

NORD STREAM 2 ANNUAL MONITORING REPORT 2019

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

DATE **26.5.2020**

PROJECT **PO 17-5149**

CLIENT **Nord Stream 2 AG**

DOCUMENT ID **W-PE-EMO-PFI-REP-892-AR2019EN-08**

SITOWISE

Cover photos:

upper left © Nord Stream 2/ Axel Schmidt

upper right © Nord Stream 2/ Axel Schmidt

lower left © Nord Stream 2/ Axel Schmidt

lower right © Nord Stream 2/ Wolfram Scheible

SITOWISE

Nord Stream 2
Natural Gas Pipeline construction and operation
in the Finnish EEZ
Environmental and Technical Monitoring
Annual Monitoring Report 2019

The Annual Monitoring Report 2019 builds upon the Annual Monitoring Report 2018. If there are conflicting information in the Annual Monitoring Reports, it is due to data available at the time of reporting and the Annual Monitoring Report 2019 prevails.

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.

SITOWISE

ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
ADD	Acoustic deterrent device
BQR	Biological quality ratio
DCC	Distance cross course
DP	Dynamic positioned
EEZ	Exclusive Economic Zone
EIA	Environmental impact assessment
FKP	Finnish kilometre point
FNU	Formazin nephelometric unit (turbidity)
GES	Good environmental status (Marine strategy framework directive)
GKP	Global kilometre point
GOFREP	Gulf of Finland reporting system
JNCC	Great Britain's Joint Nature Conservation Committee
MBES	Multi-beam echo sounder
MMO	Marine mammal observer
NEQ	Net explosive quantity
NSP	Nord Stream project
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
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
UXO	Unexploded ordnance
WP	Water Permit

CONTENTS

ABBREVIATIONS	4
SUMMARY	7
1 INTRODUCTION	10
1.1 Project.....	10
1.2 Permits.....	12
2 SCOPE OF ENVIRONMENTAL MONITORING AND IMPACT ASSESSMENTS.....	14
2.1 Scope of the Annual Monitoring Report 2019.....	14
2.2 Environmental monitoring targets	15
2.2.1 Monitoring targets defined by the NSP2 monitoring programme	15
2.2.2 Additional monitoring targets.....	17
2.3 Definition of receptors of impact assessment.....	19
2.4 Methodology used for the impact assessment	21
3 CONSTRUCTION ACTIVITIES	22
3.1 Timing of activities	22
3.2 Munitions clearance (completed in 2018).....	25
3.3 Rock placement	26
3.3.1 Origin, transport and placement of rock material	26
3.3.2 Rock placement in 2018	29
3.3.3 Rock placement in 2019	29
3.4 Infrastructure crossings	32
3.4.1 Crossing agreements and methods	32
3.4.2 Cable crossings.....	33
3.4.3 Pipeline crossings.....	33
3.5 Pipelay.....	34
3.5.1 Pipelay procedure.....	34
3.5.2 Pipelay in 2018.....	35
3.5.3 Pipelay in 2019.....	36
3.6 Notifications related to construction	38
3.7 Unplanned events	39
4 ENVIRONMENTAL BASELINE	40
4.1 Weather conditions in 2019	40
4.2 Physical and chemical environment.....	42
4.2.1 Seabed morphology and sediments	42
4.2.2 Hydrography and water quality	43
4.2.3 Underwater noise	45
4.3 Biotic environment.....	46
4.3.1 Biodiversity.....	46
4.3.2 Marine mammals.....	46
4.3.3 Protected areas.....	48
4.4 Socio-economic environment.....	51
4.4.1 Cultural heritage	51
4.4.2 Ship traffic.....	52
4.4.3 Commercial fishery.....	52
4.5 Marine strategy and Water framework directives	52

5	ENVIRONMENTAL MONITORING.....	54
5.1	Notifications related to monitoring	54
5.2	Water quality and currents.....	55
5.2.1	Monitoring methods	55
5.2.2	Water quality and currents in 2018.....	58
5.2.3	Water quality and currents in 2019.....	58
5.3	Sediment contaminants (completed in 2018)	61
5.4	Underwater noise (completed in 2018).....	62
5.4.1	Monitoring methods	62
5.4.2	Underwater noise results	64
5.5	Marine mammals	64
5.6	Cultural heritage.....	66
5.7	Commercial fishery	67
6	TECHNICAL MONITORING	68
6.1	Pipelay accuracy	68
6.2	Avoidance of barrels	70
6.3	Construction in the vicinity of the Mussalo fairway	72
7	EVALUATION OF RESULTS	74
7.1	Physical and chemical environment.....	74
7.1.1	Seabed morphology and sediments	74
7.1.2	Hydrography and water quality	76
7.1.3	Underwater noise	79
7.2	Biotic environment.....	81
7.2.1	Biodiversity.....	81
7.2.2	Marine mammals.....	82
7.2.3	Protected areas.....	84
7.3	Socio-economic environment.....	86
7.3.1	Cultural heritage	86
7.3.2	Ship traffic	87
7.3.3	Commercial fishery.....	88
7.4	Marine strategy and Water framework directives	88
7.5	Transboundary impacts	91
8	RECOMMENDATIONS FOR FUTURE ENVIRONMENTAL MONITORING	92
9	CONCLUSIONS	94
	LIST OF REFERENCES.....	98

Annexes

Annex 1. Nord Stream 2 Construction activities in 2019

Annex 2. Nord Stream 2 Environmental monitoring in 2019

Annex 3. Permit provisions

Annex 4. Long-term water quality and current monitoring in the Gulf of Finland. October 2019-December 2019. Luode Consulting. February 24, 2020

SUMMARY

Scope of this report

The Annual Monitoring Report 2019 presents the results of 2019 environmental and technical monitoring. It includes a summary of 2018 monitoring results and the assessment of observed impacts of NSP2 pipeline construction in the Finnish EEZ in the period 2018-2019. It describes the scope and methodology used in the assessment and discusses the results. The final results of the entire construction phase (2018-2020) will be published in the Annual Monitoring Report 2020.

Nord Stream 2 project

Nord Stream 2 AG is constructing a new offshore twin pipeline natural gas system from Russia to Germany through the Baltic Sea. The length of the corridor is approximately 1,230 km. Pipelines pass through the territorial waters and/or Exclusive Economic Zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany. In the Finnish EEZ, the route is approximately 374 km long and parallels the existing Nord Stream pipeline route. Construction started in April 2018 and the only remaining construction work in 2020 is post-lay rock placement.

Monitoring targets

The monitoring targets according to the Environmental monitoring programme (approved within the Water Permit decision 53/2018/2) include underwater noise, water quality and currents, commercial fishery and cultural heritage. Additional monitoring activities have been implemented through specialist studies, to strengthen the assessment of impacts from Nord Stream 2 implementation, and to enhance scientific knowledge of the Baltic Sea environment. These cover sediment contaminants, marine mammals, ship traffic and transboundary impacts.

Construction activities in the Finnish EEZ in 2018–2019

The Nord Stream 2 construction activities in 2018 included munition clearance, rock placement, mattress installation and pipelay. Munition clearance and mattress installation were completed in 2018. Construction activities in 2019 included pipelay and rock placement. Pipelay was completed in 2019. Rock placement will be completed in spring 2020.

Environmental monitoring results 2018-2019

The Nord Stream 2 monitoring during 2018–2019 was performed in line with the environmental monitoring programme. Results of monitoring were compared to modelled impacts and assessments presented in the Water Permit application, as well as to monitoring results from the Nord Stream pipeline project. All impacts were in line or smaller than assessed in permitting phase.

Underwater noise

The modelling done for Water Permit application overestimated the noise released during the munitions clearance work. The measured peak levels were lower and the calculated PTS areas much smaller than modelled. Often the munition charge was smaller than predicted, and it is also possible that the bubble curtain mitigated noise more effectively than expected.

The impacts underwater noise had on biodiversity (via marine mammals) were minor and on protected areas negligible, as predicted in the modelling for the Water Permit application.

Water quality and currents

The impacts on water quality from the relocation of sediments during construction activities (munitions clearance and rock placement) were predicted to be minor. Construction was predicted not to deteriorate the conditions for the biota at the Sandkallan Natura 2000 site.

Turbidity impacts were generally lower than predicted and briefer in duration. At the long-term monitoring stations, including Sandkallan, only natural variation in turbidity could be detected from April 2018 to December 2019.

The impacts of construction work on water quality were minor, as predicted, and the integrity of the Natura 2000 network was not threatened by any impacts from NSP2 construction in the Finnish EEZ during 2018–2019.

Commercial fishery

The impacts on commercial fishery in the Finnish EEZ, via possible changes in trawling patterns, will be assessed two years after the construction of the pipeline system.

Cultural heritage

All cultural heritage sites within 250 m of the pipeline route were evaluated by a marine archaeologist, and two targets were identified to require precaution during construction work.

For a World War II submarine barrage, the construction activities in the proximity had to be carried out in the way that minimised the damage to the target. As the anti-submarine net spreads across a large distance in the Gulf of Finland, it couldn't be avoided completely. To limit the damage to the target, pipeline was laid across the barrage mostly with a freespan. Some length of the pipeline is, however, in contact with the net, and therefore the impact is assessed to have been minor.

A safety zone of 50 m was required around a cannon barge from the 18th or 19th century. No construction activities were carried out within the safety zone. Line A was laid at a 130 m distance in 2018 and Line B was laid at the distance of about 63 m from the target in 2019. No further construction activities were done or are planned in the surroundings. It is assessed that the impact on the target has been negligible.

A thorough post lay survey (planned for 2020) of both targets will be carried out after the construction activities in the Finnish EEZ have been completed (2020) to confirm that no damage to the monitoring targets have occurred during the implementation of the project by any construction activity.

Sediment contaminants

Although the overall impact of contaminant relocation was assessed as negligible in the updated EIA, spreading of heavy metals and explosive residuals around the munition clearance sites was studied. The results of 17 sediment samples confirm that detonations did not increase concentrations of harmful substances in the surface sediments. No explosive residuals were detected in the samples, and the heavy metal concentrations, similar to those found in earlier studies in the Gulf of Finland sediments, varied randomly at the seafloor. There was no correlation between the distance to the detonation site and concentration.

Marine mammals

A series of mitigation measures were successfully implemented to reduce the environmental impacts of underwater noise due to munition clearance. Acoustic deterrent devices were used to drive marine mammals out from the clearance area. Trained marine mammal observers confirmed the absence of animals in the vicinity of the detonations. The noise released by the clearances was minimized by surrounding the munitions with a bubble curtain during detonations.

Both the permanent and temporary threshold shift zones were much smaller than predicted, limiting the possibility that any marine mammals would have experienced damage from the construction work noise. Threshold shift zones (PTS and TTS) did not extend to any Natura 2000 areas with marine mammals as conservation objects. Noise did not cause any behavioural impacts on grey seals at the Kallbådan seal reserve based on the Metsähallitus remote video camera monitoring.

The monitored impacts of underwater noise on marine mammals were in line with predicted impacts, minor, for both grey seals and for Baltic ringed seals at both individual and population level.

Ship traffic

The Nord Stream 2 project has impact on ship traffic in the Gulf of Finland via the temporary safety zones established around the construction vessels.

No incidents related to ship traffic were reported either in 2018 or 2019. It is therefore assessed that the impact was negligible for the whole route.

Transboundary impacts

The only possible transboundary environmental impacts of the Nord Stream 2 project were assessed to be the potential impacts on marine mammals due to underwater noise during munitions clearance. The underwater noise monitoring at the two stations in Estonian waters confirmed that the NSP2 construction activities related noise levels in Estonia never exceeded the TTS, nor PTS limits. It is assessed that the impact significance was minor, as predicted.

Summary of evaluation of results 2018-2019

Project impacts on seabed have been assessed to be similar to or smaller than initially predicted in the EIA and in the permit application. Similarly, impacts on water quality were minor and less than predicted.

Only minor or negligible impacts on marine biota, biodiversity and protected areas have been observed, in line with predictions.

Minor impacts have been observed to the Baltic sea submarine net in few locations where the pipelay could not be done with free span. For the nearby cannon barge no impacts have been observed. The absence of impacts will be ensured with a survey after all construction works have been completed.

Negligible impacts on ship traffic were observed.

The project has not impeded the achievement of the targets of the European Union Marine strategy and Water framework directives (as implemented in the national legislation).

1

INTRODUCTION

1 INTRODUCTION

The Annual Monitoring Report 2019 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 in 2019. Monitoring is based on the environmental monitoring programme, which was approved within the Water Permit decision. Furthermore, information and findings of relevant studies and follow-up to complement the mandatory monitoring are described. The Annual Monitoring Report 2019 also summarizes the results from the 2018 monitoring, which is presented in detail in the Annual Monitoring Report 2018.

1.1 Project

Nord Stream 2 AG is constructing a new offshore twin pipeline natural gas system from Russia to Germany through the Baltic Sea. The length of the corridor is approximately 1,230 km. The parallel pipelines pass through the territorial waters and/or Exclusive Economic Zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany (Figure 1).

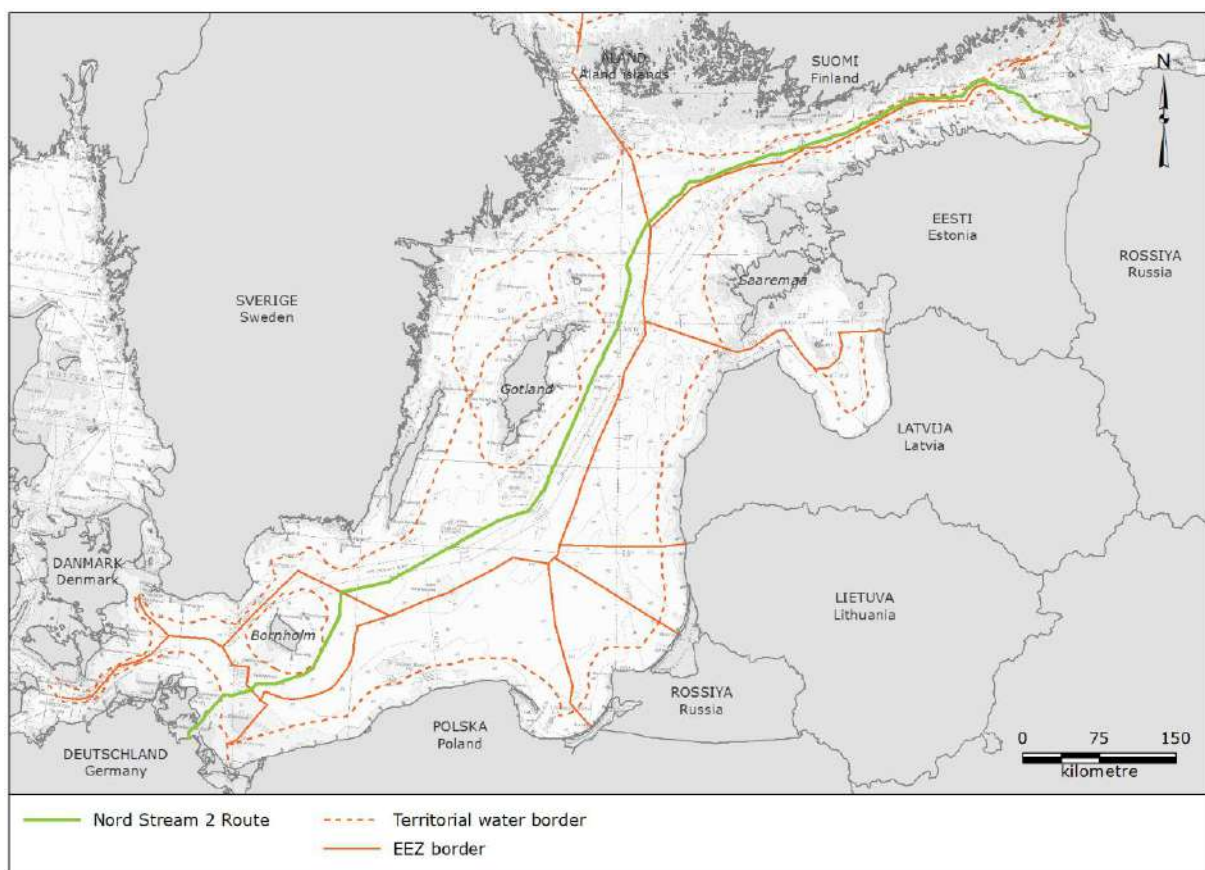


Figure 1. Nord Stream 2 pipeline route.

In the Finnish EEZ, the route is approximately 374 km long and parallels the existing Nord Stream pipeline route (Figure 2). Pipelay of Line A in the Finnish EEZ started on September 5, 2018 and was completed on April 30, 2019, and pipelay of Line B started on May 18, 2019 and was completed on

August 21, 2019. The only remaining construction work is rock placement. When construction activities are completed in all countries the pipelines will be taken into operation.

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 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.

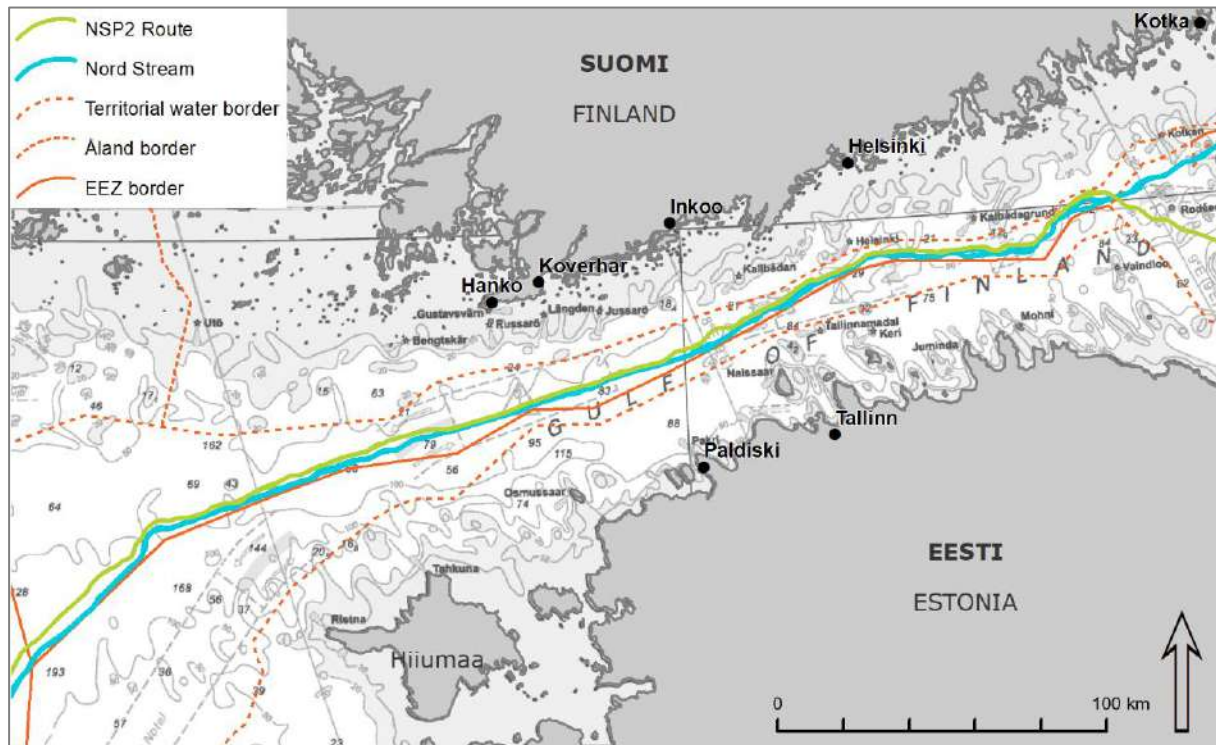


Figure 2. Nord Stream 2 pipeline route passes through the Finnish EEZ. It is situated north of the existing Nord Stream pipelines with an exception of a short section in the eastern section near Russian waters.

The Nord Stream pipelines were taken into operation in 2011 and 2012. Nord Stream monitored construction in the Finnish waters from 2009 to 2012. Monitoring during the operation phase is still ongoing. 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 than or as predicted in the application documents /1/.

1.2 Permits

The construction and operation of the Nord Stream 2 pipelines required two permits in Finland: Water Permit from the Regional State Administrative Agency 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 Finnish 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 consent to use the Finnish EEZ for construction of a natural gas pipeline system 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. The permit became legally binding on August 19, 2019.

Table 1. The main permits regarding construction and operation of Nord Stream 2 pipeline.

Permit	Consent to use the Finnish Exclusive Economic Zone	Water Permit
Issued	April 5, 2018	April 12, 2018
Document number	TEM/1810/08.08.01/2017	N:o 53/2018/2, Dnro ESAVI/9101/2017
Authority	Council of State of Finland	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. In seal sanctuaries the permit was valid from April 15, 2018 to December 31, 2018 and, at all other areas from March 12, 2018 to December 31, 2018.

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.



Figure 3. Solitaire with a pipe supply vessel. Photo: © Nord Stream 2 AG/ Thomas Eugster.

2

SCOPE OF ENVIRONMENTAL MONITORING AND IMPACT ASSESSMENTS

2 SCOPE OF ENVIRONMENTAL MONITORING AND IMPACT ASSESSMENTS

This chapter describes the scope of the Annual Monitoring Report 2019, including the definition of how the monitoring targets have been defined and which environmental receptors have been assessed and why. The scope of the mandatory monitoring is presented in the Environmental monitoring programme which was approved within the Water Permit decision on April 12, 2018.

2.1 Scope of the Annual Monitoring Report 2019

Main purpose of the Annual Monitoring Report 2019 is to report monitoring results and the assessment of observed impacts of NSP2 pipeline project in the Finnish EEZ in the year 2019. It covers construction time monitoring of the year 2019 and summarizes the results of 2018 monitoring. Additionally, the observed and assessed impacts will be compared with the predictions made in the EIA and Water Permit application and with the monitoring results from Nord Stream Project. The most vital parts of the Annual Monitoring Report are in-depth data analysis of the monitoring results, and thorough discussion on the observed and assessed impacts and their significance (Figure 4).

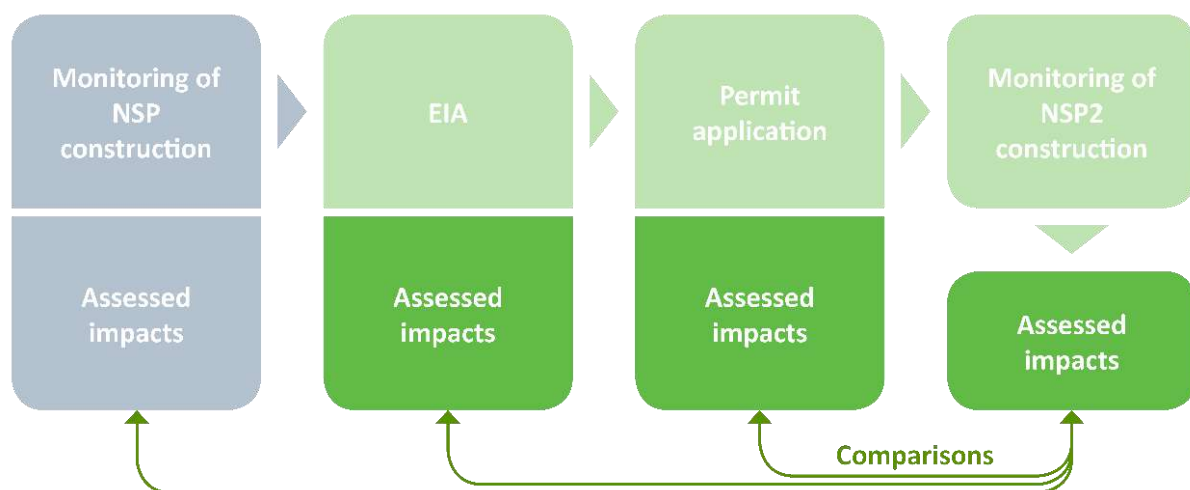


Figure 4. Phases of the analysis of monitoring results and assessment of their impacts in the Nord Stream 2 project. Monitoring results of Nord Stream project were used to predict impacts for EIA and for permit application. Monitoring results of the NSP2 project (measured impacts) are compared to the predicted impacts and to the impacts measured during the Nord Stream project.

2.2 Environmental monitoring targets

2.2.1 Monitoring targets defined by the NSP2 monitoring programme

The scope of monitoring is presented in the Environmental monitoring programme /2/. The programme was approved within the Water Permit decision on April 12, 2018 (53/2018/2). Monitoring is most intensive during the construction phase (Table 2).

Table 2. General schedule for the monitoring activities during 2018–2023 in the Finnish EEZ (based on /2/, modified).

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

* Water quality and currents monitoring continues in 2020 until four weeks after the completion of the construction work in the vicinity of the monitoring site.

Underwater Noise (Monitored in 2018 only)

The construction phase of the Nord Stream 2 pipeline system, especially the munitions clearance, may generate underwater noise that may be harmful to biota.

The monitoring of underwater noise was carried out during munitions clearance, as this activity potentially has an impact on the marine life. The stationary monitoring areas were selected based on their location with respect to the highest density of munitions, water depths, location of the Natura 2000 sites and known seal populations and the distance to the pipeline route. In addition, three vessel-based monitoring campaigns were performed during the clearances of three targets of different size and type.

Main objectives for the underwater noise monitoring programme were to evaluate:

1. How far does the noise originating from munition clearance operations penetrate into the sensitive areas in the archipelago
2. How high are the maximum noise levels
3. How well do the impacts modelled during the EIA and permitting phases correspond to the measured values.
4. How does the use of a bubble curtain as a mitigation measure affect the underwater noise levels

Monitoring also addressed the following uncertainties:

1. The levels of background noise during munitions clearance in the Gulf of Finland
2. The impact of munitions clearance related activities (i.e. vessels) to the background noise level

Monitoring of underwater noise was carried out in 2018 and no new data on underwater noise is provided in this report.

Water quality and currents/Sediment spreading (Monitored in 2018 and 2019)

The construction phase of the Nord Stream 2 pipeline system generates sediment spreading that can have an environmental impact on marine life.

Main objectives for the turbidity and current monitoring program were to evaluate:

1. How far do the sediments originating from construction operations travel?
2. How high does the sediment spill rise from the seabed?
3. What is the maximum turbidity generated by the construction?
4. How much does the construction related sediment spreading elevate the background levels in monitoring locations?
5. How well do the impacts modelled during the EIA phase match with the measured values?

Commercial fishery

The NSP2 pipeline may change trawling and other fishing patterns in the proximity of the pipeline.

In addition to a fishery questionnaire, data will be gathered by tracking fishery vessels. The vessels' avoidance of the pipeline area and possible changes in fishing patterns in the Finnish EEZ will be monitored two years after completed construction of the pipeline system. The tracking data obtained prior to the construction will be compared with the tracking data collected during and after construction of the pipeline system.

Cultural heritage (Monitored in 2018 and 2019)

The construction phase of the Nord Stream 2 pipeline system may disturb cultural heritage objects along the pipeline route.

Two marine archaeological objects within the zone of influence of the NSP2 route were identified during surveys on the planning phase of the NSP2. The cultural heritage monitoring covers these objects, a late 18th — early 19th century wooden gun barge wreck and a World War II Anti-submarine net. A minimum safety perimeter has been set for the barge, which is regarded as an important archaeological site, and detrimental interventions must be minimized with the World War II Anti-submarine net. To verify that these safety provisions were respected in construction, the results of the post-lay inspections of pipelay of both pipelines will be analysed. In addition, a more detailed survey of the targets by independent contractor will be performed, when all construction activities are completed in the Finnish EEZ.

2.2.2 Additional monitoring targets

Additional monitoring activities that are outside the scope of the national monitoring programme have been implemented through specialist studies to strengthen the assessment of impacts from Nord Stream 2 implementation and to enhance scientific knowledge of the Baltic Sea environment. The general schedule for the additional monitoring activities is presented in Table 3.

Table 3. General schedule for the additional monitoring activities during 2018–2023 in the Finnish EEZ.

Monitoring target	Construction		Operation			
	2018	2019	2020	2021	2022	2023
Sediment contaminants	X					
Marine mammals	X		X			
Ship traffic	X	X	X			
Transboundary impacts	X					

Sediment Contaminants (Monitored in 2018)

Toxic explosive residuals may accumulate in the sediments due to underwater detonations in munitions clearance work.

In 2018, altogether 17 sediment samples from areas close to detonation of two targets were collected in order to study explosive residuals and heavy metal spreading in the clearance site surroundings.

Marine mammals (Monitored in 2018)

Marine mammals are sensitive receptors of underwater noise and changes in water quality.

During the munitions clearance period, trained marine mammal observers on clearance vessels visually monitored the perimeter of the vessels before and after each detonation for a minimum of one-hour period before the scheduled initiation of the charge. Passive acoustic monitoring was also performed to ensure that no marine mammals were present in the monitored area.

In 2018, Metsähallitus monitored grey seals in the Kallbådan seal sanctuary, using remote video camera equipment from June to August. In 2019, monitoring took place from May to July, but due to series of technical issues it was not possible to collect a full range of data. All Metsähallitus monitoring results will be presented in the Annual Monitoring Report 2020, to be published in May 2021.

Ship traffic (Monitored in 2018 and 2019)

Surveys and construction of a large-scale project close to shipping lanes may cause risks to maritime traffic. Therefore, safety zones were established around the construction vessels and activities of the vessels were notified to the authorities.

Ship traffic monitoring confirms that NSP2 complies with the following provisions:

1. NSP2 submits monthly plans and weekly and daily notifications on construction activities to relevant bodies well in advance.
2. Third party ships are not allowed to enter the safety zones established around the construction vessels.
3. For the time of pipelay (Line A and Line B) near a shallow close to Kalbådagrund, a tug is to be stationed nearby in order to respond to potential ship emergencies, such as danger of grounding.

Transboundary impacts from Finnish EEZ to Estonia (Monitored in 2018)

Underwater noise travels long distances and may reach protected areas, designated to seals, even in Estonian waters. The NSP2 monitoring programme included two underwater noise monitoring stations (Uhtju and Malusi) in Estonian waters to monitor transboundary impacts. The monitoring of underwater noise in Estonian waters was completed in 2018.

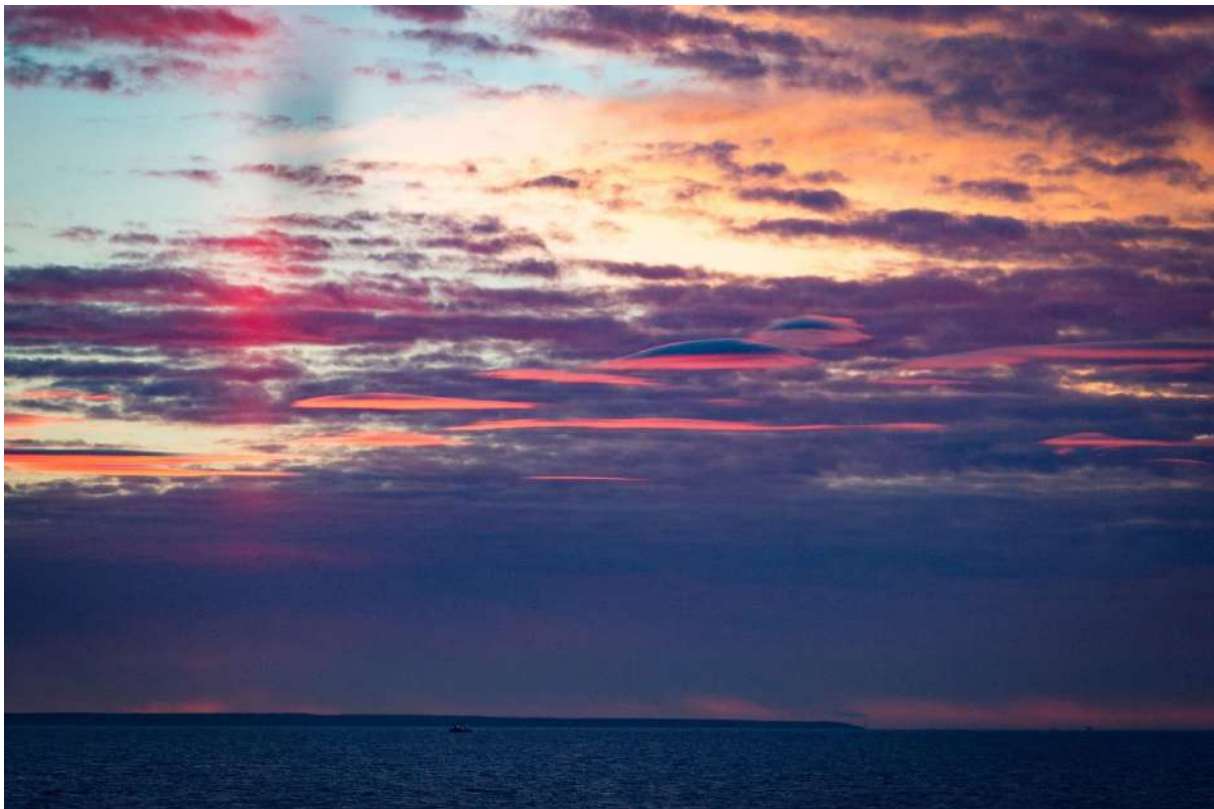


Figure 5. Survey support vessel GoElectra at work at the Baltic Sea. Photo: © Nord Stream 2/ Axel Schmidt.

2.3 Definition of receptors of impact assessment

Monitoring of the impacts during the construction of the Nord Stream gas pipeline in 2010–2012 indicated that most of the impacts were minor. Therefore, the Nord Stream 2 Monitoring Programme, approved within the Water Permit decision (Nro 53/2018/2, Dnro ESAVI/9101/2017), targeted the monitoring on a limited number of receptors most likely to experience impacts (minor or moderate). NSP2 also decided to add some additional monitoring targets (specialist studies) to complement the assessment of actual impacts. The coverage of the NSP2 monitoring targets and impact receptors (compared to assessments in the EIA) is shown in Table 4.

In this monitoring report, an impact assessment has been carried out for the receptors that have been identified as potentially experiencing impacts from the construction activities of the NSP2 pipeline. Assessment is based on the monitored impacts. For example, for assessing the impact on marine mammals, results of monitoring of underwater noise, water quality and currents and actual marine mammal monitoring were used (Table 4). For assessing impacts on seabed morphology, not only monitoring data but also reports from construction contractors were analysed, and for Compliance analysis (whether the project meets the requirements stated in the Marine strategy and Water framework directive, as implemented in the Finnish national legislation) monitoring data of water quality and currents, contaminant release and marine mammals (as part of biodiversity) and several different types of contractor reports were analysed. As underwater noise does not yet have quantitative indicators (“target conditions”), the results of underwater noise were evaluated as factors affecting living conditions of biota.

Table 4. The NSP2 monitoring targets and impact assessment coverage in the EIA. The receptors for which the assessment was conducted are shown in bold. Compliance assessment of receptor "Underwater noise", marked in parenthesis below, was performed through evaluation of impacts on living conditions of biota, as it does not yet have quantitative indicators.

Impact receptors		Monitoring targets							
		In monitoring programme				Additional			
		Underwater noise	Water quality and currents	Commercial fishery	Cultural heritage	Contaminants	Marine mammals	Ship traffic	Underwater noise in Estonia
Included in the EIA 2017	Climate and air quality								
	Seabed morphology and sediments		X			X			
	Hydrography and water quality		X						
	Underwater and airborne noise	X							
	Benthic flora and fauna								
	Fish								
	Marine Mammals	X	X				X		
	Birds								
	Protected areas	X	X				X		
	Non-indigenous species								
	Biodiversity	X	X				X		
	Ship traffic							X	
	Commercial fishery			X					
	Military areas								
	Infrastructures								
	Future use of EEZ								
	Scientific Heritage								
	Cultural heritage				X				
	Social impacts								
	Compliance assessment	(X)	X			X	X		
Transboundary: Underwater noise, marine mammals, biodiversity and protected areas									X

2.4 Methodology used for the impact assessment

A multi-criteria analysis methodology (IMPERIA) /3/ was applied in evaluating the significance of impacts in all assessments in the EIA, Water Permit application and monitoring. The approach takes into account both the sensitivity of the impact receptor and the magnitude (intensity and direction) of change resulting in the significance of impact (Table 5). Using the same approach in all assessments prior to implementation, and in the assessment of impact significance of monitored impacts, enables reliable comparison of the predicted and monitored impacts (see Chapter 6.3).

Table 5. Categories of impact significance in the approach developed in the IMPERIA project (Adapted from /4/).

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

3

CONSTRUCTION ACTIVITIES

3 CONSTRUCTION ACTIVITIES

Construction activities started in April 2018. Munitions clearance was completed in June 2018 and installing of support (mattresses) at infrastructure crossings was completed in October 2018. Pipelay and rock placement started in 2018 and continued in 2019. The pipelay of both Line A and Line B was completed in Finnish EEZ in 2019, and the only remaining construction activity continuing in 2020 is post-lay rock placement.

3.1 Timing of activities

The construction activities during 2018 included munitions clearance, mattress installation, rock placement and pipelay of Line A (Table 6). Munitions clearance and mattress installation were completed in 2018. Pipelay of Line A continued and of Line B commenced in 2019, and pipelay of both lines was completed in 2019. Rock placement continued in 2019 (Table 7) and will continue in 2020 for the last post-lay berms.

Table 6. Timing of construction activities in 2018.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Munitions clearance												
Mattress installation												
Rock placement												
Pipelay of Line A												

Table 7. Timing of construction activities in 2019.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rock placement												
Pipelay of Line A												
Pipelay of Line B												

The offshore operations in the Finnish EEZ during 2018–2019 involved several survey vessels, two munitions clearance fleets (each with two vessels; one clearance vessel and one bubble curtain vessel), several dynamic positioned (DP) rock placement vessels, DP mattresses installation off-shore construction vessels, two DP pipelay vessels and supply vessels for these activities (Figure 6, Figure 7).

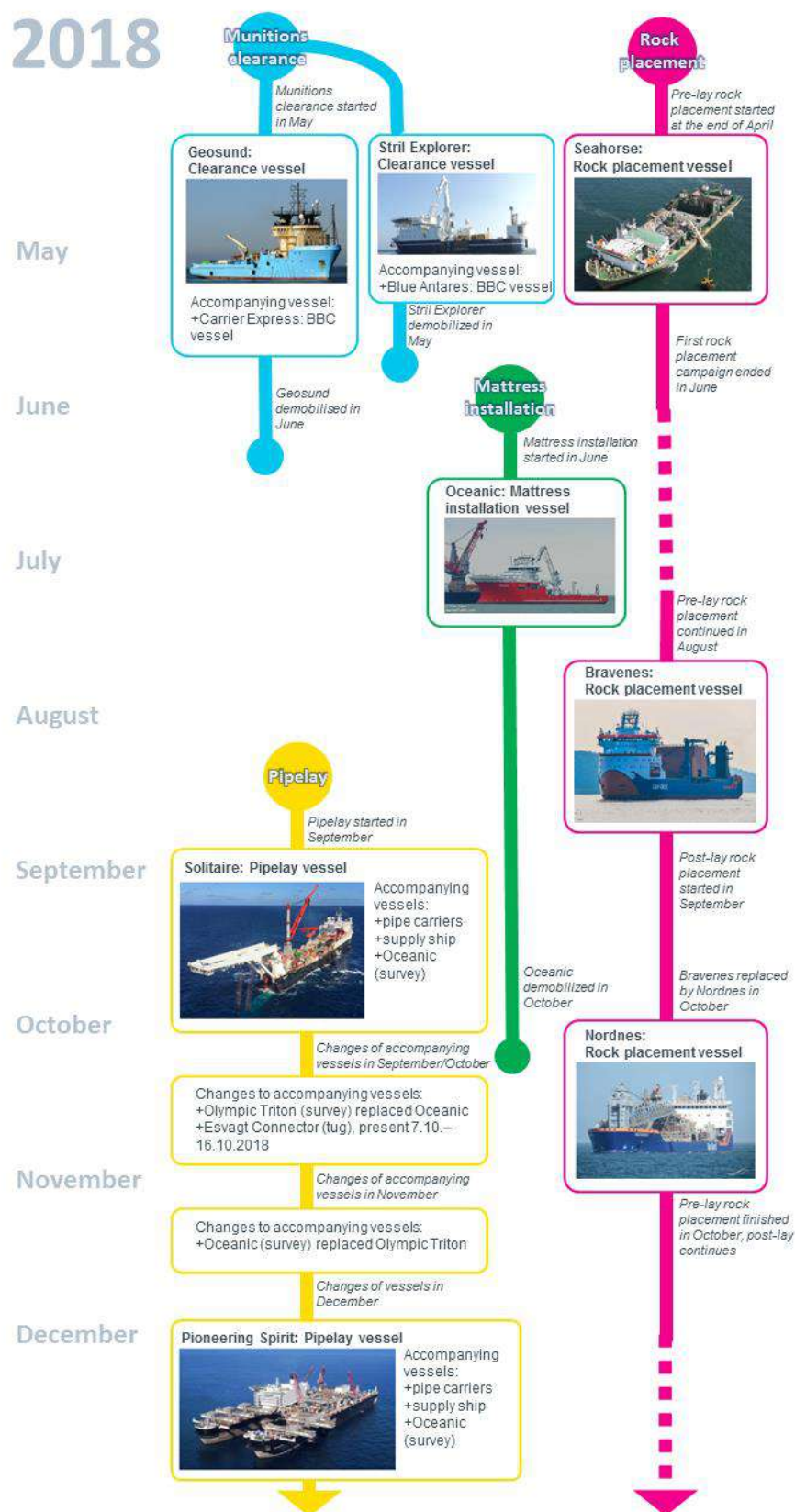


Figure 6. Vessels performing construction for the Nord Stream 2 project in the Finnish EEZ during 2018.

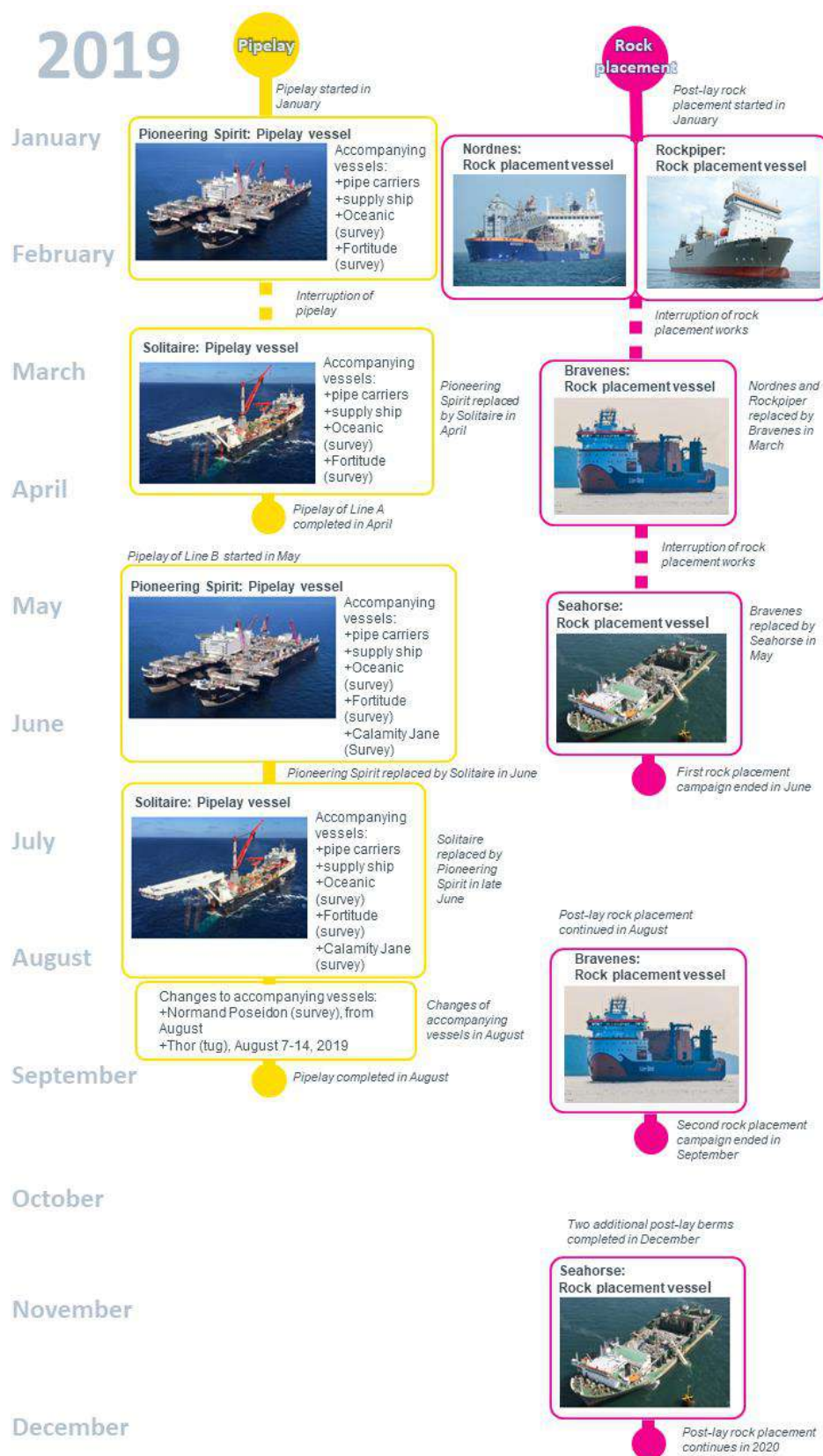


Figure 7. Vessels performing construction for the Nord Stream 2 project in the Finnish EEZ during 2019.

3.2 Munitions clearance (completed in 2018)

In total 74 munitions were cleared from the pipelay corridor during the one-month campaign in 2018. A detailed survey during the clearance work confirmed that of the planned 87 clearance targets, 14 were not munitions. One target was not found, but the survey uncovered two additional munitions on the route. Most munitions were cleared on site utilizing a donor charge, and only three munitions were relocated prior to detonation to enable the efficient use of bubble curtain and to ensure safe distance to cables. Bubble curtain, as a mitigation measure to reduce noise from the detonation, was used for 58 detonations. These included all detonations with a total explosive quantity (munition charge plus donor charge) of 22 kg or more; all detonations taking place on sensitive area east of GKP 174; and those detonations in which the owner of a cable within a 500 m security corridor had so requested.

The munitions clearance contractors were committed to ISO 14001 based Environmental Management Plans and were responsible for the implementation of mitigation measures in line with Great Britain's Joint Nature Conservation Committee (JNCC) guidelines /5/.

Nord Stream 2 AG provided a procedure for the deployment of mitigation measures for marine mammals, fish and birds for the munition clearance operators /6/. The procedure follows the JNCC Guidelines for minimizing the risk of injury to marine mammals from using explosives /5/. According to the clearance reports, both contractors followed the given procedure in majority of cases /7, 8/ (Table 8). The exceptions were: Due to equipment failure, nine detonations were performed with 3 acoustic deterrent devices (ADDs), and in four cases the range of observation for marine mammals was reduced to 500 m radius due to weather conditions. In five detonations in the beginning of the campaign the pressure wave was not recorded.

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. Similarly, no schools of fish were detected in the detonation area prior to detonation /7, 8/.

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.

Munition clearance was completed in 2018.

Table 8. NSP2 requirements and munitions clearance contractors' implementation of mitigation measures for the munition clearance work /7, 8/.

Action	N-Sea/Bodac 44 detonations	MMT Sweden Ab/Ramora 30 detonations
4 ADD ¹ s	Applied in all detonations.	9 detonations with 3 ADDs (equipment failure) Applied in 21/30 detonations.
MMO ² , > 1 km radius	Applied in all detonations.	Radius 500 m in 4 cases (weather conditions) Applied in 26/30 detonations.
PAM ³	Applied in all detonations.	Applied in all detonations.
Fish finder (Sonar sweep)	Applied in all detonations.	Applied in all detonations.
Bubble curtain	Applied in required detonations (40 cases)	Applied in required detonations (18 cases)
Pressure wave sensor (Hydrophone)	Applied in 39/44 detonations.	Applied in all detonations.

¹ Acoustic deterring device; ² Marine mammal observer; ³ Passive acoustic monitoring device

3.3 Rock placement

3.3.1 Origin, transport and placement of rock material

The term 'rock placement' refers to the use of rock to locally reshape the seabed before and/or after pipelay, thereby providing support to the pipelines to ensure their long-term stability and integrity. Rock placement is required for example for free-span correction and for the crossings with other gas pipelines (NSP and Balticconnector). Most of the rock material is used for pre- and post-lay stress/free-span correction berms (Figure 8). The size and shape of each rock berm are individually designed in order to ensure the required pipeline support. The total permitted volume of rock material for Nord Stream 2 project is 1,7 million m³ (Water Permit, 53/2018/2, ESAVI/9101/2017).

Unweathered crushed granite used for berm construction was mainly acquired from three Rudus Oy's quarries in Finland: Rajavuori quarry in Kotka; Inkoo quarry in Inkoo; and Skogsmora quarry in Karjaa. The rock material is chemically stable for at least 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) /9/. The material used does not contain any contaminants, such as heavy metals, that could 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 of 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 /9/. 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. The Skogsmora rock material has been inspected by third party (Kiwa Inspecta) in June 2019 and conforms to similar contractual quality and cleanliness requirements as rock material from Kotka and Inkoo quarries /10/.



Figure 8. Example from a ROV video still image from an as-laid survey of the Line B from vessel Fortitude on July 19, 2019. Pipeline has been laid on top of a supporting rock berm. (Source: Allseas Group S.A.)

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 rock containing sub-soils are placed into separate stock areas. The rock containing sub-soils 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, 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 /11/. 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. In addition, rock material is transported to Inkoo port area from Skogsmora quarry in Karjaa /12/.

The rock material is transported from the port to the offshore rock placement site by dynamically positioned (DP) fall pipe vessels. The seabed profile is confirmed prior to rock placement using an ROV /13/. 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 9). For the monitoring of

berm installation, an ROV-device is mounted to the lower end of the fall pipe /14/, allowing to minimize the amount of rock material used, and thus the impacts on seafloor.

The volume of placed rock is recorded, bathymetric profiles and 3D-modelling provide quality control. Upon completion of rock placement at individual berm sites, a survey is conducted to ensure that the shape of the rock berm is as designed /13/.

In order to minimize risks involving third party ship traffic, a 500 m wide safety zone is established around the rock placement vessels /14, 15/ when working at the rock placement site.

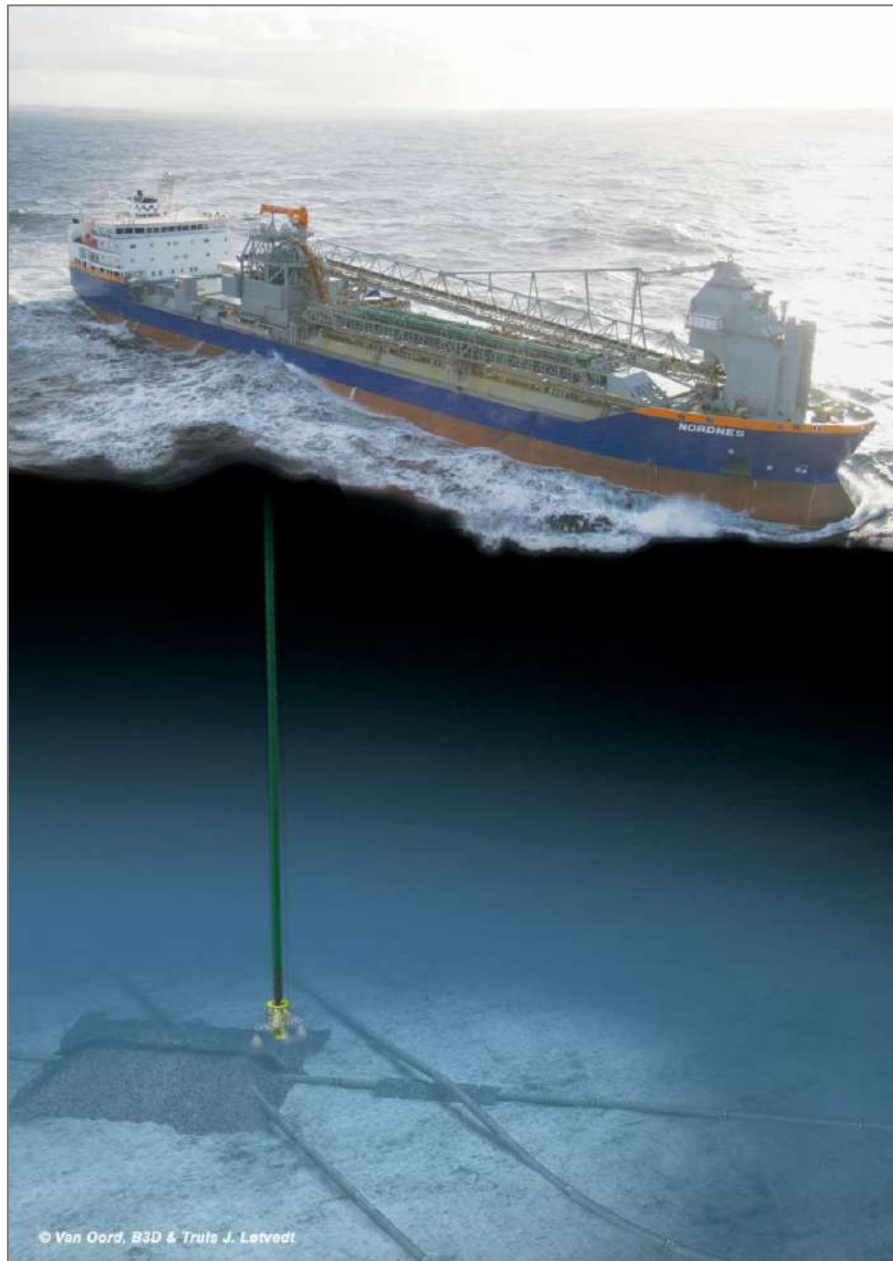


Figure 9. Post-lay rock placement using a fall-pipe. Figure: © Van Oord 2019.

Four long-term scientific monitoring stations (LL5, LL6A, LL7S and LL11) are located near the pipeline route. To mitigate 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 campaigns, which took place in June 2018 and in May-June 2019. A minimum distance of 2 km was kept from the mentioned works to the monitoring sites prior to and during the SYKE sampling campaign.

3.3.2 Rock placement in 2018

Most rock placement works during 2018 took place east of Inkoo, Finland (GKP 255). The first pre-lay rock placement campaign by rock placement vessel Seahorse took place from April to June. The second campaign started in August and continued to the end of the year with vessels Bravenes (August to October) and Nordnes (from October on). Post-lay placement was initiated in September. The responsible contractors were Boskalis Offshore Contracting B.V. and Van Oord Offshore B.V. (BoVO).

The volume of placed rock material during 2018 was 478,700 m³ and only Finnish rock was used. Altogether 144 berms were constructed, but as one berm can comprise either pre- or post-lay, or both, the work in 2018 included 69 pre-lay and 87 post-lay berms. Furthermore, five top-ups were added to berms constructed earlier. The need for top-ups is determined when berms are revisited some time after installing. Additional rock (top-up) is placed if berms have naturally deformed, due to conditions at the seafloor, to a shape which does not satisfy the minimum design requirements. Top-ups are performed until the design condition is once again reached. The volumes of installed individual berms varied between 186 m³ and 16,000 m³. Rock placement activities in 2018 are described in detail in the Annual Monitoring Report 2018.

Since the publishing of the Annual Monitoring Report 2018 /16/, there was a small specification in the as-built register for berms /17/: the total volume of post-lay stress/freespan correction increased by 200 m³, which can be seen as a difference when comparing the total installed volume reported in the Annual Monitoring Report 2018 to the volume reported in this Annual Monitoring Report 2019.

3.3.3 Rock placement in 2019

The rock placement during 2019 took place between GKP 114 and GKP 429 (Figure 10). Rock placement works were most active during the first half of the year, slowing down in the autumn when focus was on completion of the rock placement works in Russia /18, 19, 20, 21/. By the end of 2019, the total amount of rock material placed was 903,000 m³ (Table 9). 45 % of this was installed during 2019. Of the rock material used in 2019, 18,300 m³ was of Norwegian origin and the rest was Finnish rock material /17/.

Dynamically positioned (DP) fall-pipe vessels Seahorse, Bravenes, Nordnes and Rockpiper were used for the rock placement works in 2019. Of these, Rockpiper was the only one that did not conduct works already in 2018. /17/

Rock placement was conducted by Nordnes from January 4 until January 12, 2019. The work was continued by Rockpiper from January 11 to February 9, 2019 and subsequently by Bravenes from March 13 until April 7, 2019. The work was continued by Seahorse from May 22 to June 17, 2019. Bravenes resumed rock placement after a summer pause on August 2 and continued until September 8, 2019. Rock placement was conducted by Seahorse from September 30 to October 3, 2019. Bravenes continued rock placement in the Finnish EEZ from November 16 to November 17, 2019. Bravenes returned to the Finnish EEZ on December 2, 2019 and continued rock placement until December 6, 2019. In the end of 2019, construction of two berms was started but not completed. Their volume will be reported in the Annual Monitoring Report 2020. /18, 19, 20, 21/

In addition to post-lay rock placement works performed throughout the year, in January and during the summer, there were also pre-lay rock placement works. The pre-lay rock placement conducted in January was to provide additional support in predicted freespan areas for Line B. The pre-lay rock placement during May and June was conducted in order to build crossings for the Line B with the Balticconnector and the Nord Stream gas pipes. The total volume of pre-lay rock placement in 2019 was 39,300 m³. This is approximately 9 % of the total rock placement volume in 2019. During 2019, 68 % of the total rock placement volume was installed for Line A and 32 % for Line B. /17/

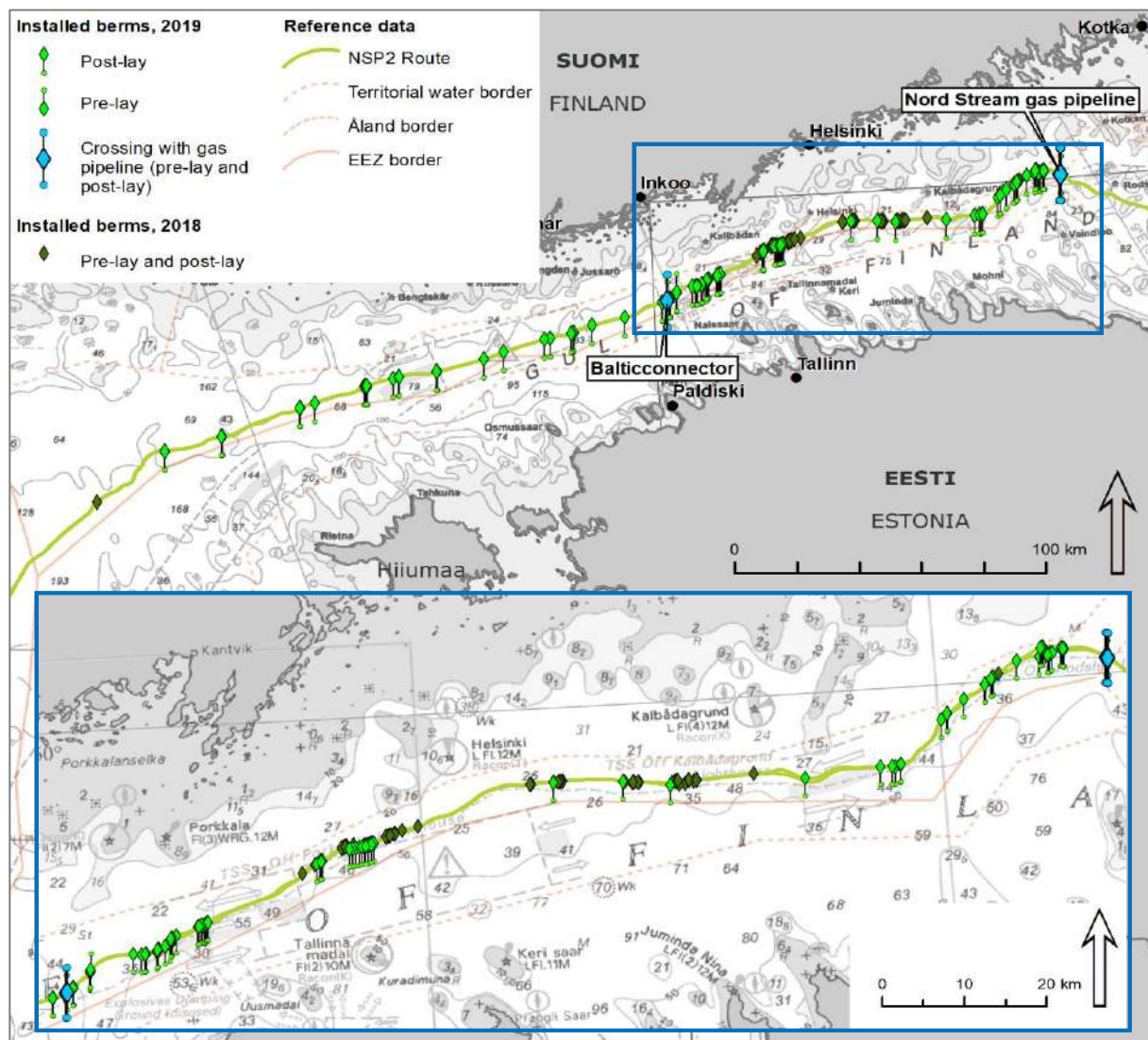


Figure 10. Rock placement in the Finnish EEZ during 2018–2019. The lower map shows the selected area (blue frame) in more detail.

From the comparison of permitted volumes and installed volumes (Table 9), the main differences are observed for berm types pipeline crossings and unexploded ordnance (UXO).

Table 9. Rock placement status in the end of 2019 /17, 22/.

Berm type	Installed volume, m ³ *			Estimate in the Water Permit application, m ³
	2018	2019	2018-2019	
Pipeline crossings	40,200	67,200	107,400	37,300
Pre-lay	40,200	22,600	62,800	
Post-lay	---	44,600	44,600	
Stress/freespan correction	377,700	286,900	664,500	901,100
Pre-lay	256,400	16,700	273,100	
Post-lay	121,300	270,200	391,400	
In-service buckling mitigation (post-lay)	57,000	40,300	117,300	352,600
Spot gravel placement for on-bottom stability (post-lay)	4,100	---	4,100	39,600
Unexploded ordnance (post-lay)	---	9,800	9,800	---
Total	478,900	424,100	903,000	1,330,600**

* Installed volume is notified to Nord Stream 2 by contractors as tonnes (t), which is converted to cubic meters using a factor 1.5625 t/m³.

** Total rock volume estimated in the Water Permit application including allowances, losses and installation tolerances was 1,703,000 m³.

The amount of rock material at pipeline crossings is higher than estimated in the Water Permit application. This is mainly due to redesign of the crossing with the Nord Stream gas pipeline. Redesign was needed based on a detailed survey prior to pipelay across the Nord Stream pipeline. In the update, the number of pre-lay berms was increased. In addition, post-lay rock placement and counterfill berms as well as wingle berms surrounding the pre-lay berms were added. The Balticconnector gas pipeline was built after the pipelay of Line A. The design for the crossing with the Balticconnector pipeline was finalized after Nord Stream 2 had submitted the Water Permit application and therefore the rock volume for the crossing was not known and hence not included in the Water Permit application /23/. In addition, three berms were constructed to avoid unexploded ordnance (UXO) /17/ detected during the detailed pre-lay survey for Line B.

3.4 Infrastructure crossings

3.4.1 Crossing agreements and methods

The pipeline currently crosses 30 cables in the Finnish EEZ, 10 of which are out of use. In addition, three cables that will in future cross the pipeline are currently in planning phase. The pipeline has also crossings with the Nord Stream and Balticconnector gas pipelines (Figure 11).

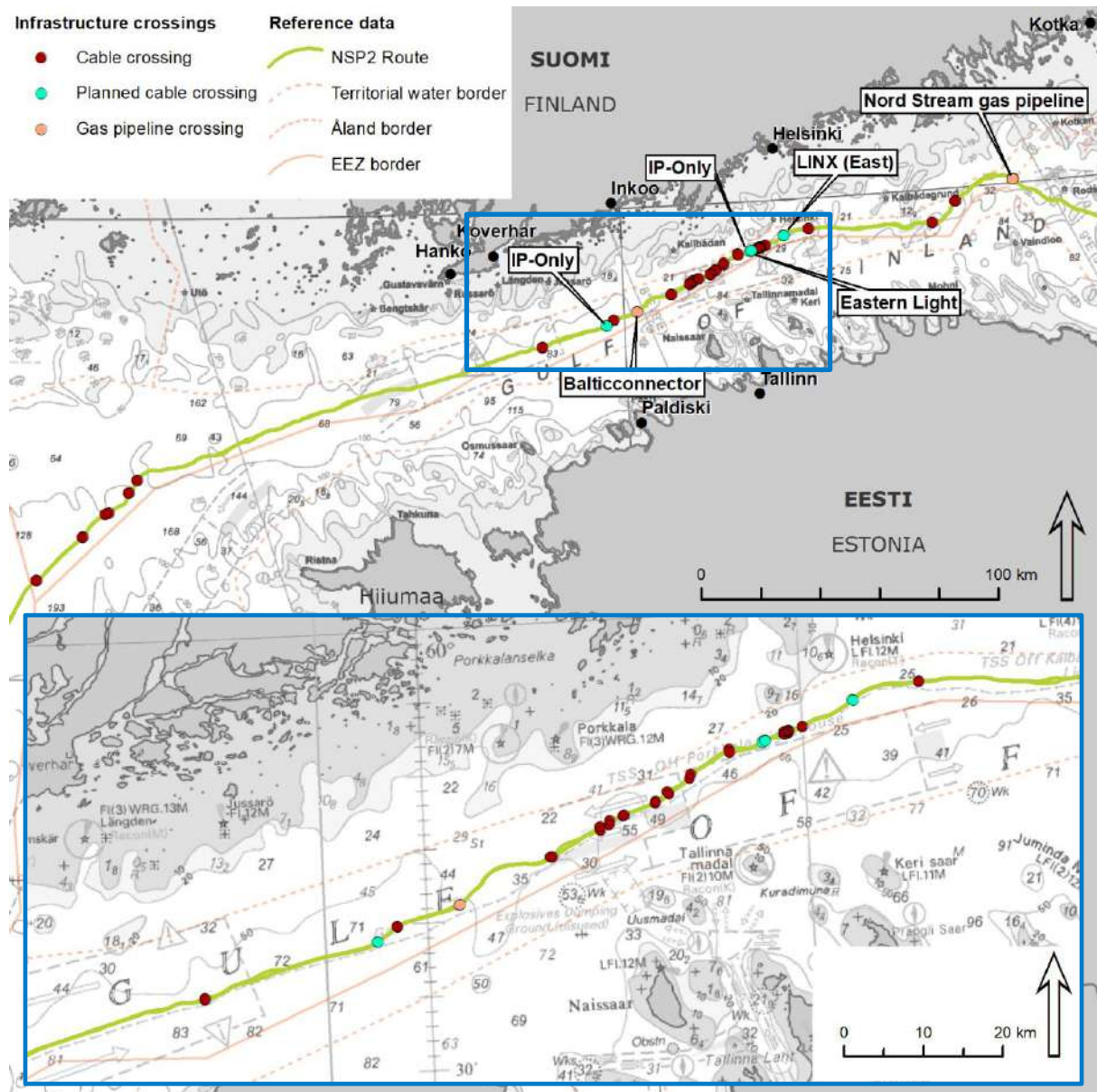


Figure 11. Crossings between NSP2 pipelines, cables and other gas pipelines.

For the cables with known owners, crossings were 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 owner and written agreements have been signed for all known owners of active cables. For the pipeline crossings, similar agreements have been made.

For cables with unknown owners, surveys were conducted in order to locate cables and to determine whether they are in use /24/. All cables that were not confirmed to be out of use were protected with concrete mattresses to shield them from any damage.

Prior to mattress installation, pre-installation survey of the installation locations was performed by an ROV to verify the status of the existing infrastructure. Two types of mattresses were used: flexible multi-block concrete mattresses with tapered edges and rigid concrete beam mattresses. Flexible mattresses were placed between the cable and pipeline, and rigid mattresses to support the pipeline from below on both sides of the crossing. The installation work was monitored by the ROV. After the installation of mattresses, the ROV carried out the as-built survey using a multi-beam echo sounder (MBES) and visual (video) inspection in order to document that the mattress was installed correctly /25/.

In the crossing with the Nord Stream gas pipeline rock berms were used in addition to concrete mattresses. In the crossing with Balticconnector gas pipeline, support with rock berms was sufficient. /17, 26/.

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 /14/ on site.

Within a period from June to October 2018, altogether 492 mattresses were constructed to protect the crossings with cables /27/. Of these, 178 were flexible and 60 rigid mattresses for Line A, to cross 18 cables, four of these twice, and 200 flexible and 54 rigid mattresses for Line B, to cross 18 cables, three of these twice. The total number of flexible mattresses was lower than notified in 2018 to the authorities, 378 instead of 393, due to changes in design of one crossing during detailed survey prior to mattress installation. The total number of rigid mattresses was as notified in 2018.

Mattress installation for cable crossings was completed in 2018 and reported in the Annual monitoring report 2018 /16/.

3.4.2 Cable crossings

In 2018, pipelay of Line A crossed with 15 cables.

In 2019, pipelay of remaining part of Line A crossed with 4 cables and the pipelay of the complete Line B with 19 cables.

In November 24–25, 2019, Elisa Oyj's E-Finest telecommunication cable between Espoo and Tallinn was laid on top of Lines A and B /28, 29/. Therefore, in the end of 2019, the Nord Stream 2 pipeline route has crossings with 20 cables in use.

In addition, there are still three planned cables that may cross the pipeline in future. The planned 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 /30/. The permitted and laid part of the cable does not cross the NSP2 pipeline. The planned IP-only cable will cross both pipelines twice. The owner of the planned LINX (East) cable is unknown.

3.4.3 Pipeline crossings

Nord Stream 2 pipelines cross the Nord Stream twin pipeline and the Balticconnector gas pipeline, from Inkoo, Finland, to Paldiski, Estonia.

The crossing area of Nord Stream gas pipeline and Nord Stream 2 includes four crossing points since both are twin pipelines. Support structures for the crossing area contain altogether 12 mattresses and several large rock berms.

Plans for the Nord Stream gas pipe crossing and the Balticconnector's construction plans were specified after the Water Permit application /23/. The revised plans of the Balticconnector required minor route deviations for both Line A and Line B. The route deviations at line A fall outside the installation corridor but within the security corridor (max offset of 10 m), while the route deviations of Line B fall inside the installation corridor (max offset < 7 m) (see Chapter 6.1 for details) /31/. The Balticconnector pipeline was built after the completion of the Nord Stream 2 Line A in the Finnish EEZ, and before Nord Stream 2 Line B. Balticconnector was laid on top of Line A on June 5, 2019 and Line B was laid on top of Balticconnector on July 17, 2019.

Seabed intervention works in the crossing included pipelay operations and rock placement. Two berms were constructed in order to support Line B over the Balticconnector, one on each side of the Balticconnector pipeline (Figure 12).

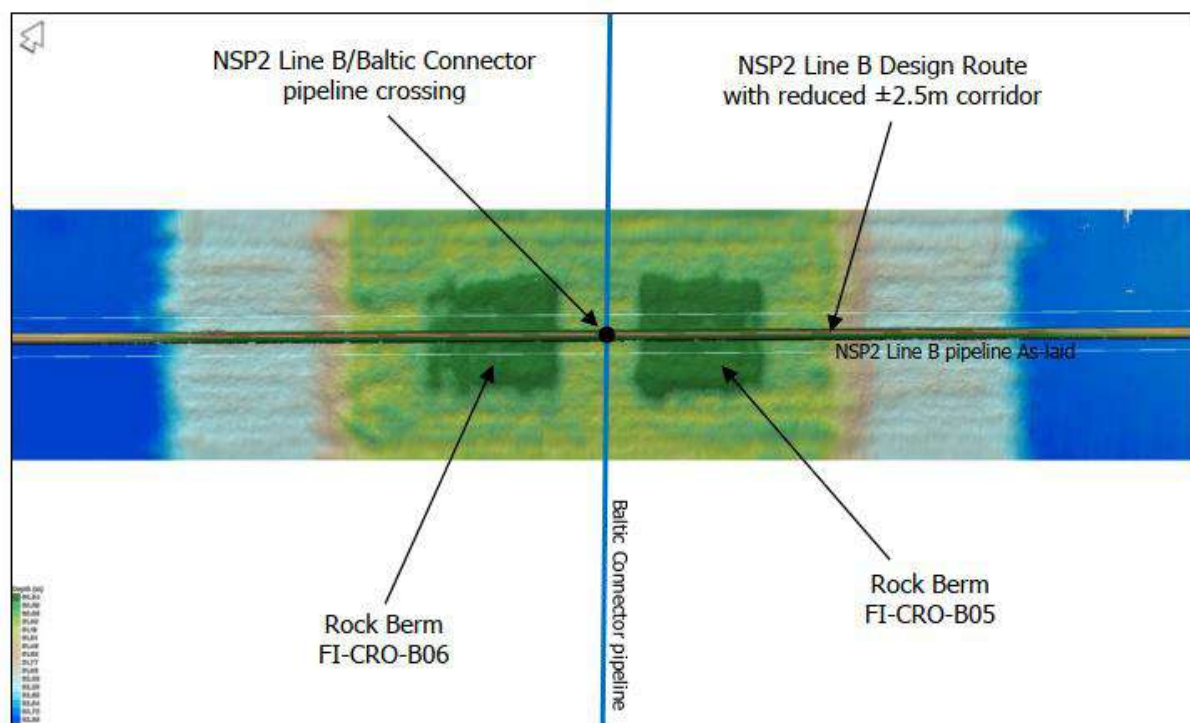


Figure 12. As-laid documentation of NSP2 Line B placement above the Balticconnector and on top of the supporting berms /32/.

In 2019, there were no simultaneous operations between the vessels involved in the construction of the Nord Stream 2 pipelines and the vessels involved in the construction of the Balticconnector pipeline. Construction of Balticconnector and NSP2 at the crossing area was conducted at different times.

3.5 Pipelay

3.5.1 Pipelay procedure

Once munitions clearance had ensured safe installation, pre-lay rock placement had evened rough parts of the seafloor and mattresses were in place to protect the cable crossings, pipelay could commence. Pipelay of Line A in the Finnish EEZ started in September 2018 and was completed in April 2019, and pipelay of Line B started in May 2019 and was completed in August 2019.

Pipelay was done by two large, dynamically positioned (DP) pipelay vessels, Solitaire and Pioneering Spirit. Both vessels can lay pipe at most weather conditions. When it was necessary to interrupt pipelay due to unsuitable weather conditions, the pipeline was laid down in a controlled manner. A special head was welded to the pipeline, and a cable was connected to the head, after which the pipeline was laid on the seabed for later recovery. Once weather conditions had improved, the vessel could recover the pipeline back onto the vessel. The cable was then disconnected, and the head was removed before regular pipelay continued.

Pipelay work was supported by survey vessels. These use ROV video cameras to monitor pipeline touchdown and cable crossings and help in pipeline abandonment and recovery procedure. They also performed as-laid surveys of the pipeline.

3.5.2 Pipelay in 2018

Most of the Line A pipelay took place in 2018 (Figure 13). The pipelay vessel Solitaire commenced the pipelay of Line A in September and continued until October. Solitaire had a four-day service break in Muuga Port, Estonia, and then continued pipelay of Line A until late December, when it was replaced by the pipelay vessel Pioneering Spirit. By the last day of 2018, approximately 260 km of Line A had been laid between GKP 117 in eastern and GKP 376 in western Gulf of Finland, crossing 19 cables, three of these twice. In 2018, pipelay had eight short interruptions due to weather conditions unsuitable for pipelay. There were 103 days of effective pipelay, making the average speed 2.5 km/day. The highest daily lay speed during the year was approximately 4.2 km/day for Pioneering Spirit and 3.6 km/day for Solitaire.

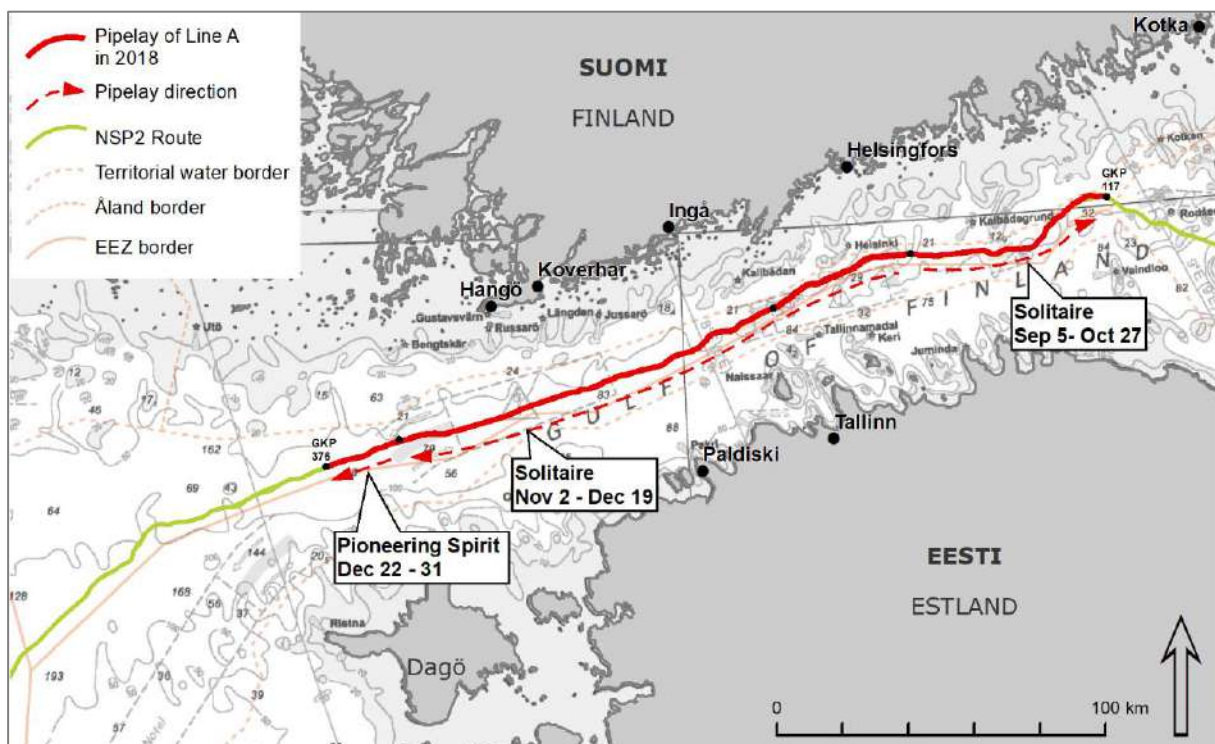


Figure 13. Pipelay in 2018 in the Finnish EEZ by the pipelay vessels Solitaire and Pioneering Spirit.

3.5.3 Pipelay in 2019

The year 2019 started with a storm “Aapeli”, forcing the pipelay to standby. Pipelay in 2019 could only be resumed on January 3, when Pioneering Spirit continued pipelay of Line A from GKP 377 in southwest direction until the western part of Line A was completed on February 4, 2019 at GKP 488 (Figure 14). Pipelay had to be interrupted and the pipeline temporarily laid down due to weather conditions on January 11, but after a short weather downtime period, the pipeline was picked up again and pipelay was continued on the same day. The Fortitude and Oceanic provided survey support to Pioneering Spirit, including Touch Down Monitoring (TDM), help in pipeline abandonment and recovery operations and support at cable crossing locations. In addition, Oceanic also performed pre- and post-lay surveys.

The pipelay vessel Solitaire commenced pipelay of the last, about 3 km long section of Line A from GKP 117 to GKP 114 on April 29, completing the pipelay of Line A in the Finnish EEZ the next day (Figure 14). The survey vessel Oceanic provided survey support.

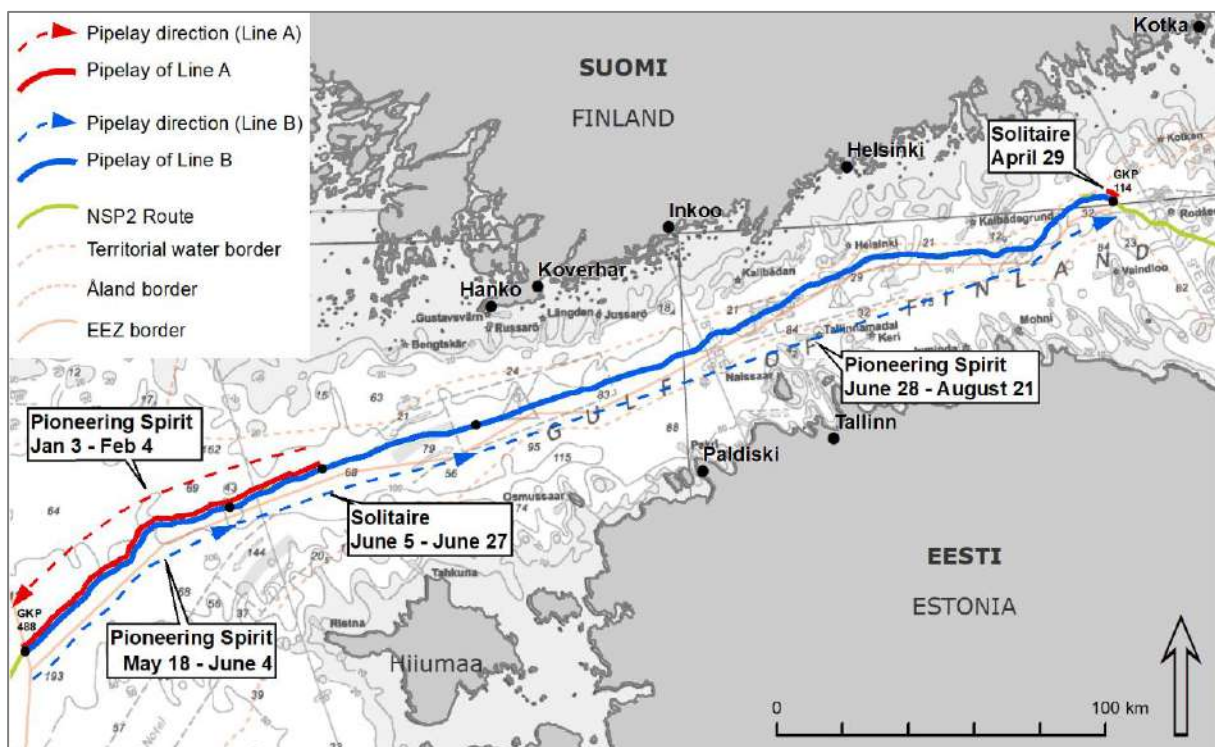


Figure 14. Pipelay in 2019 in the Finnish EEZ by the pipelay vessels Solitaire and Pioneering Spirit.

The pipelay vessel Pioneering Spirit arrived in the Finnish EEZ on May 18, 2019 and started pipelay of Line B at GKP 488. Pioneering Spirit continued pipelay until June 4, 2019 and Solitaire took over on June 5, 2019 at GKP 408. Solitaire continued pipelay until June 27, 2019 when Pioneering Spirit returned and commenced pipelay of Line B on June 28, 2019 at GKP 329. Pioneering Spirit continued the pipelay of Line B through July and August until the pipelay of Line B in the Finnish EEZ was completed on August 21, 2019 at GKP 114 (Figure 14). The vessels Oceanic, Fortitude and Calamity Jane and from August on also Normand Poseidon took turns providing ROV survey support to the pipelay vessels. This included Touch Down Monitoring (TDM), help in pipeline abandonment and recovery operations and support at cable and pipeline crossing locations. The survey support vessels also performed pre- and post-lay surveys.

As requested in the Water Permit, an intervention tug “Thor” was stationed in the vicinity of Kalbådagrund Traffic Separation Scheme, near the 13 m shallow southwest of the Kalbådagrund lighthouse during the time when the pipelay passed the area (August 7 to August 14, 2019). The tug was on standby to respond to third party ship emergencies, such as danger of grounding. The pipelay proceeded without external incidents, and no support from the tug was needed.

After the storms in January there were no interruptions in pipelay due to weather conditions during 2019.

Efficiency of pipelay during 2019:

- approximately 488 km of pipelay, of which 114 km of Line A and 374 km of Line B
- 130 effective days of pipelay
- pipelay at 6 cable crossings for Line A and at 30 cable crossings for Line B
- pipelay of both Line A and Line B across the two Nord Stream gas pipelines and once, for Line B, across Balticconnector gas pipeline
- highest daily speed approximately 5.4 km/day for Pioneering Spirit and 4.1 km/day for Solitaire
- average daily speed approximately 3.8 km/day (effective days)

3.6 Notifications related to construction

Nord Stream 2 has submitted general implementation plans prior to the initiation of different project construction campaigns and monthly plans to present upcoming activities in Finland. Monthly plans were submitted approximately one week before the beginning of each month. In addition, the Nord Stream 2 construction vessels have provided weekly and daily authority notifications regarding the progress and scheduling of construction activities according to the Consent to use the Finnish EEZ and Water Permit provisions.

In 2018, eleven and in 2019, two notifications related to the construction in the Finnish EEZ were submitted to the Finnish authorities (Table 10). Notifications related to unplanned events are presented in Chapter 3.7.

Table 10. Notifications related to construction in Finnish EEZ during 2018–2019 and submitted to Finnish authorities according to permit provisions.

Date	Content
26.3.2018	Provisional notification of the General Implementation Plan on rock placement, munition clearance and mattress installation in the 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 the 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 the 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
25.6.2019	Notification on two new pipe supply vessels to start supporting pipelay in the Finnish EEZ.
25.7.2019	Notification on the use of tug at Kalbådagrund TSS area.

3.7 Unplanned events

Four minor oil leaks occurred during the construction activities in 2018 and two in 2019. All these unplanned events were notified to the relevant authorities (Table 11). A comprehensive investigation was performed after the largest (150 L) incident that took place in October 2018 /33/. No measurable environmental impacts occurred due to any of the unplanned events, and the authorities did not request any actions to be taken due to the incidents.

Table 11. Notifications related to incidents submitted to the Finnish authorities in 2018–2019.

Date	Content
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.
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.
22.10.2018	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.
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.
26.7.2019	Notification on small oil leak. A crane used onboard survey support vessel Fortitude leaked about 20 L of biodegradable, non-bioaccumulable hydraulic fluid on deck. Of the total spill, about 10 L could be banded on the deck.
12.8.2019	Notification on oil leak. The rock placement vessel Bravenes lost 40 L of oil from one of its azimuth thrusters to the sea. The major constituents of the oil are inherently biodegradable, although it contains components that may persist in the environment. According to the Product Safety Sheet, the oil is practically non-toxic to marine life.

4

ENVIRONMENTAL BASELINE

4 ENVIRONMENTAL BASELINE

This chapter describes the weather conditions during 2019 and presents prevailing environmental conditions in the project area. The chapter portrays the state of the Baltic Sea as assessed in the marine strategy of Finland and describes baseline physical, chemical, biological and anthropogenic conditions in the project area. Only those environmental conditions that the Nord Stream 2 project may have impact on, as assessed in the EIA, are described. Therefore, data on fish and birds are not included. Baseline data is collected from observations of the NSP2 monitoring contractors and from various public sources and was to large extent presented in the Annual Monitoring Report 2018. New and/or updated data, compared to results presented in the Annual Monitoring Report 2018, has been added to chapters 4.1 Weather conditions in 2019, 4.2.3 Underwater noise, 4.3.2 Marine mammals, 4.3.3 Protected areas and 4.5 Marine strategy and Water framework directive.

4.1 Weather conditions in 2019

The statistics of the Finnish Meteorological Institute show that the weather in Finland in 2019 was 0.9 °C warmer than the long-term (1981–2010) average. On the southern coast, the year was one of the three warmest in the history of measurement at many observation stations. /34/. Precipitation was slightly higher than the long-term (1981–2010) average. For example, in Helsinki Kaisaniemi observation station the average temperature was more than 1.5 °C above, and annual precipitation 85 mm higher than the long-term average (1981–2010) (Figure 15) /35/.

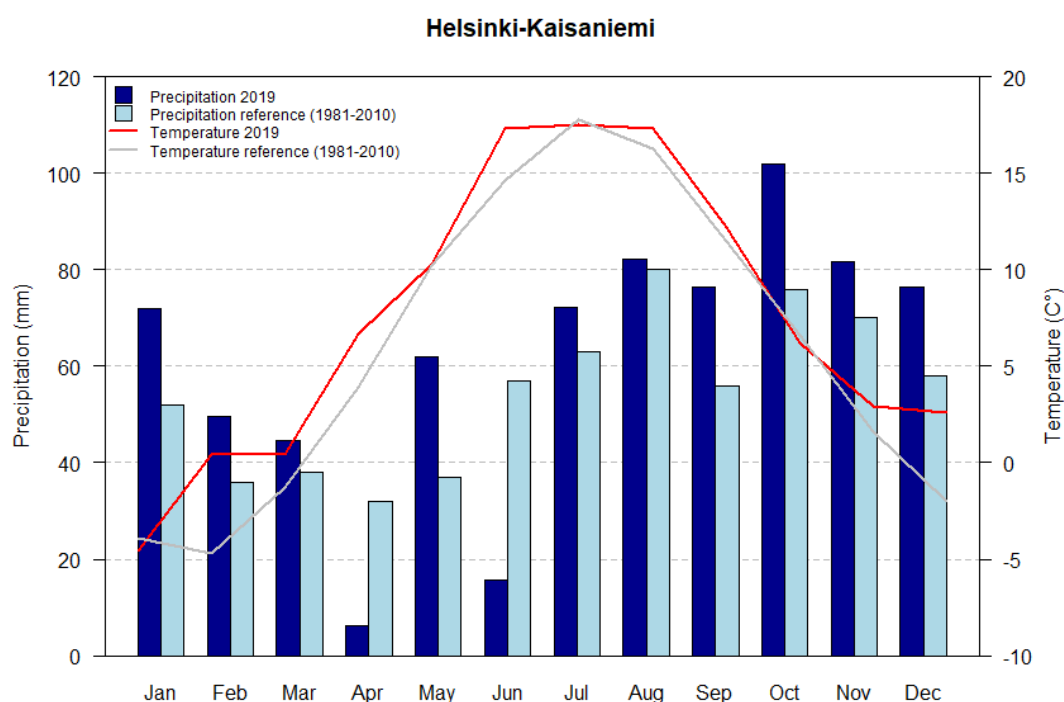


Figure 15. Monthly average temperature (°C) and monthly precipitation sum (mm) in Helsinki Kaisaniemi observation station in 2019 and during the reference period (1981–2010). Data from Finnish Meteorological Institute /35, 36/.

The most notable weather event in 2019 was the storm “Aapeli” on the night of January 2, 2019. A new national record, 32.5 m/s for the maximum sustained wind speed at maritime stations was recorded on the Bogskär islets situated on the southwest coast of Finland.

Data for wind speed and direction was collected from the Finnish Meteorological Institute weather observation stations Jussarö, Eestiluoto and Orrengrund, representing western, central and eastern Gulf of Finland coastal conditions, respectively (Figure 16). Southwest dominated the wind direction, and the average wind speed was 5–10 m/s. Occasional wind speeds reaching 15 m/s were measured at all stations, and up to 20 m/s in both western and eastern Gulf of Finland, more often in Jussarö, which is closer to the open Baltic Proper (Figure 16).

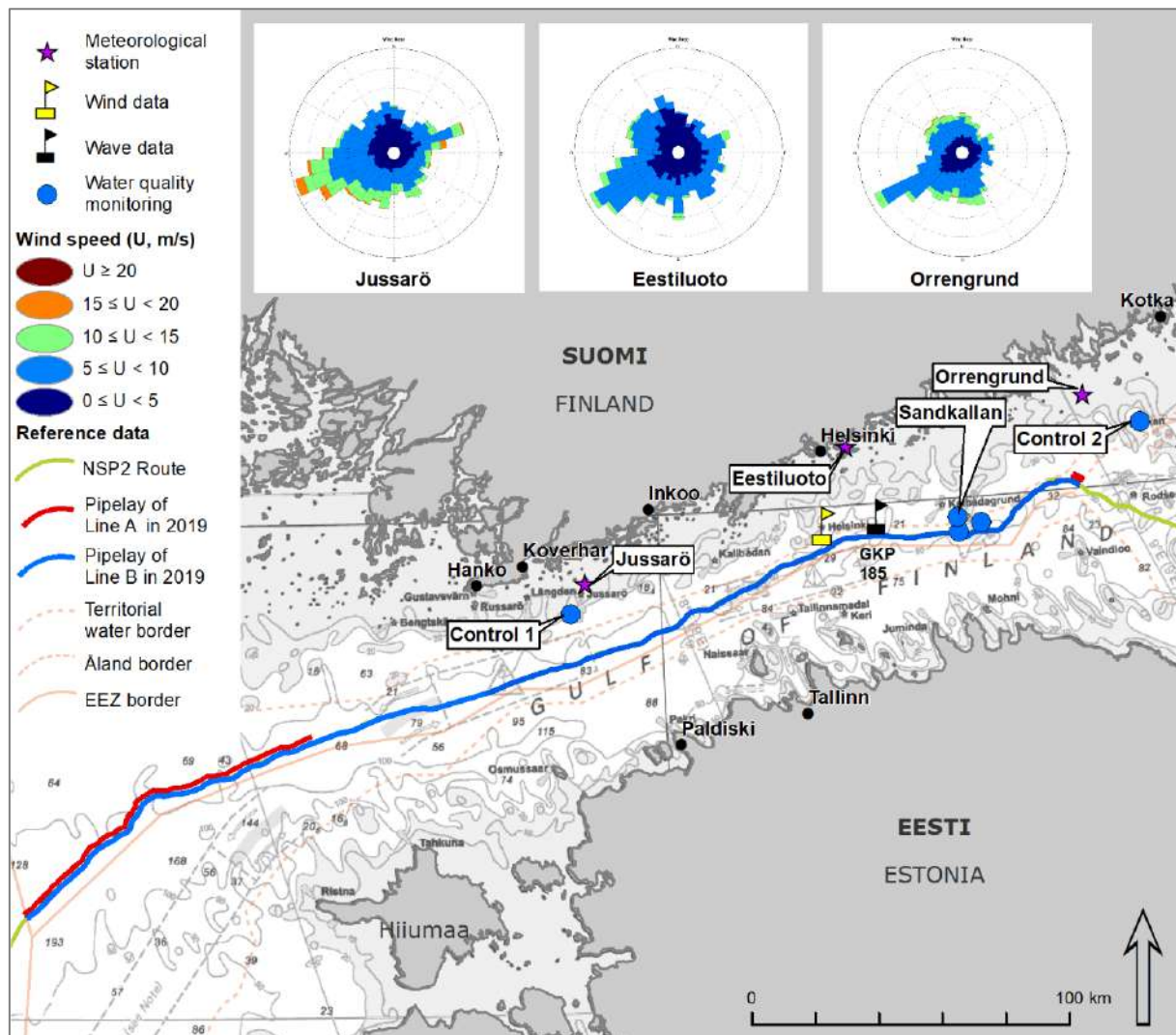


Figure 16. The observation stations of the Finnish Meteorological Institute and the Nord Stream 2 monitoring stations in the Gulf of Finland. Wind data /36/.

The significant wave height observation data was collected from an open sea wave buoy located in the Gulf of Finland approximately six kilometres north of GKP 185. Wave height varied from 0.1 to 3.6 m, with higher waves measured during the winter (Q1 and Q4) than during the summer (Q2 and Q3).

According to the Finnish Meteorological Institute /37/, the winter of 2018/2019 was mild until mid-January, when the weather turned very cold for two weeks. The extent of the ice cover was at its

maximum on January 27, 2019, covering 88,000 km² of the northern Baltic Sea (Figure 17). Thereafter, the weather was milder than usually, with alternating short mild and cold periods. The conditions were, however, challenging for ship traffic due to floating and pack ice. The easternmost part of the Gulf of Finland was not completely free of ice until the week before the end of April.

By the end of 2019 no ice had yet formed in the Gulf of Finland.

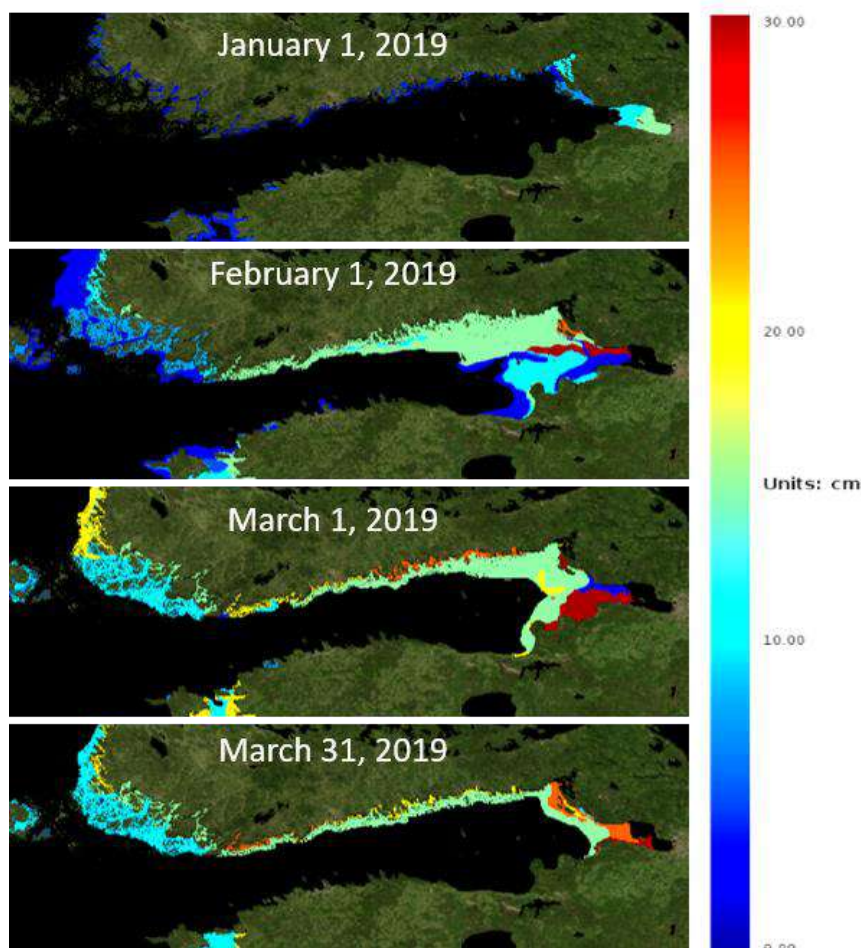


Figure 17. Thickness of sea ice (cm) in the Gulf of Finland in 2019. Adapted from /36, 38/.

4.2 Physical and chemical environment

4.2.1 Seabed morphology and sediments

The seabed of the pipelay corridor consists of sedimentation areas, erosion areas and transportation areas, where material alternately accumulates and shifts away. 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 inflows, organic matter decomposing) /39/.

Presence of contaminants was analysed from seven areal stations in the surface sediments along the survey area and the results were presented in detail in the EIA Report /4/. 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 dumping /40/. 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) /39/.

4.2.2 Hydrography and water quality

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 gradually 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. More than 90 % of the pipeline route is located in depths more than 60 m, and 34 % in depths more than 80 m (Figure 18).

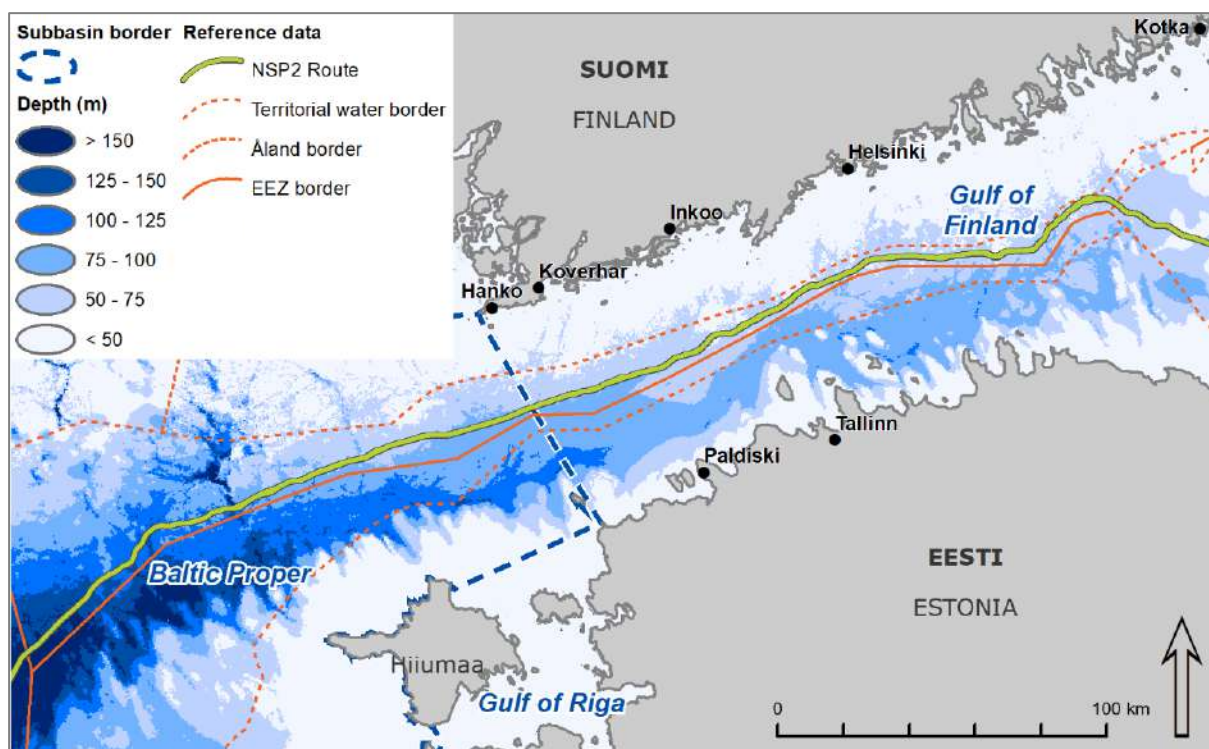


Figure 18. Baltic Sea subbasins and water depth conditions along the route.

Currents in the Gulf of Finland (Figure 19) are mainly induced by wind, but also by variations in salinity and temperature. Mean surface circulation is cyclonic. Current speed was monitored during the construction activities of the Nord Stream pipelines in 2010–2011 in the open, deep sea waters of the Gulf of Finland. At the depth range 60–80 m the average current speed was 0.05 m/s. The highest single value recorded was 0.21 m/s /4/.

A dominant feature of the Gulf of Finland is the stratification structure shaped by differences in temperature and salinity across the water body. The large input of freshwater from the rivers in the drainage basin create a surface salinity gradient from east (salinity almost zero) to west (salinity up to

10 PSU (practical salinity unit)). In the deepest layers, salinity is higher due to an incoming deep current from the Baltic Proper and range from 0–5 PSU in the east to over 10 in the west.

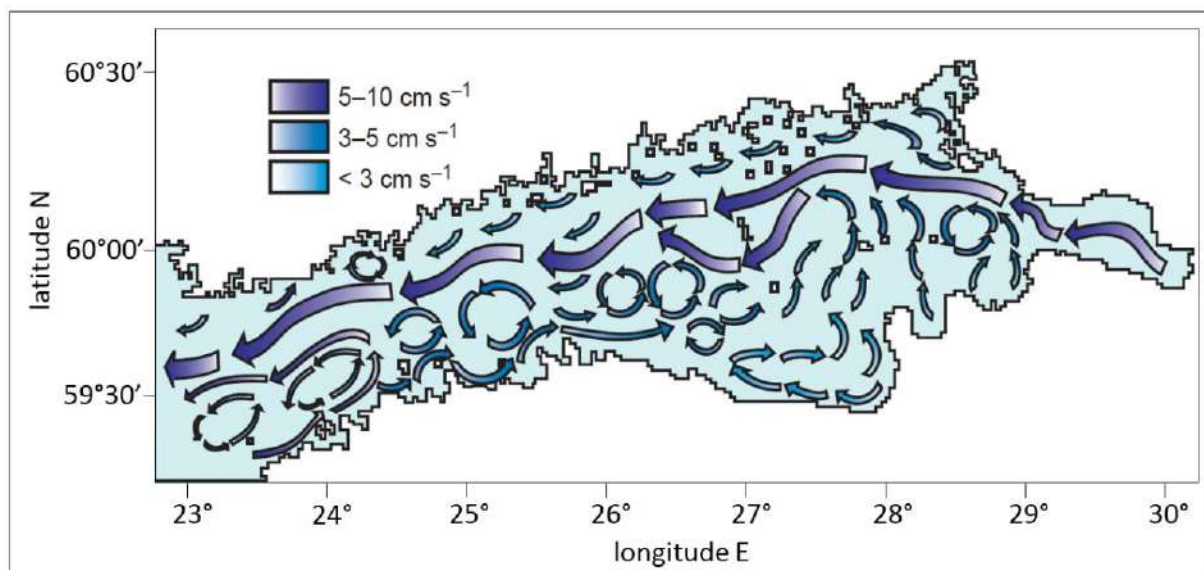


Figure 19. Schematic illustration of the mean circulation in the Gulf of Finland /4/.

In the low salinity surface waters, the temperatures vary seasonally from ice cover in winter to over 20 °C in late summer. The warm layer in summer is only 10–20 m deep; below thermocline (a thin transition layer where temperature decreases rapidly), water is cold and does not mix with the warm surface water until in autumn. At the Nord Stream 2 long-term monitoring stations (see Chapter 5.2) thermal stratification prevailed from April to late July in 2018 and from March to October–November in 2019.

In the deepest layers, below about 70 m depth, temperatures are stable, at around 2–3 °C year-round, due to the nearly permanent halocline (a thin transition layer where salinity increases rapidly). Density differences between the layers above and below the halocline limit the mixing of the deep, high salinity waters with the less saline layers above, leading to persistent anoxia at the sediment floor. This is also evident at the deepest Nord Stream 2 long-term monitoring station Sandkallan 3 (67 m), where high salinity at the deepest layers limited mixing for most of the monitoring period from April 2018 to December 2019. Consequently, oxygen concentrations were low at the seafloor /41/. Poor oxygen conditions inhibit colonization by benthic fauna on most of the Gulf of Finland sediments below 70 m depth.

Water stratification structure plays an important role in vertical dispersal of sediments released from the bottom during construction, as well as in natural resuspension process during storm events. Strong salinity and temperature stratification reduce the mixing of bottom water and upper water column, thus limiting the spreading of released sediment spill to below halocline and thermocline. Strong temperature stratification also reduces natural resuspension at areas shallower than the permanent halocline, until the stratification break-up takes place, typically in autumn.

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” /42/.

4.2.3 Underwater noise

Water carries sounds over long distances, and the underwater world is never silent. Natural sources of sound are for example wind, waves and animals, whereas anthropogenic sources include activities such as ship traffic and echo sounding. Sounds are either continuous or impulsive. In excess, both types disturb underwater fauna. A good environmental status with respect to underwater sound requires that the level and distribution of both continuous and impulsive sounds should not cause negative impacts on marine life /43/. So far, such levels have not been defined for sound sensitive species in the Baltic Sea /44/.

The sound levels vary widely across the Baltic Sea. Continuous sound in the Baltic Sea has been monitored in a comprehensive study using automated hydrophone loggers in 2014 /45/. The results indicate that both impulsive and continuous sound are present in the Baltic Sea and can be perceived by for example fish, seals and harbour porpoise at a wide range of frequencies /44/. High sounds levels were found along major shipping routes especially in the southernmost areas (Figure 20). The NSP2 pipeline route largely follows the major shipping routes. Impulsive sounds are not monitored, but since 2015 it has been possible to log activities associated with loud impulsive sounds into a regional registry hosted by ICES /46/. By 2016, Denmark, Estonia, Finland, Germany, Lithuania, Poland had registered such activities, with Latvia and Russia yet to join the registry. In the future, the registry can be used to evaluate magnitude and distribution of activities that generate impulsive sound.

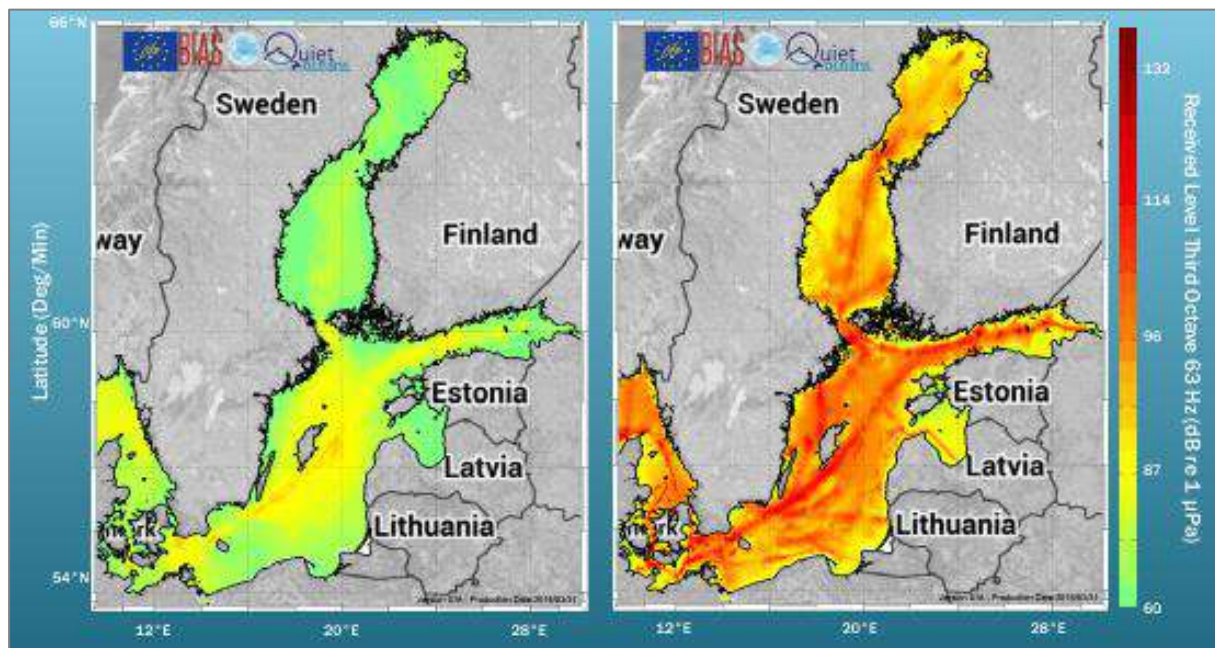


Figure 20. Soundscape maps modelled in the BIAS project for June 2014 showing the sound pressure levels for the 63 Hz band that are exceeded 95% (left) and 5% (right) of the time considered /47/.

4.3 Biotic environment

4.3.1 Biodiversity

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 /44/.

Benthic habitats are sensitive to eutrophication, physical disturbance, habitat loss /44/ fishing (trawling) /48/. 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 0.6–0.8. A good status for a benthic habitat would be 0.6 or higher. The core indicators classify the benthic quality in the area as “not good” /44/.

Pelagic habitats are sensitive to 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 status of phytoplankton and zooplankton, which are used as core indicators, is classified as “not good” /44/.

4.3.2 Marine mammals

Three marine mammal species occur in the Finnish waters of the Baltic Sea: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus grypus*) and the Baltic 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 12.

Table 12. 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	-	-

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 /49/. The severe decline of the harbour porpoise population in the Baltic Proper makes it the smallest population of harbour porpoises in the world /50/. The latest population estimate was done during the SAMBAH project 2016. The remaining number of porpoises in the Baltic Proper was estimated to be approximately 500, although the estimate was rough, with a 95% confidence interval covering a range of 80–1,100 /51/. Based on

observations and acoustic detection /51/ porpoises are likely to be found in low densities in most of the Gulf of Finland and the Archipelago Sea /49/.

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 /49/. 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.

The subpopulation in the Archipelago Sea was estimated to be 140-300 individuals during 2002–2005 /52/. An estimate of 100 individuals for the Gulf of Finland population was made in 2011, which compared to an estimate of 300 in the 1990s indicates a rapid decline, if correct /49/. The main part of this subpopulation inhabits Russian waters, but to some extent reaches across the border to Finnish as well as to Estonian areas. With the support of Nord Stream 2 AG and in cooperation with experts and state and private stakeholders, marine mammal scientists have been carrying out telemetry studies of the Baltic ringed seals in the Gulf of Finland since 2017. By 2018, 11 and by the end of 2019, 18 individual ringed seals were tagged and their movements were monitored in the Russian waters in separate spring and autumn campaigns. The results agree with earlier data of the population distribution in the Gulf of Finland, confirming that ringed seals inhabit remote and relatively untouched sea areas. The results add to the growing knowledge base of movements within and between subpopulations /53, 54/.

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 /49, 55/. Seal counts during 2016 (30,116 individuals), 2017 (30,348 individuals) and 2019 (38,000 individuals; data from LUKE - Natural resources institute Finland) suggest that the population is still increasing. Part of the sudden, large increase from 2018 to 2019, however, is explained by the exceptionally good weather during counting in 2019. 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 /49/.

Table 13. Protection criteria of the Natura 2000 sites designated to the protection of seals and distance from the pipeline (source: /58/).

Site and distance from the pipeline	Site code	Grey seal	Ringed seal
Archipelago Sea, 14.5 km	FI0200090	x	x
Tammisaari and Hanko MPA, 17.8 km	FI0100005	x	
Pernaja Bay and Pernaja Archipelago, 13.1 km	FI0100078	x	x
Eastern Gulf of Finland Archipelago, 23.5 km	FI0408001	x	x
Kallbådan Islets and waters, 9.8 km	FI0100089	x	
Archipelago of Söderskär and Långören, 12.5 km	FI0100077	x	

Grey seal hunting is allowed in Finland from April 16 to December 31. The Gulf of Finland quota was 140 individuals for 2018/2019 and 300 individuals for 2019/2020 hunting period /56, 57/.

There are no Natura 2000 sites along the pipeline in the Finnish waters designated to the protection of harbour porpoise, and it is unlikely that a harbour porpoise would appear along the NSP2 route /49/.

Three Natura 2000 sites designated to the protection of both **ringed seal** and **grey seal** are located within 100 km of the NSP2 route: Archipelago Sea, Pernaja Bay and Pernaja Archipelago, and Eastern Gulf of Finland archipelago (see Table 4.7.1. in /49/). (Table 13, Figure 21).

Altogether 15 Natura 2000 sites designated to the protection of **grey seal** are located within 100 km of the NSP2 pipeline route. The closest sites are Kallbådan Islets and Waters at a distance of 9.8 km and Archipelago of Söderskär and Långören at a distance of 12.5 km from Line A (see Table 5.7.2. in /49/) (Table 13, Figure 21).

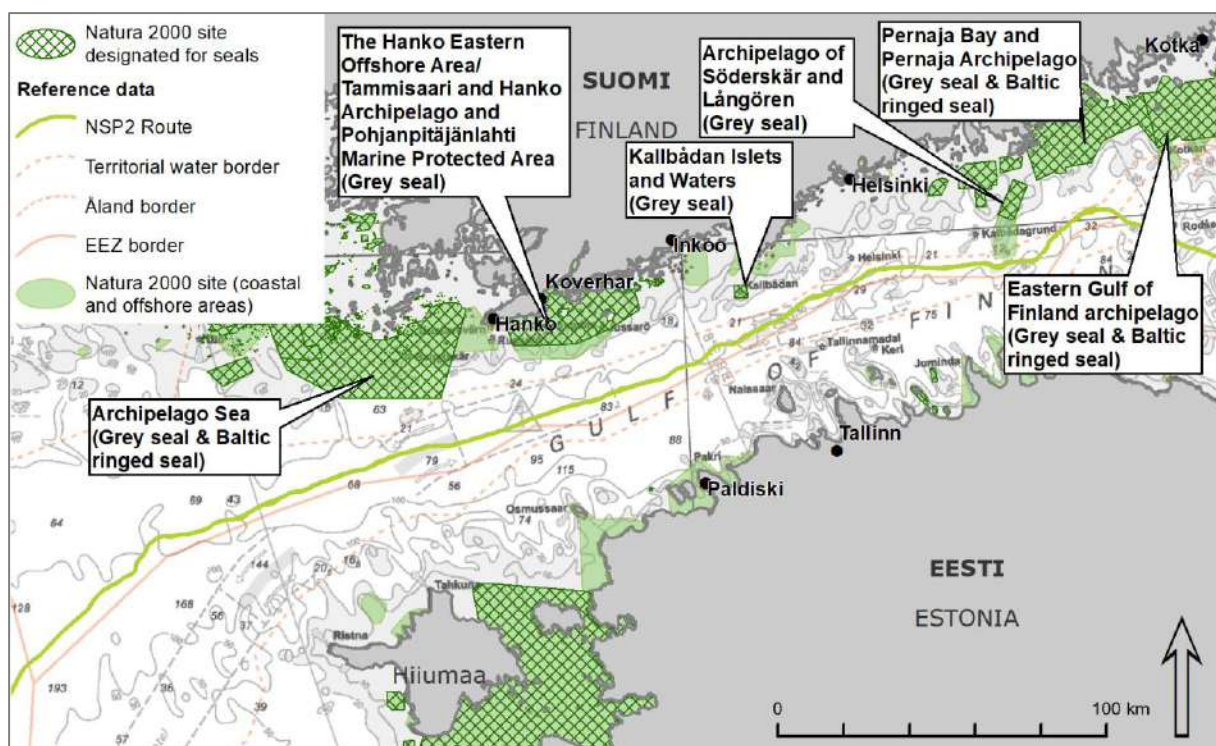


Figure 21. Natura 2000 sites designated to the protection of the seals.

4.3.3 Protected areas

The Natura 2000 site **Sea Area South of Sandkallan** (SAC FI0100106) total area is 7,468 ha. Of that, 220 ha are reefs (code 1170), which is an Annex I habitat type protected as a special area for conservation under the Habitats Directive. No Annex II species under the Habitats Directive or Annex I species under the Birds Directive exists in the area. This area is the closest reef to the pipeline, 1.9 km to the 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 Natura 2000 site **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 1,520 hectares, and it is located in an offshore area southwest of Porkkalanniemi. In 2018, the habitat type reefs (code 1170) and habitat Boreal Baltic islets and islands in outer archipelago and open sea zones (code 1620) were added covering approximately 511 ha within the protected area (Figure 22) /59/. 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.

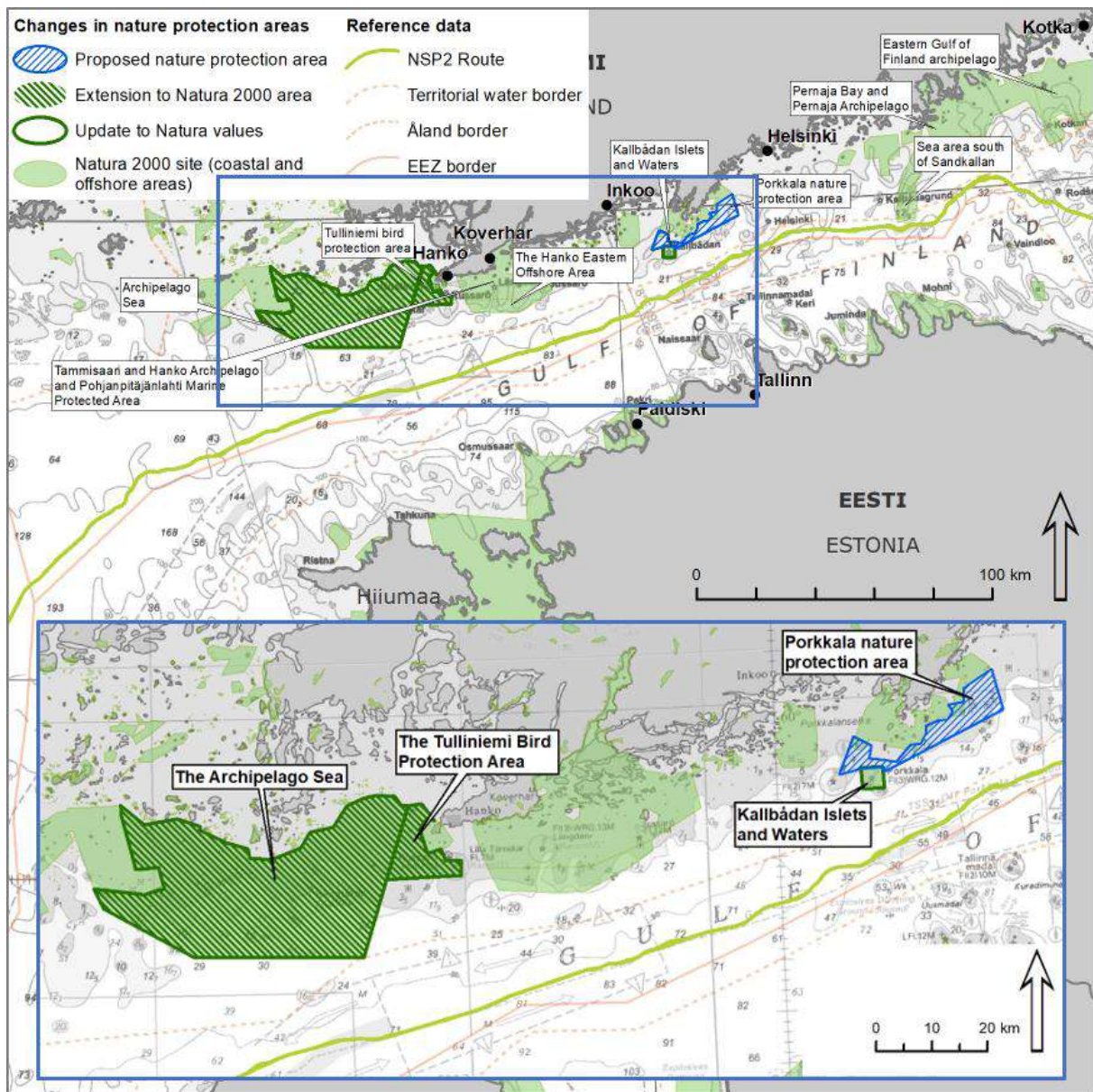


Figure 22. Changes to the Natura 2000 and nature protection areas in 2018 (lower map). The coastal and offshore Natura areas are shown on the upper map, and the names of closest protected areas to the NSP2 pipeline route are indicated. Information on updates to protection areas from /42, 59, 60/.

The Natura 2000 site **The Hanko Eastern Offshore Area** (SAC FI0100107), at a distance of 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 constitute 40 % of the bottom. This area is exposed to noise and vibration from the Finnish Defense Forces, as it is adjacent to a military training area.

The Hanko Eastern Offshore Area is connected to another Natura 2000 site, **Tammisaari and Hanko Archipelago and Pohjanpitäjänlahti Marine Protected Area** (SPA/SAC FI0100005) at a distance of 17.8 km to the Line A. 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 Annex II species under the Habitats Directive present in the area is the grey seal.

The Natura 2000 site **The Archipelago Sea** (SPA FI0200164 and SAC/SCI FI0200090) at a distance of 14.5 km from the Line A includes different delineations of SPA, SAC and SCI areas. The surface area of FI0200164 approximately tripled to 162,205 ha in 2018 with an extension decision of Finnish Government (Figure 22) /59/. 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) to 152,223 ha. 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 Defense Forces. The Annex II species under the Habitats Directive present in the area are the grey seal and the Baltic ringed seal.

The Natura 2000 site **The Tulliniemi Bird Protection Area** (SPA FI0100006), more than 23 km north of the Line A, was extended in 2018 to the west to include the sea area around the previously protected islands (Figure 22) /59/. The surface area today, 11,155 ha (96.6% marine), is now approximately five times larger than in 2017. 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. The archipelago area is significant for sea birds. Water covered sandbanks and reefs are unique and relatively well preserved in spite of anthropogenic pressures. The largest habitats are Sandbanks which are slightly covered by sea water all the time (code 1110) 866 ha, Reefs (code 1170) 715 ha, Boreal Baltic islets and islands in outer archipelago and open sea zones (code 1620) 581 ha and Vegetated sea cliffs of the Atlantic and Baltic coasts (code 1230) 120 ha. Additionally, 12 habitats smaller than 100 ha exists in the area. The area is connected to the Archipelago Sea Natura area (FI0200164/FI0200090) in the west.

Pernaja Bay and Pernaja Archipelago Natura 2000 site (FI0100078) total area is 65,760 ha. It includes Special Areas of Conservation (SAC) and Special Protection Areas (SPA). It forms an internationally valuable ecological entity representing biota variation caused by differing salinity and other environmental conditions. There are a wide variety of habitat types: Boreal Baltic narrow inlets 10,900 ha (code 1650), Reefs 8,400 ha (code 1170), Coastal lagoons 2,400 ha (code 1150), Sandbanks which are slightly covered by sea water all the time 533 ha (code 1110) Estuaries 200 ha (code 1130), Transition mires and quaking bogs (code 7140) 150 ha and Large shallow inlets and bays (code 1160) 120 ha. On top of these there exists 16 other habitat types with area less than 100 ha. The Annex II species under the Habitats Directive present in the area are the grey seal and the Baltic ringed seal (proposed, not confirmed).

Natura 2000 site of **Eastern Gulf of Finland archipelago** (FI0408001) area is 95,628 ha out of which 99% is marine. It is confirmed as Sites of Community Importance (SCI) and designated as Special Protection Areas (SPA) and as Special Areas of Conservation (SAC). The largest habitats are Reefs (code 1170) which cover 7,847 ha, Sandbanks which are slightly covered by sea water all the time (code 1110) covering 2,746 ha, Boreal Baltic islets and small islands (code 1620) covering 1,439 ha, Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation (code 1610) covering 534 ha and Vegetated sea cliffs of Atlantic and Baltic Coasts (code 1230) covering 188 ha. In addition, there are 18

other habitat types smaller than 100 ha represented. The Annex II species under the Habitats Directive present in the area are the grey seal and the Baltic ringed seal.

In 2019, no changes to Natura areas were proposed.

The Finnish Government is working towards establishing a 12,777 ha **Porkkala Nature Protection Area** (Figure 22) under the Nature Protection Act (1096/1996) with a Government Decree. The area is located north of Kallbådan islets and Waters Natura 2000 Area (Figure 22, indicated with blue raster). 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. The Ministry of Environment requested comments on the draft on regulations concerning state nature reserves by February 2019 /60/.

4.4 Socio-economic environment

4.4.1 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 and other underwater objects of historical value) 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 /2/.

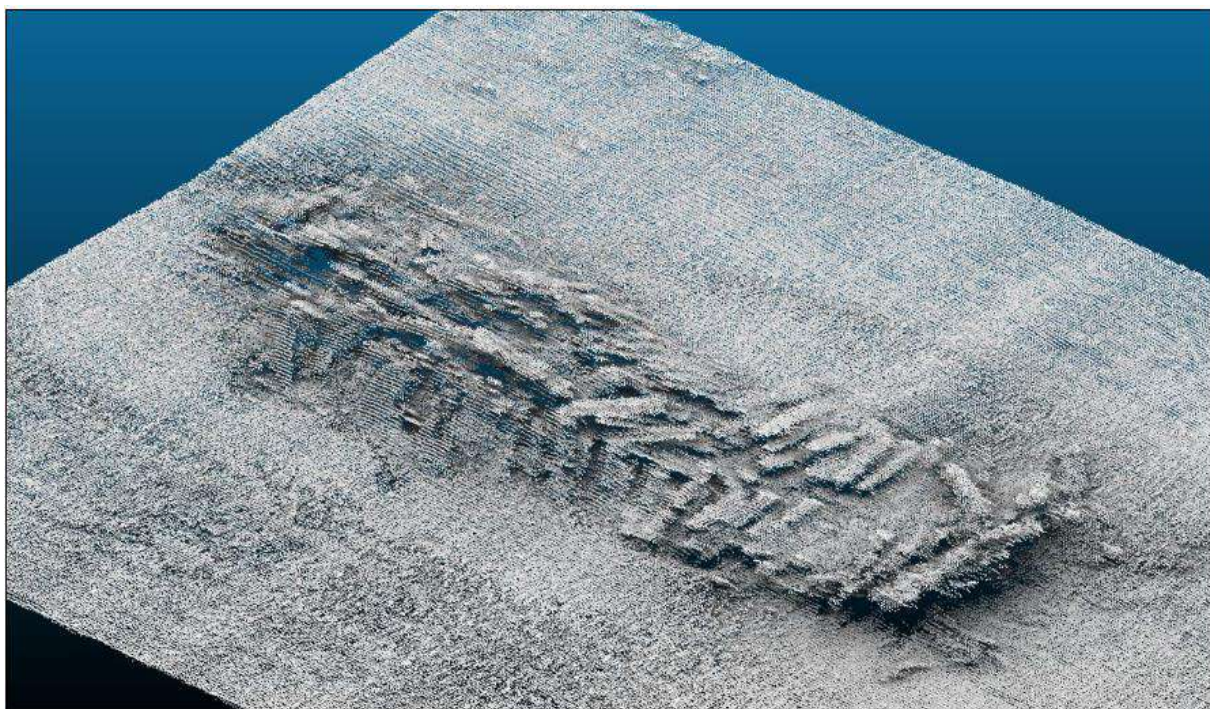


Figure 23. Point cloud 3D image of the cannon barge from 2018 inspection survey. Source: /75/.

The target S-R05-7978 is a wreck that consists of the remains of a cannon barge. The wreck is of cultural historical interest, as 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.

The target S-R09-09806 is a World War II anti-submarine net that has been laid along a prominent rock outcrop in the seabed. Only the associated floats/ buoys and the cable are visible /61/.

4.4.2 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 summertime.

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.

4.4.3 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, licensed offshore. By 2019, the number had decreased to 34 vessels /62/. Professional fishery consists of both coastal and offshore fishing. In the coastal areas, mostly nets and trap nets are used. Offshore fishing comprises mid-water trawling (no bottom trawling is performed in the Finnish waters) and long-line fishing /58, 63/.

European sprat and Baltic herring comprise 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/.

4.5 Marine strategy and Water framework directives

Marine strategy framework directive aims at attaining a good environmental status (GES) of the European Union's marine waters. The Water framework directive aims at achieving a good ecological status and preventing deterioration of the ecological status of all aquatic environments within the Union. The directives have been implemented in Finland by the Act on the Organisation of River Basin Management and the Marine Strategy (1299/2004, amendment 272/2011), by the Government Decree on the Organisation of the Development and Implementation of the Marine Strategy (980/2011), by the Government Decree on Water Resources Management (1040/2006) and by the Government Decree on Water Resources Management Regions (1303/2004).

The first part of the Finnish Marine strategy (Merenhoitosuunnitelma, Marine management Plan) was completed in 2012 and approved by the Government. The first part included a preliminary assessment of the current state of the sea, the determination of good environmental status of the marine environment, and the setting of environmental objectives and related indicators. The second part, the Marine Management Monitoring Program, was completed in 2014. The Government approved the third part, the Marine Management Operational Program for 2016–2021, in 2015. The “State of the Marine Environment in Finland 2018” report /42/ is an update to the first part of the Finnish Marine Management Plan. The status report also includes an assessment of the pressures on the marine environment, identifies good environmental status and presents environmental status objectives and related indicators to monitor the achievement of the objectives. The state of the marine environment

is assessed through eleven qualitative indicators of good status based on the EU Marine strategy directive.

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 (into the sea) and underwater noise. Of these descriptors, those potentially affected by NSP2 project are biodiversity, eutrophication, seabed integrity, contaminants, and underwater noise. In addition to affecting the descriptors of good environmental status, the project may also affect commercial fishery, cultural heritage and ship traffic.

The status of the Finnish marine environment is determined either as good or deteriorated.

The study of Finnish Environmental Institute /42/ summarizes the state of the Finnish marine environment as follows:

“The greatest pressure on coastal and offshore environment is the excessive nutrient loading and the consequent eutrophication. Due to the eutrophication as well as other pressures, a significant share of broad sea-floor habitats are in deteriorated status. The status is worst in the offshore areas of the Northern Baltic Proper and the Gulf of Finland which suffer from oxygen deficiency. The state of the Gulf of Bothnia is predominantly good. Assessment of hazardous substances still shows deteriorated status, but the state impacted by marine litter was not assessed even though amounts of litter were much higher close to human activities and in areas accumulating litter. Status of alien species was estimated as good. The two seal species have different status in Finnish marine area: the grey seal populations has grown in recent years and indicates good status, but the ringed seal indicates good status only in the Gulf of Bothnia and deteriorated status in the Archipelago Sea and the Gulf of Finland, where the ringed seal population is scarce and does not grow. Populations of several breeding water birds are declining, and their state is predominantly not good. Commercially exploited fish stocks, on the other hand, are mainly in good status, but the status of especially eel and sea trout stocks is worrying.”

In the Water framework directive, the ecological status is defined mainly through the living conditions for the biota, compared to pristine conditions. The factors affecting the conditions include chemical, physical and biological factors. In the coastal areas of the Gulf of Finland, included in the sphere of influence of the Water framework directive, the main pressures to the marine environment are related to eutrophication, and the potential impacts caused by NSP2 relate to release and spreading of nutrients and contaminants from the sediment disturbed during construction /4/.

The ecological status of the water body is classified on a scale of excellent, good, satisfactory, passable or poor. The status of the Finnish coastal waters in the Gulf of Finland ranges from poor to satisfactory, with most of the area classified as passable in the 2019 preliminary assessment /64/.

5

ENVIRONMENTAL MONITORING

5 ENVIRONMENTAL MONITORING

Nord Stream 2 monitoring is based on the Nord Stream 2 Environmental Monitoring Programme, Finland. The programme was approved on April 12, 2018 within the Water Permit decision (Nro 53/2018/2, Dnro ESAVI/9101/2017). In addition, Nord Stream 2 performed additional monitoring to strengthen the assessment of impacts from Nord Stream 2 implementation. The chapter presents the methods, activities and results of the NSP2 monitoring in 2019, and summarizes the results of the 2018 monitoring, already presented in detail in the 2018 Annual Monitoring Report, to give a holistic view on the observed impacts of the construction. Environmental monitoring has been intensive in the Finnish EEZ during the construction phase from spring 2018 to the end of 2019. The majority of monitoring activities took place in 2018.

5.1 Notifications related to monitoring

According to the permit provisions of the Water Permit (53/2018/2), Nord Stream 2 AG submits notifications in relation to environmental and technical monitoring to the Finnish authorities. During 2018 Nord Stream 2 AG submitted 11, and during 2019 two such notifications (Table 14).

The first notification, dated February 15, 2019, was to clarify contradicting dates for the submission of the Annual Monitoring Report, which differed between the monitoring programme and the Water Permit. Nord Stream 2 proposed to the Uusimaa ELY Centre that the Annual Monitoring Reports are to be submitted to the authorities by the end of May of the following year /65/. With its decision on February 22, 2019, Uusimaa ELY Centre approved the schedule in line with the proposal (UUDELY/9564/2017a).

The second notification of 2019, on October 9, was to propose an amendment of monitoring scope in 2020 to the Uusimaa ELY Centre /66/. The proposed amendment was to reduce the monitoring scope for 2020 from the existing five stations to three stations due to limited amount construction work remaining in 2020, and the high quality and extensive quantity of data gathered in 2018–2019. With its decision on November 8, 2019, Uusimaa ELY Centre approved the suggested amendment (UUDELY/9564/2017b). Accordingly, in 2020, water quality and currents will be monitored at three stations at the Sandkallan long term monitoring site, but no longer at the Control sites in eastern and western Gulf of Finland.

Table 14. Notifications related to monitoring during 2018–2019 and submitted to the Finnish authorities.

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 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 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
15.2.2019	Clarification on the Annual Monitoring Report submission date.
9.10.2019	Amendment of the monitoring scope in 2020

5.2 Water quality and currents

5.2.1 Monitoring methods

The construction of Nord Stream 2 pipeline system generates sediment spreading that can potentially impact marine life. Sediment spreading is monitored by turbidity measurements with water quality probes. In addition, current fields are measured with ADCP devices (Acoustic Doppler Current Profiler). The main objective for turbidity and current monitoring is to evaluate how far the construction related sediment spills travel, how high sediment spills rise in the water column and what is the maximum turbidity generated by the construction.

Impacts of pipelay and pipe supply on sediment resuspension were monitored also in the Nord Stream project, in which both anchored and dynamically positioned (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 /67/. In the Nord Stream 2 project, only DP pipelay vessels were used. As the effects of pipelay and pipe supply were assessed to be none or negligible, they were not monitored in the Nord Stream 2 project.

Water quality and current monitoring was carried out with self-logging oceanographic sensors. Sensors were moored to the seabed and brought to the surface only for regular service with an acoustic releaser system (Figure 24). This allowed monitoring without visible surface buoys and disturbance to third party shipping activities.

Short-term monitoring of water quality took place at four locations and long-term monitoring took place at three locations. A set of three monitoring arrays was used in a triangular shape around each selected short-term monitoring station (i.e. rock placement and munition clearance site), as well as at the Sandkallan long-term monitoring site. At each site the three monitoring arrays represented three sectors to measure the potential impact from the origin. At the other long-term monitoring stations only one array was used. All arrays consisted of three sensors, located 2, 5 and 15 meters above the seabed (Figure 24). In addition, one array per station was equipped with a 3D-current sensor (Figure 24), which measured the current speed and direction at all depths.

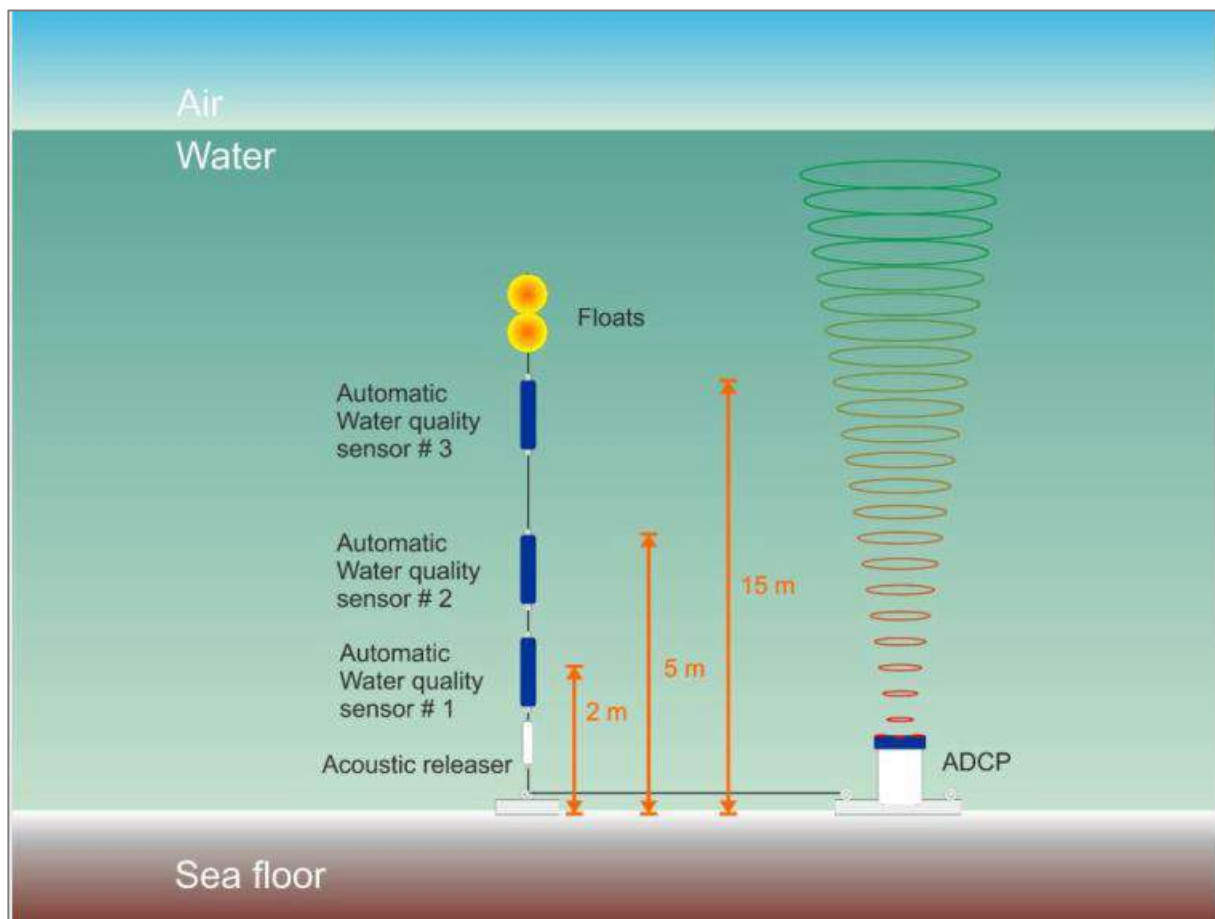


Figure 24. Measurements setup for the water quality and current monitoring stations /68/.

Water quality monitoring was performed with probes, which record salinity, temperature, oxygen concentration and turbidity at each of the monitoring sites at 15-minute intervals. Turbidity and oxygen concentration 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 ADCP's (Acoustic Doppler Current Profiler). 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.

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

The short-term monitoring at the rock placement sites and at the munition clearance sites was completed in 2018. Detailed information regarding monitoring methodology is presented in the Annual Monitoring Report 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 25). In addition to Control 1 and 2 stations, three stations were deployed at the Sandkallan area (Figure 25). 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 at stations Control 1 and Control 2 was completed in December 2019. Monitoring at Sandkallan site continues until four weeks after the completion of the construction work in the nearby area (UUDELY/9564/2017b).

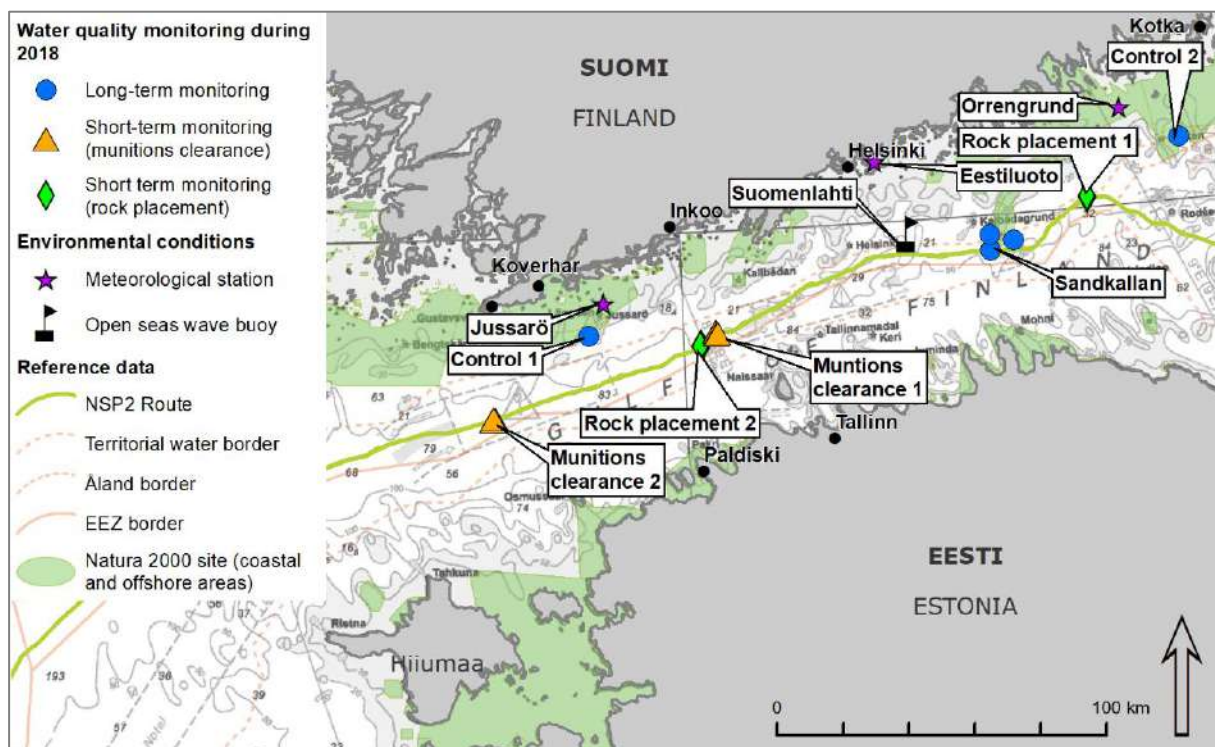


Figure 25. Long-term monitoring sites Control 1, Control 2 and Sandkallan and short-term monitoring sites Munition Clearance 1 and 2 as well as Rock Placement 1 and 2, together with the nearest weather and wave monitoring station operated by Finnish Meteorological Institute.

5.2.2 Water quality and currents in 2018

Rock Placement

Altogether 25,000 t (16,000 m³) of rock material was placed close to the monitoring site Rock placement 1. The constructed rock berm (FI-A1001) is one of the largest berms in the Finnish EEZ. 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, but the impacts were in general smaller than predicted in the modelling for the EIA report /4/ (see Table 17).

The rock berm (FI-B1031) at the Rock Placement 2 site was significantly smaller compared to the Rock Placement 1 berm. The site was selected for monitoring due to a very soft clay seabed /2/. Altogether 9,000 t (5,760 m³) rock material was placed close to the monitoring site Rock Placement 2 within two days of operation. The impact of rock placement on turbidity was detected by the network of turbidity sensors, but none of the modelled turbidity estimates /4/ were exceeded.

Munition clearance

The measured impact of munitions clearance on water quality was small and short-term (Table 17). No impacts on water quality were detected from the actual detonations but impacts of preparation and follow up works could be seen. The maximum measured turbidity peak was 9.2 turbidity units (FNU). Turbidity impact was limited to the layer near the bottom, 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 (1–2 FNU).

When comparing the monitoring locations to the estimated route of the released sediment plume at both Munition Clearance monitoring sites, it is possible that the released sediment plume 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. The significant wave height peaks matched with the turbidity peaks. 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. The average background turbidity at all sites remained below 1 FNU.

5.2.3 Water quality and currents in 2019

The results cover the period between December 2018 and December 2019. No impacts from construction activities were detected in water quality at long-term monitoring sites Control 1, Control 2 and Sandkallan during the monitoring period /41/.

Clear seasonal variations of temperature can be seen in the data of both Control stations, which represent relatively shallow coastal area between depths of 40–50 m (Figure 26). In the shallower station Control 1 (42 m) temperature fluctuations are distinct ranging from 0 °C measured in February to 13 °C measured in October 2019. In the slightly deeper station Control 2, the lowest temperature, 2 °C, was measured one month later, in March, and similarly, the highest temperature, 8 °C, one month later in November. The general trend in the Gulf of Finland is that temperature fluctuations decrease with increasing water depth. Accordingly, the delay between atmospheric temperature changes and water temperatures increases. Both Control stations also show occasional irregular rapid temperature

changes of several degrees caused by wind-induced upwelling and downwelling events. In these events, rapid vertical movements of water masses take place. Surface water is pushed towards deeper water layers (downwelling) and deeper water masses towards the surface (upwelling).

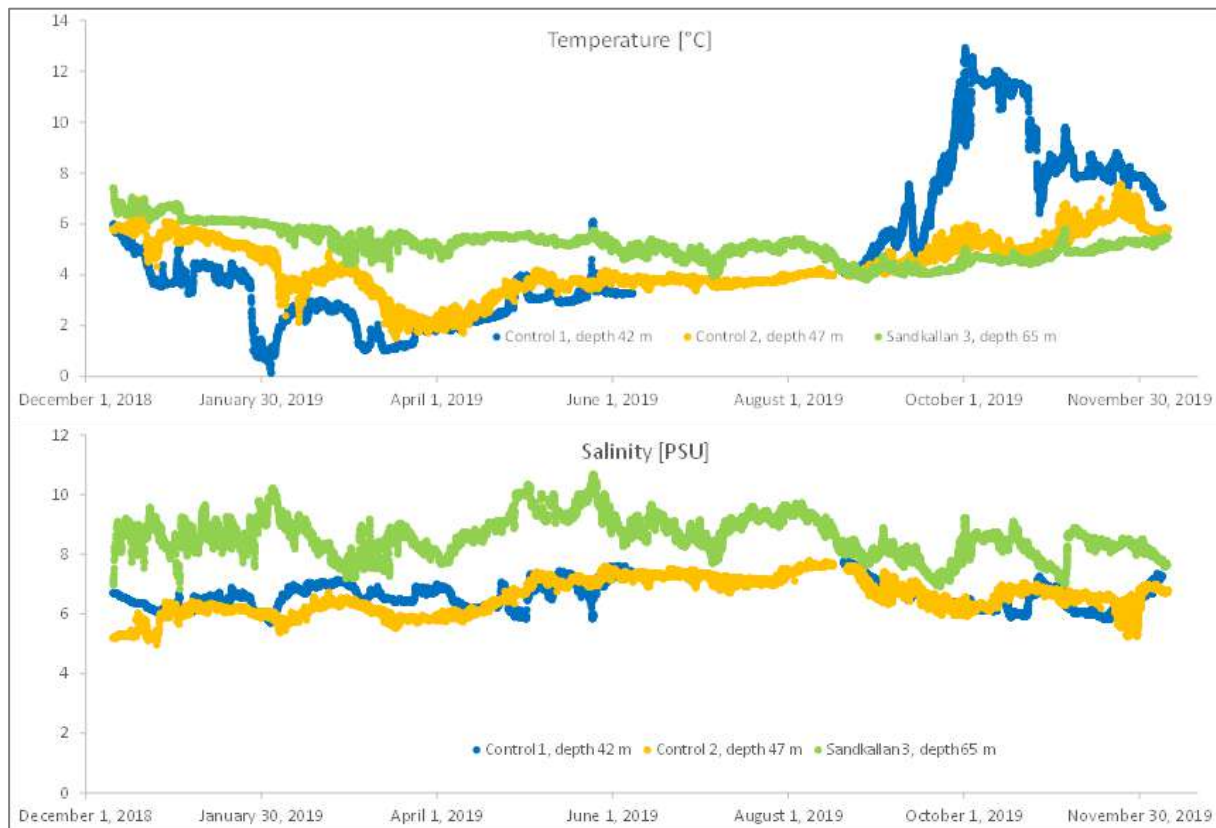


Figure 26. Temperature and salinity 2019 measured 2 m above the seafloor in the long-term monitoring stations Control 1, Control 2 and Sandkallan 3.

At the Sandkallan site, the shallower stations Sandkallan 1 and Sandkallan 2 show similar trends as the Control stations of the same depth range. However, the deepest long-term measurement station, Sandkallan 3 (65 m) differs clearly from both of the Control stations (Figure 26). Water temperature variation (4–7 °C) 2 m above seafloor is low and no clear seasonality can be seen. Almost complete decoupling from the atmospheric variations is caused by the halocline, which separates the deep water mass of high salinity from the surface water affected by fresh water input from the rivers. The salinity in Sandkallan 3 is high compared to the average conditions in the Gulf of Finland. In 2019, it varied irregularly between 7–11 PSU with slightly decreasing trend towards the end of the year. Strong halocline prevents also transport of oxygen from the surface water leading into anoxic conditions recorded regularly below the depth of 60 m.

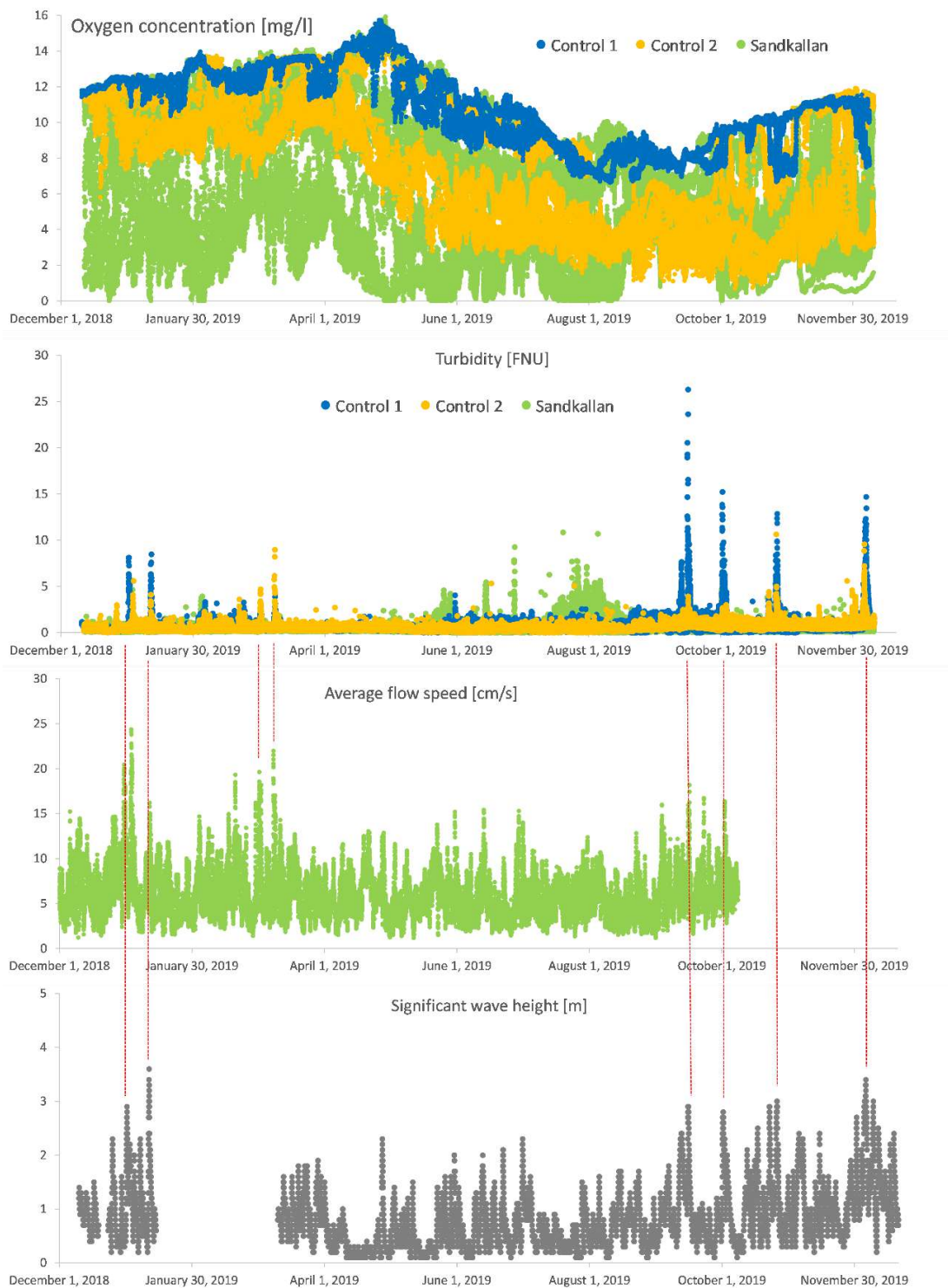


Figure 27. Oxygen concentration, turbidity and flow speed at the monitoring sites Control 1, Control 2 and Sandkallan, and the significant wave height measured /36/. Wave data are not available for the winter months due to occasional presence of ice. Due to weather limitations flow speed sensor (ADCP) was not serviced in December 2019 and therefore no data for the end of the year is presented in this report. Wind induced high wave and flow episodes and their connection to increased turbidity are indicated by red hairlines. The images are combinations of all measurements carried out at the monitoring sites. They represent the depth range of 2-15 m above the seabed.

During the year 2019, stormy periods with strong currents and high wave action induced elevated levels of water turbidity with peak values up to 26 turbidity units (FNU) (Figure 27). The reason for the phenomenon was resuspension of sediment on the shallow bottoms. It was observed most clearly at the relatively shallow site of Control 1. At the monitoring site Control 2, the highest values were slightly lower, 10 FNU. The effects of stormy periods were hardly detectable at the three deeper Sandkallan monitoring stations.

Construction activities did not have any impact on the measured turbidity at Sandkallan in 2019 (Figure 28). However, slightly increased turbidity up to 10 FNU was observed at the deeper monitoring stations of the Sandkallan site in July – August (Figure 28). This was connected to anoxic conditions, in which iron and manganese are soluble in water. When the anoxic water meets first traces of oxygen, iron and manganese start to form insoluble oxides observed as turbidity.

There was high variation in the oxygen concentration at the monitoring sites (Figure 27). At Control 1, Western Gulf of Finland, oxygen concentration was high, above 8 mg/L most of the time. At Control 2, Eastern Gulf of Finland, oxygen concentration remained around 8 mg/L over the winter period, but relatively low concentrations, down to 1 mg/L, were measured in summer and autumn close to the bottom. At Sandkallan site, the deepest measurement stations suffered regular oxygen deficiency. On the contrary, the shallowest station of Sandkallan showed good oxygen conditions throughout the year.

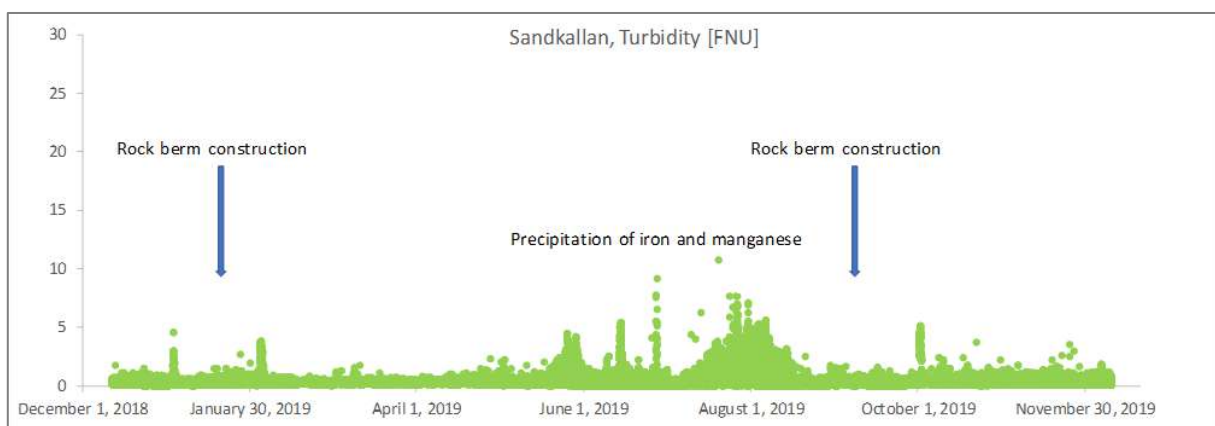


Figure 28. Turbidity measured at the three Sandkallan stations in 2019. Three rock berms were constructed within the radius of 10 km of the monitoring stations, indicated by blue arrows; two on January 7 and January 9 (only one arrow due to scale), the third on September 6. In summer, turbidity caused by precipitation of iron and manganese was observed.

5.3 Sediment contaminants (completed in 2018)

In 2018, altogether 17 sediment samples from two targets were collected in order to study explosive residuals and heavy metal spreading in the clearance site surroundings. Heavy metal concentrations in the sediments were compared with the concentrations prior to the munitions clearance work, analysed in a baseline study in 2016.

The detailed results of contaminant study are presented in the Annual Monitoring Report 2018. A brief summary of results is presented below.

Target R-R08-5261

Six sediment samples were taken from the seabed surrounding the target R-R08-5261 before and after its relocation and detonation. The target was a possible Russian depth charge BM- 1, which contained 25 kg of explosives and was cleared with a 5 kg donor charge. A bubble curtain was used during the clearance to decrease the pressure and noise impact to the surrounding environment.

Collected sediment sample data 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.

Target R-R09-7495

Eleven sediment samples were taken approximately two months after the detonation at the location of a German EMC-1 mine, which contained 300 kg of explosives and was cleared with a 10 kg donor charge of. Bubble curtain was used during the detonation. The delay between clearance and sampling time has no impact on results due to the persistent characteristics of the compounds to be analysed.

Collected sediment sample data 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. Seabed heterogeneity is evident, as duplicate samples from the same station showed different concentrations. /69/.

5.4 Underwater noise (completed in 2018)

5.4.1 Monitoring methods

Munitions clearance generates impulsive noise and high peak sound pressure levels, which can have impacts on marine life. Monitoring of underwater noise associated to munitions clearance was carried out in 2018. The details are presented in the Annual Monitoring Report 2018.

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 /70/.

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 $\mu\text{Pa}^2\text{s}$ (Sound exposure level, 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) describes the sound exposure level which is the onset for the risk of a short-term hearing loss after which 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 $\mu\text{Pa}^2\text{s}$ (SEL). /71/

The calculated PTS areas, based on measured data, were compared with modelling results. Modelling was done for the environmental impact assessment /71/, updated EIA report /58/ for the Water Permit application and the Natura assessment /72/. Munition by munition modelling /70/ was based on the maximum individual peak pressure levels measured during the Nord Stream project.

The monitoring consisted of 8 fixed long-term monitoring stations with continuous recording and vessel-based on-site monitoring of three munitions clearance operations.

Long-term monitoring stations were established near the Natura 2000 areas with marine mammals as a conservation objective. Six stations were placed along the Finnish coastline and two stations along the Estonian coastline.

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.

In total 74 targets were cleared during the munition clearance campaign. In accordance with the permit application, bubble curtain was 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). Bubble curtain was used for 58 targets. For three targets, the distances to the long-term stations were too high to record the detonations, and the detonations were not recorded by clearance contractors' vessels due to technical reasons. In total, noise created by detonations of 71 clearance targets were measured and analysed.



Figure 29. Bubble curtain in use to mitigate underwater detonation noise. Photo: © Nord Stream 2/ Axel Schmidt.

5.4.2 Underwater noise results

Peak levels and SEL

Altogether 254 peak levels were measured and compared to the values modelled for the permit application. 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. The measured SEL-values at the long-term monitoring stations did not exceed PTS, nor TTS, and it is therefore assessed that no TTS area of any clearance operation extended to the Kallbådan Natura 2000 site.

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. The measured PTS areas were on average only 24 % of the modelled, exceeding the modelled only in one case. The results indicate that the bubble curtain used attenuated noise effectively.

Time-series at the long-term monitoring stations

During the long-term monitoring most of the clearance operations were detected at Kallbådan A, which is the closest monitoring station to areas with highest munition density.

Munition clearance operations did not affect the noise levels at Hanko monitoring stations. 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.

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.

5.5 Marine mammals

During munitions clearance, a trained marine mammal observer made visual observations from the clearance contractor's vessel before and after each detonation for a minimum of one-hour period before the scheduled initiation of the charge. Passive acoustic monitoring was also performed, indicating that no marine mammals were present in the monitored area. (See Table 8 for implemented mitigation measures). No injured marine mammals were observed before, during or after munitions clearances.

Metsähallitus monitored behaviour of seals at Kallbådan seal sanctuary (Figure 30) from May 3, 2018 to August 23, 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 sanctuary /73, 74/. The distance between the detonations and the seal sanctuary was so long that seals did not react to the detonations at all.

Metsähallitus monitored the seals also in 2019 from May to July. However, due to a series of technical issues it was not possible to collect all data. It was agreed with Metsähallitus that consolidated results will be presented in the Annual Monitoring Report 2020, to be published in May 2021.

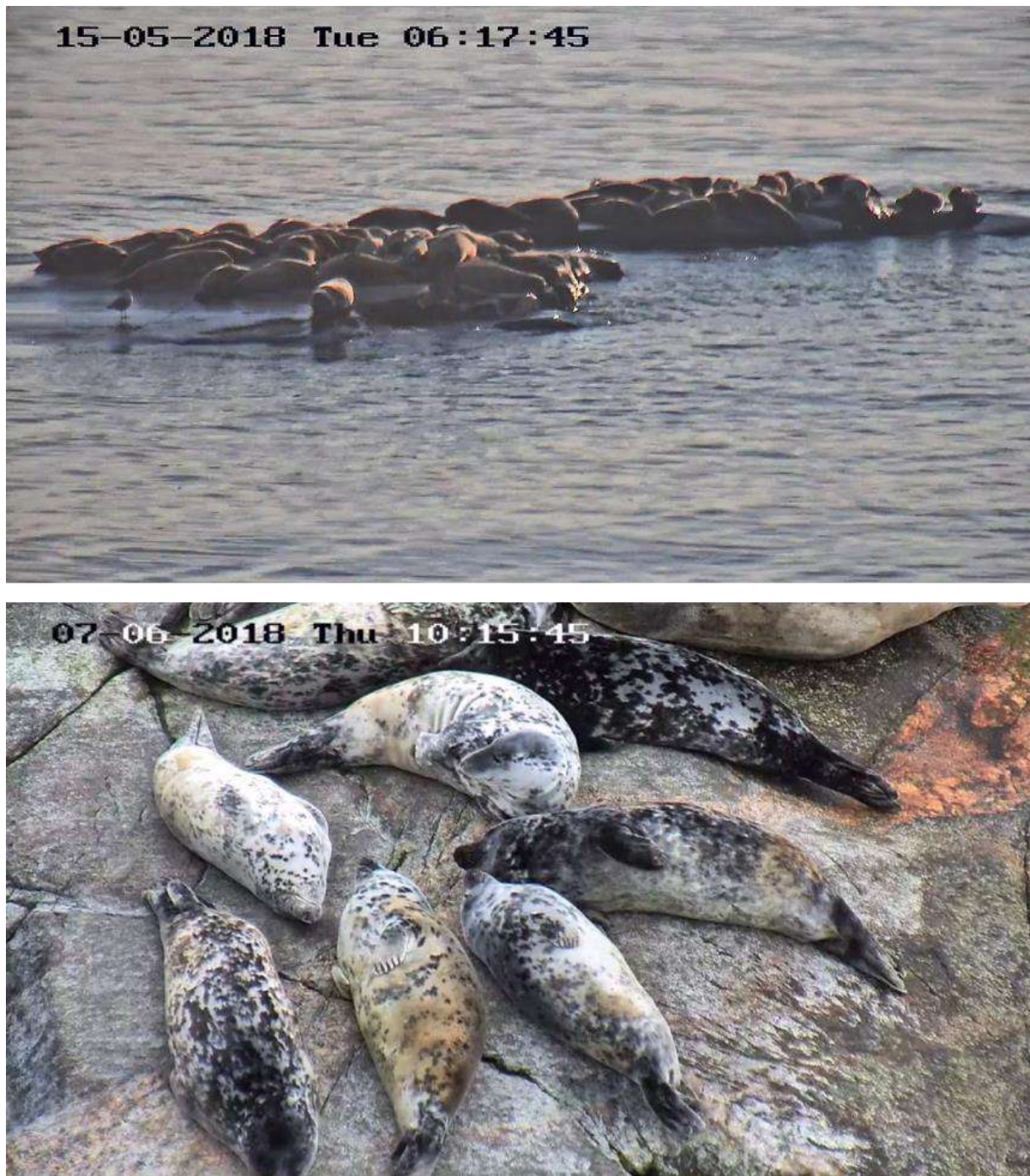


Figure 30. Grey seals in Kallbådan seal sanctuary on May 15, 2018, when munition clearance work was proceeding near the Kallbådan area, and on June 7, 2018, a day after the last clearance. Figures from Metsähallitus remote recording camera equipment (Source: Antti Below, Metsähallitus).

5.6 Cultural heritage

Thorough pre-lay surveys were carried out for the two targets subject to monitoring, a cannon barge wreck (S-R05-7978) /75/, and an anti-submarine net (S-R09-09806) /76/, in May 2018. A thorough post survey of these two targets will be carried out after the construction activities in the Finnish EEZ have been completed to confirm that no damage to the monitoring targets have occurred during the implementation of the project. No new cultural heritage objects or indications of such were found during the construction activities.

The wreck of the **cannon barge** is located approximately 58 m from the nearest pipeline (Line B). The Water Permit provisions require a 50 m safety zone around the cannon barge. A post-lay survey of Line A in 2018 confirmed that the pipeline has been laid within the lay tolerance at a distance of approximately 130 m from the wreck /77/. The lay tolerance for Line B was reduced to minimize any potential construction related impacts during the pipelay of Line B. A post-lay survey of Line B in 2019 confirmed that line B has been laid within the reduced tolerance corridor, at approximately 63 m from the wreck /78/.

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 spans across the Gulf of Finland, making it impossible to avoid crossing the net. The Water Permit provisions require that construction work must be carried out in the way that minimises damage to the net.

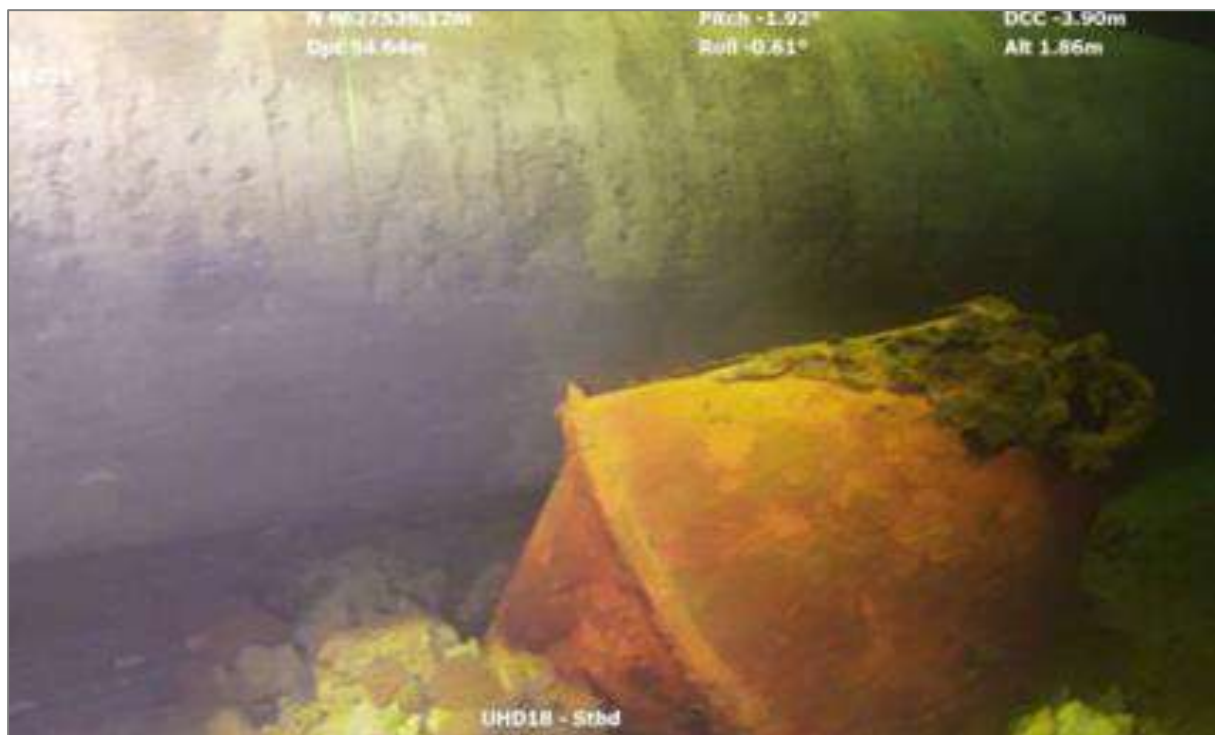


Figure 31. Example of a ROV video still image of the buoy of the anti-submarine net after pipelay of Line B across the net in 2019 /32/.

According to the post-lay survey results /31, 32/, both Line A and Line B were laid across the anti-submarine net mostly with a freespan, thus limiting the impacts onto the target. Some length of the pipeline is, however, in contact with the net (Figure 31).

5.7 Commercial fishery

Commercial fishery study will be performed after two years of operation as a survey including a questionnaire to fishermen. 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 during and after construction activities. The results of the commercial fishery monitoring will be available after the survey is completed.

6

TECHNICAL MONITORING

6 TECHNICAL MONITORING

This chapter summarises the technical monitoring results of pipe installation accuracy of Line A and Line B, avoidance of barrels, and the compliance with the regulations for the construction work in the vicinity/across the Mussalo fairway, as requested in the Water Permit.

6.1 Pipelay accuracy

The Water Permit allows minor modifications from the planned pipelay route within the ± 35 m security corridor. Route changes may be carried out in order to avoid munitions or other objects identified along the route. In general, the pipeline installation corridor is ± 7.5 m from the centreline on a straight section and ± 15 m on a curve. On several locations the installation corridor has been narrowed, for example at the cable crossings and in the vicinity of known munitions and cultural heritage objects.

To monitor the pipelay accuracy in relation to the centreline, as-laid surveys of the pipeline were conducted after pipelay. The survey results were analysed for distance cross course (DCC) of the laid pipeline as horizontal perpendicular distance from the designated route. The DCC gives negative values when the pipeline is laid to the south and positive values when the pipeline is laid to the north of the designed centreline (Figure 32).

For Line A, minor deviation to the planned route (Rev 54) was used between GKP 255 and GKP 265 to accommodate the crossing with Balticconnector /31, 79/. This is seen as an 11.05 m deviation to south (Figure 32) and it represents the only exceedance to the ± 7.5 m installation corridor of Line A. The modification was done to ensure safe crossing with the Balticconnector gas pipeline by maximizing the length of a straight stretch over a berm. In addition, the narrowed tolerance limits were exceeded once, by 1.4 m at a 2.5 m limit /80/. Such narrowed limits have been ordered in locations where the usual ± 7.5 m installation accuracy is not sufficient due to structures or objects at the seafloor. A typical example is a cable crossing, where it is important to lay the pipeline exactly across a pre-installed supporting mattress.

For Line B, pipelay accuracy in the ± 7.5 m corridor was largely achieved, with only very small deviations (from 0.05 to 0.20 cm) /81/. In addition, there were three sites on Line B route where minor deviations in route were necessary /32, 81, 82/. Two of the three modifications in route of Line B can be seen as deviation from the centreline at GKP 209 and GKP 451 (Figure 32), whereas the deviation at GKP 256 was less than 7.5 m /32/ and therefore falls within the normal installation corridor. From GKP 207 to GKP 209 at Line B, a minor deviation in route (Rev 60) was needed due to steep sloping of the seabed near several cable crossings. The minor deviation took the pipelay to a more even area to guarantee mattress stability at the crossings. From GKP 450 to GKP 453 at Line B, a minor deviation in route (Rev 59) was necessary due to large boulders at the seafloor, endangering mattress installation and thereby safe cable crossing with a cable of unknown owner. These minor changes in route were notified to the authorities /79/.

In addition, for Line B, the narrowed tolerance limits (usually ± 2.5 m) were exceeded nine times /78, 81, 82, 83/. The deviance varied from 0.15 m to 1.05 m.

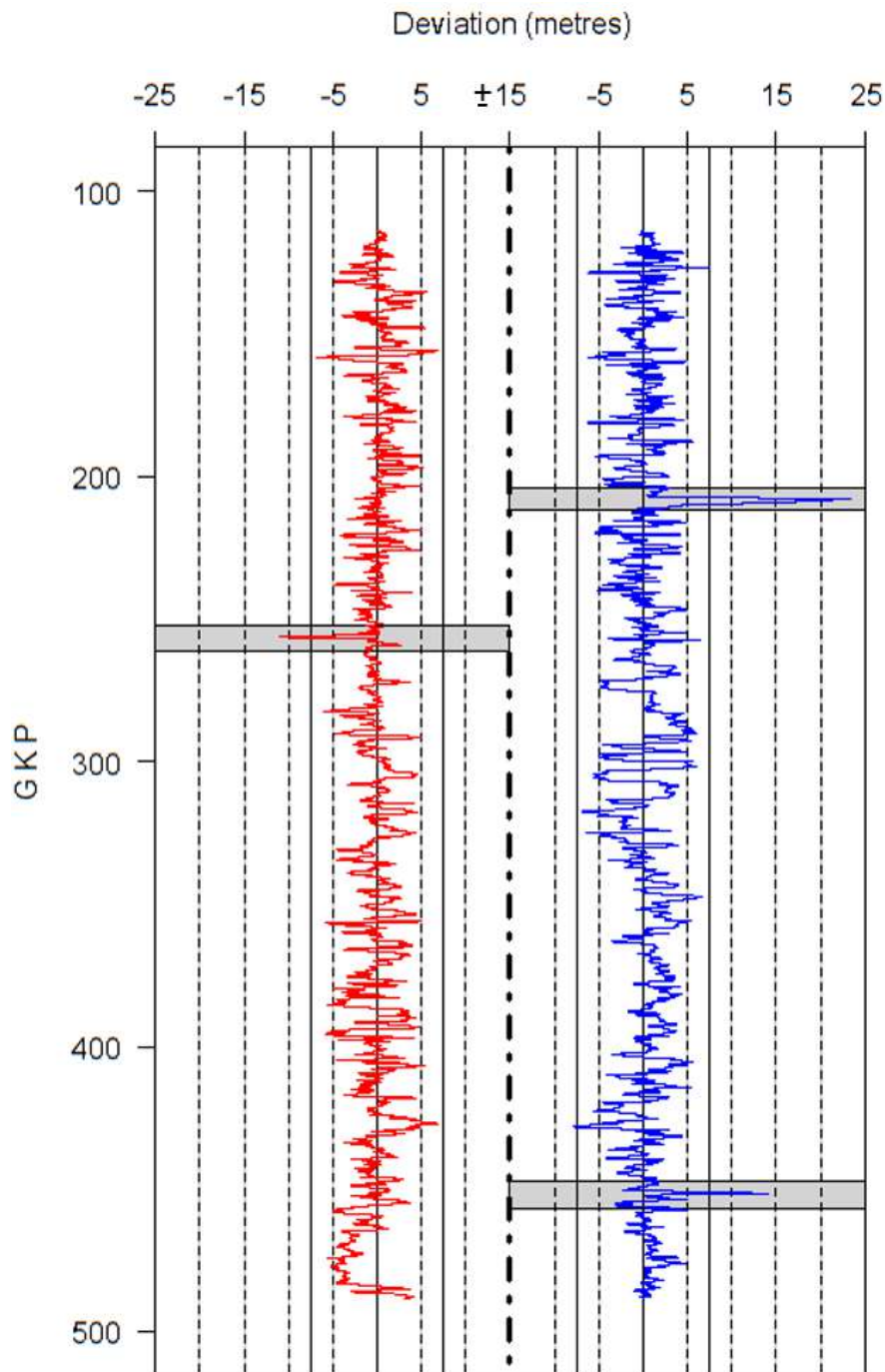
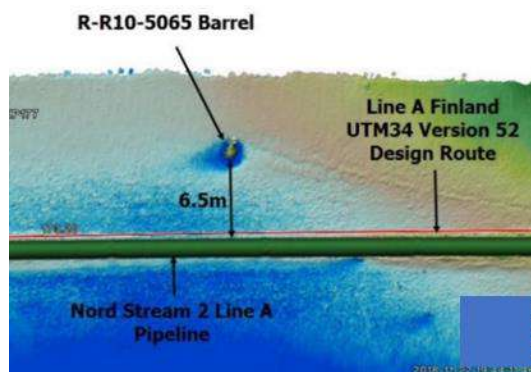


Figure 32. Accuracy of the pipelay of Line A (red) and Line B (blue) shown as deviation (m) from the centerline (distance cross course of the laid pipeline as horizontal perpendicular distance from the designated route). The shadowed areas show where re-routing was used in pipelay (see text for details). Data has been compiled from contractor's as-laid reports.

6.2 Avoidance of barrels

Nord Stream 2 has stated in its application documents that it will use best endeavour to avoid eight barrels located in the pipelay corridor in the Finnish EEZ. Three of these barrels are located along Line A and were surveyed (post-lay survey) in 2018 (Figure 33). Five barrels are located along Line B and were surveyed (post-lay survey) in 2019 (Figure 34). None of the barrels were disturbed by construction activities.



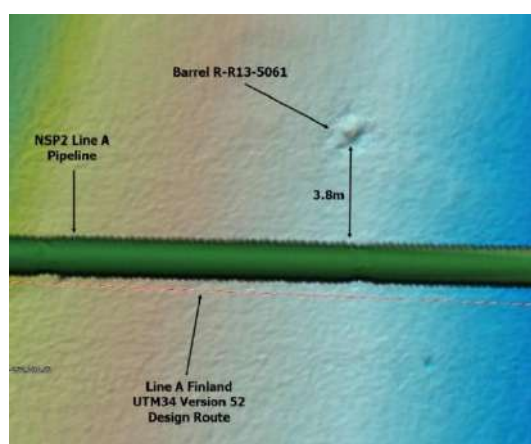
Target R-R10-5065 at Line A, GKP 287 A 200-l steel drum

The barrel was passed on November 22, 2018. The as-laid survey conducted on the same day confirms the barrel to be 6.5 m minimum separation from the installed Line A pipeline. The barrel did not appear to have been disturbed. /84/.



Target R-R12-0073 at Line A, GKP 342 A metal drum

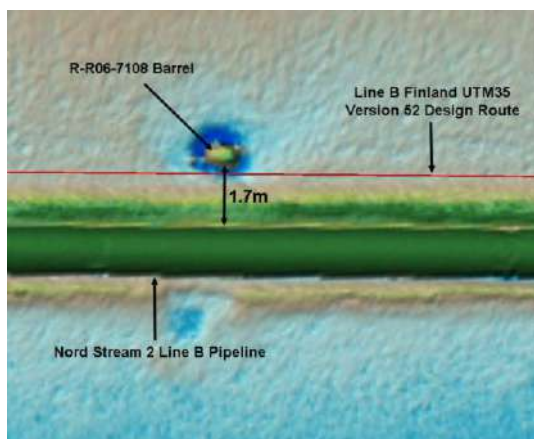
The barrel was passed on December 15, 2018. The as-laid survey conducted confirms the barrel to be 3.3 m from the installed Line A. The barrel did not appear to have been disturbed. /85/.



R-R13-5061 at Line A, GKP 364 A barrel drum

The barrel was passed on December 28, 2018. The as-laid survey conducted on the same day confirms the barrel to have 3.8 m minimum separation from installed Line A. The barrel did not appear to have been disturbed. /86/.

Figure 33. Avoidance of barrels on Line A. Lines show pipelay of Line A as planned (red) and as-laid (green).



Target R-R06-7108 at Line B, GKP 148

A metal drum

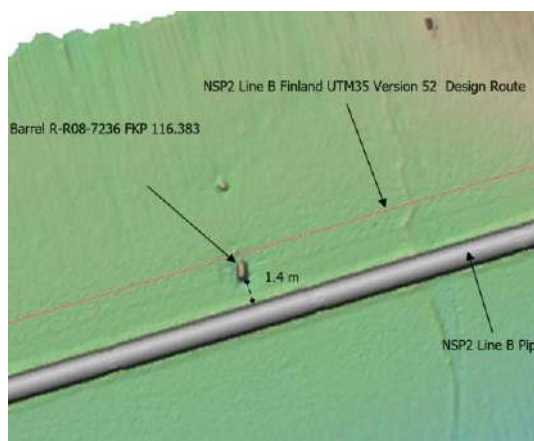
The barrel was passed on August 13, 2019. The as-laid survey conducted on the same day confirms the barrel to be 1.7 m minimum separation from the installed Line B pipeline. The barrel did not appear to have been disturbed. /87/.



Target R-R06-7207 at Line B, GKP 169

A metal drum

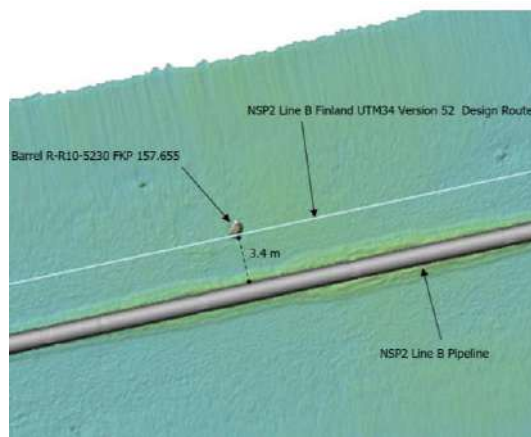
The barrel was passed on August 7, 2019. The as-laid survey conducted on August 11, 2019 confirms the barrel to be 5.3 m from the installed Line B. The barrel did not appear to have been disturbed. /88/.



R-R08-7236 at Line B, GKP 230

A steel barrel

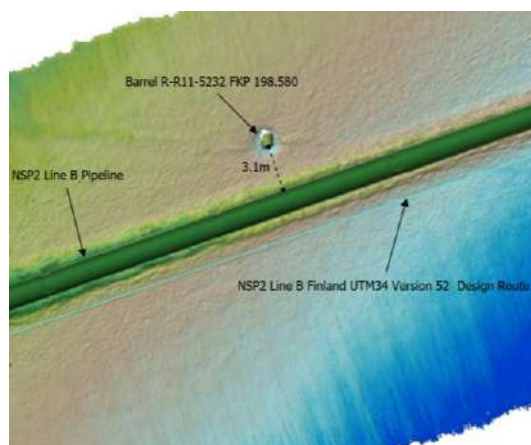
The barrel was passed on July 23, 2019. The as-laid survey conducted on July 25, 2019 confirms the barrel to have 1.4 m minimum separation from installed Line B. The barrel did not appear to have been disturbed. /89/.



R-R10-5230 at Line B, GKP 271

A steel barrel

The barrel was passed on July 13, 2019. The as-laid survey conducted on July 15, 2019 confirms the barrel to have 3.4 m minimum separation from installed Line B. The barrel did not appear to have been disturbed /90/.



R-R11-5232 at Line B, GKP 312

A barrel drum

The barrel was passed on July 2, 2019. The as-laid survey conducted on July 5, 2019 confirms the barrel to have 3.1 m minimum separation from installed Line B. The barrel did not appear to have been disturbed /91/.

Figure 34. Avoidance of barrels on Line B. Lines show pipelay of Line B as planned (thin line) and as-laid (thick line).

6.3 Construction in the vicinity of the Mussalo fairway

The Water Permit provisions state that 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 (i.e. average water surface level). Draft of the Mussalo fairway is 15.3 m /92/. The pipeline crosses the fairway area at approximately from GKP 118 to GKP 127.

The depth of the pipeline at any given point is reported in the as-laid reports that are based on the post-lay ROV surveys. For Line A, the shallowest depth measured from top of the pipeline is 44.4 m at GKP 123 /77, 93/. For Line B, the corresponding shallowest depth is 38.6 m at GKP 122 /78/.

Berm installation is still ongoing. The highest point of a rock berm is typically a maximum of 2 m above the highest point of the pipelines /94/. It is assessed that all parts of the pipeline system will be at lot greater depths than 20 m within the Mussalo fairway. The final minimum water depths will be reported after as-laid reports of the last berms are available, in the Annual Monitoring Report 2020, to be published in May 2021.

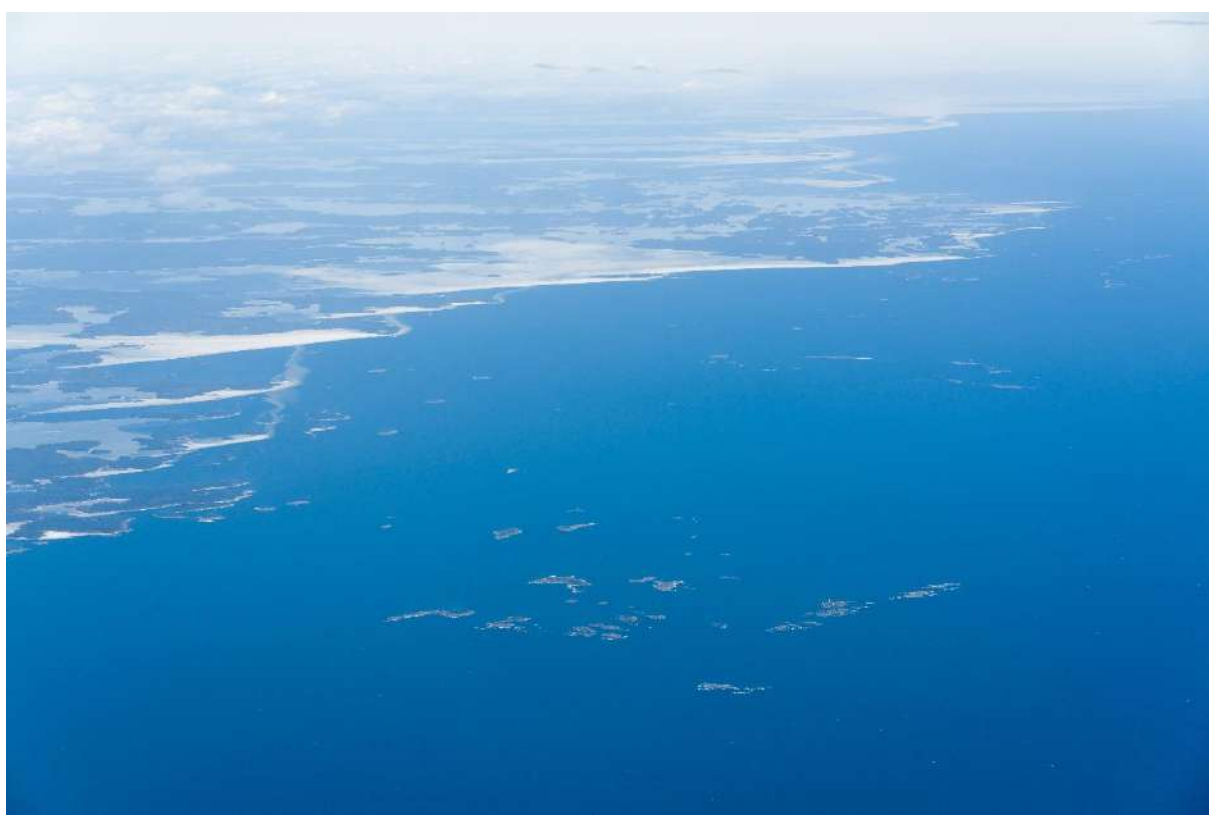


Figure 35. Finnish coastline. Photo: © Nord Stream 2/ Wolfram Scheible.

7

EVALUATION OF RESULTS

7 EVALUATION OF RESULTS

This chapter discusses the main observed impacts of Nord Stream 2 construction in the years 2018–2019. The impact receptors discussed here are presented under themes Physical and chemical environment, Biotic environment and Socio-economic environment, and in relation to Marine strategy and Water framework directives. In addition, transboundary impacts are considered. In this chapter, the results of the monitoring in NSP2 are also compared to the assessments presented in the EIA and in the application documents, and with the results from the monitoring of the Nord Stream project. For assessing the significance of impacts upon the environment, Imperia-methodology is used. It takes into account both the sensitivity of the receptor and the magnitude of change.

7.1 Physical and chemical environment

7.1.1 Seabed morphology and sediments

In the Finnish EEZ, more than 90 % of the approximately 374 km long pipeline is located in depths more than 60 m. Approximately 60 % of the total project area in the Finnish EEZ consists of soft sediments. The seabed along the pipeline route does not have special geological value, and the sensitivity of the seabed was assessed as low in the EIA. However, near Sandkallan Natura 2000 area and near Porkkala area (see Figure 21 for approximate locations), reef-like hard seabed types can potentially be found, and on those areas the sensitivity was assessed as medium (Table 15).

The main impacts of the project are related to the construction activities that relocate sediments from the seafloor. Of these, munitions clearance and rock placement were predicted to have negligible or minor impact on the seabed morphology and sediments in the EIA (Table 15). Pipelay using dynamically positioned (DP) pipelay vessels was assessed to have negligible impacts and is not discussed further in this report.

Munitions clearance lifts sediments from the seafloor, resulting in a crater and a sediment plume in the near bottom water layers. Such craters are nearly permanent at hard seafloor but at soft bottoms may even out over time. The resuspended solids in the sediment plume resettle, with the smallest particles travelling furthest from the crater.

In the EIA, 20 m³ and 42 m³ crater volumes were used for medium and large detonations, based on experience from the Nord Stream project. These were in the EIA assessed to have a low impact (Table 15). Later, a more detailed modelling of individual munitions along the route in the Finnish EEZ resulted in an estimate of the crater diameters varying from 2 to 10 m and the crater volumes varying from 7 to 205 m³, depending on the munition charge weight and the type of sediments at the location /70/. The monitoring by the clearance contractors, however, show that the actual sediment displacement through the detonations exceeded 5 m³ only at ten locations. Of these, nine craters were smaller than 15 m³ and the largest crater was 30.8 m³ – only 15 % of the estimated highest volume. The results are in line with the results of the **Nord Stream** project, in which the radius of the craters created by munitions clearance varied between 0–7.6 m and the crater volume varied from 0 to 40 m³.

The monitored impact was much smaller than estimated in the modelling. It is assessed to have negligible magnitude of impact, resulting in negligible significance of impact (Table 15).

Similar to munitions clearance, also rock placement disturbs the seafloor, creating a sediment plume. In addition, construction of rock berms changes seabed morphology. The latter impact is irreversible, but local, and impact was assessed to be negligible or minor in the EIA (Table 15). Construction work continues in 2020. By the end of 2019, approximately 53 % of the total rock material volume estimated

to be needed had been installed (see Table 9). As the volume installed so far is within the volume for which the impact assessment has been done, it is concluded that the magnitude of impact is low, as assessed during the EIA, resulting in negligible to minor significance of the impact at the different areas. The final assessment will be done after the construction has been completed and will be reported in the Annual Monitoring Report 2020, to be published in May 2021.

The significance of impact of the re-sedimentation of the sediment plume was assessed to be negligible in the updated EIA, as the impact is negligible compared to natural resuspension and resettling processes occurring during storms. The monitoring results confirm this assessment. The effects of the sediment relocation on water quality are discussed in the Chapter 7.1.2.

Although the overall impact of contaminant relocation, coupled to the resettling sediments, was assessed as negligible in the updated EIA, spreading of heavy metals and explosive residuals around the munition clearance sites was studied in the Nord Stream 2 project. The results confirm that detonations did not increase concentrations of harmful substances in the surface sediments.

In addition to construction activities, the permanent structures constructed in the project have an impact on the seabed. As these have been estimated to cover approximately 0.03 % of the seabed in the Finnish EEZ, the structures were predicted to have a negligible to minor impact (Table 15). The construction of post-lay berms still continues in 2020. The volume of rock material installed by the end of 2019 is within the planned. Of the structures completed so far, the actual twin pipeline has been laid according to plans (see Chapter 6.1). The number of mattresses installed at the infrastructure crossings (completed in 2018) was 15 mattresses less than planned, due to changes in design of one crossing during detailed survey prior to mattress installation. It is therefore concluded that the magnitude of impact of the structures is similar or lower than assessed, resulting in minor impact significance. The final assessment will be done after the construction has been completed and will be reported in the Annual Monitoring Report 2020, to be published in May 2021.

Table 15. Assessment of impact significance for seabed morphology and sediments. Receptor sensitivity is assessed in the EIA, as well as predicted magnitude of change. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact	Receptor	Magnitude of change		Overall significance	
	sensitivity	Predicted	Assessed	Predicted	Assessed
Munitions clearance, other areas	Low	Low	Negligible	Negligible	Negligible
Munitions clearance, Sandkallan and Porkkala	Medium	Low	Negligible	Minor	Negligible
Rock placement, other areas	Low	Low	Low	Negligible	Negligible
Rock placement, Sandkallan and Porkkala	Medium	Low	Low	Minor	Minor
Structures on seabed, other areas	Low	Low	Low	Negligible	Negligible
Structures on seabed, Sandkallan and Porkkala	Medium	Low	Low	Minor	Minor

In the **Nord Stream** project, the permanent structures covered in the end 2.8 times larger area (footprint) and had 28 % higher total volume than was originally assessed. Still, the impact remained local and of minor significance.

7.1.2 Hydrography and water quality

Assessment of the sensitivity of the sea water ecosystem in the EIA was based on the variable oxygen concentration, and thereby living conditions for biota. These vary together with the stratification conditions along the pipeline route. The sensitivity of the water layers near the seafloor was assessed as low in the western and mid-section of the route, where the conditions are almost permanently poor, and medium in the eastern part (Table 16).

The impacts the Nord Stream 2 project may have on hydrological conditions in the Finnish EEZ are limited to potential changes in pattern and magnitude of near-bottom currents due to structures on seafloor, and changes in temperature due to temperature difference between the gas inside and the water surrounding the pipeline. Both were assessed to have negligible impacts, with the exception of minor impacts predicted for the near-bottom currents locally /4/. These impacts are not further assessed in this report.

The impacts on water quality mainly arise from the relocation of sediments during construction activities. In addition, anodes protecting the pipeline from corrosion may release heavy metals into the water /4/. The latter effect may start already during the construction phase and continues throughout the operation phase.

To assess sediment relocation, elevating turbidity and thereby possibly affecting living conditions of fish, benthic fauna and marine mammals, concentration of resuspended solids in the water column was modelled. In addition to momentary turbidity peak immediately after the impact, the persistence of turbid conditions was modelled for various hydrological conditions ranging from calm, stratified summer conditions to stormy winter conditions with high current speeds. Based on the modelling results, the impacts were predicted to be minor (Table 16). In addition, the Natura 2000 assessment for the Area south of Sandkallan (SAC FI0100106) concluded that NSP2 construction activities will not increase turbidity nor sedimentation and will not deteriorate the conditions for the biota at Sandkallan Natura 2000 site /95/.

Table 16. Assessment of impact significance for hydrography and water quality. Receptor sensitivity is assessed in the EIA, as well as predicted magnitude of change. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact	Receptor sensitivity	Magnitude of change		Overall significance	
		Predicted	Assessed	Predicted	Assessed
Munitions clearance, other areas	Low	Low	Low	Minor	Minor
Munitions clearance, eastern Gulf of Finland	Medium	Low	Low	Minor	Minor
Rock placement, other areas	Low	Low	Low	Minor	Minor
Rock placement, eastern Gulf of Finland	Medium	Low	Low	Minor	Minor

Water quality monitoring in the Sandkallan monitoring site confirmed the conclusions of the Natura 2000 assessment, as increased turbidity was only observed at the Sandkallan site in July – August 2019, due to natural variability in oxygen conditions that induced flocculation of metal oxides, causing turbidity. No water quality effects due to construction activities were detected at the Sandkallan long-term monitoring site (Table 17).

Turbidity was monitored in the vicinity of two munition clearance sites and two rock placement sites in 2018. The measured impacts were generally lower than predicted and briefer in duration (Table 17).

For munitions clearance, the measured impacts of munitions clearance were significantly lower than predicted. However, it is possible that the monitoring setup did not record the complete extent of the spreading sediment plume at the munition clearance sites. It is unlikely that the extent of the impact would exceed the modelled values, considering that the rock placement impacts were significantly lower than modelled impacts. In addition, the impacts monitored were similar to those measured in the **Nord Stream** project for similar targets /1/. For Nord Stream project, the overall impact of munitions clearance was minor. Due to the uncertainty about the recording the full extent of the impact, the impact magnitude for NSP2 munitions clearance is assessed as low instead of negligible, resulting in minor overall impact significance (Table 16).

The maximum turbidity caused by rock placement exceeded the values modelled for the calm summer conditions, prevailing during the monitoring campaign in approximately 2 % of cases but were lower than predicted for stormy conditions in more than 99 % of cases (Table 17). The duration of slightly elevated turbidity was shorter than predicted for calm conditions, and the high turbidity period, exceeding 10 FNU was significantly shorter than predicted for the calm conditions (Table 17). The impact magnitude is assessed as similar to predicted, low, resulting in minor overall impact significance (Table 16), similar to assessment in the **Nord Stream** project.

So far, there are no reports on the release of heavy metals from the anodes protecting the pipeline from corrosion. During monitoring performed for the **Nord Stream** pipeline in August 2012 the concentrations of heavy metals (Cr, Cu, Hg, Co, Zn, Ni, Pb, Cd and As) in sea water near the anode were low or under the detection limit /1/.

Table 17. Impacts on water quality (turbidity) related to construction activities (rock placement and munitions clearance) predicted in the modelling for the EIA and in the Natura Assessment for the Water Permit application, impacts monitored during the construction phase of the Nord Stream 2 project (rock placement impacts monitored April 18 to July 10, 2018 and August 14 to October 2, 2018; munitions clearance impacts monitored May 9 to July 9, 2018 and May 23 to June 21, 2018;), and impacts monitored during the Nord Stream project.

IMPACT SOURCE: Turbidity caused by rock placement and munitions clearance. Potential impact receptors: fish, benthic fauna, marine mammals	
PREDICTED *	MONITORED
Rock placement: The maximum modelled turbidity is 61 FNU in stormy winter conditions and 22 FNU calm summer conditions.	The maximum measured turbidity was 64 FNU. Only one result out of 3456 measurements exceeded the modelled stormy conditions maximum, and 82 exceeded the modelled calm conditions maximum.
Rock placement: The modelled duration of the impact exceeding 2 FNU is 165 h in calm summer conditions and 24 h in stormy winter conditions.	The duration of the impact exceeding 2 FNU was 44 h.
Rock placement: The modelled duration of the impact exceeding 10 FNU is 19 h in calm summer conditions and 7 h in stormy winter conditions.	The duration of the impact exceeding 10 FNU was 6.5 h.
Munitions clearance: The modelled maximum turbidity is 107 FNU.	The maximum measured turbidity was 9.2 FNU.
Munitions clearance: The modelled duration of the impact exceeding 2 FNU is 23 h in calm summer conditions and 20 h in stormy winter conditions.	The measured duration of the impact was 12 h.
Munitions clearance: The modelled duration of the impact exceeding 10 FNU is 9 h in calm summer conditions and 7 h in stormy winter conditions.	The measured impact never exceeded 10 FNU. The maximum measured turbidity was 9.2 FNU.
Construction activities will not increase turbidity nor sedimentation and will not deteriorate the conditions for the biota at Sandkallan Natura 2000 site.	Increased turbidity was only observed at the Sandkallan site in relation to natural variability in oxygen conditions. There were no water quality effects due to construction activities
Nord Stream monitoring results: The maximum recorded turbidity impact originated from rock placement was 53 FNU. The duration of the impact exceeding 10 FNU was between 12–24 hours. The maximum measured turbidity impact originated from munitions clearance remained below 10 FNU. Increased turbidity values were measured in near-bottom waters up to 10–15 meters above the seabed in an area having a radius of approximately 250 m around the munition.	

* Turbidity was modelled as solid matter concentration (mg/l) and measurements are expressed as turbidity units (FNU). In this report the common conversion factor 1:1 has been used. It is based 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 scale.

7.1.3 Underwater noise

International regulation, such as Marine strategy directive, aim at ensuring that the degree of impulsive and continuing noise is not increasing, is at a level that does not exceed natural noise levels, and does not cause harmful effect on the ecosystem, nor economic harm to the coastal and marine industry. However, so far quantitative indicators have not been developed, and the baseline status of the conditions in the Baltic Sea remain to be defined.

The underwater noise from the construction activities may have impacts on receptors such as marine mammals and protected areas (via effects on living conditions of marine mammals). These impacts are described in chapters 7.2.2 Marine mammals and 7.2.3 Protected areas.

Despite the lack of actual quantitative indicators, underwater noise was modelled for the EIA, in order to enable estimation of the impacts on sensitive receptors. Modelling was done for munitions clearance and rock placement, which have been assessed to be the activities most likely to create significant underwater noise.

The modelling results indicated that even with the planned, behaviour-based mitigation measures, such as acoustic deterrent devices, munitions clearance could lead to blast injuries or hearing thresholds shift to marine mammals, and the risk area could extend to several kilometres from the detonation site /4/. Therefore, Nord Stream 2 decided to implement bubble curtain as a further noise mitigation technique for around 20 munitions that were either large, in the vicinity of protected areas and/or near areas with sensitive marine mammal population. This reduced the extent of risk areas by 59 –73 % /58/. In the final phases of permitting, when detailed studies of the munitions to be cleared were finalized, NSP2 committed to using bubble curtain for nearly all munitions – 80 of the planned 87 detonations. This reduced the extent of risk areas further, resulting in a revised assessment predicting minor impacts on marine mammals /96/.

The detailed modelling for the Water Permit application was based on detailed surveys and took into account the extended use of bubble curtain /70/. Still, the modelling results overestimated the noise. The measured peak levels were lower and the calculated areal coverages much smaller than modelled (Table 18). This was due to conservative approach in modelling, where the charge of munitions, when exact value could not be determined, was estimated to be higher rather than lower, and the attenuation of noise due to bubble curtain was estimated to be lower rather than higher, as there was no experience from the use of bubble curtain from conditions similar to those in the Baltic Sea (shallow, low salinity, stratified). In several cases, the munition charge was smaller than predicted. It is also possible that the bubble curtain mitigated noise more effectively than expected. Sound attenuation is also naturally effective in the shallow areas of the northern Gulf of Finland.

Similar to NSP2, also in the **Nord Stream** project the peak pressure levels (the only data gathered in the project) were lower than predicted. The peak pressure levels, corrected to the 300 m measuring distance, were on average 225 dB for Nord Stream project, which is about 15 dB higher than in the NSP2. As the dB scale is logarithmic, there is a significant difference in the peak pressure levels, demonstrating the efficiency of the bubble curtain as a mitigation method.

Table 18. Underwater noise impacts from munitions clearance predicted in /70/; except for Kallbådan: /97/ for the Water Permit application, impacts monitored during the construction phase of the Nord Stream 2, and impacts recorded during the Nord Stream project.

IMPACT SOURCE: Underwater noise created by munitions clearance. Potential impact receptors: marine mammals	
PREDICTED	MONITORED
The modelled Peak Sound Pressure level range is 172–238 dB re 1 µPa.	The monitored Peak Sound Pressure level range (corrected to 300 m measuring distance) was 130–234 dB re 1 µPa, on average 210 dB; 253 out of 254 levels lower than modelled.
The whole Natura 2000 site of Kallbådan is covered by the TTS zone from the five largest munitions.	No TTS area of any clearance operation extended to the Kallbådan Natura 2000 site. The highest measured SEL at the long-term monitoring stations was 163.3 dB re 1 µPa ² s (below TTS threshold 164 dB re 1 µPa ² s) measured at Kallbådan A, closest to the clearance operations. The SEL measured at Kallbådan B of this same clearance operation, at a distance of 180 m outside the Natura site, had attenuated to 154,8 dB re 1 µPa ² s.
The modelled highest PTS distance with bubble curtain mitigation is 15,100 m.	The monitored highest PTS distance with bubble curtain mitigation was 4,900 m.
The modelled PTS distance with bubble curtain mitigation is higher than 10,000 m for 10 munitions.	The highest 10 monitored PTS distances ranged from 1,620 to 4,900 m.
Of the modelled PTS distances, 87 % exceed 2 km, and 42 % exceed 5 km.	Of the monitored PTS distances, 9 % exceeded 2 km, and none exceeded 5 km.
The modelled PTS zone area range, with bubble curtain mitigation when needed, is 13–49 km ²	Monitored PTS zone areas were smaller than modelled in all but one case. The areas were on average 24.4 % of the modelled.
Nord Stream monitoring results: Peak pressure level data was collected by clearance contractors during munitions clearance operations for NSP. Measured peak pressure levels (corrected to 300 m measuring distance) were generally below 232 dB, and on average 225 dB. Only in four cases out of 70 the actual peak pressure level was higher than the predicted.	

7.2 Biotic environment

7.2.1 Biodiversity

Biodiversity is a complex concept that is used to describe the variability within species (i.e. genetic diversity), between species (i.e. species diversity) and between ecosystems. The measurement of biodiversity in natural ecosystems is a challenging task, for which the methodology is still largely debated in the scientific community. For the purpose of the monitoring reporting, the impact on biodiversity is assessed according the indications of the Marine strategy framework directive: the report will assess impacts on biodiversity in terms of species and habitat levels. Impacts at the ecosystem levels (e.g.: food webs) will not be assessed, as they would require trans-national assessments. The specific targets identified to be potentially affected and for which monitoring data was collected are benthic species and their habitats, marine mammals and their habitats and species inhabiting protected areas.

Benthic biodiversity is sensitive to eutrophication, physical disturbance, habitat loss /44/ and fishing (trawling) /48/. In the EIA, all impacts of NSP2 construction activities and operation phase on biodiversity were assessed to be negligible, with the exception of marine mammals. Significance of impacts on marine mammals is discussed in Chapter 7.2.2.

More than 90 % of the gas pipeline corridor in the Finnish EEZ is in deep waters where the diversity of benthic fauna is low or sparse and consists only of few organisms that can survive in the sediments with low oxygen content. However, habitats of high sensitivity with zonation of benthic communities are located near the pipeline, such as the reef formations at the Sea Area South of Sandkallan, areas adjacent to it and the pipeline section in front of Porkkala (Table 19).

Munition clearance increased turbidity due to displacement of sediments from the seafloor. The impacts of sediment resuspension were restricted to near-bottom layers, and at 15 m above the seafloor no effects could be measured. Water column was stratified during munition clearance, limiting the spread of resuspended sediments, which reduced the risk of resuspended sediments reaching shallower habitats with higher biodiversity. The impact magnitude of munitions clearance on benthic biodiversity is assessed to have been negligible.

Similar to munitions clearance, rock placement increased turbidity due to displacement of sediments from the seafloor. During the monitoring campaign near the rock placement sites in 2018, the water column was stratified, preventing the spread of resuspended sediments to shallower areas /68/. The rock placement takes place to large extent on areas where nearly permanent salinity stratification limits mixing of the water layers, similar to the conditions during the monitoring campaign. Due to these impact-mitigating conditions, together with the fact that at these depths the biodiversity is very poor, it is assessed that the impact magnitude of rock placement on benthic biodiversity is negligible. Taken together, the impacts of construction activities on benthic biodiversity are assessed to have been negligible (Table 19).

Table 19. Impact significance analysis for biodiversity. Receptor sensitivity is assessed in the EIA, as well as predicted magnitude of change. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact	Receptor	Magnitude of change		Overall significance	
	sensitivity	Predicted	Assessed	Predicted	Assessed
Munitions clearance, other areas	Low	Negligible	Negligible	Negligible	Negligible
Munitions clearance, Sandkallan and Porkkala	High	Negligible	Negligible	Negligible	Negligible
Rock placement, other areas	Low	Negligible	Negligible	Negligible	Negligible
Rock placement, Sandkallan and Porkkala	High	Negligible	Negligible	Negligible	Negligible

During the munitions clearance operations some bird activity was observed during the pre-watch. However, before detonation no birds were detected in the vicinity of the detonation area. Similarly, no schools of fish were detected in the detonation area prior to detonation. No systematical monitoring of fish was included in the monitoring.

Impacts of construction activities on marine mammals are discussed in detail in Chapter 7.2.2 and impacts on protected areas in Chapter 7.2.3.

The environmental monitoring in the **Nord Stream** project confirmed that the effects on the benthic communities were in line with the estimated effects: minor, temporary and local. The poor state of the benthic communities in the vicinity of the pipeline route at these deep areas is due to the unfavorable living conditions that result from the present state of the Gulf of Finland /1/.

7.2.2 Marine mammals

Marine mammals are sensitive receptors of underwater noise. The impacts on the Baltic Sea marine mammals were carefully assessed at several stages of the project planning, and the level of mitigation was increased to minimize the impacts on the marine mammals. The main effects of NSP2 construction activities on marine mammals were assessed to consist of the underwater noise created by munitions clearance detonations, rock placement and increased vessel traffic. All other possible effects, such as increased turbidity, were assessed to have negligible impacts.

At both the **population level and at individual level**, the impacts were assessed to be minor for both the grey seal and the Baltic ringed seal /58, 96/ (Table 20). The updated EIA took into account the use of bubble curtain for 20 munitions, only. In later stages of permitting, NSP2 committed to using bubble curtain for nearly all munitions to be cleared. The effect of this extensive mitigation significantly reduced the potential impact on marine mammals /70, 96/. The impacts of rock placement and vessel traffic were assessed as minor in the EIA /96/. The third marine mammal species in the Baltic Sea, the harbour porpoise, occurs very seldom in the Gulf of Finland, based on Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise study, Life+ /51/. It is therefore not included in this assessment.

Sensitivities of marine mammals and their habitats, and magnitude of impact (underwater noise, sediment spill and release of contaminants) have been discussed among specialists in 2016 expert assessment /98/.

Table 20. Assessment of impact significance for underwater noise from munitions clearance on marine mammals. Receptor sensitivity is assessed in the updated EIA. The predicted magnitude of change is assessed in the updated EIA and in a re-assessment /96/ after the detailed modelling done for the Water Permit application. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact	Receptor	Magnitude of change		Overall significance	
	sensitivity	Predicted	Assessed	Predicted	Assessed
Grey seal, individual level	Medium	Low	Low	Minor	Minor
Grey seal, population level	Low	Low	Low	Minor	Minor
Ringed seal, individual level	Medium	Low	Low	Minor	Minor
Ringed seal, population level	Medium	Low	Low	Minor	Minor

Based on the monitoring results the sensitivity of the grey seals is low on population level and medium at individual level. Grey seal population is stable and increasing and grey seals occur in the Finnish EEZ regularly but not in high abundances. The assumption of scarcity is confirmed by onboard marine mammal observers, who made no visual observations of any marine mammals during munitions clearance despite high visibility. In addition, passive acoustic monitoring gave no indication of marine mammals' presence in the monitored area during detonation phase.

The ringed seal population is fragmented into different sea areas, and the Gulf of Finland population is recognised as a special concern by HELCOM, due to a notable drop in population during the past three decades, the current very small population size, and sensitivity to anthropogenic and natural stressors.

Based on telemetry studies and a small population size, ringed seals occur in the Finnish EEZ only in low or medium densities. The assumption of scarcity is confirmed, as mentioned earlier, by the visual monitoring and the passive acoustic monitoring that showed no marine mammals during the clearances. Neither did passive acoustic monitoring give indication of any marine mammals' presence in the monitored area. Based on the monitoring results the sensitivity of the ringed seals on a population and individual level is assessed to be medium in the Finnish EEZ.

The munition clearance created less noise than predicted in munition by munition modelling. Often the munition charge turned out to be smaller than predicted, and in addition, part of the old charge may have dissolved in the water over the years. In addition, effective mitigation methods were used. Acoustic deterrent devices were used to scare the animal away from the area, and marine mammal observer confirmed visually the absence of animals in the vicinity of the detonation area. Bubble curtain to attenuate the noise were used in 78 % of detonations (all munitions with a total explosive quantity of 22 kg or more and all detonations taking place on sensitive area). Lower charge combined with effective mitigation measures indicates that the impacts of munitions clearance on marine mammals did not exceed the expected impacts; rather, they were lower. This was confirmed by the underwater noise monitoring results, in which 99.6 % of measured peak levels were lower than the modelled values. The results of the Metsähallitus seal behaviour monitoring, using remote recording camera equipment at the Kallbådan area, show that the seals were not stressed by the detonation noise. Modelling of the measured noise levels, together with actual measurements close to Kallbådan seal sanctuary, indicate that noise at the level that would be even temporarily affect the hearing of the seals did not reach any protected areas designated for seals.

Based on the use of the efficient mitigation methods, results of monitoring and as no seals were observed during munitions clearance, the impact of munitions clearance on marine mammals is assessed to be **minor for both seal species, on both individual and population level**.

Underwater noise from rock placement was not monitored in Nord Stream 2 project. In the EIA it was stated the effect is strictly local, temporary and of low intensity. Similarly, the disturbance caused by construction vessel noise was estimated to be local and temporary, and insignificant compared to general level of shipping in the Baltic Sea.

Resuspension of sediments may affect seals by visual impairment or behavioural changes, but these effects are assessed to be temporary and pass as the sediment disperses and sinks, and therefore not to affect any of the species at population level. Similarly, the effects are temporal at individual level. The significance of impact was assessed to be negligible in the EIA. Resuspension of sediments from the seafloor may also release contaminants to the food web. However, turbidity monitoring revealed that the amount and duration of resuspended sediment were lower than assessed in the EIA. Therefore, the impact of sediments and resuspended contaminants on marine mammals are assessed to negligible, as assessed in the EIA.

In the **Nord Stream** project, underwater noise was not monitored, but based on the pressure waves measured by the munitions clearance operators, the impacts from munitions clearance were assessed to have been minor. No injuries, fatalities or other significant impacts were reported /99/ either during munitions clearance, nor during other construction activities of the Nord Stream project. Only minor negative impacts on individual marine mammal behaviour were observed due to break-up of ice during rock placement during winter /1/. In the Nord Stream project 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 /67/.

7.2.3 Protected areas

In the EIA, underwater noise and spreading of sediments were identified as possible risks for the protected areas. Noise created by munition clearance and turbidity of water as a result of sediment resuspension due to munitions clearance and rock placement could deteriorate the conditions for the marine mammals. Settling of resuspended sediments could also affect benthic habitats negatively.

The sensitivity of Nature 2000 areas with reefs or seals as conservation objectives is high. However, in the updated EIA that included also two Natura assessment studies and two Natura assessment screening studies covering four Natura areas, it was concluded that NSP2 project will not significantly deteriorate the Natura values due to which the Natura sites were included in the Natura network.

A Natura assessment was done for the Kallbådan Islets and Water, including the Kallbådan seal sanctuary /97/. Based on the assessment, all the impacts of both construction and operation of the pipeline were assessed to be negligible, with the exception of underwater noise created by munitions clearance, which was assessed to have minor significance due to mobility of grey seals (Table 21). Individuals outside Natura area during detonation were assessed to potentially experience onset of PTS. However, it was noted that due to the mitigating effect of the bubble curtain, seals in the 4–5 km proximity of the Natura area would not be affected by the offset of PTS.

Similarly, for the other Natura areas, all the impacts of both construction and operation of the pipeline were assessed to be negligible, with the exception of underwater noise created by munitions clearance, which was assessed to have minor significance, based on high sensitivity of ringed seal to disturbances. The use of bubble curtain in sensitive areas was estimated to reduce the likelihood that any ringed seal would be affected during detonations, and the overall significance for grey and ringed seals was assessed to be minor at population level (Table 21) /58/.

All impacts on receptors in the protected areas with underwater habitats and/or birds as conservation objectives were assessed in the updated EIA to be negligible (Table 21) /58/.

Table 21. Assessment of impact significance for protected areas. Receptor sensitivity is assessed in the EIA, and predicted magnitude of change in the updated EIA. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact, conservation object	Receptor sensitivity	Magnitude of change		Overall significance	
		Predicted	Assessed	Predicted	Assessed
Underwater noise, seals area 1	High	Low	Low	Minor	Minor
Underwater noise, seals area 2	Low	Low	Low	Minor	Minor
Underwater noise, seals area 3	Low	Negligible	Negligible	Negligible	Negligible
Underwater noise, birds	Low	Negligible	Negligible	Negligible	Negligible
Underwater noise, underwater habitats	Medium	Negligible	Negligible	Negligible	Negligible
Sediment spreading, all seal areas	Low	Negligible	Negligible	Negligible	Negligible
Sediment spreading, birds	Low	Negligible	Negligible	Negligible	Negligible
Sediment spreading, underwater habitats	Medium	Negligible	Negligible	Negligible	Negligible
Seal protection area 1: Kallbådan Islets and Waters Natura site, Kallbådan seal sanctuary					
Seal protection area 2: Sandkallan seal sanctuary, Stora Kölhällen seal sanctuary, Söderskär and Långören Archipelago, Pernaja bay and Pernaja Archipelago, Open Sea Area Southeast from Hanko, Söderskär and Långören Archipelago Ramsar site, Bird Wetlands of Hanko and Tammisaari Ramsar area, The Tammisaari Archipelago National Park					
Seal protection area 3: all other protection areas with seals as protection objectives					

The evaluation of monitoring results confirms that the estimates of impact significance presented in the Updated EIA were accurate.

The significance of impacts of construction activities on marine mammals, based on monitoring results of underwater noise and water turbidity, were assessed to be minor (see Chapter 7.2.3 for details) (Table 21). This was also confirmed by the Metsähallitus monitoring of seal behaviour, in which it was found that the seals did not react to the construction activities at all.

Turbidity created by munitions clearance was dramatically lower than assessed and, consequentially, also lasted for a shorter period than estimated in the modelling for the Updated EIA. The spreading was limited to 1.5 km from the detonation in the Munitions clearance site 1, and to 2.2 km distance at site 2 /16/, confirming that re-settling occurs fast, making the impact rather local.

The modelling of effects of rock placement also overestimated the extent of effects. About 2.3 % of measured values exceeded the modelled value, with the majority being much lower. High turbidity conditions were monitored to last for 6.5 h instead of 19 h, as modelled for the calm summer conditions prevailing during monitored rock placement work. Similarly, the period with slightly elevated turbidity was monitored to be four times shorter than predicted for the summer conditions. Monitoring of turbidity took place about 200–300 m from the construction work. As water masses spread further,

resettling and mixing decrease the concentration of sediment particles in the water. Therefore, neither high turbidity conditions, nor significant resettling extend far from construction activity.

Based on these monitored effects and the long distance to the protected areas, spreading and resettling of sediments due to munition clearance and rock placement is assessed to have no or negligible impacts on biodiversity of the reefs along the pipeline (Table 21).

It is assessed that the integrity of the Natura 2000 network was not threatened by any impacts from NSP2 construction in the Finnish EEZ during 2018–2019. It is unlikely that the rest of the construction activities in 2020 would change to this judgement.

The final results will be presented in the 2020 Annual Monitoring Report to be published in May 2021.

Neither monitoring directly related to Natura 2000 areas nor underwater noise monitoring was carried out within **Nord Stream** monitoring. As summarized in Chapter 7.2.2, the effects were similar to NSP2 (minor).

7.3 Socio-economic environment

7.3.1 Cultural heritage

In the EIA /4/, all cultural heritage sites within 250 m of the pipeline route were evaluated from detailed high-resolution data by a marine archaeologist. These sites included two significant wrecks and two World War II historical sites. Underwater wrecks, wreck parts and other individual man-made objects that may be considered over 100-year-old are protected by national law and international conventions and assessed as having high sensitivity. The sensitivity of the World War II historical sites is medium.

Mechanical damage can occur to cultural heritage objects during construction work. However, the impact in case of both wrecks was assessed as negligible in the updated EIA /58/, due to the negligible probability of the construction and operation activities affecting the site. Similarly, the impact was assessed to be negligible for one of the World War II sites. In case of a submarine barrage (S-R09-09806), rock placement for the support of the pipelines buries part of the object and therefore the magnitude of impact was assessed to be low. The impact of pipe-laying on the barrage is direct and permanent. Assuming that only relatively small parts of the barrage remain under the pipeline, the magnitude of change was assessed as low. The impact significance for this site was therefore assessed as minor (Table 22).

The Water Permit provisions require that construction work in the proximity must be carried out in the way that minimises damage to the **submarine barrage**. According to as-laid reports, both Line A and Line B were laid across the barrage mostly with a freespan, thus limiting the impacts onto the target in line with Water Permit provisions. Some length of the pipeline is, however, in contact with the anti-submarine net. It is therefore assessed that the impact significance is minor (Table 22).

Due to the close proximity of the pipelines to one of the wrecks, a **cannon barge** from the 18th or 19th century (S-R05-7978), the Water Permit provisions require a 50 m safety zone around the cannon barge. No construction activities have been carried out in the safety zone. For the Line B, a reduced lay tolerance in the vicinity of the barge was respected, with the Line B laid at the distance of about 63 m from the target (planned distance according to updated EIA was 58 m). The Line A was laid at 130 m distance in 2018. No further construction activities, such as rock placement are planned in the surroundings. It is therefore assessed that the impact significance is negligible (Table 22).

Table 22. Assessment of impact significance for cultural heritage. Receptor sensitivity is assessed in the EIA, as well as predicted magnitude of change. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact	Receptor sensitivity	Magnitude of change		Overall significance	
		Predicted	Assessed*	Predicted	Assessed*
Burial of submarine barrage	Medium	Low	Low	Minor	Minor
Disturbance of cannon barge	High	Negligible	Low	Minor	Negligible

* final assessment to be made after the construction activities in the Finnish EEZ have been completed

A thorough post survey of both targets will be carried out after the construction activities in the Finnish EEZ have been completed (2020) to confirm that no damage to the monitoring targets have occurred during the implementation of the project by any construction activity.

Based on surveys performed between 2009–2013 for the **Nord Stream** project, no impacts were recorded on known wrecks near the installation corridor during different pipeline construction activities.

7.3.2 Ship traffic

The construction of the Nord Stream 2 gas pipeline takes place along the major maritime routes. The temporary safety zones around the construction vessels impact other ship traffic in the area.

In the EIA, the impact of the construction phase on the Gulf of Finland ship traffic was assessed to be mainly negligible, due to integrated mitigation through marine notifications. However, there were two exceptions, the TSS areas Off Kalbådagrund and Off Porkkala Lighthouse (Table 23). Near Kalbådagrund the area suitable for marine traffic north of the westbound lane is very narrow. When the construction vessels are working in the area, the temporary safety zones make it even narrower. Near Porkkala the traffic patterns are complicated due to crossing shipping routes.

Table 23. Assessment of impact significance of construction work safety zones on ship traffic. Receptor sensitivity is assessed in the EIA, as well as predicted magnitude of change. Assessed magnitude of change is based on monitoring results. Overall significance is assessed based on those two variables.

Impact	Receptor sensitivity	Magnitude of change		Overall significance	
		Predicted	Assessed	Predicted	Assessed
Ship traffic	Low	Negligible	Negligible	Negligible	Negligible
Ship traffic at TSS Off Kalbådagrund and at TSS Off Porkkala Lighthouse	Medium	Low	Negligible	Minor	Negligible

During the construction activities, Nord Stream 2 has provided general implementation plans to the Finnish authorities to inform them about construction activities well in advance. The main vessels have provided weekly and daily notifications regarding their activities and schedules (Chapter 3.6). The established safety zones were agreed with the Finnish Transport Agency/VTS Centre. The radius of the safety zone was determined based on the construction activity and the vessel in question. A distance of 1 nautical mile (NM) was applied for the pipelay vessels, except at the Kalbådagrund TSS area where a reduced safety zone of 0.5 NM was established. Around the munition 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 the 13 m shallow close to Kalbådagrund a tug was stationed nearby in order to respond to ship emergencies, such as danger of grounding, under the request of the Finnish Transport Agency (Table 24). The tug was on standby to assist the contractor and third-party vessels by towing and pushing, if necessary. No such situations occurred either in 2018 or 2019.

No incidents related to ship traffic were reported either in 2018 or 2019. It is therefore assessed that the impact significance is negligible for the whole route in the Finnish EEZ.

Table 24. Presence of an intervention tug at Kalbådagrund shallow in 2018 and 2019.

2018 pipelay of Line A	2019 pipelay of Line B
Intervention tug Esvagt Connector	Intervention tug Thor
October 7 to October 16, 2018	August 7 to August 14, 2019

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

7.3.3 Commercial fishery

In line with the monitoring programme, no commercial fishery monitoring was carried out during the years 2018 and 2019. Monitoring of commercial fishery is planned to be performed when the pipeline has been two years in operation.

During the construction phase of the project, Nord Stream 2 project has been submitting Notifications to Fishermen to inform them about the activities in the Finnish EEZ. The notifications have included locations of the work planned for the coming month, vessels to be used and their call signs and radius' of the safety zones around the vessels as well as sources of further information (e.g. /100/).

7.4 Marine strategy and Water framework directives

Both Marine strategy and Water framework directives aim at reaching and/or maintaining a good status of the water ecosystems. The directives obligate the member states to evaluate all proposed projects in relation to these goals, and to grant permits only to projects that do not prevent the achievement of the good status.

The possible impacts of the NSP2 project that would affect the national compliance with the Marine strategy directive were assessed in the EIA /4/ and later in the updated EIA /58/. For all impacts the assessments state that NSP2 will not prevent the achievement of the long-term goals for good environmental status. In case of introduction of underwater noise to the sea, the assessment points out the lack of quantitative indicators. To date, these have not been developed.

The analysis made within EIA 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.

Similarly, the possible impacts of the NSP2 project that would affect the national compliance with the Water framework directive were assessed in the EIA and later in the updated EIA. It was concluded that

NSP2 will not increase the pressures related to eutrophication and, therefore, NSP2 will not be contrary to the objectives and initiatives set out in the Water framework directive.

Since the monitoring results of the year 2018 and 2019 indicate that the impacts were either in line or below the assessed, it is confirmed that the construction of NSP2 in 2018–2019 does not have an impact on Finland's ability to reach GES.

The Summary Table 25 presents the descriptors of the good environmental status as defined in the Marine strategy framework directive, the environmental status of the Gulf of Finland in 2011–2016 by various receptors /42/, the predicted impact of Nord Stream 2 project on those receptors /4, 58/, and the assessed impact, based on the results of the NSP2 monitoring in 2018 and 2019 (see Chapters 7.1 and 7.2).

Table 25. The descriptors of the good environmental status as defined in the Marine strategy framework directive, the environmental status of the Gulf of Finland in 2011–2016 by various receptors /42/, the predicted impact of Nord Stream 2 project on those receptors (EIA and updated EIA), and the assessed impact, based on the results of the NSP2 monitoring in 2018 and 2019.

Descriptors of GES	Status 2011–2016	Impact on reaching the GES	
		Predicted	Assessed
1. Biodiversity is maintained			
Reef habitats (outer archipelago)	Good	Minor/Negligible	Negligible
Offshore sea-floor habitats	Deteriorated	Negligible	Negligible
Offshore plankton	Deteriorated	Not assessed	Not monitored
Grey seal	Good	Negligible	Negligible
Ringed seal	Deteriorated	Negligible	Negligible
Harbour porpoise	Deteriorated	Negligible	Not monitored
Sea trout	Deteriorated	Negligible	Not monitored
2. Non-indigenous species do not adversely alter the ecosystem			
Non-indigenous species	Good	Negligible	Not monitored
3. The population of commercial fish species is healthy			
Commercial fish stock	Good/Deteriorated	Negligible	Not monitored
4. Elements of food webs ensure long-term abundance and reproduction			
Foodwebs	Deteriorated	Negligible	Not monitored
5. Eutrophication is minimized			
Eutrophication	Deteriorated	Negligible	Not monitored
6. The sea floor integrity ensures functioning of the ecosystem			
Seabed integrity	Status not available	Minor	Minor
7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem			
Hydrographical conditions	Good	Negligible	Negligible
8. Concentrations of contaminants give no effects			
Hazardous substances	Good/Deteriorated	Negligible	Negligible
Radioactivity	Deteriorated	Not assessed	Not monitored
9. Contaminants in seafood are below safe levels			
Contaminants in fish and seafood	Good	Negligible	Not monitored
10. Marine litter does not cause harm			
Marine litter	Status not available	Not assessed	Not monitored
11. Introduction of energy (incl. underwater noise) does not adversely affect the ecosystem			
Underwater noise	Status not available	No quantitative indicators available	

7.5 Transboundary impacts

The only transboundary environmental impacts of the Nord Stream 2 project, assessed to deviate from negligible, were the impacts on marine mammals. These were assessed to be minor when all mitigation measures are being used /70, 96/. The underwater noise monitoring at the two stations in Estonian waters, carried out in 2018, confirmed that while most of the munitions clearance operations were detected at the Malusi station, and clearance operations east of Helsinki were detected additionally at the Uhtju station, the noise levels never exceeded the TTS, nor PTS limits (Annual Monitoring Report 2018). As sound travels further in deep, open Estonian coast than in shallow Finnish coast, the impact was assessed conservatively as **minor**, as predicted.

During the Updated EIA it was assessed that Nord Stream 2 does not prevent the achievement of long-term good environmental status in Estonia /58/. The assessment is confirmed by the monitoring results that confirm that the impacts did not exceed the predicted.

In the **Nord Stream** project, underwater noise was not monitored. Only the impact of construction activities on the concentrations of harmful substances in sediments across the border were measured. Based on the monitoring results the construction activities in the Finnish EEZ in 2010-2012 did not cause any measurable transboundary impacts in the Estonian EEZ.

8

RECOMMENDATIONS FOR FUTURE ENVIRONMENTAL MONITORING

8 RECOMMENDATIONS FOR FUTURE ENVIRONMENTAL MONITORING

The Nord Stream 2 monitoring programme is based on the Nord Stream 2 EIA and the experiences gained during monitoring of the earlier Nord Stream project. In addition to the mandatory programme, further monitoring activities were implemented through specialist studies to diversify the assessment of impacts from Nord Stream 2 and to enhance scientific knowledge of the Baltic Sea environment. The monitoring carried out so far is comprehensive enough to enable reliable assessment of environmental impacts of construction of the Nord Stream and the Nord Stream 2 pipelines.

The following general recommendations for future large scale marine construction projects are based on the evaluation of the monitoring results and experience of Nord Stream 2 construction in 2018-2019 in the Finnish EEZ. These recommendations will be re-evaluated once the NSP2 pipeline construction has been finalized in the Finnish EEZ in 2020.

The need to monitor background water quality at both below and above halocline was recognized during monitoring of Nord Stream. It is recommended here, in addition, to position the control stations so that the background information of natural, seasonal changes in sea water quality reflect the conditions at the pipelay route. This may, however, be technically challenging, as pipelay often takes place at deep areas in the open sea and/or at shipping lanes.

So far, there is a limited number of studies on the water quality and underwater noise impacts of munitions clearance and other construction activities, especially in shallow but stratified waters. Any future projects that include activities generating underwater noise are recommended to monitor underwater noise.

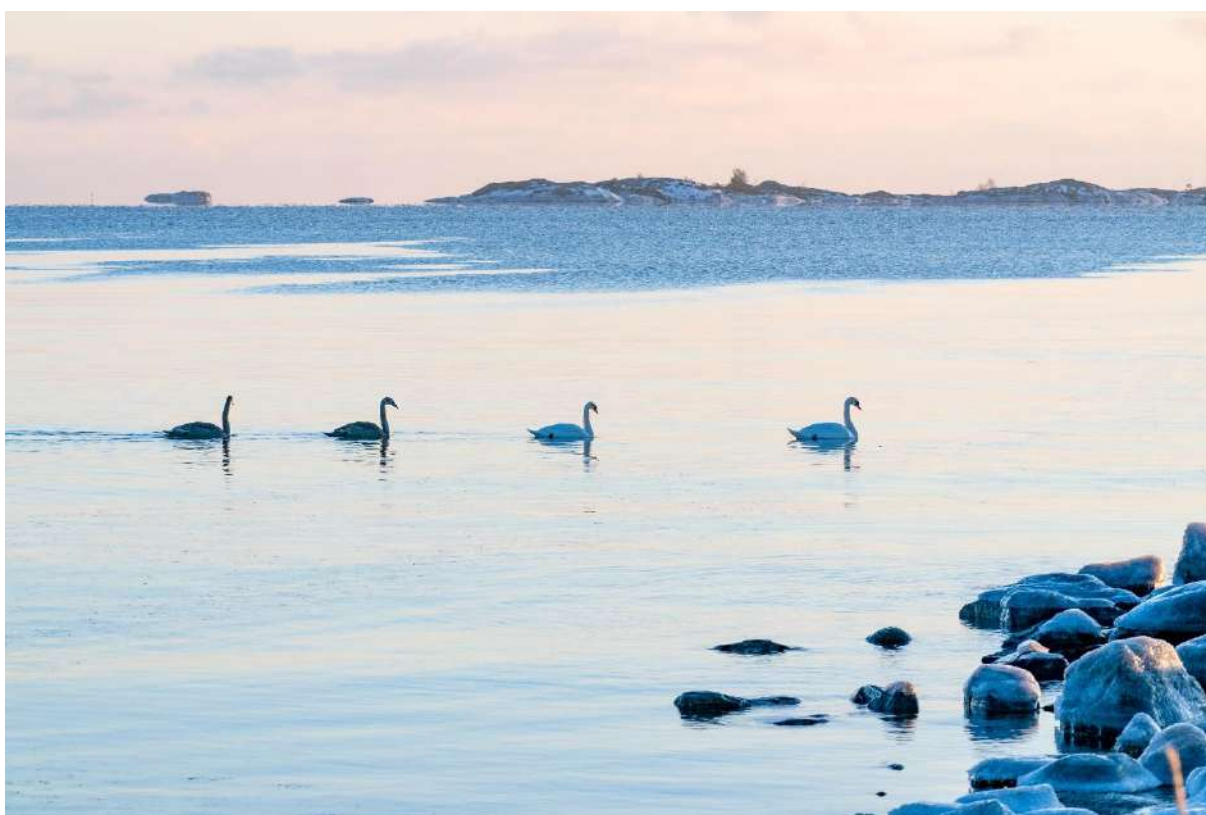


Figure 36. Gulf of Finland in winter. Photo: © Nord Stream 2/ Wolfram Scheible.

9

CONCLUSIONS

9 CONCLUSIONS

Construction activities in the Finnish EEZ in 2018–2019

The Nord Stream 2 construction activities in 2018 included munition clearance, rock placement, mattress installation and pipelay. In 2019, pipelay continued and was completed. Rock placement continued in 2019. It will be completed in spring 2020.

Munition clearance activities were successfully completed in 2018. In total, 74 munitions were cleared. The lower number of munitions cleared, compared to permitted (87 munitions) is due to detailed pre-clearance surveys on site.

Rock placement continued through 2019. Pre-lay rock placement was completed in 2019. Post-lay rock placement will be completed in spring 2020. The volume of rock material installed so far is approximately 53 % of the permitted volume. It is assessed that the final volume will be within the permitted volume.

Mattress installation is done to support and protect pipeline crossings with existing cables and pipelines. In total 492 mattresses were installed on the seabed in 2018. The number of mattresses was lower than permitted (607) due to changes in design during detailed survey prior to mattress installation. Mattress installation was completed in 2018.

Pipelay of Line A in the Finnish EEZ started in 2018 and pipelay of Line B in 2019. Both Lines were completed in 2019. Pipelay corridor was locally adapted at the crossing with Balticconnector for Line A and for Line B. For Line B, minor route deviations were necessary in three locations. One of these was at the crossing with Balticconnector, which however was within the installation corridor width (< 7.5 m). In addition, minor deviations from narrowed pipelay corridor occurred once for Line A and 11 times for Line B.

Six **unplanned events** occurred during construction work in 2018–2019. These were small leaks of biodegradable oil that were notified to the appropriate authorities. No actions were required.

Environmental monitoring

The Nord Stream 2 monitoring during 2018–2019 was performed in line with the environmental monitoring programme. Results of monitoring were compared to modelled impacts and assessments /4, 58, 96/ presented in the Water Permit application, as well as to monitoring results from the Nord Stream pipeline project /1/.

Underwater noise

The modelling done for Water Permit application overestimated the noise released during the munitions clearance work. The measured peak levels were lower and the calculated PTS areas much smaller than modelled. Often the munition charge was smaller than predicted, and it is also possible that the bubble curtain mitigated noise more effectively than expected. Sound attenuation is also naturally effective in the shallow areas of the northern Gulf of Finland.

The impacts underwater noise had on biodiversity (via marine mammals) were **minor** and on protected areas **negligible**, as predicted in the modelling for the Water Permit application.

In the **Nord Stream** project, only peak pressure levels of noise were measured. These were lower than predicted in the modelling. The peak pressure levels (distance corrected to enable comparison) were on average 225 dB in the Nord Stream project and approximately 210 dB in the NSP2. The 15 dB difference is significant and highlights the efficiency of the bubble curtain used as a mitigation method in the NSP2.

Water quality and currents

The impacts on water quality from the relocation of sediments during construction activities (munitions clearance and rock placement) were predicted to be minor. Construction was predicted not to deteriorate the conditions for the biota at the Sandkallan Natura 2000 site.

According to the results of the short-term monitoring of turbidity and currents around two munitions clearance sites and two rock placement sites in 2018, the turbidity impacts were generally lower than predicted and briefer in duration. At the long-term monitoring stations, including Sandkallan, only natural variation in turbidity could be detected from April 2018 to December 2019.

The impacts of construction work on water quality were **minor**, as predicted, and the integrity of the Natura 2000 network was not threatened by any impacts from NSP2 construction in the Finnish EEZ during 2018–2019.

Monitoring results are in line with those from the **Nord Stream** project, in which rock placement and munitions clearance were both assessed to have had a minor negative impact in the water quality, and no impacts on protected areas.

Commercial fishery

The impacts on commercial fishery in the Finnish EEZ, via possible changes in trawling patterns, will be assessed two years after construction.

Cultural heritage

All cultural heritage sites within 250 m of the pipeline route were evaluated by a marine archaeologist, and two targets were identified to require precaution during construction work. In the EIA, only the submarine net was assessed to have minor impacts; all other targets were assessed to have negligible impacts from construction activities of NSP2.

For a World War II submarine barrage, the construction activities in the proximity had to be carried out in the way that minimised the damage to the target. As the anti-submarine net spreads across a large distance in the Gulf of Finland, it couldn't be avoided completely. To limit the damage to the target, pipeline was laid across the barrage mostly with a freespan. Some length of the pipeline is, however, in contact with the net, and therefore the impact is assessed to have been **minor**.

A safety zone of 50 m was required around a cannon barge from the 18th or 19th century due to the close proximity of the pipelines to a wreck. No construction activities were carried out within the safety zone. Line B was laid at the distance of about 63 m from the target in 2019, and Line A was laid at a 130 m distance in 2018. No further construction activities, such as rock placement were done or are planned in the surroundings. It is therefore assessed that the impact on the target has been **negligible**.

A thorough post survey of both targets will be carried out after the construction activities in the Finnish EEZ have been completed to confirm that no damage to the monitoring targets have occurred during the implementation of the project by any construction activity.

Similar to these results, no impacts were recorded on known wrecks for the **Nord Stream** project.

Sediment contaminants

Although the overall impact of contaminant relocation was assessed as negligible in the updated EIA, spreading of heavy metals and explosive residuals around the munition clearance sites was studied. The results of 17 sediment samples confirm that detonations did not increase concentrations of harmful substances in the surface sediments. No explosive residuals were detected in the samples, and the heavy metal concentrations, similar to those found in earlier studies in the Gulf of Finland sediments, varied randomly at the seafloor. There was no correlation between the distance to the detonation site and concentration.

Marine mammals

A series of mitigation measures were successfully implemented to reduce the environmental impacts of underwater noise due to munition clearance. Acoustic deterrent devices were used to drive marine mammals out from the clearance area. Trained marine mammal observers and passive acoustic monitoring confirmed the absence of animals in the vicinity of the detonations. The noise released by the clearances was minimized by surrounding the munitions with a bubble curtain during detonations.

Both the permanent and temporary threshold shift zones were much smaller than predicted, limiting the possibility that any marine mammals would have experienced damage from the construction work noise. Threshold shift zones (PTS and TTS) did not extend to any Natura 2000 areas with marine mammals as conservation objects. Noise did not cause any behavioural impacts on grey seals at the Kallbådan seal reserve based on the Metsähallitus remote video camera monitoring.

The monitored impacts of underwater noise on marine mammals were in line with predicted impacts, **minor**, for both grey seals and for Baltic ringed seals at both individual and population level.

In the **Nord Stream** project, underwater noise was not monitored, but based on the pressure waves measured by the munitions clearance operators, the impacts from munitions clearance were assessed to have been minor.

Resuspension of sediments may affect seals by visual impairment or behavioural changes and may also release contaminants to the food chain. Turbidity monitoring revealed that the amount and duration of resuspended sediment were lower than assessed in the EIA, in which the significance of the impact was assessed to be negligible. Therefore, the impact of sediments and resuspended contaminants on marine mammals are assessed to **negligible**, as assessed in the EIA.

Ship traffic

The impact of Nord Stream 2 project has on ship traffic is via the temporary safety zones established around the construction vessels. The impacts on the Gulf of Finland ship traffic were assessed to be mainly negligible, except for the TSS areas Off Kalbådagrund and Off Porkkala Lighthouse.

Nord Stream 2 provided general implementation plans and monthly plans, and contractors have sent weekly and daily notifications to the Finnish authorities to inform them about construction activities well in advance. The established safety zones were agreed with the Finnish Transport Agency/VTS Centre. Third party ships were not allowed to enter the safety zones. In addition, for the time of pipelay near the 13 m shallow close to Kalbådagrund, a tug was stationed nearby in order to respond to contractor and third-party ship emergencies, such as danger of grounding. No emergencies occurred either in 2018 or 2019.

No incidents related to ship traffic were reported either in 2018 or 2019. It is therefore assessed that the impact was **negligible** for the whole route.

In the **Nord Stream** project, a few minor ship traffic incidents occurred in 2010 and 2011. While there were no significant impacts, the overall impact was assessed as minor, due to the incidents.

Transboundary impacts

The only potential transboundary environmental impacts of the Nord Stream 2 project were the impacts on marine mammals. The underwater noise monitoring at the two stations in Estonian waters confirmed that the NSP2 construction activities related noise levels in Estonia never exceeded the TTS, nor PTS limits. It is assessed that the impact significance was **minor**, as predicted.

In the Updated EIA it was assessed that Nord Stream 2 does not prevent the achievement of long-term good environmental status in Estonia (/58/). The assessment is confirmed by the monitoring results that show that the impacts did not exceed the predicted.

In the **Nord Stream** project, the only transboundary impact monitored was the harmful substance concentration in the sediments. The construction activities in the Finnish EEZ did not cause any measurable transboundary impacts in the Estonian EEZ.

Overall conclusions

The as-laid reports confirm that the construction of the NSP2 in 2018–2019 has been performed according to plans presented in the Water Permit application.

The environmental monitoring results 2018–2019 confirm that all monitored Nord Stream 2 related environmental impacts are in line or lower than assessed in the application documents.

The construction of NSP2 does not prevent Finland from achieving the good environmental status. NSP2 does not increase the pressures related to eutrophication and, therefore, NSP2 does not contradict the objectives and initiatives set out in the Water Framework Directive.

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

Transboundary impacts of the NSP2 construction activities are limited to underwater noise, possibly affecting marine mammals. Harmful levels of noise did not reach Estonian EEZ.

Final monitoring results, covering the entire construction phase (2018–2020), will be presented in the Annual Monitoring Report 2020 to be published in May 2021.

LIST OF REFERENCES

LIST OF REFERENCES

Permits and consents

TEM/1810/08.08.01/2017. Suostumus Suomen talousvyöhykkeen taloudelliseksi hyödyntämiseksi. Päättös. Valtioneuvosto, 5.4.2018. Unofficial translation, W-PE-LEG-PFI-PER-961-EEZPEREN-01: Nord Stream 2. Consent to exploit Finland's exclusive economic zone. TEM/1810/08.08.01/2017. April 5, 2018.

53/2018/2. Päättös vesilupahakemuksesta: Kahden maakaasuputken sijoittaminen Suomen talousvyöhykkeelle ja valmistelulupa. Drno. ESAVI/9101/2017. ESAVI (= Regional State Administrative Agency of Southern Finland), 2018. Unofficial translation, W-PE-LEG-PFI-PER-961-WATPEREN-01: Nord Stream 2. Placing two natural gas pipelines within the Finnish EEZ and authorisation for preparation. Regional State Administrative Agency, Southern Finland, Decision 53/2018/2, Reg. No ESAVI/9101/2017. April 12, 2018.

325/2018/06.06.02. Päättös. Tutkimus- ja liikkumislupa melun mittaamiseen Kallbådanin ja Sandkallanin-Stora Kölhällenin hylkeidensuojelualueille sekä muille valtion vesialueille liittyen Nord Stream 2 maakaasuputkien ympäristövaikutusten rakentamisaikaiseen seurantaan. Metsähallitus. March 12, 2018. (Decision. Research and trespassing permit for measuring noise in Kallbådan and Sandkallan-Stora Kölhällen seal protection area related to Nord Stream 2 project.)

5395/2018/06.06.02. Päättös. Tutkimus- ja liikkumislupa melun mittaamiseen Kallbådanin ja Sandkallanin-Stora Kölhällenin hylkeidensuojelualueille sekä muille valtion vesialueille liittyen Nord Stream 2 maakaasuputkien ympäristövaikutusten rakentamisaikaiseen seurantaan. Metsähallitus. December 7, 2018. (Decision. Research and trespassing permit for measuring noise in Kallbådan and Sandkallan-Stora Kölhällen seal protection and other state water areas related to Nord Stream 2 project.)

UUDELY/9564/2017a. Tarkkailuraporttien toimittamisaikataulun hyväksyminen. Esitys tarkkailun tulosten vuosiraportoinnin ajankohdasta 15.2.2019. Uudenmaan ELY-keskus 22.2.2019. (Approval of proposal A clarification on the schedule of submission of the annual monitoring reports to Uusimaa ELY Centre on February 15, 2019. Uusimaa ELY Centre. February 22, 2019.)

UUDELY/9564/2017b. Tarkkailun muutosesityksen hyväksyminen. Tarkkailun muutosesitys 9.10.2019. Uudenmaan ELY-keskus 8.11.2019. (Approval of proposal for amendment in monitoring. Amendment proposal October 9, 2019. Uusimaa ELY Centre. November 8, 2019.)

Literature and internet

1. G-PE-EMS-MON-100-0321ENG0-B. Nord Stream Gas Pipeline Construction and Operation in the Finnish EEZ, Environmental Monitoring 2012, Annual Report. Ramboll. July 3, 2013.
2. W-PE-EMS-PFI-REP-805-032300EN-11. Nord Stream 2. Natural gas pipeline route through the Baltic Sea – Environmental monitoring programme, Finland. Ramboll. February 1, 2018.
3. IMPERIA (2015) Guidelines for the systematic impact significance assessment – The ARVI approach. IMPERIA Project Report, December 31, 2015. https://jyx.jyu.fi/bitstream/handle/123456789/49498/Guidelines_for_impact_significance_assessment.pdf?sequence=1&isAllowed=y. Date of access April 29, 2019.
4. W-PE-EIA-PFI-REP-805-030100EN-09. A Natural Gas Pipeline through the Baltic Sea. Environmental Impact Assessment Report, Finland. Ramboll, 2017.

5. JNCC (2010). JNCC guidelines for minimising the risk of injury to marine mammals from using explosives. JNCC, Marine Advice, UK. August 2010.
6. W-PE-EMO-PFI-MIS-800-MUNMONEN-01. Nord Stream 2. Guidance Note: Deployment of Mitigation Measures for Marine Mammals, Fish and Birds during Munition Clearance in Finland. March 22, 2018.
7. W-SU-UXO-PFI-REP-808-EODSUREN-02. Nord Stream 2. EOD Summary Report, Route Clearance and UXO Removal, UXO Clearance Survey, Bay of Finland, May-June 2018. MMT Sweden Ab. August 2, 2018.
8. W-SU-UXO-PFI-REP-831-GEOFRREN-03. Nord Stream 2. Munitions Clearance Finnish EEZ, EOD Summary Report, MV Geosund. Sea and Bodac, August 1, 2018.
9. W-OF-RDU-POF-PRO-830-ROTESEN-04. Rock Testing Method Statement. Boskalis Offshore Contracting B.V. & Van Oord Offshore B.V. (BOVO). January 17, 2018.
10. Routama V, Virtanen T (2019). Statement on rock quality in Skogsmora Quarry, Karjaa. Rudus OY. March 31, 2020.
11. W-OF-RDU-POF-PRO-830-RTMSKOEN-05. Rock Transportation Method Statement Kotka. Boskalis Off-shore Contracting B.V. & Van Oord Offshore B.V. (BOVO). January 19, 2018.
12. Elzenga J (2020). RE: Rock for NSP2 from Skogsmora quarry - Anno Domini 2018 & 2019. E-mail notification from Boskalis to NSP2. Sent February 24, 2020.
13. W-SU-OF-PFI-STG-800-CONPCSEN-03. Nord Stream 2. Construction and Post Construction Surveys. Finnish Exclusive Economic Zone. October 3, 2017.
14. 800-961-PE-EIA-PFI-EMA-180326EN. Nord Stream 2: General Implementation Plan for Rock Placement, Munition Clearance and Mattress Installation in the Finnish EEZ. Notification to the Finnish Border Guard and Finnish Transport Agency. March 26, 2018.
15. 800-961-PE-EIA-PFI-EMA-180921EN. Nord Stream 2: Second amendment to the General Implementation Plan for rock placement, munition clearance and mattress installation in the Finnish EEZ. Notification to the Finnish Border Guard and Finnish Transport Agency. September 21, 2018.
16. W-PE-EMO-PFI-REP-892-ANNREPEN-08. Nord Stream 2. Annual Monitoring report 2018. Sitowise. October 21, 2019.
17. W-OF-RDU-POF-CRB-830-ASBREGEN-15. Nord Stream 2. As-Built Register, Rock Placement Works. Boskalis Offshore Contracting B.V. & Van Oord Offshore B.V. (BOVO). December 16, 2019.
18. W-PE-EMO-PFI-RQU-892-RQU119EN-05. Nord Stream 2 Natural Gas Pipeline construction and operation in the Finnish EEZ. Environmental and Technical Monitoring. Quarterly Report Q1 2019. Sitowise. June 26, 2019.
19. W-PE-EMO-PFI-RQU-892-RQU219EN-04. Nord Stream 2 Natural Gas Pipeline construction and operation in the Finnish EEZ. Environmental and Technical Monitoring. Quarterly Report Q2 2019. Sitowise. September 23, 2019.
20. W-PE-EMO-PFI-RQU-892-RQU319EN-04. Nord Stream 2 Natural Gas Pipeline construction and operation in the Finnish EEZ. Environmental and Technical Monitoring. Quarterly Report Q3 2019. Sitowise. December 10, 2019.
21. W-PE-EMO-PFI-RQU-892-RQU419EN-04. Nord Stream 2 Natural Gas Pipeline construction and operation in the Finnish EEZ. Environmental and Technical Monitoring. Quarterly Report Q4 2019. Sitowise. March 17, 2020.

- 22.W-PE-EIA-PFI-PER-999-WATREPEN-02. Water Permit Application for the Nord Stream 2 Project to the Southern Finland Regional State Administrative Agency. September 19, 2017.
- 23.Chidlow R (2020). RE: Rock volumes at the crossing with NSP1 in Finland. E-mail from Chidlow to DeLuca. Internal correspondence of NSP2. March 10, 2020.
- 24.W-SU-CRO-GEN-REP-800-UNKNOWNEN-03. Cables in Finland: Unknown Owners. Surveys and Confirmation Status: Out-of-Use. Nord Stream 2. December 18, 2017.
- 25.W-OF-PLA-POF-PRO-850-PROM01EN-05. Nord Stream 2. Pipelay and Associated Works. Mattress Installation Procedure – Oceanic. Allseas Group S. A. June 25, 2018.
- 26.W-OF-PLA-POF-DPR-800-18115OC-01. Nord Stream 2. Oceanic (NSP2 Rep WSR8) - Mattress Installation Campaign. E-mail from Duncan Rae and Matt O'Mahony. October 25, 2018.
- 27.W-EN-OFP-POF-MTO-804-D70123EN-04. Nord Stream 2 Offshore Pipeline Detail Design. Saipem. August 29, 2018.
- 28.Lilaco Offshore Ltd (2019a). Matinkylä – Kagumae, Route Elisa Finest. Daily ship progress report 02, November 24, 2019.
- 29.Lilaco Offshore Ltd (2019b). Matinkylä – Kagumae, Route Elisa Finest. Daily ship progress report 03, November 25, 2019.
- 30.Eastern Light (2019). Eastern Light dark fiber build-out. <https://easternlight.se/build-out/>. Accessed March 29, 2019.
- 31.A-OF-POL-PFI-REP-850-ASL004EN-02. Nord Stream 2. As-laid Survey (OCV Oceanic), Finland Line A, GKP230.610 to GKP260.802 (FKP116.814 to FKP147.006). Allseas Group S. A. January 30, 2019.
- 32.B-OF-POL-PFI-REP-850-ASL011EN-01. As-laid Survey (MOCV Fortitude), Line B, Finland, GKP 219.032 to GKP 260.638 (FKP 105.000 to FKP 146.606). Allseas Group S. A. August 7, 2019.
- 33.INC-SOL-407010-06. Incident reporting – Investigation report Solitaire. Incident date 2018-10-22. Allseas Group S.A. February 18, 2019.
- 34.Finnish Meteorological Institute (2020). Vuosi 2019 oli lähes asteen tavanomaista lämpimämpi. (The year 2019 was nearly a degree warmer than usual). FMI Press release January 2, 2020. <https://ilmatieteenlaitos.fi/tiedote/1225384314>. Accessed January 3, 2020.
- 35.Finnish Meteorological Institute (2012). Tilastoja Suomen ilmastosta 1981-2010. (Finnish weather statistics 1981-2010). Ilmatieteen laitoksen raportteja 2012:1.
- 36.Finnish Meteorological Institute. Open data. www.ilmatieteenlaitos.fi
- 37.Finnish Meteorological Institute (2019a). Viimeisetkin jäät ovat sulaneet Perämereltä. (The last ice has melted from the Bothnian Bay.) FMI bulletin May 14, 2019. https://ilmatieteenlaitos.fi/tiedotearkisto/-/journal_content/56/30106/980718279. Accessed June 5, 2019.
- 38.EU Copernicus Marine Service Information and Finnish Meteorological Institute (2019). Baltic Sea – Sea ice concentration and thickness charts. http://marine.copernicus.eu/services-portfolio/access-to-products/?option=com_csw&view=details&product_id=SEAICE_BAL_SEAICE_L4_NRT_OBSERVATIONS_011_004. Exported from site June 6, 2019.
- 39.W-PE-EIA-PFI-REP-812-FINBESEN-04. Environmental Baseline Surveys in the Finnish Exclusive Economic Zone. Luode Consulting. October 21, 2016.
- 40.Ministry of the Environment (2015). Ministry of the Environment guidelines on sediment dredging and deposition (2015). Ympäristöhallinnon ohjeita 1/2015. 72 pp.

- 41.W-PE-PFI-REP-812-WQCR05EN-03. Long-term water quality and current monitoring in the Gulf of Finland. October 2019 - December 2019. Luode Consulting. February 24, 2020.
- 42.SYKE (2018). Suomen meriympäristön tila 2018 (State of the marine environment in Finland 2018). Korpinen S, Laamanen M, Suomela J, Paavilainen P, Lahtinen T. Ekebom J (eds.). 248 pp. SYKE Publications 4.
- 43.HELCOM (2013). HELCOM Copenhagen Ministerial Declaration: Taking Further Action to Implement the Baltic Sea Action Plan - Reaching Good Environmental Status for a healthy Baltic Sea. Copenhagen, Denmark. October 3, 2013.
- 44.HELCOM (2018). State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016. Baltic Sea Environment Proceedings 155.
- 45.BIAS (2016). The BIAS Project. <https://biasproject.wordpress.com>. Accessed January 24, 2020.
- 46.ICES (2018). HELCOM registry of impulsive events. <http://ices.dk/marine-data/data-portals/Pages/underwater-noise.aspx>
- 47.BIAS (2017). BIAS Layman's report. https://biasproject.files.wordpress.com/2017/01/bias_laymansreport_v7.pdf. Accessed January 25, 2020.
- 48.Thrush SF, Hewitt JE, Cummings VJ, Dayton P (1998). Disturbance of the Marine Benthic Habitat by Commercial Fishing: Impacts at the Scale of the Fishery. *Ecological Applications* 8(3):866-879.
- 49.Teilmann J, Galatius A, Sveegaard S (2017). Marine mammals in the Baltic Sea in relation to the Nord Stream 2 project. - Baseline report. Aarhus University, DCE – Danish Centre for Environment and Energy, 52 pp. Scientific Report from DCE – Danish Centre for Environment and Energy No. 236.
- 50.Anon (2016). ASCOBANS. Recovery Plan for Baltic Harbour Porpoises (Jastarnia Plan).
- 51.SAMBAH (2016) Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise (SAMBAH). Final report under the LIFE+ project LIFE08 NAT/S/000261. Kolmårdens Djurpark AB, Sweden. 81 p.
- 52.Miettinen M, Halkka A, Högmänder J, Keränen S, Mäkinen A, Nordström M, Nummelin J, Soikkeli M (2005). The ringed seal in the Archipelago Sea, SW Finland: population size and surveys techniques. International conference on Baltic seals. Helsinki, Finland. February 15–18, 2005.
- 53.Nord Stream 2 AG (2018). Telemetry Studies of the Baltic ringed seals in the Gulf of Finland. Nord Stream AG, October 2018.
- 54.W-PE-EIA-OFR-REP-999-INTR19EN-01. Ringed seal telemetry in the Gulf of Finland. Technical report. Pro Mare MTÜ and St. Petersburg Scientific Centre of the Russian Academy of Sciences. Interim report 2019.
- 55.HELCOM (2016). Population trends and abundance of seals. HELCOM core indicator report. January 2016.
- 56.Finnish Wildlife Agency (2018). Maa- ja metsätalousministeriö vahvisti hallin, itämerennorpan ja euroopanmajavan metsästyskiintiöt. (Ministry of Agriculture and Forestry has confirmed the hunting quota for grey seal, Baltic ringed seal and European beaver.) Bulletin August 1, 2018. <https://riista.fi/maa-ja-metsatalousministerio-vahvisti-hallin-itamerennorpan-ja-euroopanmajavan-metsastyskiintiot/>. Accessed April 20, 2020.
- 57.Finnish Wildlife Agency (2019). Harmaaahylkeen kiintiömetsästys. (Hunting quota for grey seal). <https://riista.fi/metsastys/palvelut-metsastajalle/lupahallinto/harmaaahylkeen-kiintiometsastys/>. Accessed April 20, 2020.
- 58.W-PE-EIA-PFI-REP-805-032200EN-10. Nord Stream 2. A Natural Gas Pipeline through the Baltic Sea. Updated Project Description and Offshore Impact Assessments. Ramboll. February 21, 2018.

59. Finnish Government (2018). Valtioneuvoston päätös Euroopan unionin Natura 2000-verkoston Suomen ehdotuksen ja ilmoituksen täydentämisestä sekä Natura 2000 –alueiden tietojen tarkistuksista. (Government decision to supplement the Finnish proposal and notification of the Natura 2000 network of the European Union and to revise the information on Natura 2000 sites). December 5, 2018.
60. Ministry of Environment (2019). Luonnokset asetuksista koskien Uudellemaalle perustettavia valtion luonnonsuojelualueita. Lausuntopyynnön diaarinumero VN/5011/2018. Draft regulations concerning state nature reserves to be established in Uusimaa. Request referral number VN/5011/2018. January 17, 2019.
61. W-SU-UXO-PFI-REP-831-FMASWNEN-01. Munitions clearance Finnish EEZ, Field Report 001, Anti-Submarine Net, Verification Survey. ARK-Sukellus, Rami Kokko July 10, 2018.
62. LUKE (2020). Natural Resources Institute Finland. Commercial marine fishery in Finland. <https://stat.luke.fi/kala-ja-riista>. Accessed March 3, 2020.
63. LUKE (2019). Natural Resources Institute Finland. Commercial marine fishery in Finland. <https://stat.luke.fi/kala-ja-riista>. Accessed April 10, 2019.
64. Vesikartta-application. <http://paikkatieto.ymparisto.fi/vesikartta>. Updated ecological classification of Finnish waters. SYKE and ELY Centres. Accessed March 23, 2020.
65. 800–961-PE-EIA-PFI-NTE-190215FI. Esitys tarkkailun tulosten vuosiraportoinnin ajankohdasta Uudenmaan ELY-keskukselle. (A clarification on the schedule of submission of the annual monitoring reports to Uusimaa ELY Centre.) February 15, 2019.
66. 800-961-PE-EIA-PFI-NTE-191009EN. Amendment of monitoring scope in 2020. Proposal to Uusimaa ELY Centre. October 9, 2019.
67. G-PE-EMS-MON-100-0306ENG-B. Nord Stream gas pipeline construction in the Finnish EEZ. Environmental monitoring 2010. Annual report. Ramboll. 2011.
68. W-PE-EMS-PFI-REP-812-WQCR01EN-05. Water quality and current monitoring in the Gulf of Finland. April – September 2018, Luode Consulting Oy. January 14, 2019.
69. W-PE-EMS-PFI-REP-812-SEDTOXEN-03. Results of sediment toxicity analysis for targets R-R08-5261 and R-R09-7495. Luode Consulting. September 26, 2018.
70. W-PE-EIA-PFI-REP-999-MBYM00EN-08. Nord Stream 2. Munitions clearance. Environmental impacts on Munition by Munition basis. Finnish EEZ. ACRB. July 25, 2018.
71. W-PE-EIA-PFI-REP-805-030600EN-06. Nord Stream 2. Underwater noise modelling, Finland. Ramboll. December 7, 2016.
72. W-PE-EIA-PFI-REP-805-031700EN-06. Nord Stream 2. Natura 2000 Underwater noise modelling, Finland. Ramboll. September 27, 2017.
73. W-PE-EMO-PFI-REP-961-METREPEN-01. Monitoring of Grey Seals in Kallbådan Seal Reserve in 2018. Antti Below, Metsähallitus 2019.
74. W-PE-EMO-PFI-SPE-961-METSTAEN-01. Statement regarding the monitoring of the Kallbådan Seal Reserve in Kirkkonummi in 2018. Antti Below, Metsähallitus 2019.
75. W-SU-DET-POF-REP-808-CHO001EN-01. Cultural heritage object inspection report S-R05-07978. MMT Sweden. May 2018.
76. W-SU-DET-POF-REP-808-WRK014EN-03. Cultural heritage target inspection S-R09-09806 and SD-ALT1-3372. MMT Sweden. November 2016.

- 77.A-OF-POL-PFI-REP-850-ASL003EN-02. Nord Stream 2. As-laid Survey (OCV Oceanic), Finland Line A, GKP123.796 to GKP165.796 (FKP10.000 to FKP52.000). Allseas Group S. A. January 11, 2019.
- 78.B-OF-POL-PFI-REP-850-ASL013EN-02. As-laid survey (CSV Normand Poseidon), Finland Line B, GKP 114.032 to GKP 164.032 (FKP 0.00 to FKP 50.000). Allseas Group S. A. December 2, 2019.
- 79.800-961-PE-EIA-PFI-EMA-200327EN. Minor route deviations and additional berm. Notification to the ELY Centres Uusimaa, Southwest Finland and Southeast Finland. March 27, 2020.
- 80.A-OF-POL-PFI-REP-850-ASL008EN-02 Nord Stream 2. As-laid Survey (OCV Oceanic), Finland Line A, GKP413.796 TO GKP488.104 (FKP300.000 TO FKP374.308). Allseas Group S. A. September 9, 2019.
- 81.B-OF-POL-PFI-REP-850-ASL117EN-01. As-laid survey (MOCV Fortitude), Finland Line B, GKP 419.032 TO GKP 487.943 (FKP 305.000 TO FKP 373.911). Allseas Group S. A. June 9, 2019.
- 82.B-OF-POL-PFI-REP-850-ASL012EN-02. As-laid Survey (MOCV Fortitude), Line B, Finland, GKP 164.032 to GKP 219.032 (FKP 50.000 to FKP 105.000). Allseas Group S. A. October 16, 2019.
- 83.B-OF-POL-PFI-REP-850-ASL120EN-01. As-laid Survey (MOCV Fortitude), Line B, Finland, GKP 334.032 to GKP 419.032 (FKP 220.000 to FKP 305.000). Allseas Group S. A. July 1, 2019.
- 84.A-OF-OF-P-POF-REP-850-GEN027EN-01. Site Memorandum, Oceanic – UHD89 / UHD 90, R-R10-5065 Barrel Passage at Line A GKP 286.982 (FKP 173.186). Allseas Group S. A. December 12, 2018.
- 85.A-OF-OF-P-POF-REP-850-GEN035EN-01. Site Memorandum Oceanic – UHD89 / UHD 90, R-R12-0073 Barrel Passage at Line A GKP 342.292 (FKP 228.496). Allseas Group S. A. January 29, 2019.
- 86.A-OF-OF-P-POF-REP-850-GEN030EN-02. Site Memorandum Oceanic – UHD 89 / UHD 90, R-R13-5061 Barrel Passage at Line A GKP 364.585 (FKP 250.789). Allseas Group S. A. January 31, 2019.
- 87.B-OF-OF-P-POF-REP-850-GEN707EN-01. Site memorandum Normand Poseidon – UHD16, R-R06-7108 Barrel Passage at Line B FKP 34.323 (GKP 148.355). Allseas Group S. A. August 15, 2019.
- 88.B-OF-OF-P-POF-REP-850-GEN423EN-02. Site memorandum MOCV Fortitude. R-R06-7207 Barrel Passage at Line B, FKP 55.457 (GKP 169.489). Allseas Group S. A. August 19, 2019.
- 89.B-OF-OF-P-POF-REP-850-GEN424EN-01. Site memorandum MOCV Fortitude. R-R08-7236 Barrel Passage at Line B, FKP 116.383 (GKP 230.415). Allseas Group S. A. August 16, 2019.
- 90.B-OF-OF-P-POF-REP-850-GEN425EN-02. Site memorandum MOCV Fortitude. R-R10-5230 Barrel Passage at Line B, FKP 157.655 (GKP 271.687). Allseas Group S. A. August 19, 2019.
- 91.B-OF-OF-P-POF-REP-850-GEN419EN-01. Site memorandum MOCV Fortitude. R-R11-5232 Barrel Passage at Line B, FKP 198.580 (GKP 312.612). Allseas Group S. A. July 6, 2019.
- 92.Finnish Transport Infrastructure Agency (FTA) (2020). Fairway database, downloaded from WFS on February 18, 2020.
<https://julkinen.liikennevirasto.fi/inspirepalvelu/avoin/wfs?request=getcapabilities>
- 93.A-OF-POL-PFI-REP-850-ASL119EN-01. Nord Stream 2. As-laid Survey (OCV Oceanic), Finland Line A, GKP113.796 TO GKP123.796 (FKP0.000 TO FKP10.000). Allseas Group S. A. September 9, 2019.
- 94.W-PE-EIA-PFI-PER-999-REJWPAEN-01. Rejoinder to the statements issued in the Water Permit application. February 22, 2018.
- 95.W-PE-EIA-PFI-REP-805-032000EN-05 Natura assessment for Natura site Sea Area South of Sandkallan, Porvoo (FI0100106). Ramboll. September 4, 2017.
- 96.W-PE-EIA-PFI-REP-805-033300EN-02. Nord Stream 2. Statement on the changes in assessments after the submission of permit applications. Ramboll. January 19, 2018.

- 97.W-PE-EIA-PFI-REP-805-031400EN-08. Natura assessment for Natura site Kallbådan Islets and Waters (FI0100089). Ramboll. September 5, 2017.
- 98.W-PE-EIA-PFI-REP-805-DCE020EN-05. Nord Stream 2. Marine mammals in Finnish, Russian and Estonian waters in relation to the Nord Stream 2 project – Expert assessment. DCE/Institute for Bioscience, Aarhus University March 2016.
- 99.G-PE-EIA-REP-000-MRMCLFIE-B. Nord Stream munitions clearance in the Finnish EEZ. Final monitoring results on Munition by munition basis. Witteween + Bos. January 31, 2011.
100. Nord Stream 2 AG (2018). Notification to Fishermen on July 26, 2018.

Maps and GIS data

Background admiralty charts, 2018. Charts are not to be used for navigation. © Crown Copyright and/or database rights. Unauthorized copying prohibited. Reproduced in Sitowise Oy by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.GOV.uk/UKHO) and Bundesamt für Seeschifffahrt und Hydrographie (BSH). Other copyright holders include Finnish Transport Agency, Department of Navigation and Oceanography of the Ministry of Defence of the Russian Federation, and Estonian Maritime Administration.

Baltic Sea Hydrographic Commission, 2013, Baltic Sea Bathymetry Database version 0.9.3. Downloaded from <http://data.bshc.pro/> 2018.

European Environmental Agency (EEA) 2018. Natura 2000 sites. © Directorate-General for the Environment (DG ENV).

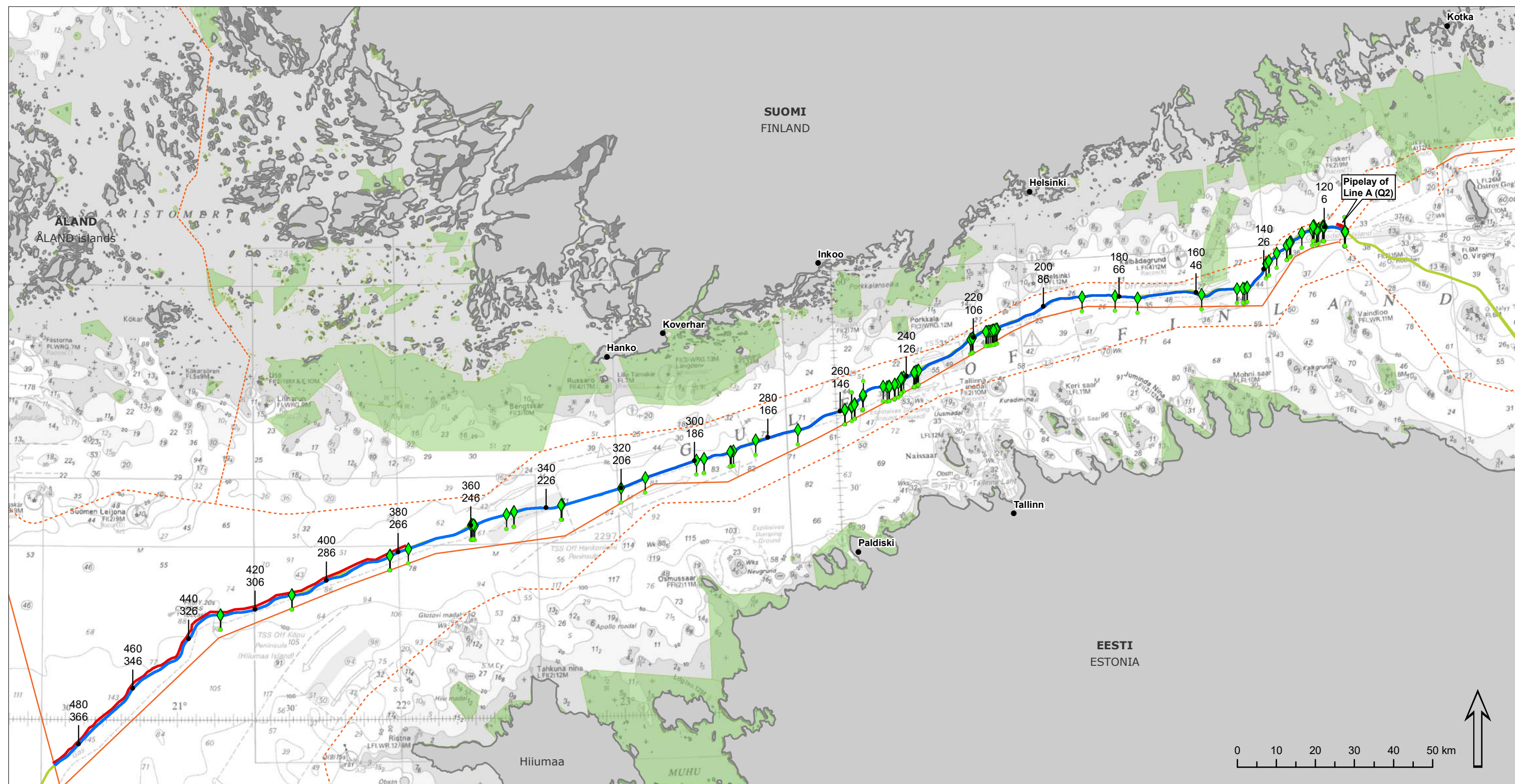
Finnish Environmental Institute (SYKE) 2018. Natura 2000 sites.

HELCOM 2018b. PLC Subbasins.

International Boundaries Research Unit (IBRU) 2010. Borders of Exclusive Economic Zones and Territorial Waters.

Finnish Transport Infrastructure Agency (FTA) 2020. Fairway database, downloaded from WFS on February 18, 2020. <https://julkinen.liikennevirasto.fi/inspirepalvelu/avoim/wfs?request=getcapabilities>

ANNEX 1



Nord Stream 2 Construction activities in 2019

Pipelay

- Pipelay of Line B
- Pipelay of Line A

Rock placement

- Post-lay
- Pre-lay

Reference data

- NSP2 Route
- Territorial water border
- Åland border
- EEZ border

GKP
FKP

Global and Finnish
kilometre point



Natura 2000 site (coastal
and offshore areas)

References:

- Limits of Exclusive Economic Zones and Territorial Waters: IBRU May 2010
- Background sea charts are "Not to be used for navigation"
- Background sea chart; © Crown Copyright and/or database rights. Unauthorized copying prohibited. See further copyright description in the report.
- Natura 2000 sites. EEA and SYKE 2018.

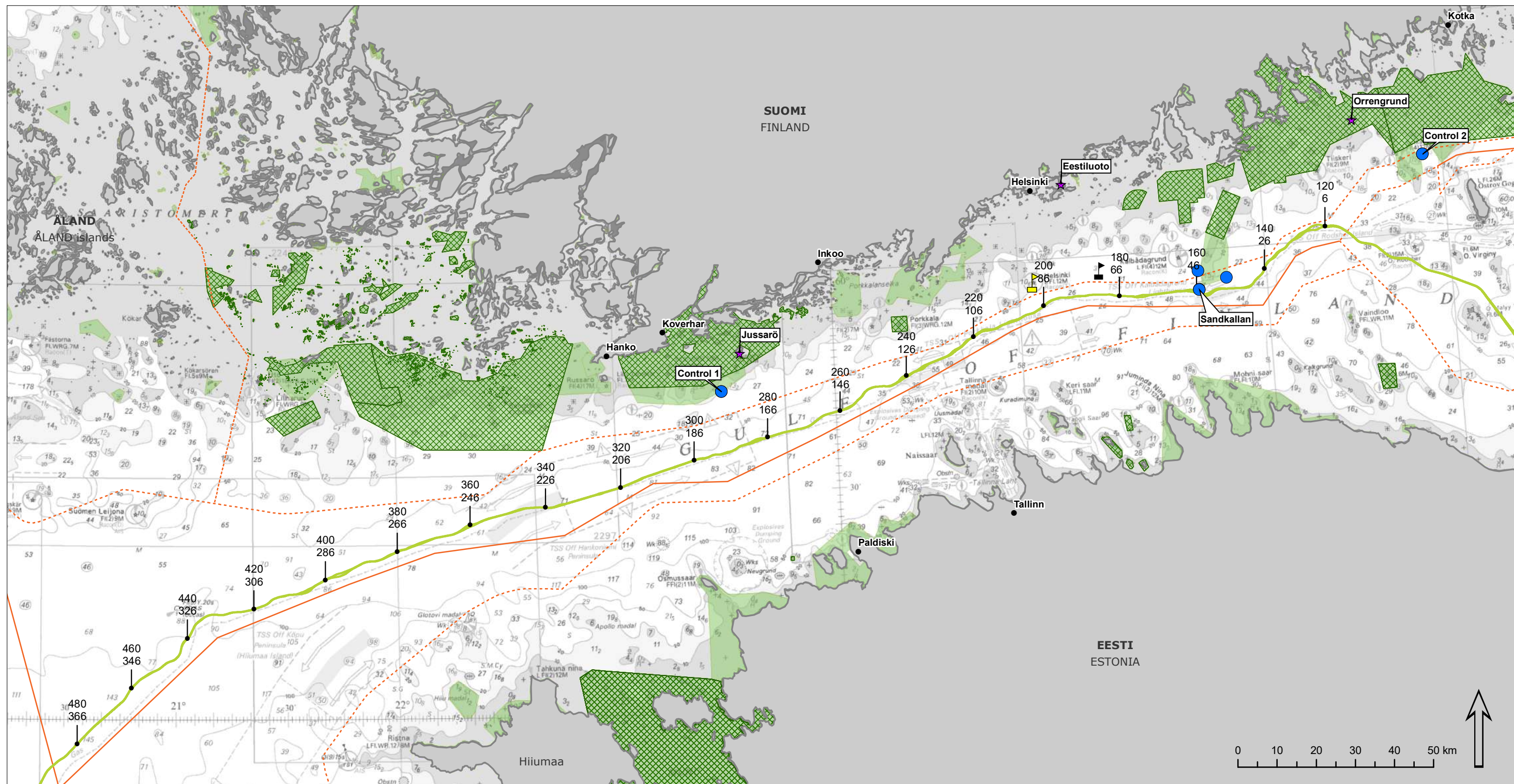
Annex 1

Version: 2019 Annual report EN ver8
Code: W-PE-EMO-PFI-REP-892-AR2019EN-08
Date: 26.5.2020
Prepared: Antti Kinnunen
Controlled: Sanna Vaalgamaa

Construction activities in 2019

SITOWISE

ANNEX 2



Nord Stream 2 Environmental monitoring in 2019

Water quality monitoring

- Long-term monitoring

FMI monitoring stations

- ★ Meteorological station
- 🚩 Wave data
- 🚩 Wind data

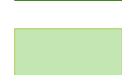
Reference data

- NSP2 Route
- - - Territorial water border
- - - Åland border
- EEZ border

GKP
FKP



Global and Finnish
kilometre point



Natura 2000 site
designated for seals

Natura 2000 site (coastal
and offshore areas)

References:

- Limits of Exclusive Economic Zones and Territorial Waters: IBRU May 2010
- Background sea charts are "Not to be used for navigation"
- Background sea chart; © Crown Copyright and/or database rights. Unauthorized copying prohibited. See further copyright description in the report.
- Natura 2000 sites. EEA and SYKE 2018.

Annex 2

Version: 2019 Annual report EN ver8
Code: W-PE-EMO-PFI-REP-892-AR2019EN-08
Date: 26.5.2020
Prepared: Antti Kinnunen
Controlled: Sanna Vaalgamaa

Environmental monitoring in 2019

SITOWISE