N:o 53/2018/2, Dnro ESAVI/9101/2017	The Regional State Administrative Agency of Southern Finland

A permit for research and monitoring in the seal sanctuaries of Kallbådan and Sandkallan-Stora Kölhällen (325/2018/06.06.02) was issued by Metsähallitus on March 12, 2018. The permit covers the environmental monitoring during construction of the Nord Stream 2 natural gas pipelines at underwater noise and water quality monitoring stations. The permit was valid from April 15, 2018 to December 31, 2018 regarding the seal sanctuaries and from March 12, 2018 to December 31, 2018 regarding all other areas.

A permit extension for research and monitoring in the seal sanctuaries of Kallbådan and Sandkallan-Stora Kölhällen (5395/2018/06.06.02) was issued on December 7, 2018. The permit is valid from January 1, 2019 to June 30, 2020.

1.3 Notifications

This chapter presents the notifications submitted by Nord Stream 2 AG to the Finnish authorities in relation to environmental and technical monitoring according to the permit provisions of the Water Permit (53/2018/2) (Table 2). In addition, the chapter presents the notifications related to construction activities in line with the provisions in the water permit decision and in the Government consent (the EEZ permit decision).

Table 2. Notifications related to monitoring during 2018 and submitted to the ELY Centres.

Date	Content
18.4.2018	Notification on commencement of works
23.4.2018	Change to the monitoring programme regarding underwater noise monitoring
11.5.2018	Updated information on munitions not requiring big bubble curtains during clearance in the Finnish EEZ
14.5.2018	Preliminary results of underwater noise measurements (as per monitoring programme)
15.5.2018	Summary table and map of munitions (interim version)
24.5.2018	Interim technical underwater noise report (as per monitoring programme)
25.5.2018	Notification regarding chance finds
31.5.2018	Non-conformity notification regarding use of big bubble curtains
29.6.2018	Summary table and map of munitions (final version)
9.7.2018	Notification on munitions not requiring clearance
6.8.2018	Notification regarding changes in mattress amount and size

Nord Stream 2 has submitted general implementation plans prior to the initiation of project activities and in addition monthly plans to present upcoming activities in Finland. Monthly plans were submitted approximately one week before the beginning of each month.

Notifications related to the construction works in the Finnish EEZ are listed below (Table 3). These notifications were submitted (among others) to the Finnish Border Guard and to the Finnish Transport Agency.

Table 3. Notification related to construction in Finnish EEZ and submitted to Finnish Border Guard, Finnish Transport Agency, the Gulf of Finland Vessel Traffic Centre, the Western Finland Vessel Traffic Centre and Turku Radio.

Date	Content
26.3.2018	Provisional notification of the General Implementation Plan on rock placement, munition clearance and mattress installation in Finnish EEZ
21.4.2018	Amendment to the General Implementation Plan submitted on March 26, 2018, on rock placement, munition clearance and mattress installation in Finnish EEZ.
21.4.2018	Delivery of pipeline location data (coordinates) for the overall project
2.7.2018	General Implementation Plan on start of pipelay of Line A in the Finnish EEZ.
13.8.2018	Amendment to the General Implementation Plan, submitted on July 2, 2018, for Nord Stream 2 pipelay activities for Line A in the Finnish EEZ
24.8.2018	Notification on the use of a tug at Kalbådagrund TSS area
21.9.2018	Second amendment to the General Implementation Plan, submitted March 26, 2018, on rock placement, munition clearance and mattress installation in the Finnish EEZ
19.10.2018	Notification on schedule update for Solitaire in the Finnish EEZ
9.11.2018	Notification on change of pipelay vessel. Pioneering Spirit to replace Solitaire in December 2018.
28.11.2018	Amendment to the General Implementation Plan for pipelay of Line A in the Finnish EEZ. Fortitude as survey vessel for Pioneering Spirit.
18.12.2018	Notification on additional vessel and change in the scope of work for Fortitude

In addition, the Nord Stream 2 construction vessels have provided weekly and daily authority notifications regarding the progress and scheduling of construction activities under the EEZ and Water Permits.

Notifications related to unplanned events are presented in chapter 2.8.

2

**CONSTRUCTION ACTIVITIES
DURING 2018**

2 CONSTRUCTION ACTIVITIES DURING 2018

2.1 Timing of construction activities

The construction activities during 2018 included munitions clearance, rock placement, mattress installation and pipelay of Line A (Table 4).

Munitions clearance started on May 3, 2018 and was completed on June 6, 2018.

The first rock placement campaign in Finland started on April 29, 2018 and it was completed on June 15, 2018. Rock placement continued on August 24, 2018 until the end of November.

Mattress installation at the pipeline and cable crossings started on June 30, 2018 with pre-installation surveys. The actual installation of mattresses in the Finnish EEZ started on July 1, 2018 and it was finished in mid-October.

The pipelay of Line A commenced on September 5, 2018 and continued throughout 2018. The construction of Line A continued until February 5, 2019 when the pipelay vessel entered the Swedish EEZ. The final approximately 2 km section of Line A in the Finnish EEZ at the Russian border was finalised in April 2019. Line B is planned to be laid during the summer period of 2019. Both lines are expected to be laid by the end of 2019, after which the pipelines will be taken into operation.

Table 4. Construction activities during 2018.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Munitions clearance												
Pre-lay rock placement												
Post-lay rock placement												
Mattress installation												
Pipelay of Line A												

2.2 Activities performed and vessels used in 2018

The offshore operations in the Finnish EEZ involved several survey vessels, two munitions clearance fleets (each with two vessels; one clearance vessel and one big bubble curtain vessel), several dynamic positioned (DP) rock placement vessels, DP mattresses installation offshore construction vessels, two DP pipelay vessels and supply vessels for these activities. The overall construction schedule and the main vessels used are presented in Figure 3.

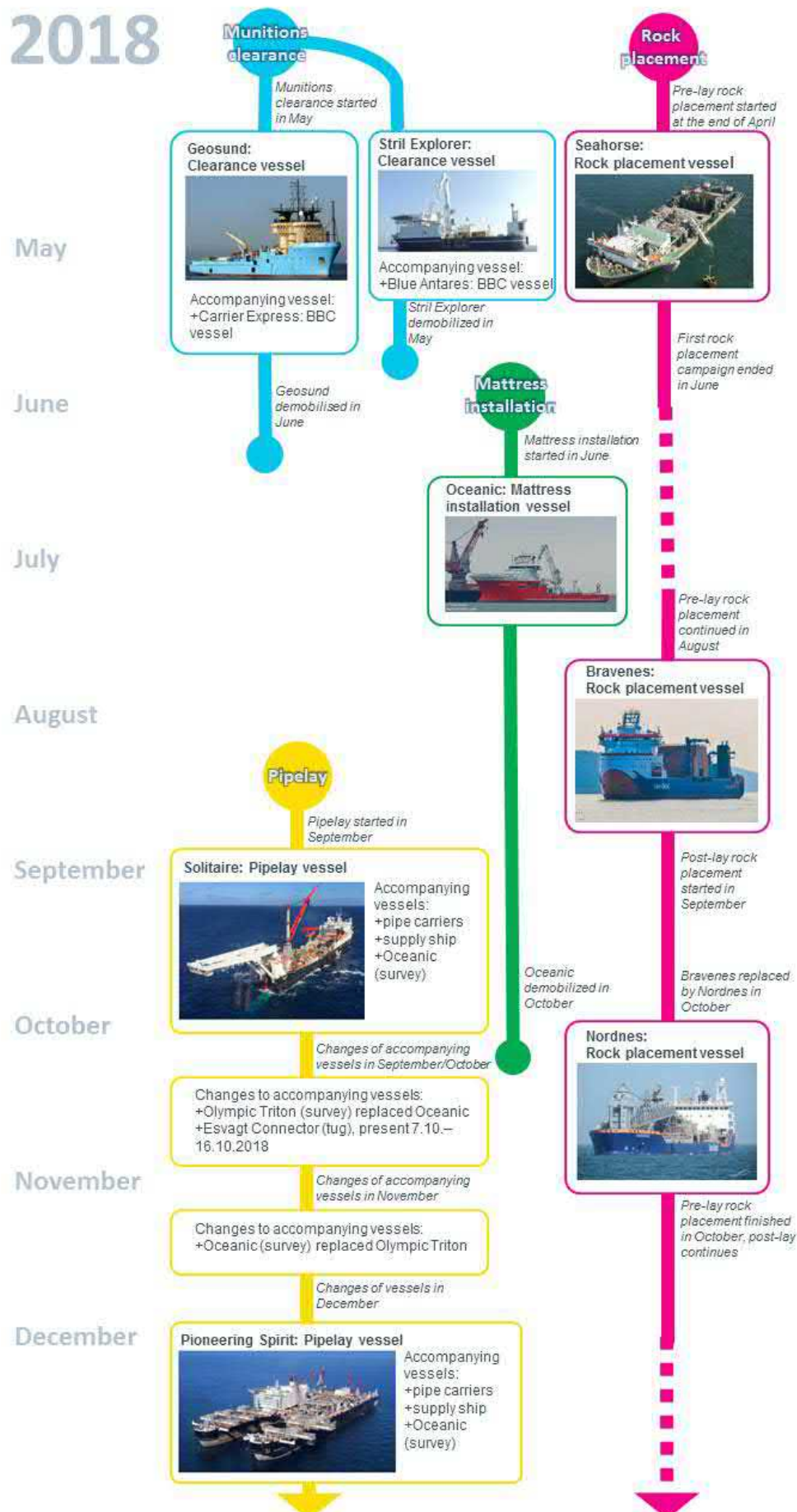


Figure 3. Vessels performing construction works for the Nord Stream 2 project in the Finnish EEZ.

2.3 Surveys

The construction of Nord Stream 2 pipelines requires numerous surveys to ensure the safe installation of the pipelines and associated structures according to the required specifications /3/. During the design and planning phase of the project (2015 to 2017), detailed corridor surveys took place. These were used as basis for environmental impact assessments. Surveys have been described in more detail in the EIA report, chapter 4.1.3 /4/. Different survey corridors around the pipeline routes are shown in Figure 4.

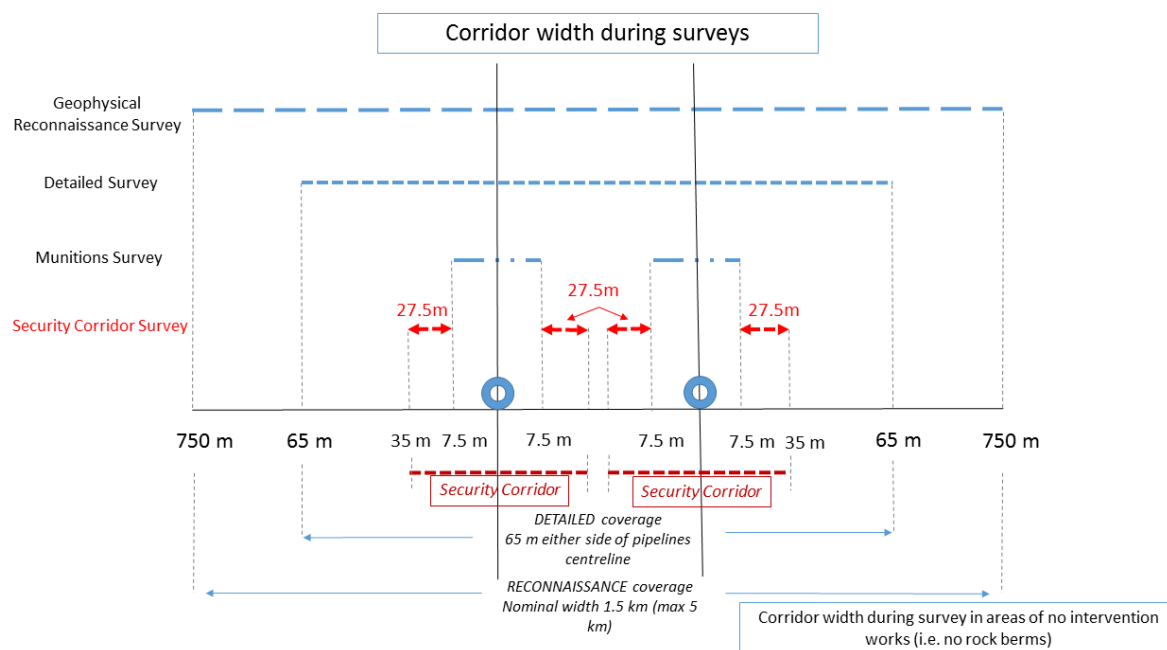


Figure 4. Corridor widths around the planned pipeline routes. (Adapted from /4/).

Surveys supporting engineering included reconnaissance surveys, geotechnical surveys, detailed geophysical surveys and visual surveys. Reconnaissance surveys were carried out to identify the best route for the pipelines based on information on geological and anthropogenic features. The surveys covered corridors of various width (from 1.5 km to 5 km in the Finnish EEZ) and utilized side-scan sonar, sub-bottom profiler, multibeam echo sounder and magnetometer. Geotechnical surveys were performed to optimise the pipeline route and detail design including the required seabed interventions to ensure the long-term integrity of the pipeline system. Visual surveys were performed to identify different kinds of objects on the seabed, e.g. ship wrecks and munitions (Figure 5). The surveys were



Figure 5. An ROV from Stril Explorer was used in the munitions survey. Photo: © Nord Stream 2 AG 2018 / Axel Schmidt.

conducted using devices, such as a video camera or a multibeam echo sounder (MBES) mounted on an ROV (Remotely operated vehicle) (Figure 6).

Surveys supporting construction include pre-lay surveys, construction support surveys, as-laid surveys and as-built surveys. The scope of the pre-lay survey was to confirm the previous bathymetric survey and to ensure that no new obstacles are present on the seabed.

Construction support surveys include touch down monitoring where required and any ad hoc survey activities, for which the need may arise during pipeline construction. In touch down monitoring the actual touch down point of the pipeline is observed on the seabed. This will ensure that the pipeline is laid in the correct position. These construction support surveys were performed by the pipelay fleet survey vessels Oceanic and Olympic Triton.

As-laid survey for Line A was conducted after pipelay to ensure that the pipeline is correctly installed, stable and up to specifications. The survey establishes the as-laid position and condition of the pipeline, as well as any free-spans present. A variety of geophysical survey equipment was used: MBES, side-scan sonars, sub-bottom profilers, pipe-tracker and magnetometers, as well as ROVs for visual inspection works. Seven as-laid surveys covering the sections installed in 2018 were performed by the pipelay fleet survey vessels.



Figure 6. An ROV inspecting post-lay berm. Figure: © Van Oord 2019.

Surveys supporting construction continue in 2019. After the construction work is complete, an as-built survey will be conducted to create the final record of installed structures.

2.4 Munition clearance

2.4.1 Description of clearance activities

The seabed of the Baltic Sea is scattered with unexploded World War I and II munitions. The Nord Stream 2 pipeline installation and security corridors were surveyed for munitions during the planning phase (e.g. /5, 6/). The pipeline route was optimized to avoid munitions to the extent possible. However, some munitions had to be cleared to ensure the safe installation and operation of the pipeline.

The scope of munitions clearance included the clearance and/or disposal of unexploded ordnance at the locations identified by Nord Stream 2 during the planning phase and for any further “chance finds” identified during the work, in order to create a safe construction corridor prior to construction works. Most munitions were cleared on site utilizing a donor charge. Three munitions were relocated prior to detonation.

The results of the clearance works are presented in the munition clearance contractors’ summary reports /7, 8/ as well as in the individual clearance reports e.g. /9, 10/.



Figure 7. Munitions clearance vessel Stril Explorer and supporting bubble curtain vessel Blue Antares at work. Photo: © Nord Stream 2 AG 2018 / Axel Schmidt.

Munition clearance was performed by two fleets; MMT/Ramora and N-Sea/Bodac (Figure 7). Out of 87 planned clearance targets, 15 were found not to be munitions in the final pre-survey performed during the preparation of the individual clearance plans. Additionally, two chance finds were cleared. The total number of cleared munitions was 74 (Table 5 and Figure 8). Out of 74, MMT/Ramora cleared 30 munitions and N-Sea/Bodac 44 munitions /7, 8/.

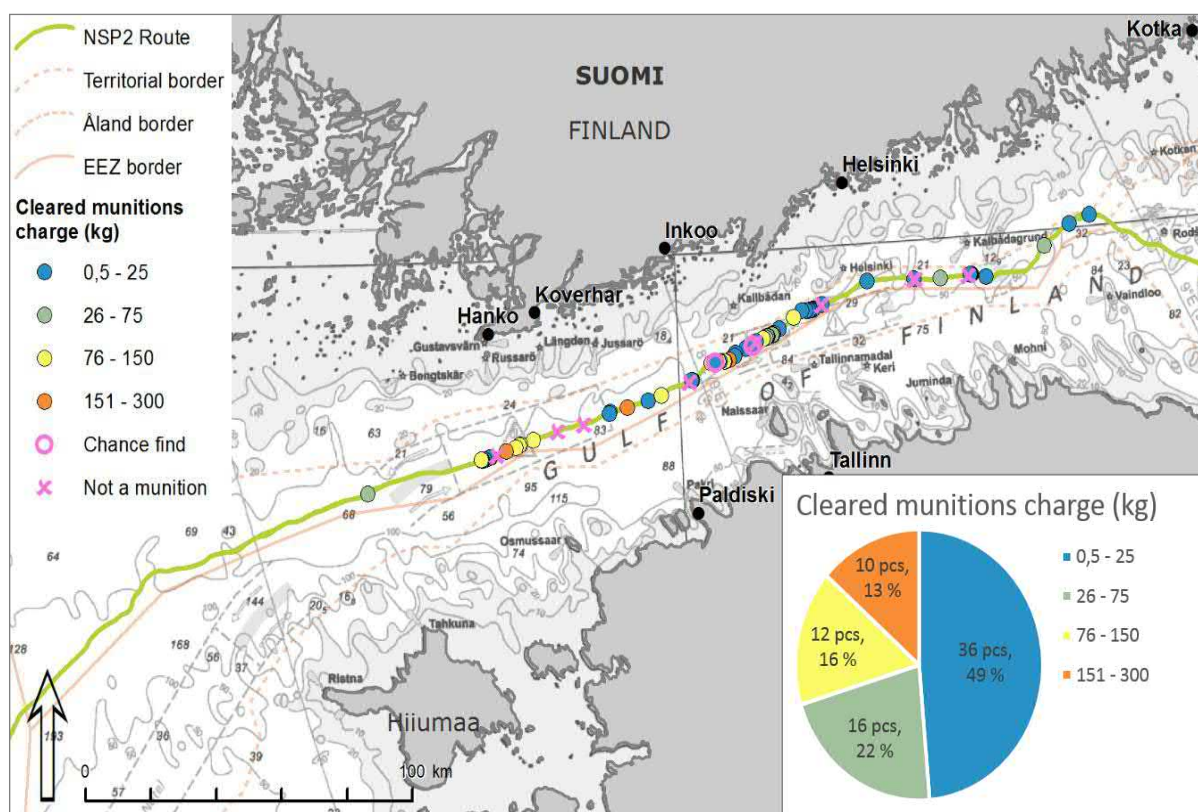


Figure 8. In total 74 munitions were cleared. During clearance 15 targets were identified not to be munitions and two chance finds were cleared.

Table 5. Munition clearance campaign from May 5, 2018 to June 6, 2018.

	Planned	Actual	Difference between planned and actual
Munitions clearance	87 No.	74 No.	15 objects were found not to be munitions*, additionally 2 chance finds were cleared.
Use of big bubble curtain	80 No.	58 No.	26 munitions had a total NEQ** smaller than 22 kg and of these, 16 were cleared without bubble curtain. In addition, 15 were not munitions and therefore did not require clearance.
Donor charge	15 kg	2.5–10 kg	The donor charges were 10, 5 or 2.5 kg, out of which 5 kg was most commonly used.
Charge	2–795 kg	0.5–300 kg	The total NEQ of all munitions was either smaller or equal to the estimated values. Small increases in munition sizes (max of 4 kg) were compensated by the use of smaller donor charge.

* 1 object was not found, 1 was left in situ, 13 were recovered to deck

** the total net explosive quantity NEQ (munition charge plus donor charge)

Munitions clearance contractors developed Environmental Management Plans (based on ISO 14001), which as a minimum included:

- Commitments from National and Espoo EIAs
- Development of procedures to achieve the environmental objectives
- Mitigation measures and implementation plan
- Waste management and disposal plans for recovered 'debris' associated with the munitions clearance
- Ship traffic management plan to interface with the national maritime authorities, ensuring the safety of third-party shipping

To reduce or attenuate the acoustic noise from the detonation, thus mitigating noise levels, bubble curtains were used based on the following criteria:

- if the total net explosive quantity (NEQ)** of target was larger than 22 kg,
- within a sensitive marine environment (i.e. east of GKP 174)
- or requested by a cable owner of with a cable within a 500 m security corridor

Munitions were cleared in line with individual clearance plans. The clearance plans include a re-assessment of the target and the sequence of the clearance work e.g. /11/. The sequence of work describes the security warnings, monitoring and mitigations applied during each munition clearance event (Figure 9).

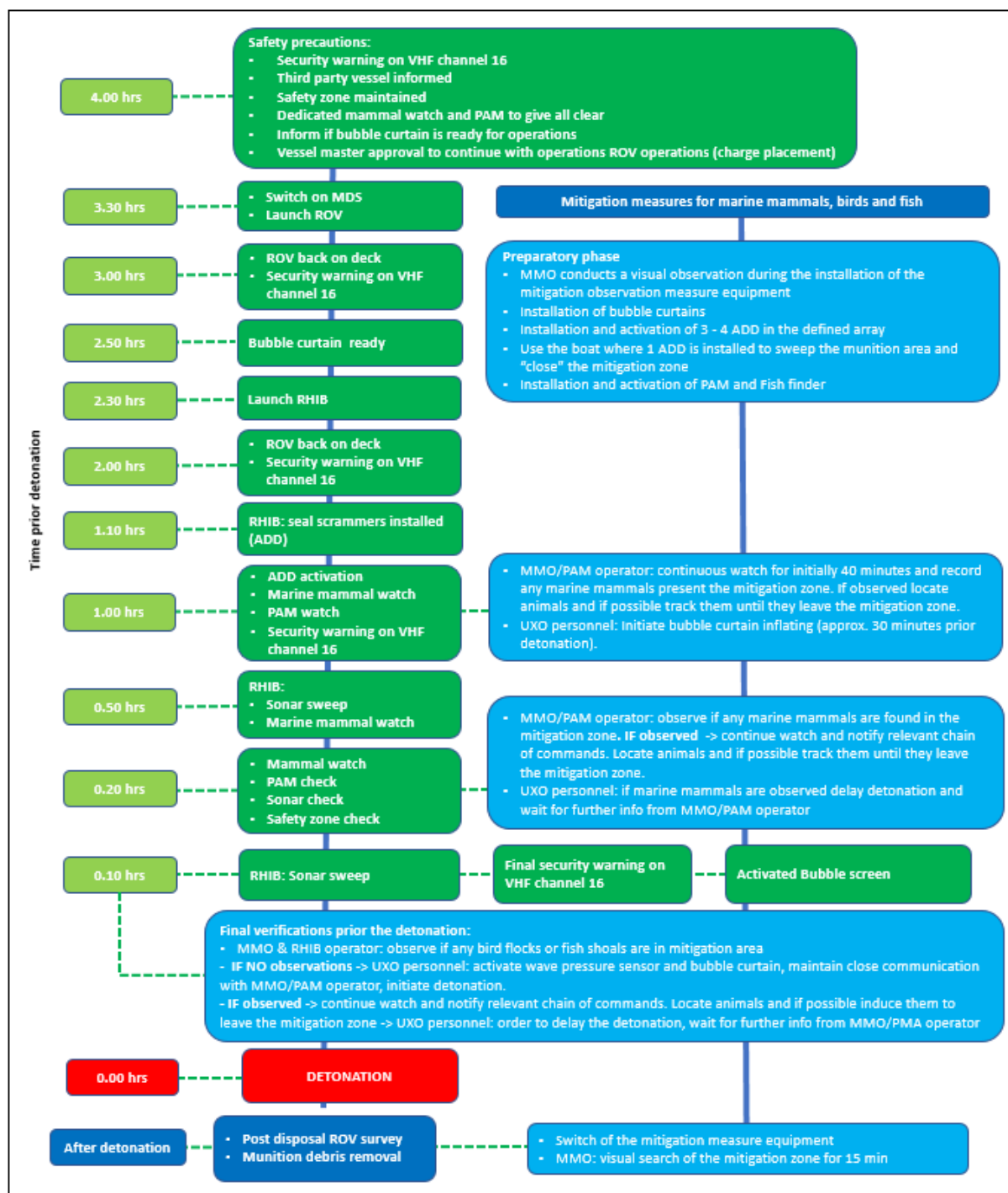


Figure 9. Sequence of work for munition clearance events. Modified from N-Sea/Bodac Clearance plan /11/ and Nord Stream 2 Guidance Note /12/.

The actual charge of the munitions was either comparable to the charge presented in the permit application or smaller. The duration of the munition clearance campaign was shorter than planned (1 clearance/fleet/day) because of the reduced scope (15 objects were re-assessed not to be munitions) and favourable weather conditions allowing uninterrupted operation, including clearance of more than one munition object a day on several occasions. All munitions were cleared during daylight and ice-free period with safety zones as defined in the water permit decisions. Before and after the detonations, the condition of cables and pipelines within a 500 meters radius were inspected, and no disturbances due to the detonations were observed. After the detonations, remains larger than a certain size were removed from the clearance area.

Two chance finds were added to the scope of the campaign. These were identified through additional inspections of previously identified targets. One was re-evaluated as a Russian depth mine with a 25 kg charge, and the other as a Russian fish mine with a 10 kg charge. Both were interpreted as boulders after the initial survey in July 2016. Rerouting of the pipelines was not feasible because of uneven seabed, so these two munitions were cleared.

Three munitions were relocated prior to clearance. One shell munition was relocated prior to detonation due to the sloped and rugged seabed topography, which would not have allowed the deployment of a big bubble curtain at the original location /9/. The two other munitions, depth charges, were relocated due to their proximity to cables /13, 14/.

2.4.2 Monitoring and mitigation measures

During munition clearance the contractors were responsible for the implementation of mitigation measures in line with Great Britain's Joint Nature Conservation Committee (JNCC) / guidelines/15/.

NSP2 project provided a procedure for the deployment of mitigation measures for marine mammals, fish and birds for the munition clearance operators /12/. The procedure follows the JNCC Guidelines for minimizing the risk of injury to marine mammals from using explosives /15/. The NSP2 procedure instructs, as minimum requirements, the use of the following devices/personnel:

- 4 Acoustic deterrent devices (ADD)
- 1 Marine mammal observer (MMO)
- 1 Passive acoustic monitoring device (PAM)
- 1 Fish finders (additional)
- 1 Big bubble curtain
- 1 Pressure wave sensor

"Mitigation zone" is defined by the JNCC Guidelines as the area having a radius of 1 m around the munition to be cleared /15/. In order to ensure that no marine mammals are within the effective range of the ADDs, the mitigation zone considered was at least 1 km and up to 2 km (if possible). Implemented mitigation measures are described in Figure 9. According to the clearance reports, both contractors followed the given procedure /7, 8/ as described in Table 6.

Concerning ship traffic, a safety zone of 1.5–2.5 km radius was established around the munition clearance sites, depending on the size of the munition.

Table 6. Implemented mitigation measures.

Action	N-Sea/Bodac (44 detonations)	MMT Sweden Ab/Ramora (30 detonations)
ADD	Four seal deterrent devices (ADD) were deployed and a watch carried out to ascertain that no cetaceans were present. Applied in all detonations.	Targets disposed in the period between May 13th and May 17th were conducted with three ADDs, the targets disposed during the period were smaller than 100 kg. For the rest of the targets 4 ADD's were used. Applied in all detonations.
MMO	Marine Mammal Observer was on board. Observation minimum radius was 1 km diameter, but up to 2 km. Observation time was minimum 1 h. Applied in all detonations.	The MMO observations were conducted according to JNCC guidelines. The visibility for marine mammal observation was at least 1 km, except four locations, where weather conditions reduced the observation radius. Observation time was a minimum 1 h. Applied in all detonations.
PAM	For a period of minimum 1 hour prior to each scheduled detonation. Applied in all detonations.	Deployment of PAM observations were conducted according to each Disposal Plan prior to and following detonation. PAM was started a minimum of 1 h prior to detonation and it continued throughout operations. Applied in all detonations.
Fish finders	Prior to initiation of the charge, a sweep of the area was performed to check for schools of fish within the area of influence of the munition detonation. Applied in all detonations.	MMO observation. Applied in all detonations.
Bubble curtain	Applied in all needed detonations (40 cases)	Applied in all needed detonations (18 cases)
Pressure wave sensor	Passive hydrophone yielded peak pressure measurements which were used to assess explosive noise as a function of range. Applied in all detonations.	Acoustic monitoring equipment was deployed from the main disposal vessel to record the peak pressure of the detonation blast. Applied in all detonations.

During the clearance of the 74 munitions, both contractors followed the NSP2 procedures with regards to mitigation measures. Both contractors deployed three to four seal deterrent devices, conducted a minimum of one-hour passive acoustic monitoring and measured peak pressure of the detonation blast during all clearances. Marine mammal observer was used for every clearance. Observation was conducted with a minimum observation time of one hour and a minimum observation radius of 1 km. In four cases out of 74, the radius was between 0,5 – 1 km due to reduced visibility. Big bubble curtains (Figure 10) were deployed for all munitions fulfilling the criteria for the use of big bubble curtains, altogether in 58 cases out of 74. During the operations, no marine mammals were observed. Some bird activity was observed during the pre-watch, however before detonation no birds were detected in the vicinity of the detonation area. During the post-detonation survey, seabirds were observed in the mitigation area for 17 munitions (23 % of the operations). Some fish kills were detected during the post-detonation survey for 55 munitions (74 % of the operations).

Underwater noise, sediment spill and marine mammal impacts caused by munition clearance are discussed in chapters 4.2, 4.3, 5.1 and 5.2.



Figure 10. Big bubble curtain was applied to mitigate underwater noise of munition clearance operations. Photo: © Nord Steam 2 AG 2018 / Axel Schmidt.

2.5 Rock placement

2.5.1 Description of rock placement

The term 'rock placement' refers to the use of rock to locally reshape the seabed before or after pipelay, thereby providing support to the pipelines to ensure their long-term integrity. Rock placement is required for example for free-span correction and for the crossings with other pipelines. Most of the rock material is used for pre- and post-lay stress/free-span correction berms (Figure 11). The size and shape of each rock berm are individually designed in order to ensure the required pipeline support and/or protection.

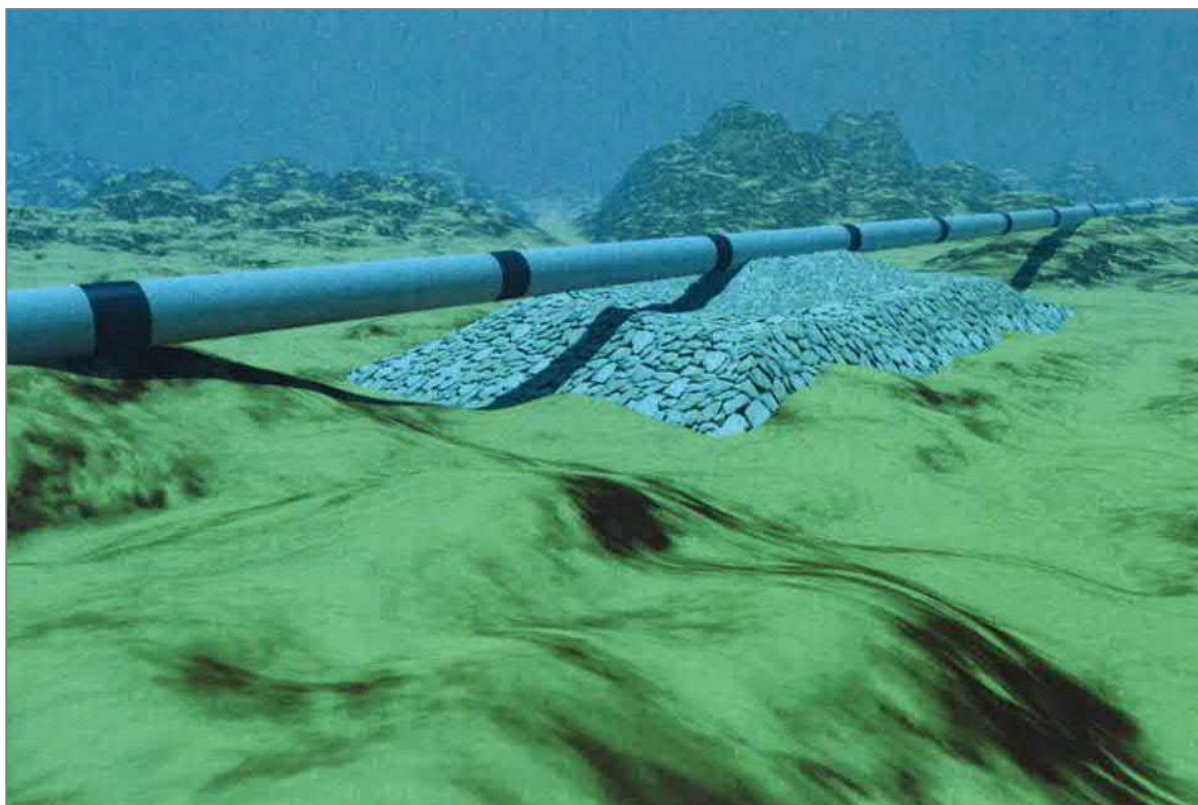


Figure 11. Visualization of a typical pre-lay stress/freespan correction rock berm /16/.

New and un-weathered granite used for berm construction was acquired from Rudus Oy's Rajavuori quarry in Kotka and from Inkoo quarry, Finland. The rock material is chemically stable for the 50-year-long lifetime of the pipelines. The average size of the rock material is 50–70 mm (total range from 16 to 125 mm) /17/. The material used does not contain any contaminants, such as heavy metals, that can be released in the water environment. In addition, it is clean, i.e. does not contain any clay, silt, lime, vegetation or other scattering constituents or any additional waste materials.

Continuous quality control for rock material is carried out at the quarries. Testing during rock production is part of the quarry quality procedure and is described in the inspection and test plan /17/. Particle size distribution is tested according to the test standard BS EN 993-1 once per 5,000 t (3,200 m³*) and dry bulk density is tested once per 15,000 t (9,600 m³*). In addition, visual inspection is carried out for all the rock material. Rock material that does not meet quality specifications, is not used.

Securing cleanliness of the rock material starts with the selection of high-quality natural rock as raw material. In the beginning of extraction, explosives used in detonations and their housing pots are eradicated. After blasting, clean rock and dirty rock containing sub-soils are placed into separate stock areas, and the dirty rock requires segregation before entering the clean rock area. The clean rock is then further reduced in size and transferred to the crushing area. The rock crushing process allows for fine-grained rock material or other quality reducing materials, such as plastic, to be removed through the sieving processes. Processed rock material is placed into the storage area prior to transportation. In order to prevent dusting, the storage piles are watered in the quarry and at the port storage area.

In Kotka, rock material is transported by trucks from the quarry to the temporary rock storage site in Mussalo port. The rock transport method statement, prepared by the Contractor Boskalis Van Oord,

* Installed volume was notified to Nord Stream 2 by contractors as tonnes (t), which was converted to cubic meters using factor 1/1.5625.

describes the details and requirements for handling and transporting of rock material from Rajavuori quarry to Mussalo Port. The descriptions in the method statement ensure that all personnel involved in the transportation activities know their respective task and assure that all operations are conducted in a safe manner /18/. Traffic management related to the transport was discussed with the City of Kotka and the Southeast Finland ELY Centre in a meeting in November 2017. The views from the authorities were implemented in the final document.

In Inkoo the rock material transport from the quarry to the vessel-loading is done entirely within the port area.

The rock material is transported from the port to the rock placement site by a fall pipe vessel. Dynamically positioned fall-pipe vessels Seahorse, Bravenes and Nordnes were used for the rock placement works in 2018. The rock material is loaded into the fall-pipe by conveyors on the vessel and placed onto the bottom through the fall-pipe, which extends through the water column. The lower end of the fall-pipe is equipped with nozzles to allow precise shaping of each rock berm (Figure 12).

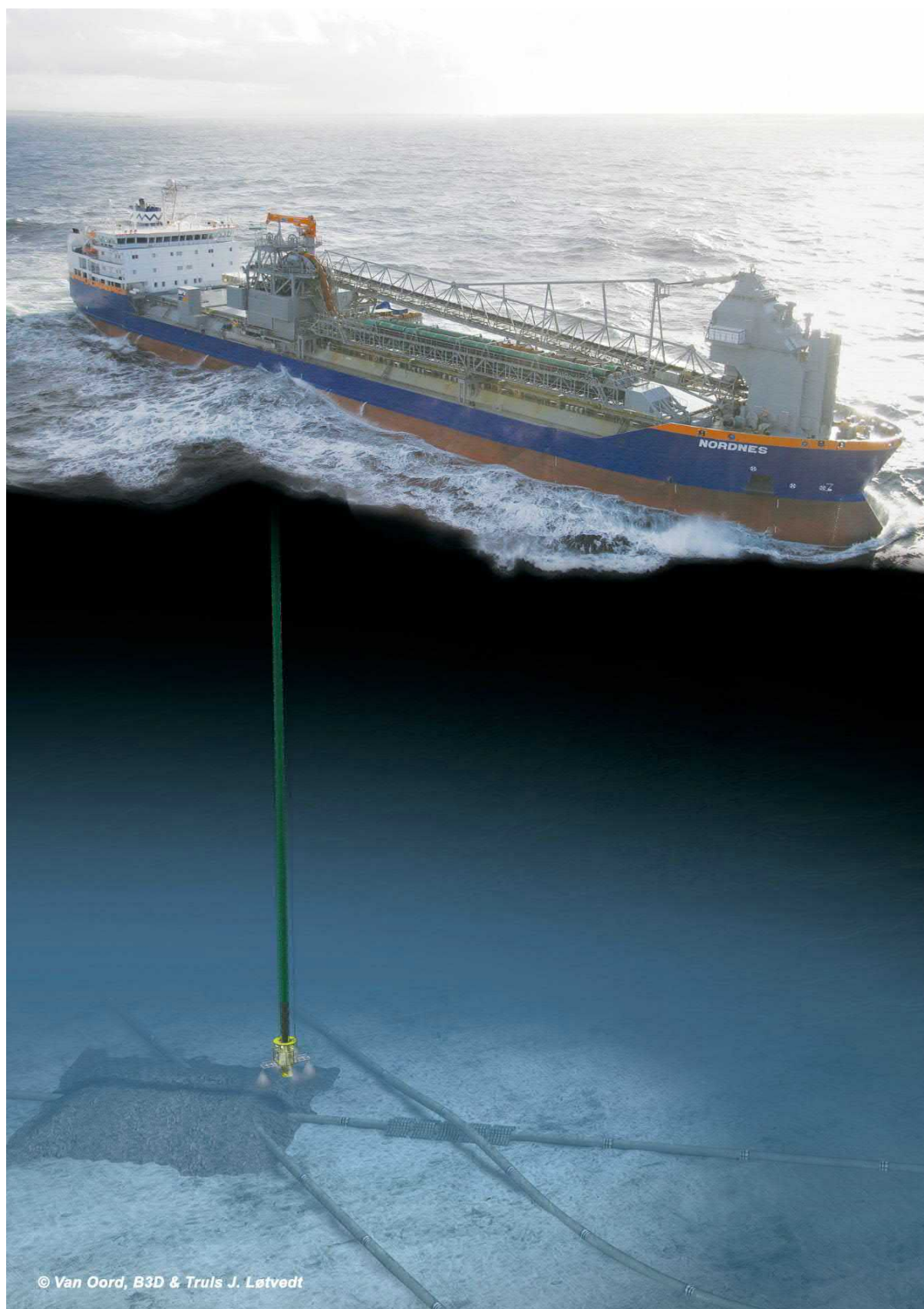


Figure 12. Post-lay rock placement using a fall-pipe. Figure: © Van Oord 2019.

Most rock placement works during 2018 took place east of Inkoo, Finland (GKP 255, Figure 13). The first pre-lay rock placement campaign by Seahorse took place from April 29, 2018 to June 15, 2018. Rock

placement resumed after a summer pause on August 24, 2018. Rock placement was conducted by vessel Bravenes (Figure 14) until October 3, 2018, after which the work was continued by Nordnes. Post-lay placement was initiated on September 15, 2018 and will be completed after pipelay. The last pre-lay berm constructed during 2018 was completed on October 21, after which the work continued solely with post-lay rock placement. Pre-lay rock placement was completed for Lines A and B, and post-lay began only for Line A. The responsible contractors were Boskalis Offshore Contracting B.V. and Van Oord Offshore B.V. (BoVO).

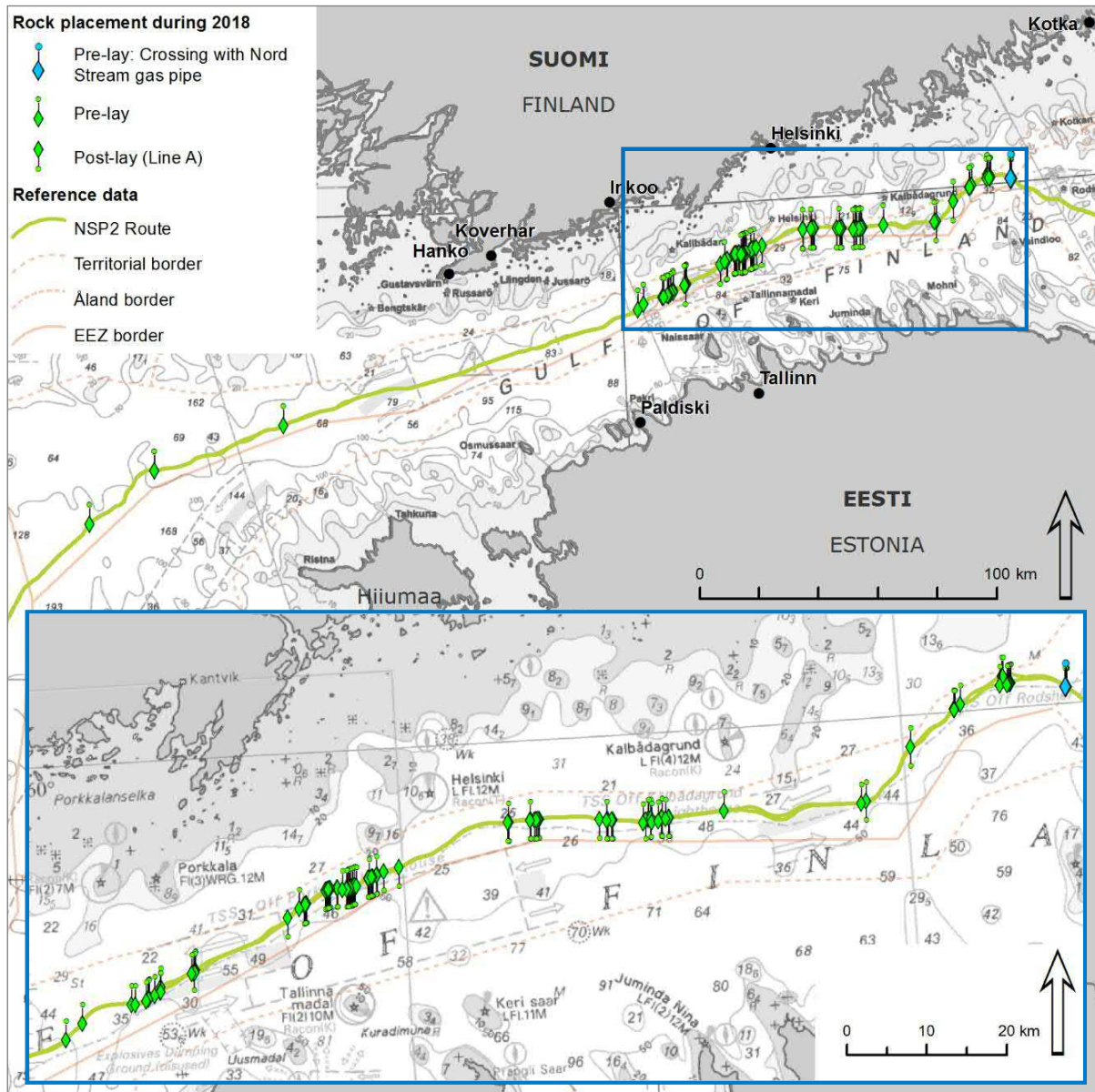


Figure 13. Rock placement in the Finnish EEZ during 2018. The lower map shows the selected area (blue frame) in more detail.

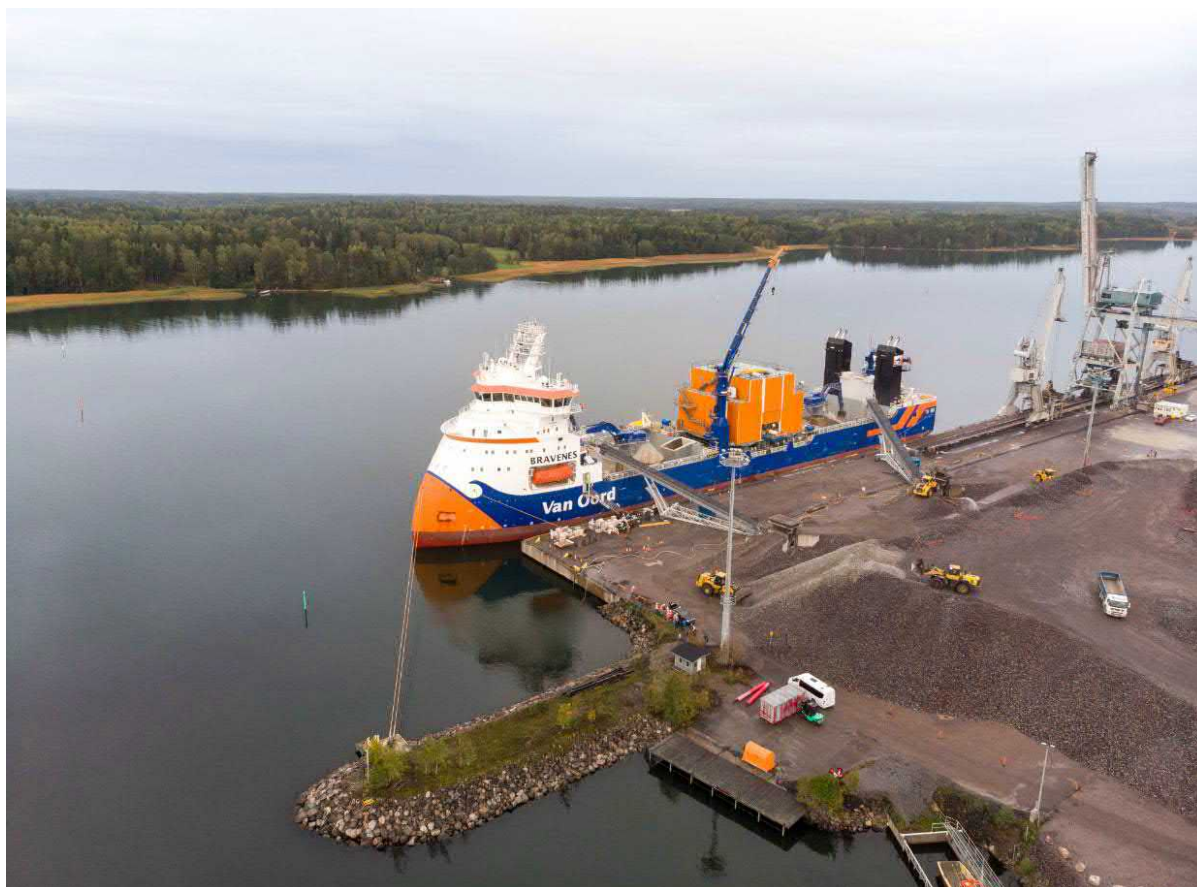


Figure 14. Rock placement vessel Bravenes loading at Inkoo Port. Photo: © Nord Stream 2 AG 2018 / Thomas Eugster.

The volume of placed rock material during 2018 was 478,700 m³ (Table 7). Approximately 65 % of the rock material was installed for Line A and 35 % for Line B. The number of finalized berms in 2018 was 144 (one berm can include rock placement in several phases) including 69 pre-lay berms and 87 post-lay berms, and five later top-ups. The volumes of installed individual berms varied between 186 m³ and 16,000 m³.

Table 7. Rock placement status in the end of 2018 (53/2018/2, /19/).

Berm type	Installed volume 2018*	Water permit estimation
Pipeline crossings (pre-lay)	40,200 m ³	37,300 m ³
Stress/freespan correction	377,400 m ³	901,100 m ³
Pre-lay	256,400 m ³	
Post-lay	121,000 m ³	
In-service buckling mitigation (post-lay)	57,000 m ³	352,600 m ³
Spot gravel placement for on-bottom stability (post-lay)	4,100 m ³	39,600 m ³
Total	478,700 m ³	1,330,600 m ³
Total rock volume including allowances losses and installation tolerances	---	1,703,000 m ³

* Installed volume was notified to Nord Stream 2 by contractors as tonnes (t), which was converted to cubic meters using factor 1/1.5625.

2.5.2 Monitoring and mitigation measures

The status of the seabed prior to rock placement was surveyed before seabed intervention works /3/. For the monitoring of berm installation, an ROV-device was mounted to the lower end of the fall pipe /20/ also allowing to minimize the amount of used rock material and thus the impacts on water quality.

The volume of rock is recorded with profiles and 3D-modelling to provide quality control. Upon completion of rock placement at individual berms, a survey is conducted to ensure that the shape of the rock berm is as designed /3/.

In order to minimize risks involving third party ship traffic, a 500 m wide safety zone was established around the rock placement vessels /20, 21/ when working at the site.

A few long-term scientific monitoring stations are located near the pipeline route. Regarding potential impact on scientific heritage, NSP2 project agreed with the Finnish Environmental Institute (SYKE) that neither munition clearance nor rock placement activities were to be performed simultaneously or just before the annual benthos monitoring campaign, which took place in June 2018. A minimum distance of 2 km was kept to the SYKE monitoring sites LL5, LL6A, LL7S and LL11 during and prior to the SYKE sampling campaign.

The potential impacts of rock placement on water quality and cultural heritage are discussed in chapters 4.3 and 4.4.

2.6 Mattress installations at infrastructure crossings

2.6.1 Description of mattress installation

The pipeline route crosses 29 existing and four planned cables in the Finnish EEZ. For cables with known owners, the crossings are constructed according to the cable-crossing agreement between Nord Stream 2 AG and the owner of the cable. Detailed information on the crossings was provided to the applicable cable/pipeline owner and written agreements have been signed for all known owners of active cables except one with whom negotiations are still ongoing.

The number and type of mattresses in the different project phases are presented in Table 8.

Table 8. Specifications of the number and dimensions of mattresses. Figures do not contain the crossings with the Nord Stream gas pipelines. (Source: Nord Stream 2 AG 2018).

	Water permit application 19.9.2017	Changes notified 3.7.2018	Final design
No. of biflex mattresses	app. 364	393	378
Dimensions of biflex mattresses	6 m x 2.5 m x 0.3 m	6 m x 3 m x 0.3 m	6 m x 3 m x 0.3 m
No. of rigid mattresses	app. 114	114	114
Dimensions of rigid mattresses	10 m x 3 m x 0.3 m	10 m x 3 m x 0.3 m	10 m x 3 m x 0.3 m
Total no. of mattresses	478	507	492

Active cables and pipelines

Active cables and cables, which have not been confirmed to be out of use, were protected with concrete support mattresses prior to pipelay in order to avoid any damage (Figure 15). Two types of mattresses were used: flexible multi-block concrete mattresses with tapered edges and rigid concrete beam

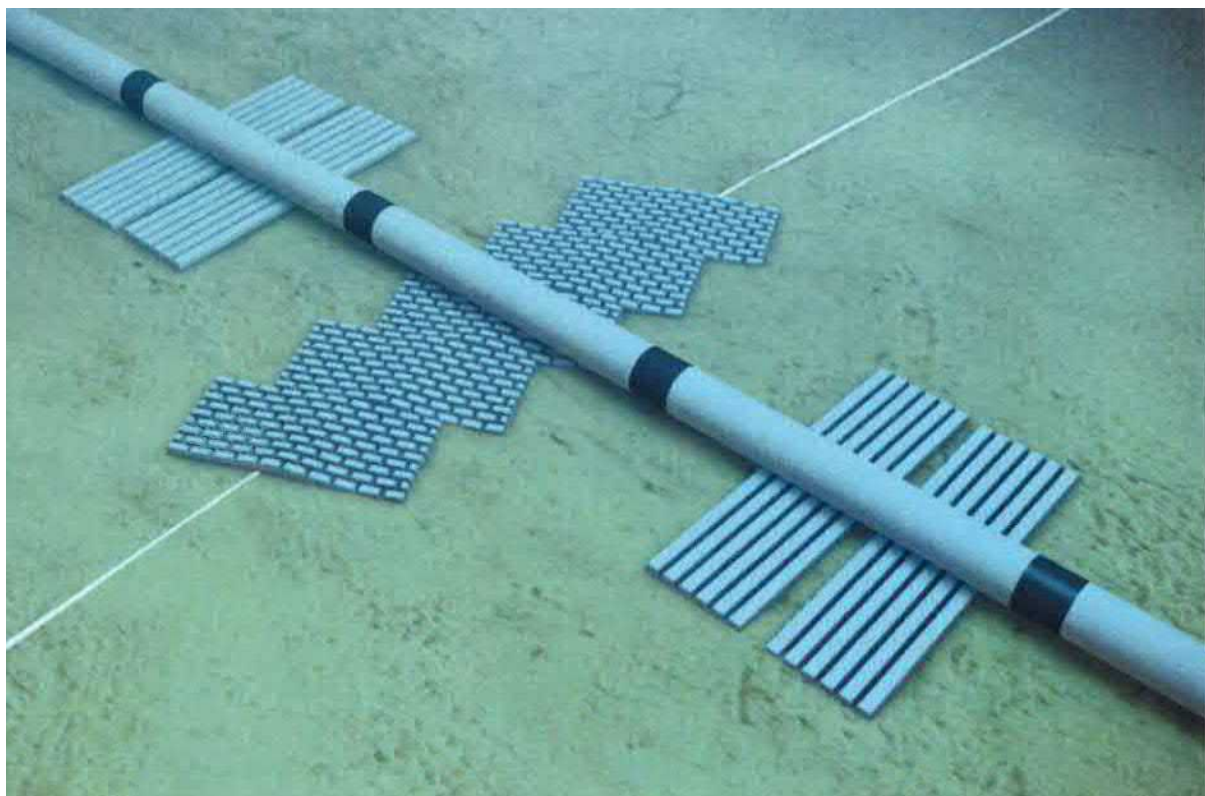


Figure 15. Visualization of a typical cable crossing. Biflex mattresses are placed between the cable and pipeline, and rigid mattresses support the pipeline below on both sides of the crossing /16/.

mattresses. No mattresses were used for cables confirmed to be out of use in the EIA-report, water permit application or the cable survey /4, 16, 22/.

Mattress installation in Finland started on June 30, 2018 with pre-installation surveys. Actual installation work commenced on July 1, 2018. During the latter half of 2018, 492 mattresses were installed for 43 cable crossings at Line A and for 39 cable crossings at Line B, as well as additional 12 mattresses for crossings with the Nord Stream pipeline. Installation works took place along the entire pipeline route, although works focused on the area between Inkoo, Helsinki and Tallinn (Figure 16).

2.6.2 Planned cables and pipelines

Since the submission of the water permit application, Elisa's Telecommunication (E-Finest) cable between Espoo and Tallinn has been granted a water permit (192/2018/2). Construction of the cable is expected to take place during 2019, and the cable will cross the NSP2 Line A. Based on the latest information, the cable is expected to be laid prior to the pipelay of the NSP2 Line B.

Eastern Light cable is a telecommunication cable between Finland and Sweden with potential future connection from Finland to Estonia and further south. A section between Parainen and Kotka was laid during the winter 2018–2019 /23/. The permitted and laid part of the cable does not cross the NSP2

pipelines. The owner of the planned LINX (East) cable is unknown. The cable had not been installed when the Line A was laid.

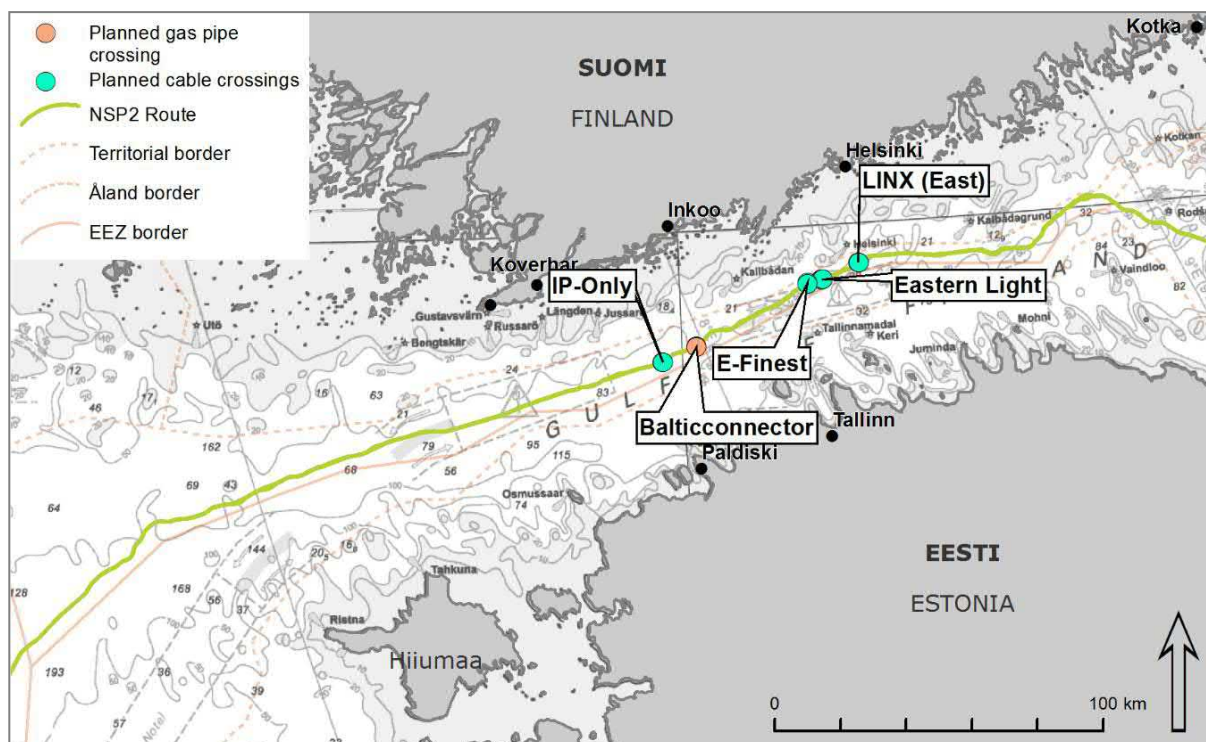


Figure 17. Crossings with planned cables and pipelines.

The planned IP-only cable crosses each pipeline twice. The cable had not yet been installed when the Line A was laid.

Balticconnector's construction plans were further developed after the submission of the NSP2 water permit application /24/. The revised plans required rerouting of the NSP2 Line A within the pipelay installation corridor (± 7.5 m, ± 15 m in curves). Since the NSP2 Line A was laid prior to the Balticconnector, no seabed intervention works were conducted for the preparation of the crossing area in 2018.

2.6.3 Monitoring and mitigation measures

Prior to mattress installation, pre-installation survey of the installation locations was performed by an ROV in order to assess the presence of debris and/or obstructions and to verify the status of the existing infrastructure. To detect cables, a survey was performed with the ROV moving along the proposed route of the pipeline at low speed (~ 0.4 m/s) and low altitude above the seabed. This survey obtained detailed bathymetrical information using multibeam system, pipetracker, cameras and sonar at 30 m range. The installation work itself was monitored by the ROV. After the installation of mattresses, the ROV carried out the as-built (using a MBES) and visual inspection in order to document that the mattress was installed correctly /25/.

During pipelay the actual touch down point of the pipeline on the seabed is monitored. In particular, this is done in curves, when placed over mattresses or on rock berms /3/.

In the end, all cable crossings are surveyed again as part of the as-laid-survey (Figure 18). After this, a final as-built drawing for each crossing location is prepared.

In order to minimize risks involving third-party ship traffic, a 500 m radius safety zone was established around the mattress installation vessels during the installation works /20/ on site. In addition, mattress installation was not carried out during winter ice conditions.

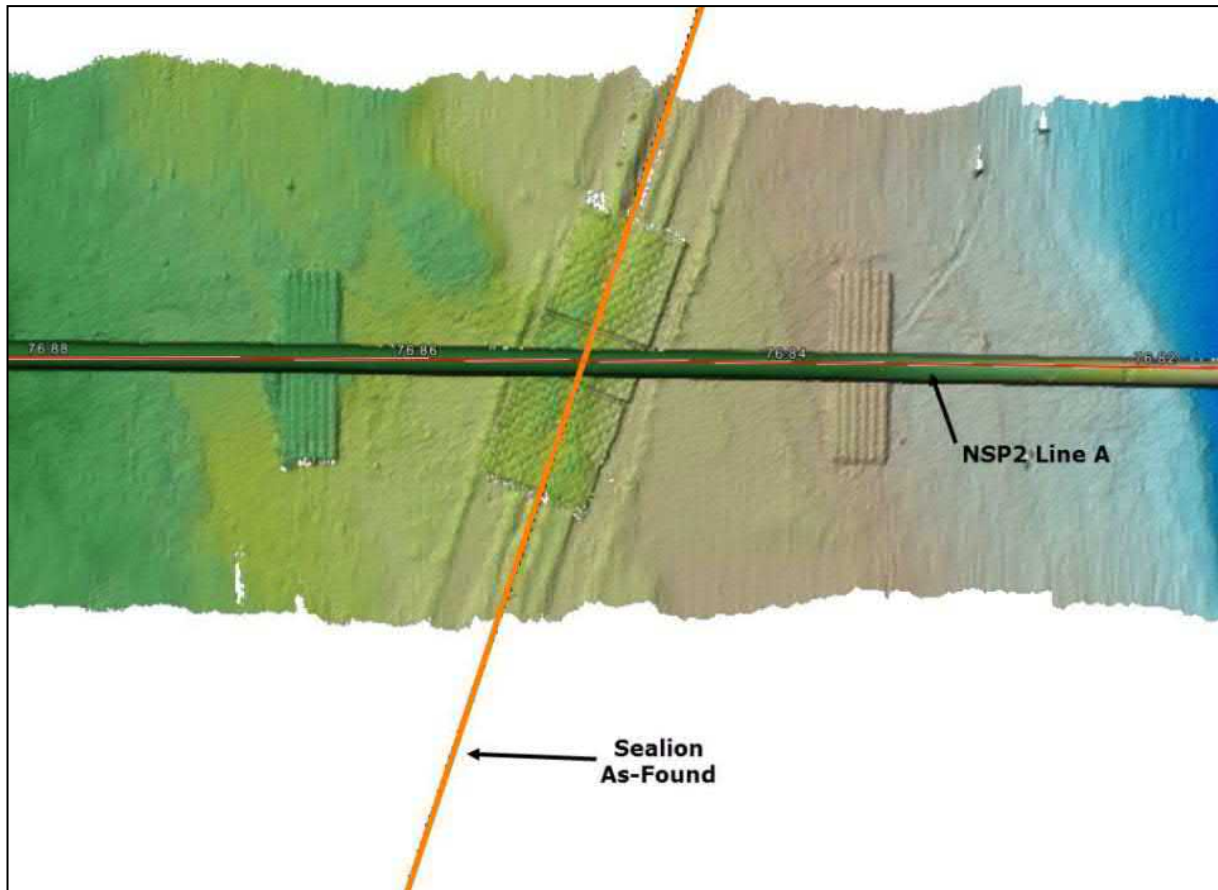


Figure 18. As-laid survey imagery from a cable crossing in the Finnish EEZ with installed mattresses /26/.

2.7 Pipelay

2.7.1 Description of pipelay

The pipelay vessel *Solitaire* commenced the pipelay of Line A on September 5, 2018 south of Porkkala (GKP 231) and continued eastward reaching position GKP 117 near the Russian territorial water border on October 27, 2018 (Figure 19).

The vessel transferred to Muuga Port, Estonia, for Azimuth thruster replacement (one of 10 thrusters) from October 29, 2018 to November 1, 2018. After that *Solitaire* transferred to position GKP 231 and commenced pipelay westwards on November 2, 2018. *Solitaire* reached position GKP 352 on December 19, 2018, laid down the pipeline and departed from Finland for the pipelay of Line B in the Swedish waters. The pipelay vessel *Pioneering Spirit* (Figure 19) replaced *Solitaire* and started pipelay from GKP 352 on December 22, 2018. She reached position GKP 376 on December 31, 2018.

Pipelay had eight short interruptions in 2018 due to weather conditions unsuitable for pipelay. When it is necessary to interrupt pipelay, the pipeline is abandoned in a controlled manner, and a special head is welded to the pipeline. A cable is connected to the head, after which the pipeline is laid on the seabed for later recovery.

Once weather conditions have improved, the vessel can recover the pipeline back onto the vessel. The cable is then disconnected, and the head is removed before regular pipelay continues.

Efficiency of pipelay during 2018 is presented below:

- approximately 260 kilometers of pipelay in 2018
- 103 days of effective pipelay
- pipelay at 29 cable crossings
- highest daily lay speed during the year was approximately 4.2 km/day for Pioneering Spirit and 3.6 km/day for Solitaire.
- effective average daily pipelay distance was 2.5 km in 2018 (including only the days of effective pipelay)

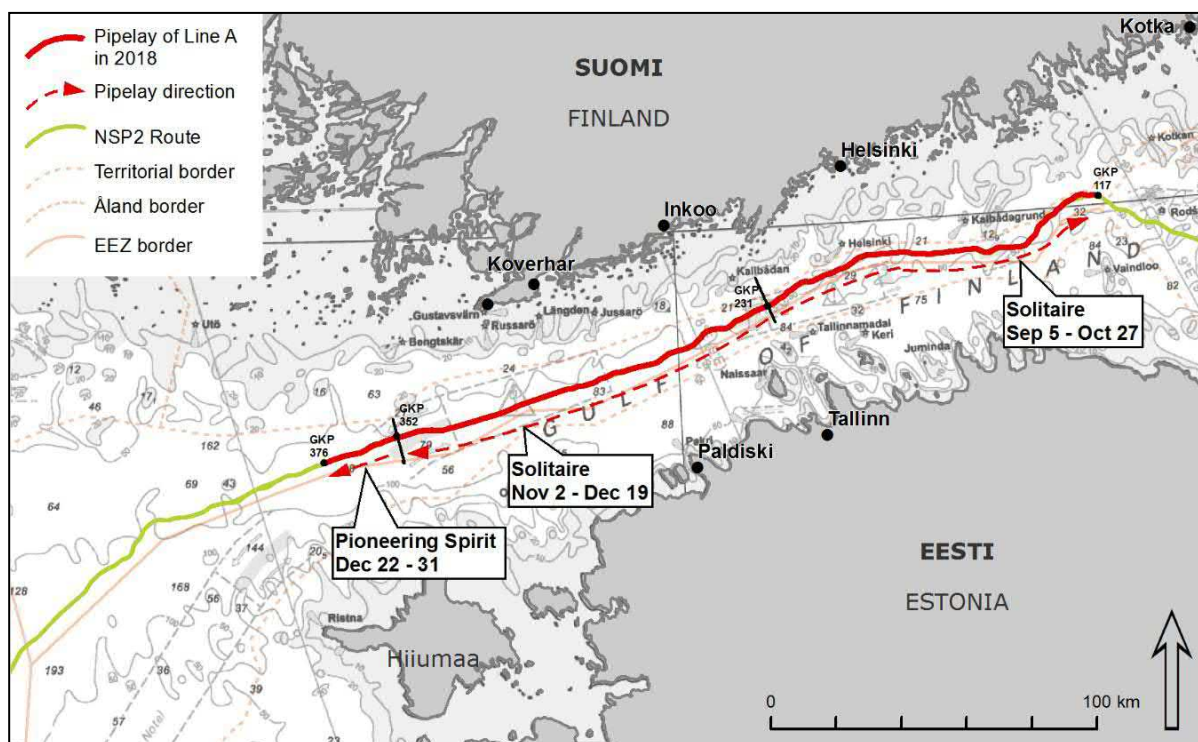


Figure 19. Pipelay of Line A during 2018 in the Finnish EEZ by the pipelay vessels Solitaire and Pioneering Spirit.

In the beginning of pipelay, MV Olympic Triton supported the Solitaire in the abandonment and recovery, touch down monitoring and pipelay. The OCV Oceanic took over the scope on October 26, 2018.

A tug, Esvagt Connector was stationed at the 13 m shallow southwest of Kalbådgrund lighthouse and to the north of the Kalbådgrund Traffic Separation Scheme, TSS (GKP 148–GKP 161) during pipelay installation operation from October 7, 2018 to October 16, 2018. This vessel was mobilized during the pipelay in order to respond to ship emergencies, such as danger of grounding, under the request of the Finnish Transport Agency. The tug was on standby to assist the contractor and third-party vessels by towing and pushing, if necessary. No such situations occurred in 2018.

2.7.2 Monitoring and mitigation measures

According to the water permit, the pipeline installation accuracy is ± 7.5 m from the centreline on a straight section and ± 15 m on a curve. Minor modifications may be carried out to the gas pipeline location in the installation phase (within the ± 35 m security corridor). Route changes may be carried out in order to reroute around munitions or other objects identified along the route.

To monitor the pipelay accuracy in relation to the centreline, an as-laid survey of the pipeline was conducted after pipelay. Altogether 290,004 data points were collected. Pipeline installation was locally adapted between GKP 255 and GKP 265 to accommodate the future further developed crossing

design with Balticconnector /24/. This can be seen as an 11.05 m deviation to south (Figure 20) and it represents the only exceedance of 7.5 m from the centreline.

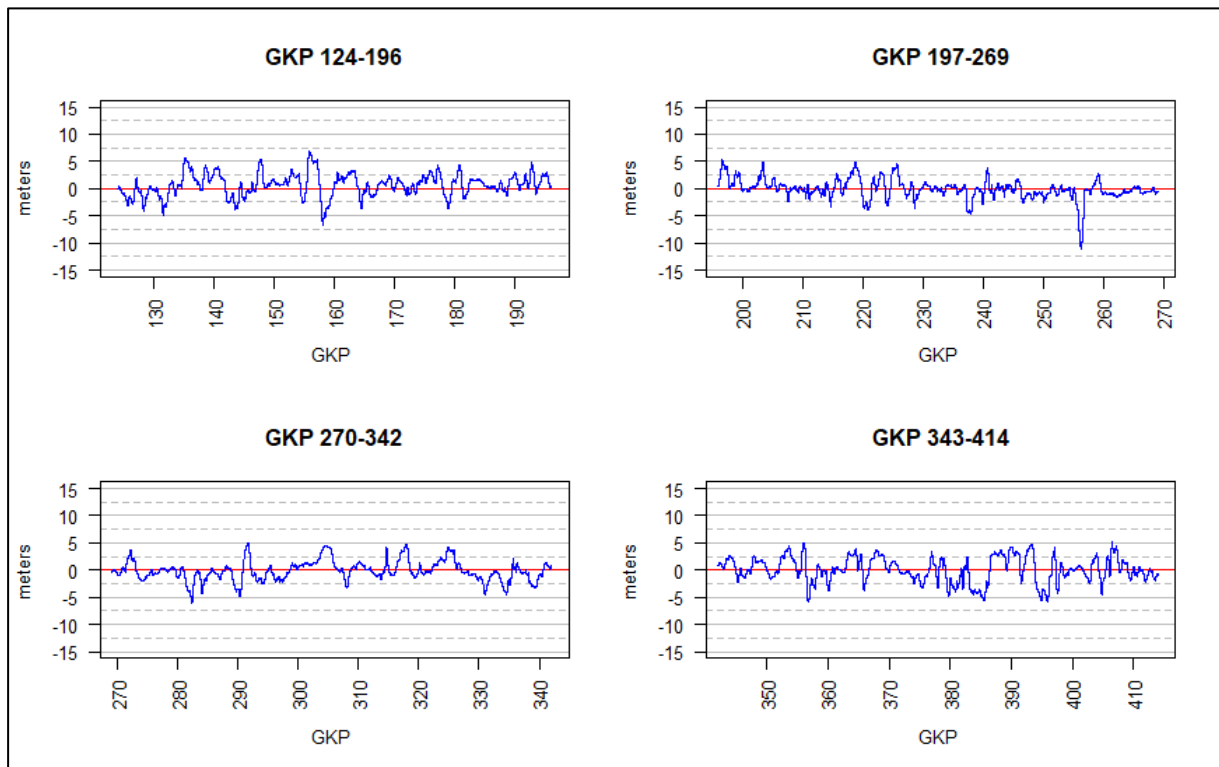


Figure 20. As-laid survey results. Figures describe the laid pipeline distance cross course (DCC) as horizontal 'perpendicular distance from the designed route.

DCC is negative (-) when the pipeline is laid to the south and positive (+) when the pipeline is laid to the north of the designed centreline. The red line represents the planned centreline (0). In the figure, pipelay is divided into four sections by GKP. /24, 26, 27, 28, 29, 30, 31/

NSP2 project has a commitment to use best endeavour to avoid 8 barrels located in the pipelay corridor in the Finnish EEZ in line with the permit application documentation. Three of these barrels are located along Line A and were surveyed (post-lay survey) in 2018 (Figure 21).

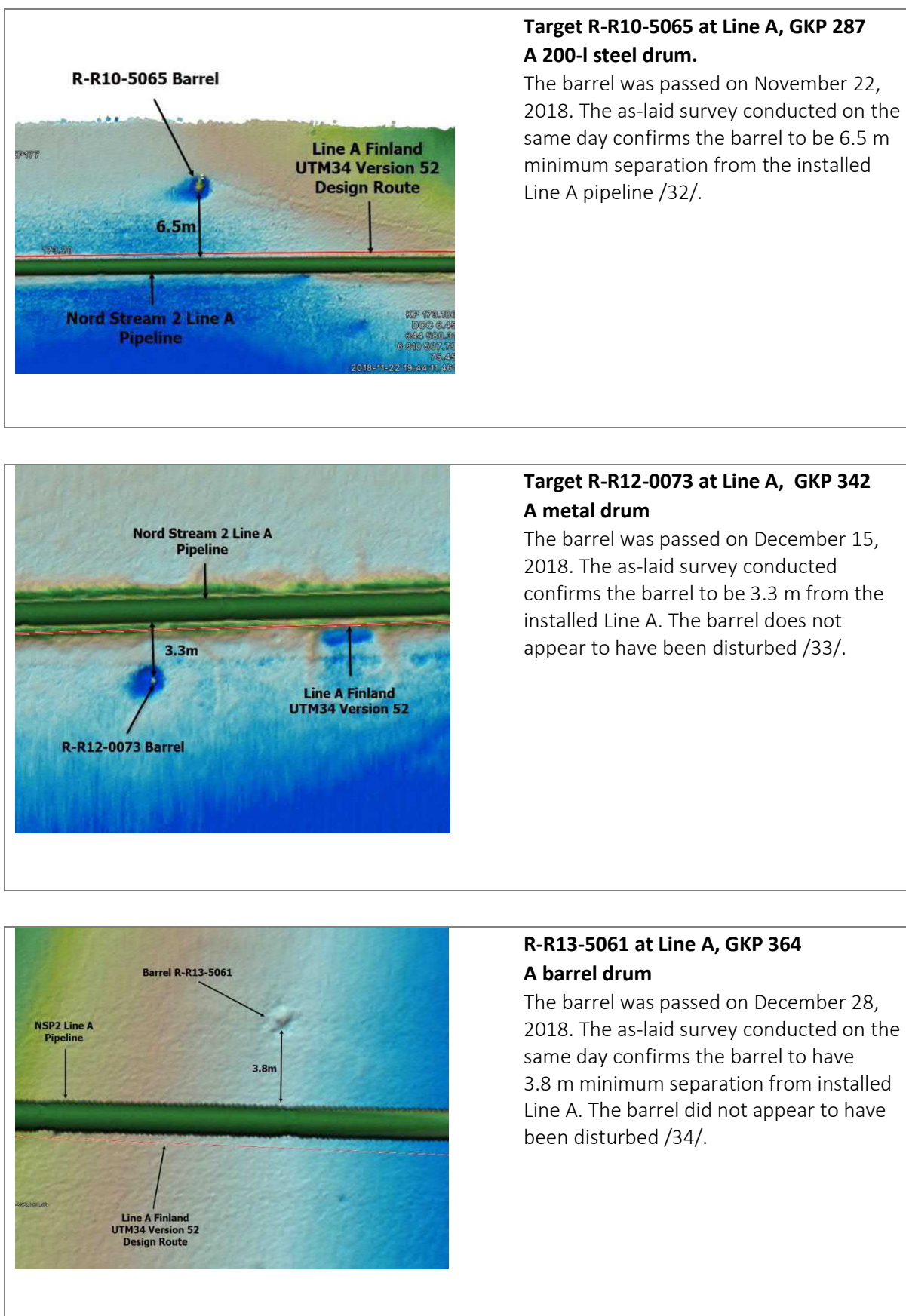


Figure 21. Avoidance of barrels. Line A as planned (thin red line) and as-laid (green).



Pipelay vessel Pioneer Spirit. © Nord Stream 2 AG 2018 / Axel Schmidt.



Pipelay vessel Solitaire. © Nord Stream 2 AG 2018 / Thomas Eugster.



Pipelay by Solitaire. © Nord Stream 2 AG 2018 / Thomas Eugster.



Pipeline preparations on board prior to installation © Nord Stream 2 AG 2018 / Thomas Eugster.

Figure 22. Images of pipelay activities.

2.8 Unplanned events

Four minor oil-leaks occurred during the construction works in 2018. All these unplanned events were notified to the relevant authorities (Table 9). No environmental impacts occurred due to the unplanned events.

Table 9. Notifications related to incidents submitted to the ELY Centres and the Border Guard in 2018.

Date	Content	Closed/Actions required
12.7.2018	Incident Report - minor oil leak. A small oil leak (release of 4 l of biodegradable oil) occurred with the ROV of the vessel Oceanic.	No actions required
16.9.2018	Notification on small oil leak. A small amount of biodegradable oil (< 2 l) was leaked into the water from the ROV of the vessel Olympic Triton.	No actions required
20.10.2018	Notification on oil leak. An oil-leak occurred during Solitaire pipelay. The vessel's thruster leaked approximately 150 l of gearbox lubrication oil. It is estimated that the slow release of the oil started at GKP 132.0 and was subsequently detected and stopped at GKP 130.4.	The leaked oil is expected to be biodegradable, not to bio-accumulate through food chains and not classified as dangerous to the environment. Remedial measures to stop the leak were taken immediately by the vessel crew.
1.11.2018	Notification on small oil leak. A small amount of biodegradable oil (approx. 4 l) was leaked into the water from the ROV of the vessel Oceanic.	No actions required

3

**ENVIRONMENTAL
BASELINE**

3 ENVIRONMENTAL BASELINE

This chapter presents prevailing environmental and weather conditions of the project area during the monitoring period Q2-Q4 in 2018. The chapter focuses on describing baseline conditions, such as seabed and sediments, hydrography and water quality and biodiversity of protected areas. Baseline data is collected from observations of the NSP2 monitoring contractors and from various public sources.

3.1 Weather conditions

Wave height and wind observations are recorded by the FMI (Finnish Meteorological Institute) at several observation stations. Wave height observation data was collected from an open sea wave buoy located in the Gulf of Finland approximately six kilometers north of GKP 185. Data for wind speed and direction was collected from the following meteorological stations: Jussarö, Eestiluoto and Orrengrund. The locations of the observation stations are shown in Figure 23.

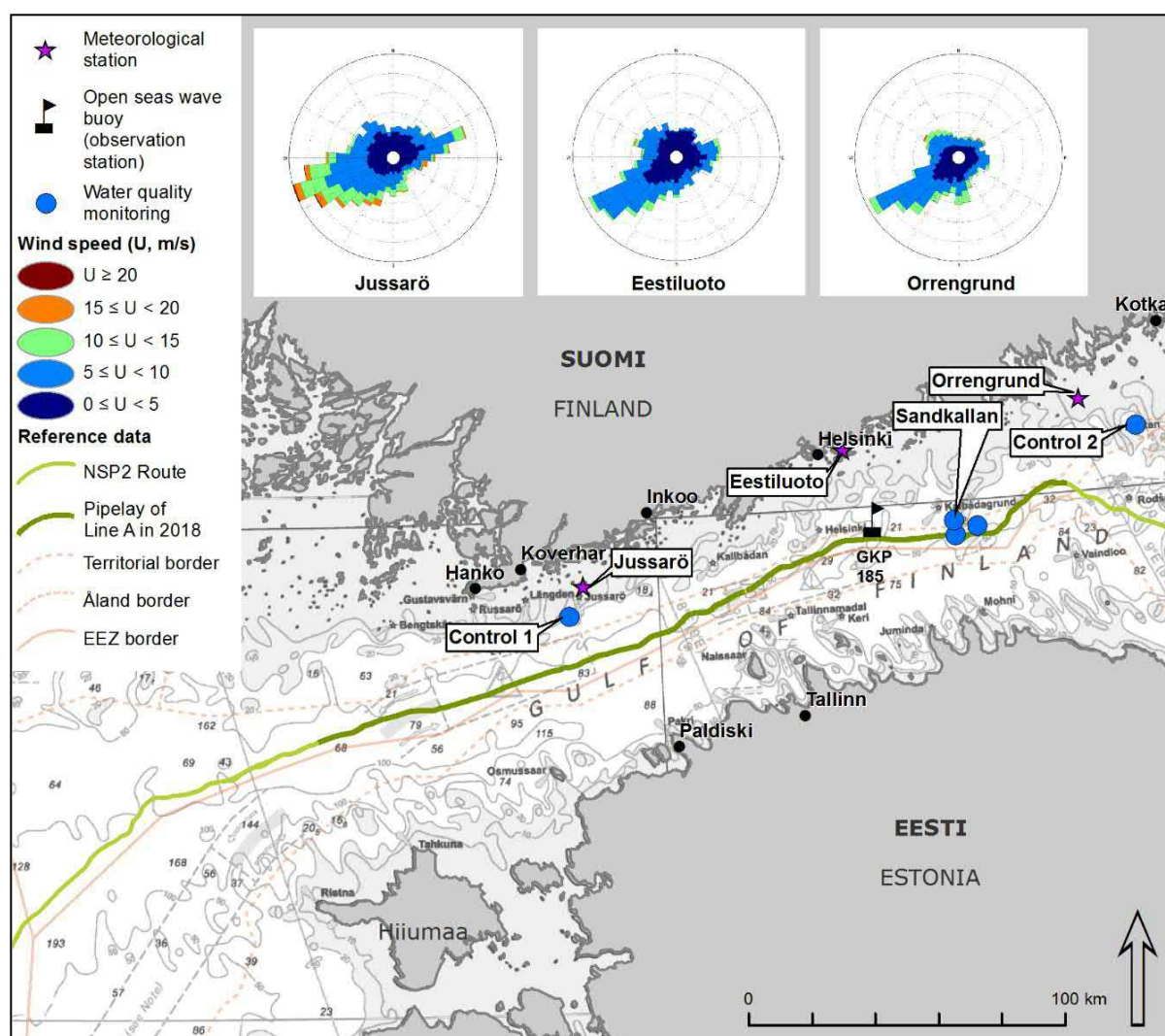


Figure 23. Finnish Meteorological Institute observation stations and the Nord Stream 2 monitoring stations in the Gulf of Finland. (Wind data: /35/).

During the monitoring period, southwest was the dominant wind direction measured at all three meteorological stations and the average wind speed was 5–10 m/s. However, occasional winds over

10 m/s were measured at all stations. In Jussarö wind speed reached as high as 15 and 20 m/s. Wind roses describing the wind speed and directions are presented in Figure 23.

During the monitoring period the wave height was mainly below 1.5 m. However, the maximum significant wave height exceeded 3 m on several occasions in June, October and December, and 4 m in September.

The statistics of the Finnish Meteorological Institute for 2018 show that the weather in Finland was 1–2°C warmer than the long-term average. Furthermore, precipitation remained below average at many observation stations in 2018 (Figure 24).

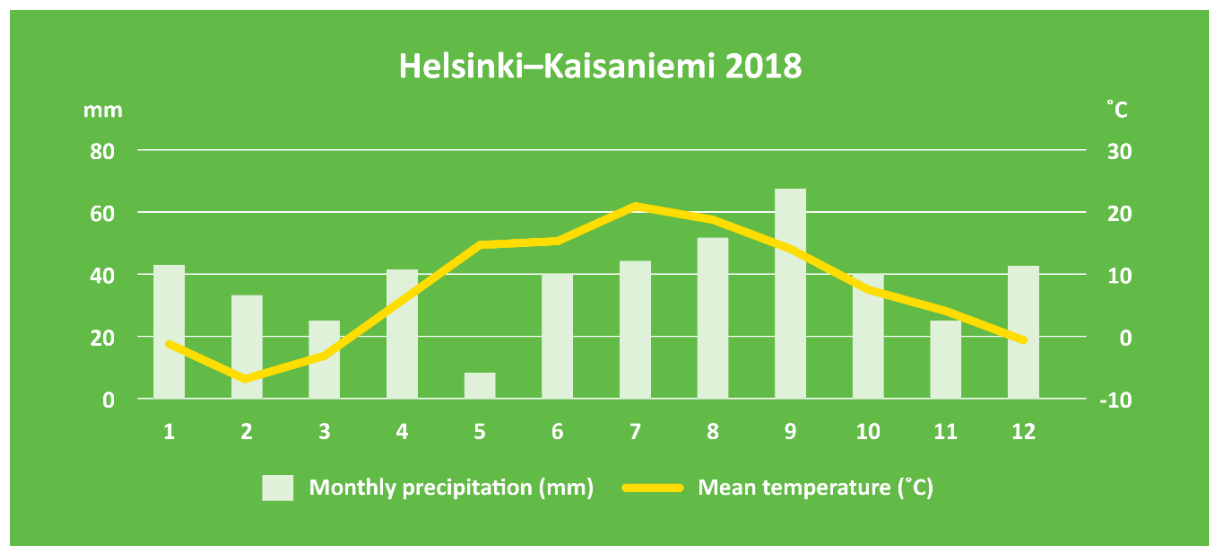


Figure 24. Precipitation and temperatures in Southern Finland during 2018 /35/.

The water column in the Gulf of Finland was clearly stratified, as could be seen in salinity, temperature and oxygen concentrations, from April 18, 2018 to July 10, 2018 /36/. Stratification break up was recorded at the NSP2 monitoring sites in mid-September. After the stratification break up, wind driven waves and currents were mixing the entire water column causing significant sediment resuspension during storm events.

There was no ice cover on the NSP2 corridor and the fairways to Kotka, Inkoo and Koverhar were accessible for the entire monitoring period.

3.2 Seabed and sediments

The seabed of the pipelay corridor consists of sedimentation areas, erosion areas and a mixture of them. In the eastern part of the Finnish EEZ, the pipelay corridor is mainly located on hard seabed consisting of hard clay, while the middle and western parts mainly consist of soft clay/mud sediments. Soft seabed areas form about 60 % of the total project area. Oxygen conditions near the seafloor fluctuate between good and poor due to natural processes (mixing, saline pulses, organic matter decomposing) /37/.

Sediment samples were taken from seven areal stations in order to analyse the presence of contaminants in the surface sediments along the survey area. The normalized concentrations of metals were mainly at concentration level 1 (concentrations close to natural background levels) according to the Ministry of the Environment guidelines on sediment dredging and deposition /38/. Normalized concentrations of some metals in single samples were within levels 1A- 1C (increasing impact, but affecting less than 5 % of biota). The concentrations were within the higher level 2 only in five samples,

in four cases with respect to nickel (60.4; 60.8; 93.7; and 130.6 mg/kg with level 2 limit >60 mg/kg; all in surface sediment) and once for copper (95.5 mg/kg with level 2 limit >90 mg/kg, at the sediment layer 10-15 cm) /37/.

3.3 Hydrography and water quality

3.3.1 Hydrography

The average water depth in the Gulf of Finland is 37 m and the maximum depth is 123 m at the Paldiski deep. The water depth increases from the Gulf of Finland without a sill towards the deeper Baltic Proper basin, where depths exceed 185 m within the Finnish EEZ. The depth of the pipeline route corridor within the Finnish EEZ varies from 34 m to 183 m. Much of the route is located in the area of the deepest waters (over 60 m) (Figure 25).

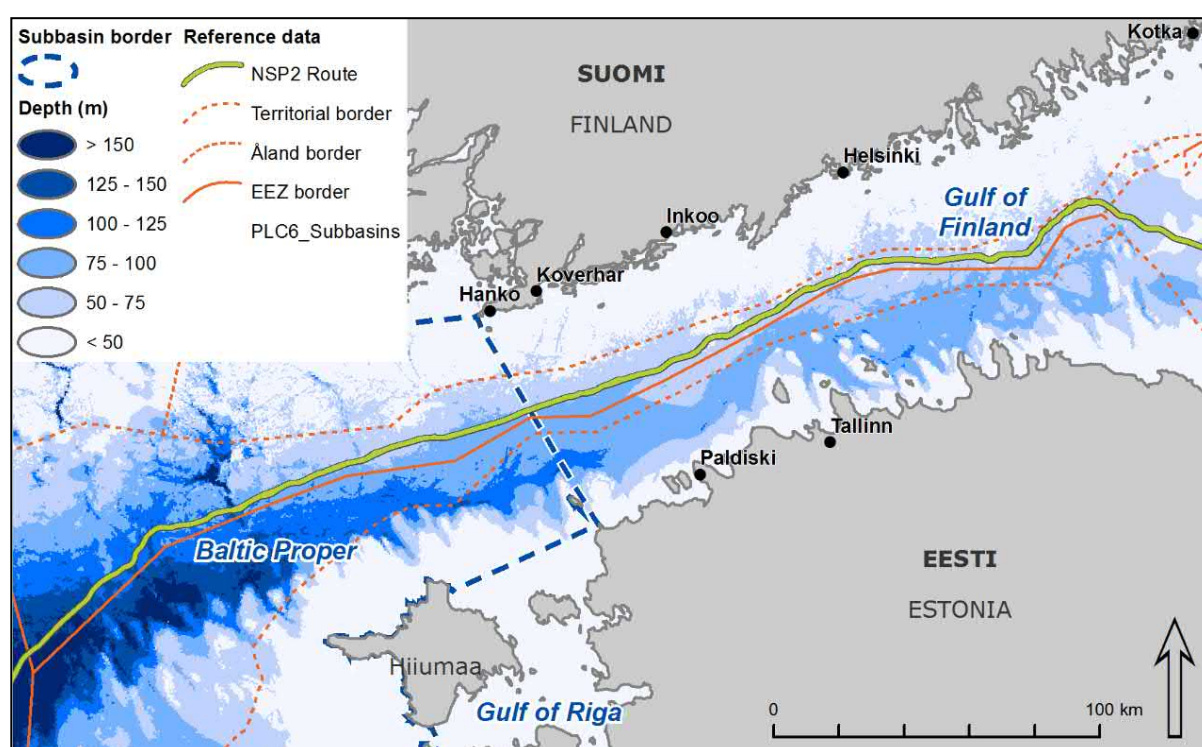


Figure 25. Baltic Sea sub-basins and water depth conditions along the route.

Currents in the Gulf of Finland are mainly created by wind, but also by variations in salinity and temperature (Figure 26). Mean surface circulation is cyclonic. The average current magnitude was 0.04–0.06 m/s based on measurements during the Nord Stream project.

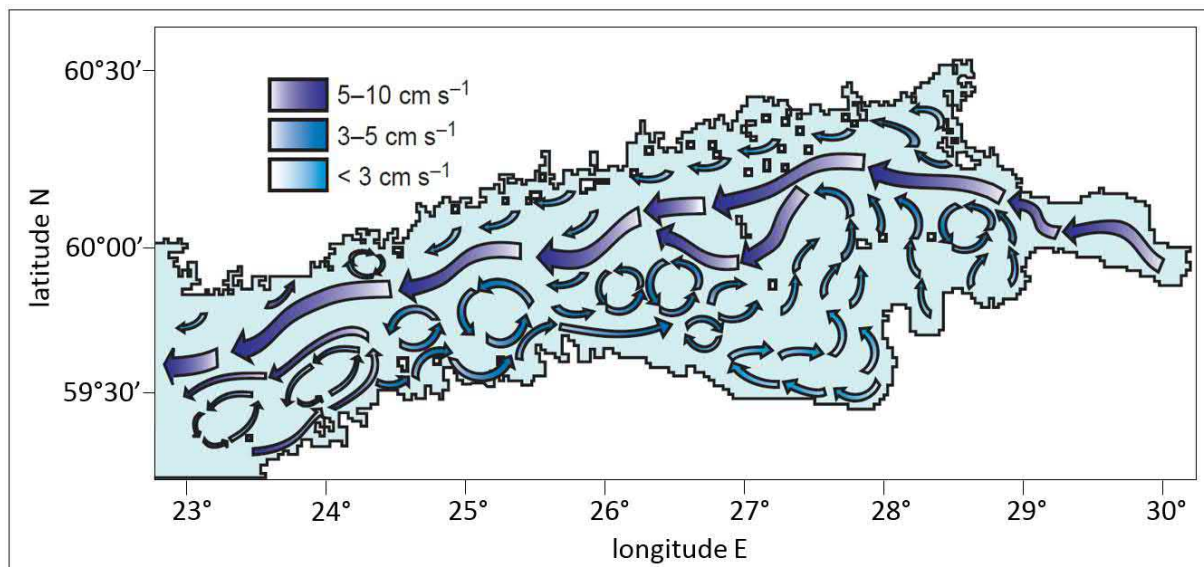


Figure 26. Schematic illustration of the mean circulation in the Gulf of Finland /4/.

3.3.2 Water quality

The current status of the marine environment in the Gulf of Finland is classified as “poor” for the physico-chemical indicators “eutrophication” and “contaminants and the impacts of contaminants”, and “good” for “changes in hydrography” /39/.

Salinity conditions (Figure 27) in the Gulf of Finland vary relatively widely in the east-west axis. In surface waters, the salinity increases from 0 PSU in the east to 5–6 PSU in the west. In the lowermost layers the salinity varies between 0–5 PSU (east), 5–8 PSU (middle) and 7–9 PSU (west).

Sea water stratification

Sea water stratification structure plays an important role when analyzing vertical dispersal of sediments released from the bottom during construction, as well as in natural resuspension process during storm events. Strong saline and temperature stratification reduces the mixing of bottom water and upper water column, thus limiting the spreading of released sediment spill to below halocline and thermocline. Strong stratification structure also reduces natural resuspension until the stratification break up takes place (typically in autumn).

Water quality monitoring results from both short-term and long-term monitoring locations showed that the measured 15 m bottom water layers were strongly stratified during the period when construction works were ongoing. Temperature stratification was weak with a gradient of only 0.4 to 1.5°C between the measured layers at 2 m and 15 m above the sea floor. Saline stratification was anyway predominant at all monitoring sites with a typical average salinity gradient varying from 1.5 to 1.9 PSU between the near bottom water layer measured 2 m above the sea floor and the upper water column measured 15 m above the sea floor.

Water quality was measured at two control stations by Luode Consulting /40/ during 2018 (Chapter 4.3). The near bottom measurements were carried out at the control stations located well outside of the impact area of any construction works. The measurements in Control 1 (western Gulf of Finland, Figure 23) were carried out at a depth of 41 m and Control 2 (eastern Gulf of Finland, Figure 23) at a depth of 46 m. Distance from the bottom was 2 m at both stations. Water quality measurements include: salinity, temperature, oxygen and turbidity levels and they were recorded at 15-minute intervals. Monitoring started on April 18, 2018 and continued through year 2018.

Water temperature at the control stations varied between 1°C and 12°C and the highest temperatures were measured in October. Measured oxygen concentrations varied between 2–13 mg/l. Generally, lower oxygen values were measured in the eastern Gulf of Finland, and the lowest values were measured at the end of the summer period. Salinity varied between 5.0 and 8.4 PSU. Turbidity remained low during the spring and summer due to generally calm weather conditions, except for the midsummer storm on June 22, 2018. During the storm turbidity increased to up to 5 FNU in the western Gulf of Finland (Control 1) while the background levels remained at 1–2 FNU. The stormy season started on September 12, 2018 which can be seen in the wave height data as the significant wave height rose up to 3.7 m. At the same time high turbidity values (> 20 FNU) were measured both in the western and eastern Gulf of Finland. The first storm of autumn also induced an upwelling event in the western Gulf of Finland. Upwelling can be seen as dropping temperature and rising salinity in surface water. During the autumn and early winter significant wave heights of over 3 m were observed regularly, which commonly induced the rise of turbidity to the level of 5–15 FNU.

According to the data retrieved from the control stations weather conditions strongly affected the dynamics of the near bottom water quality. The wave buoy of FMI, located in the Gulf of Finland (Figure 23), gives a good reference for the general weather conditions of the project area in the Finnish EEZ.

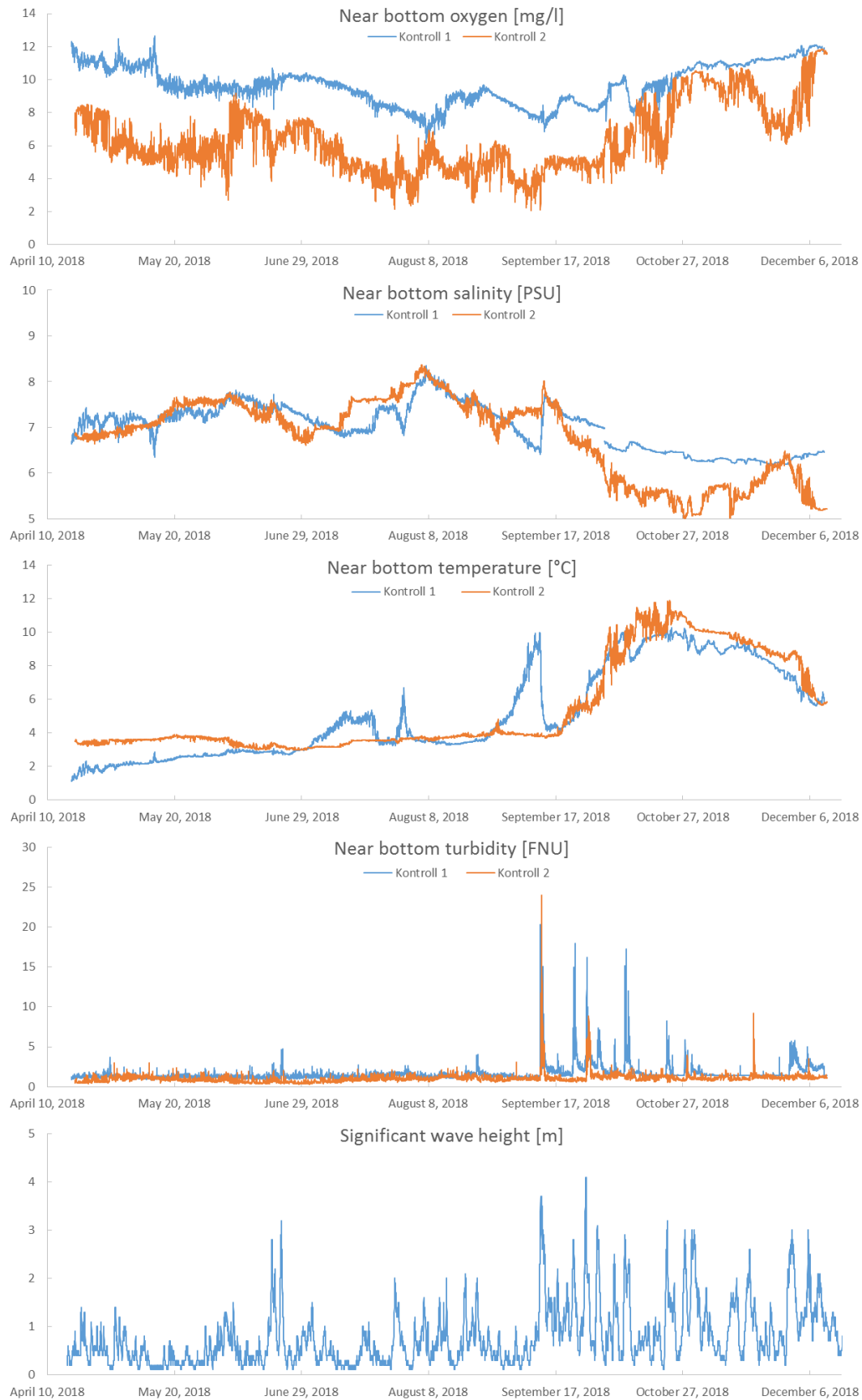


Figure 27. Water quality results from Control 1 and Control 2 stations, and wave height data from the Gulf of Finland wave buoy from April 1, 2018 to December 31, 2018.

3.4 Cultural heritage

Historically and archaeologically significant underwater cultural heritage sites have been taken into consideration when planning the route of the pipelines in the Finnish EEZ. Detailed surveys were carried out to identify cultural historical sites (wrecks) on the seabed along the planned route. All potential underwater cultural heritage sites in the proximity (within 250 m) of the pipeline route have been evaluated by a marine archaeologist. Additional pre-lay surveys were carried out for the two targets (S-R05-7978 and S-R09-09806) subject to monitoring according to the environmental monitoring programme /41/.

Wreck S-R05-7978

The wreck consists of the remains of a cannon barge with numerous iron cannons, at least 20, which can be observed on each side of the vessel. The cannons are placed side by side along the vessel with alternating positioning of rear and front ends. Among the iron cannons there is also a well-preserved bronze mortar (Figure 28). The wreck is considered to be of cultural historical interest.

The cannon barge can provide new insight and information about warfare, technical solutions and everyday life during the second half of the 18th century in the Baltic.



Figure 28. Wreck midship, cannons, cannon balls and debris /42/.

Anti-submarine net S-R09-09806

The World War II anti-submarine net has been laid along a rock outcrop, which dominates the surroundings. The eastern margin of this outcrop forms a steep scarp face with a 33 % gradient. Water depth ranges from 58 m on the plain to 53 m at the top of the rock outcrop.

Only the associated floats / buoys and the cable were seen during the survey performed in 2016 (Figure 29). No munitions or other debris items were visible. Based on the updated set of digital video/photo images taken by N-Sea Bodac B.V. in 2018, it appears that no changes have occurred on the site since 2016 /79/.



Figure 29. Buoy attached to submarine net/wires (SD-Alt1-3372-J) /43/.

3.5 Flora, Fauna and Protected Areas

3.5.1 Marine mammals

There are three marine mammal species generally occurring in the Finnish waters of the Baltic Sea: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus grypus*) and the ringed seal (*Pusa hispida botnica*). Both the grey seal and the ringed seal are isolated subspecies endemic to the Baltic Sea. The marine mammals' protection statuses are listed in Table 10.

The harbour porpoise was widely distributed in the Baltic Sea until the first half of the 20th century. However, a dramatic decline was observed during the past 50-100 years /44/. The severe decline of the harbour porpoise population in the Baltic Proper makes it the smallest population of harbour porpoises in the world /45/. The latest population estimate was done during the SAMBAH project 2016, in which the remaining number of porpoises in the Baltic Proper was estimated to be approximately 500 /46/. Based on observations and acoustic detection /46/ porpoises are likely to be found in low densities in most of the Gulf of Finland and the Archipelago Sea /44/.

The ringed seal population has passed a major decline over the last 100 years and is now recovering from very low numbers. The population was estimated to be around 200,000 individuals in the beginning of the 20th century, around 3,000–5,000 in the 1970s, and 11,500–17,400 individuals by 2014 /44/. The situation of the subpopulations in the Gulf of Finland, in the Archipelago Sea and in the Gulf of Riga is unclear due to poor data from recent years. A population estimate of 100 individuals for the Gulf of Finland was made in 2011, which compared to an estimate of 300 in the 1990s indicates a rapid decline if correct. The main part of this subpopulation inhabits Russian waters, but to some extent reaches across the border to Finnish areas. The subpopulation in the Archipelago Sea was estimated to be 140-300 individuals during 2002-2005 /47/.

The grey seal population of the Baltic Sea has been increasing in recent years. It was estimated to have comprised 80-100,000 individuals approximately 100 years ago, but it decreased to critical numbers of 4,000 individuals during the 1970s due to hunting and pollution. Since then, the abundance has increased again, and the total population during 2014 was estimated to be more than 40 000 individuals /44, 48/. Seal counts during 2016 (30,116 individuals) and 2017 (30,348 individuals; data from LUKE -

Natural resources institute Finland) suggest that the population is still increasing. The grey seal moves across great distances in the Baltic Sea and gathers in coastal areas, preferably on drift ice during winter and in undisturbed islands during summer /44/.

Table 10. Marine mammals and their protection statuses in the Baltic Sea. Roman number refers to the Annexes of a directive, a convention or an agreement.

Species	Harbour porpoise	Baltic ringed seal	Grey seal
Habitats Directive	II, IV	II, V	II, V
HELCOM	CR, Critically endangered	VU, Vulnerable	LC, Least concerned
IUCN	CR, Critically endangered	LC, Least concerned	LC, Least concerned
Bern Convention	III	III	III
Bonn Convention	II	-	-
Washington Convention	II	-	-
ASCOBAN Agreement	Included	-	-

There are no Natura 2000 sites along the pipeline in the Finnish waters with harbour porpoise listed as the selection criterion, and it is unlikely that a harbour porpoise would appear along the NSP2 route /44/.

Three Natura 2000 sites designated to the protection of **ringed seal** are located within 100 km of the NSP2 route: Archipelago Sea FI0200090, Pernaja Bay and Pernaja Archipelago FI0100078, and Eastern Gulf of Finland archipelago FI0408001 (see Table 4.7.1. in /44/). (Figure 30).

Altogether 15 Natura 2000 sites designated to the protection of **grey seal** are located within 100 km of the NSP2 pipeline route, the closest two are Kallbådan Islets and Waters being at a distance of 9.8 km Archipelago of Söderskär and Långören at a distance of 12.5 km from Line A (see Table 5.7.2. in /44/) (Figure 30).

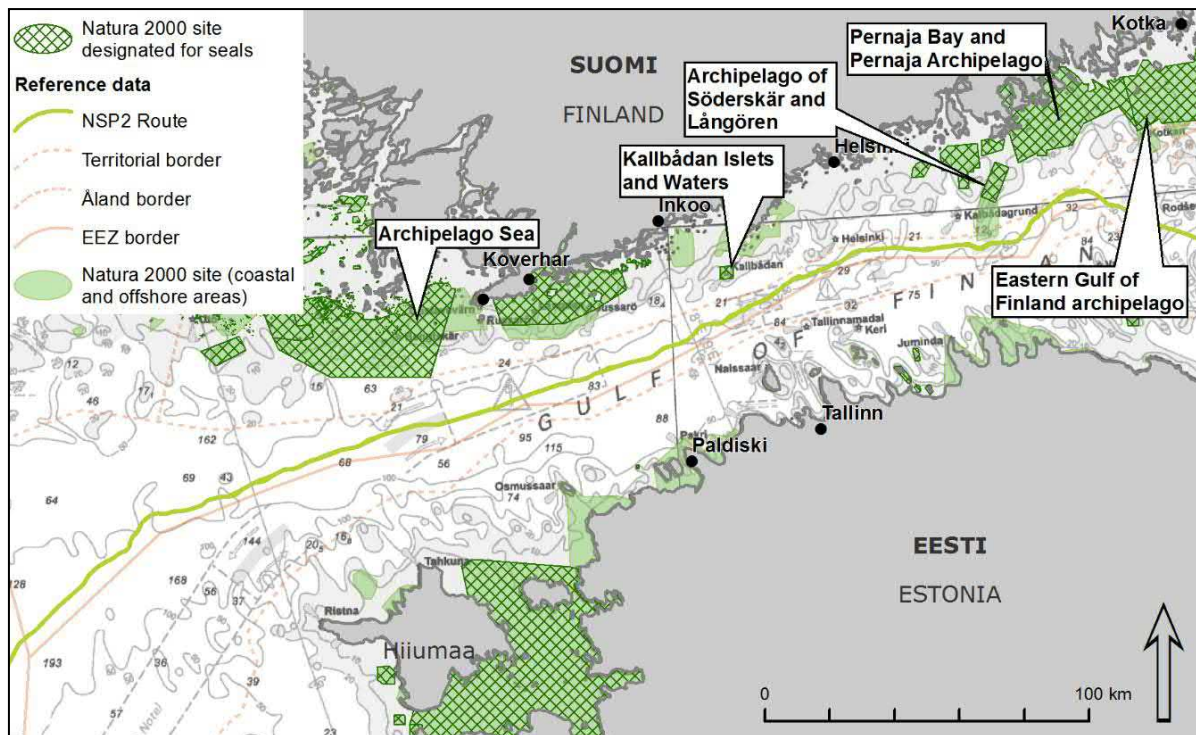


Figure 30. Natura 2000 sites designated to the protection of seals. Archipelago Sea, Pernaja Bay and Pernaja Archipelago and Eastern Gulf of Finland archipelago have ringed seal as a protection criterion. The Kallbådan Islets, Waters and Archipelago of Söderskär and Långören have grey seal as a protection criterion.

3.5.2 Fish stock

The Baltic Sea is host to approximately 70 marine fish species and another 30–40 brackish or freshwater species. In the Gulf of Finland, the Baltic herring (*Clupea harengus*) and the European sprat (*Sprattus sprattus*) are the main species targeted in commercial fishing, the latter mainly as by-catch /78/. These two species, together with the three-spined stickleback (*Gasterosteus aculeatus*) are the most common fish species occurring along the Nord Stream 2 pipeline. Migrating species in the area are the Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*) and whitefish (*Coregonus lavaretus*), with salmon being commercially exploited. Less commonly occurring species in the area are eel (*Anguilla anguilla*), river lamprey (*Lampetra fluviatilis*) and burbot (*Lota lota*).

According to the Red List 2019 /49/ six species known to occur in the area are red listed. Burbot is listed as near threatened (NT) in the Baltic Sea. Eel is critically endangered (CR), while river lamprey is near threatened (NT). The salmon is vulnerable (VU) and sea trout, both sea spawning and sea migrating, are endangered (EN). The status of whitefish in Finland is vulnerable (VU) for river spawning whitefish and endangered (EN) for sea spawning whitefish (Table 11).

Table 11. Threat status of species occurring in the central Gulf of Finland.

Species	Threat status	
Burbot (Baltic Sea)	Near threatened	NT
Eel	Critically endangered	CR
Lamprey	Near threatened	NT
Salmon	Vulnerable	VU
Sea trout	Endangered	EN
Sea trout (sea migrating)	Endangered	EN
Whitefish (river spawning)	Vulnerable	VU
Whitefish (sea spawning)	Endangered	EN

3.5.3 Birds

The Baltic Sea is an important resting, feeding, moulting, breeding and wintering area for around 80 bird species /39/. However, the Finnish EEZ is of limited value as a feeding and/or stop-over area for breeding and migrating birds, as there are no islands in the EEZ. The area has even less value for wintering bird species, as the majority is found in shallow waters less than 10 m deep.

None of the internationally, nationally or regionally important bird areas (IBA and FINIBA areas; updated 2016), nor the new nominations for areas 2018 /50/ are in the vicinity of the NSP2 route. The shortest distance to any classified important bird areas from the NSP2 route is 8.2 km (Kirkkonummi Archipelago (FI082)). The occurrence of marine birds in the vicinity of the NSP2 pipeline is low, and their possible occasional presence has been taken into account in all assessments (Espoo report, EIA and Natura 2000 appropriate assessments) /4, 51, 52, 53, 54/.

3.5.4 Biodiversity

General

The Baltic Sea is low in salinity and its brackish waters host a low number of species, some of which are endemic. Despite this, the salinity gradient and the variety of habitat types create a basis for a diverse flora and fauna. Species in the Baltic Sea, both with marine and freshwater origin, are stressed by the brackish water, making them even more sensitive to anthropogenic impacts. To conserve habitats and species, the Marine Protected Areas (MPAs) and other conservation efforts are of great importance /55/.

Benthic habitats are sensitive to eutrophication, physical disturbance, habitat loss /55/ and fishing (trawling) /56/. An integrated biodiversity status assessment with focus on soft bottom habitats shows an integrated biological quality ratio (BQR) of 0.4–0.6 along the southern coast of Finland, and 0.2–0.4 in the central Gulf. The coast of Estonia has a value of 0.8–1.0. A good status for a benthic habitat would be 0.6 or higher. The core indicators class the benthic quality in the area as “good” /55/.

Pelagic habitats are sensitive towards anthropogenic impacts, such as hazardous substances and eutrophication as well as climate change and high fishing pressures. The health of pelagic habitats is commonly monitored by studying zooplankton diversity and primary producers, such as phytoplankton. The BQR of pelagic habitats in the Gulf of Finland is 0.2–0.4 along the pipeline area, and 0.4–0.6 closer to the coasts of Finland and Estonia. The core indicators class phytoplankton and zooplankton statuses as “not good” /55/.

Protected areas

Concerning biodiversity, the relevant Natura 2000 areas are listed below. Information regarding the Natura 2000 areas was acquired from Natura forms /57/.

The **Sea Area South of Sandkallan (SAC FI0100106)** site is protected as a special area for conservation under the Habitats Directive. The surface of the site is 7,468 hectares, and the Natura data form cites reefs as an Annex I habitat type under the Habitats Directive. The data form does not mention Annex II species under the Habitats Directive or Annex I species under the Birds Directive. This area is the closest reef to the pipeline – 1.9 km to Line A. The seafloor is diverse with hard and soft substrates. Rock formations at depths between 15–20 m provide habitats for blue mussels (*Mytilus edulis*), with a maximum cover of 80 %, and barnacles (*Amphibalanus improvisus*) as well as red algae and clawed fork weed (*Furcellaria lumbricalis*). The species abundance decreases with depth, and blue mussels occur to a depth of approximately 30 m. Hydrozoans occur in sparse colonies on hard bottoms between 40–50 m. At 50 m depth, the substrate consists of smooth clay bottoms. Other important species south of Sandkallan are the Baltic macoma (*Limecola balthica*), isopods (*Saduria entomon*), amphipods (*Gammarus* sp.), ragworm (*Hediste/Nereis diversicolor*), and the European eelpout (*Zoarces viviparus*). The area is important for species distribution and survival, as it is located in a sea area off the coast.

The **Kallbådan islets and waters (SAC FI0100089)** site was primarily established for the protection of grey seals, and it includes a seal sanctuary by the same name. It is protected as an area for conservation under the Habitats Directive. The size of the site is approximately 1,500 hectares, and it is located in an offshore area southwest of Porkkalanniemi. The Annex I habitat types under the Habitats Directive present at the site are the Baltic outer archipelago and marine zone islets and small islands groups. In addition, in 2018 the habitat type reefs and sublittoral algae zone sections of rocky beaches was added as a new one covering 510 ha within the protected area. The Annex II species under the Habitats Directive present in the area is the grey seal. The distance from this area to Line A is 9.8 km.

The **Hanko Eastern Offshore Area (SAC FI0100107)** – 13.7 km to Line A is defined and protected as a 1,200 ha reef (code 1170). Average depth is 35 m and hard substrates constitutes 40 % of the bottom. This area is exposed to noise and vibration from the Finnish Defence Forces, as it is adjacent to a military training area. Hanko Eastern Offshore Area is connected to other protected marine areas (Tammisaari, Hanko archipelago and Pohjanpitäjänlahti bay), and together they create a nature type succession from poor species diversity at sea, to a bladder wrack (*Fucus vesiculosus*) belt in the outer archipelago and ultimately highly diverse inner archipelagic areas. Soft seabed in the area is dominated by Baltic macoma, blue mussels, isopods and polychaetes.

The **Archipelago Sea (SPA FI0200164 and SAC/SCI FI0200090)** Natura area includes different delineations of SPA, SAC and SCI areas. The surface area of FI0200164 approximately tripled in 2018. The extension was also established as a SCI area (Sites of Community Interest), which means that EU member states proposed the area as a SAC area. When approved, this will triple the SAC surface area (FI0200090).

The area is a significant breeding and migration area of birds. Many Annex I species under the Birds Directive and nationally threatened species have been observed in the area. It is also used by the Finnish Defence Forces.

The **Tulliniemi Bird Protection Area (SPA FI0100006)** was extended in 2018 to the west to include the sea area around the previously protected islands. The surface area is now approximately five times larger than in 2017. The area is connected to the Archipelago Sea Natura area (FI0200164/FI0200090) in the west. The Natura site is protected as both a special area for conservation under the Habitats Directive and a special protection area under the Birds Directive.

On December 5, 2018, the Finnish Government decided to extend some Natura areas and change the protection values in others /58/. The recent changes to Natura 2000 areas are shown in Figure 31.

Furthermore, the **Porkkala Nature Protection Area** of 12,777 ha is proposed to be established under the Nature Protection Act (1096/1996) with a Government Decree. The area is located north of Kallbådan connecting it to the Natura area of Kirkkonummi Archipelago (SPA, FI0100105).

The aim of establishment is protection and conservation of western archipelagic nature representative to the region of Uusimaa, valuable shallows, biodiversity, landscape and related cultural heritage; the area is also established for public recreation and camping, nature activities, education and research. Limited hunting of seals, some sea birds and invasive species is allowed from September 10 to December 31 /59/.

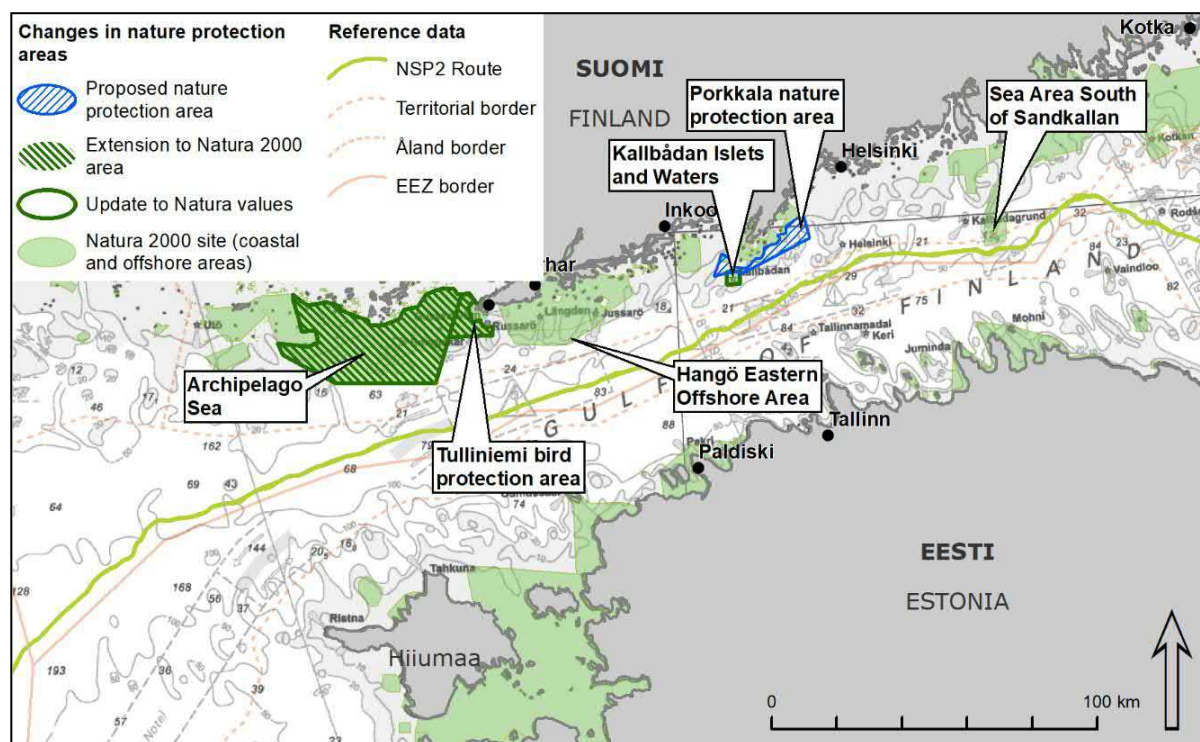


Figure 31. Relevant changes to the Natura 2000 and nature protection areas during 2018. (Information on updates to protection areas from /57, 59, 60/.

3.5.5 Ship traffic

The Gulf of Finland has considerable ship traffic volumes both by freight and other commercial traffic in the east-west direction and vice versa. Recreational and commercial cruise ship traffic flows are present in the archipelago area and between Finland and Estonia, particularly in summer time.

The commercial ship traffic in the Gulf of Finland is organised via the use of the mandatory ship reporting system (GOFREP), vessel traffic services (VTS) and traffic separation scheme (TSS). For the most extent, the Nord Stream 2 pipeline route is located in the GOFREP area, which is an intensive traffic area that is also covered by the local VTS services.

3.5.6 Commercial fishery

There were 1,506 commercial fishing vessels operating in the Finnish waters on the southern coast of Finland in 2015. Nearly the whole fleet consisted of small coastal fishery boats under 10 m in length. In 2017 there were 40 fishing vessels longer than 12 m, licenced offshore. Professional fishery consists of both coastal and offshore fishing. In the coastal areas, mostly nets and trap nets are used. Offshore fishing is comprised of trawling and long-line fishing with trawls. These are the principal gear types used in commercial fishery in the open waters of the Baltic Sea /61, 62/.

European sprat and Baltic herring are the most important commercially fished species, comprising about 95 % (by weight) of the total commercial catch in the Finnish EEZ fisheries in the Gulf of Finland, the Archipelago Sea and the Northern Baltic Proper /4/.

4

ENVIRONMENTAL MONITORING ACCORDING TO THE MONITORING PROGRAMME

4 ENVIRONMENTAL MONITORING ACCORDING TO THE MONITORING PROGRAMME

4.1 Introduction

4.1.1 Environmental monitoring

Nord Stream 2 AG is responsible for environmental monitoring and reporting during the construction and operation of the pipelines. The scope of monitoring is presented in the Environmental monitoring programme /41/. The programme was approved with the water permit decision on April 12, 2018 (53/2018/2).

Environmental monitoring is most intensive in the Finnish EEZ during the construction phase from 2018 to 2019. The majority of the monitoring activities have taken place in 2018. Based upon the experience from the environmental monitoring from 2010 to 2012 of the previous **Nord Stream** project, most of the impacts were minor. Therefore, the Nord Stream 2 monitoring is concentrating on the impacts expected to be the most significant, taking into account the results of assessments and the statement of the EIA Coordinating Authority on the EIA report.

The schedule for environmental monitoring is presented in Table 12. Monitoring will continue after the construction phase to cover the operational phase. During 2018, environmental monitoring concentrated on underwater noise, water quality and currents as well as monitoring of cultural heritage (Figure 32). Monitoring results for 2018 are presented in chapters 4.2.2, 4.3.2 and 4.4.2.

Table 12. General schedule for the monitoring activities during 2018–2023 in the Finnish EEZ (based on /41/ modified).

Monitoring target	Construction		Operation			
	2018	2019	2020	2021	2022	2023
Underwater noise	X					
Water quality and currents	X	X				
Commercial fishery					X	
Cultural heritage	X		X			

The supervisory authorities for monitoring of underwater noise, currents and water quality are the Regional ELY Centres (The Centre for Economic Development, Transport and the Environment). For fishery monitoring, the supervisory authority is the Southwest Finland ELY Centre. For cultural heritage, the supervisory authority is the Finnish Heritage Agency (former National Board of Antiquities).

The monitoring results are presented in the quarterly and annual monitoring reports during the construction phase and in the annual reports during operation.

Quarterly reports aim at presenting the main results from technical and environmental monitoring. The first quarterly reports were prepared for the 2nd /63/, 3rd /64/ and 4th /65/ quarters of 2018 and were submitted to the authorities in line with the water permit provisions 3 months after the end of each quarter.

Annual reports include further data analysis, comparisons to the impact assessments presented in the EIA Report and the permit application and more thorough discussion on the observed impacts. Annual reports are submitted by the end of May of the following year.

To clarify contradicting dates in the monitoring programme and the water permit decision, Nord Stream 2 proposed on February 15, 2019 /66/ to the Uusimaa ELY Centre a clarification on the schedule of submission of the annual monitoring reports. The Uusimaa ELY Centre approved the schedule in line with the proposal, which states that annual reports are to be submitted to the authorities by the end of May of the following year.



Figure 32. Environmental monitoring activities. Photos: © Nord Stream 2 AG 2018 / Axel Schmidt.

4.1.2 Environmental Impact Assessment methodology

The environmental impact assessment (EIA) Report for the Nord Stream 2 project in the Finnish EEZ was conducted in compliance with the Finnish EIA Act (468/1994) and EIA Decree (713/2006).

The Finnish EIA report was submitted to the coordinating authority, the Uusimaa ELY Centre (The Centre for Economic Development, Transport and the Environment of Uusimaa) on April 3, 2017. Transboundary impacts were assessed according to the Espoo Convention (The Convention on Environmental Impact Assessment in a Transboundary Context) in the Espoo report, which was part of

the submitted EIA documentation. In addition, the Finnish EIA report presented transboundary impacts from the project in Finland to other countries.

The EIA Report Update Finland, February 21, 2018 /62/ provides updated information about the Nord Stream 2 project and environmental, transboundary and cumulative offshore impact assessments. The EIA update included the information for additional studies stated in the statement of the EIA coordinating authority on the EIA report.

An IMPERIA-based multi-criteria analysis methodology /67/ has been applied for evaluating the significance of impacts in all assessments in the EIA, permit applications and monitoring. This allows the clear comparison of assessments to the monitored results (Figure 33). The approach compares the sensitivity of the impact receptor with the magnitude of change resulting in the significance of impact (Table 13).

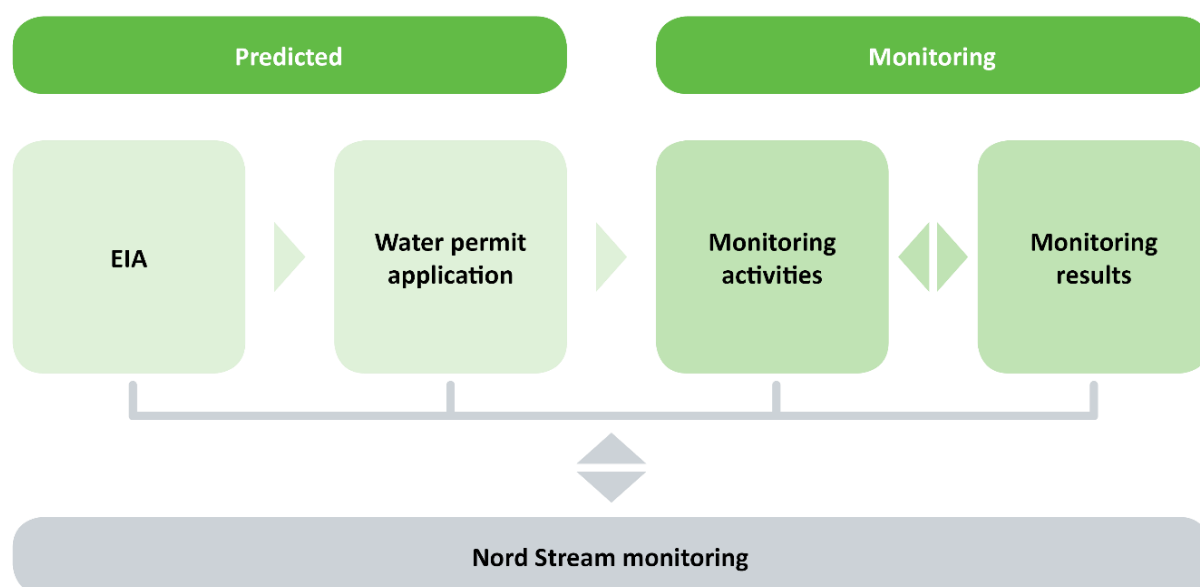


Figure 33. Phases of the assessment of impact significance in the Nord Stream 2 project.

Table 13. Categories of impact significance in the ARVI approach. (Adapted from: /4/.)

Impact significance		Magnitude of change						
		High	Medium	Low	Negligible	Low	Medium	High
Sensitivity of receptor/target	Low	Moderate	Minor	Minor	Negligible	Minor	Minor	Moderate
	Medium	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	High	Major	Moderate	Moderate	Negligible	Moderate	Moderate	Major

4.2 Underwater noise monitoring

Munitions clearance during the construction phase of the Nord Stream 2 pipeline system (described in Chapter 2.4) generates impulsive noise and high peak sound pressure levels, which can have impacts on marine life. Long-term noise measurements were used to investigate the potential impact of the project on the overall background noise level, which is influenced by shipping, wind and waves. Typically, for example, one-hour sound exposure levels are measured, whereby individual noise events do not show as their own peaks, but are averaged over a one hour period. Short-term measurements are suitable for measuring the effects of noise from short-term, impulsive events. These include blasting, underwater extraction, drilling and piling. In this case, the measurements focus on peak sound levels as well as the total energy quantities of individual noise events, and individual noise-causing events can be distinguished.

The main goals of the underwater noise monitoring were to:

- measure the maximum noise levels
- measure the noise distribution from munition clearance into the most sensitive protected areas
- compare impacts modelled during the EIA and permitting phases with measured values
- define potential changes in background noise levels from construction activities (i.e. use of clearance vessels)

4.2.1 Monitoring methods

Underwater noise was monitored by Luode Consulting Oy according to the approved Environmental monitoring programme /41/. Three main indicators were calculated based on the measured data:

- Peak Sound Pressure Level (SPL) is the maximum sound pressure level that is measured during the noise event. It is expressed in dB re 1 μ Pa.
- Sound exposure level (SEL) is the total noise energy to which the mammal is exposed during a given duration, e.g. during one explosion event. It is expressed in dB re 1 μ Pa²s.
- Equivalent continuous sound pressure level, L_{eq} , is also known as the RMS (root mean squared) level and is defined as the average pressure over e.g. a 1 h time period. It is expressed in dB re 1 μ Pa².

Peak- and SEL- levels were calculated for each munition clearance and in most cases the same clearance event was monitored at several stations. Measured peak levels were compared against the assessments of the water permit application /68/.

Measured sound exposure levels were used for the re-modelling of the Permanent Threshold Shift (PTS) areas. PTS describes the sound exposure level which is the onset for the risk of a permanent damage for hearing. For marine mammals this level is 179 dB re 1 μ Pa²s (SEL). PTS is usually presented as the area where the 179 dB level is exceeded. It can also be presented as the maximum distance from the sound source where the 179 dB level is still reached. The temporary threshold shift (TTS) is a short-term hearing loss and the animal will regain its original detection abilities after a recovery period. TTS thresholds for single impulsive noise for marine mammals is 164 dB re 1 μ Pa²s (SEL). /69/

The calculated PTS areas based on measured data were compared with modelling results. Modelling was done for the environmental impact assessment /69/, the water permit decision Nro 53/2018/2 /68/ and the Natura assessment /70/. Munition by munition modelling is based on the maximum individual peak pressure levels measured during the **Nord Stream** project (Figure 34).

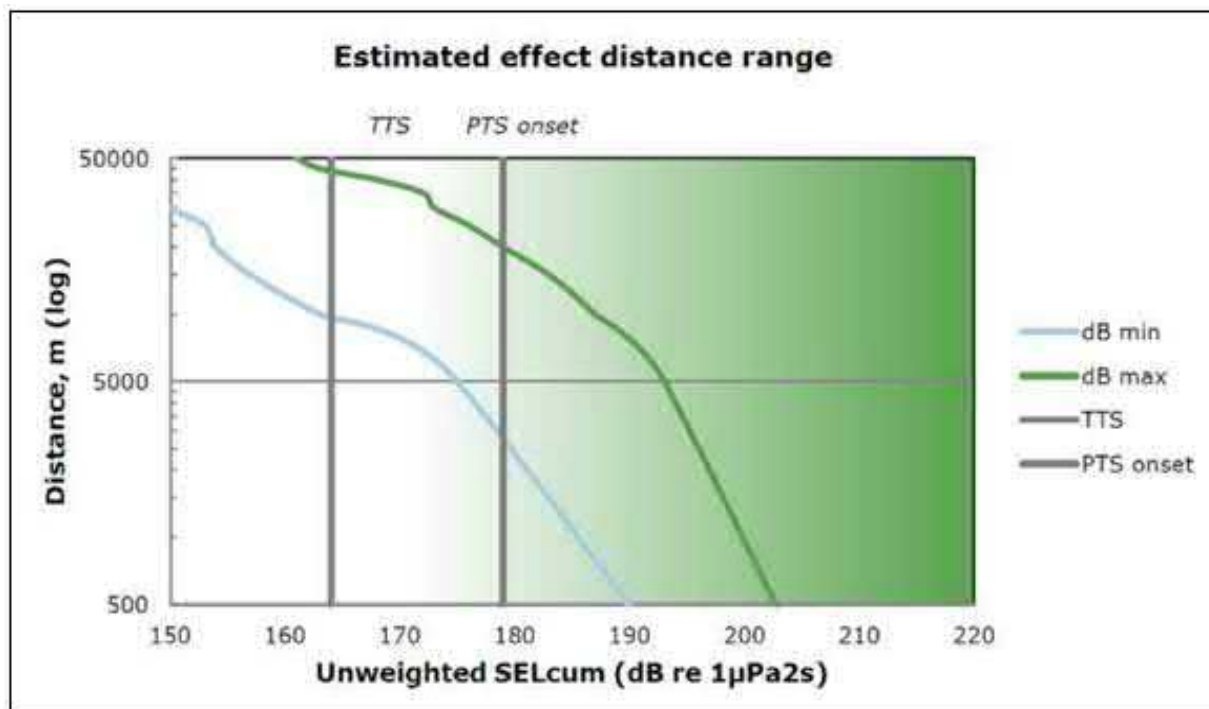


Figure 34. Modelled effect distance range as a function of the SEL threshold. The green curve is the maximum propagation and the blue curve represents the minimum propagation for the modelled location conditions. Vertical lines bordering the green shades areas represent the TTS, PTS, onset thresholds /62/.

Continuously recorded data from the long-term monitoring stations was processed to the 1 hour equivalent continuous sound pressure level $Leq(1h)$. $Leq(1h)$ was compared with the measured peak pressure levels from the munitions clearance activities. Local wind data was incorporated into the ambient noise level because if local shipping or other anthropogenic noise levels are low, wind and waves dominate the background noise.

The monitoring consisted of 8 fixed long-term monitoring stations with continuous recording and vessel-based on-site monitoring of three munitions clearance operations. This monitoring was conducted by the environmental monitoring Contractor, Luode Consulting. In addition, vessel-based measurements were carried out by the munition clearance contractors N-Sea/Bodac and MMT/Ramora. Schematic illustrations of typical long-term installation and vessel-based on-site monitoring arrays are introduced in Figure 35.

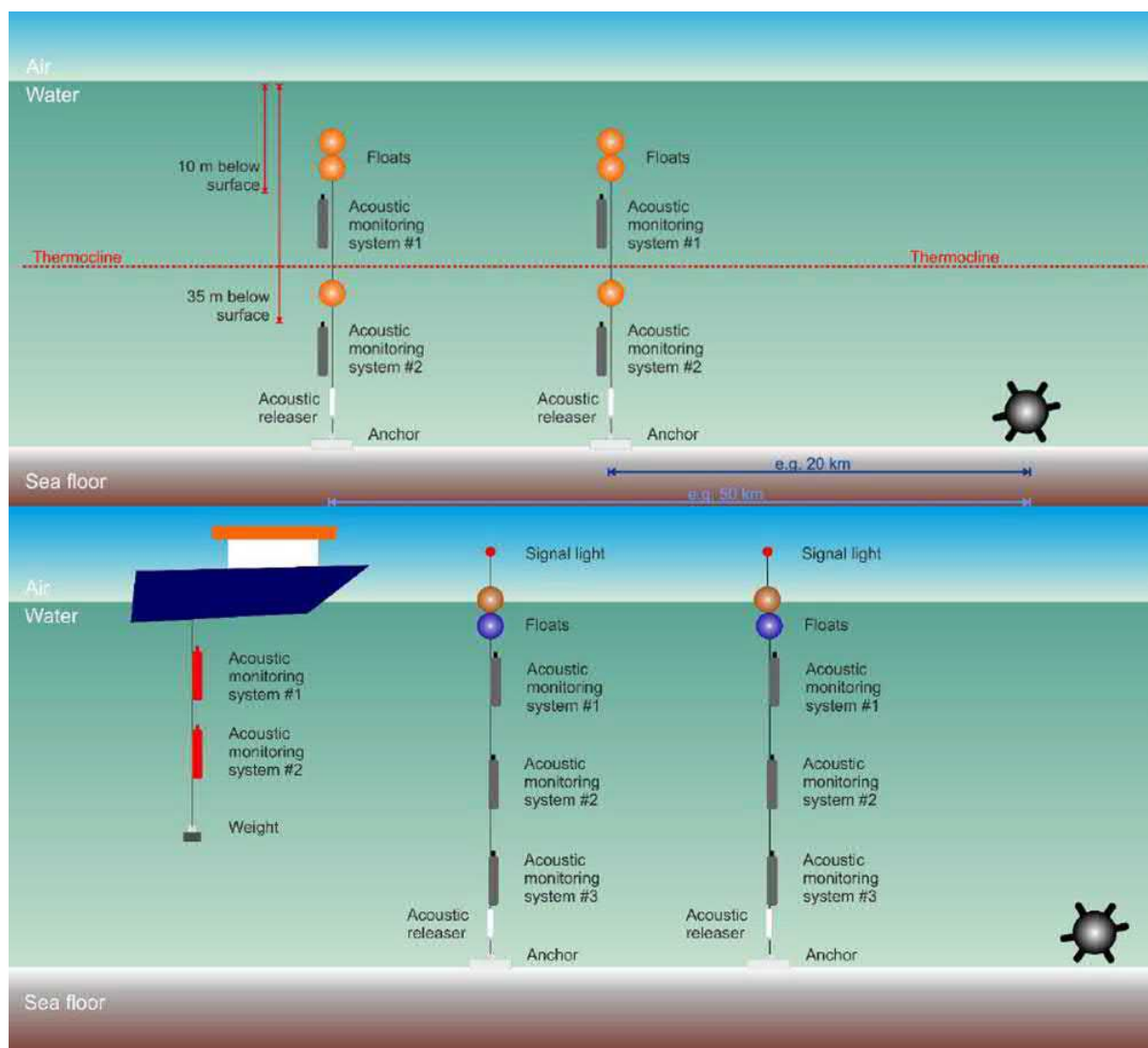


Figure 35. Top: Schematic illustration of the long-term installation. Bottom: Schematic illustration of vessel-based monitoring arrays. Figures are not in scale /71/.

Long-term monitoring stations were established near the Natura 2000 areas with marine mammals as a conservation objective (Figure 36). Six stations were placed along the Finnish coastline and two stations along the Estonian coastline. The long-term stations were installed from April 17 to April 23, 2018, serviced from May 14 to May 26, 2018 and recovered from July 9 to July 17, 2018. Two sub-stations with 4-5 NM separation from each other were installed in Hanko and in Porkkala Kallbådan area. The

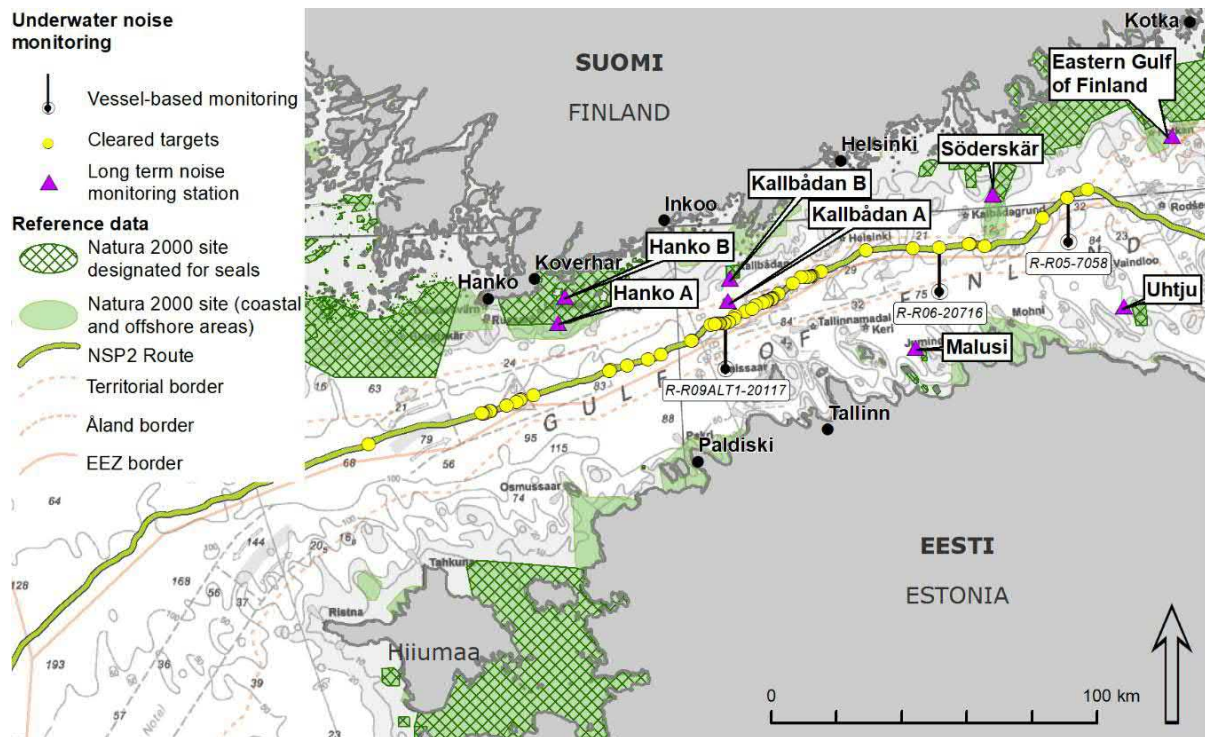


Figure 36. Locations of the long-term monitoring stations and cleared munitions.

latter is known to have an intense seal population. Hanko area is of scientific interest, because it has many academic research sites and installations. Other monitoring areas at Söderskär, Eastern Gulf of Finland, Malusi and Uhtju were all equipped with one sub-station.

In addition to long-term monitoring, three **vessel-based monitoring campaigns** with high resolution sample rate were performed during the clearances of three targets of different size and type. These short-term monitoring campaigns were conducted in the beginning of the clearance operations in order to provide high resolution information as early as possible.

4.2.2 Results

In total 74 targets were cleared during the munition clearance campaign. Five targets required two detonations to complete the clearance, since after the first attempt the munition was intact or not completely cleared. Data was not available for three targets, as the distance to the long-term stations were too high and the detonations were not recorded by clearance contractors' vessels due to technical reasons. In total, 71 clearance targets were measured and analysed. In accordance with the permit application, big bubble curtains were used for munitions with a net explosive quantity (NEQ, explosive charge + donor charge) of 22 kg or more and all munitions east of GKP 174 (FKP 60). Big bubble curtains were used for 58 targets.

Peak levels and SEL

Altogether 254 peak levels were measured and compared to the modelled values in the permit application. Measured peak levels are distinguished by a different colour depending on the measurement method (Figure 37). 253 out of 254 peak levels were lower than the modelled values in the permit application.

Variation in measured peak levels increased with the distance to the detonations. Distance attenuation was more effective along the Finnish coast due to the low water depth and variable bathymetry when compared to the Estonian deeper coastline with less islands.

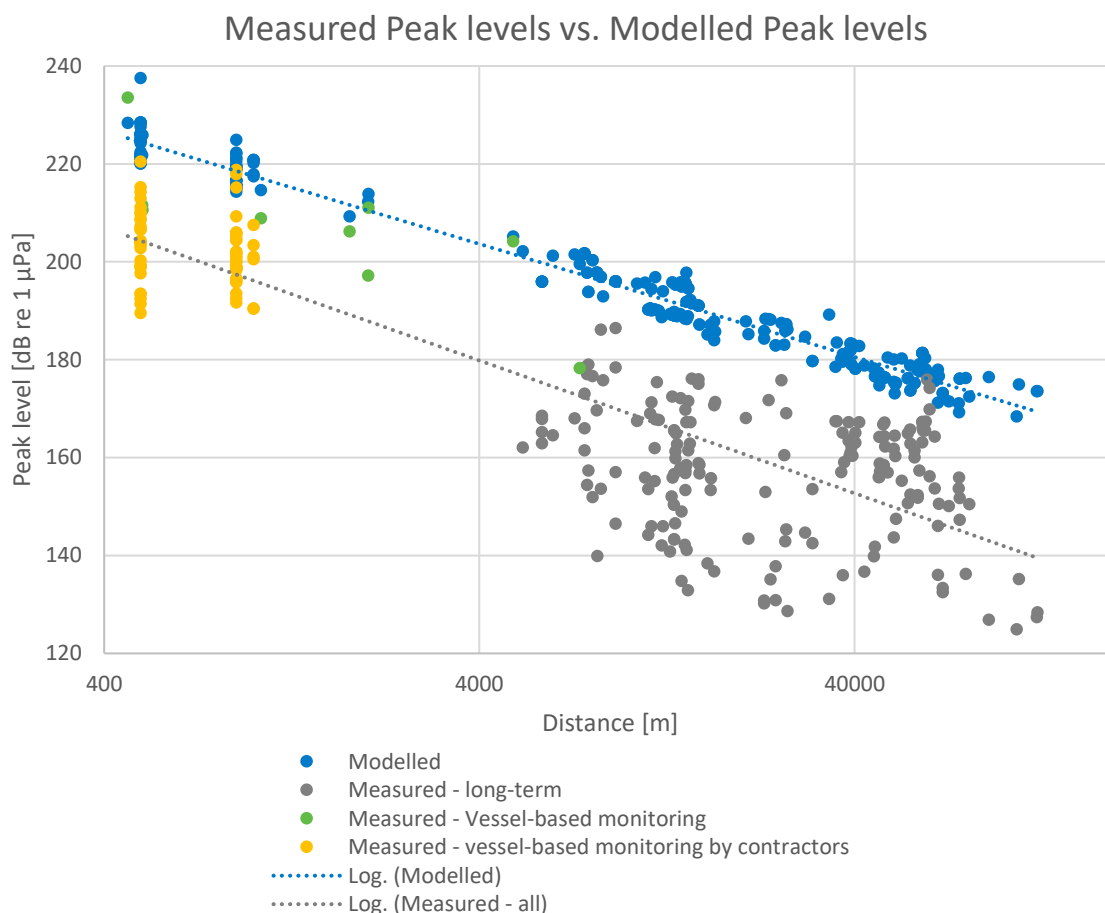


Figure 37. Peak sound pressure levels (SPL) from munitions clearance events. The SPL levels used in the permit application are based on modelling /62/.

The measured SEL-values at the long-term monitoring stations neither exceeded PTS (179 dB re 1 μ Pa²s) nor TTS (164 dB re 1 μ Pa²s). The highest measured SEL at the long-term monitoring stations was 163.3 dB re 1 μ Pa²s. It was measured at Kallbådan A during the second clearance attempt of the 115 kg Russian contact mine (R-R09ALT1-20467). Cleared munition density was the highest near Kallbådan, and Kallbådan A station was closest to the clearance operations suggesting that the PTS or TTS areas did not extend to the nearest protected area with seals as conservation objective, which is located 9.8 km from the pipeline route.

PTS areas

The permanent threshold shift (PTS) distances were calculated based on the close-range measurement data received from the munition clearance vessels and the vessel-based monitoring campaigns. Results from the long-term stations were used for validation. Summary of the measured PTS zones are shown in Table 14. The modelled and measured PTS areas are introduced in Figures 38 and 39.

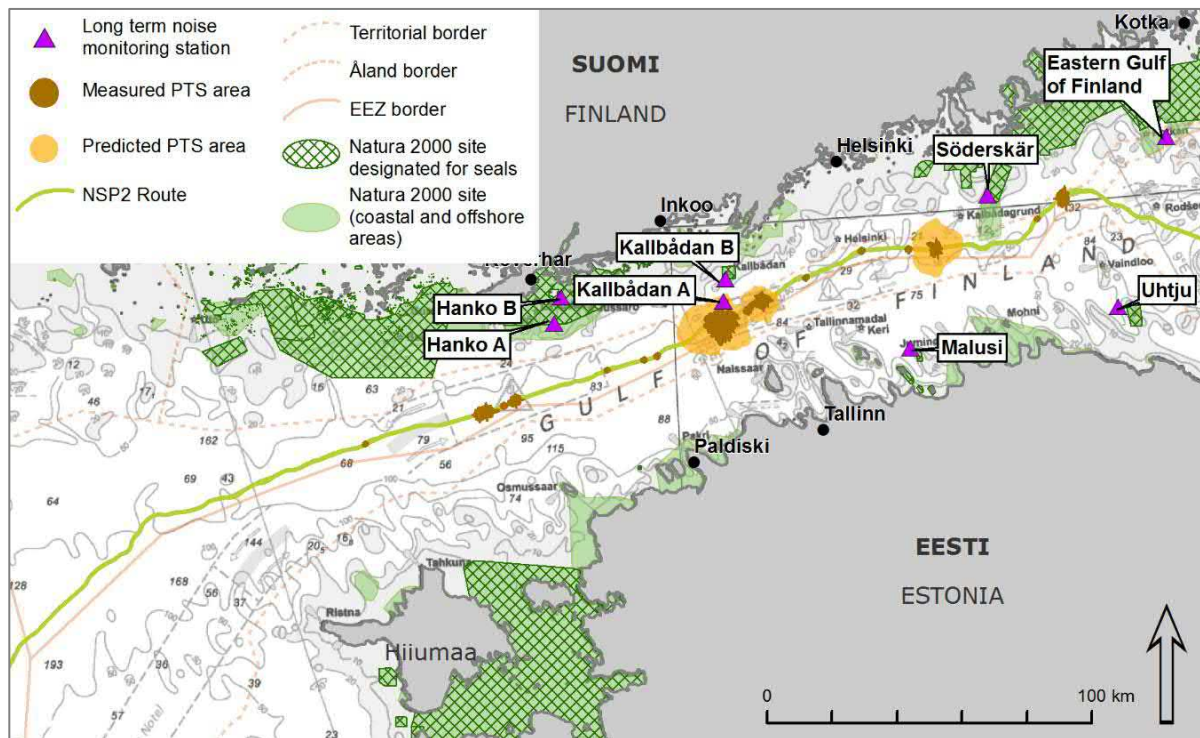


Figure 38. The modelled maximum for 7 munitions in the Natura Assessment modelling and the measured PTS for 62 munitions cleared from May 3 to June 6, 2018.

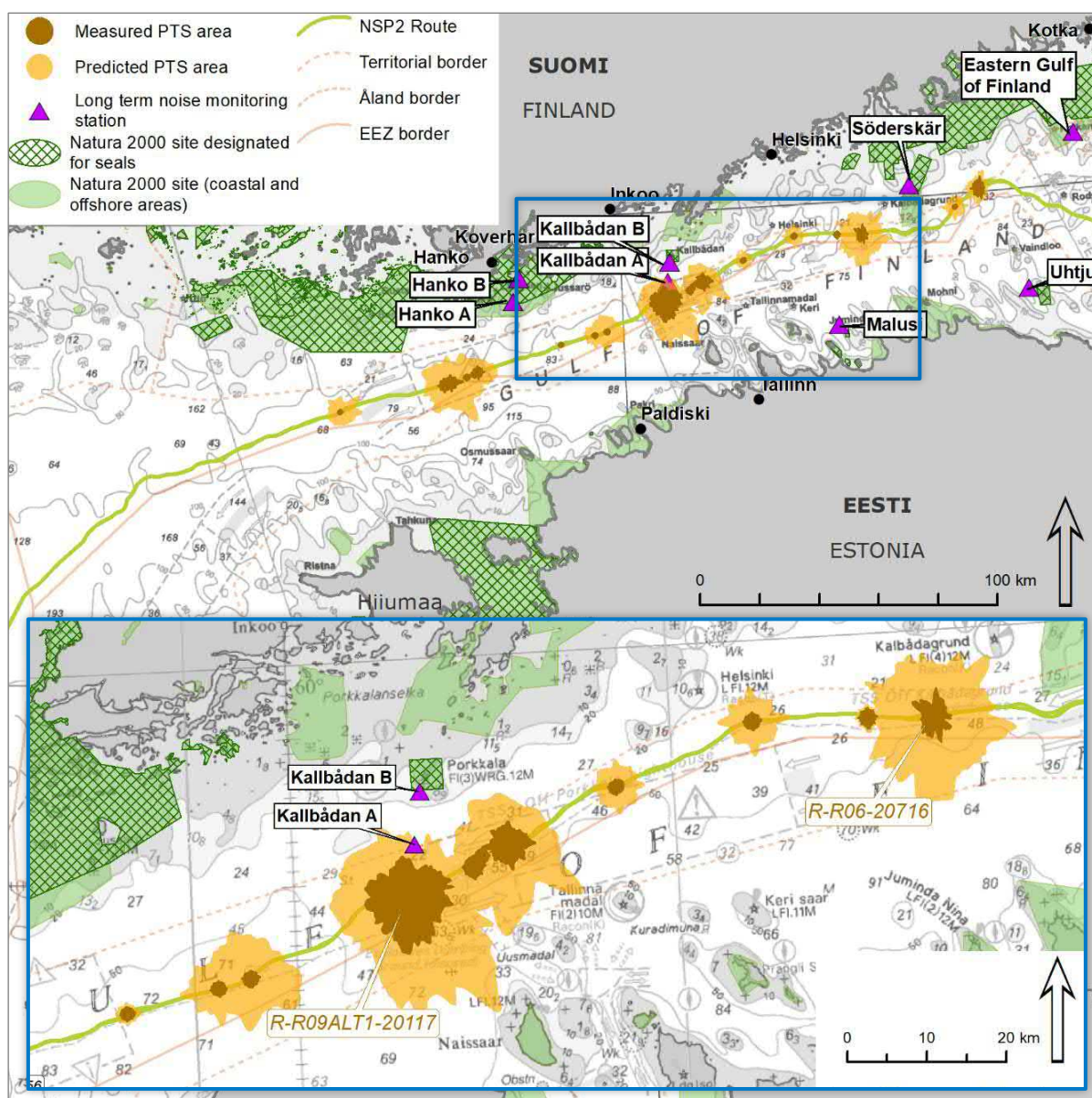


Figure 39. The modelled maximum and the measured PTS levels for 62 munitions from May 3 to June 6, 2018. The lower map shows the selected area (blue) in more detail.

Table 14. Summary of the measured PTS zones.

PTS range	Qty of munition clearances	Average range [m]	Min range [m]	Max range [m]
< 500 meters	19	-	-	-
500 - 1000 meters	30	825	530	920
1000 - 2000 meters	11	1436	1000	1900
2000 - 5000 meters	6	2787	2120	4900

Time-series at the long-term monitoring stations

During the long-term monitoring most of the clearance operations were detected at Kallbådan A (Figure 40), which is the closest monitoring station to areas with highest munition density (Figure 39). However, the area between Kallbådan A and B is so shallow that noise attenuation was effective and measured peak levels were clearly lower at Kallbådan B.

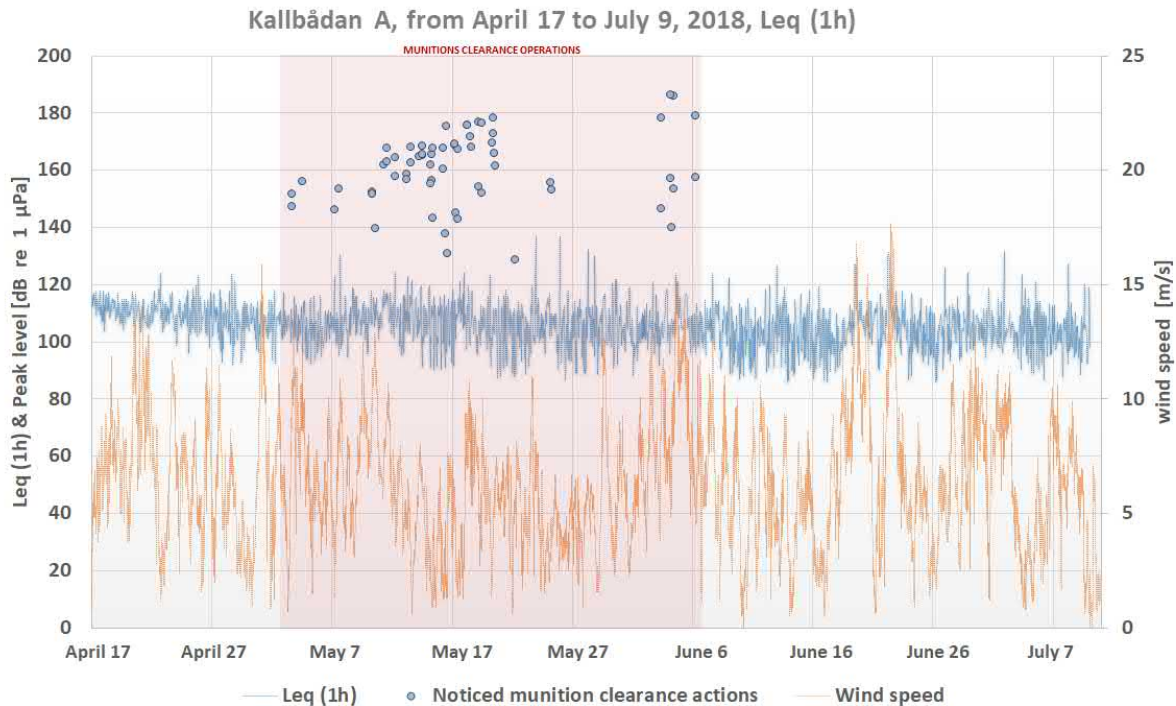


Figure 40. Time-series Leq (1 h), wind data and munition clearance events – Kallbådan A. The highest recorded sound peak values are shown for munition clearance events.

Munition clearance operations did not affect the noise levels at Hanko monitoring stations. No detonations were detected at Hanko B and only one at Hanko A. Shallow areas at Söderskär and in the Eastern Gulf of Finland effectively blocked the noise caused by clearance operations to enter the stations and no detonations were detected. Noise propagation was stronger to the deeper coastline of Estonia. Even though the average distance was 48 km, most of the clearance operations were detected at Malusi. At Uhtju the clearance operations east of Helsinki were detected (Figure 39).

The ambient noise level was mainly influenced by shipping, which exceeded the noise caused by nature. The background levels did not increase because of the Nord Stream 2 activities.

4.2.3 Correlation to predictions

According to the Environmental Impact Assessment, the most significant threat associated to munition clearance was related to the peak sound pressure levels of individual detonations which could cause temporary reduction in hearing sensitivity, irreversible reduction in hearing sensitivity or even mortal injury.

Peak levels

Altogether 254 peak levels were measured and 253 out of 254 peak levels were lower than the modelled values in the permit application. The modelled results were higher because of several reasons. First, they are based on the maximum individual peak pressure levels measured during the Nord Stream

project. Secondly, in several cases the munition charge weight appeared to be smaller than predicted. In addition, parts of the old charge may have dissolved in the water over the years and parts of the old munition may pose less of a threat. This is supported by the fact that there is no correlation between the munitions charge weight and the measured sound peak pressure level (see Figure 34 and Figure 37).

PTS and TTS areas

Based on modelling, which was done for the permit applications, the PTS areas from the munition clearances did not extend to any of the Natura sites included in the Natura assessment and screening studies. The TTS areas were only modelled to reach one of the Natura sites (Tammisaari and Hanko Archipelago and Pohjanpitäjänlahti Marine Protected Area), however none with marine mammals as designated targets.

The measured and simulated PTS distances were smaller than the modelled average and maximum values in the EIA report. In average, they were as low as 24 % of the modelled areas. The source levels used for EIA modelling were based on the measured average and maximum peak pressure levels of all munitions cleared during the previous Nord Stream project. The data was divided into four sections along the length of the pipeline corridor in Finnish waters. Note that the EIA modelling for Nord Stream 2 did not consider the mitigation effect of big bubble curtains.

The modelling results used for the Natura assessment were based on the maximum source levels and considered the use of big bubble curtains. The Natura assessment included 7 modelled PTS areas and 6 of the measured areas were smaller than modelled (Table 15). In average, they were as low as 23 % of the modelled areas (Figure 39). The modelling results used for the Natura assessment covered 7 modelled PTS areas (Figure 39) including detailed modelling of the worst-case scenarios potentially affecting the Natura 2000 area. Five modelled PTS areas were located near Kallbådan and two were near Söderskär. These were chosen due to their large explosive charge (kg) and proximity to the Natura 2000 area. The measured SEL-values at the long-term monitoring stations did not exceed the TTS threshold limit. A SEL value of 163.6 dB was measured at a distance of 9249 meters, suggesting that TTS did not reach the nearest protected area with seals as a conservation objective, which is located 9.8 km from the pipelines. The use of big bubble curtains was taken into consideration in the modelling by reducing the source level.

The measured PTS areas were also considerably smaller than the “worst case” scenario used in the water permit application. Altogether, the measured PTS areas add up to as little as 11 % of the maximum modelled area in the permit application. The modelling for the permit applications was done for 8 munitions with various Sound Exposure Levels (SEL) and/or munition charge weights. Modelling was based on the maximum individual measured peak pressure levels measured during the Nord Stream project. The results have been used as basis for the parameterisation of threshold distances for all munitions included in the Munitions by Munitions assessment /68/. Modelling considered the use of bubble curtains for all 58 munitions, for which bubble curtains were used.

Neither the PTS-level (179 dB unweighted SEL (single event)) nor the TTS- level (164 dB unweighted SEL (single event)) were exceeded at the long-term monitoring stations during the munitions clearance operation.

Underwater noise propagation was higher in the Estonian coast due to the constant depth, but the PTS or TTS levels did not extend to the Natura 2000 areas designated for marine mammals. Impacts in Estonia were smaller than assessed in the EIA Report and the permit application. Likewise, the monitoring results confirm that neither the PTS nor TTS levels reached the Natura 2000 areas designated for marine mammals.

In the **Nord Stream** monitoring peak pressure data was collected during munitions clearance /72/. Measured peak levels were lower in the NSP2 project than measured peak levels in Nord Stream,

because no big bubble curtains were used during NSP. PTS and TTS areas were not calculated/modelled in NSP monitoring.

Table 15. Underwater noise impact comparison table.

Predicted			Monitoring	
Underwater Noise	EIA	Water permit application	Monitoring activities in 2018	Monitoring results
<p>Underwater noise of munitions clearance operations</p> <p>Peak levels and SEL</p> <p>PTS area</p> <p>TTS area</p>	<p>The extent of the TTS and PTS impact zones are modelled to be considerable for both seals and porpoises. The PTS zone around munition clearance sites cover a relatively large area (up to 15 km from the NSP2 route).</p> <p>The initial assessment of munitions clearance resulted in the need for mitigation of the noise impact on marine mammals for specific munitions.</p>	<p>In the original Permit Application, NSP2 project proposed to use bubble curtains for 20 munitions in order to reduce the impact to the protected Natura 2000 areas with seals as a conservation objective, and to limit potential impacts to the Ringed Seal population in the Gulf of Finland.</p> <p>After the submission of the Permit Application, Nord Stream 2 AG decided to use bubble curtains for all munitions that have a charge greater than 22 kg.</p>	<p>74 munition clearance operations. 8 fixed long-term monitoring stations with continuous recording, vessel-based monitoring of three munitions clearance operations and on-site measurements carried out by munitions clearance contractors. Mitigation measures: ADD, MMO, PAM, fish finders and pressure wave sensors were applied as planned.</p> <p>Further noise mitigation with bubble curtains were applied for 58 targets. Bubble curtains were used for munitions with a total NEQ (explosive charge + donor charge) of 22 kg or more and for all munitions east of GKP 174.</p>	<p>253 out of 254 peak levels were lower than the modelled values in the permit application. The calculated PTS zones were smaller than modelled average/maximum results in the EIA report and considerably smaller than the “worst case” scenario modelled in the water permit application.</p> <p>The PTS or TTS levels did not reach the Natura 2000 areas with marine mammals as a conservation objective neither in Finland nor Estonia.</p> <p>Some fish kills were detected during the post detonation survey. Based on the results, bubble curtains successfully reduced the noise from munition clearance.</p>
Nord Stream monitoring	Peak pressure level data was collected during munitions clearance operations for NSP. Measured peak pressure levels were generally below 232 dB, only in four cases the actual peak pressure level was higher than the predicted.			

4.3 Water quality and current monitoring

The construction phase of Nord Stream 2 pipeline system generates sediment spreading that can potentially have an environmental impact on marine life. Sediment spreading was monitored during construction in 2018 by turbidity measurements with water quality sondes. In addition, current fields were measured with ADCP devices (Acoustic Doppler Current Profiler). This chapter presents and compares the monitoring data with the modelling results. The main objective for turbidity and current monitoring is to evaluate how far construction related sediments travel, how high sediment spills can rise and how high the maximum turbidity readings are.

Impacts of pipelay and pipe supply on sediment resuspension were monitored in the **Nord Stream** project, in which both anchored and DP pipelay vessels were in use. For the DP vessels, the monitoring results gathered at 1.5-2.0 m above the seabed or through the water column along the transects indicated no disturbance of bottom sediments from the pipelay performed with the DP lay barge /73/. In the Nord Stream 2 project, only DP pipelay vessels were used. As the effects of pipelay were assessed to be none or negligible, they were not monitored in the Nord Stream 2 project.

4.3.1 Monitoring methods

Water quality and current monitoring was carried out with self-logging oceanographic sensors deployed from a survey vessel. Sensors were moored to the seabed and brought to the surface only for regular service with an acoustic releaser system (Figure 41). This allowed monitoring without visible surface buoys and disturbance to third party shipping activities. A set of three monitoring arrays was used in a triangular shape around each selected rock placement and munition clearance site, as well as at the Sandkallan monitoring site. At each site the three monitoring arrays represented three sectors to measure the potential impact from the origin. All arrays consisted of three sensors, located 2, 5 and 15 meters above the seabed (Figure 41). In addition, one array was equipped with a 3D-current sensor (Figure 41), which measured the current speed and direction at all depths.

Water quality monitoring was performed with EXO2-sondes, which record salinity, temperature, oxygen and turbidity levels at each of the monitoring sites at 15 minute intervals. Turbidity and oxygen levels were measured with optical sensors equipped with automatic cleaning system in order to prevent the false readings caused by bio-fouling. Sensors were calibrated at 6 month intervals.

Current monitoring was performed with RD-Instruments Workhorse ADCP's. Current speed and direction were measured from the sea floor to the surface with two-meter vertical resolution at 15 minutes intervals. Sensors were also equipped to measure pressure, pitch, roll and temperature. Any errors caused by tilting due to potentially uneven seabed were automatically corrected.

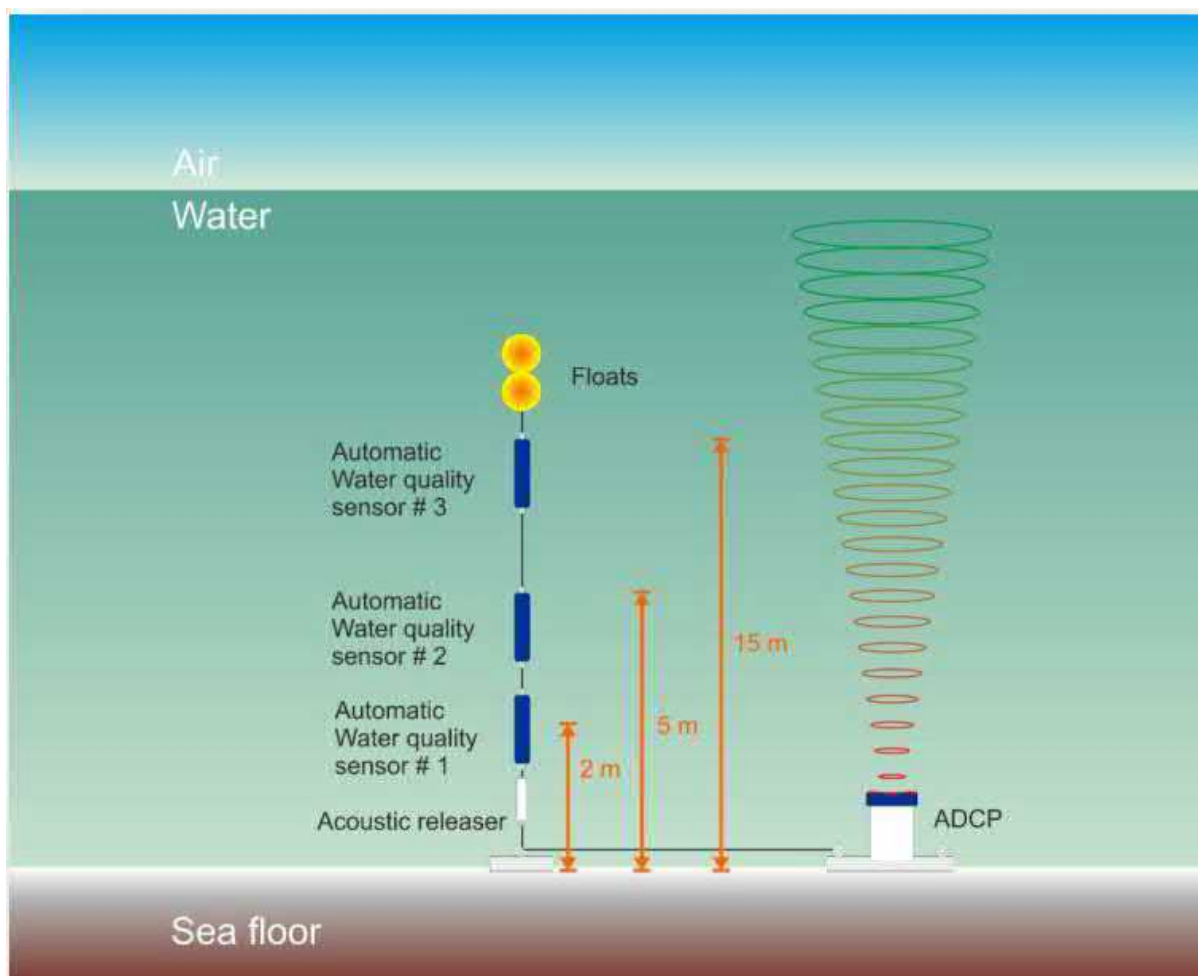


Figure 41. Measurement setup for the water quality and current monitoring stations /36/.

Short-term monitoring at the rock placement and munition clearance sites

Water samples are used to collect background information for those parameters that cannot be measured with automatic instruments. In addition, they can be used for comparison of the measured and modelled impacts, which are both based on different units. Measured data was based on turbidity units [FNU, NTU] and modelled data on solid matter concentration (total suspended solids, mg/l). In this report the common conversion factor 1:1 has been used. It is based both on the original definition of turbidity as well as a very large amount of parallel measurements in the Gulf of Finland. The same factor can be used throughout the whole scale.

Prior to pipelay, several rock berms were constructed on the seabed in order to prevent long free-spans or areas with sharp rock formations and strong depth gradients in the pipeline installation corridor. Rock placement operations can cause resuspension and spreading of sediment to surrounding waters. Therefore, the impacts of rock placement were monitored at two locations; Rock Placement 1 and Rock Placement 2. Monitoring covered the periods prior, during and after the rock placement operations.

Rock Placement 1 monitoring site was located in the eastern part of the Gulf of Finland (Figure 42) with depth variation from 59 meters to 62 meters at monitoring locations. Rock placement works were ongoing during the period from April 28 to May 1, 2018 with a total rock mass of 25,000 t being placed.

Rock Placement 2 monitoring site was located in the western part of the Gulf of Finland (Figure 42) with depth variation from 61 m to 64 m at the monitoring locations. Rock placement works were ongoing on

September 7, 2018 and September 10, 2018 and a total rock mass of 9,000 t was placed (significantly lower than at Rock Placement 1 site).

In addition to rock placement operations, the impacts of munition clearance were monitored at two locations named Munition Clearance 1 and Munition Clearance 2. During munition clearance, 74 targets were cleared by detonations. Detonations can cause turbidity spreading into surrounding water, as the targets to be cleared were located either on the surface layer of sediments or buried in the seabed.

Munition Clearance 1 monitoring site is located in the western part of the Gulf of Finland and it represents the sea floor area with depth variations from 64 m to 70 m (Figure 42). A Russian M-8 munition type with a 115 kg explosive charge (R-R09ALT1-20467) was cleared at this location. Two detonation attempts with a 5 kg donor charge were needed to fully clear the target. Monitoring at the site was performed from May 9, 2018 to July 9, 2018. The detonations took place on June 3, 2018 and June 4, 2018.

Munitions Clearance 2 monitoring site is located further west from Munition clearance 1 site, and it was the deepest monitoring site with a depth of 80 m (Figure 42). An M-26 contact mine (R-R12-10513) with a 240 kg explosive charge was successfully cleared with one detonation (in the permit application an initial explosive charge of 350 kg was assumed, this was re-evaluated to 240 kg by the munition clearance contractor). The donor charge was a 5 kg explosive charge weight. The detonation took place on May 31, 2018. In addition to the target munition R-R12-10513, three other munitions were cleared in the proximity of Munition Clearance 2 monitoring area. The explosive charges of the three munitions were 240 kg for two munitions and 2 kg for one munition. The monitoring period took place from May 23, 2018 to June 21, 2018.

Long-term monitoring

Three monitoring locations, Control 1, Control 2 and Sandkallan were selected to provide long-term monitoring data for water quality during the construction phase. Control 1 and Control 2 stations were placed in the same locations as used during the Nord Stream project, far from any project related construction activities (Figure 42). In addition to Control 1 and 2 stations, three stations were deployed at the Sandkallan area (Figure 42). The Sandkallan area was selected as a long-term monitoring location due to its vicinity to several rock berms as well as munition clearance operations. In addition, the Sandkallan area is part of the Natura 2000 network. Monitoring started at Control 1 site on April 17, 2018 and at Control 2 and Sandkallan sites on April 18, 2018. Long-term monitoring is currently ongoing and will continue until a few months after the end of all construction works in the Finnish EEZ.

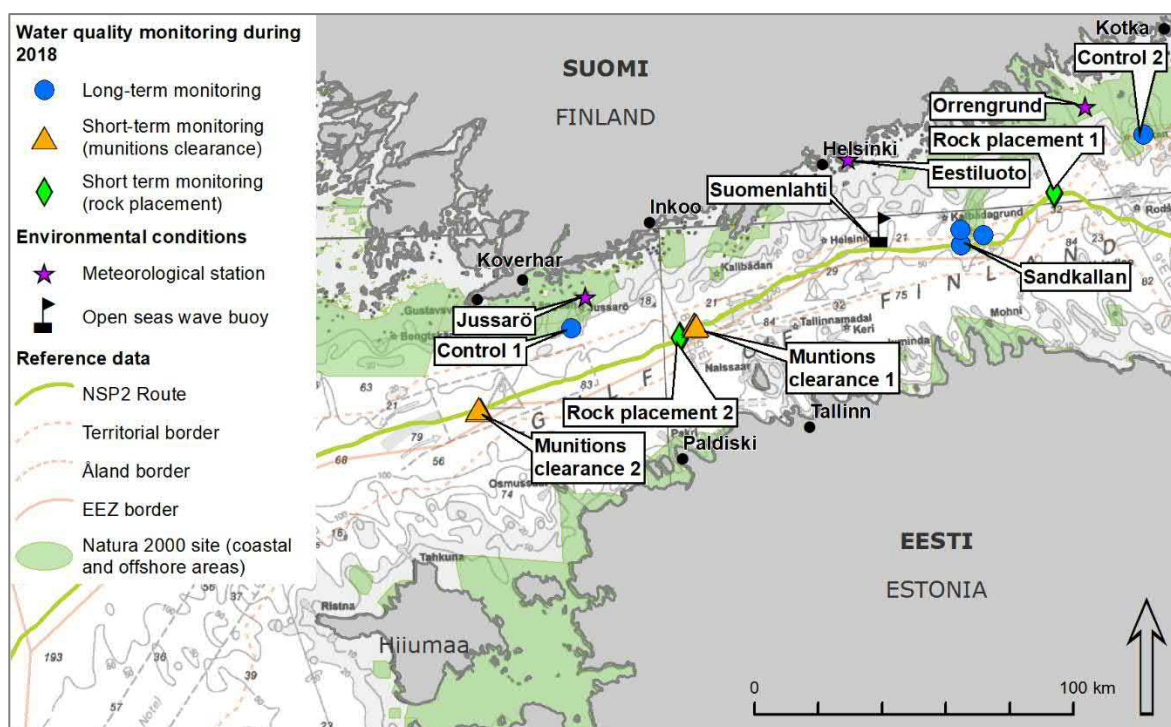


Figure 42. Map of the monitoring locations and the Nord Stream 2 pipeline route. Long-term monitoring sites are Control 1, Control 2 and Sandkallan. Short-term monitoring sites are Munition Clearance 1 and 2 as well as Rock Placement 1 and 2. The nearest weather monitoring stations and wave monitoring station operated by Finnish Meteorological Institute are presented in the figure.

4.3.2 Results

Rock Placement

Rock Placement 1

Altogether 25,000 tonnes of rock were placed close to the monitoring site Rock placement 1. The constructed rock berm is one of the largest berms in the Finnish waters. Only the berm needed for the crossing of the Nord Stream pipeline is larger. Another reason for the selection of this berm is its location on soft sediment.

The impact of rock placement on turbidity was clearly detected by the network of turbidity sensors (Figure 43). During the four days rock placement operation, only one out of 3456 recorded measurements (0.03 %) exceeded the modelled (EIA report) winter maximum level of 61 FNU. The modelled summer maximum was exceeded in 82 measurements (2.4 %). All the high values were measured close to the bottom at distances of 2 and 5 meters. Turbidity values decreased below 10 FNU in 6.5 hours and below 2 FNU in 44 hours after the rock placement operation was completed.

Measured impact was detected at the monitoring sites located at a distance of 200–300 m from the rock berm. The exact magnitude and duration of the impact further away from the origin was not measured. However, as the water mass moved further away, the concentration decreased because of sedimentation and mixing. The recorded current speeds indicate that the near bottom water layer moved 2.1–2.6 km in 24 hours.

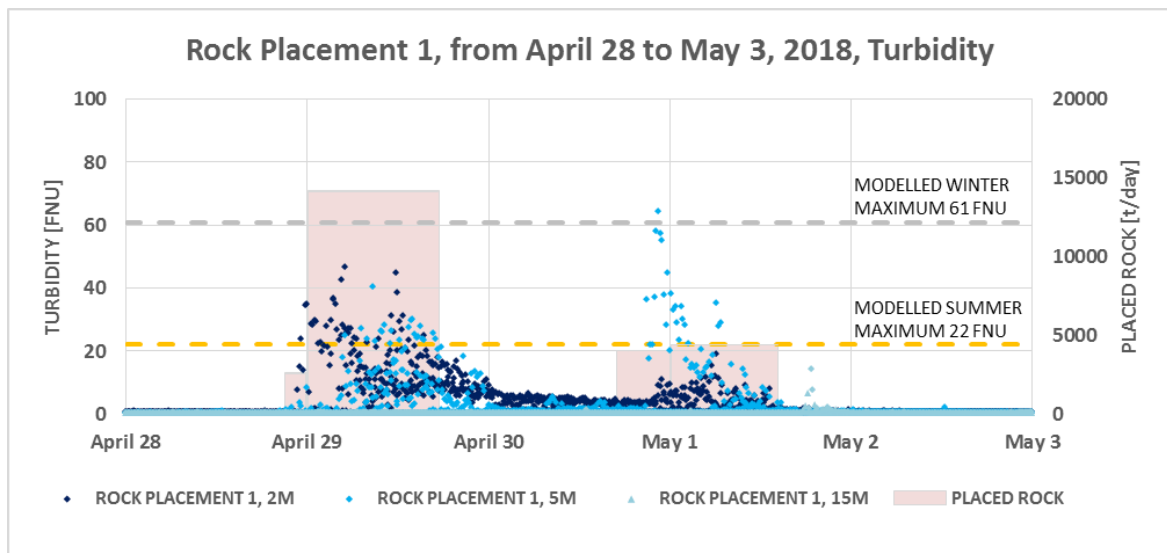


Figure 43. Measured turbidity data recorded at 2 m, 5 m and 15 m above the sea floor during the rock placement operation at the monitoring site Rock Placement 1. The pink colour indicates the total amount and duration of rock placement.

Rock Placement 2

The rock berm at the Rock Placement 2 site was significantly smaller compared to the Rock Placement 1 berm. The site was selected for monitoring due to very soft clay seabed /41/. Altogether 9,000 tonnes of rock were placed close to the monitoring site Rock Placement 2 within two days of operation (September 7, 2018 and September 10, 2018).

The impact of rock placement on turbidity was detected by the network of turbidity sensors (Figure 44). The highest single measured value was 13 FNU. All other measurements stayed below 10 FNU. None of the modelled turbidity limits (EIA report) were exceeded.

The duration of the impact lasted only for the period when the rock placement operation was ongoing. Turbidity values decreased to background levels below 1 FNU immediately after the completion of the rock placement operation.

Only 2 days after the rock placement was completed, a natural high current speed episode (>30 cm/s) elevated the background turbidity to the same level as measured during the operation.

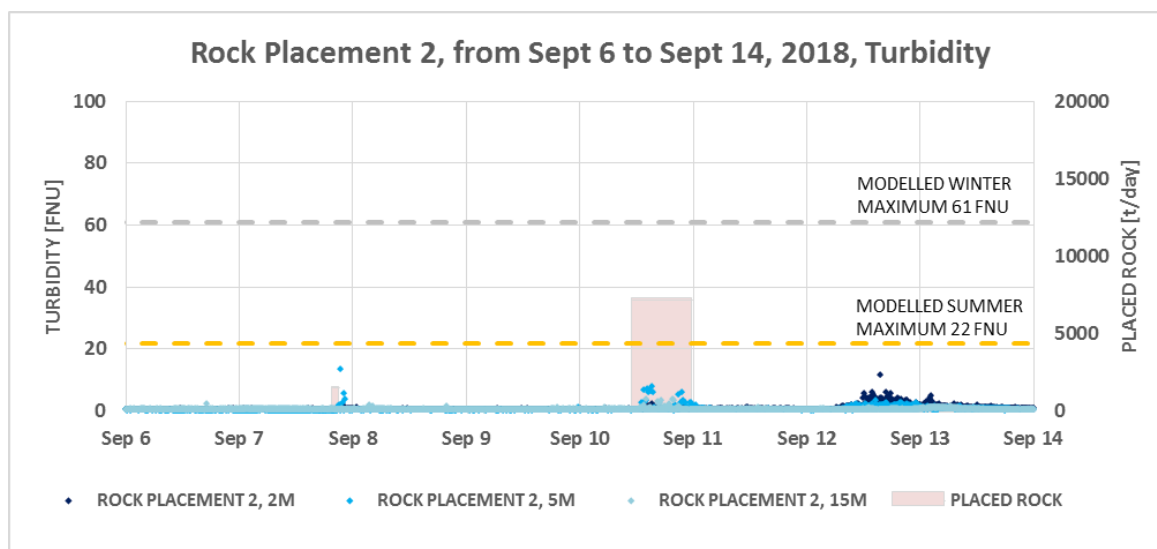


Figure 44. Measured turbidity data recorded at 2 m, 5 m and 15 m above the sea floor during the rock placement operation at the monitoring site Rock Placement 2. The pink colour indicates the total amount and duration of rock placement.

Munition clearance

The measured impact on water quality caused by munitions clearance was small. The impacts on water quality from the actual detonations were not detected but impacts of preparation and follow up works could be seen. The maximum measured turbidity peak value is 9.2 FNU and the maximum measured background peak level is 5.8 FNU at the Munition Clearance 2 site (Figure 45). Turbidity impact was limited to the stratified near bottom layer measured at 2 m and 5 m above the sea floor. Turbidity in the upper layer measured at 15 m above the sea floor remained below the background levels. At the Munition Clearance 1 site, no clear signs of increased sea water turbidity levels caused by the munition clearance operation were detected (Figure 45).

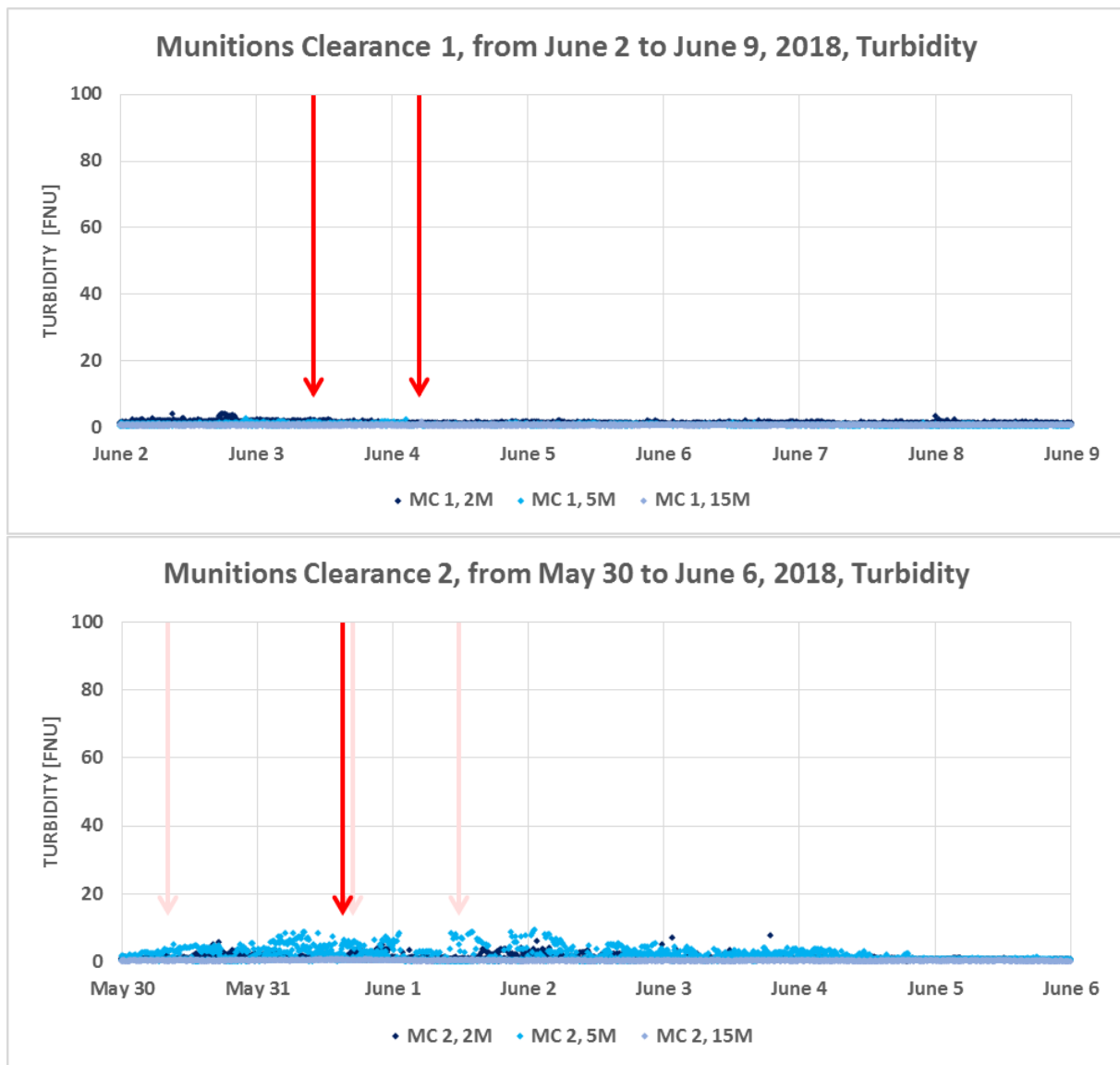


Figure 45. Measured turbidity during the munition clearance operation at monitoring sites Munition Clearance 1 (above) and 2 (below). Red arrows indicate the clearance time of the main targets, light red arrows indicate the clearance times of other targets located in the vicinity of the monitoring area.

Recorded current speed and direction data were used to estimate the distance of the sediment spill at both Munition Clearance monitoring sites:

- At the Munition Clearance 1 site, sediment spill scattered within 0.5-1.5 km distance from the detonation crater during a 24 h period after the detonations.
- At the Munition Clearance 2 site, released sediment spill was carried out of the monitoring area with a strong current during the 24 h period after the detonation. In the layers of 2 m and 5 m above the sea floor, particles ended up 1.6-2.2 km to the north from the detonation crater. In the upper layer measured at 15 m above the sea floor, where sediment spill was not detected, the flow was even faster and released particles could have potentially travelled as far as 8 km from the detonation crater in 24 h.

When comparing the monitoring locations in relation to the estimated route of the sediment spills at both Munition Clearance monitoring sites, it is possible that the released sediment spill did not travel directly towards the monitoring locations and thus impacts were not fully recorded with the water quality sensors.

Long-term monitoring

Results from the long-term monitoring stations show natural changes in water quality. All recorded turbidity peaks during the monitoring period were linked to storm events with mainly strong southwestern winds having the longest open fetch for waves to develop. The significant wave height peaks also matched with the turbidity peaks (Figure 46). The maximum recorded turbidity value was 20 FNU at the Control 1 site, 24 FNU at the Control 2 site and 12 FNU at the Sandkallan site. Outside of the storm events, the background average turbidity level remained below 1 FNU at all sites.

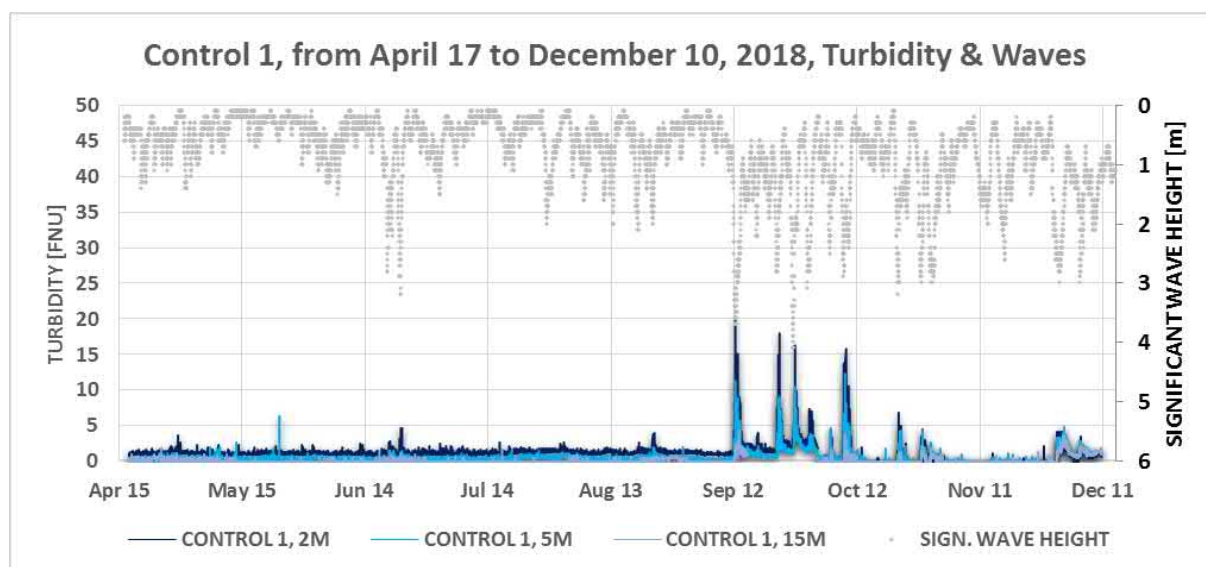


Figure 46. Measured turbidity readings at the monitoring site Control 1 between April 17, 2018 and December 11, 2018 plotted with the significant wave height recorded in the middle of the Gulf of Finland.

4.3.3 Correlation to predictions

Rock Placement

The model results in the EIA phase estimated that the elevated turbidity values are limited to a range of few hundred meters from the construction site. The modelled maximum value was 61 FNU in winter conditions and 22 FNU summer conditions. The duration, for which the concentration threshold of 2 FNU is exceeded, was estimated to be 165 h during calm summer conditions and 24 h in winter conditions (Table 16). The model was based on Nord Stream project current measurements (ADCP). The modelled summer period (June 2010) represented calm current conditions and relatively strong temperature and salinity stratification. The modelled winter period (November 2010) represented relatively strong current conditions and relatively low temperature and salinity stratification.

In the Water Permit phase, the impacts of rock placement operations were estimated to be limited to the near bottom water layer. Increased turbidity levels up to 20 FNU were expected to be found at 1 km distance from the origin. The duration of the impact (>10 FNU) was estimated to be from 2 to 19 h depending on the hydrographic conditions.

The measured turbidity values related to rock placement activities matched better with the EIA phase model for winter conditions. The highest turbidity values were measured in May, when the stratification structure is still weak and closer to the modelled winter conditions than strong summer stratification, which enables stronger current conditions in the bottom layer. The highest measured values were also at the same level with Nord Stream monitoring of similar construction sites. The highest recorded turbidity in the Nord Stream monitoring was 53.8 FNU.

There is no monitoring data available at the distance of 1 km as modelled in the Water Permit application. However, the duration of the impact recorded as close as 200-300 m from the construction site was 6.5 h. This is clearly below the maximum duration of 19 h described in the Water Permit application for the distance of 1 km.

Munition clearance

Model results from the EIA phase estimated minor impacts to follow from munition clearance operations on sea water turbidity values. Modelling showed that maximum turbidity values stayed below 107 FNU. Duration of turbidity levels exceeding the threshold of 2 FNU was modelled to be 15-23 hours under typical summer conditions.

In the water permit phase, munition clearance operations were estimated to cause a short-term increase in turbidity values. Increased turbidity levels were estimated to be found at 1 km distance from the detonation crater and the duration of local impact (>10 FNU) was estimated to be 24 h or less.

The measured turbidity values related to the munition clearance activities were lower than predicted in the EIA report, but at the same level as measured during the Nord Stream monitoring for similar targets. The maximum measured turbidity was 9.2 FNU and it was most probably caused by the preparation activities. The detonation itself did not cause turbidity levels to increase above the background variation. The duration of turbidity peaks was typically about 12 h, which is shorter than the modelled duration (Table 17).

In the **Nord Stream** monitoring elevated turbidity values were measured in bottom close waters up to 10- 15 meters above the seabed in an area having a radius of approximately 250 m around the munition. The maximum turbidity value is similar to the one measured during the Nord Stream monitoring (<10 FNU) /73/.

When comparing the monitoring locations in relation to the estimated route of the sediment spills at both Munition Clearance monitoring sites, it is possible that the released sediment spill did not travel directly towards the monitoring locations, and thus impacts were not fully recorded with the water quality sensors.

Table 16. Impacts of rock placement on water quality.

Water quality		Predicted		Monitoring
Rock placement	EIA	Water permit application	Monitoring activities in 2018	Monitoring results
Potential impact receptors: Fish, benthic fauna, marine mammals and aquatic vegetation	The maximum modelled turbidity: 61 FNU in winter conditions and 22 FNU in summer conditions	Increased turbidity levels of up to 20 FNU were estimated to be found at 1 km distance from the detonation crater	Impacts were monitored at two locations both with 9 turbidity sensors located at 3 sites each with 3 measurement depths. The measurement arrays were set up at distances of 200–300m from the rock berms.	The maximum measured turbidity is 64.3 FNU
	Duration of the impact exceeding 2 FNU: 165 h in summer conditions and 24 h in winter conditions.	Duration of local impact exceeding 10 FNU was estimated to be 19 h or less.	Rock Placement 1, total placed rock 25 000 tonnes, and Rock Placement 2, total placed rock 9 000 tonnes	Measured turbidity levels match better with the model simulations describing winter conditions The duration of the impact exceeding 10 FNU was 6.5 h, and 44 h exceeding 2 FNU The duration of the impact exceeding 10 FNU is clearly below the duration modelled in the water permit.
Nord Stream monitoring	The maximum recorded turbidity impact originated from rock placement was 53.8 FNU. The duration of the impact exceeding 10 FNU was between 12–24 hours.			

Table 17. Impacts of munition clearance on water quality.

Water quality		Predicted		Monitoring
Munitions clearance	EIA	Water permit application	Monitoring activities in 2018	Monitoring results
Potential impact receptors: Fish, benthic fauna, marine mammals and aquatic vegetation	The maximum modeled value is 107 FNU.	Increased turbidity levels were estimated to be found at 1 km distance from the detonation crater.	Impacts were monitored at two locations both with 9 turbidity sensors located at 3 sites each with 3 measurement depths:	The maximum measured turbidity is 9.2 FNU.
	Duration of the impact exceeding 2 FNU was modelled to be between 15 and 23 h.	Duration of local impact exceeding 10 FNU was estimated to be 24 h or less.	Munition Clearance 1, Russian M-8 munition type with a 115 kg explosive charge Munition Clearance 2, M-26 contact mine with a 240 kg explosive charge	Modelled results overestimated the impact. Measured duration of the impact is 12 h, which is shorter than the modelled duration Impact of actual munition clearance detonation was not detected but impacts of the munition clearance preparation and follow up work could be seen.
Nord Stream monitoring	The maximum measured turbidity values remained below 10 FNU. Increased turbidity values were measured in bottom close waters up to 10-15 meters above the seabed in an area having a radius of approximately 250 m around the munition.			

4.4 Cultural heritage monitoring

Thorough pre-lay surveys were carried out for the two targets subject to monitoring according to the environmental monitoring programme. A thorough post survey of these two targets will be carried out after the construction works in the Finnish waters have been completed to confirm that no damage to the monitoring targets have occurred during the implementation of the project.

4.4.1 Monitoring methods

Pre-surveys were carried out for two monitoring objects, a cannon barge wreck (S-R05-7978), and an anti-submarine net (S-R09-09806).

The inspection of the presence and condition of the historical anti-submarine net, target S-R09-09806, was performed by the MV Geosund on May 2, 2018. A Multibeam Echo Sounder (MBES) sweep was performed from north to south across the installation corridor for Line A and Line B. The Remotely Operated Vehicle (ROV) then proceeded to visually trace the line of floats and cables of the anti-submarine warfare net. Various locations defined by the NSP2 project were then inspected, and their condition was recorded for future reference.

The wreck inspection using the Remotely Operated Vehicle (ROV) survey for the cannon barge, target S-R05-7978, was performed by the MV Stril Explorer on May 6, 2018.

As the net remains are planned to be partly buried by the berms and the pipelines, it is recommended that the post-lay inspection covers the outer edges of the berms where the rock backfill meets the seafloor. In this way it will be possible to assess the extent of the burial of the net under both pipeline berms. As previously, high resolution MBES, SSS, video and photo will be used in due course as applicable.

It is noted that large seabed installations may cause changes i.e. to the direction of prevailing sea-bottom currents, and in the long run, this may lead to altered site-formation processes, such as scouring and sedimentation in the different sections of the site. These may affect the long-term preservation of the site. In the future, monitoring will be regular, i.e. included in the regular pipeline maintenance inspections /74/.

4.4.2 Results

The results presented in this chapter are preliminary. A thorough post-lay survey will be performed once all construction activities in the Finnish EEZ will be completed. Tables 18 and 19 present the preliminary results after the pipelay of Line A.

Cannon barge wreck S-R05-7978

The wreck of the cannon barge S-R05-7978 is located approximately 60 m from the nearest planned pipeline (Line B). A post-lay survey of Line A shows that the pipeline has been laid within the lay tolerance at a distance of approximately 130 m from the wreck. The lay-tolerance for Line B was reduced to minimize any potential construction related impacts during the pipelay of Line B.

No further construction activities, such as rock placement are planned in the surroundings. The distance from the wreck to the nearest planned rock berm is more than 500 m. The distance to the nearest munition clearance site is 6.9 km.

Anti-submarine net S-R09-09806

According to the monitoring results, Line A was laid across the anti-submarine net mostly with a freespan, thus limiting the impacts onto the target (Figure 47).

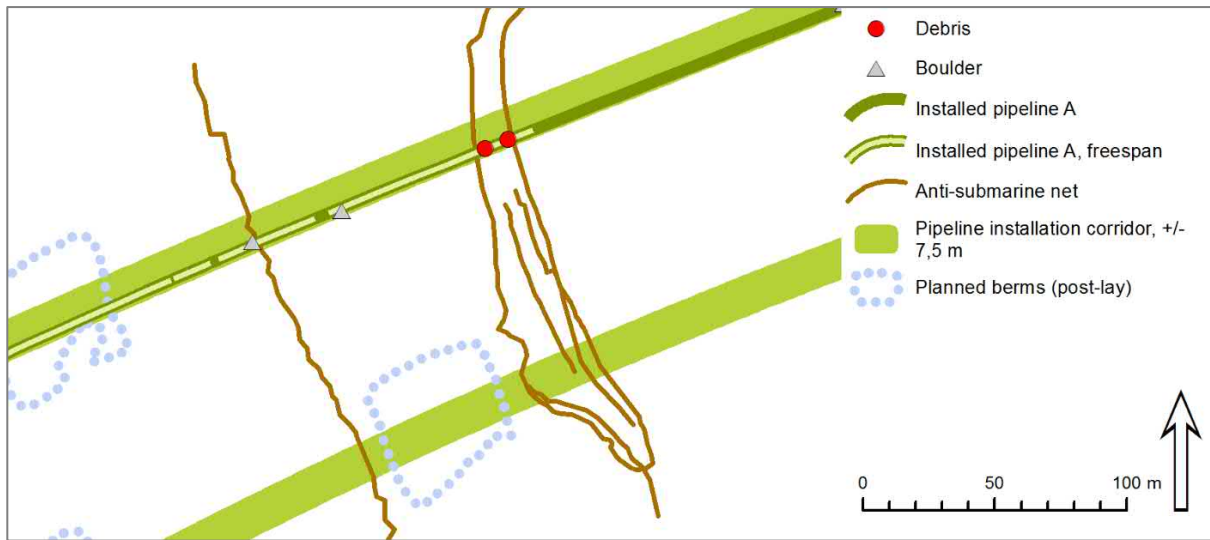


Figure 47. World War II anti-submarine net site documented objects and the installed pipeline Line A and the planned pipeline Line B. (Data provided by NSP2 and Van Oord; /27/).

Table 18. Cannon barge wreck impact comparison table

		Predicted		Monitoring
Cultural Heritage	EIA	Water permit application	Monitoring activities in 2018	Monitoring results
Cannon Barge Probably from the late 18th-early 19th century. Sensitivity is ranked high.	The magnitude of change and significance of impact during construction and operation phases have been assessed to be negligible.	A 50 m minimum safety perimeter is recommended for the wreck site. A post-pipelay inspection is recommended for the site due to the relatively short offset distance to Line B routing.	Each component location, detailed in the 2016 survey report, was revisited to acquire identical video recordings and images for comparison purposes. No additional findings were observed. The ROV wreck inspection was performed on May 6, 2018, before the munitions clearance operations by MMT Sweden Ab	Pipeline (Line A) was laid on October 19, 2018 as planned within the lay tolerance (appr. 147 m distance from the wreck) causing no impact on the target. Line B, which is closer to the wreck, will be laid in 2019. Line B lay tolerance is reduced towards the wreck. Mitigation measures for Line A were implemented as planned - respecting the safety zone of 50 m radius. A thorough monitoring will be performed once all construction activities in the proximity will be completed.
Nord Stream monitoring	Not relevant because of different targets and distances to pipeline centrelines. No impacts on wrecks were detected during the Nord Stream construction work or munitions clearance.			

Table 19. Anti-submarine net impact comparison table

Predicted		Monitoring		
Cultural Heritage	EIA	Water permit application	Monitoring activities in 2018	Monitoring results
Anti-Submarine Net Sections of the “western” and “eastern” parts of the “Walross” anti-submarine net (barrage) from World War II. Sensitivity is ranked as medium.	The magnitude of change in the construction and operation phase has been assessed to be low, and the significance of impact is minor.	Both pipelines are planned to be laid on top of the net taking into account minimal damage to the target	N-Sea Bodac carried out an Anti-Submarine Net Field Verification Survey on May 2, 2018.	Pipeline (Line A) was laid over the target December 28, 2018. As-built survey will be carried out immediately after the pipelay of Line B. A thorough monitoring will be performed once all construction activities in the proximity will be completed.
Nord Stream monitoring	Not relevant because of different targets and distances to pipeline centrelines. No impacts on wrecks were detected during the Nord Stream construction work or munitions clearance.			

4.5 Commercial fishery monitoring

During the operation phase, two years after the end of construction, a survey including a questionnaire to fishermen will be performed. The aim of the survey is to monitor trawling patterns of the Finnish professional fishermen, avoidance of the pipeline area and possible changes in the fishing patterns in the NSP2 pipeline area within the Finnish EEZ. The results of the commercial fishery monitoring will be available after the survey is completed (planned for 2022).

5

ADDITIONAL MONITORING TARGETS

5 ADDITIONAL MONITORING TARGETS

This chapter presents the results of studies and information complementing the environmental monitoring presented in chapter 4. These include the sediment contaminant study near munitions clearance sites and the Kallbådan Seal Video monitoring. Furthermore, the potential impacts on marine mammals, biodiversity and ship traffic are addressed.

5.1 Sediment Contaminant Study

In order to prepare a safe installation corridor for the two pipelines, munitions were cleared from the seabed. In addition to the potential impact on underwater noise and water quality (Chapter 4) NSP2 project conducted sampling of sediments after munition clearance operations in order to study potential toxic material release to the seabed during the detonation of munitions /75/.

5.1.1 Monitoring methods

In 2016, sediment samples were collected and analysed in order to provide reference data for the Environmental Baseline studies for the Nord Stream 2 –project /37/. The munitions in the sea contain toxic compounds such as trinitrotoluene (TNT) and its decomposition products as well as mercury (Hg), methylmercury (MeHg) and lead (Pb), which were used both in detonators and explosive capsules. Samples were taken from the uppermost layer of the seabed. Samples were placed in containers, labelled and stored in the cold until the delivery to the laboratory. Laboratory analyses were carried out for explosive residuals and the following heavy metals: arsenic, lead, cadmium, chrome, copper, nickel, mercury and zinc.

Altogether 17 sediment samples were collected in order to provide reference data of potential explosive residuals and heavy metal spreading in the clearance site surroundings. In this study samples were taken from two targets.

Target R-R08-5261

From June 5, 2018 to June 6, 2018, the munition clearance contractor N-Sea conducted sediment sampling from the vessel MV Geosund with the ROV. Six sediment samples were taken from the surrounding seabed of target R-R08-5261, which was cleared on June 6, 2018. Due to safety reasons target R-R08-5261 was relocated 240 m from its original location before detonation. It was a possible Russian depth charge BM-1, which contained 25 kg of explosives and was cleared with a 5 kg donor charge. The target was cleared with a bubble curtain decreasing the pressure and noise impact to the surrounding environment.

Target R-R09-7495

On July 11, 2018 Luode Consulting Oy took 11 sediment samples from the seabed surrounding the target R-R09-7495, which was cleared on May 13, 2018. Samples were taken from the vessel “Monitor” with a Gemax gravity corer. The delay between clearance and sampling time has no impact on results due to the persistent characteristics of the compounds to be analysed.

For target R-R09-7495 sediment sampling was carried out with a GEMAX type sampler, which was lowered to the sea floor with a hydraulic winch. Target R-R09-7495 was a German EMC-1 mine, which contained 300 kg explosives and was cleared with a 10 kg donor charge. It was also cleared with the use of a big bubble curtain.

5.1.2 Results

Target R-R08-5261

Collected sediment sample datasets showed that none of the analysed six samples contained explosive material residuals that exceeded the laboratory detection limits. The analysed metal concentrations varied randomly and no clear pattern between the location and concentration could be seen. The samples showed similar concentrations before and after the detonations. Lead concentrations in samples taken after the detonation were smaller than those taken before, most likely caused by natural variability of the seabed conditions. In addition, the loose top layer of sediment is often relocated during the detonation. Mercury was at the same level before and after the detonation (Table 20).

Target R-R09-7495

The collected sediment sample datasets showed that none of the analysed eleven samples contained explosive material residuals that exceeded the detection limits. Heavy metal concentrations varied randomly and no clear pattern between the location and concentration could be seen. The analysed concentrations were on comparable level to those measured during the baseline surveys in 2016 from the same area. Slightly elevated arsenic concentrations were measured both at 20 m and 300 m distance, while samples taken at 100 m and 200 m distance had lower concentrations. In general, some single individual concentrations were slightly higher than average concentrations during 2016 the baseline sampling /37/, but most readings showed the same or lower levels (Table 20). Clear evidence of seabed heterogeneity is that duplicate samples from the same station showed different concentrations.

Table 20. Main toxicity monitoring results.

Monitoring	Results
Toxicity monitoring	No residues of explosives exceeding the laboratory detection limits were found. Heavy metal concentrations were typical when compared to those measured in earlier studies in the Gulf of Finland /75/.
Nord Stream monitoring	The results from the pre and post activity sampling rounds did not indicate any significant sediment relocation or increases in the concentrations of contaminants.

5.2 Marine mammals

5.2.1 Monitoring methods

The following impact chain and assessment of impact significance were used in the EIA Report and in the Water permit application:

- Munitions clearance cause detonation pressure wave impact, which are dependent on the munitions charge, distance and bottom characteristics. Detonation of the munitions including the donor charges cause shock wave and underwater noise. In addition, rock placement and pipe supply cause underwater noise. Therefore, these actions may cause deleterious effects or disturbance on marine mammals due to underwater noise and disturbance due to waterborne noise from vessels.
- Munition clearance and rock placement cause disturbance to the seabed and the release of sediments to the water column. In addition, pipe supply and pipe laying may disperse sediments. Therefore, these actions may cause visual impact from increased vessel activity and visual impairment due to sediment dispersion.
- Munitions clearance and rock placement may cause behavioural disturbances in marine mammals due to sediment dispersion and health effects caused by contaminants.

These effects are described in detail in Chapters 4.2 in regard to underwater noise, 4.3 in regard to water quality and 5.1 in regard to sediment contaminant release. In addition, grey seal monitoring took place from June 3, 2018 to August 24, 2018 in the Kallbådan seal reserve. The monitoring was performed by Metsähallitus and it is described in more detail in chapter 5.2.2

In order to mitigate impacts on marine mammals several mitigation measures were implemented. For example, a trained marine mammal observer made visual observations from the clearance contractor's vessel before and after each detonation. The observer was monitoring a perimeter (minimum radius of 1 km, up to 2 km) around the munition to be cleared. Observations were conducted for a minimum of one hour period before the scheduled initiation of the charge. Acoustic deterrent devices were used to keep marine mammals away from the clearance area, and in addition, noise attenuating big bubble curtains were used for larger detonations and always within a sensitive marine environment (see Chapter 3.4.1).

5.2.2 Results

The detailed monitoring results of the construction activities and their potential impacts on marine mammals are presented in chapters 4.2. Underwater noise monitoring and 4.3. Water quality and currents monitoring.

During construction works of the **Nord Stream** project no injuries, fatalities or other significant impacts were observed. Only minor negative impacts on individual marine mammal behaviour were observed due to break-up of ice during winter period rock placement /2/. During the Nord Stream munition clearance campaign in the Finnish EEZ a total of 49 munitions were cleared. No injuries, fatalities or other significant impacts were reported /72/.

Video monitoring at Kallbådan

Metsähallitus monitored seals at Kallbådan from 3 May, 2018 to 23 August, 2018 using remote recording camera equipment. According to the study, the detonations had no impact on the occurrence of grey seals on the islets, even when the detonations were closest to the Kallbådan Seal Reserve /60, 76/. The distance between the detonations and the seal reserve was so long that seals did not react to the detonations at all.

5.2.3 Correlation to predictions

In several cases the weight of munition charge was smaller than predicted, and in addition, parts of the old charge may have dissolved in the water over the years. Mitigation measures, such as bubble curtains and automatic deterrent devices were used, and no injured marine mammals were observed before, during or after munitions clearance. Therefore, we conclude that the impact on marine mammals by munitions clearance did not exceed the expected impacts; rather, they were lower. The impacts are assessed as minor for harbour porpoise and ringed seal (on both individual and population levels) due to the species' low occurrences in the area combined with the mitigation efforts. For the grey seal, the impact on population level is minor as well (Table 21).

On an individual level the impact on grey seals was predicted during the EIA to be moderate. No bubble curtains were planned to be used at that time. In the permit applications bubble curtains were planned to be used for some high order munitions but the impact assessment remained moderate. In the final phase of permitting Nord Stream 2 decided to use bubble curtains for almost all munitions. Due to this and as no seals were observed during munitions clearance, the impact is assessed to minor on individual level.

Suspension of sediments may affect individuals in the area by visual impairment or behavioural changes, however these effects are assessed to be temporary, and therefore not to affect any of the species at population level. At individual level, the effects may be temporal but passing as the sediment disperses and sinks. The potential risk of formation of sediment clouds bears a risk of contaminants entering the food chain. However, turbidity monitoring revealed that the amount and duration of suspended sediment were lower than assessed in the EIA. In the **Nord Stream monitoring**, the effects of pipelay (touchdown of the pipeline and effect of vessel presence/activity) on sediment spill were assessed to be none or negligible /73/. Therefore, we assess that the impact of sediments and resuspended contaminants on marine mammals are similar or lower than assessed in the EIA and the water permit application.

Table 21. Predicted impacts and impacts according to the monitoring results of marine mammals.

Predicted			Monitoring	
Marine mammals	EIA	Water permit application	Monitoring activities in 2018	Monitoring results
Underwater noise Sediment spill Release of contaminants	Moderate impacts from underwater noise of munitions clearance (blast injury and PTS) for grey seals and ringed seals on individual level have been assessed. Moderate to minor impacts from underwater noise (blast injury and PTS) for ringed seals on population level has been assessed.	Minor impacts from underwater noise (blast injury, PTS, TTS, avoidance and masking) on harbor porpoise, grey seal and ringed seals (at individual and population level) have been assessed. At population level, the selected mitigation measures and updated munitions data in the Eastern Gulf of Finland significantly decrease impacts compared to assessments have been assessed during the EIA phase.	Short-term vessel based as well as long-term underwater noise monitoring were undertaken. Marine mammals were observed during munitions clearance. Metsähallitus performed video monitoring of seals in Kallbådan. Water quality (turbidity) and currents were monitored along the construction area	We estimate minor impacts of blast injury, TTS and PTS on grey seal, ringed seal and harbour porpoise (both at individual and population levels). PTS and TTS zones did not extend to any of the adjacent Natura 2000 areas with marine mammals as a conservation object. According to onboard marine mammal observers, no marine mammals were observed in the munition mitigation areas before, during or after detonations.
	Minor impacts from underwater noise (blast injury, PTS, TTS, avoidance and masking) on harbor porpoise and ringed seals (only for TTS) and grey seals (at population level) have been assessed.	Negligible impacts from the release of contaminants from munitions clearance and rock placement have been assessed. Negligible impacts due to sediment spill have been assessed.		No effects on seal behavior at Kallbådan seal reserve in relation to munition clearance could be observed.
	Negligible impacts from the release of contaminants from munitions clearance and rock placement. Negligible impacts due to sediment spill have been assessed.			We assessed that the impact of suspended sediments and release of contaminants were negligible on all marine mammals.
Nord Stream monitoring	No significant impacts on marine mammals due to munition clearance or construction activities were observed. Only on a few occasions, minor behavioural impacts on individual marine mammals were observed as a consequence of ice break-up during rock placement activities.			

5.3 Biodiversity

In this chapter we describe the main aspects related to impacts on biodiversity. The impacts on marine mammals are dealt with in chapter 5.2.

Diverse habitats with zonation of benthic communities occur near the pipeline, such as the reef formations at the Sea Area South of Sandkallan, its adjacent areas and the pipeline sections in front of Porkkala.

The gas pipelines will mainly be located in deep waters where the diversity of benthic fauna is low and consists of species that can tolerate oxygen fluctuations and deficiencies. The depth zone of 30–60 m (approximately 9 % of the route) is mainly inhabited by a few opportunistic species, such as the red-gilled mud worm (*Marenzelleria* sp.), the scale worm (*Bylgides sarsi*) and the Baltic macoma (*Limecola balthica*). These organisms can survive in the sediments with low oxygen content. At deeper depths of 60–80 m (approximately 57 % of the route), temporary anoxic conditions apply, and the benthic community here is sparse. Water layers were stratified during munition clearance and rock placement, limiting the spread of suspended sediments. The impacts on sediment suspension, related Munition clearance, were restricted to 2–5m above the seafloor. Stratification reduced the risk of sediments affecting shallower, more biodiverse habitats. However, during the post-rock placement, fine particles spread across the stratification to more oxygen rich areas. This impact was short-term and limited to 24 h.

As sediment suspension is a temporary effect of munition clearance and rock placement, it is assessed to have no or negligible impacts on the biodiversity of the protected areas along the pipeline.

The monitoring related to the **Nord Stream** project confirmed that the effects on the benthic communities were in line with the estimated effects. The poor state of the benthic communities in the vicinity of the pipeline route at these deep sea areas is due to the unfavourable living conditions that result from the present state of the Gulf of Finland /73/.

Monitoring of fish population was not required for the NSP2 project. However, during munition clearance, fish were observed to float on the surface, but the quantities of the floating and sinking fish are difficult to assess, as known from the Nord Stream monitoring results /73/. No crucial spawning areas are in the NSP2 project area /77/ and commercial fish stocks have a good status /78/. As munition clearance effects are temporary (noise and sedimentation), all mitigation measures were implemented and no spawning grounds occur in the area, the impacts on fish stock levels were considered negligible.

Similarly, in the **Nord Stream** project, estimated indirectly from the water quality data, impacts on individual fish or fish populations were assessed to be highly unlikely during the construction works. During the munitions clearance in 2009–2010, small numbers of fish, mainly Baltic herring, were killed by the detonations /68/.

5.4 Ship traffic

Nord Stream 2 has provided general implementation plans to the Finnish Border Guard and the Finnish Transport Agency to inform about construction activities well in advance. The main vessels have provided weekly and daily notifications regarding their activities and schedules (Chapter 1.3).

The impact on third party ship traffic from the Nord Stream 2 construction works is due to the safety zones established around the construction vessels. The established safety zones were agreed with the Finnish Transport Agency/VTS Centre. The radius of the safety zone depends on the construction activity and the vessel in question. A distance of 1 NM was applied for the pipelay vessels, except at the Kallbådagrund TSS area where a reduced safety zone of 0.5 NM was established. Around the munitions

clearance vessels a safety zone of 1.5-2.5 km radius was established based on the size of the munition to be cleared. A safety zone of 500 m radius was established around the rock placement, mattress installation and survey vessels. Third party ships were not allowed to enter the safety zones.

For the time of pipelay near a shallow close to Kalbådagrund (October 7, 2018 to October 16, 2018; GKP 148–GKP 161) a tug, Esvagt Connector was stationed nearby in order to respond to ship emergencies, such as danger of grounding, under the request of the Finnish Transport Agency. The tug was on standby to assist the contractor and third-party vessels by towing and pushing, if necessary. No such situations occurred in 2018.

No incidents related to ship traffic were reported in 2018.

In the **Nord Stream** project, experiences during the construction work confirmed the validity of the assessments that there are no significant impacts on ship traffic.

5.5 Transboundary Impacts

Transboundary impacts from the project activities in Finland could potentially affect Russia, Estonia and Sweden. However, neither the EIA Report nor the Updated Assessment state that there would be any significant transboundary impacts from project activities in Finland towards any other jurisdiction, as defined for example in article 2 of the Espoo Convention.

The only performed monitoring of potential transboundary impacts was the underwater noise monitoring at two sites within the Estonian waters. The permanent threshold shift (PTS) levels monitored during munition clearance did not reach the Estonian territorial waters.

Since the water quality impacts were limited to the vicinity of the pipeline (munitions clearance and rock placement along the route), they are not expected to have an impact on the Estonian waters (see Chapter 4.3).

The environmental monitoring results of the 2018 construction activities are therefore in line with the assessments or smaller. Similarly, in the **Nord Stream** project, the monitoring results confirmed that the construction activities in the Finnish EEZ during 2010-2012 did not cause any measurable transboundary impacts in the Estonian EEZ.

6

MARINE STRATEGY AND WATER FRAMEWORK DIRECTIVES

6 MARINE STRATEGY AND WATER FRAMEWORK DIRECTIVES

According to the Marine Strategy Framework Directive, adaptive management on the basis of the ecosystem approach shall be applied with the aim of attaining the Good Environmental Status of the European Union's marine waters. The targets, qualitative descriptors and associated indicators of the Good Environmental Status are presented in table 7-1 and table 7-2 of the EIA Report /26/. The possibility that the Nord Stream 2 project will pose a risk to the achievement of the long-term goals for the Good Environmental Status is discussed in Chapter 11.20 of the EIA Report, and is covered also in section 5.21 of the Updated Assessment. The descriptors for the Good Environmental Status are biodiversity, food webs, non-indigenous species, commercial fish, eutrophication, seabed integrity, hydrographical conditions, contaminants, contaminants in fish and seafood, marine litter and introduction of energy and underwater noise.

The analysis made within the water permit application /16/ states that the project will not prevent the achievement of any of the goals set up in the Government Decision December 13, 2012 (the first part of the Finnish marine strategy). The project will neither prevent achievement of goals set in the programme of measures of the Finnish Marine Strategy for the period of 2016–2021, adopted by the Finnish Council of State on December 3, 2015 (the third and final part of the Finnish marine strategy). This was also noted on a general level by the EIA Authority in the EIA Statement and confirmed by the Updated Assessment.

The analysis made within the water permit application /16/ states that the potential impacts caused by the Nord Stream 2 project are connected to the release and spreading of nutrients and contaminants during the construction of the pipelines and supporting structures. The impact area is restricted to the vicinity of the construction sites and the changes in water quality are temporally very short. The long distance to coastal areas ensures sufficient dilution so that there will be no water quality impacts in coastal areas and, consequently, no impacts on the ecological status. Overall, it is concluded that the Nord Stream 2 project will not increase the main pressures on the environment and, therefore, the Nord Stream 2 project will not be contrary to the objectives and initiatives set out in the Water Framework Directive /16/.

Based on the Nord Stream 2 monitoring during 2018, it is concluded that the project will not prevent the achievement of goals set in the programme of measures of the Finnish Marine Strategy for the period 2016–2021.

7

RECOMMENDATIONS FOR FUTURE ENVIRONMENTAL MONITORING

7 RECOMMENDATIONS FOR FUTURE ENVIRONMENTAL MONITORING

Based on the evaluation of the results of the environmental monitoring during the construction works in 2018, the environmental monitoring according to the environmental monitoring programme /41/ gives a good representation of the impacts of the construction work, including underwater noise, water quality and currents as well as cultural heritage. Additional monitoring targets add more details to the overall view of the impacts of the projects. Taken together they form a comprehensive description of the effects that the construction work had on the environment. For 2019, no need for changes to the Nord Stream 2 monitoring programme was identified.

Recommendations for similar future projects will be given in the Annual Monitoring Report covering 2019 activities.

8

CONCLUSIONS

8 CONCLUSIONS

Construction activities during 2018 in the Finnish EEZ

The Nord Stream 2 construction activities in 2018 included munition clearance, rock placement, mattress installation and pipelay.

Munition clearance activities were successfully completed. In total, 74 munitions were cleared prior to other construction works.

Rock placement works progressed as planned. All pre-lay rock berms for Lines A and B have been completed. Post-lay rock placement for Line A has commenced and will continue through 2019. Post-lay rock placement for Line B will be performed in 2019.

In the preparation of crossings with the existing cables and pipelines a total of 492 mattresses were installed on the seabed.

The pipelay of Line A started on September 5, 2018 and continued to the end of the year. A total of approximately 260 km of Line A were laid in the Finnish EEZ in 2018. Lines A and B will be completed in 2019.

Four unplanned events occurred during construction in 2018, all being small leaks of biodegradable oil that were notified to the appropriate authorities. No detectable damage to the environment occurred.

Environmental monitoring

The Nord Stream 2 monitoring during 2018 was performed in-line with the environmental monitoring programme. Results of 2018 monitoring were compared to modelling and impact assessments presented in the EIA Report and the permit application, as well as monitoring results from the Nord Stream pipeline project.

Underwater noise monitoring

A series of mitigation measures were successfully implemented to reduce the environmental impacts of underwater noise due to munition clearance. These were the use of big bubble curtains, acoustic deterrent devices and marine mammal observers.

According to the noise measurements, the peak sound pressure levels were lower than predicted in the EIA report and the water permit application. In several cases, the total weight charge was smaller than predicted and some of the old munition charge may pose less of a threat over the years in the water. In general, no correlation between the munition charge weight and peak pressure level could be found.

The calculated permanent threshold shift zones based on the measured sound levels were significantly smaller than modelled in the EIA report and the water permit application. Neither the permanent nor temporary threshold shift zones reached any Natura 2000 areas with marine mammals as a conservation objective.

In conclusion, the monitored impacts of underwater noise on the various receptors were either in-line or lower than assessed in the application documents (Table 22).

Water quality and current monitoring

The impact of *rock placement* on water quality in the bottom close waters layers were measured at two selected sites.

The modelling results in the EIA phase estimated that the elevated turbidity values are limited to a few hundred meters range from the construction site. The estimated duration of impacts varied between different hydrographic conditions.

The duration of all measured impacts stayed significantly below predictions. In general, the measured values at 200-300 m offset were below the predicted winter levels as presented in the EIA report.

The measured turbidity from *munitions clearance* on water quality were lower and of shorter duration than assessed. Furthermore, the higher turbidity levels were mainly limited to the stratified near bottom layer of the sea. Detonations from clearance showed no increase in turbidity levels above the background variation, the only observable effect is the preparation works prior to the detonation itself.

Sediment contaminant sampling was performed at two munition locations to study the effect of potential toxic material release during the detonations. Based on the analysed sediment samples, no residuals of explosives were detectable. The heavy metal concentrations of sediment samples were typical to those seen in the earlier baseline studies in the Gulf of Finland.

In conclusion, the monitored impacts on water quality were in line or lower than assessed in the application documents (Table 22).

Marine mammals

Neither the permanent nor temporary threshold shift zones extended to any adjacent Natura 2000 areas with marine mammals as conservation object. No impact on grey seals at the Kallbådan seal reserve was observed by Metsähallitus in relation to munition clearance.

In conclusion, the monitored impacts of *underwater noise* on marine mammals were in line or lower than assessed in the application documents (Table 22).

The impact of *suspended sediments* and release of contaminants to the water column were smaller than modelled, thus their effects on all marine mammals are in line with the water permit application.

Comparison to the Nord Stream project

The measured underwater peak levels of the Nord Stream 2 project were generally lower than the modelled values, which is in line with results of the Nord Stream monitoring results.

The highest measured turbidity values were at the same level with the Nord Stream monitoring of similar construction sites. The measured turbidity values related to the munition clearance activities were lower than predicted in the EIA report, but at the same level as measured during the Nord Stream monitoring for similar targets.

The results from the Nord Stream pre- and post- activity sampling did not indicate any significant sediment relocation or increases in the concentrations of contaminants. For the Nord Stream 2 project, no residues of explosives were found in the surroundings of the two monitored detonations. The heavy metal concentrations were typical when compared to those measured in the earlier studies in the Gulf of Finland.

The munitions clearance and construction activities of the Nord Stream project had no significant impacts on marine mammals. In only a few cases minor impacts on the behavior of individual marine mammals were observed due to ice-break during winter. Likewise, during the Nord Stream 2 project, no injuries, fatalities or other significant impacts on marine mammals were observed. The impact on marine mammals during 2018 is assessed to be minor.

Overall conclusion

The monitoring results confirm that all monitored Nord Stream 2 related environmental impacts are in-line or lower than assessed in the EIA report and the application documents (Table 22).

The project will not prevent the achievement of goals set in the programme of measures of the Finnish Marine Strategy for the period of 2016–2021.

Furthermore, the project will not increase the main pressures on the environment and, therefore will not be in contradiction with the objectives and initiatives set out in the Water Framework Directive.

The integrity of the Natura 2000 network was not threatened by any NSP2 construction related impacts.

Regarding the transboundary impacts, the permanent threshold shift levels of underwater noise monitored during munition clearances did not extend to the Estonian territorial waters. Furthermore, as the water quality impacts were limited to the vicinity of the pipeline, they are not expected to have an impact in Estonian waters.

Final monitoring results covering the entire construction phase (2018-2019) will be presented in the annual report 2019 to be published in May 2020.

Table 22. Environmental impact summary table.

Monitoring target	Impact	Predicted significance		Monitored significance
		EIA	Water permit application	Monitoring results
Seabed Morphology	Munitions clearance detonation (crater)	Minor	Minor	Minor
	Rock placement (berms)	Minor	Minor	Negligible
Turbidity and sedimentation	Spreading of sediments caused by munitions clearance	Minor	Minor	Minor
	Spreading of sediments caused by rock placement	Minor	Minor	Negligible
Biodiversity	Underwater noise impacts on ringed seal on individual level	Moderate	Minor	Minor
	Underwater noise impacts on ringed seal on population level	Moderate	Minor	Minor
	Underwater noise impacts on grey seal on individual level	Moderate	Minor	Minor
	Underwater noise impacts on grey seal on population level	Minor	Minor	Minor
Natura 2000 and protected areas with seals as conservation objective	Underwater noise	Moderate	Minor	Negligible
	Spreading of sediments from munition clearance, rock placement and pipelay	Negligible	Negligible	Negligible
Protected areas with underwater habitats as conservation objectives	Spreading of sediments from munition clearance, rock placement and pipelay	Negligible	Negligible	Negligible
Cultural heritage, Cannon barge wreck S-R05-7978	Munitions clearance, rock placement and pipelay	Negligible	Negligible	Negligible*
Cultural heritage, Anti-submarine net S-R09-09806	Munitions clearance, rock placement and pipelay	Minor	Minor	Minor*

*final assessment will be done based on post-construction survey in 2020.

9

LIST OF REFERENCES

LIST OF REFERENCES

Permits and consent

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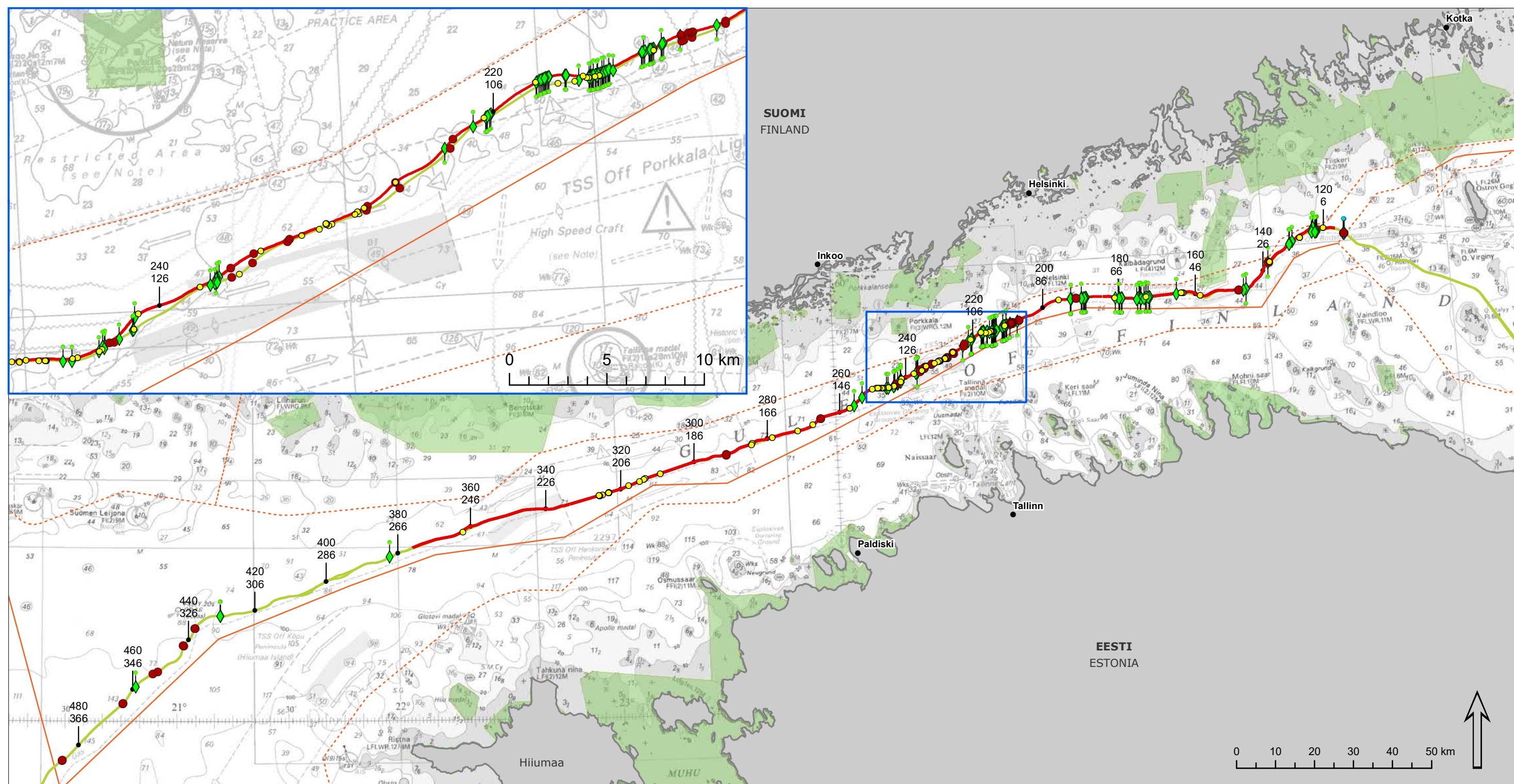
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1

ANNEX



Nord Stream 2 Construction activities in 2018

Munition clearance

- Cleared targets

Pipelay

- Pipelay of Line A

Mattress installation

- Installation finished

Rock placement

- ◆ Pre-lay: Crossing with Nord Stream gas pipe
- ◆ Pre-lay
- ◆ Post-lay (Line A)

Reference data

- NSP2 Route
- GKP
FKP
↓
Global and Finnish kilometre point
- Natura 2000 site (coastal and offshore areas)

- Territorial border
- Åland border
- EEZ border

References:
 - Limits of Exclusive Economic Zones and Territorial Waters: IBRU May 2010
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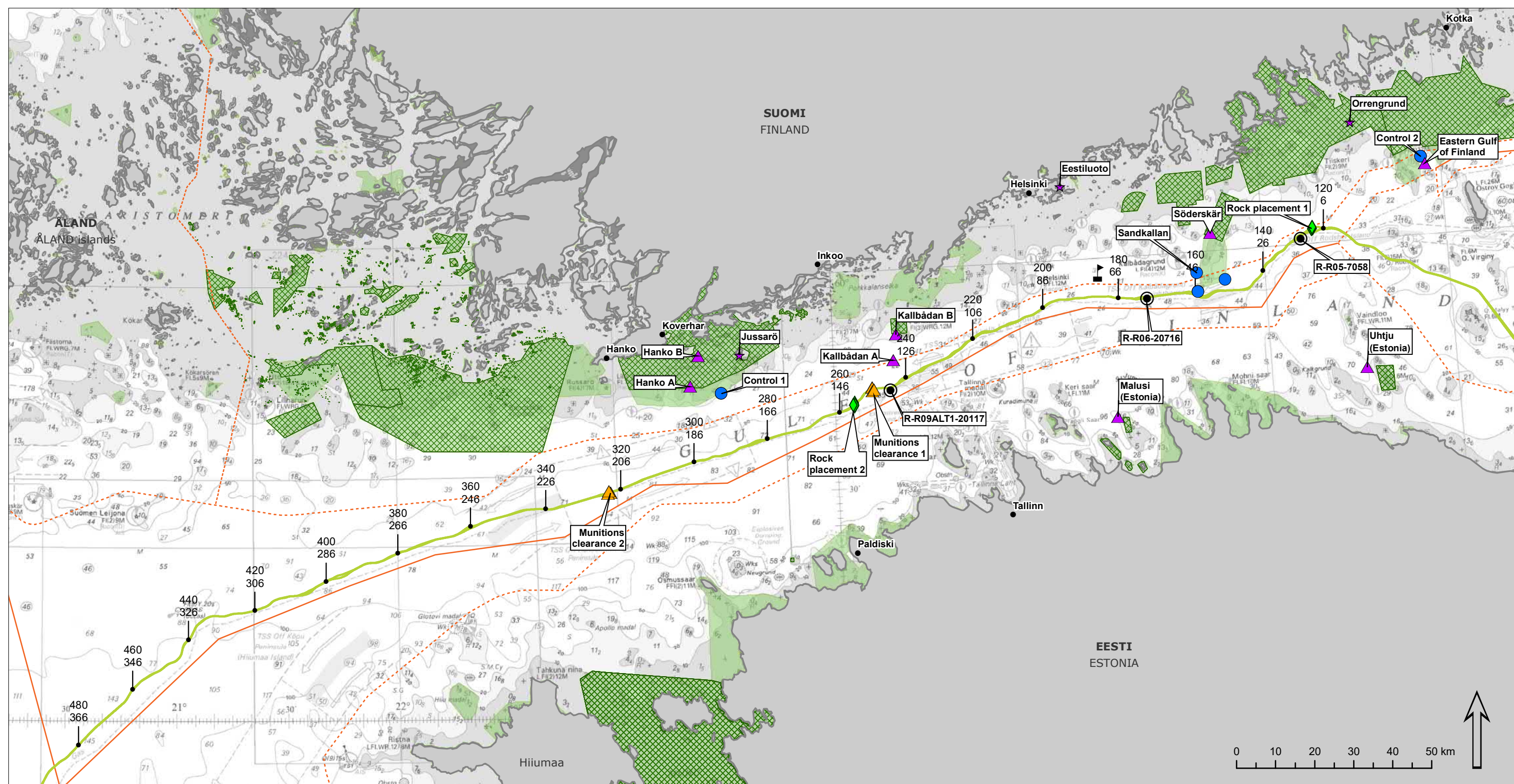
Version: 2018 Annual report EN ver8
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 Date: 21.10.2019
 Prepared: Antti kinnunen/Sonja Oksman
 Controlled: Sanna Vaalgamaa

Construction activities in 2018

SITOWISE

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ANNEX



Nord Stream 2 Environmental monitoring in 2018

Water quality monitoring

- Long-term monitoring
- ▲ Short-term monitoring (munitions clearance)
- ◆ Short-term monitoring (rock placement)

Underwater noise monitoring

- Vessel-based monitoring
- ▲ Long term noise monitoring station

FMI monitoring stations

- ★ Meteorological station
- ▲ Open seas wave buoy (observation station)

Reference data

- NSP2 Route
- Natura 2000 site designated for seals

- Natura 2000 site (coastal and offshore areas)

- GKP
FKP
↓
Global and Finnish kilometre point
- Territorial border
- Åland border
- EEZ border

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 Prepared: Antti Kinnunen/Sonja Oksman
 Controlled: Sanna Vaalgamäe

Environmental monitoring in 2018

SITOWISE

3

ANNEX

ANNEX 3 Permit provisions

Water Permit (W-PE-LEG-PFI-PER-961-WATPEREN-01) and EEZ permit (W-PE-LEG-PFI-PER-961-EEZPEREN-01) provisions related to construction and environmental impacts are listed with a reference to the chapter providing more information of the fulfilment of the provision.

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 1 - Pipeline location and re-quired structures	<p>The natural gas pipelines may be placed on the seabed and the seabed intervention works required for the pipelay may be carried out in accordance with the detailed pipeline route maps (version 52) included in appendix 6 of the application. The amount of rock material to be used for the fillings may not exceed 1.7 million m³. The length of the offshore section of the gas pipelines in the Finnish EEZ is 374 km. Pipeline installation accuracy is ± 7.5 m on a straight section and ± 15 m on a curve.</p> <p>Minor modifications may be carried out to the gas pipeline location in the installation phase. Route changes may be carried out in order to go around munitions or other objects identified along the route, or in order to reduce seabed modification. Route changes must be notified to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring.</p>	Chapter 2.7 Pipelay, Chapter 2.5 Rock Placement	Fulfilled
Finnish Water Permit	WP 2- Pipeline location and re-quired structures	<p>If required, necessary additional* berms may be built. These works must be notified to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring before commencement of work.</p> <p>A justified reason for building additional berms must be given in the notification of works. Of the works, the final amount of material and construction designs must be reported to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring.</p> <p>*Whereas additional berms refer to any berm that would be necessary in case of route deviation from permitted route v52 and/or if the total rock volume threshold of 1.7mill m³ is exceeded.</p>	Chapter 2.5 Rock placement	Fulfilled
Finnish Water Permit	WP 3 - Pipeline location and re-quired structures	<p>The pipe used for the pipelines must conform to the application. The external diameter of the concrete-coated pipes is approximately 1.4 m. Pipe assembly and joint protection must conform to the application. Corrosion protection and re-quired structures pursuant to the application may be installed on the pipeline. The pipeline protection may be modified if it is necessary for pipeline durability. Working methods and protection modifications must be notified to the Centre for</p>	Chapter 2.7 Pipelay	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
		Economic Development, Transport and the Environment in charge of regional monitoring.		
Finnish Water Permit	WP 4 - Pipeline installation works and performance of works	The pipelines must be installed so that the need for seabed intervention works is minimal. Rock placement on the seabed must be carried out by using a fall-pipe. Only clean rock material may be used for seabed fillings.	Chapter 2 Construction activities during 2018, Chapter 2.5 Rock placement	Fulfilled
Finnish Water Permit	WP 5 - Pipeline installation works and performance of works	The gas pipelines must be installed into the sea by using a dynamically positioned vessel.	Chapter 2.7 Pipelay	Fulfilled
Finnish Water Permit	WP 6 - Pipeline installation works and performance of works	Seabed intervention works and pipeline installation must be carried out so that the work causes minimal harm to the marine environment and its use. Works may not be carried out when the working site is covered in solid ice.	Chapter 2 Construction activities during 2018 Chapter 3.1 Weather conditions	Fulfilled
Finnish Water Permit	WP 7 - Pipeline installation works and performance of works	If the pipeline is damaged in pipelay, the necessary reparatory actions must be undertaken without delay. The situation must be notified and the reparatory actions taken must be reported to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring and the Finnish Border Guard.	Chapter 2.7 Pipelay	Fulfilled
Finnish Water Permit	WP 8 - Pipeline installation works and performance of works	Waste created by pipeline installation must be collected and delivered for handling or utilisation on land. The waste, its amount, and delivery locations must be recorded. When necessary, the records must be presented to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring.	Not described in the annual report, is recorded by contractors	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 9 - Water depth in the fairway	The pipelines and any related constructions and protections in the Mussalo fairway must be at a water depth of at least 20 m measured from the water centreline. When installing the pipelines close to the fairway, the potential expansion of the fairway must also be taken into account. The procedures of the works relating to the water depth, traffic management methods and safety equipment issues in the Mussalo fairway must be agreed with the Finnish Transport Agency in good time before commencement of the works.	Not described in the annual report	Fulfilled
Finnish Water Permit	WP 10 - Consideration of archaeological objects	Within a 50 m safety zone around S-R05-7978, rock placement and any other construction work that could harm the object is prohibited.	Chapter 4.4 Cultural heritage monitoring	Fulfilled
Finnish Water Permit	WP 11 - Consideration of archaeological objects	Any pipelay activities and other construction work in the proximity of S-R09-09806 must be carried out in a way that minimises damage to said object.	Chapter 4.4 Cultural heritage monitoring	Fulfilled
Finnish Water Permit	WP 12 - Consideration of archaeological objects	After the pipelay, the objects must be inspected by means of cameras so that the objects and their parts in the proximity of the pipelines as well as any changes can be documented. The picture material must be sent to Finnish National Board of Antiquities.	Not described in the annual report	
Finnish Water Permit	WP 13 - Consideration of archaeological objects	If new cultural heritage objects or indications of such are found during the construction works, they must be reported to the National Board of Antiquities without delay, and procedures for handling the findings must be agreed upon where necessary.	Chapter 4.4 Cultural heritage monitoring	Fulfilled
Finnish Water Permit	WP 14 - Munitions clearance	The condition of cables and pipelines within a 500 m radius from the detonation location must be inspected before and after the detonation.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 15 - Munitions clearance	During the clearance, the radius of the safety zone must be at least 1.5 kilometres when the explosive charge is less than 100 kg; at least 2 kilometres when the explosive charge is 100–300 kg; at least 2.5 kilometres when the explosive charge is 300–500 kg; and 3 kilometres when the explosive charge exceeds 500 kg.	Chapter 2.4 Munition clearance Chapter 5.4 Ship traffic	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 16 - Munitions clearance	Munitions clearance must be done during daylight. At least 30 minutes before the intended detonation, observation of any marine mammals, shoals of fish and sea birds must be started in the safety zone surrounding the detonation location. The observation must be based on acoustic methods and visual inspection. If any marine mammals, sea birds or significant shoals of fish are observed in the safety zone, the detonation must be postponed until they have been deterred from entering the area. If, however, there are any significant flocks of birds resting or feeding near the clearance location, no clearance measures must be undertaken until the birds have left.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 17 - Munition clearance	Acoustic deterrent devices and echo finders must be used prior to each detonation in accordance with the application.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 18 - Munitions clearance	During munitions clearance, big bubble curtain must be used in accordance with the application and its supplements, if the total explosive weight (of the munition and detonation charge combined) is 22 kg or more or if the munition is located in the eastern part of the Gulf of Finland (east of KPF 60). If the location of the munition is such that the big bubble curtain cannot be efficiently used, the permit holder may move the munition to a new location for clearance with big bubble curtains. Munitions may be cleared without a big bubble curtain, if the munition cannot be moved to a new location due to safety or environmental concerns. These must always be notified beforehand to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 19 - Munitions clearance	Before detonating the munition, it must be ensured that there are no vessels or small boats within a two-kilometre radius.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 20 - Munitions clearance	The clearance must be carried out using such methods and schedules that cause as little harm as possible to the sea area and its use. The clearance work must be carried out when there is no ice in the area.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 21 - Munitions clearances	Detonation activity is to be avoided during periods when weather conditions result in strong currents.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 22 - Munitions clearance	Once the clearance is complete, the remains of the munitions must be removed from the detonation area.	Chapter 2.4 Munition clearance	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 23 - Munitions clearance	The permit holder may, for scheduling reasons or due to unforeseen events, move munitions to a new, previously inspected location. Clearance work must be carried out in compliance with the procedures set out in the permit decision. Prior to moving a munition, the permit holder shall notify the Centre for Economic Development, Transport and the Environment in charge of regional monitoring, the Finnish Transport Agency and the Finnish Border Guard. The permit holder must provide these authorities with a clearance plan including a munition specific impact assessment at least 48 hours before the controlled clearance of the moved munition on the seabed.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 24 - Munitions clearance	The clearance of any previously unidentified munitions found along the gas pipeline installation corridor or in its immediate vicinity during clearance or related surveying or of any new munitions potentially drifted into the area after the completion of the pipeline installation work must be carried out in compliance with the procedures set out in the application plan and this permit decision. All new objects must be notified to the Centre for Economic Development, Transport and the Environment in charge of regional monitoring and to the Finnish Border Guard and the Finnish Defence Forces. At least the following information must be submitted before the detonation: the precise location of the munition and information about the neighbouring areas, corresponding to what has been set out in the permit application, and grounds for the necessity of the clearance.	Chapter 2.4 Munition clearance	Fulfilled
Finnish Water Permit	WP 25 - Maritime traffic control	The coordinates of the planned natural gas pipeline routes for the entire length must be submitted to the Finnish Transport Agency in a standard GIS format (WGS84 coordinate system) without delay for placing on the nautical charts and for informing seafarers.	Chapter 1.3 Notifications	Fulfilled
Finnish Water Permit	WP 26 - Maritime traffic control	In addition, the Finnish Transport Agency must be provided with an operating plan for the pipelay vessel no later than six weeks before the installation of the pipelines begins. The plan must include the names of the vessels involved in the work, their call signs, the requested safety distances for the work vessels, the VHF channels monitored by the vessels and the details of the contact person (name, phone and e-mail). Changes to these details and schedules must be communicated to the Finnish Transport Agency without delay.	Chapter 1.3. Notifications	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 27 - Maritime traffic control	The permit holder must submit the information required for the maintenance of maritime and border security to the Finnish Border Guard. This provision shall be followed in munitions clearance, works related to the installation of the natural gas pipelines, the monitoring of the condition of the natural gas pipelines, maintenance during operation and project impact monitoring. The information to be submitted includes the complete call and contact details of the vessels, vessel safety plans and diagrams, general operating plan and updates to it, daily notice and details of any exceptional situations as soon as they are detected (operational errors, accidents, release to water of substances that may threaten the environment). The Finnish Border Guard may issue more detailed instructions on the content of information to be submitted.	Chapter 1.3. Notifications	Fulfilled
Finnish Water Permit	WP 28 - Maritime traffic control	During the installation works, the person responsible for the project or a designated contact person must submit daily and weekly reports describing the ongoing works, work locations and future works with schedules to the Gulf of Finland Vessel Traffic Centre, the Western Finland Vessel Traffic Centre, the national coordinator and Turku Radio, which sees to the safety radio communications. Vessels participating in survey and construction works must maintain continuous contact with the Gulf of Finland or Western Finland Vessel Traffic Centre. The vessels must also comply with the instructions of the VTS authority and the rules of the road at sea. Vessels participating in the project must use an AIS transmitter.	Chapter 1.3. Notifications	Fulfilled
Finnish Water Permit	WP 29 - Cable and pipeline crossings	A written agreement on the manner of crossing must be made with cable and pipeline owners or persons responsible for the maintenance of cables and pipelines. The crossings must be carried out according to the agreements so that existing cables and pipelines remain intact. The owners of each cable and pipeline must be informed about the coordinates of the crossing site and a detailed explanation on how the crossing is carried out.	Chapter 2.6 Mattress installations at infrastructure crossings	Fulfilled
Finnish Water Permit	WP 30 - Cable and pipeline crossings	If the owner of the cable or pipeline is not known or if a crossing agreement is not made before the works are performed, the crossings must be carried out as presented in the application and so that existing cables and pipelines remain intact.	Chapter 2.6 Mattress installations at infrastructure crossings	Fulfilled
Finnish Water Permit	WP 31 - Cable and pipeline crossings	The permit holder must allow any pipelines and cables to be installed in the future to cross the natural gas pipelines.	Not described in the annual report	

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 32 - Pre-commissioning, operation and maintenance of the gas pipelines	Dry pre-commissioning must be used in the pre-commissioning of the gas pipelines.	Not described in the annual report	
Finnish Water Permit	WP 33 - Pre-commissioning, operation and maintenance of the gas pipelines	The permit holder must ensure proper maintenance of the gas pipelines and the related support structures, and cable and pipeline crossings	Not described in the annual report	
Finnish Water Permit	WP 34 - Pre-commissioning, operation and maintenance of the gas pipelines	The condition of the gas pipelines and the support structures must be inspected in accordance with the monitoring programme attached to the supplement to the application dated 1 February 2018. The Finnish Border Guard must be notified in advance of the inspection.	Not described in the annual report	
Finnish Water Permit	WP 35 - Pre-commissioning, operation and maintenance of the gas pipelines	<p>The rock berm repair and making required additional berms, any dredging relating to the repairs and other works relating to the improvement of the condition of the pipelines may be carried out in compliance with the permit conditions of this permit decision. These works must be notified to the ELY Centre in charge of regional monitoring and to the Finnish Border Guard before commencement of work. If there is an immediate threat of damage to the pipelines, the aforementioned works may be carried out immediately following the notification.</p> <p>A justified reason for the repair works must be given in the notification of repair works. Of all the works, the final amount of material and construction designs must be reported to the ELY Centre in charge of regional monitoring after the completion of the works.</p>	Not described in the annual report	
Finnish Water Permit	WP 36 - Pre-commissioning, operation and maintenance of the gas pipelines	All gas pipeline operations-related exceptional events that may cause a pipeline breakage risk or that may result in a danger to other users of the marine area or to the marine environment must be immediately notified to the ELY Centre in charge of regional monitoring and to the Finnish Border Guard.	Not described in the annual report	

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 37 - Fishery fee	<p>A fishery fee of EUR 33,500 must be paid to the fishery authority of Southwest Finland ELY Centre annually by the end of March. The first fishery fee falls due for payment for the first time one month after the commencement of the work referred to in this decision.</p> <p>The fishery fee must be used for mitigation measures (including measure planning and result monitoring) concerning the harm to fishery caused by the installation and operation of the natural gas pipelines.</p> <p>By the end of 2023, the permit holder must submit to the permit authority a fishery fee review application. The application must include a report on the project's impact on fishery, and a proposal for a fishery obligation, or a fishery fee. After the first review, the permit holder must submit a corresponding application every five years to the permit authority, unless the authority stipulates otherwise.</p>	Not described in the annual report	
Finnish Water Permit	WP 38 - Compensations	The permit holder is liable to compensate the reparation costs of any damage potentially caused to cables or pipelines	Not described in the annual report	
Finnish Water Permit	WP 39 - Compensations	An immediately arising loss of benefit caused by the performance of the work must be compensated to the damaged party without delay.	Not described in the annual report	
Finnish Water Permit	WP 40 - Compensations	If the project causes losses of benefits that were not foreseen when the permit was issued and that the permit recipient is liable for under the provisions of the Water Act and the matter is not agreed, compensation for the loss of benefit can be claimed by an application to the Regional State Administrative Agency this decision notwithstanding.	Not described in the annual report	
Finnish Water Permit	WP 41 - Monitoring	<p>The permit holder must monitor the project's effects on the state of the marine environment, and the recovery of the conditions. Monitoring must be carried out according to the monitoring programme, dated 1 February 2018, included as a supplement to the application.</p> <p>The monitoring programme may be amended in a way approved by the Uusimaa Centre for Economic Development, Transport and the Environment, provided that the changes do not undermine the reliability of the results or the coverage of the monitoring or cause excessive additional costs.</p>	Chapter 4 Environmental monitoring according to the monitoring programme	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Finnish Water Permit	WP 42 - Monitoring	The monitoring activities must be reported in accordance with the monitoring plan. The results of the monitoring must be submitted electronically to the respective Centres for Economic Development, Transport and the Environment for Southeast Finland, Uusimaa and Southwest Finland (responsibility area of Environment and Natural Resources); the fishery authority at the Centre for Economic Development, Transport and the Environment for Southwest Finland; the environmental protection authorities of the cities of Espoo, Hanko, Helsinki, Kotka, Parainen, Porvoo, Raasepori and Loviisa and of the municipalities of Föglö, Inkoo, Kemiönsaari, Kirkkonummi, Kökar, Pyhtää and Sipoo, annually by the end of February, and every quarter during the construction phase, and, when required, the results must be presented to those whose rights or interests they may concern.	Chapter 4 Environmental monitoring according to the monitoring programme	Fulfilled
Finnish Water Permit	WP 43 - Commencement and performance of the work	The implementation of the project must commence in three years' time, and the project must be completed for its key parts within five years from the date of this decision becoming lawful and binding. Otherwise, the permit will lapse.	Chapter 1.3. Notifications	Fulfilled
Finnish Water Permit	WP 44 - Notifications	The commencement of work must be notified beforehand to the respective Centres for Economic Development, Transport and the Environment for Southeast Finland, Uusimaa and Southwest Finland (responsibility area of Environment and Natural Resources), to the fishery authority at the Centre for Economic Development, Transport and the Environment of Southwest Finland, to the Finnish Transport Agency's Fairway Unit and to the Finnish Border Guard.	Chapter 1.3. Notifications	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 01 - General	The project shall be executed (both the construction and operation phases) in accordance with the precautionary principle, paying particular attention to the Baltic Sea's sensitivity and vulnerability and taking all possible measures to prevent and minimise any damage potentially caused by the project. In this regard the applicant must present a sufficient clarification in the permit proceedings pursuant to the Water Act on the construction of the gas pipeline system;	Water permit Application	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 02 - General	If the competent Regional State Administrative Agency grants the project a construction permit under the Water Act, the applicant must comply with the permit conditions set for the project by the Regional State Administrative Agency at least to the extent operation extend into the Finnish EEZ;	For information – final evaluation to follow at the end of construction	On-going

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Consent to Exploit Finland's EEZ	EEZ P 03 - time priority and economic exploitation	The project shall be executed (both the construction and operation phases) taking into consideration the time priority principle and as well as all projects for economic exploitation already existing within the Finnish EEZ and the rights of their owners;	For information – final evaluation to follow at the end of construction	On-going
Consent to Exploit Finland's EEZ	EEZ P 04 - future exploitation of the EEZ	The project shall be executed in such a manner so as not to prevent any subsequent energy, telecommunications or other infrastructure projects, involving the construction of cables, pipelines or constructions intersecting with the gas pipelines;	For information – final evaluation to follow at the end of construction	On-going
Consent to Exploit Finland's EEZ	EEZ P 05 - future exploitation of the EEZ	The project must be carried out in such a way that any future economic exploitation or marine scientific research would be affected as little as possible.	For information – final evaluation to follow at the end of construction	On-going
Consent to Exploit Finland's EEZ	EEZ 6 - EIA Statement	The applicant must meet requirements for providing further clarification relating to the water permit process as laid down in the statement of the Uusimaa Centre for Economic Development, Transport and the Environment on the EIA Report;	Chapter 1 Introduction, Chapter 4.1.2 Environmental Impact Assessment methodology	Fulfilled
Consent to Exploit Finland's EEZ	EEZ 07 - Use of DP	The applicant must use a dynamically positioned pipe-laying vessel in Finland's exclusive economic zone;	Chapter 2 Construction activities during 2018	Fulfilled
Consent to Exploit Finland's EEZ	EEZ 08 – Plan for maintenance and repair of the pipeline	The applicant must submit a plan outlining the upkeep, maintenance and repair of the pipeline system to the Finnish Border Guard, the Finnish Transport Agency and the ELY Centres that are the competent authorities in their respective regions;	Not described in the annual report	
Consent to Exploit Finland's EEZ	EEZ 09 - FTA Statement	The applicant must submit the information and reports required in the statement given by the Finnish Transport Agency in the manner required in the statement.	Chapter 1.3. Notifications	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 10 - Notifications	The applicant must give the proper notifications required for the maintenance of marine and border security during the project in the manner separately agreed	Chapter 1.3. Notifications	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
		with the Finnish Border Guard, the Gulf of Finland Coast Guard and its command centre;		
Consent to Exploit Finland's EEZ	EEZ P 11 - Compliance with COLREG	The applicant must comply with the International Regulations for Preventing Collisions at Sea 1972 (COLREG);	Chapter 3.5.5 Ship traffic and 5.4. Ship traffic	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 12 - Notifications	The applicant must contact the proper VTS centre in sufficient time before entering the EEZ;	Not described in the annual report	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 13 - Notifications	The applicant participate in the Vessel Traffic Service as provided for in the Vessel Traffic Service Act (623/2005);	Not described in the annual report	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 14 - Notifications	The applicant must comply with the conditions of entry into the Finnish territory to the extent that the operations related to the project are carried out in Finland's territorial waters;	Not described in the annual report	Fulfilled
Consent to Exploit Finland's EEZ	EEZ P 15 - Notifications	The applicant must submit a contingency plan concerning disturbances in the pipeline transport system when it is in operation, to Finnish Border Guard and to the Finnish Transport Agency;	Not described in the annual report	
Consent to Exploit Finland's EEZ	EEZ P 16 - Notifications	When construction is finished in the economic zone, the applicant must inform the Ministry of Economic Affairs and Employment of it, by letter, within 30 days;	Not described in the annual report	
Consent to Exploit Finland's EEZ	EEZ P 17 - Notifications	The applicant must notify the Ministry of Defence, the Finnish Border Guard and the Finnish Transport Agency of the final installation route of the pipeline system before the installation of the pipelines and the final position coordinates of the installed pipelines to the Ministry of Economic Affairs and Employment, the Ministry of the Environment, the Ministry of Defence, the Finnish Border Guard and the Finnish Transport Agency without delay following installation. The Finnish authorities must have the opportunity to check the information before beginning the installation of the pipelines.	Chapter 1.3. Notifications	Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
Consent to Exploit Finland's EEZ	EEZ P 18 - Notifications	When the start date of pipeline operation is approaching, the applicant must inform the Ministry of Economic Affairs and Employment of it, by letter, and at least 30 days in advance;	Not described in the annual report	
Consent to Exploit Finland's EEZ	EEZ P 19 - Compensations	Under the principles laid down by the Act on Criteria for Charges Payable to the State (150/1992), must compensate, to a reasonable extent, the costs for the preparation of this decision to the competent authority in charge of the permitting procedure;	Not described in the annual report	
Consent to Exploit Finland's EEZ	EEZ P 20 - General	The consent of the Council of State does not include a right to carry out any other activities within the Finnish EEZ than those described in the application;	Not described in the annual report	Fulfilled – ongoing
Consent to Exploit Finland's EEZ	EEZ P 21 - General	Furthermore, the applicant must observe any other provisions and regulations included in legislation or international treaties.	Not described in the annual report	Fulfilled - ongoing
Rejoinder for water permit application	WP rejoinder 2 - fairways	The vessels that support the pipelay, i.e. the vessels that transport line pipes and rock to the pipeline route, will use the ports of Hamina, Kotka, Inkoo, and Koverhar and generally the official fairways to exit and enter the ports.	Not described in the annual report	Fulfilled – ongoing
Water Permit application Finland	WP application - Safety zones	To ensure marine safety and as successfully implemented during the Nord Stream 2 project, safety zones, will be defined to ensure that there will no interaction between the project vessels and third-party vessels. Nord Stream 2 AG will discuss the implementation of the safety zones around the project vessels, with limited ability to manoeuvre as defined in COLREG Rule 10, with the Finnish Transport Agency and the Finnish Border Guard ("Safety Zones", as defined later in section 10.3.1). The Safety Zone for the DP vessels is one nautical mile. This area may be reduced in certain TSS areas.	Chapter 2.4 Munitions clearance	Fulfilled
Water Permit application Finland	WP application - Notifications	Nord Stream 2 AG and its contractors will provide information on project vessels' plans and schedules to the Finnish Transport Agency for Notices to Mariners. The information will be provided in notifications, and monthly, weekly and daily reports to be completed by Nord Stream 2 AG or Nord Stream 2 AG contractors. At Traffic Separation Scheme ("TSS") Off Kallbådagrund and TSS Off Porkkala Lighthouse, consultation will be taken with the pipelay contractor and relevant authorities to reduce the Safety Zone around the pipelay vessel from radius of a 1.0 nm to a radius of 0.5 nm. Nord Stream 2 AG will station a tug in the area of Off Kalbådagrund TSS during	Chapter 1.3. Notifications	Fulfilled Fulfilled

Source Document Title	Title	Description	Reference to the Annual Report 2018	Status after 2018
		pipelay operations in order to reduce the risk of a ship grounding. The tug will be on standby to assist contractor and third party vessels by towing and pushing as necessary. Nord Stream 2 AG will also notify the Finnish authorities of unplanned events during pipeline operation.	Chapter 2 Construction activities during 2018	
Espoo Report	E-145 - Espoo report - information to fishermen	CONTRACTOR will inform fishermen about the locations of construction vessels and their associated safety exclusion zones to increase awareness of the vessel traffic associated with the project.	Not described in the annual report	Fulfilled