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# **NORD STREAM 2 ENVIRONMENTAL AND SOCIAL MONITORING IN SWEDISH WATERS, 2018**

## NORD STREAM 2

Environmental monitoring in Swedish waters, 2018

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## ABBREVIATIONS AND DEFINITIONS

AIS	Automatic Identification System
AUV	Autonomous Underwater Vehicle
BCM	Billion cubic metres
CHO	Cultural Heritage Object
DP	Dynamically Positioned
DHI	Danish Hydrological Institute
DM	Dry matter (same as dry weight)
EEZ	Exclusive Economic Zone
EPA	Swedish Environmental Protection Agency
ES	Environmental Study
FOI	Swedish Defence Research Agency
GPS	Global Positioning System
KP	Kilometre point
LOI	Loss Of Ignition
MBES	Multibeam echo sounder
NSP	Nord Stream project
NSP2	Nord Stream 2 project
PAH	Polycyclic aromatic hydrocarbon
PIG	Pipeline Inspection Gauge
ROV	Remote Operated Vehicle
SAF	Swedish Armed Forces
SCG	Swedish Coast Guard
SGU	Geological Survey of Sweden
SMA	Swedish Maritime Administration
SMTM	Swedish Maritime and Transport Museums
SSC	Suspended Sediment Concentration
SWAM	Swedish Agency for Marine and Water Management
TOC	Total Organic Carbon
TSS	Traffic Separation Scheme

# 1. SUMMARY

A Swedish translation of this summary is attached as Appendix A.

## 1.1 Introduction

The Nord Stream 2 Pipeline system (NSP2) through the Baltic Sea will deliver natural gas from vast reserves in Russia directly to the European Union (EU) gas market. The twin 1,230 km subsea pipelines will have the capacity to supply about 55 billion cubic metres (bcm) of gas per year in an economical, environmentally safe and reliable way.

NSP2 builds on the successful construction and operation of the existing Nord Stream Pipeline system (NSP), which has been recognised for its high environmental and safety standards, green logistics as well as the transparent public consultation process applied during its development. NSP2 is developed by a dedicated project company: Nord Stream 2 AG.

The NSP2 project envisages construction and subsequent operation of twin subsea natural gas pipelines with an internal diameter of 1,153 mm (48 inches). Each pipeline will require approximately 100,000 24 tonne concrete-weight-coated steel pipes laid on the seabed. Pipe laying started in 2018 and is currently carried out by specialised vessels handling the entire welding, quality control and pipe laying process. Both pipelines will continue to be laid during 2019, to facilitate testing and commissioning of the system at the end of 2019. The route will stretch from the Russian Baltic coast at Kurgalsky Peninsula in Narva Bay to the landfall near Lubmin, Germany. The NSP2 routing is largely parallel to NSP, however, the landfall facilities in both Russia and Germany will be separate from NSP.

As part of the permit commitments in Sweden for the construction and operation of the pipelines, a monitoring program covering activities from 2018 to approx. 2024 within the Swedish EEZ has been elaborated by NSP2 in consultation with the Swedish authorities.

This document provides an overview of said environmental and socio-economic monitoring activities carried out by NSP2 in 2018 (also slightly into 2019 where suitable) within the Swedish EEZ in relation to the following:

- Monitoring of cultural heritage
- Monitoring of ecotoxicological effects
- Monitoring of ship traffic

This document covers the status of monitoring in general terms along with the overall results. Detailed descriptions of environmental monitoring activities and results are presented in specific reports, one for each monitoring module.

This document is the first of seven planned annual reports (2019-2025), the purpose of which is to document the status and the results of the monitoring activities in the Swedish EEZ and if necessary recommend appropriate adjustments to the monitoring scope.

## 1.2 Construction activities in 2018

In 2018, the construction activities for NSP2 were initiated within the Swedish EEZ on 28 July when the vessel Oceanic started to install mattresses over cables to be crossed in the northern part of the Swedish EEZ. Thereafter, other preparatory construction activities (mattress installations and pre-lay rock placement) were performed a few times during Q3 and Q4.

Pipelay was initiated on 23 December when the pipelay vessel *Solitaire* initiated work in the southern part of the Swedish EEZ, close to the Danish EEZ border, laying in a northerly direction. By the end of the year, 27 km of pipes had been laid on the seabed in the Swedish EEZ.

### 1.3 Monitoring of cultural heritage

The purpose of cultural heritage monitoring is to document the condition of cultural heritage objects (CHOs) before and after the construction works.

To verify that the cultural heritage object sites have not been affected by the pipelay, pre- and post-construction surveys are to be performed by a visual inspection by ROV and a MBES (multibeam) survey. Possible impacts of the construction activities to the CHO site /will be detected by having marine-archaeological expertise (SMTM) comparing the pre- and post-lay survey results.

The survey company MMT filmed seven objects that were of interest for the Swedish authorities in the beginning of January 2019, before the pipelines were laid at those locations. SMTM analysed the videos in March/April 2019 and concluded that only three of those objects were wrecks older than 1850 and considered to be ancient monuments. The condition of the seven objects was documented and will be used for comparison when pipelay has been completed.

### 1.4 Monitoring of ecotoxicological effects

Due to questions regarding potential eco-toxicological effects, raised by the Swedish EPA, NSP2 developed a control program to monitor potential ecotoxicological effects in mussels. The monitoring program set-up was divided in a sequence of three different steps to represent actual environmental impacts on the marine fauna/mussels and considered to be a better approach compared to the monitoring set-up for NSP. The three steps included:

1. Sampling and analysis of sediments at the planned trenching site
2. Leaching tests on the sediment samples
3. Laboratory accumulation tests using mussels from trenching region

Whether the monitoring program should proceed to the next step or not depended on the results of the previous step.

The sampling for Step 1 was carried out on 24 November 2017 when six locations were sampled outside Hoburgs bank and Norra Midsjöbanken within two planned trenching sections at different depths.

Only few samples exceeded the guideline values for class 1 according to (Swedish EPA, 1999) (SGU, 2017). The only exception to this was for copper (Cu) where many of the samples did have a "natural" concentration slightly above the reference value for class 1, and where the mean concentration for sediment for the planned post-lay trenching section is "belonging" to class 2. As the copper content is not a result of anthropogenic contamination, and as it is assessed that copper in general is heavily bound to the inorganic mineral structures of the glacial till, the amount of dissolved and bioavailable copper from the trenching activities is assessed to be low. Also taking into account the amount of sediment to be handled, the very short duration that sediment will be in suspension, and the low increased concentration of copper in the sediment, it was assessed that there will be no risk of impacts on marine fauna. The results were also compared to effect-based limit values, prepared by the Swedish Agency for Marine and Water Management for lead, cadmium, anthracene, fluorine, TBT (Swedish Agency for Marine and Water Management, 2013) and copper (Swedish Agency for Marine and Water Management, 2018).

The results were presented to the environmental authorities and it was concluded that there is no sign of any significant anthropogenic contamination of the area where trenching is planned to be

carried out. There is therefore no risk that polluted sediments will spread to the sensitive mussel banks and it was agreed that the ecotoxicological monitoring did not have to proceed to Step 2.

## **1.5 Monitoring of ship traffic**

In the Swedish sector, NSP2 construction activities leads to increased ship traffic in the form of pipe-laying, pipe supply to the lay vessels, mattress installation, rock placement and post-lay trenching. Based on the assessment in the Swedish ES, the activities cause a slightly increased risk of accidents involving third-party vessels. The assessment is based on the expected behaviour of both the construction vessels and the third-party vessels passing the construction vessels. The purpose of the control and monitoring related to marine traffic is to verify that the agreed efforts and measures to minimize the risk of collisions or other accidents (involving commercial shipping traffic and/or vessels carrying out construction activities for the project) are implemented correctly and that they are efficient.

The marine traffic monitoring in Swedish waters includes the following activities:

- Notifications to authorities as agreed (Activity 1);
- Monitor construction ship traffic using AIS (Activity 2);
- Monitor the commercial ship traffic, passing the slow-moving construction vessels (e.g. the lay-vessels), using AIS data (Activity 3)

The methodology included gathering and analysing of construction notifications sent by NSP2 to the authorities as well as daily information sent from the construction ships. For confirmation of actual construction activities within the Swedish EEZ as well as movement to and from the construction locations historical AIS data was analysed.

The results showed that NSP2 followed the commitment in the permit and informed the shipping authorities at least one month before construction work started. Construction vessels did in most of the cases send notifications to the authorities 24 hours before the work was planned to be initiated in Swedish EEZ (and always before any work was initiated). Analysed historic AIS data gathered from the Swedish Maritime Administration confirmed that the movements of the construction vessels were within the reported areas and that official shipping lanes were used for transportation to and from the construction locations.

## 2. INTRODUCTION

### 2.1 Construction permit and commitment related to monitoring

The Nord Stream 2 Pipeline system (NSP2) through the Baltic Sea will deliver natural gas from vast reserves in Russia directly to the European Union (EU) gas market. The twin 1,230 km subsea pipelines will have the capacity to supply about 55 billion cubic metres (bcm) of gas per year in an economical, environmentally safe and reliable way.

NSP2 builds on the successful construction and operation of the existing Nord Stream Pipeline system (NSP), which has been recognised for its high environmental and safety standards, green logistics as well as the transparent public consultation process applied during its development. NSP2 is developed by a dedicated project company: Nord Stream 2 AG.

The NSP2 project envisages construction and subsequent operation of twin subsea natural gas pipelines with an internal diameter of 1,153 mm (48 inches). Each pipeline will require approximately 100,000 24 tonne concrete-weight-coated steel pipes laid on the seabed. Pipe laying will be done by specialised vessels handling the entire welding, quality control and pipe laying process. Pipe laying began in 2018 and is ongoing, to facilitate testing and commissioning of the system at the end of 2019. The route will stretch from the Russian Baltic coast at Kurgalsky Peninsula in Narva Bay to the landfall near Lubmin, Germany. The NSP2 routing is largely parallel to NSP. The landfall facilities in both Russia and Germany will be separate from NSP.

Kilometre Points (KPs) presented in this report are Global KPs, with KP 0 being at the Russian landfall. The KPs for the 512 km long Line B (East) through the Swedish EEZ range between the global KPs 488 and 1000.

Nord Stream 2 AG has been granted a permit for the construction and operation of the two pipelines. The permit was issued by the Swedish Government on 7 June 2018. According to the permit and the project's commitments, the monitoring program shall include:

- Environmental Monitoring modules, such as sediment spreading and release of contaminants during intervention works and the impacts of this on mussel banks. Furthermore, NSP2 committed to measure that turbidity during trenching do not exceed 15 mg/l above the natural background values at Hoburgs bank and Norra Midsjöbanken.
- Socio-Economic Monitoring modules, such as shipping (e.g. that agreed communication procedures are followed) and that Cultural Heritage Objects should be avoided.

### 2.2 Environmental and socio-economic monitoring

The program presented in this document focuses on the monitoring activities that were carried out based on work performed in the Swedish EEZ in 2018 (also slightly into 2019 where suitable) and includes:

- Monitoring of cultural heritage
- Monitoring of ecotoxicological effects
- Monitoring of ship traffic

The document covers the status of monitoring in general terms along with the overall results. Detailed descriptions of environmental and socio-economic monitoring activities and results are presented in specific monitoring reports, one for each monitoring module.

The monitoring program (Ramboll, 2018) has been finalised in consultation with the Swedish Coast Guard, the SGU, the Swedish Environmental Protection Agency (EPA), the Swedish Maritime



Administration, the Swedish Transport Agency, the Swedish Agency for Marine and Water Management (SwAM) and the SMHI and has been adjusted where necessary to accommodate permit condition and permit commitments.

## 2.3 Purpose of the document and reading instructions

This document provides an overview of all environmental and socio-economic monitoring activities carried out by NSP2 in 2018 (also slightly in to 2019 where suitable) within the Swedish EEZ. It is the first of seven planned annual reports (2019-2025), the purpose of which is to document the status and the results of the monitoring activities in the Swedish EEZ and if necessary recommend appropriate adjustments to the monitoring scope (see table below). The reports are planned to be submitted in May/June each year and cover all activities undertaken the previous year.

**Table 1 Preliminary schedule for NSP2 environmental and social reporting**

Monitoring target	2019	2020	2021	2022	2023	2024	2025
<b>Sediment transport</b> (after construction) <sup>1</sup>		*				*	
<b>Turbidity in Natura 2000 area</b> (during construction)		*					
<b>Ecotoxicological effects</b> (prior, during and after construction)	*						
<b>Benthic fauna</b> - reef effect (after construction) <sup>1</sup>					*		*
<b>Commercial fishery</b> (prior and after construction) <sup>1</sup>				*			
<b>Cultural heritage</b> (prior and after construction)	*	*					
<b>Ship traffic</b> (during construction)	*	*					
<b>Underwater noise</b> (prior and during construction)		*					
<b>Technical Inspections</b> (during operations) <sup>2</sup>			*	*		*	

<sup>1</sup> Might also be reported after 2024/2025

<sup>2</sup> The frequency depends on the results from previous inspections, but this will be monitored during the whole operation phase

This document starts with a summarised description, in Chapter 3, of all construction activities undertaken in 2018. In Chapter 4, the status of the monitoring of the environmental parameters is described, followed by a status of the monitoring of socio-economic parameters in Chapter 5. A comparison with the results of the monitoring and the assessments made in the Environmental Study is presented in Chapter 6, followed by conclusions and recommendations in Chapter 7.

The monitoring activities are divided into eight different modules in accordance with the alignment below.

- Environmental parameters:
  - Monitoring of benthic fauna
  - Monitoring of ecotoxicological effects
  - Monitoring of turbidity
  - Monitoring of underwater noise
  - Monitoring of sediment transport
  
- Socio-economic parameters:
  - Monitoring of commercial fishery
  - Monitoring of cultural heritage
  - Monitoring of ship traffic

It should be noted that the focus of the monitoring modules in 2018 is baseline monitoring. The monitoring of potential environmental effects of the pipelay only starts in 2019, when most of the construction activities take place in the Swedish EEZ and will hence be reported in the yearly report in 2020.

### 3. CONSTRUCTION ACTIVITIES IN 2018

On 7 June 2018, the Swedish government granted the construction permit for NSP2. Shortly thereafter, on 28 July, the construction activities were initiated within the Swedish EEZ. The first work performed was mattress installations at cable crossings in the northern part of the Swedish EEZ.

In Figure 1, construction activities during 2018 are shown. Depending on the specific activity, the location along the pipeline route and the period when the activity was undertaken, construction works may result in effects on the marine environment. Therefore, the planned construction works form the basis for the set-up of the monitoring program (Ramboll , 2018), which has been discussed and agreed together with the Swedish authorities. In this chapter, the construction activities performed in 2018 are briefly described. No unexpected or risk related events occurred during the construction works in 2018. The initial monitoring results are presented in the following chapters.

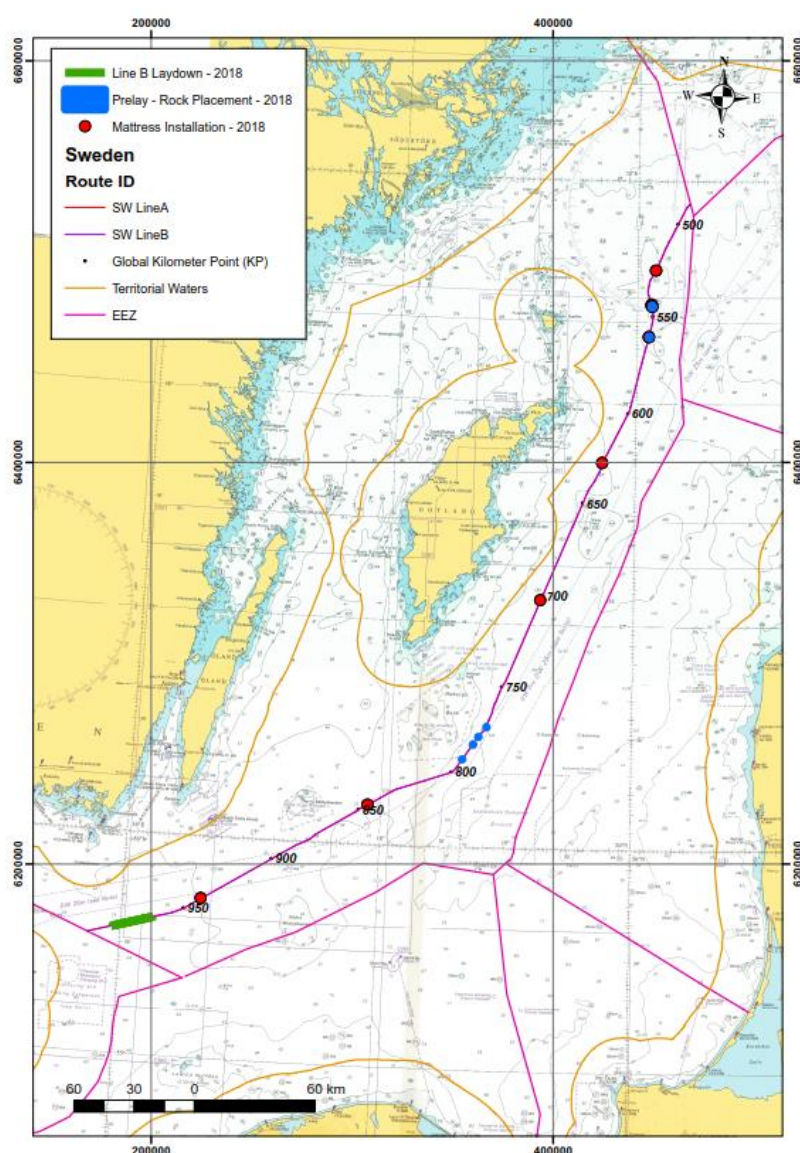


Figure 1 Construction activities in 2018

### 3.1 Cable and pipeline crossings (mattress and rock installations)

The construction of the pipelines necessitated the crossing of several fibre optic and power cables as well as the existing Nord Stream pipelines. Each cable crossing was designed to e.g. take into consideration the specific crossing angle, the cable burial depth and the type of cable. Most crossing designs included the installation of concrete mattresses on the existing infrastructure to provide the required separation between the NSP2 pipelines and the already existing cables/pipelines.

The mattress installation activities for NSP2 was carried out by the company Allseas (the main pipelay contractor) and it utilised the vessel Oceanic to perform the work. The work took place at various times between 28 July and 20 October and the scope covered all cables and pipelines to be crossed, with the exception of the SwePol cables, for both pipelines. The mattresses over the SwePol cables are planned to be installed in the summer 2019. In Figure 2, the process of laying mattresses and how it looks on the seabed is shown.

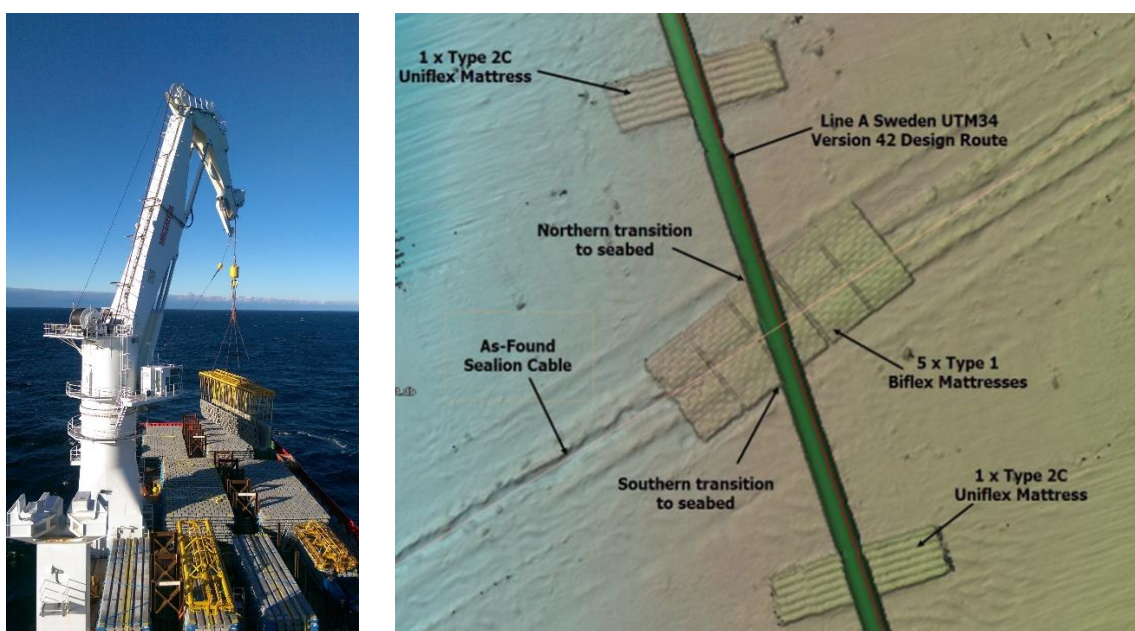
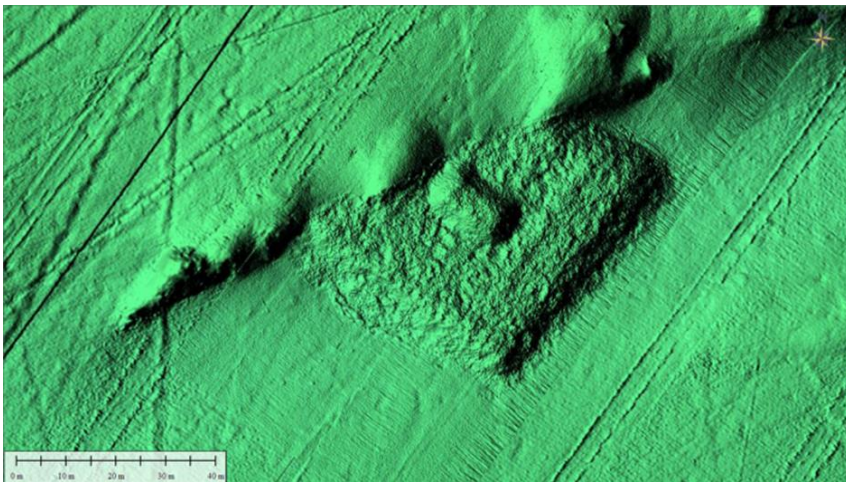
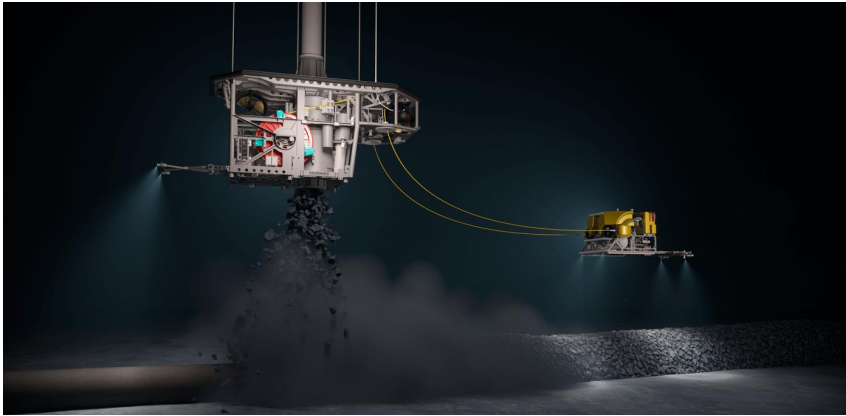


Figure 2 Mattresses being laid and as seen from above when lying on the seabed

### 3.2 Rock placement

The contractor for the rock placement scope for NSP2 is the joint venture BoVo (the companies Boskalis and Van Oord). The vessels used for the Swedish pre-lay scope in 2018 were Bravenes and Nordnes. The rock placement activities were performed from 15 August (when Bravenes initiated its work) and onwards. The work scope also includes the rocks that are required for the crossings of the Nord Stream pipelines and the LVS1 telecom cable. The total amount of rocks placed within the Swedish sector in 2018 was around 110,000 tons, which equals approx. 75,000 m<sup>3</sup>. For most positions, the expected amounts of rock were placed, but a few berms needed additional loads in order for the technical specification criteria to be met. Figure 3 shows the rock placement process with a fallpipe and how a typical pre-lay rock berm looks on the seabed from above.





**Figure 3 Pre-lay rock placement, seen from above**

### 3.3 Pipelay

As stated above, the contractor for the offshore pipelay scope is Allseas. All pipelay works in the Swedish EEZ are carried out by so called DP (Dynamically Positioned) lay-vessels. This means that the vessels maintain position with the help of GPS and thrusters and that no anchors are needed for such purposes.

Preparatory works started on 5 December by the survey vessel Fortitude (supported by the tug vessel Union Bear). Pipelay was thereafter initiated on 23 December when the DP lay-vessel Solitaire started laying down the pipeline to the seabed at KP 994, ca 6 km from the Danish EEZ border. Pipelay was carried out in a northerly direction and had reached KP 966 by the late evening on 31 December. During these nine days of work, approx. 27 km of pipes were laid within the permitted corridor on the seabed, equivalent to an average daily rate of 3 km. A safety zone of one nautical mile (1,852 m) was requested around the lay-vessel, which was communicated to third party maritime traffic via the Swedish Notice to Mariners.

Normally, four pipe carriers (transporting pipes from the stockyard at the Karlshamn harbour) supported the lay-vessel Solitaire. In addition, one general supply vessel (Alegria) was operating from the supply base in Karlshamn and one survey vessel (Fortitude) performed pre-lay and as-laid surveys, as well as supporting Solitaire with touchdown monitoring in order to confirm the correct positioning of the pipeline on the seabed.

## 4. ENVIRONMENTAL MONITORING

### 4.1 Monitoring of sediment transport

Monitoring of sediment transport will be performed in order to verify that the pipelines will not impact the topographical environment along the route, and that the pipelines (including rock berms) will not significantly hinder natural sediment movements.

#### 4.1.1 Method for monitoring of sediment transport

The sediment height will be measured using a multibeam echo sounder (MBES) at nine positions in transects across the pipelines. The collected data from the maintenance surveys will be compared to the data captured in the "as build survey" (which will be performed after the construction activities have been completed) to detect any possible changes in the surrounding seabed up to 5 m from the installed pipeline.

#### 4.1.2 Monitoring and results 2018

No monitoring was carried out in 2018 and results from 2019 will therefore be presented in 2020.

### 4.2 Monitoring of turbidity in Natura 2000 area

The focus of the monitoring of turbidity will be the environmental values on the shallow banks of Hoburgs bank and Norra Midsjöbanken (within the Natura 2000 area of Hoburgs bank and Midsjöbankarna) where precaution will be taken to avoid any high levels of suspended sediments during an extended period of time. Numerical modelling of the sediment dispersion has been carried out for NSP2. The modelling has shown that increased sediment concentrations as a result of seabed interventions work in Swedish waters will be limited to the close vicinity of the construction sites. The purpose of the program for monitoring of dispersion of released sediments is to verify the modelling results and control that the threshold value of 15 mg/l above the natural background values at the boundaries of the banks is not exceeded.

#### 4.2.1 Method for monitoring of turbidity

As the assumed sediment spill rate from trenching is 1-2 orders of magnitude larger than the assumed sediment spill rate from rock placement, the sediment spill monitoring will only measure turbidity arising from trenching. Turbidity is a well-recognized parameter for monitoring of suspended matter in water and it is recommended to use turbidity sensors for sediment tracking. Vessel-based monitoring will take place in trenching sections close to the important banks. Results of suspended sediment concentration (SSC) from the NSP-modelling will be used as a function of the distance from the trenching site under the assumption that the concentration of 15 mg/l above the natural background values will not be exceeded. In case a concentration limit near the trenching site is exceeded, depending on current velocities and direction, control transects are immediately to be performed between the pipeline and the nearest bank. If the thresholds are exceeded in several transects in the direction of the banks, suitable mitigation measures will be initiated (this could e.g. be: slowing down the trenching speed, delaying start of next trenching section, pausing work awaiting lower turbidity levels or shifting the order of sections to be trenched).

#### 4.2.2 Monitoring and results 2018

No monitoring was carried out in 2018 and results from 2019 will therefore be presented in 2020.

### 4.3 Monitoring of ecotoxicological effects

Due to questions raised by the Swedish EPA regarding potential eco-toxicological effects, NSP2 developed a control module to monitor potential ecotoxicological effects in mussels. The monitoring of ecotoxicological focuses on effects on biota caused by release of sediment and associated contaminants during the construction work.

#### 4.3.1 Monitoring program, purpose and period of monitoring

The ecotoxicological monitoring program has been designed with the objective to:

- Describe and evaluate potential effects on the Common mussel inside Hoburgs bank and Norra Midsjöbanken from contaminants brought in suspension during post-lay trenching activities along the pipeline route.
- Evaluate the results and conclusions described in the Swedish ES and the concerns raised by the Swedish EPA and other stakeholders, regarding environmental effects from a potential increased concentration of contaminants.

To set up a meaningful monitoring program for the assessment of the environmental impacts on mussels at the border of the two banks, it was important to know the type of impact that can be foreseen. For instance, the type and concentration of contaminants that potentially can be dissolved in the water environment from trenching and the concentration of dissolved contaminants at the border of the two banks. More so, the duration of the impacts (the time that mussels will be exposed to increased concentrations of contaminants), and the period of the year when impact may occur.

Based on the results from the environmental survey carried out in 2015 (DHI, 2015) and the sediment properties (glacial erosion bottom), increased concentrations of contaminants were not expected. The Swedish EPA, however, requested that more substances were to be measured and that the measurements should be taken at deeper levels, representing sediment that could be brought in suspension by trenching.

The sampling for Step 1 was carried out on 24 November 2017.

#### 4.3.2 Methods for NSP2 ecotoxicological monitoring

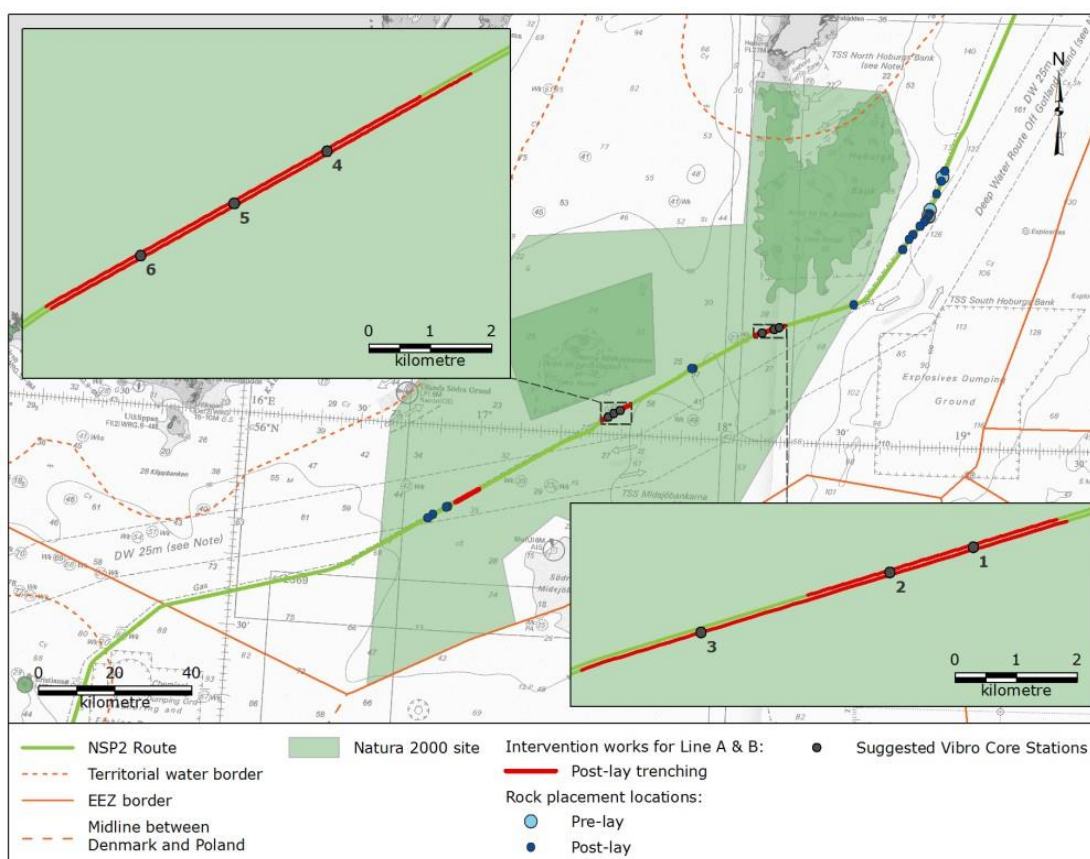
The monitoring program set-up (Ramboll, 2018) was divided in three different steps to represent actual environmental impacts on the marine fauna/mussels and considered to be a better approach compared to the monitoring set-up for NSP. This since a long-term test with mussel frames in the Natura 2000 area might provide ambiguous data, in which it will be difficult to distinguish and make any conclusions about the contribution from the NSP2 project compared to other activities (including bottom trawling) and natural occurrences. The three steps are:

1. Sampling and analysis of sediments at the planned trenching site
2. Leaching tests on the sediment samples
3. Laboratory accumulation tests using mussels from trenching region

Whether the monitoring program should proceed to the next step or not depended on the results of the previous step. The different steps are described in more detail below even though the monitoring was finalised after Step 1. Results are described in 4.3.3.

##### 4.3.2.1 Step 1

Includes sampling at six stations, with three stations at the planned trenching south of Hoburgs bank, and three stations at the trenching section at Norra Midsjöbanken. The locations of the sediment sampling stations are shown in Figure 4.



**Figure 4 Sediment monitoring stations 1 – 6 at the two selected trenching sections**

Vibrocore samples to a depth down to 1.5 m below the seabed surface will be sampled in order to represent sediment that can be brought in suspension by trenching. Sediment samples for chemical analyses for content of contaminants (metals and organic substances) were taken at depths: 0 -0.02 m, 0 -0.5 m, 0.5 -1.0 m, and 1.0 -1.5 m. Furthermore, analyses of dry matter (DM), total organic carbon (TOC), and loss of ignition (LOI) are carried out on all samples.

If results from chemical analyses for substances is in line with previous results from 2015, and results from substances not analysed in 2015 are below detection limit or in accordance with guideline values (Swedish EPA, 1999) (SGU, 2017), no additional steps are deemed necessary.

If results show increased content of contaminants of any significance, then monitoring must continue, see step 2.

#### 4.3.2.2 Step 2

Includes leaching tests on the vibrocore sediment samples by using natural seawater at a temperature according to the temperature when trenching is planned to be carried out. As a most conservative approach, the leaching test should be undertaken for a period comparable to the duration of the trenching activities inclusive the period from where sediment is brought in suspension and until it would reach the border of the Natura 2000 areas.

Leaching water is to be analysed for the specific contaminants that in Step 1 were found with increased concentrations.

If results from the leaching test show concentrations of contaminants below detection limit or in accordance with guideline values for substances according to (Swedish EPA, 1999) and (Swedish



Agency for Marine and Water Management , 2013), as well as the EU Directive 2013/39/EU, then it is proposed to finalize monitoring, as there will be no risk of impacts.

If the result shows increased concentrations of contaminants in the leaching water then monitoring must continue, see Step 3.

#### **4.3.2.3 Step 3**

Laboratory accumulation tests using mussels from the region with trenching is done, using sediment from location and/or leaching water.

The time for mussels to be exposed to seawater with increased content of contaminants is preliminary assessed to be between two – five days.

Mussel tissue and water samples from the mussel tests will be analysed for content of contaminants both before and after the mussel accumulation test have been carried out.

The numbers of tests/analyses to be carried out have to be agreed upon so that the results will be statistically solid.

#### **4.3.3 Monitoring and results 2018**

A report with analysed results from Step 1 was sent to the environmental authority group on 18 October ahead of the meeting on 24 October. The results from the physical and chemical measurements/analyses are shown in Table 2 to Table 6. Results shown in tables are compared with Swedish guideline values.

It was planned to take sediment samples for chemical analyses at stations 1 – 6 by both vibrocore and haps core sampler. The planned vibrocore samples down to 1.5 m below the seabed were carried out for all stations. Haps core of the surface sediment was only possible for four of the stations. At stations 2 and 6 it was not possible, despite several attempts, to take the surface samples because of the very hard bottom/stony bottom conditions.

Table 2 Results from physical and chemical analyses of sediment samples from stations 1–6

Station <sup>2</sup>	Sample depth	Dry matter	LOI	TOC	As	Pb	Cd	Cr	Cu
	M	% <sup>1</sup>	% of DM		mg/kg DM				
1	0-0.02	81.0/82.3	0.2	0.070	<1.0	5.6	<0.10	2.2	3.1
	0-0.5	84.6/85.4	1.8	0.18	3.7	13	0.11	25	14
	0.5-1.0	85.0/85.6	1.1	0.17	3.3	13	0.13	22	13
	1.0-1.5	86.5/86.8	1.3	0.17	3.5	12	0.12	21	13
2 <sup>2</sup>	0-0.5	82.9/83.8	1.3	0.17	3.3	13	0.16	27	17
	0.5-1.0	83.3/85.0	1.4	0.20	3.8	15	0.28	31	18
	1.0-1.5	83.4/83.5	1.9	0.27	3.6	15	0.16	35	20
3	0-0.02	83.3/83.6	0.2	0.053	<1.0	5.3	<0.10	2.6	7.5
	0-0.5	83.6/85.0	0.3	<0.050	<1.0	4.9	<0.10	11	6.5
	0.5-1.0	89.7/90.7	0.8	0.15	3.3	10	<0.10	19	15
	1.0-1.5	89.8/90.9	1.1	0.27	3.5	12	0.12	22	17
4	0-0.02	76.2/78.4	1.5	0.27	4.6	15	<0.10	30	20
	0-0.5	76.2/75.5	1.6	0.19	4.6	16	<0.10	41	22
	0.5-1.0	73.7/76.4	2.2	0.22	5.2	18	0.16	49	25
	1.0-1.5	75.3/77.4	2.0	0.20	5.8	17	0.13	44	23
5	0-0.02	79.9/83.4	1.6	0.19	10	16	<0.10	40	17
	0-0.5	80.9/81.8	1.9	0.22	4.2	15	0.11	34	32
	0.5-1.0	82.2/83.0	2.4	0.20	4.6	17	0.15	36	35
	1.0-1.5	81.7/82.7	1.7	0.19	4.3	15	0.15	33	35
6 <sup>2</sup>	0-0.5	84.9/82.7	2.2	0.24	<1.0	4.3	<0.10	8.4	17
	0.5-1.0	87.4/87.9	1.6	0.15	5.7	14	0.35	29	22
	1.0-1.5	89.7/90.9	1.2	0.11	6.0	19	0.12	31	22
Guideline value <sup>3</sup>		Klass 1 (Mycket låg halt)			≤10	≤31	≤0.2	≤80	≤15
		Klass 2 (Låg halt)			≤17	≤49.6	≤0.5	≤96	≤30
		Klas 3 (Medelhög halt)			≤28	≤80.6	≤1.2	≤120	≤49.5
<div>1. A/B where A is dry matter analyses on de-frozen samples, and B is dry matter by freeze drying.</div> <div>2. HAPS sampling (0-0.02 m depth) from station 2 and 6 could not be carried out because of hard/stony seabed.</div> <div>3. Swedish Environmental protection agency. 2000. Environmental quality criteria. Coasts and seas. Report 5052.ISBN: 91-620-5052-4 /2/.</div>									

Table 3 Results from physical and chemical analyses of sediment samples from stations 1–6

Station <sup>2</sup>	Sample depth	Dry matter	LOI	TOC	Co	Hg	Ni	V	Zn
	M	% <sup>1</sup>	% of DM		mg/kg DM				
1	0-0.02	81.0/82.3	0.2	0.070	<1.0	<0.020	1.5	5.0	12
	0-0.5	84.6/85.4	1.8	0.18	7.4	<0.020	19	29	55
	0.5-1.0	85.0/85.6	1.1	0.17	6.8	<0.020	18	28	49
	1.0-1.5	86.5/86.8	1.3	0.17	6.5	<0.020	17	27	47
2	0-0.5	82.9/83.8	1.3	0.17	7.0	<0.020	18	37	73
	0.5-1.0	83.3/85.0	1.4	0.20	8.0	<0.020	20	39	76
	1.0-1.5	83.4/83.5	1.9	0.27	8.5	<0.020	22	45	60
3	0-0.02	83.3/83.6	0.2	0.053	<1.0	<0.020	1.6	5.7	13
	0-0.5	83.6/85.0	0.3	<0.050	1.1	<0.020	6.6	7.8	16
	0.5-1.0	89.7/90.7	0.8	0.15	5.7	<0.020	13	26	47
	1.0-1.5	89.8/90.9	1.1	0.27	5.8	<0.020	15	27	46
4	0-0.02	76.2/78.4	1.5	0.27	8.0	<0.020	22	40	56
	0-0.5	76.2/75.5	1.6	0.19	11	<0.020	28	52	67
	0.5-1.0	73.7/76.4	2.2	0.22	13	<0.020	33	58	85
	1.0-1.5	75.3/77.4	2.0	0.20	12	0.021	32	52	74
5	0-0.02	79.9/83.4	1.6	0.19	11	0.030	27	49	78
	0-0.5	80.9/81.8	1.9	0.22	9.0	0.021	25	42	60
	0.5-1.0	82.2/83.0	2.4	0.20	9.6	0.021	26	43	61
	1.0-1.5	81.7/82.7	1.7	0.19	9.2	0.020	26	39	59
6	0-0.5	84.9/82.7	2.2	0.24	1.9	0.027	7.2	2.1	16
	0.5-1.0	87.4/87.9	1.6	0.15	9.5	0.036	28	30	86
	1.0-1.5	89.7/90.9	1.2	0.11	7.6	0.025	24	33	55
Guideline value <sup>3</sup>		Klass 1 (Mycket låg halt)			≤14	≤0.04	≤33	-	≤85
		Klass 2 (Låg halt)			≤23.8	≤0.12	≤49.5	-	≤127.5
1. A/B where A is dry matter analyses on de-frozen samples, and B is dry matter by freeze drying.									
2. HAPS sampling from station 2 and 6 could not be carried out because of hard/stony seabed.									
3. Swedish Environmental protection agency. 2000. Environmental quality criteria. Coasts and seas. Report 5052.ISBN: 91-620-5052-4 /2/.									

Table 4 Results from physical and chemical analyses of sediment samples from stations 1–6

Station	Sample depth	Organotin <sup>2</sup>	Total PAH <sup>3</sup>	Phenols <sup>4</sup>	PCB <sup>5</sup>
	(m)	µg/kg DM			
1	0-0.02	<0.1	<5	<0.1	<0.1
	0-0.5	<0.1	<5	<0.1	<0.1
	0.5-1.0	<0.1	<5	<0.1	<0.1
	1.0-1.5	<0.1	<5	<0.1	<0.1
2	0-0.5	<0.1	<5	<0.1	<0.1
	0.5-1.0	<0.1	<5	<0.1	<0.1
	1.0-1.5	<0.1	<5	<0.1	<0.1
3	0-0.02	<0.1	<5	<0.1	<0.1
	0-0.5	<0.1	<5	<0.1	<0.1
	0.5-1.0	<0.1	<5	<0.1	<0.1
	1.0-1.5	<0.1	<5	<0.1	<0.1
4	0-0.02	<0.1	24.9 <sup>6</sup>	<0.1	<0.1
	0-0.5	<0.1	<5	<0.1	<0.1
	0.5-1.0	<0.1	<5	<0.1	<0.1
	1.0-1.5	<0.1	<5	<0.1	<0.1
5	0-0.02	<0.1	6.6 <sup>7</sup>	<0.1	<0.1
	0-0.5	<0.1	<5	<0.1	<0.1
	0.5-1.0	<0.1	<5	<0.1	<0.1
	1.0-1.5	<0.1	<5	<0.1	<0.1
6	0-0.5	<0.1	<5	<0.1	<0.1
	0.5-1.0	<0.1	5.1 <sup>8</sup>	<0.1	<0.1
	1.0-1.5	<0.1	<5	<0.1	<0.1

1. HAPS sampling from station 2 and 6 could not be carried out because of hard/stony seabed.  
 2. Organotin: (Tri-dioctyl-dibutyl-monobutyl – triphenyl)-tin-cation.  
 3. Sum of 16 EPA PAH compounds.  
 4. Phenols: 4-tert-octylphenol (detection limit: 1 µg/kg DM), 4-n-Nonylphenol (detection limit: 1 µg/kg DM), iso-Nonylphenol ((detection limit: 10 µg/kg DM).  
 5. Sum PCB congener: PCB 28, 52, 101, 118, 138, 153, 180.  
 6. Benzo(b)fluranthen: 7.5 µg/kg DM. Indeno(1,2,3-cd)pyren: 5.7 µg/kg DM. Benzo(g,h,i)perylene: 5.0 µg/kg DM.  
 7. Phenanthren.  
 8. Fluoranthen.  
 9. S. Josefsson. 2017. Klassning av halter av organiska föroreningar i sediment. SGU-rapport 2017:12


 : Guideline value for "Klass 2 (Låg halt)" according to 9 /3/.



Table 5 Results from physical and chemical analyses of sediment samples from stations 1–6

Station	Sample depth (m)	Phtalats			Pesticides	
		Phtalat 1 <sup>2</sup>	DiNP <sup>3</sup>	DiDP <sup>4</sup>	Chlordan/HCH <sup>5</sup>	DDE/DDD/DDT <sup>6</sup>
		mg/kg DM				
1	0-0.02	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0-0.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0.5-1.0	<0.050	<2.5	<2.5	<0.00010	<0.00010
	1.0-1.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
2	0-0.5	<0.050	3.5	<2.5	<0.00010	<0.00010
	0.5-1.0	<0.050	<2.5	<2.5	<0.00010	<0.00010
	1.0-1.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
3	0-0.02	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0-0.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0.5-1.0	<0.050	<2.5	<2.5	<0.00010	<0.00010
	1.0-1.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
4	0-0.02	<0.050	<2.5	<2.5	<0.00010	<0.00010 p,p-DDD: 0.00013 o,p-DDT: 0.00018
	0-0.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0.5-1.0	<0.050	<2.5	<2.5	<0.00010	<0.00010
	1.0-1.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
5	0-0.02	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0-0.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0.5-1.0	<0.050	<2.5	<2.5	<0.00010	<0.00010
	1.0-1.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
6	0-0.5	<0.050	<2.5	<2.5	<0.00010	<0.00010
	0.5-1.0	<0.050	<2.5	<2.5	<0.00010	<0.00010
	1.0-1.5	<0.050	<2.5	<2.5	<0.00010	<0.00010

1. HAPS sampling from station 2 and 6 could not be carried out because of hard/stony seabed.  
 2. Phtalat 1: DEP (Diethylphtalat), DIBP (Di-iso-Butylphtalat), DEHP (Bis(2-ethylhexyl)phtalat), DBP (Dibutylphtalat), BBzP (Butylbenzylphtalat).  
 3. Diisononylphtalat.  
 4. Diisodecylphtalat.  
 5. Cis -/trans Chlordan, Alpha-, beta-, gamma-, delta HCH.  
 6. o,p-DDE. p,p-DDE. o,p-DDD. p,p-DDD. o,p-DDT. p,p-DDT.  
 7. S. Josefsson. 2017. Klassning av halter av organiska föroreningar i sediment. SGU-rapport 2017:12


 : Guideline value for "Klass 2 (Låg halt)" according to 7 /3/.

Table 6 Results from physical and chemical analyses of sediment samples from stations 1–6

Station	Sample depth	Pesticides		- <sup>4</sup> PFOA, PFOS <sup>4</sup>	Bromiated flame retardants	
		Nonachlor <sup>2</sup>	HCB <sup>3</sup>		PBDE <sup>5</sup>	HBCDD <sup>6</sup>
	(m)	µg/kg DM				
1	0-0.02	<0,50	<0.10	<3.0	<0.050	<5.0
	0-0.5	<0,50	<0.10	<3.0	<0.050	<5.0
	0.5-1.0	<0,50	<0.10	<3.0	<0.050	<5.0
	1.0-1.5	<0,50	<0.10	<3.0	<0.050	<5.0
2	0-0.5	<0,50	<0.10	<3.0	<0.050	<5.0
	0.5-1.0	<0,50	<0.10	<3.0	<0.050	<5.0
	1.0-1.5	<0,50	<0.10	<3.0	<0.050	<5.0
3	0-0.02	<0,50	<0.10	<3.0	<0.050	<5.0
	0-0.5	<0,50	<0.10	<3.0	<0.050	<5.0
	0.5-1.0	<0,50	<0.10	<3.0	<0.050	<5.0
	1.0-1.5	<0,50	<0.10	<3.0	<0.050	<5.0
4	0-0.02	<0,50	<0.10	<3.0	<0.050	<5.0
	0-0.5	<0,50	<0.10	<3.0	<0.050	<5.0
	0.5-1.0	<0,50	<0.10	<3.0	<0.050	<5.0
	1.0-1.5	<0,50	<0.10	<3.0	<0.050	<5.0
5	0-0.02	<0,50	<0.10	<3.0	<0.050	<5.0
	0-0.5	<0,50	<0.10	<3.0	<0.050	<5.0
	0.5-1.0	<0,50	<0.10	<3.0	<0.050	<5.0
	1.0-1.5	<0,50	<0.10	<3.0	<0.050	<5.0
6	0-0.5	<0,50	<0.10	<3.0	<0.050	<5.0
	0.5-1.0	<0,50	<0.10	<3.0	<0.050	<5.0
	1.0-1.5	<0,50	<0.10	<3.0	<0.050	<5.0

1. HAPS sampling from station 2 and 6 could not be carried out because of hard/stony seabed.

2. Trans-Nonachlor.

3. Hexachlorbenzen.

4. Perfluorinated compounds: Perfluorooctanoic acid (PFOA). Perfluorooctanesulfonic acid (PFOS).

5. Polybrominated diphenyl ethers (PBDE 28, 47, 99, 100).

6. Hexabromocyclododecane (brominated flame retardant).

7. S. Josefsson. 2017. Klassning av halter av organiska föroreningar i sediment. SGU-rapport 2017:12

: Guideline value for "Klass 2 (Låg halt)" according to 7 /3/.

The composition of the sediment at stations 1 – 6 showed an undisturbed intact sediment profile of glacial till. The uppermost surface sediment was in general characterized by coarse sediment where the fine particulate material had been eroded away.

The lowest concentrations of the different analysed metals were found in the surface sediment layer where, as described above, the fine particulate material had been eroded away, while natural higher concentrations of metals were located in the intact glacial till. Based on the results shown in Table 2 and Table 3 concentrations of the metals copper (Cu), cadmium (Cd) and zinc (Zn) were found with concentrations above the Swedish guideline value for class 1.

For organic contaminants (see Table 4 to Table 6) most of the parameters could not be detected (concentrations below the detection limit). Where organic contaminants have been measured is related to the surface sediment layer (except for the low content of fluoranthene in station 6, - possible in the clay layer from 0.35 – 0.6 m depth). As expected, no organic contaminants were

found in glacial till below the seabed surface. The low concentration of organic contaminants in the few samples found at station 2, 4, 5 and 6 can be interpreted as sediment that has been temporary re-sedimented from other areas with content of organic contaminants. The only substances measured above the detection limit was diisononylphtalat (one sample of 22 samples), substances of polycyclic aromatic hydrocarbons (three samples of 22 samples), and Dichlorodiphenyldichloroethane (DDD) and Dichlorodiphenyltrichloroethane (DDT) (one sample of 22 samples). Only for p,p-DDD was the concentration measured above the Swedish guideline value for class 1.

When looking on the mean concentration for each substance there was no exceedance of the guideline values for class 1 for the planned trenching section south of Hoburgs Bank. Along the trenching site south of Norra Midsjöbanken the copper concentration is increased when compared to the class 1 value with a factor of 1.7 (Swedish EPA, 1999).

Overall, based on results from analyses of sediment samples there were only a few samples found where the guideline values for class 1 were exceeded according to (Swedish EPA, 1999) (SGU, 2017). The only exception to this is for copper (Cu) where many of the samples did have a "natural" concentration slightly above the reference value for class 1, and where the mean concentration for sediment for the planned post-lay trenching section is "belonging" to class 2. As the copper content isn't a result of anthropogenic contamination, and as it is assessed that copper in general is heavily bound to the inorganic mineral structures of the glacial till, the amount of dissolved and bioavailable copper from the trenching activities is assessed to be low. Furthermore, only a minor part of copper in the dispersed sediment will be dissolved and may be bioavailable to marine organisms.

The Swedish EPA requested, during the meeting on 24 October 2018, that the results also were to be related to effect-based limit values, prepared by SwAM (Swedish Agency for Marine and Water Management, 2013), for five substances in sediments (lead, cadmium, anthracene, fluorine and TBT). Also new limit values for copper published in a new report from the authority (Swedish Agency for Marine and Water Management, 2018) should be compared to. In addition, a few minor clarifications regarding the initial report was requested. Responses and clarifications were prepared by Ramböll and delivered to the authorities by NSP2, together with the draft meeting minutes on 6 November. Since the other authorities were fine with the information that had been provided, it was agreed that NSP2 and Ramböll could continue the dialogue with EPA separately. A follow up mail with additional information from Ramböll was thereafter provided to EPA on 30 November. The EPA (on the basis of all additional information provided) concluded in a mail on 20 December that the results showed low levels of contaminants, that sediment will not spread to the sensitive mussel banks and that the monitoring program therefore did not have to proceed to Step 2 in the program (EPA case file nr: NV-08027-18). Hence, this module of the monitoring program could be finalized.

In conclusion, only parts of the sediment handled during trenching will be dispersed and brought in suspension, where the main part of the sediment will be deposited close to and around the trench. Also considered the amount of sediment to be handled, the very short duration that sediment will be in suspension, and the low increased concentration of copper in the sediment, it was assessed that there will be no risk of impacts on marine fauna.

#### **4.4 Monitoring of benthic fauna**

The purpose of monitoring benthic fauna along the pipeline route will be to evaluate and document the establishment and growth of epifauna on and in the near vicinity of the pipelines and rock berms following completion of all construction activities in order to identify the establishment of communities on the new habitats (artificial reefs).

#### **4.4.1 Method for monitoring benthic fauna**

Visual inspection/video recording of the pipeline and rock berms will be conducted using ROV. Epifauna inspections will take place in four sections along the route; two sections on the pipeline within the Natura 2000 area and in two sections where rock placement is planned.

At each of the suggested locations, a 250 m section of the pipeline will be recorded using three video cameras mounted on an ROV covering the top and sides of the pipeline.

#### **4.4.2 Monitoring and results 2018**

No monitoring was carried out in 2018 and results from monitoring in 2022 and 2024 will be presented in the yearly reports in the following years.

### **4.5 Monitoring of underwater noise**

Due to concerns for disturbance of behaviour and masking effects on harbour porpoise, monitoring of underwater noise will be conducted to further verify the conclusions in the Environmental Study and expert opinions presented during the public referral regarding potential impact from NSP2 construction activities on harbour porpoise in the Natura 2000 area.

#### **4.5.1 Methods for NSP2 underwater noise monitoring**

Harbour porpoises produce short ultrasonic clicks (130 kHz peak frequency, 50-100  $\mu$ s duration). To measure if construction activities (including noise from construction vessels) produce high energy frequencies with potential to mask harbour porpoise echolocation, monitoring of underwater noise during construction of the NSP2 pipelines will cover frequencies up to 150 kHz.

In order to align with the underwater noise measurements performed by FOI (for NSP) in 2012 and benefit from those efforts in the analyses of the results, the set-up of these new measurements will follow those used by FOI where possible and deemed appropriate. However, since the focus is somewhat different to what was requested by the authorities at that time, the set-up will deviate to some extent.

The measurements will include:

- Field survey to cover background levels (base line)
- Field survey to cover post-lay rock placement
- Field survey to cover pipelay

#### **4.5.2 Monitoring and results 2018**

No monitoring was carried out in 2018 and results from 2019 will be presented in 2020.



## 5. SOCIO-ECONOMIC MONITORING

### 5.1 Monitoring of commercial fishery

From a technical point of view, the NSP2-pipeline system is designed to allow fishing over the pipelines without damage to the pipelines, i.e. to withstand hits from all types of trawling equipment used in the Baltic Sea. However, some fishery communities have raised concern about the conditions for trawling over and in the vicinity of the NSP2 (as well as the Nord Stream Pipelines - NSP). Thus, a monitoring program for fishery, similar to what was done for NSP, has been set up for NSP2.

#### 5.1.1 Methods for monitoring commercial fishery

Analyses will be based on fisheries data collected by SwAM as part of the statutory reporting of fishery patterns and fish catches by the Swedish fishing fleet. The collected data will be compared and evaluated against the baseline conditions to see if there are any changes in the fisheries patterns due to the pipelines.

#### 5.1.2 Monitoring and results 2018

No monitoring was carried out in 2018 and results comparing data from before and after the construction works will be presented in 2022.

### 5.2 Monitoring of cultural heritage

Detailed seabed surveys have been performed in order to prevent damage to cultural heritage sites during the pipe-lay. The surveys scope consists of a geophysical survey, visual inspection and an expert evaluation of the findings. The Swedish Maritime and Transport Museums (SMTM) have assessed the cultural heritage value of the objects found.

Prior to construction, the area of directly affected seabed was surveyed again to verify the seabed conditions i.e. that there are no new objects. A controlled installation procedure, including the safety zones to be used, has been agreed with SMTM for the locations where archaeologically significant wreck sites should be safeguarded. The protection zone around cultural heritage sites (50 m) was established to minimize the risk of impacts to these sites. In the vicinity of cultural heritage sites, the pipe-laying is also followed closely by ROV. For selected cultural heritage objects in the vicinity of the pipeline route, a post-lay inspection will be done after the pipelay activities have been finalised in that section of the route. Also, these results will be reviewed by SMTM, this in order to conclude that the construction activities have not caused any impact to those objects.

#### 5.2.1 Monitoring program, purpose and period of monitoring

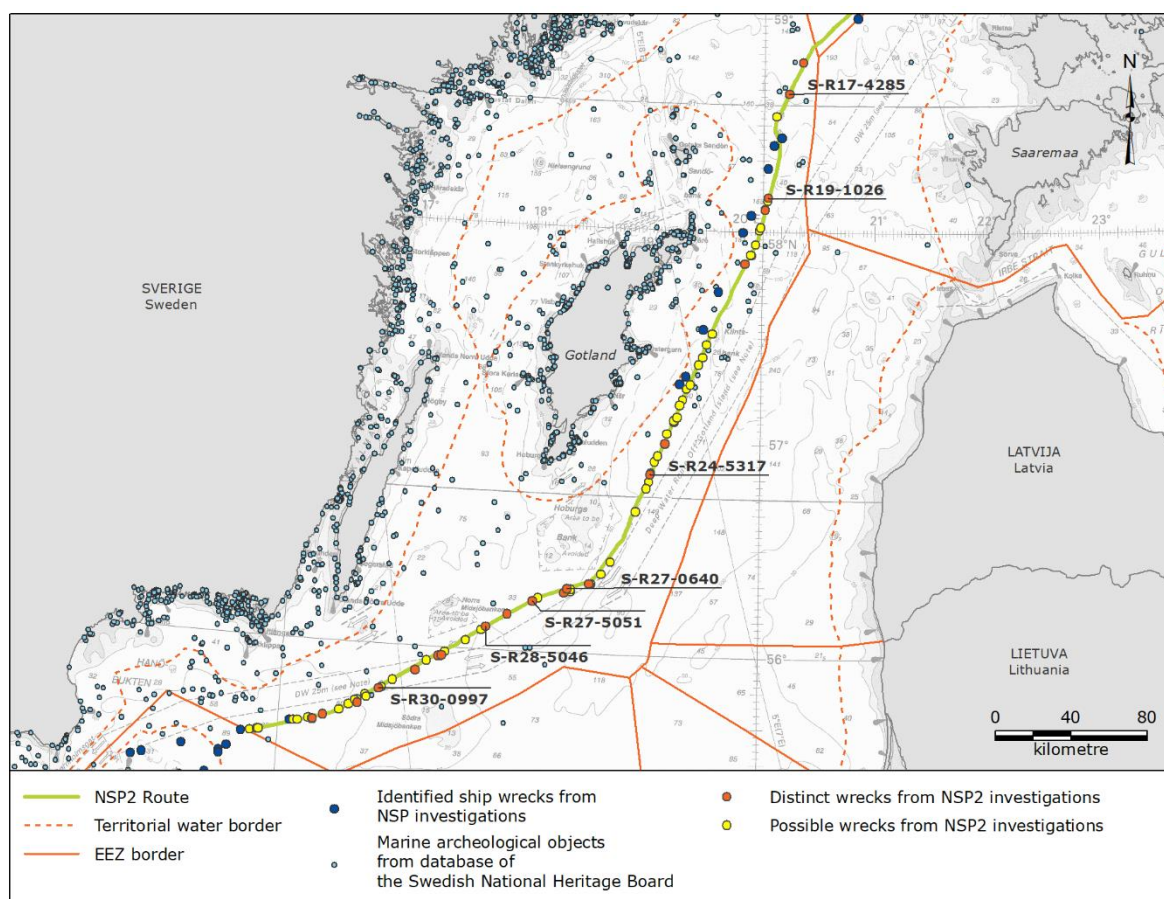
The purpose of the cultural heritage monitoring is to document the condition of a number of selected potential cultural heritage objects (situated close to the pipelines route) before construction and to verify the condition of those objects after construction. The pre-lay monitoring was performed between 4 and 8 January 2019 by the survey company MMT with the vessel Stril Explorer.

On the Swedish continental shelf, the planned pipeline route passes close to 23 identified potential cultural heritage objects according to the survey results. Six objects are located within 250 m from either of the pipelines, but none is closer than 50 m. SMTM and NSP2 have agreed to include those objects within 250 m from either pipeline as part of the monitoring program. In addition, one object (S-R30-0997, approximately 700 m from the pipeline corridor) is of special interest for the Swedish cultural heritage authorities and is therefore also included in the monitoring program (see Table 7).

**Table 7 Monitoring of impacts on cultural heritage**

Parameters, methods and timing of monitoring				
Target group	Parameter	Method	Location	Timing/frequency
S-R17-4285 S-R19-1026 S-R24-5317 S-R27-0640 S-R27-5051 S-R28-5046 S-R30-0997	Condition (intact/impacted)	ROV visual inspection  MBES survey	Location of CHO sites	Prior to pipelay activities.  After pipelay activities have been finalised.

In the figure below, the positions of the potential wrecks, chosen together with SMTM to be part of NSP2s cultural heritage monitoring, are shown.

**Figure 5 Known wrecks and objects chosen to be part of NSP2's cultural heritage monitoring**

### 5.2.2 Methods for NSP2 cultural heritage monitoring

The methodology follows the same approach used during NSP. The condition and location of each of the selected cultural heritage sites were surveyed prior to start of pipelay activities. To verify that the cultural heritage object sites have not been affected by the pipelay, a post-construction survey will also be performed (later in 2019) by a visual inspection by ROV and a MBES (multibeam) survey. Possible impacts of the construction activities to the CHO sites will be detected by having marine-archaeological expertise comparing the baseline survey and the post-lay survey results.

### 5.2.3 Monitoring and results 2018

The baseline monitoring results of cultural heritage (based on the survey in January 2019) are presented in Table 8. Out of the seven objects analysed, five are wrecks and two (S-R27-0640 and S-R27-5051) are rock outcrops. SMTM estimates in the report (Fredholm, 2019) that three wrecks (S-R17-4285, S-R28-5046 and S-R30-0997) foundered before 1850, and they are therefore considered to be ancient monuments according to the definitions in the Swedish Heritage Conservation Act (1988:950). These three objects are described below in more details.

**Table 8 Cultural heritage monitoring results**

ID No.	Distance to pipeline (m)	FMIS/ Fornreg reg.no	Ancient monument	Description
S-R17-4285	203	61:3	Yes	Wreck
S-R19-1026	238	2:160/ L2019:159	No	Wreck
S-R24-5317	93	2:164/ L2019:143	No*	Wreck
S-R27-0640	232	-	No	A rock outcrop
S-R27-5051	171	-	No	A rock outcrop
S-R28-5046	142	2:48	Yes	Wreck
S-R30-0997	730	2:165/ L2019:170	Yes	Wreck

\*Although SMTM argues that it most likely has sunk after 1850, a younger wreck can be classified as an ancient monument by the County Administrative board, according to the definitions in the Swedish Heritage Conservation Act, if certain criteria are fulfilled.

#### **S-R17-4285**

This is a wooden wreck that is 17 m long and 5 m wide. The construction, anchor, ships boat, capstan, details etc. indicates a 17th or an 18th century construction date. The wreck is carvel-built. It has two standing masts, a mainmast and a foremast in the bow. An anchor is hanging on the starboard side near the bow and one stands on the seafloor just off the bow. A "ship's boat"<sup>1</sup> lies on deck on the port side. The ships boat has a flat bottom and the sides are clinker built (Mikael Fredholm, 2019).

<sup>1</sup> Ship's boat is a utility boat carried by a larger vessel, which is used to move loads and people between shore and ship, and between ships.



Figure 6 Photo from the starboard side. From the left: the capstan, the flat-bottomed ships boat, the bilge pump and to the right end the main mast

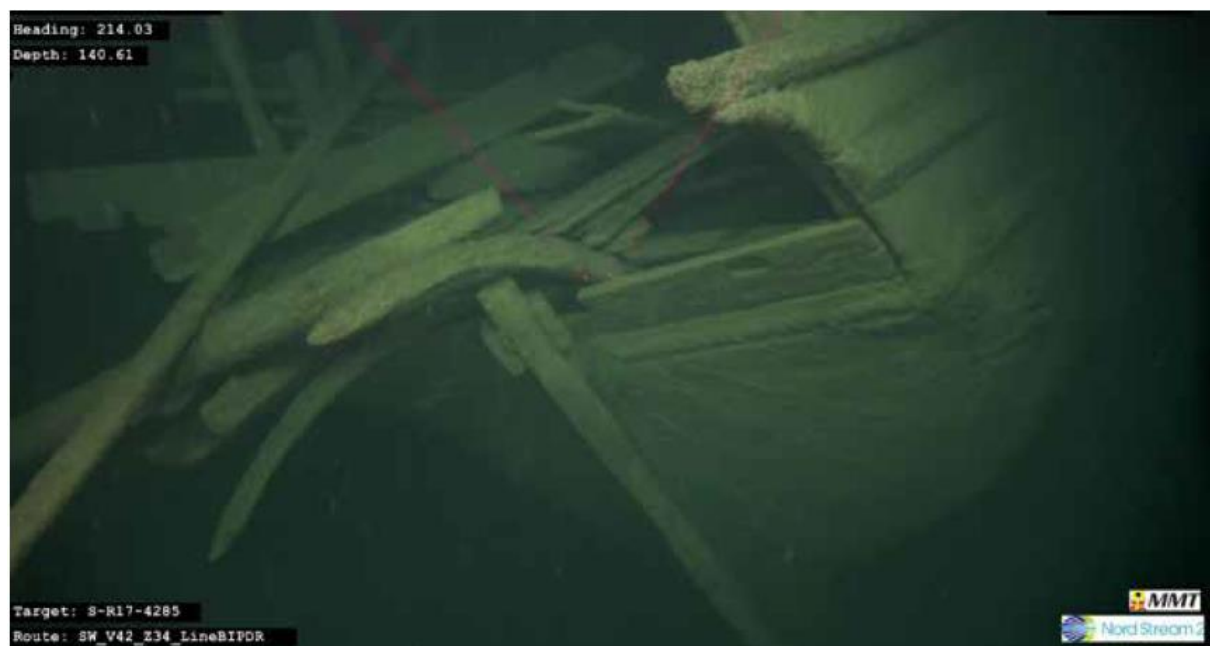


Figure 7 The stern



**Figure 8 The anchor on the starboard side**

### **S-R28-5046**

This wreck was already investigated for the Nord Stream project (then having the wreck number S-29-93462). It is a clinker built ship with a cargo (ballast) of lime stones and barrels with iron, possibly a so-called Osmund iron that was a common Swedish export commodity in medieval times until the 17<sup>th</sup> century.

The first inspection of the wreck took place in December 2009. During ROV-inspection in 2012, after the construction of Nord Stream, it was noticed that the sedimentation was different than in 2009, but the wreck itself was unchanged since 2009. The wreck as a whole does look unchanged between 2009 and 2019. An unknown circular object, a small wheel (with a diameter of approx. 20 cm) was filmed by ROV in 2019. This object was not noted during the first surveys in 2009. The wheel seems to be of a more modern type (probably made of metal) than the wreck itself. So, it might have been dropped on the site after 2009 (probably after 2012), or maybe sediments that have moved since 2009-2012, have made it visible (Mikael Fredholm, 2019).





**Figure 9** The cargo or ballast stones and an unknown small wheel

### **S-R30-0997**

This is a wooden wreck, 24 m long and 6 m wide. Based on earlier ROV-pictures and bathymetry, the wreck was preliminary dated to the 18-19th century, and the size and hull shape has similarities with the fluit ship "Jutholmsvraket" from around 1700, or galiots from 18-19th century. Most of the interior of the wreck is full with loose ship timbers, frames, planking and some blocks. Outside the wreck on the starboard side there is a gaff beam. Pictures of gaff-rigged sails appeared during the mid-17th century and became more common in the 18th century. The wreck is probably not older than late 17th century but is more likely to be from the 18th century (Mikael Fredholm, 2019).



**Figure 10** Gaff beam



Figure 11 The rounded stern. The loose rudder is partly visible on the far lower right



Figure 12 Anchor

### 5.3 Monitoring of ship traffic

The monitoring activities focus on demonstrating that information has been provided to the authorities as agreed (activity 1), that the construction vessels behave as intended (activity 2) and that third-party vessels respect the safety zone of the construction vessels (activity 3).

#### 5.3.1 Monitoring program, purpose and period of monitoring

The purpose of the control and monitoring related to marine traffic is to verify that the agreed efforts and measures to minimize the risk of collisions or other accidents (involving commercial shipping traffic and/or vessels carrying out construction activities for the project) are implemented and that they are efficient. The monitoring activities for maritime traffic focus on the information provided

from NSP2 to the authorities, up-front as well on a day-to-day basis in relation to notification of work plans and monitoring of third-party vessels passing the construction activities.

### 5.3.2 Methods for NSP2 ship traffic monitoring

The following tasks are performed in relation to monitoring in the Swedish EEZ:

Activity 1:

- Information provided to the authorities as agreed

Activity 2:

#### Construction performed as planned

- Pipe-laying (incl. guard vessels as required)
- Rock placement (pre-lay and post-lay)
- Post-lay trenching
- Cable crossings
- Survey vessels during construction (including pre-commissioning)
- Pipe carriers
- Supply vessels

Activity 3:

- Third-party vessels around the lay-barge (and other construction vessels) acknowledging the safety zones during construction works

#### 5.3.2.1 Activity 1

The purpose of this activity is to document that NSP2 has provided information to the authorities and other stakeholders as proposed in the Swedish ES. The details as to the information to be provided, the timing and frequency of when it is delivered etc. was further detailed during meetings with the Swedish Coast Guard, the Swedish Maritime Administration, the Swedish Transport Agency, and the Swedish Armed Forces as well as the fishing organisations before construction works were initiated.

#### 5.3.2.2 Activity 2

Activity 2 consists of monitoring construction ship traffic in AIS data to document proper and safe behaviour of the construction vessels. This reporting can be done several times during the construction phase based on NSP2's continuous monitoring of the construction vessels.

The purpose of this monitoring activity is to document to the authorities that the construction vessels followed their intended routes, performed their activities within the planned timelines, areas of work etc.

AIS data for the construction vessels have been and will be gathered and analysed to illustrate observed ship tracks from the construction vessels. The observed ship tracks from the construction vessels have been compared to the intended behaviour of the construction vessels as described in the authority notifications for the construction activities and the restrictions given by the safety zones. The comparison is done to show how the observed behaviour of the construction vessels matches the plans.

#### 5.3.2.3 Activity 3

Activity 3 consists of monitoring the commercial ship traffic, passing the slow-moving construction vessels (e.g. the lay-barge), using AIS data. This is done to document to the authorities that the commercial ship traffic has safe and free navigation when passing the construction vessels.



Any unexpected vessels entering a 'closest point of approach' radius are contacted and monitored closely. If necessary and available, support vessels of the spread (or guard vessels) are used to alert them. In order to notify smaller vessels, fishing organizations and maritime organizations are informed (via notice to mariners from SMA) prior to the start of construction works and updated during the performance of the construction works.

AIS data for the commercial ships have been gathered and analysed to show ship tracks from the commercial vessels when passing the safety zones around the slow-moving lay barges.

The observed ship tracks from the commercial ships show if the commercial ships are able to recognise the construction vessels and their safety zones in due time to safely plan their journey around the slow-moving construction vessels.

Furthermore, when the slow-moving construction vessels are working close to a Traffic Separation Scheme (TSS), south of Gotland, east of Hoburgs bank, then the observed ship tracks from the passing commercial ships show, if the commercial vessels are able to pass the safety zones of the construction vessels and stay inside the TSS, maintaining safe and free navigation.

If incidents of special interest have occurred, then movies presenting vessel movements in space and over time can be produced to illustrate the situation. This monitoring is done continuously throughout the construction period and will enable NSP2 to either confirm or adjust (in consultation with the Swedish Coast Guard, the Swedish Maritime Administration, the Swedish Transport Agency, and the Swedish Armed Forces) the safety measures adopted to enable safe and free passage of commercial ships passing the construction activities.

### **5.3.3 Monitoring and results 2018**

#### **5.3.3.1 Activity 1**

Nord Stream 2 has committed to notify the Swedish Maritime Administration (SMA), the Swedish Coast Guard (SCG) and the Swedish Armed Forces (SAF) at least one (1) month before the construction- or maintenance works begin. Furthermore, NSP2 must keep the authorities informed about the progress of the construction work and when the work will be completed.

By analysing correspondence between NSP2, authorities and other stakeholders, it is verified that information has been provided as agreed.

NSP2 provided notifications (in an agreed format) to the authorities for intervention works and pipelay in time (one month before). In addition to those notifications, the authorities also received daily notifications from the construction vessels to inform the authorities about the construction progress and finalisation.

#### **Intervention works notification**

A preliminary construction notification was issued by Nord Stream 2 AG to the agreed distribution list, consisting of SMA, SCG and SAF, on 29 March 2018 concerning upcoming rock placement works. The notification was preliminary since the permit had not been issued at that time. The rock placement was planned to be initiated on 29 April 2019, but since the permit had not been issued by then, the initiation of work was postponed.

On 27 June 2018, after the permit was issued (on 7 June 2018), a construction notification concerning rock placement and placement of concrete mattresses, was issued by NSP2 to the authorities. The construction activities were planned to start on 1 August at the latest and the first construction activity took place on 28 July when concrete mattresses were placed at a cable crossing

in the northern part of Swedish EEZ, which means that NSP2 informed in time (one month in advance).

### **Construction notification (including the pipelay)**

On 9 November 2018, a construction notification was sent to the authorities concerning the start of pipelay. The construction activities were forecasted to start around mid-December 2018. The pipe-laying vessel *Solitaire* entered the Swedish EEZ on 19 December, and work was initiated on 23 December and therefore the authorities were informed more than one month in advance before pipelay started.

Several construction notification updates were sent during November and December 2018. The format of those reports were discussed in meetings with the Swedish Coast Guard and it was agreed that it also fulfils the Coast Guards information requirements. It was decided that NSP2 should send such notifications approximately on a monthly basis to inform about completed, ongoing and planned construction activities in order to provide all recipients with a holistic view of the project, which NSP2 thereafter did.

### **Daily notifications from the construction vessels**

In 2018 and thereafter, the respective construction vessels sent daily authority notifications, from 24 hours before entering Swedish EEZ and/or 48 hours before performing work and continuing until the work scope/campaign was finalised. The notifications were sent out slightly late (less than 24 hours in advance of entering Swedish EEZ) on few occasions but were always sent before any work actually started. Meetings have been held with the shipping authorities on a regular basis and the authorities have during these meetings confirmed that they feel that the communications from NSP2 and the respective vessels have worked well.

## **5.3.3.2 Activity 2**

The pipelay activities did not begin in the Swedish EEZ until the end of December 2018. Prior to that, only occasional intervention works took place. The monitoring scope for 2018 was therefore limited in terms of construction activities to be controlled. The work has been carried out in the following way: The activity log of the construction vessels has been compared with reconstructed routes of the same vessels from recorded AIS data. The purpose has been to consider if the activity log was coherent with the reconstructed routes, when looking at the locations and times of the ships.

The monitoring only shows some minor discrepancies between reported construction vessel behaviour, e.g. pipe supply traffic to the correct location, but on slightly more or different days than previously communicated. Overall, there is a good coherence between notification information and actual work performed. AIS data coverage has in some cases been low or suffered from missing data during specific dates, in particular on 5 December and 29 December (Ramboll, 2019).

The permit includes a commitment that pipe supply vessels (and other project vessels where relevant) should use a predetermined route between the shallow banks south of Gotland (to protect birds) and use shipping lanes as far as possible. The analysis of historical AIS data has also proved that construction vessels were moving at significant distance to the banks and that official shipping lanes were utilised.

## **5.3.3.3 Activity 3**

The purpose of this activity was to document that the commercial ship traffic had safe and free navigation when passing the construction vessels and that the safety exclusion zone around the NSP2 construction vessel was respected. Navigation safety was confirmed by monitoring of third-party vessels movements.

As the pipe laying vessels have the biggest safety zones (1 nm) that third party vessels shall avoid, this report concentrate on the traffic around such construction vessels. During 2018, pipe-laying activities took place from 23 December to 31 December and was carried out by the vessel Solitaire. The vessel personnel recognized that there was very little ship traffic in the area of construction and that no commercial ships were coming close to the pipe laying vessel or entered its safety zone. That was confirmed by reviewing the reconstructed routes from AIS data of all vessels in the area during the period 23 December to 31 December. The replay provides a movie-like view of the ship traffic, showing that most commercial traffic passed in the deep-water shipping lane to the north. Conclusions are, however, restricted by a limited AIS data coverage in some areas.

## 6. MONITORING RESULTS VS. ES-ASSESSMENTS

### 6.1 Ecotoxicological impacts

Impacts from sediment spreading and sedimentation was assessed in the ES (chapter 8.6 -pelagic environment, 8.7 -benthic environment and 8.8 -fish) (Ramboll , 2016).

Impacts from contaminants within the shallower areas at Hoburgs Bank, at the Northern and Southern Midsjö Banks and in the area east of Gotska Sandön were not expected, as there is no increased contamination in the surface sediments within these areas. Based on previous calculations and monitoring results from NSP, bioaccumulation of substances was evaluated not to occur based on the limited area affected and the short duration of the suspended sediment.

The monitoring results from 2018 is in conformity with the assessment made in the ES, in that the ecotoxicological impacts are negligible.

### 6.2 Cultural heritage

The impacts on cultural heritage were assessed in the ES (Chapter 8.17 Cultural heritage).

It was assessed in the ES that there is a low probability of any impact on cultural heritage objects during seabed intervention works and pipe laying activities, provided the procedures agreed by NSP2 are followed. Overall, the impact from seabed intervention works and pipe-laying on CHOs was considered to be of no or negligible significance.

NSP2 has agreed with SMTM that seven objects need to be checked before and after construction of the pipeline in order to see if the construction work has had any effect on their state of preservation. The inspection has been conducted before construction activities in the beginning of 2019. Later analysis of ROV-films from the wrecks after the pipelay will be performed to verify that no impact has taken place.

### 6.3 Monitoring of ship traffic

Impacts on shipping was assessed in the ES (Chapter 8.14 Shipping and shipping lanes).

In the ES, the impacts from safety zones around the project vessels were assessed not to entail any permanent change in the structure or function of the shipping traffic during the construction phase. There is sufficient space and water depth for the ships to plan their route and navigate safely around the construction vessels. The overall importance of the impacts on shipping traffic during the construction phase was considered to be minor.

In 2018 during construction activities in the Swedish EEZ, the construction vessels followed the communication and reporting procedures that were agreed with the shipping authorities. There were no accidents or incidents involving maritime traffic, including fishing vessels. Impact on maritime traffic is thus confirmed as being minor, localised and of short-term nature.

## 7. TECHNICAL INSPECTIONS DURING OPERATION

In addition to the reporting of monitoring activities, it has been agreed between NSP2 and the supervisory permit authority (the Swedish Coast Guard) that reporting of performed and planned project work during the operational phase shall be included in a chapter in this yearly report. Such work mainly includes survey activities but could also in the future include maintenance and repair measures.

Regular inspection surveys of the pipeline system will be carried out as part of the inspection, maintenance and repair program throughout the entire operation phase. The main goal of the inspection surveys is to ensure the safe and reliable operation of the pipeline system throughout its lifetime.

Before the start of operation of the pipeline system, an inspection strategy will have been finalised. It will e.g. describe the main types of inspections to be performed, their requirements and their expected frequency. All the inspection requirements identified during the design phase as affecting the overall pipeline integrity (safety and reliability) during operation are to be covered in this document. Two types of inspections are planned over the full pipeline length in Swedish EEZ, internal and external inspections. In the following sections, the work scopes for those surveys (as well as for potential other works during the operational phase) are presented based on the project's current planning.

### 7.1 External inspections

External inspection will evaluate the pipeline / seabed configuration and the external condition of the pipelines. This inspection survey will be executed from a survey vessel equipped with ROVs or AUVs having visual, acoustic and electro-magnetic survey tools. During offshore external inspections the following information is gathered:

- Damages to the pipelines e.g. to concrete coating and field joints.
- Damage to pipeline support structures e.g. rock berms and cable-crossing support mattresses.
- Damage or depletion of anodes and deficiencies of cathodic protection.
- Significant movement of pipelines, in particular if movement is outside of the installation corridor.
- Locations where rock placement has to be carried out as a remedial action to support the pipeline, based on the survey inspection information.
- Possible new objects (UXO, CHO or other) within the pipeline installation corridor.
- The location and condition of wrecks and cultural heritage artefacts in the vicinity of the pipelines.
- The location of munitions in the vicinity of the pipelines.

All collected data will be compared with previous surveys and annual inspection surveys to allow comparison to the design and as-built condition. Historical trending is used to assess the development of such items as free spans, seabed scour, areas prone to damage and consumption and physical loss of anodes (prediction of anode wastage).

### 7.2 Internal inspections

Internal inspections are performed with pipeline inspection gauges (PIGs) travelling through the pipelines. The PIGs are accompanied by a survey vessel following the progress of the PIGs as they

travel from the Russian landfall towards the German landfall. The main scope of these inspections is to detect potential local anomalies in the pipeline geometry:

1. Pipe internal metal losses (wall thickness anomaly) e.g. due to corrosion
2. Individual wrinkles (internal diameter anomaly)
3. Out-of-roundness (ovality) dents
4. Change in curvature of the pipelines (bending)

The location and extent of the anomalies as for aforementioned parameters are proposed to be reported, if:

1. Pipe wall thickness anomaly is greater than 10% of wall thickness
2. Pipe internal diameter anomaly is greater than 2.5 mm
3. Pipe ovality is greater than 1% of internal diameter
4. Pipeline bending is greater than 0.125% of bending strain (pipeline radius/bend radius)

### **7.3 Inspection frequency**

The first internal and external inspections are done shortly after that the construction works have been completed. Depending on the results of those inspections, further inspections will be planned for the coming years. The frequency and the starting date of each following inspection will depend on the results of the previous inspection surveys. It is foreseen that the number of external inspections will greatly exceed the number of internal inspections during the lifetime of the pipelines.

Both the internal and external inspections are expected to include vessels with ROV capacity. The Swedish Maritime Administration, the Swedish Coast Guard, the Swedish Armed Forces and the Swedish Transport Agency will be informed well in advance before such inspections take place.

### **7.4 Maintenance**

If the pipeline parameters are discovered to deviate critically from the design limits in any of the inspections, an appropriate maintenance or repair program will be implemented. The frequency and the starting date of each maintenance work will depend on the results of the previous inspection surveys and the relevant authorities (as a minimum the Swedish Maritime Administration, the Swedish Coast Guard and the Swedish Armed Forces) will be informed well in advance of any such maintenance work.

In addition, any unexpected events which may impair the safety and reliability of the pipeline system shall be analysed and corrective action might take place, e.g. top-up rock placement on rock berms or on the pipeline to prevent unplanned movements.

## 8. CONCLUSION AND RECOMMENDATIONS

The ecotoxicological monitoring results shows that impacts are negligible. Levels of contaminants are low and non-anthropogenic and will not spread to the sensitive mussel banks. Any additional steps of the ecotoxicological monitoring program will not be needed and it has been confirmed by the environmental authorities that the program can be finalised.

The pre-construction part of the monitoring of cultural heritage has been finalised since the condition of all seven selected potential cultural heritage objects have been documented before any pipelay activities took place in those areas. These records will be used in order to verify the condition of the sites after construction. The results of that assessment, which will be performed by SMTM, will be part of the yearly monitoring report in 2020.

The shipping monitoring shows that the construction vessels have followed the communication and reporting procedures that had been agreed with the shipping authorities. The analysis of historical AIS data has proved that construction vessels were moving at significant distances from the sensitive shallow banks and that official shipping lanes were utilised. The pipe-laying activities started at the end of 2018 and there was only little commercial traffic in the area covered by the lay vessel at that time. Ramböll therefore recommends extending the monitoring period for the three following months (beginning of 2019). This in order to have a broader data spectrum available for the discussion with the shipping authorities regarding if any practical improvements can be implemented, by NSP2 or the authorities, during the construction phase.

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## **Appendix A- Swedish summary / Svensk sammanfattning**

### **Introduktion**

Nord Stream 2 (NSP2) är ett rörledningssystem som ska transportera naturgas genom Östersjön från de omfattande fyndigheterna i norra Ryssland till den Europeiska Unionens (EU) inre gasmarknad. De två 1230 km långa submarina rörledningarna ska ha årlig kapacitet att leverera cirka 55 miljarder kubikmeter gas, på ett ekonomiskt, miljövänligt och tillförlitligt sätt.

NSP2 bygger på det framgångsrika konceptet med konstruktion och drift av det redan existerande Nord Stream-rörledningssystemet (NSP), som erkänts för sin höga miljö- och säkerhetsmässiga standard, effektiva logistik samt öppna dialog och publika konsultationsprocesser. Projektet drivs av bolaget Nord Stream 2 AG.

NSP2-projektet omfattar anläggande och drift av två rörledningar genom Östersjön med en inre diameter av 1 153 mm. Färdigställandet av vardera rörledning kräver cirka 100 000 del-stycken bestående av 24 ton tunga betongbelagda stålrör utlagda på havsbotten. Rörutläggningen startade 2018 och sker via specialbyggda rörlägningsfartyg som svetsar samman respektive rörledningssegment ute till havs, kontrollerar dessa samt lägger ut rörledningarna succesivt. Båda rörledningarna kommer att läggas under 2019 så att testning och idrifttagande kan ske vid slutet av 2019. Rutten kommer sträcka sig från Östersjökusten i Ryssland vid Kurgalsky-halvön i Narvabukten till landföringen i Tyskland nära Lubmin. Sträckningen är mer eller mindre parallell till NSP. Landföringsanläggningar i både Ryssland och Tyskland kommer att vara skilda från NSP.

Kilometerpunkter (KPs) som presenteras i denna rapport är Globala KP; med KP 0 motsvarande landföringen i Ryssland. KPs för den 512 km långa linjen B (östlig ledning) genom den svenska ekonomiska zonen sträcker sig mellan de globala KPs 488 och 1000.

Som en del av tillståndsåtaganden för rörledningens anläggande och drift i Sverige har bolaget i samråd med myndigheter fastställt ett kontrollprogram som omfattar aktiviteter inom svensk EEZ med start år 2018 till ungefär år 2024.

Detta dokument ger en översikt över de miljö- och socio-ekonomiska övervakningsaktiviteter som NSP2 genomfört under 2018 (även något under 2019 där det är lämpligt) inom svensk ekonomisk zon med hänsyn till följande:

- Övervakning av kulturarvet
- Övervakning av ekotoxikologiska effekter
- Övervakning av fartygstrafiken

Dokumentet omfattar generell status för kontrollprogrammet samt övergripande övervakningsresultat. Detaljerade beskrivningar av miljöövervakningsaktiviteter och resultat presenteras i specifika rapporter, en för varje övervakningsmodul.

Detta dokument är det första av sju planerade årsredovisningar (2019-2025) vars syfte är att dokumentera status och resultat av övervakningsverksamheten i den svenska ekonomiska zonen och vid behov rekommendera lämpliga anpassningar till kontrollprogrammets omfattning.

### **Anläggningsaktiviteter under 2018**

Under 2018 inleddes anläggningsarbeten för NSP2 inom den svenska ekonomiska zonen när fartyget Oceanic den 28 juli började installera betongmadrasser över kablar som kommer att korsas i norra

delen av den svenska ekonomiska zonen. Därefter utfördes andra förberedande konstruktionsverksamheter (madrassinstitutioner och stenläggning) vid ett fåtal tillfällen under Q3 och Q4.

Anläggning påbörjades den 23 december när rörledningsfartyget Solitarie initierade arbeten i södra delen av den svenska ekonomiska zonen, nära den danska EEZ-gränsen, i nordlig riktning. Vid årets slut hade 27 km rör placerats på havsbotten inom den svenska ekonomiska zonen.

### **Övervakning av kulturarvet**

Syftet med övervakning av kulturarvet är att dokumentera tillståndet för vrak före och efter konstruktionsarbeten.

För att verifiera att kulturarvsobjekten inte har påverkats av rörledningen, ska undersökningar före och efter anläggning genomföras genom visuell inspektion med hjälp av ROV och en MBES (multibeam) undersökning. Eventuell påverkan på kulturarvsobjekt från konstruktionsaktiviteter kommer att upptäckas genom marinarkeologisk expertis (SMTM) som jämför undersökningsresultat från före och efter anläggning av rörledningarna.

Undersökningsföretaget MMT filmade 7 objekt som var av intresse för de svenska myndigheterna i början av januari 2019 innan anläggning av ledningarna. SMTM analyserade videon i mars-april 2019 och drog slutsatsen att endast tre av dessa objekt var vrak äldre än 1850. Tillstånden för de sju objekten dokumenterades och kommer att användas för jämförelse när rörläggning har genomförts.

### **Övervakning av ekotoxikologiska effekter**

För att bemöta de frågor om möjliga ekotoxikologiska effekter som framförts av Naturvårdsverket utvecklade NSP2 ett kontrollprogram för att övervaka potentiella ekotoxikologiska effekter i musslor. Övervakningsprogrammet uppdelades i tre olika steg för att representera verklig miljöpåverkan på marin fauna (musslor) och ansågs vara ett bättre tillvägagångssätt jämfört med övervakningsuppsättningen för NSP. De tre stegen inkluderade:

- Provtagning och analys av sediment vid den planerade dikningsplatsen
- Utlakningstest på sedimentproverna
- Laboratorieackumuleringsstest med musslor från dikningsregionen

Huruvida övervakningsprogrammet skulle fortsätta till nästa steg eller inte var beroende av resultaten från föregående steg.

Provtagningen för steg 1 utfördes den 24 november 2017 då sex platser provtogs utanför Hoburgs bank och Norra Midsjöbanken inom två planerade dikningssektioner på olika djup.

Endast få provvärden överskred riktvärdena för Klass 1 enligt (Naturvårdsverket, 1999) (SGU, 2017). Det enda undantaget för detta var för koppar (Cu) där många av proven hade en "naturlig" koncentration något över riktvärdet för Klass 1, och där den genomsnittliga sedimentkoncentrationen för den planerade efterläggningsdikningen tillhör Klass 2. Eftersom kopparhalten inte är resultat av antropogen förorening och då det bedöms att koppar generellt binder starkt till glaciallerans oorganiska mineralstrukturer, uppskattas mängden upplöst och biotillgängligt koppar från dikningsaktiviteten vara låg. Dessutom, med hänsyn till den mängd sediment som ska hanteras, den mycket korta varaktigheten av suspenderat sediment och den låga förhöjda kopparkoncentrationen i sedimentet, bedöms det inte uppkomma någon risk för påverkan på den marina faunan. Resultaten jämfördes också med effektbaserade gränsvärden, utarbetade av Havs-och

vattenmyndigheten, för bly, kadmium, antracen, fluor, TBT (Havs- och vattenmyndigheten, 2013) och koppar (Havs- och vattenmyndigheten, 2018).

Resultaten presenterades för miljömyndigheterna och det konstaterades att det inte finns några tecken på någon betydande antropogen förorening inom det område där dikning planeras. Därför finns det ingen risk att förorenade sediment kommer att sprida sig till de känsliga musslorna och man kom överens om att den ekotoxikologiska övervakningen inte behövde gå vidare till steg 2.

### **Övervakning av fartygstrafiken**

Inom den svenska sektorn kommer anläggningsarbeten att leda till en ökad fartygstrafik i form av rörläggning, rörlägningsfartyg till rörlägningsfartygen, madrassinstallationer, stenläggning och dikning efter rörläggning. Baserat på bedömningen i den svenska miljöredovisningen orsakar verksamheten en något ökad risk för olyckor med tredjeparts fartyg. Bedömningen är baserad på det förväntade beteendet hos både konstruktionsfartyg och tredjepartsfartyg som passerar konstruktionsfartygen. Syftet med kontrollen och övervakningen i samband med sjötrafiken är att verifiera att de överenskomna insatserna och åtgärderna för att minimera risken för kollisioner eller andra olyckor (med kommersiell sjöfartstrafik och/eller fartyg som utgör konstruktionsaktiviteter för projektet) genomförs korrekt och att de är effektiva.

Sjötrafiksövervakningen i svenska vatten omfattar följande aktiviteter:

- Anmälningar till myndigheter enligt överenskommelse (Aktivitet 1);
- Övervakning av konstruktionsfartyg via AIS-data (Aktivitet 2);
- Övervakning av den kommersiella fartygstrafiken, som passerar de långsamma anläggningsfartygen (t ex rörlägningsfartygen), med AIS-data (Aktivitet 3)

Metoden innefattade insamling och analys av konstruktionsnotifieringar som skickades av NSP2 till myndigheterna samt notifieringar skickade från anläggningsfartygen. För att bekräfta den faktiska konstruktionsverksamheten inom den svenska ekonomiska zonen samt rörelse till och från konstruktionsplatser analyserades historiska AIS-data.

Resultaten visade att NSP2 följde åtagandet i tillståndet och informerade sjöfartsmyndigheterna minst en månad innan konstruktionsarbete påbörjades. Konstruktionsfartygen har i de flesta fall skickat meddelanden till myndigheterna 24 timmar före arbetet planerades att utföras inom den svenska ekonomiska zonen (och alltid innan något arbete påbörjades). Analyserade historiska AIS-data som samlats in från Sjöfartsverket bekräftade att anläggningsfartygens rörelser befann sig inom rapporterade områden samt att officiella sjöfartsleder användes för transport till och från konstruktionsplatserna.