Nord Stream
The new gas supply route for Europe

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

Nord Stream Espoo Report: Annex
National EIA Summary - Russia

February 2009

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ENG

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1 Introduction

This document includes a short version of environmental impact assessment (EIA) materials for construction and operation of the Russian sector (0 - 125.5 km) of the Nord Stream gas pipeline (former North European Gas Pipeline, offshore section). The report was prepared by OOO PeterGaz (Moscow, Russia) under contract with Nord Stream AG (Zug, Switzerland) No. 103-07 dd. March 29, 2007.

The EIA materials were prepared on the basis of documentation for construction and operation of the Russian sector of the Nord Stream offshore gas pipeline; EIA and Environmental Safety sections of the Conceptual Design (Substantiation of Investments) of the North-European Gas Pipeline developed by OOO PeterGaz in 2005-2006 based on survey materials prepared by AO Nord TransGaz in 1998 for Feasibility Study of the North European Gas Pipeline, archive and textual materials, results of engineering and geotechnical surveys performed by OOO PeterGaz along the gas pipeline route in 2005-2007.

The Environmental sections included into the Design and submitted to the Russian authorities (in compliance with the Russian statutory requirements given below) include the following:

- Materials of proposed activities assessment in terms of environment impacts in the offshore and dry sections of the Nord Stream gas pipeline Russian sector
- Protection measures for environment and its separate components Waste management
- Technical and biological recultivation of disturbed soil in the dry section
- Industrial environment monitoring and control system design
- Materials of public hearings on the Design

The process, engineering and construction solutions were developed subject to climatic and geotechnical conditions of the construction site and current environmental constraints applicable to construction and operation of the designed units. The design solutions are aimed at prevention and mitigation of adverse impacts on the environment, protection of process facilities and systems against natural and technogenic impacts.

The materials were developed by OOO PeterGaz specialists in cooperation with the following science and design organizations: ZAO IEC EcoNefteGaz, Shirshov Ocean Research Institute (under Russian Academy of Science), Dorodnitsyn Computational Center (under Russian Academy of Science) and State Research Institute of Freshwater Fishing Industries (FGNU GosNIORH).

2 Legal Framework

The following documents constitute the legal basis for the Nord Stream gas pipeline construction in the Russian sector of the Baltic Sea:

- United Nations Convention on the Law of the Sea (Montego Bay, December 10, 1982)
- Federal law No. 155-FZ dd. July 31, 1998 “On Internal Seawaters, Territorial Sea and Contiguous Zone of the Russian Federation” (as amended on April 22, June 30, November 11, 2003; August 22, December 29, 2004)
- Federal law No. 191-FZ dd. December 17, 1998 "On Exclusive Economical Zone of the Russian Federation" (as amended on August 8, 2001; March 21, 2002; April 22, June 30, November 11, 2003)
- Federal law No. 187-FZ dd. November 30, 1995 "On Continental Shelf of the Russian Federation" (as amended on February 10, 1999; August 8, 2001; April 22, June 30, November 11, 2003; August 22, December 29, 2004)
- Urban Development Code No. 190-FZ dd. December 29, 2004 (in Federal Laws No. 117-FZ, dd. 22.07.2005; No. 199-FZ, dd. 31.12.2005; No. 210-FZ, dd. 31.12.2005, No. 73-FZ, dd. 03.06.2006; No. 143-FZ, dd. 27.07.2006; No. 201-FZ, dd. 04.12.2006; No. 232-FZ, dd. 18.12.2006; No. 258-FZ, dd. 29.12.2006; No. 69-FZ, dd. 10.05.2007; No. 215-FZ, dd. 24.07.2007; No. 240-FZ, dd. 30.10.2007; No. 257-FZ, dd. 08.11.2007; No. 324-FZ, dd. 04.12.2007; No. 66-FZ, dd. 13.05.2008; No. 75-FZ, dd. 16.05.2008; No. 118-FZ, dd. 14.07.2008; No. 148-FZ dd. 22.07.2008)

A permit for offshore pipeline laying is to be issued by the Federal Service for Environmental Management Supervision (RosPrirodNadzor) in accordance with the Administrative Regulation approved by Order of the Ministry of Natural Resources of the Russian Federation No. 322 dd. 10.12.2007. The scope of design materials including environmental sections is regulated by the Russian Federation Government Resolution No. 87 dd. June 16.02.2008 "On the Scope of Design Documentation Sections and Requirements for Their Content".

The structure and content of submitted EIA materials comply with the requirements approved in the Russian Federation:

- EIA Section Development Guidelines to SP 11-101-95 “Procedure of Development, Review, Approval and Content of Substantiation of Investments into Construction of Enterprises, Buildings and Structures” (Moscow, GP TsentrInvestProekt, 1998)

- Regulation of Environmental Impact Assessment for Projected Business and Other Activities in the Russian Federation (EIA Regulation) approved by the RF State Ecological Committee No. 372 dd. May 16, 2000
- Statutory and Procedural documents on environmental safety, environmental management and industrial safety
- Provisions of SNiPs, instructions, standards and GOSTs

Development of preliminary EIA section included comments from Gazprom expert report No. 93 dd. 30.12.02 on “Substantiation of Investments into Nord Stream Gas Pipeline Construction Project”, comments from the State Environmental Expert Review Board on modified Substantiation of Investments into the Nord Stream project extended to capacity of 55 billion m^3/year (RosPrirodNadzor, 2007) and:

- Comments and proposals provided during public hearings on Substantiation of Investments in Vyborg, Leningrad region, on Sept. 21 2006
- Questions, comments and proposals provided during project discussion under Espoo Convention by public authorities, organizations, non-governmental organizations and individuals (129 comments published on Nord Stream AG web site)
- Questions, comments and proposals stated in letter from Clean Baltic Coalition to the RF Government
- Questions, comments and proposals from communities received during public hearings

Considering the international status of the Nord Stream Project the following requirements and recommendations were taken into account when developing the EIA section:

- International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL) (London, November 2, 1973)
- Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki, 1992)
- Convention on Environmental Impact Assessment in a Cross-boundary Context (Espoo, February 25, 1991)
- Convention on Protection of Underwater Cultural Heritage Objects (UNESCO, Paris, November 2, 2001)
- EU Directive No. 85/337/EC (June 27, 1985)

- EU Directive No. 97/11/EC (March 3, 1997)
- Recommendation HELCOM 17/3. Information and Consultations on Construction of New Objects Having Impact on the Baltic Sea Conditions
- Recommendation HELCOM 19/1. Seabed Deposit Extraction/Excavation in the Baltic Sea Area
- HELCOM Recommendations on Pollution Monitoring (HELCOM MONAS)
- Operational directive 4.01 of the World Bank. Environmental Assessment. 1991
- Environmental Procedures. EBRD document (BDS96-23, Rev.3), 1996
- Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar, 1971

3 National Consultations

Pursuant to Federal Law No. 7-FZ dd. 10.01.2002 “On Environmental Protection” and the Urban Development Code of the Russian Federation the design materials shall include the EIA results, and the designs to be implemented on the continental shelf, in the territorial and internal waters of the Russian Federation shall be obligatory subject to the State Environmental Expert Review currently to be carried out by the Federal Environmental, Process and Nuclear Supervision Service (Rostekhnadzor), and to the Main State Expert Review to be carried out by the Ministry of Regional Development of the Russian Federation pursuant to Federal Law No. 174-FZ dd. November 23, 1995 “On Environmental Expert Review”.

Earlier, the conceptual design materials have already been reviewed by the State Environmental Expert Review Board (Rosprirodnadzor, 2007) at the stage of Substantiation of Investments into the North-European Gas Pipeline Offshore Section (currently the separate Nord Stream Project).

All EIA materials shall be obligatory presented for public discussion in accordance with the Russian Federation Federal Law “On Environmental Expert Review” and Regulation of Environmental Impact Assessment for Projected Business Activities. Nord Stream AG Company held meetings with nongovernmental environmental organizations and public hearings on the design issues in Vyborg in 2007. The following comments were incorporated while developing the design including the submitted EIA materials:

- Comments from the State Environmental Expert Review Board on modified Substantiation of Investments into the Nord Stream project extended to capacity of 55 billion m^3/year (RosPrirodNadzor, 2007)
- Comments and proposals provided during public hearings on Substantiation of Investments in Vyborg, Leningrad region, on Sept. 21 2006
- Questions, comments and proposals provided during project discussion under Espoo Convention by public authorities, organizations, non-governmental organizations and individuals (129 comments published on Nord Stream AG web site - www.nord-stream.com)
- Questions, comments and proposals stated in letter from Clean Baltic Coalition to the RF Government
- Questions, comments and proposals from communities received during public hearings

Presently, the design of the Nord Stream gas pipeline Russian sector was submitted to the Rostekhnadzor State Environmental Expert Review Board for consideration in accordance with established order. At the same time the design is being agreed with the authorized regulation bodies of Vyborg region and land users for land allocation for the gas pipeline dry section. In addition, Nord Stream AG Company is intended to continue consultations with public organizations and with nongovernmental environmental organizations in particular.

4 Project Description

4.1 Pipeline routing

When selecting the alternative routes of the North-European gas pipeline offshore section the following borders and regimes were taken into account:

- Borders of the territorial sea and exclusive economic zones (EEZ) of the states of the Baltic region
- National and international Specially Protected Natural Areas and their conservation zones
- Areas of restricted use of natural resources, valuable and vulnerable terrains and water areas
- Existing cables, pipelines, wind-driven power plants
- Basic navigational routes
- Main fishing areas
- Military training areas, minefields, explosion-hazardous and chemical weapons dumping places

Based on these assessments a principal gas pipeline route was selected and Nord Stream AG Company was established for its implementation.

Within the limits of territorial sea and exclusive economic zone of Russia three shore line intersections points were considered: the Portovaya Bay, neighborhood of ports Primorsk and Vysotsk. The latter two points are preferable from the viewpoint of construction organization (available developed infrastructure, including offshore facilities), however, intensive navigation and moreover, availability of oil-loading terminal in Primorsk make the Portovaya Bay more preferable. Further the route alternatives in the Gulf of Finland are limited by Specially Protected Natural Areas (with "Beryozovyye Ostrova" special nature reserve and "Ingermanlandskiy" wildlife area being designed in the north and "Vyborgskiy" special nature reserve in the south) and ferromanganese nodules to the north and to the south of the selected route alternative.

Different gas pipeline routes in the Gulf of Finland were considered at the investments substantiation stage. A route passing to the north of Gogland Island was accepted for further implementation based on environmental, process and economical criteria. The correctness of this alternative was confirmed by different State Environmental Expert Reviews – Federal

Environmental, Process and Nuclear Supervision Service (Order No. 183 dd. 23.03.2007 "On Approval of Report from Expert Committee of the State Environmental Review Board about "Additionally Modified Substantiation of Investments into the North-European Gas Pipeline Construction Considering Gas Export Supply Extension up to Capacity of 55 billion m^3/year") and Federal Service for Environmental Management Supervision (Order No. 187 dd. 26.06.2007 "On Approval of Report from Expert Committee of the State Environmental Review Board about "Additionally Modified Substantiation of Investments into the North-European Gas Pipeline Construction Considering Gas Export Supply Extension up to Capacity of 55 billion m^3/year (Offshore Section, Russian Sector)"). Nevertheless, Nord Stream AG Company arranged additional comparison of the pipeline route alternatives passing to the north and south of Gogland Island based on the archive materials taking into account increased public attention to the Project in all countries of the Baltic Sea region. The comparison results are given in **table 4.1** below.

Table 4.1 Route alternatives around Gogland

Environmental and other constraints	**Alternative routes**	
	To the north of Gogland Island	**To the south of Gogland Island**
Pipeline length	Approx. 20 km shorter than the “southern” route	
Seabed morphology	Rugged morphology, relief corrections required	Rugged morphology, relief corrections required
Closed water areas, military interest zones	Military training areas and restricted areas are located to the south of the route	Military training areas and restricted areas are located both to the north and south in close vicinity to the route
Underwater infrastructure and mineral reserves mining sites	Intersection with 1 telecommunication cable. No mining activities.	Intersection with 4 cables. Ferromanganesian nodules are mined in close vicinity to the route
Navigation	Navigation paths (VTS) are passing away from the gas pipeline route	Navigation paths (VTS) are passing in close vicinity to the gas pipeline route
Specially protected natural areas	No specially protected natural areas near the route	Some parts of the being designed "Ingermanlandskiy" wildlife area are located close to the route
Nesting sites and birds migration paths	There no nesting sites or mass rafts during migration within the route area	Several protected islands with mass nesting sites are located within the route area. Birds stay for rest during migration in the southern part of Gogland Island
Marine mammal breeding sites and migration paths	Seals can be observed rarely within the route area	The route crosses ringed seal migration paths
Spawning areas	There are no spawning areas near the route	The route crosses herring spawning areas
Seabed deposit pollution	Sand pebble soils with low pollutant concentrations. Secondary water pollution at seabed adjustments is unlikely.	There are no reliable mass data on seabed deposit pollution. However, the data from Sevmorgeo Company confirm high zinc and lead concentrations.

The comparison analysis of two alternatives shows that the route to the north of Gogland Island is more preferable due to a less length, remoteness from environmentally sensitive zones, military training areas and navigation paths. The route to the north of Gogland Island was selected by Nord Stream AG as a basic one.

A corridor with width of 2 km along the northern route was examined thoroughly in 2005-2007. The results of geophysical, geotechnical, hydrometeorological and engineering-environmental surveys are included into Appendices to this Design. The routes of two gas pipeline lines were selected within the examined corridor based on the following criteria:

- Seabed roughness and necessity of relief adjustment activities (pipeline free span elimination, pipeline stability ensuring, etc.)
- Presence of identified and unidentified potentially hazardous objects (ammunition)
- Presence of sunken ships and other potential cultural heritage objects
- Minimum length

The pipeline route was optimized in several stages. Primarily, the requirement to reduce the pipeline length as far as possible was taken into account at the Conceptual Design stage. The next optimization stage allowed reducing the earth work scope (gravel backfilling for support arrangement) to a possible minimum and excluding dredging operations (except for the nearshore area). The route was adjusted at the last optimization stage in accordance with archeologist recommendations and requirements of the Committee on Culture of Leningrad Region as to maintain the distance of 50-100 m from the discovered cultural heritage objects (sunken ship wrecks and separate rigging parts). Thus, the pipeline route provided in the Design is the safest alternative in terms of environment and cultural heritage objects protection, but less economically beneficial.

4.2 Construction

In terms of construction technology and methods the Nord Stream gas pipeline routes is divided into the shore approaching sections (in Russia and Germany) with depths of up to 10-20 m and a deepwater section with great depth values. The shoreline crossing section extends from the landfall at KP3+56 to KP1.5, which makes 1856 m for a western line and 1828 m for an eastern line.

The Russian nearshore sector is an ice gouging area, which is the main criterion for the pipeline burial into a trench. Considering the maximum ridged ice keel sizes, it is expected that the ices features will influence up to the sea depth of 14 m. The pipeline shall be laid in a trench, which provides the burial depth of 1.2-2.0 m from seabed surface to the pipeline top along the whole area in accordance with design solutions. Each line shall be laid in a separate trench with the bottom width of 4.4. The clearance between pipe centerlines shall be 20 m.

Prior to the gas pipeline construction commencement in the shallow water areas 2 dykes shall be constructed (one dyke on an external side of each line) to protect the prepared trenches in the shallow water areas against scouring due to wave actions. These structures shall be also used for trench excavation in the shoreline crossing area by means of ground-based equipment (excavators operating on the dykes), which will allow accelerating significantly the trench excavation in the nearshore area.

The trench shall be excavated using the following equipment:

- Ground-based equipment operating on the dykes (from the water edge to the depth of 2 m, total operation area length is 500 m)
- Pontoon-based backhoe shovel (depths from 2 m down to 5 m)
- Bucket dredger of “At Your Service” type (provided by MRTS company) with Liebherr P994 excavator (depths from 5 m down to 14 m)

A part of excavated material will be used to arrange the dykes used for ground-based equipment operation. All in all, the excavated material will be stored along the trench, which will minimize the environment impact as a result of seabed deposit redeposition.

The shore line shall be crossed by means of extended pipeline drawing from a PLV to the shore using a winch installed on the shore. A shallow draft PLV of the second generation shall be used, which will allow work commencement from a water depth of 5 m.

After drawing is complete, a pipe-laying vessel of the second generation (PLV II) continues pipe laying by its buildup using the conventional S-method up to the end of section 1 (1.8 km, 14 m isobathic line). When the required picket is reached, the pipeline end shall be set to the seabed. All operations concerning beveling, welding, quality control and weld joint insulation shall be carried out on a PLV board.

The trench shall be backfilled upon pipeline laying completion. The trench shall be backfilled from the shore by excavators using the excavated soil and the dyke material. The trench shall be backfilled offshore by pontoon-based excavators and a self-propelled barge with an opening bottom or with a side discharge system using stone-gravel mixture.

The pipeline laying operations in the main section with water depths exceeding 14 m shall include fabrication and laying on the seabed of 244.5 km length pipeline consisting of the first line – 122 km and the second line – 122.5 km.

The pipeline shall be laid on the seabed without burial in that section. The pipeline shall be erected using a PLV.

Pipes shall be laid using the conventional S-method from pipe-laying vessels with dynamic positioning or anchored vessels assisted by a towing vessel for anchorage, pipe transporting vessels and a scientific vessel, as a rule. Separate pipe sections with a length about 12 m shall be delivered to the pipe-laying vessel, where they will be fabricated into a continuous pipeline string and put down to the seabed surface (examples of such pipe-laying vessels are given below in this chapter). The following stages carried out continuously are included into the process on the pipe-laying vessel:

- Pipe welding
- Welding joint non-destructive testing
- Welding joint preparation
- Pipe laying on the seabed

Welding of new pipes to the continuous pipeline string on the vessel board shall be semiautomatic or fully automatic. Welding joints shall be tested using NDT methods. Earlier, x-ray testing was always used. Currently, this method was replaced with automatic ultrasonic testing (AUT), which ensures a greater quality and safety level when used as NDT method for the Nord Stream project pipelines. AUT shall be used for defect detection, measuring and registration. Welding defect acceptance criteria shall be developed prior to construction commencement and submitted to the appointed certification bodies for approval.

Welding joints shall be covered with anticorrosion protection upon completion of welding and AUT procedures. Different protective cover alternatives were considered for welding joints. The use of heat-shrink sleeves is one of the considered alternatives, when a thin heat-shrink sleeve made of polyolefin (polyethylene) is applied directly over a welding joint. Polyurethane foam shall be filled into a mold of polyethylene sheet to be erected around welding joints for packing of voids between concrete covers on each welding joint side.

The pipe-laying vessel shall move for a distance equal to the length of one or two pipe sections (12.2 or 24.4 m) upon assembly section joining process completion. Then, a new pipe section shall be connected to the continuous pipeline string as described above.

As far as the vessel moves forward, the continuous pipeline string is located in water in the vessel afterbody. The pipeline string is supported by the stinger (floating gangway) with a length of 40-100 m behind and lower the vessel level. The stinger is designed to control and support the pipeline configuration. The pipeline string coming from the stinger to a seabed touching point shall be always under tension to prevent the longitudinal crack risks and pipeline damage.

A force required to move the pipe-laying vessel is ensured by a system of anchors or a steerable thruster when using a vessel with dynamic positioning. The design pipe-laying rate shall be 2-3 km per day depending on weather conditions.

A special zone in the range of 2500 to 3000 m from the farthest anchor shall be arranged around the pipe-laying vessel to provide minimum disturbance from marine navigation. Unauthorized vessels, including fishing vessels, shall not be allowed entering this zone.

It is supposed that the underwater pipeline will be laid by several vessels of different types to support the construction process. One or two deep-sea pipe-laying vessels (stationary vessels with anchor-type positioning (dynamic positioning) or single-hull vessels with dynamic positioning) shall be used to lay both pipeline lines. Shallow-water pipe-laying vessels shall be used in the Russian nearshore areas.

The number of anchor vessels required for one pipe-laying vessel with anchor-type positioning ranges from 2 to 6. Anchors shall be positioned in a distance of 1000-2000 m from the pipe-laying vessel in the open sea areas. As a rule, vessels used for anchorage shall be large-sized vessels with the total length of about 130-200 m. In addition, one supply vessel is required for one pipe-laying vessel.

When laying the pipeline on irregular seabed areas free spans will appear. In such cases, when the pipeline will be under unacceptable stresses and (or) vortex vibrations, free span elimination operations by means of arranging supports of gravel-stone material having design size shall be carried out.

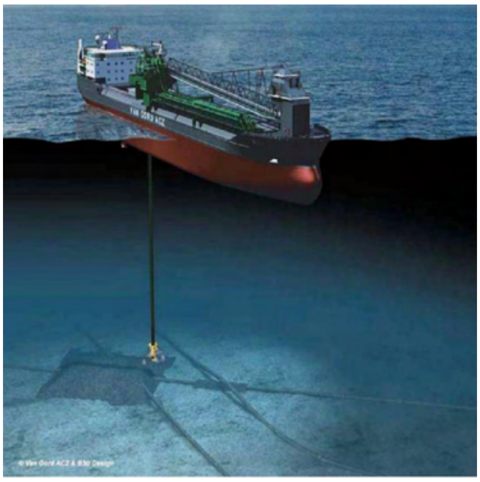
The pipeline free span elimination shall be carried out by rock riprap – rocky soil filling. At the same time, additional gravel supports, which reduce the length of free spans, shall be filled. Filling process shall be carried out in several stages in accordance with the design data. Gravel supports shall be arranged at the first stage to ensure static stability prior to pipeline laying for the East and West Lines. Gravel filling shall be carried out at the second stage to ensure static stability after pipeline laying for both lines. Gravel filling shall be carried out at the third stage to ensure dynamic stability after pipeline laying. Gravel filling shall be carried out at the fourth stage to reduce longitudinal bending after pipeline laying and gravel filling shall be carried out at the fifth stage to reduce vertical bending after pipeline laying.

The quantities of gravel-stone material required for free span elimination are given in **table 4.2** below. The design provides for gravel-stone material delivery from Erkilya borrow near Vyborg (Vozrozhdenie-Nerud management company).

Table 4.2 Quantities of gravel-stone material required for free span elimination

Gravel support type	Gas pipeline line	
	East Line	West Line
To be arranged prior to pipeline laying	30650.6	30088
To be arranged after pipeline laying (based on static loading criterion)	42903	29783
To be arranged after pipeline laying (based on fatigue damage criterion)	5538	5043
To be arranged after pipeline laying (based on buckling criterion)	668424	681959
Total	747515.6	746873

A special vessel for rock riprap and a fall pipe used for rock riprap on the seabed are shown in **figure 4.1** below.



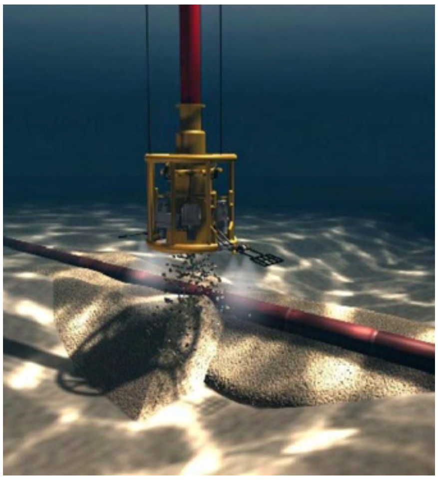


Figure 4.1 A flexible fall pipe vessel (FFPV) (to the left) and close-up view of a fall pipe distributing stone material around the pipeline (to the right)

The Nord Stream gas pipeline crosses 3 cables within the Russian sector. Special measures shall be taken to ensure safe cable crossing while constructing the pipeline. Different alternatives of safe cable crossing are possible:

- Cable cutting and laying beyond the gas pipeline corridor – in the case when the cable in question is not used and its owner consent is received

- Cable burial using water jet equipment

Selection of a particular cable crossing alternative depends both on weather conditions within the crossing area and the owner's requirements.

The Russian sector of the Nord Stream offshore gas pipeline and battery limits of OOO PeterGaz start with outlet welds of DN700 isolation spools. The onshore section ends with the golden weld which is located at KP 3+56 (356 m away from КР 0 towards the shore). The dry section includes the process part (pig launching trap) and the linear part (length of 904 m).

Process facilities area is limited to the pig launching trap site and extends from OOO PeterGaz Battery Limit. The trap site will include two pig launching traps, shutoff valves, connecting piping with pipe fittings and insulating spools intended to separate electrochemical protection systems of the trap site and the line pipe. All equipment and all piping within the trap site will be mounted on supports above the ground level. Further towards the sea (in the direction of gas flow) the trunk pipeline enters the ground by elastic bending and is buried to the design elevation of 1.2 m to the top of the pipe. An anchor flange and an anchor block will be provided between two natural bends of the pipeline to protect the pig launching traps and the insulating spool from longitudinal displacement.

Line pipe area of dry pipeline section extends from the pig launching trap site up to the landfall designated for pipeline drawing from a pipe laying barge. The linear part length is 904 m.

Golden weld between the dry section and the offshore section of the proposed pipeline is considered to be the conventional boundary of dry section line pipe area on the sea side.

A clearance of 20 m is assumed between the lines of double gas pipeline based on the field installation and operation safety considerations. Minimum width of side strips according to construction and field installation process and organizational requirements is 16 m.

Total width of longitudinal construction area is: 16m +20m +16m = 52m.

The forest within the pipeline route is cleared by bays (blocks) 100 m by 52 m each (the width of land allocation).

Pipeline within the dry section will be laid in a straight line without horizontal turns. Vertical turns will be performed by elastic bending.

The pipeline route will be laid in water-saturated soils with groundwater occurrence depths ranging from 0.7 to 0.9 m. Soil-filled polymer container ballasting devices (PCBD) will be employed to prevent the pipeline from floating and secure it in a stable position against the trench bottom according to the design profile. Based on the calculation results ballasting devices will be installed at 46 meter intervals.

Pig launching trap site will be provided in Russian dry section to allow launching of cleaning, gauging, separating and diagnostic pigs in the pipeline.

According to the design the pipelines with stop valves of pig launching traps will be laid above ground at a height of 1.8 m from the ground level to the pipe centerline. Gas pipeline ends downstream of the traps enter the ground by elastic bending with a 1.2 m high cover above the top of the pipe.

On each line of the pipeline between two elastic bends the fixed anchor blocks will be installed in the place where the pipe enters the ground. It is rigidly connected with the pipe through anchor flange and is intended to prevent longitudinal movements of the pipeline.

Prior to commencement of construction the forest-clearing operations will be carried out and a common skidway and road along the route to the storage area will be built. In each bay one of the following operations will be carried out sequentially:

- Felling of trees (up to 25 cm with a bulldozer, above 25 cm with a manual power saw)
- Branch cutting
- Wood severing and removal to the storage area
- Stump extraction, bush- and undergrowth cutting with a bulldozer
- Separate storage of merchantable wood, stumps and felling debris to be hauled is organized on a bay which is nearest to access road

Earthwork includes the following operations:

- Trench digging by a single-bucket excavator
- Backfilling of the trench by bulldozer, using soil from the stockpile, by height of at least 1.2 m above the top of the pipe

During trench excavation the vegetable soil is not stockpiled separately, due to its low fecundity and for minimization of the construction area width on the lands of GosLesFond (Forest Reserves Management Department).

The width of the trench will not be less than 1.8 m. Where ballasting devices are to be installed the width of the trench will be widened to a minimum of 2.6 m.

Pipeline backfilling operations will be carried out by an angling bulldozer advancing the trench at an oblique angle in parallel passes.

During excavation of the pit deeper than 6 m for anchor supports at the pig launching trap site the rock ripping operations will be required at depth 3.4 m. Rock will be ripped by explosives using shallow blast-hole charges. The same method will be used to rip boulders during pipeline trench excavation.

Internal hydraulically- of pneumatically driven centering skids should by used to align the joints during pipeline assembly on the trench edge. External centering skids may be used only during special welding operations (welding of last double joints, pipe joints of different thicknesses, pipe-to-part joints and pipe-to-shutoff valves joints).

Prior to welding a bell hole shall be provided in the trench to ensure obstacle-free joint welding, joint insulation and weld examination operations.

Pipes are laid using soft fabric slings; the pipe-laying machines gripping devices and arms shall have rubber coat.

As the pipeline is laid in bays of 150 m, water pumping-out from the trench over the length of 300 m will be required to weld the pipe strings in the trench. Water pumping-out volume will be 750 m^3/day. Two pumps (1 operating and 1 stand-by) with intake head up to 5 m and capacity 30 – 50 m^3/hour will be used.

All welded joints shall be subject to 100% visual inspection, 100% radiography and random ultrasonic examination (25%) in the process of pipeline erection. Pipeline joints shall be insulated with heat-shrink sleeves.

Design stipulates erection of monolith reinforced concrete foundations of total volume 1720 m^3 at the pig launching trap site.

Temporary construction projects of the Nord Stream offshore gas pipeline through the Russian sector are:

- Administration and amenities area of the construction site and contractor's construction base for the dry section and coast facilities of the offshore section 0-5 km
- Testing facilities for offshore pipeline 0 km-1200 km and on-shore section

4.3 Pre-commissioning/Commissioning

The pipeline internal cleaning and testing operations shall be carried out upon completion of all civil and erection works within construction area. Since both pipeline lines in the Russian sector will be constructed in two stages, testing shall be also carried out in two stages:

First Phase. Both dry sections together with the pig launching trap and the West Line of the dry section shall be tested. The East Line of the offshore section shall be laid from the landfall to KP 5 (sea depth – 20 m) and preserved till the next working season. For this purpose the line will be dried and filled with nitrogen.

Second Phase. Completion of construction of the East Line of the offshore gas pipeline, its testing and provision of the golden weld.

The dry testing section of the Nord Stream (both lines) on the Russian shore starts from the stationary pig launching trap and ends at the temporary pig receiving trap.

Each offshore section is bounded by temporary pig receiving and launching traps.

The Russian sectors of the West and East Lines shall be tested within the first offshore section (from KP0 to KP300).

The following types of activities shall be carried out in the offshore section of the West and East Lines:

- Flushing, calibration and cleaning of the internal surface of the offshore pipeline in order to remove particulate matter
- Filling of the offshore pipeline with water (filling is to be performed during flushing and calibration)
- Hydraulic testing (Pt=1.1Pdes)
- Pressure discharge
- Removal of water from inside the pipeline and flushing to remove salts
- Drying to remove residual water

Filling and hydraulic testing of the whole offshore pipeline shall be conducted using sea water. Water intake is envisaged near the Portovaya Bay, which is located in the Russian sector of the Gulf of Finland. Upon completion of tests the water shall be discharged into the Gulf of Finland near the isobathic line 6 at a distance of 750-1000 meters from the shore. Water intake and discharge are supposed to be carried out using a floating pumping station or a suction dredger. Water intake facilities shall be equipped with fish protection systems in compliance with SNiP 2.06.07-87. During displacement of water from the pipeline 4 welding pigs (left in the pipeline after hyperbaric welding) and 8-10 separation pigs will be received on the Russian shore. When receiving the pigs, 200 m^3 of water in front of each pig shall be directed to the settling pit for preliminary checks (and treatment, if required) before discharge to the sea. The total volume of flush water to be discharged into the settling pit after cleaning both lines is 2000 m^3.

The following sea water volume is required for the first testing stage: 1,289,200 m^3 (water intake from the Gulf of Finland).

During the second stage of testing there will be no requirement for fresh water on the Russian shore, and sea water consumption and discharge points will be the same as in the first stage (1,289,200 m^3). Thus, the total sea water volume required for hydraulic testing is 2,578,400 m^3.

Cleaning and calibration of the offshore sections of the gas pipeline shall be carried out by passing minimum 4 cleaning pigs with calibrating discs.

Filling shall begin from the first offshore section (KP 0 – KP 300); water shall be supplied by filling pumps located on the Russian shore. At KP 300 a sea vessel shall be placed to control air release from inside the pipeline, arrival of cleaning pigs to the underwater receiving trap at KP 300 and bypassing the cleaning water into the second offshore section. Once the pigs are received the flush water shall be supplied via the bypass into the second offshore section. Then the following 4 pigs shall be launched from the underwater launching trap at KP 300. The second offshore section will be filled via the bypass at KP 300. Then cleaning pigs shall be received at KP 800. Bypassing of flush water and launching of the pigs at KP 800 shall be controlled similarly from a sea vessel. Then the third offshore section shall be filled and pigs shall be received in the temporary receiving trap at KP 1200. All flush water shall be collected in a settling pit on the German shore. The total amount of flush water after flushing of a single line will be approximately 6000 m^3.

Sea water intake for hydraulic testing shall be carried out within the exclusive economical zone of the Russian Federation. Water shall be taken from the depth of 6 m at a distance of 750-1000 m from the shore. To prevent suction of debris and dirt a protective grid will be provided. The offshore section shall be filled using filtered and chemically treated sea water. The total amount of water required for filling of the offshore section is 1,289 thous. m^3.

Temporary pumping station located at the landfall is used to increase pressure in the offshore section. Water displacement from the offshore section of the pipeline shall be performed with dry compressed air pumped from the temporary compressor station. The compressor station shall be installed on the German shore.

Before water removal from the offshore section, several cleaning pigs are launched to remove the sediment (calcium carbonate) from the pipe surface. After receiving the pigs on the Russian shore, 200m^3 of water before them and the water between them will be drained off to 3000 m^3 settling pit for analysis and treatment (if required).

The space between the first four separation pigs is filled with fresh water to remove salts from the pipe wall, and then with air. Fresh water flushing is required to remove salts from the pipe walls. The total amount of water for salt flushing is 3000 m^3. The level of fresh water filtration is 50 µm, sediment content in water – not more than 20 g/m^3.

The speed of pigs is 0.5 – 1.0 m/s to avoid pig stucking and air entrance. All pigs should be equipped with sensors to detect pig location.

Russian onshore section and pig launching traps will be tested with fresh water, separately from the adjacent off-shore section. Filling, cleaning and gauging will be provided by means of the launching trap installed at the dragging boundary and a receiving trap installed on the opposite side. Filling of the pipeline with water will be made from tank trucks via a 100 m^3 tank installed on the territory of the pumping station for off-shore testing.

Cleaning of the internal surface of pipelines is performed in order to remove scale and particulate matter which may contaminate the product to be transported via the pipeline. Cleaning pigs are not used for cleaning of pig launching traps. Cleaning of the cavity shall be combined with displacement of contaminants by water flow during removal of water upon completion of hydraulic testing.

Cleaning of the onshore sections of the gas pipeline shall be carried out with clean fresh water supplied from the temporary pump station and by passing cleaning pigs from the permanent pig launching trap. In front of cleaning pig for wetting and scouring of contaminants water shall be supplied in amount 10-15% of the section to be cleaned, which corresponds to 100-150 m^3 for each line.

Flush water and pigs are received by the temporary receiving traps located at the landfall. The flush water is discharged into the settling pit 3000 m^3. Once flushing is completed, the pipeline shall be filled with water 1800 m^3 for subsequent hydraulic testing.

4.4 Operation and Decommissioning

The regular pipeline system diagnostics using ultrasonic or magnetic induction type intelligent pigs to be launched from the pig launching and receiving trap installed onshore shall be carried out during the Nord Stream offshore gas pipeline operation. The annual hydrographical survey within a strip of 200 m width along the gas pipeline route shall be carried out to assess the gas pipeline position stability and detect any seabed scouring, etc.

There are two de-commissioning alternatives for offshore pipelines: 1) complete disassembly and removal of the whole system for further salvaging and 2) disassembly of above-water structures (platforms, on-shore facilities) and in-situ conservation of the pipeline linear part (the cavity is filled with water with addition of biocides). The second variant seems more preferable from economical and environmental points of view; however the current international regulations require disassembly and removal of all engineering facilities upon operation completion. Decision on the Nord Stream system de-commissioning at the end of life (at least in 50 years) will be made by the gas pipeline owner according to the regulatory requirements and technologies which will be in use at the time.

5 Abiotic Environmental Components

5.1 Geology and Terrain Conditions

Within the Russian exclusive economic area, the pipeline route remains in the limits of the Baltic shield. Geologically, the area includes an ancient heterogenous foundation formed by proterozoic depositions and a quarternary sedimentary cover. The main part of the quarternary depositions is formed by Valday glacial depositions and subsequent Baltic glacial lakes and modern sea basins. Glacial depositions are formed by moraines i.e. compacted dense clay with inclusions of boulders, gravels and sand lenses. Lake and sea depositions are mostly formed by clays of different strength and grain size and mud.

The seabed is a plane area with hills and ridges formed by a number of subsequent glaciations and differential glacio-isostatic rising of the Baltic shield. The ridges are small elongated massifs of islands and banks grouped in the north-west direction and separated with low plane areas. The ridges are usually formed by moraine depositions. The plane areas between them are formed by clays and muds.

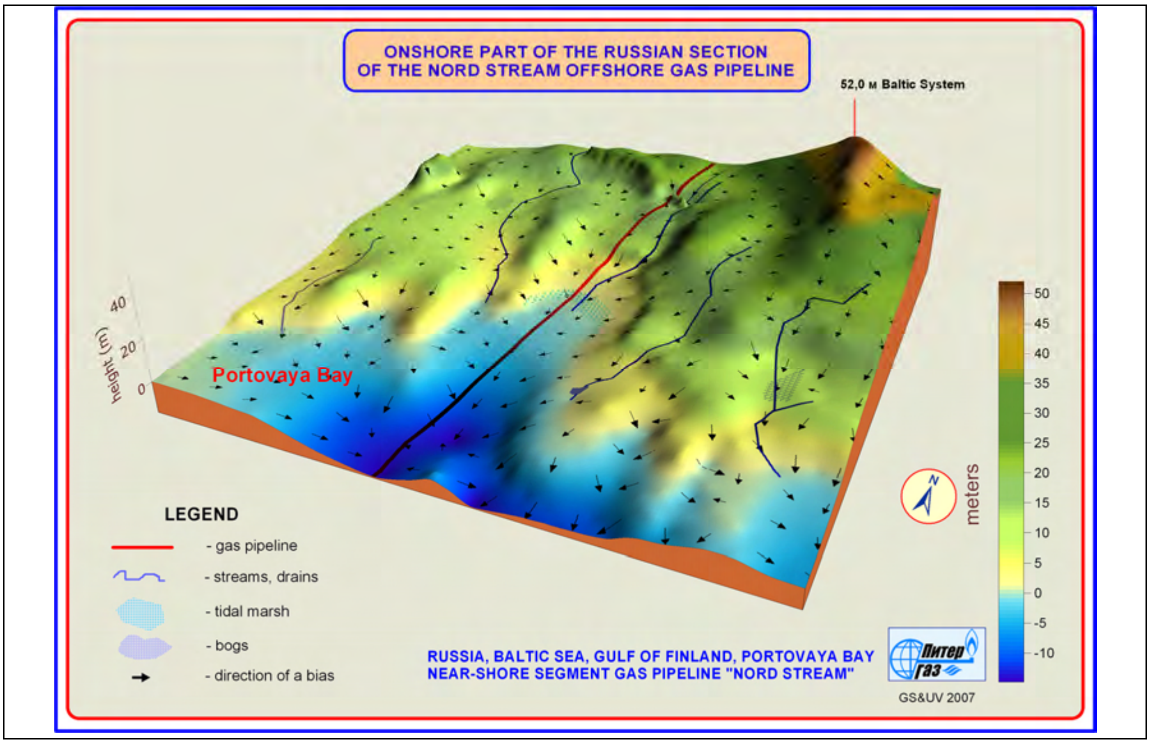


Figure 5.1 Terrain Conditions within the Dry Section of Nord Stream Gas Pipeline

The gas pipeline will be routed in a relatively safe seismic zone were earthquake strength is unlikely to exceed 5 points as per MSK-64.

Along the route, the most of areas are good for pipe laying in terms of lithological and hydro-dynamic conditions

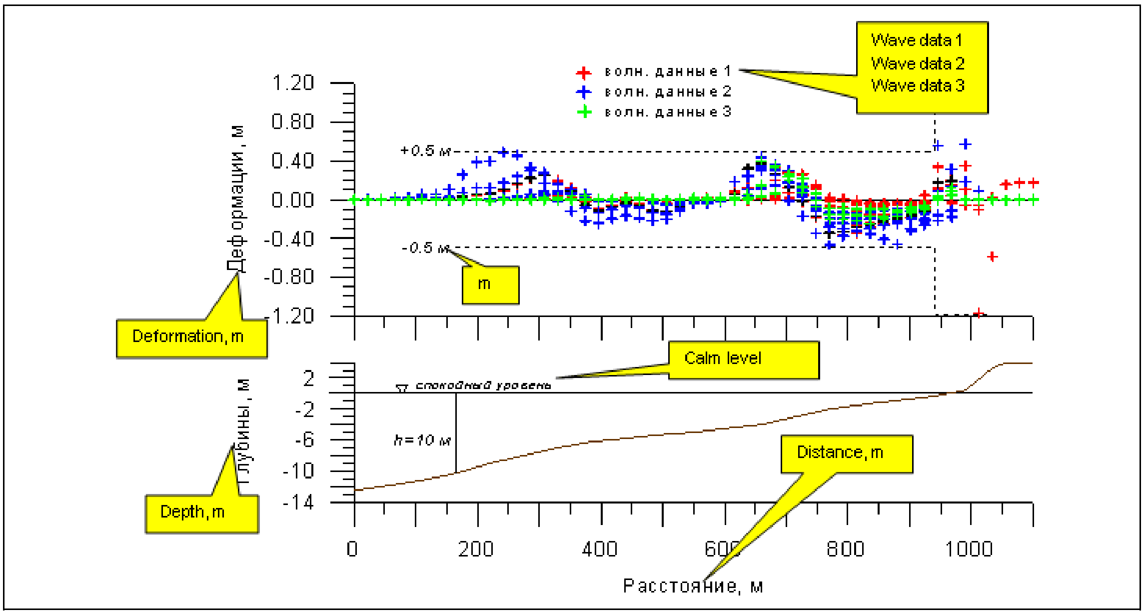


Figure 5.2 Summarized Diagram of Storm Deformation Distribution

Any observable movement of alluvia can only be found in the narrow coastal strip. However, according to alluvia forecasting results, the shore in question will remain stable. Moreover, the shore in the Portovaya bay may even accrete in the next several decades.

Also, within the offshore and dry section of the Russian sector of Nord Stream offshore pipeline there are no mineral reserves included into State Mineral Reserves Balance

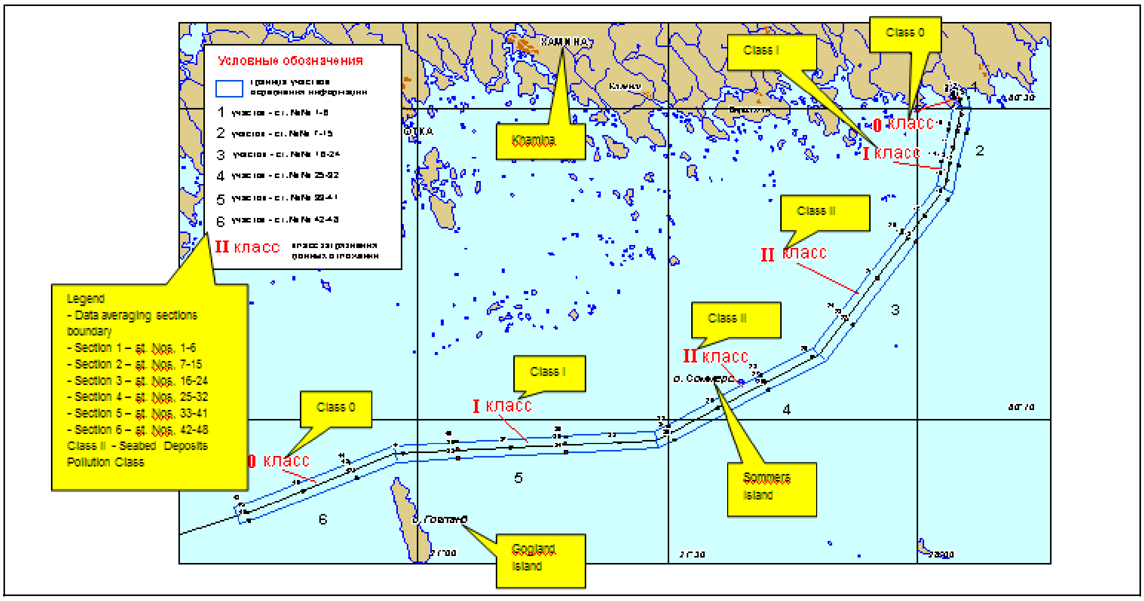


Figure 5.3 **Layout Map of Gas Pipeline Route Areas Specifying Pollution Class of Seabed Deposits According to Regional Standard "Norms and Criteria for Assessing Pollution of Seabed Deposits in Water Basins of St. Petersburg, 1996"**

According to the seabed contamination findings obtained in 2005-2007, the maximum content of heavy metals and organics occure in the muddy soil in the central part of the route. The minimum content was observed in the sandy soils around Gogland and Portovaya bay. On the whole, there are no severely contaminated sediments along the route.

5.2 Climate and Atmosphere

The eastern part of the Gulf of Finland is a moderate climatic zone with small daily and annual air temperature fluctuations, high humidity, cloudy sky and frequent precipitations. The climate of the eastern part of the Gulf is more severe than in other parts of the Gulf and in open parts of the Baltic Sea.

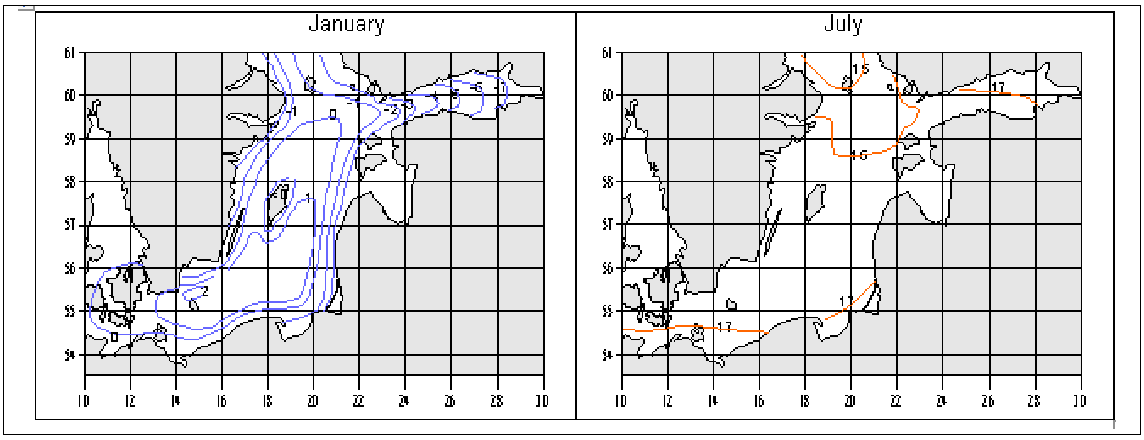


Figure 5.4 Distribution of Average Monthly Temperatures in the Baltic Sea

The predominant winds in the Gulf of Finland are west wind, southwest wind and south wind.

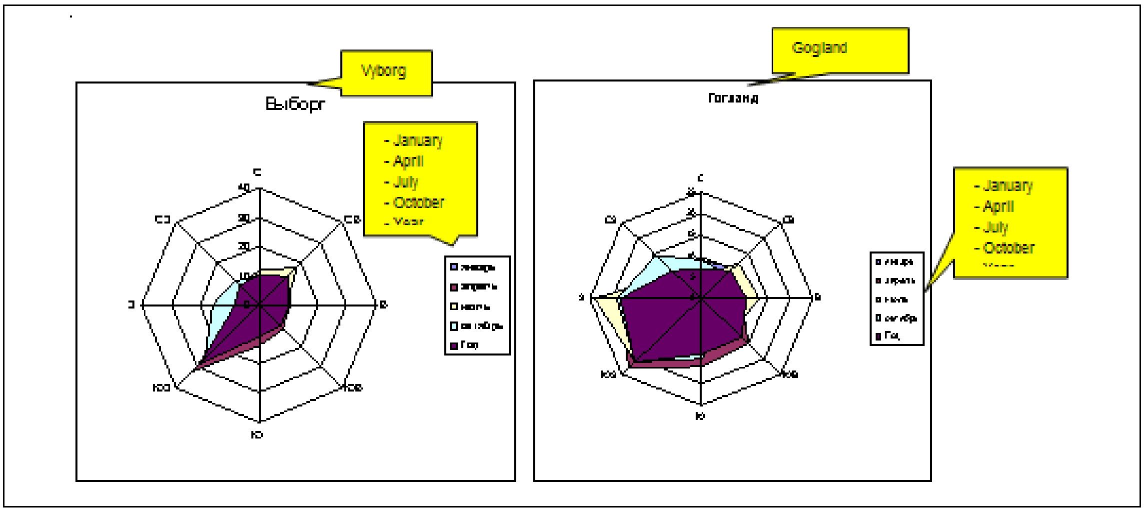


Figure 5.5 Wind Direction Frequency (%)

During the year, cloudy weather with fogs and slight precipitations (550-790 mm/year) prevails. In winter there may occur snow blizzards that last maximum 1 day. In January and February, the number of snow blizzard days may reach 10.

According to the “Annual Air Pollution Status Report for the Russian Towns and Cities”, in 1997-2005, the level of air pollution in Leningrad Region at the coast of the Gulf of Finland is mostly low. A specific feature of this area is that there are no large industrial enterprises affecting the atmospheric air.

5.3 Water Environment

The main factors influencing the overall water circulation in the Gulf of Finland are river flows and water exchange with the Baltic Sea. The water in the upper layers of the Gulf is less dense and less saline; it moves along the northern coast of the Gulf to the Baltic Sea whereas more dense and more saline and more deep seawater moves mostly along the southern coast.

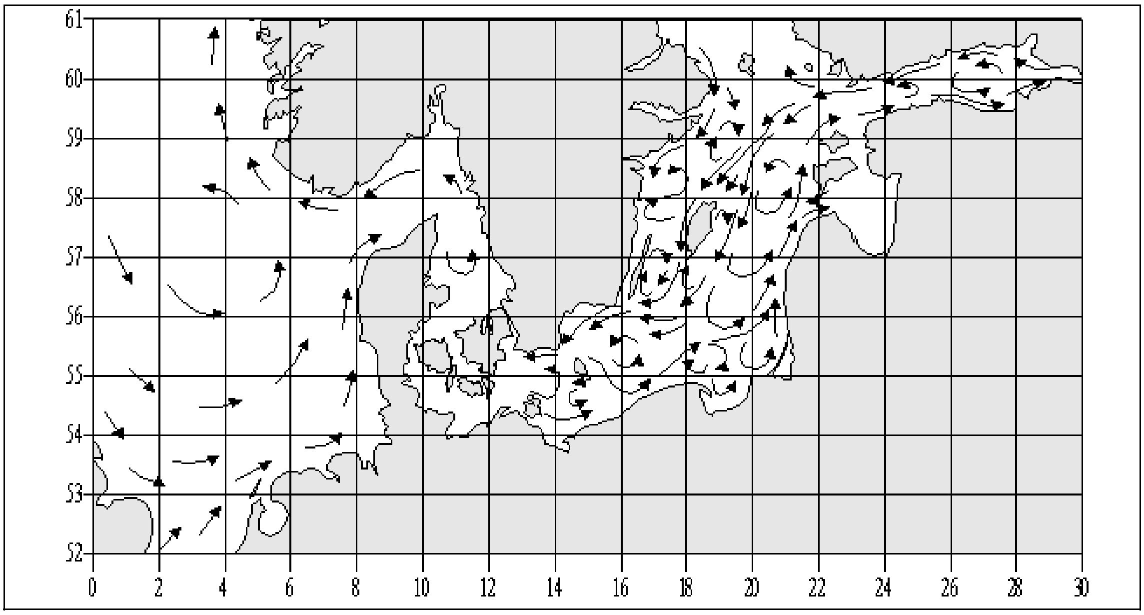


Figure 5.6 Water Circulation in the Baltic Sea – General Diagram

The main factors influencing formation of sea currents in the Gulf are wind currents, long wave currents and, to a some lesser extent, discharge currents, tidal currents and inertial currents. On the surface, the velocity of the wind currents in the open areas of the Gulf does not exceed 50 cm/s. The long (cyclonic) waves induce currents whose velocity may exceed 100 cm/s in the coastal areas of the Gulf and reach 50-70 cm/s in the open areas. The role of tides in the Gulf of Finland is not significant and tidal current velocities are low (max. 2-3 cm/s).

As to distribution of the water salinity on the surface of the Gulf, its values rise from East to West or from 1-2% to 6-6.5% respectively in all seasons of the year. With this, in the northern part of the Gulf the values are a bit lower than those around the southern coast. This is due to desalination caused by the river flows and general water circulation in the Gulf. The degree of salinity depends on the season. The minimum values of the average monthly salinity are observed in summer and in spring. The maximum values are observed in autumn and in winter.

The annual surface water temperature variations in the eastern part of the Gulf of Finland, on the whole, corresponds to that of the air temperature – and this is typical for the middle latitudes. In the eastern part of the Gulf of Finland, the water starts getting warmer from April till the end of

July/beginning of August. This is the period when the average monthly surface water temperature reaches its maximum (18-20°C).

Table 5.1 Average Water Temperatures Measured at Coastal Stations

Station	Value	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Vyborg (1977-2000)	Avg.	0.01	0.00	0.11	2.00	10.18	16.75	19.43	18.57	13.19	7.19	1.93	0.22
Moshchny (1977-1993)	Avg.	-0.06	-0.19	-0.11	0.97	8.98	15.32	18.59	17.32	12.08	6.93	2.62	0.37
Gogland (1977-1996)	Avg.	0.17	-0.09	0.08	1.16	6.78	13.33	17.01	17.32	13.21	8.76	4.60	1.56

From January till March, the entire Gulf of Finland is covered with ice. In severe winters, the ice thickness in the eastern part of the Gulf may reach 70-80 cm, whereas in the western part it usually does not exceed 40-50 cm.

Evaluation of seawater quality around the gas pipeline route in the Gulf of Finland was based on comparison of hydro-chemical values and maximum allowed values specified for fishing water bodies subject to Roskomvod and Rosgidromet relevant documents in force. Water contamination indices (WCI) were calculated based on analysis of 109 parameters.

$$WCI = \frac{\sum_{i=1}^{n} \frac{C_i}{MPC_i}}{4},$$

where Ci is average concentration of the component and ПДК is the maximum allowed value for that component.

The average WCI index for the area in question is 0.42 and therefore the seawater can be classified as clean water (II quality class).

Table 5.2 Water Contamination Criteria in Terms of WCI

Quality class	Description	WCI Value
I	Very clean	< 0.25
II	Clean	0.25 – 0.75
III	Moderately contaminated	0.75 – 1.25
IV	Contaminated	1.25 – 1.75
V	Dirty	1.75 – 3.0
VI	Very dirty	3.00 – 5.00
VII	Extremely dirty	>5.00

The hydrography of the dry section includes a great number of small water currents (less than 10 km) The dry section of the pipeline does not cross any water barriers. However, 19 meters to the east from the route, there is a brook that starts from a marsh and flows into Portovaya bay. The brook is 2 km long, 1.3 m wide and 0.2 m deep. Its drainage area is 1.67 sq. km, flow velocity is 0.2 m/s and the flow rate is 0.017 cu.m/s.

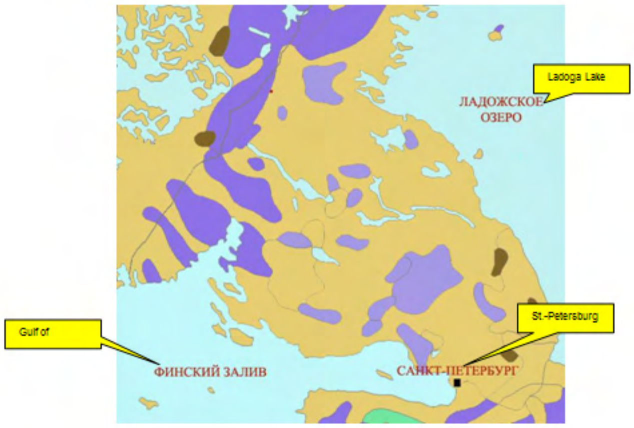
The water is calcium-bicarbonated, low-mineralized soft water. Its average turbidity does not exceed 25 g/cu.m. The average content of macro- and micro-components (heavy metals) in the water does not exceed the specified maximum allowable limits.

Since the dry section relief is mostly plane, the ground water does not run deep (0.1 – 0.3 m). The level of precipitation exceeds the level of evaporation and this causes excessive soil moisturizing and contributes to the ground water accumulation. The water bearing layer includes waters from peatlands, lakes, lake-alluvial, sea, glace alluvial and glacial depositions. The water bearing rocks are peat, sand and sometimes sand clays.

6 Biotic Environmental Components

6.1 Landscales, Soils, Vegetation and Fauna of the Dry Section

According to the natural zoning diagram, the coastal area of the Russian sector of Nord Stream project is located in Vyborg district, Baltic-Ladoga region, South-Taiga Subprovince, North-Western province of the Russian plain. In accordance with the lithogenic, vegetation and soil structure, the dry gas pipeline section may be subdivided into three following natural zones: Glacial plain with hills and ridges, old glacio-lacustrine and marine terraces, modern marine terrace. Structurally, the predominant landscapes in the area in question are old glacio-lacustrine planes and marine terraces covered mostly by fir trees and some pine spots on drained areas as well as sedge and sphagnum marshes with suppressed small-leaved forests on low mesorelief sites.



– Mid-taiga forests with Picea abies dominating

– South-taiga forests with Picea abies dominating

– Mid-taiga and south-taiga forests with Pinus sylvestris dominating

Figure 6.1 A Fragment from European Natural Vegetation E-Map (2004)

Under the branches of the above vegetation community, there are different soil combinations. Mostly they are based on specific semi/hydromorphic forest soils with admixtures of podzols.

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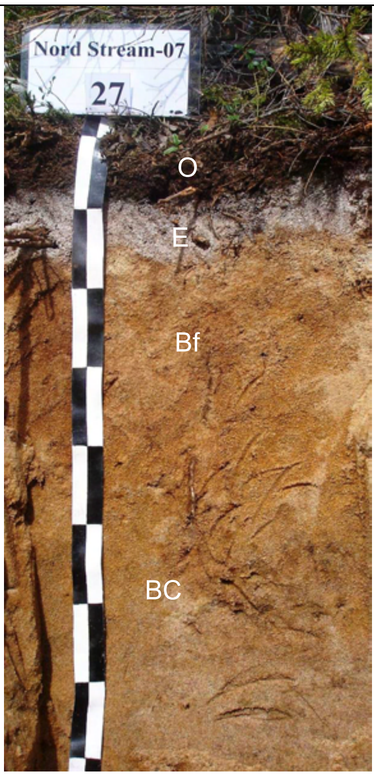
<td>
</td>
<td>Section No. 27 – Illuvial-Iron Sandy Podzolic Soil on Graded Marine Sand

O 0-7 cm. - peated forest floor

E7-17 cm – fresh, whitish, light gray medium sand; well-graded, non-structured, loose with root inclusions; limits – waved, abrupt color change.

Bf 17-42 cm – fresh, light-red, medium sand; well-graded, non-structured, loose; limits – waved, observable color change.

BC 42-80 cm – fresh, pale-red (lighter than the previous type of sand), medium sand, well graded, loose, non-structured</td>
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<td>Section No. 40-1 – Illuvial-Humic-Iron Podzolic Soil with Pebbles and Sand on Lacustrine-Glacial Depositions with Boulders:

O 0 to 9 cm – forest floor converted into peat

A1E 9 to 22 cm – damp whitish and light grey coarse sand with pebble and gravel – structureless, loose, multiple roots, undulating interface, abrupt change in colour

Bf – 17 to 42 cm, fresh, brown red coarse sand with pebble and gravel – structureless, loose, undulating interface, noticeable change in colour</td>
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Figure 6.2 Morphology of Illuvial-Iron Podzols

The main types of soils under the dry section are as follows: sod podzols, illuvial iron podzols and peat podzolic soils. All soils in the area in question are low-fertile soils with increased acidity, low humic content in the mineral horizons (0.12-0.86%), high humic content in the organic part (8.33%), and very low content of movable nutrients. According to the soil sanitary evaluation, the soil in the area is “clean”. By total arsenic and mobile chromium, their level of pollution is estimated as allowable.

A great part of the dry section is formed by tree-felling sites. The felling was performed 15-20-25 years ago and now these sites are covered with young fir-trees or pines. However, no cutting-backs were performed there from that time and now the young pines and fir-trees have become “jungles” that can be hardly used by animals for their habitation. In these areas there are no even typical species of that region – common frogs, thrushes, chaffinches, tree pipits, elks and other vertebrates that are usually quick to inhabit abandoned felling sites.

On the whole, the mammal fauna around the pipeline route is relatively poor in terms of species. This is because the vegetation community is not divergent, the forests are small and discontinuous and the landscape itself is changed due to intensive agricultural activities.

On felling sites that were abandoned 2-3 years ago, the number of observed vertebrates did not exceed 10 species and this may be deemed as occasional migration.

Also human economic activities prevent large animals like elks, wild pigs, bears and other species typical for the region from using these areas. However, wolves and foxes are typical in that area. Also there are a lot of arctic hares and even some species of weasels. As to mouse-type rodents and insectivorous mammals, the number of their species is very limited and their entire population in this part of the coast and forests is relatively small.

On the whole, in the construction area there are 24 mammal species. Some of them are protected. Thus, in Leningrad region there is one protected species (Myotis daubentoni), in the Baltic region there are 3 protected species and in the eastern Fennoskandia there are 3 protected species. The mammals, included into the RF Red Book are not mentioned here.

In the area around the dry section of the gas pipeline, there are almost no protected birds and this is due to the local living environment conditions. The most typical birds in the area are thrushes (blackbirds and throstles) chaffinches, willow warblers, half-collared flycatchers and greater spotted woodpeckers. Sometimes in mature forests black woodpeckers, wood grouses, woodcocks and wood pigeons appear. The most numerous birds (1.5-3 birds/hectare) in the area are tree pipit (Anthus trivialis), whitethroat (Sylvia communis), willow warbler (Phylloscopus trochilus), sedge warbler (Acrocephalus schoenobaenus), yellowhammer (Emberiza citrinella) and chaffinch (Fringilla coelebs).

One more characteristic feature of the gas pipeline dry section area is that there are a lot of water-birds that actively inhabit the coastal area in summer and at the time of their seasonal migrations. The area is very close to the birds main migration route (migrations from the White Sea to the Baltic Sea) that crosses some islands in the Gulf of Finland and some sites near Vyborg.

In the area in question there are about 20 species of birds and mammals that can be an object of hunting.

The gas pipeline construction area has been revealed to be inhabited by 4 protected species of superior vascular plants. One of them - sweet gale (Myrica gale L.) is included in the RF Red Book of plants. The rest of protected species of superior vascular plants and all protected muscoid, lichen and fungi species are included in the Leningrad Region Red Book.

Figure 6.3 Sweet Gale (Myrica gale L.)

All protected species of plants grow in groups and are very far from the construction sites where the gas pipe line is to be laid.

6.2 Biotic Seawater Components

6.2.1 Living Organisms in Pelagial Zone (Sea Plankton)

According to the archive data, in the Gulf of Finland there are more than 300 species of algae. The most divergent are green algae (141 species), diatomic algae (141 species) and blue-green algae (48 species) Now, the most of the species are olygosaprobic algae. They make up 88.7%. The share of meso- and polysaprobic alfare is 11.3%.

The seasonal development of phytoplanktone in the Gulf of Finland and in the Baltic Sea depends on temperatures, light exposure and quantity of nutrients supplied with the river flows. Therefore phytoplankton development reaches its maximum in spring and in summer. In spring, the fraction of Ascillatoria and some chlorococcae algae increases (especially in shallow waters). In June and July, these algae make more than 90% of the total quantity and up to 80-90% of the biomass. In deep waters in summer, blue-green algae also prevail and make up more than 70% of the total phytoplankton biomass.

Domination of green and blue green algae is a typical feature of the phytoplankton structure in spring and in summer in the Gulf of Vyborg and other parts of the Gulf of Finland Last years, blue-green algae (cyanobacteria) prevail in these groups. Their overall distribution is the main reason of water blooming The role of green algae in plankton gradually becomes secondary. Moreover, in autumn their divergence reduces abruptly, whereas the blue-green algae go on with their vegetation.

Last years in the Gulf of Finland there is a structural reorganization of the phytoplankton community in favor of eutrophic species. The increase of oscillatoric-chlorococcus community is a proof that man-made impact to the system and accumulation of organic components in the soils and in the water have also increased.

The prevailing species in zooplankton of the Gulf of Finland are infusoriae (more than 36 species), rotifera, cladocera and copepoda. The main part of the zooplankton biomass is a brackish water community. The permanent species include Eurytemora hirundoides and Bosmina obtusirostris maritima. There are also some others species in that community that prefer a more saline water: Limnocalanus grimaldii, Acartia bifilisa, A. tonsa, Synchaeta baltica, S. monopus, Keratella quadrata, Brachionus calyciflorus.

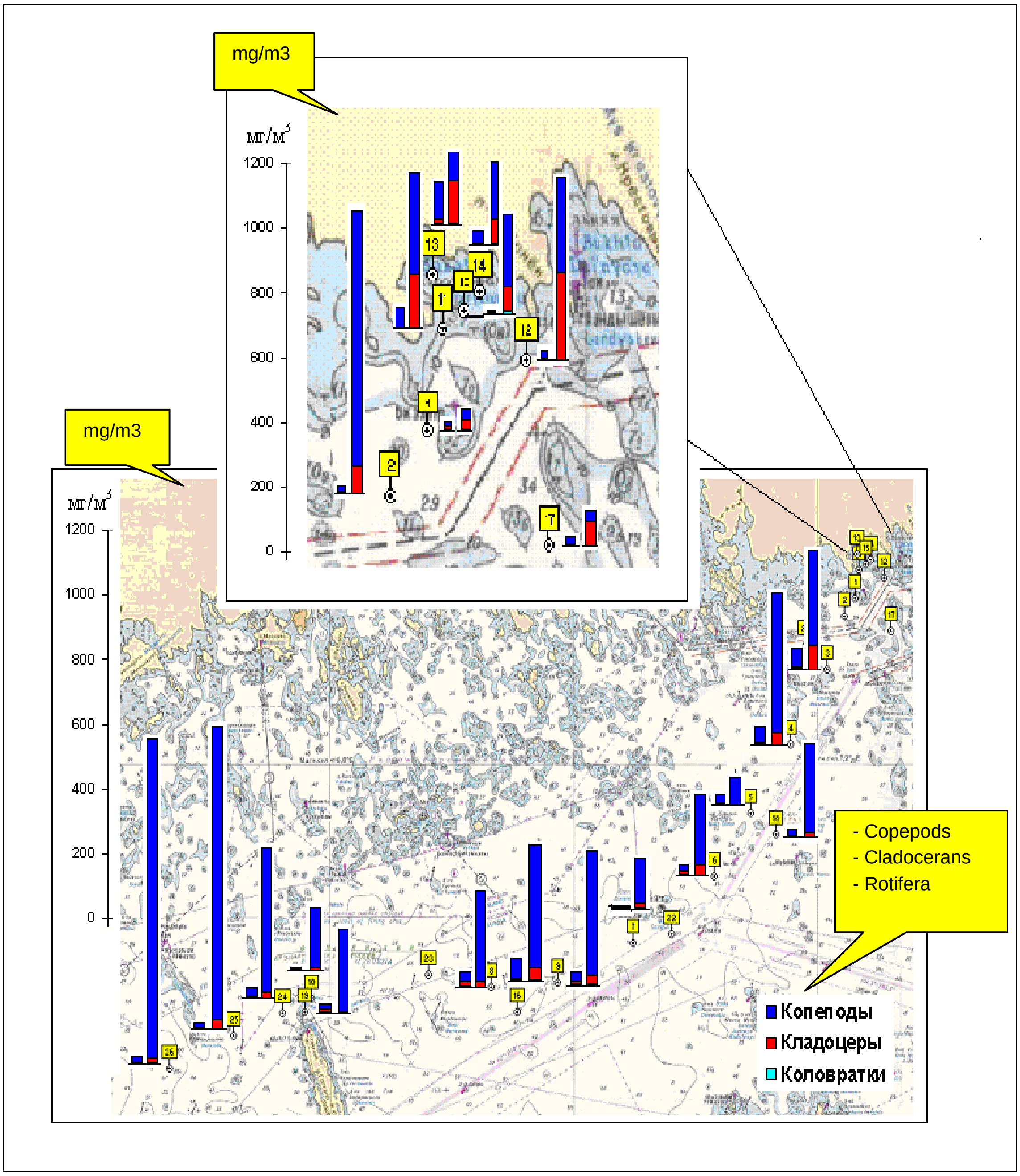

Figure 6.4 **Zooplankon biomass (mg/m^3) in the Eastern Part of the Gulf of Finland around Nord Stream Gas Pipeline in June (left column) and in August (right column) in 2006**

Seasonal changes in zooplankton biomass and species depend on water salinity. Thus, in spring (May – beginning of June), brackish water species and euryhaline-freshwater species prevail. When the salinity level drops significantly, the main influence in the epilimnion belonged to nauplii and colepoditae (Eurytemore spp) and euryhaline/freshwater Notholcae caudatae, K.

quadratae, S. grandes. In summer there appear saline water masses from the west and therefore the quantity of euryhalines (Podon polyphemoides, P. intermedius, E. nordmanni) increases. The zooplankton biomass in summer may reach 2.1-3.1 g/m^3. In autumn, the quantity of the zooplankton in the entire eastern part of the Gulf of Finland will drop. Cladocera and Rotifera now became very rare in the zooplankton. The main part of the biomass (up to 98-99%) are copepods. In shallow areas, the zooplankton biomass decreases to 0.01-0.10 g/m^3, and in deeper areas it drops to 0.1-0.4 g/m^3. The quantity and composition of the plankton in winter are very poor. Its main components are local copepods – brackish water Limnocaslanus, Eurytemora and Acartia bifilosa.

In terms of zooplankton/phytoplankton distribution around the gas pipeline route it can be said that the zooplankton biomass in coastal areas (Portovaya bay) will increase as compared with the open part of the Gulf of Finland.

6.2.2 Seabed Communities (seabed macrophytes and zoobenthos)

The seabed flora of the Baltic sea is a combination of seawater and freshwater species. Their distribution and quantity depends mainly on salinity, soil parameters and water transparency. In the Gulf of Finland there are 45 species of the seabed macrophytes.

The seabed algae are very widespread in the sandy or slight muddy shallows in the eastern part of the Gulf of Finland (e.g. in Portovaya bay). The algae often cover all the surface of the shallow bed and form a dense coating including fragments from the upper water vegetation (fennel-leaved pondweed, filiform pondweed, clasping leaved pondweed, small pondweed, horned pondweed, batrachium marinum and some others). The area of algae distribution extends to the depth of two meters. The phytobenthos mainly include green filamentous algae, sometimes with a significant quantity of charo-phytes.

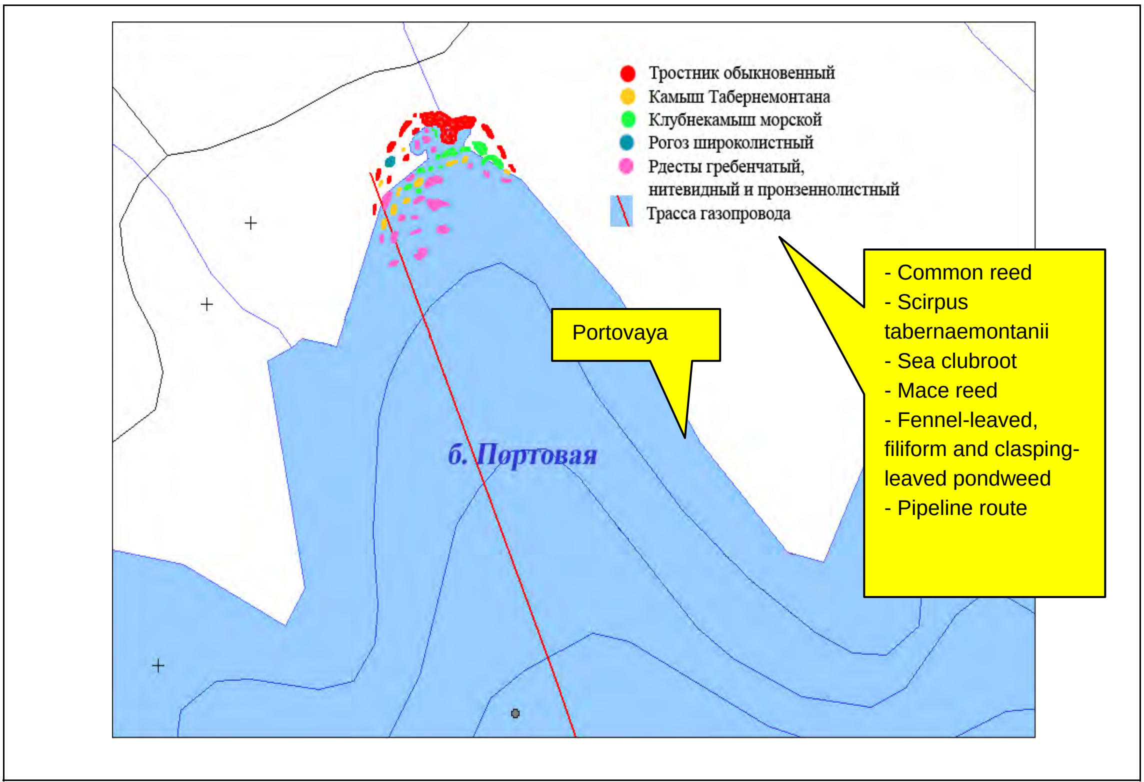

Figure 6.5 Distribution of Main Phytocoenoses of Water and Amphibious Plants in Portovaya Bay

The total area covered by water and amphibious plants in Portovaya bay is about 12 hectares. 5 of them are covered with water plants and 7 are covered with amphibious plants.

In the gulf of Finland (except of Neva bay where freshwater fauna dominates) there are about 180 species of seabed invertebrates. The seawater and freshwater segments include almost identical quantity of sippes: 39 and 40% respectively.

In the meiobenthos nematodes, harpacticoida and ostracoda prevail. The structure of meiobenthos becomes simpler gradually from west to east. As to its quantitative distribution, there is an express vertical gradient: the meiobenthos community development reaches its peak in the coastal area and falls to the minimum level in the deep zones where the meiobenthos organisms often become almost the only representatives of metazoans. The quantity and the biomass of the entire meiobenthis and its separate groups and species varies greatly. The overall quantity varies from 400 to 386400 organism/m^2 and the biomass varies from 0.2 – 5154.5 mg/m^2.

Table 6.1 Occurrence of Meiobenthos groups in the Gulf of Finland

Meiobenthos Groups	Occurrence, %
Nematoda	100
Harpacticoida	63
Ostracoda	53
Oligochaeta	42
Chironomidae	5
Cladocera	5
Cyclopoida	47
Turbellaria	26
Acari	26
Tardigrada	16

For the macrozoobenthos of the Gulf of Finland there are 5 types of widespread biocoenoses: Macoma baltica – polytopic marine boreal biocoenosis; Mesidothea entomon – euredaphic brackish water relic arctic biocoenosis; Pontoporeia affinis – euredaphic brackish water relic arctic biocoenosis; Pontoporeia femorata – marine relic arctic biocoenosis and Mytilus edulis – lithofilous marine biocoenosis.

In terms of macrozoobenthos abundance and distribution, there are two expressly outlined areas around the gas pipeline route: Portovaya Bay (a relatively shallow coastal area) and Nord Stream route section from Portovaya Bay till Gogland. The Benthos in Portovaya bay is more divergent and the biomass content is higher. In the area from Portovaya Bay till Gogland, the macrozoobenthos is uniform and poor, its biomass is low and in some areas with muddy sands, there is no macrozoobenthos at all.

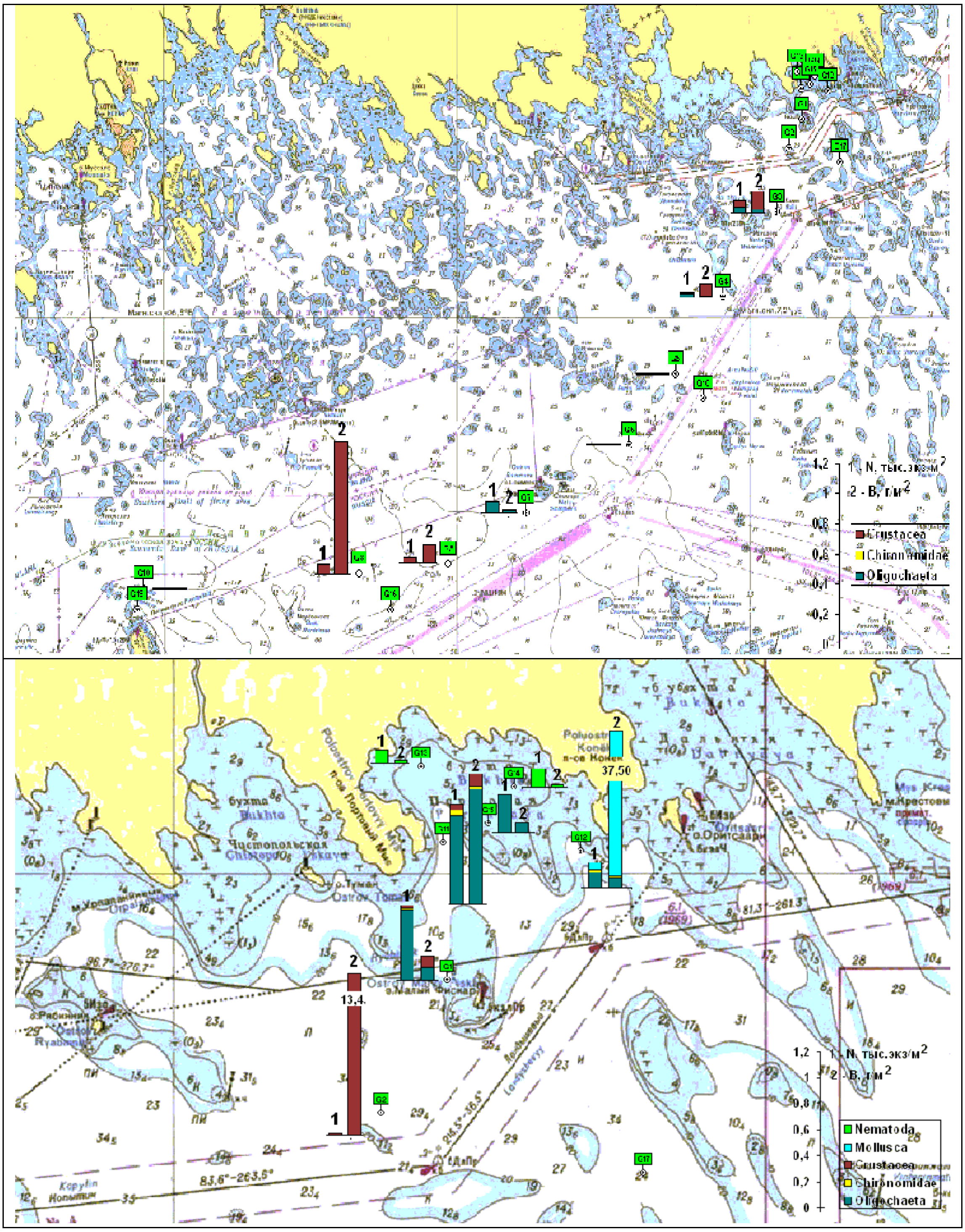

Figure 6.6 The Quantity (1- thousand org./m^2) and Biomass (2 - g/m^2) of Macrozoobenthos in the Open Sea (A above) and in Portovaya Bay (B below) around Nord Stream Route

The low biomass of the zoobenthos in the Gulf of Finland (about 20 g/cm^2 avg) is caused by the following two main reasons: 1) On t5500 km^2 of the Gulf area (more than 70-80 m deep) there is no zoobenthos due to unfavorable gas conditions and 2) almost a half of the area covered by the zoobenthos is inhabited by crustaceans relic arctic biocoenoses with low biomass.

Thus, the most of Nord Stream route will be laid in the areas where there is no macrozoobenthos at all or in the areas with benthos communities are poor and uniform. The shallow communities in the coastal area have the biggest biomass and their distribution is very divergent. They are the most important resource for both birds and fish.

6.2.3 Ichthyofauna

The gulf's ichthyofauna include species of two faunal complexes – marine and fresh water, which is a result of the relatively low salinity or desalinization of the eastern Gulf of Finland.

Fresh water fish primarily inhabit the Neva River estuary and other estuaries of rivers such as the Luga, Sestra, and Narva, Vyborg Bay and the nearshore shallows along almost the entire perimeter of the gulf.

Representatives of the marine faunal complex primarily inhabit the area around Gogland, Bolshoy and Maly Tiuters, Moshchny and other Russian Federation island west of Luga Bay. Saltwater fish -- snailfish, fourhorned sculpin, eelpout and Baltic sprat -- are fairly common in those locations. Baltic herring is common throughout the gulf, avoiding only areas where water salinity is below 2% in desalted and estuary areas of Vyborg, Neva and Luga bays. The abundance of smelt in summer is closely related to the availability of food organisms and also depends on the salinity and temperature of the water. According to various authors, more than 60 species of fish and eels are found in the eastern Gulf of Finland.

There is a clear trend in the change in species composition with distance from shore and an increase in water salinity. The nucleus of the ichthyocenoses in the nearshore biotype (species of fish with an occurrence above 50%) consists primarily of fresh water fish – perch, ruffe, pikeperch, roach and silver bream. In the marine areas the nucleus of the ichthyocenoses is formed by marine species -- Baltic herring, sprat, eelpout, sculpin – with the addition of migrating and indifferent species – smelt, eel and stickleback.

Marine fish (plaice, flounder, turbot, sole, haddock, red hake), which have pelagic rose, reproduce only in the bottom layers of the open sea, where salinity its high (more than 10.5%). The plaice, sole and turbot, with their high requirements for salinity during spawning (at least 13-14%) spawn outside of the Gulf of Finland in the salty southwestern areas of the Baltic Sea (west of Bornholm Island). Haddock, flounder and red hake are less demanding of water salinity (at least 10.5-11.0%) and their roe is found in the bottom layers over a wider area, including the Saarema-Hiiumaa area. Because of the euryhalinity (5-20%), the spray has a broad spawning areal. Marine fish (Baltic herring, sanderling, garfish, snailfish, lumpfish, sculpins), which deposit demersal roe, occupy nearshore areas and desalininzed bays, including the Gulf of Finland.

There are five reproduction areas for Baltic herring in the Gulf of Finland: 1 – West (nearshore area adjacent to Tallinn), 2- Narva Bay, 3 – East (Luga and Koporsky bays) 5 – Island (Moshchny, Maly, Seskar, Gogland islands), 5 – Northeast (nearshore area from the boundary with Finland to Peschany Cape, including Berezovye Islands), i.e., the Baltic herring spawning grounds in the eastern Gulf of Finland account for 4/5 of the total area of the Gulf of Finland reproduction area.

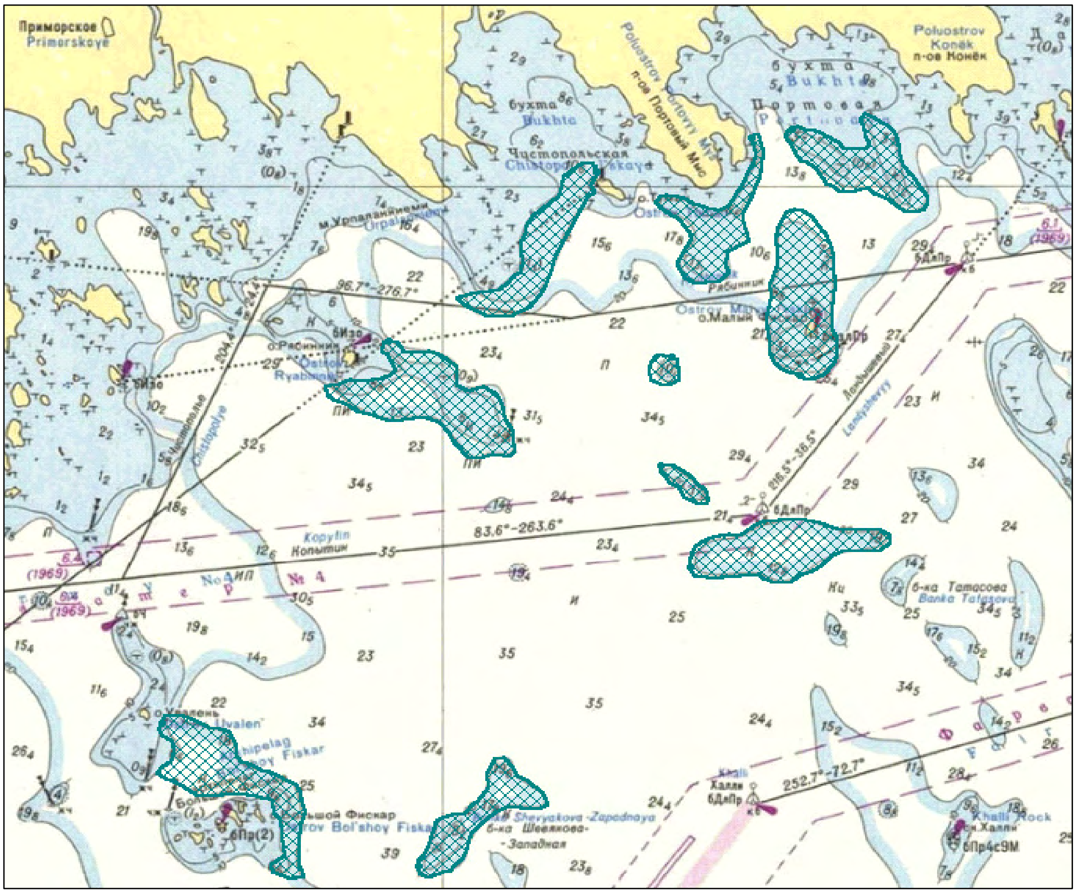

Figure 6.7 Baltic Herring Spawning Sites in the Eastern Part of the Gulf of Finland

The traditional major commercial fish in the eastern Gulf of Finland are the Atlantic herring (Clupea harengus L.), European sprat (Sprattus sprattus L.), European smelt (Osmerus eperlanus L.), pikeperch (Stizostedion lucioperca), European perch (Perca fluviatilis), carp bream (Abramis brama); the species with definite commercial value also include the common whitefish (Coregonus lavaretus), roach (Rutilus rutilus (L.), and Eurasian ruffe (Gymnocephalus cernua (L.) There has been almost no change in the species composition of the major commercial fish in the last decade. But the quantitative change has been substantial. The major decline in catches pertained to salt water fish (Baltic herring more than fivefold; anchovies more than tenfold).

6.3 Birds

The local sea bird fauna comprises 69 species and 5 orders and includes a great number of the arctic migrants.

In the Russian part of the Gulf of Finland there are some important bird areas and wetlands of international importance (Berezovye islands, Kurgalsky peninsula and Lebyazhye coinciding with the important bird areas) that are critical for biodiversity in the area and migrating birds. These areas are mostly far from the planned gas pipeline route and the construction of the gas pipeline will not have any significant impact on them. The nearest area to the route (about 15 km distance) are Beryozovye islands.

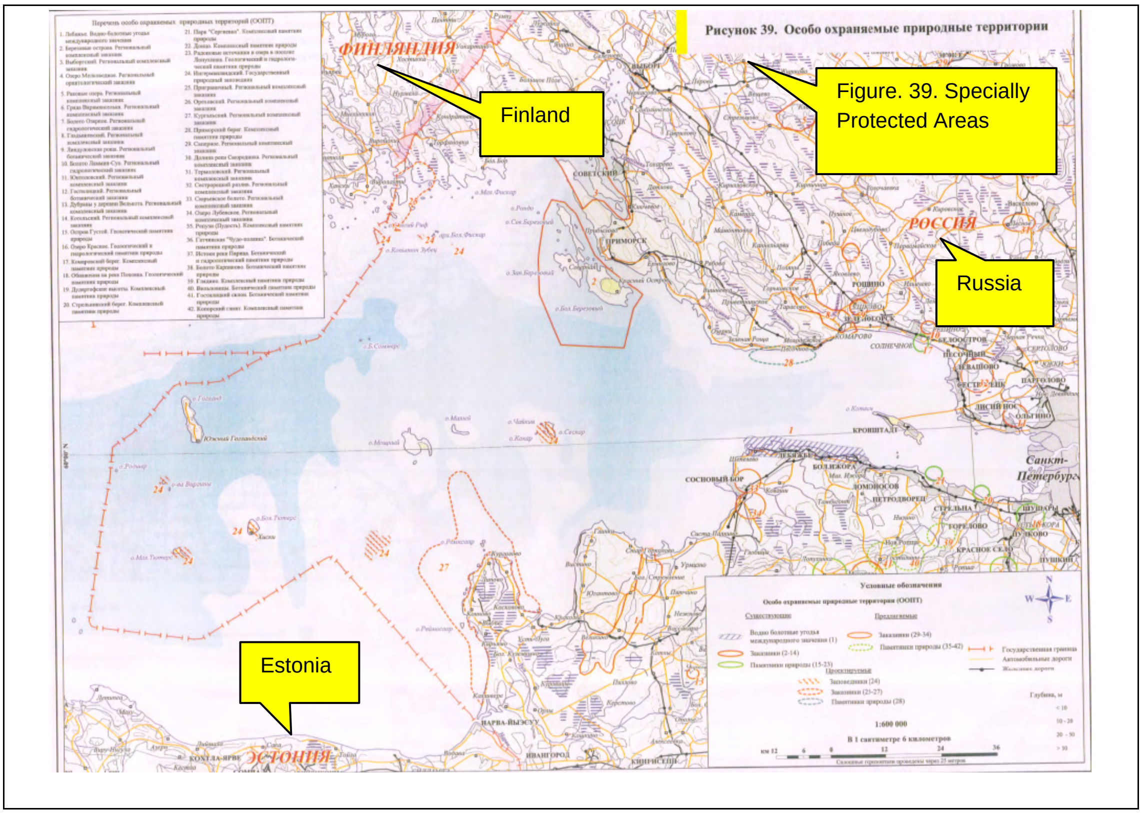

Figure 6.8 Specially Protected Areas (Red Lines) in the Gulf of Finland (Environmental Atlas, 2007)

As to seabirds migrating in the area, there are two species entered in the RF Red Book. These are black-throated diver (Gavia arctica) and eurasian oystercatcher Haematopus ostralegus). Currently it is still possible that these birds will make their nests in the area in question.

Besies, 11 species of migrants are protected in Leningrad region: black-throated diver (Gavia arctica), whooper swan (Cygnus cygnus), gray goose (Anser anser), pintail (Anas acuta), eider (Somateria mollissima), eurasian oystercatcher (Haematopus ostralegus), eurasian curlew (Numenius arquata), kelp pigeon (Larus fuscus), arctic tern (Sterna paradisaea), guillemot (Cepphus grylle). 16 species are protected in the Baltic region and 7 species are entere in Fennoscandia Red Book.

Also, there are some other birds protected in the Baltic region and Fennoscandia: gray crane (Grus grus), kestrel (Falco tinnunculus), black woodpecker (Dryocopus martius), tawny owl (Strix aluco), goatsucker (Caprimulgus europaeus).

The coast around Nord Stream area is interesting as an area of seasonal migration of water birds. There may appear small flocks of whooper swans (Cygnus cygnus) mute swans (Cygnus olor), black headed gulls (Larus ridibundus) and little gulls (Larus minutus), eurasian oystercatcher (H.ostralegus), little ringed plowers (Charadrius dubius) and fiddlers (Actitis hypoleucos), green sandpipers (Tringa ochropus), black-throated diver (G. arctica), mallards (Anas platyrhynchos) and shovelers (Anas clypeata). Sometimes great cormorants (Phalacrocorax carbo) there appear. In the bay there can be nests of black-headed gulls, little ringed plovers and shovelers. In adjacent backwaters there can also be nests of dunbirds (Aythya ferina), garganeys (Anas qurquedula) and goosanders (Mergus merganser).

6.4 Sea Mammals

Currently there are 7 species of mammals observed in the Russian part of the Gulf of Finland – 3 species of pinnipeds and 4 species of cetaceans. The cetaceans like purpoises (Phocoena phocoena), dolphins (Delphinus delphis), white-beaked dolphins (Lagenorhynchus albirostris) and bottle-nosed dolphins (Tursiops truncates) are not frequent in the Russian part of the Gulf. They just occasionally appear in the gulf but do not form stable populations there.

Table 6.2 Critical Periods of the Baltic Sea Mammals

Sea Mammals	Breeding period	Shedding (seals)
Gray seal	February-March	May-June
Common seal	April-June	August - September
Baltic ring seal	February-March	April-May
Porpoise	May-July	-

As to the pinnipods, there are only two typical species – ring seal (Phoca hispida botnica) and gray seal (Halichoerus grypus).

The number of these seals gradually rises because seal hunting is prohibited and the content of hazardous substances in the water decreases. Currently the there are approximately 300-400 ring seals and 500-600 gray seals.

7 Socio-Economic Environment

7.1 Fishing Industry

The water space of the Gulf of Finland, according to the Fishery regulations in the Baltic sea, is used for trawling of small herring fish species at the depth over 20m. The Gulf of Finland plays an important fishery role as spawning sand feeding sites of landlocked fish (bream, pike perch, roach, pike) and brackish-water fish (Baltic herring, smelt) are concentrated there. Shallow water areas of the gulf, limited by the 10 m isobathic line, are used both as spawning sites for most fish and feeding sites for their juveniles. So, in the inlets of Vyborg Bay up to 80% of bream and 45% of pike perch of the eastern part of the Gulf of Finland are reproduced.

The inshore fishery of landlocked and catadromous fish on soundings in the Gulf of Finland is performed with passive fish tackles. The base of yields is made up by smelt, stickleback, bream, pike perch, perch, roach and lab brush. Trawling in the foreshore is performed mainly in spring in the period of spawning concentrations of fish. The main commercial species of the gulf is smelt. Its yield varies around 7 to 15 thousand tons annually, and during the spawning period around 1 to 2 thousand tons. Besides, from 4 to 9 thousand tons of catadromous and landlocked fish are annually yielded in inshore fishery.

In Vyborg Bay industrial and nonprofessional fishery fisheries take place. According to information received in response to inquiry to the Administration of the Veterinary and Phytosanitary Supervision in Leningrad Region, in the foreshore 5 km area of Vyborg Bay there is the fishing ground OOO Primorskiy Rybak regulated by the license agreement.

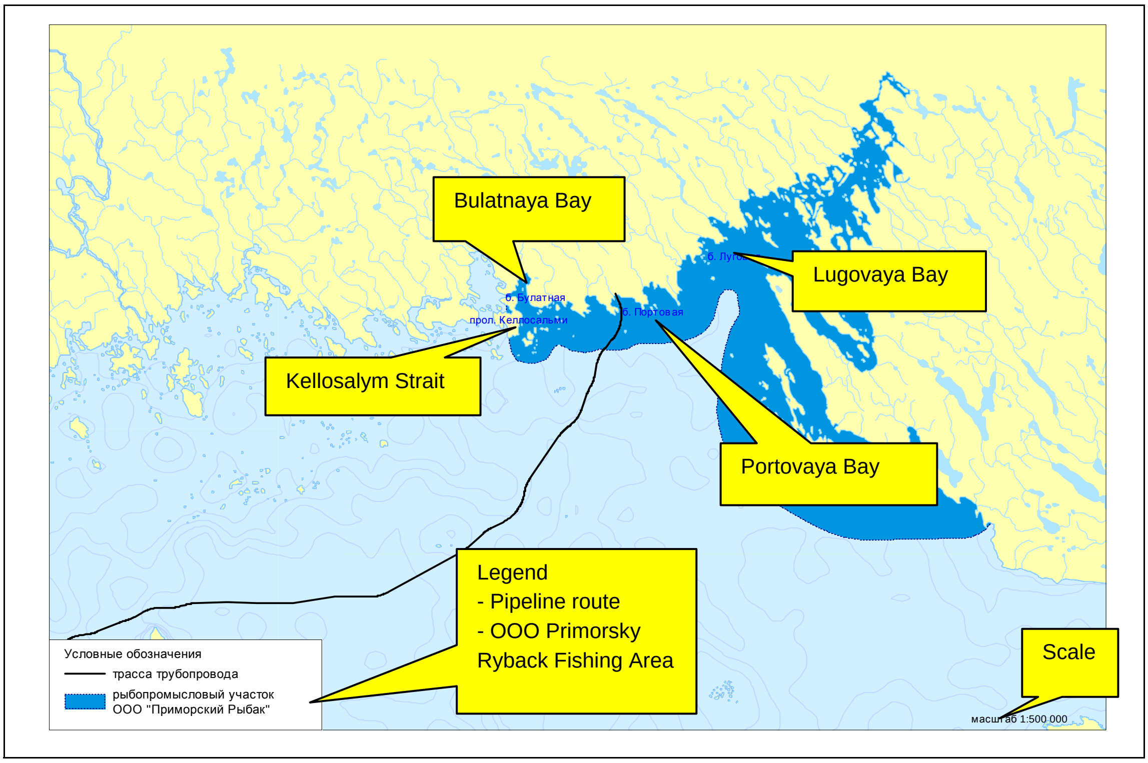

Figure 7.1 Location Map of the Fishing Ground

Previously in Portovaya Bay industrial fishery took place. Pike perch, bream, perch, roach, pike, ide prevailed in the yields. The potentially possible yield of Baltic herring in Portovaya Bay is 20 t.There are spawning sites of perch and feeding areas of juveniles of perch, Baltic herring, perch, roach in the bay. At a minor distance from the bay wintering deep holes of perch and bream can be observed. Migration paths of salmon fishes (Baltic Sea salmon, bulltrout – the species, registered in Red Data Book of the Russian Federation) go through Vyborg Bay.

Commercial species of algae in the Baltic Sea are: brown algae (Phaeophyta - bady wrack Fucus vesiculosus), red algae (Rhodophyta furcellaria lumbricalis Furcellaria lumbricalis). Algae harvesting is not practiced around the gas pipeline routing area in the Gulf of Finland. Aquaculture in the Gulf of Finland is developed in a minor way due to unfavorable environmental conditions. Within the Russian sector of the proposed gas pipeline route mariculture industries are absent.

7.2 Navigation (routes, anchor holds)

The Gulf of Finland is an area of active navigation with a great number of cargo carriage and numerous liners in the territory of the gas pipeline route. Vyborg port is specialized in transshipment of general cargo, containers and refrigerated cargo. Vysotsk port is specialized in coal and oil transfer. A significant portion of shipping is made up of planned routes (mainly passenger traffic). At present higher intensity of shipping in the region described in this document should be expected. Increase of the number of vessels and ferries, appearance of new routes are possible.

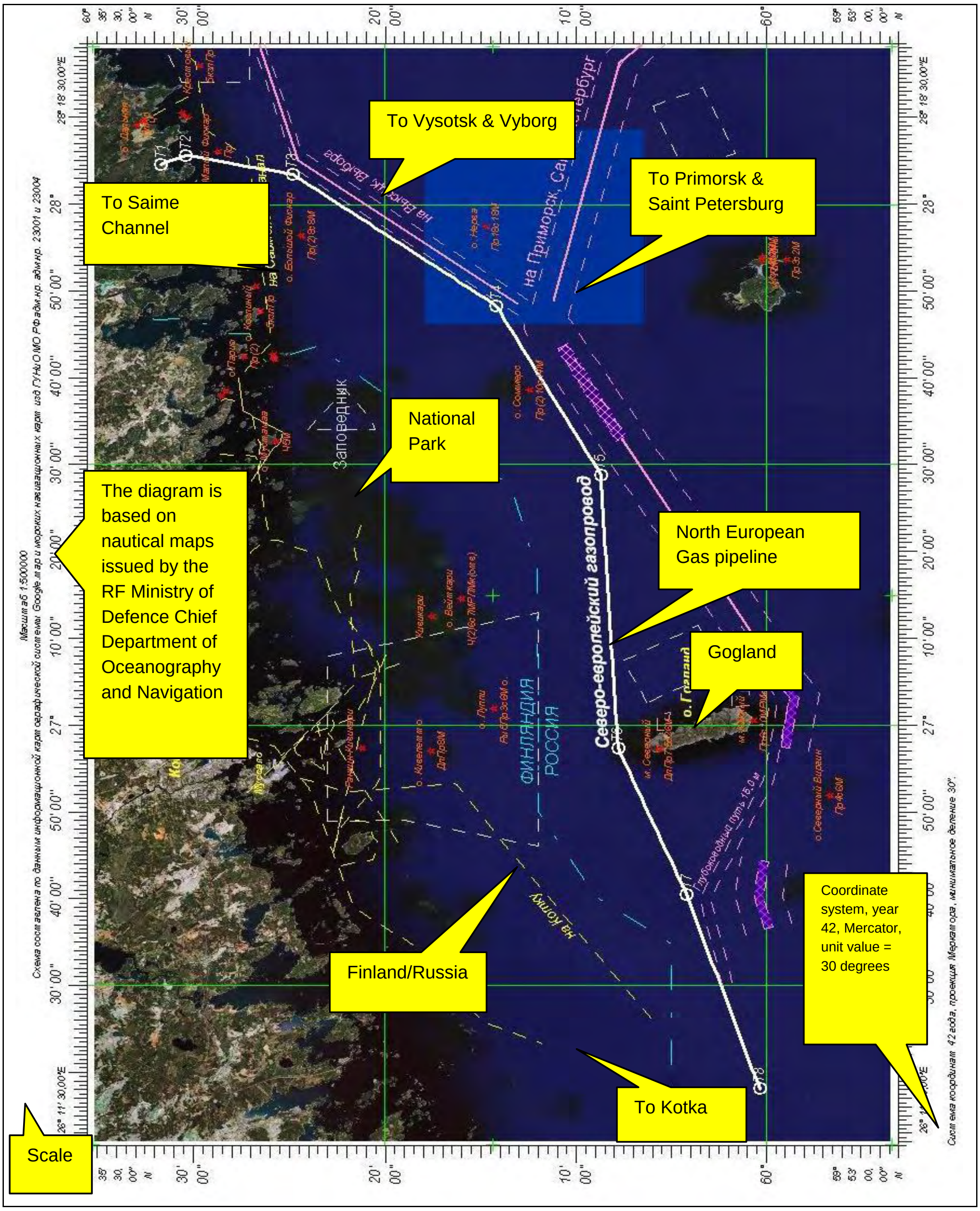

Figure 7.2 The Gas Pipeline Route Diagram in the Territorial Sea of the Russian Federation and the Traffic Routes of Vessels

7.3 Tourist Sites and Recreation Areas

The main kind of tourism in this region is domestic travel and traveling to neighboring countries. In the region there are no areas of mass tourism, but in the areas of domestic travel the concentration is rather high as. A lot of tourists stay in large cities.

Recreational tourist industry depends a lot on the season, significantly increasing during holidays and leaves. The most common kinds of recreational tourism are sea round trips, swimming, visiting historical and archaeological sites and so on.

The quality of the coastal water gradually rises. This causes increase in the number of people visiting sea beaches and choosing this kind of recreation.

Vyborg District of Leningrad Region is one of the most promising in terms of development of tourist industry. By now there is a constantly increasing demand on the part of western tourists for license hunting of elk, bear, boar, trot and others. Yet today this demand is minor satisfied. Investment into the development of the recreational sphere is exceptionally promising as in the nearest future tourist industry offers prospects of becoming one of the main revenues of the regional budget.

7.4 Objects of the Cultural Heritage

The pursuance of the preservative archaeological research in construction zones is directed at fulfilling the demands of the Law about the objects of cultural heritage (significant sites of history and culture) of the peoples of the Russian Federation dated 06/25/ 2002. According to this law, all the vessels sunken more than 40 years ago are potential significant sites of history and culture (art. 3, art. 18).

On the basis of archive and bibliographical surveys the information about historical vessels sunken in the area of the supposed installation of Nord Stream gas pipeline within the territorial sea and the exclusive economic zone of Russia was obtained.

In the course of the exploration works held by OOO PeterGaz in 2005-2007 along Nord Stream gas pipeline route within the territorial sea and the exclusive economic zone of Russia several objects possessing the characteristics of the objects of cultural heritage were found and documented. of the sunk vessels and their components. All of them represent historical monuments of the shipbuilding industry and navigation of that time, and the military vessels are also the monuments of war history.

The pipeline route is planned so that to preserve all found vessels at the place where they are found. To provide their maintenance the planned pipeline route will pass no closer than 100 m from the discovered objects.

In case of salvage during construction, their complete preservation shall be ensured. The components of the vessels discovered beyond the complexes of the objects and entering the zone of the gas pipeline installation: anchors, seaborne machinery and wooden structures may be raised to the surface under the archeologists' supervision upon condition of providing their complete storage and the following transfer to the state museum storage. On the basis of the expert opinion of the Institute of the Material Culture History of the Russian Academy of Sciences, an agreement on the gas pipeline route is met from the Committee on Culture of Leningrad Region (the Department of State Control over Maintenance and Use of the Objects of Cultural Heritage).

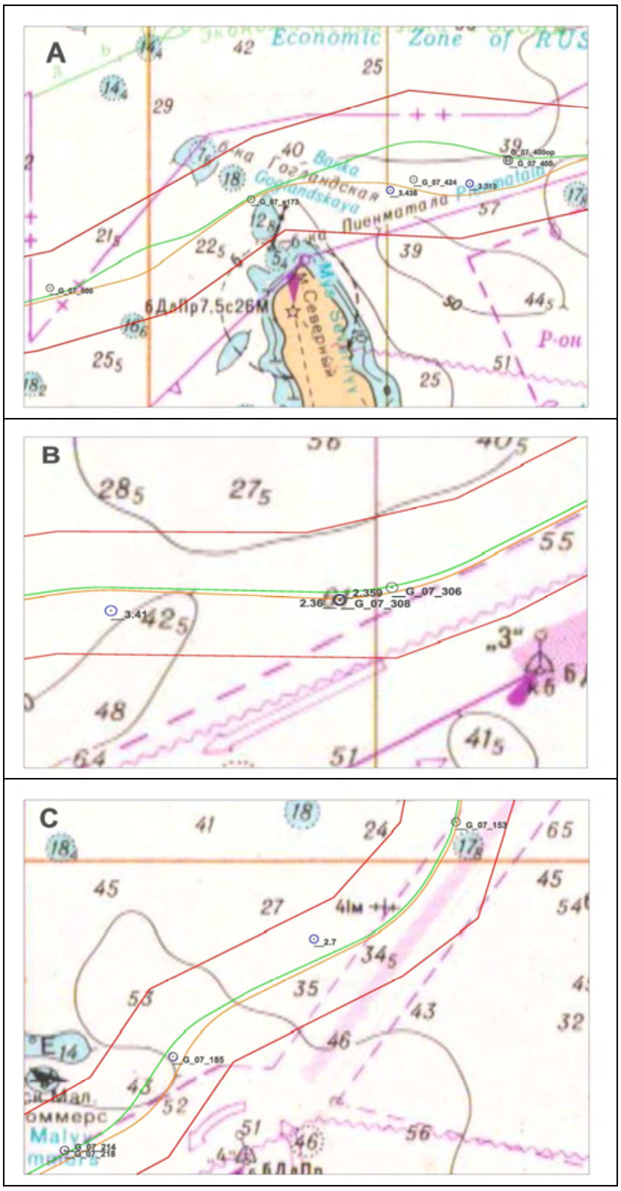

Figure 7.3 Location Map of the Objects of Cultural Heritage (A, B, C – specification of the areas of disposition of the discovered objects around the gas pipeline route)

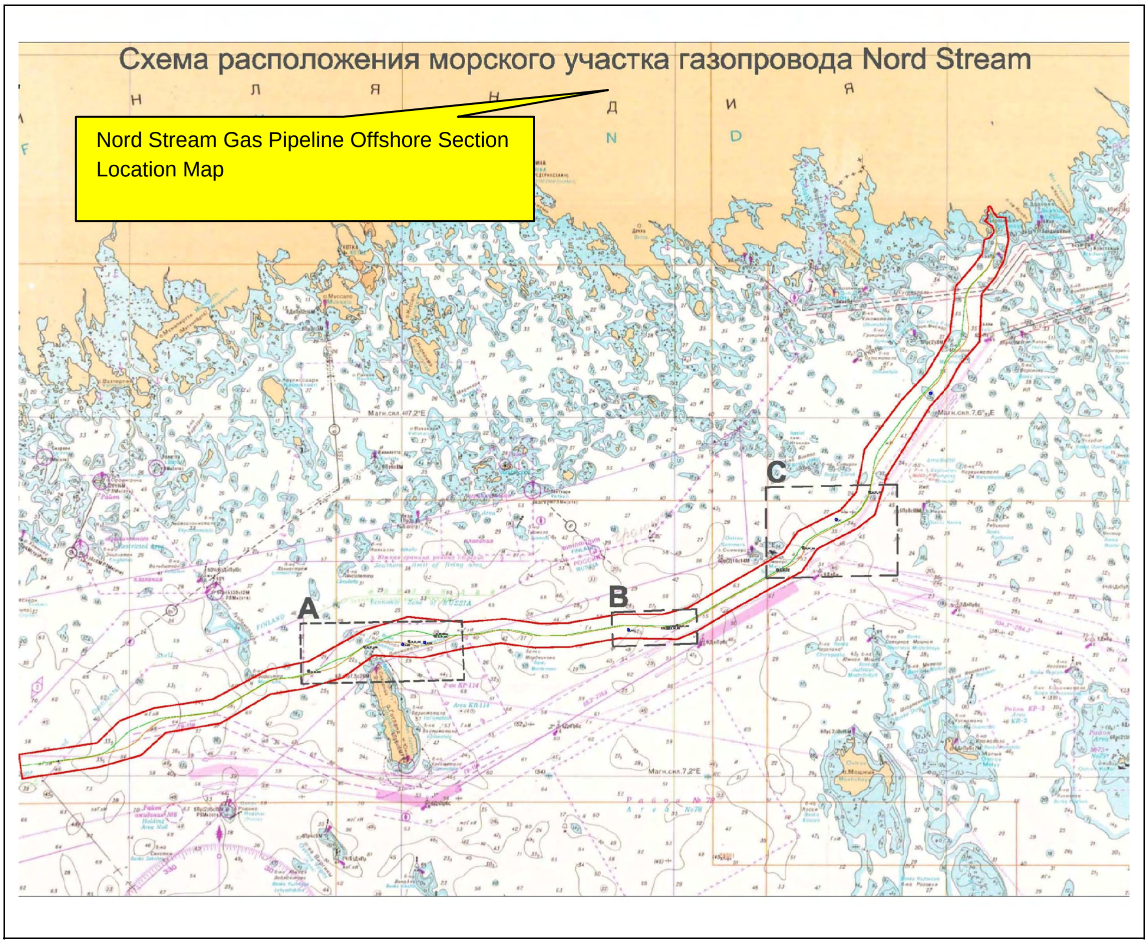

Figure 7.4 Overall location Map of the Objects of Cultural Heritage (A, B, C – specification of the areas of disposition of the discovered objects around the gas pipeline route)

8 Environmental Impact Assessment and Environmental Protection Measures

8.1 Impact Sources and Types during Construction and Hydraulic Testing Period

8.1.1 Normal Conditions of Construction and Hydraulic Testing

The main source of environmental impact during construction is the operation of construction machinery when carrying out the following operations:

- Trench excavation in the dry section and in the coastal line crossing area
- Pipeline laying both in the dry and offshore sections
- Soil dumping to eliminate free spans having the lengths hazardous for the pipeline safety

In this case the mechanical impact on soils (in the dry section) and seabed deposits (in the offshore section) will be the main type of impact. Changes in physical and chemical properties of the environment are the main consequences (results) of the impact: soil structure and properties changes, seabed topography changes, water composition and properties variations, composition changes of the ground air layer and acoustic background changes. The most of consequences are temporary and will be localized on the small areas or in the small volumes.

The main impact sources when conducting the gas pipeline hydraulic testing are as follows: operation of the pumping station, which pumps water into the erected pipeline, and water discharge after hydraulic testing. Such water use will lead to changes in its physical, chemical and bio-productive properties.

8.1.2 Operation Phase

The impacts will not be so essential during the operation phase as during the construction phase.

The pipelines laid on the Gulf of Finland seabed and stone-gravel supports arranged for unacceptable span elimination will be the main source of technogenic impact on the environment during this phase.

The main sources of impact on geological environment and relief conditions at the operation phase will be as follows:

- Changes in the seabed deposits transfer mode at the gas pipeline deep water area
- Local seabed scouring under the pipelines
- Local changes in seabed topography at the possible pipeline emergency ruptures
- Secondary seabed deposits pollution at the possible pipeline emergency ruptures in the route sections with the elevated pollutant concentrations

Sea water composition change due to the substances emission from sacrificial anodes when operating passive corrosion protection system will be the main insignificant type of impact on marine environment during operation. This impact will be insignificant and will not result in irreversible effects.

The gas transported via subsea pipelines is also a source of acoustic impact.

The gas pipeline will not affect the atmospheric air in normal operating conditions.

8.1.3 Abandonment Phase

Impact on geological and water environments and terrain conditions during abandonment of the gas pipeline (in 50 years of operation) is similar to that of the construction phase and will be considered in a separate project with the consideration of legislative requirements and technological capabilities available by the time of dismantling beginning.

8.2 Impact on Abiotic Substances

8.2.1 Atmospheric air

The atmospheric air will be mainly impacted by pollutant emissions from floating crafts and pipe laying operations during trench excavation, pipe laying and hydraulic testing. The main air pollutants are nitrogen dioxide, sulfur dioxide, carbon dioxide, hydrocarbons, etc. Welding activities generate such emissions as iron/manganese oxides, dust and hydrocarbons.

The calculations of pollutant dispersion in the atmospheric air demonstrated that the main pollutant (nitrogen dioxide) concentration will be 2.6 MAC. However, the standard maximum allowable concentration will be reached at 1.15 km from the emission source. The concentration will not exceed the sanitary limits and will be equal to 0.4 MAC at the boundary of Bolshoy Bor (village). Insignificant excess of pollutant concentration in the atmospheric air of residential area is possible during pipe laying operations in the coastal area. However, these operations will take about 1-2 days in accordance with the construction schedule as pipe laying rate will be 2.5 km/day. After that the impact sources (vessels) will move in the seaward direction. It means that the elevated concentration will be observed only within a short time span.

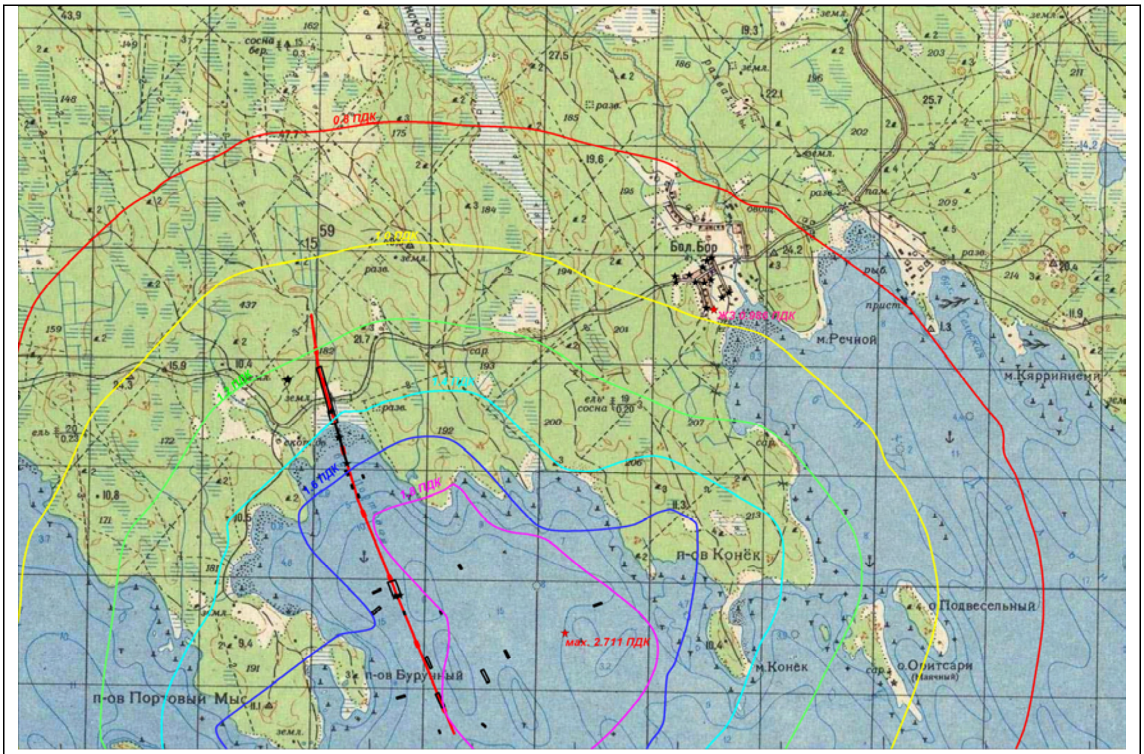

Figure 8.1 Map of nitrogen dioxide dispersion at simultaneous operation of the shore crew and pipe laying operation

8.2.2 Geological Environment and Topography Conditions

The main impact on geological environment and topography conditions during gas pipeline construction activities will result in changes of seabed deposit grain size when arranging trenches and dykes and dumping soil. Local changes in topography conditions will be registered during construction operations. They will be separated to temporary changes (when arranging trenches and dykes) and long-term changes (when arranging gravel-stone supports).

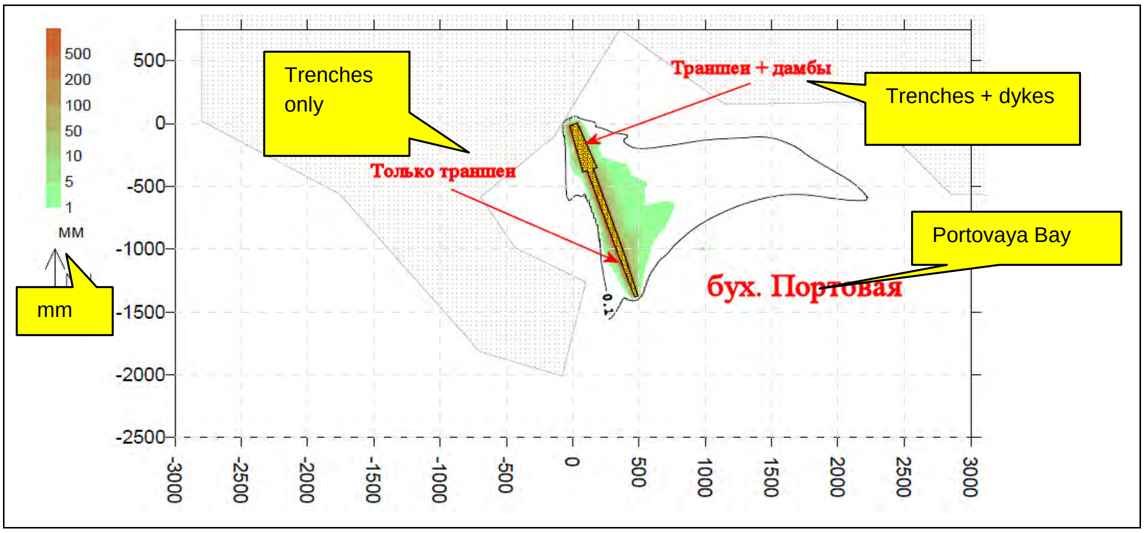

Figure 8.2 Seabed deposit layer thickness (mm) during dredging operations in the Portovaya Bay

Potential pollution of seabed deposits with hydrocarbons is possible during casual leakages of petroleum, oil and lubricants from technical and transport vessels and at emergency situations connected with petroleum product spillages. Petroleum product leakages in the dry section are possible during construction machinery operation. In this case, not only subsoil, but also subsurface water upper levels can be polluted.

All in all, impacts on geological environment and topography conditions will be limited both in area and time and can be considered as insignificant in case of non-compliance with technology based standards, construction work regulations and environmental legislation. Oil spillage risk assessment characterizes the possibility of such an event as practically impossible.

The impact on deposit transfer mode and seabed morphodynamical changes will be observed in the gravel-stone support areas during the gas pipeline operation.

Sand sediments moved under the action of waves and currents are the impacted objects influencing on the seabed morphodynamical condition changes. The pipeline along with gravel-stone basement is a solid impenetrable barrier for such sediments. The sediment discharge decreases when approaching to the barrier windward, the corresponding conditions for solid particle accumulation appear, which results in the depth decrease. In contrast, an erosion zone appears in the barrier rear part, where the deposit discharge restores from zero to the initial value. Results of simulation provide for the following conclusions:

- Stone-gravel foundation of the subsea pipeline at depth of 15-25 m represents a barrier, which, due to peculiarities of dynamic processes in the studied area, will cause accumulation of sand bars on the western side of the facility and erosion at its eastern side

- Changes of the seabed caused by the facility are localized directly at its boundaries (within zones no more than 10 m) Deformations will quickly reduce with depth increase and almost disappear with water depth more than 25 m

- Maximum deformations are expected in the area of pipeline entering the seabed surface (depth 15 m) Thickness of accumulated layer in front of the facility may achieve 1.3 m during 50 years Depth of erosion at the eastern edge will achieve up to 1 m during 50 years

The seabed erosion under the pipeline may occur at the gas pipeline operation phase with normal (accident-free) operation mode; seabed erosion in case of potential accidents will be of local spatial nature and will have no significant impact on the geological environment of the Baltic Sea.

Upon completion of construction operations and restoration of seabed topography in the trench zone approximately up to background conditions, there will be no technogenic impact on lithodynamic processes in the coastal area. Since the trench will be filled with stone-gravel mixture on the surface, no deformation of the seabed within the trench area with the existing wave conditions will be expected.

Ice gouging of the seabed and the shore in the landfall zone represents rather hazardous phenomenon for pipeline operation. Estimation results indicate that maximum estimated depth of gouging can be about 1.36 m. Trench configuration and pipe laying depth are designed considering the ice conditions in the area.

8.2.3 Marine Environment

The main impact on hydrographic characteristics and sea water quality in the Gulf of Finland will be expressed in the short-term local changes of sea water physical and chemical properties due to its pollution with mineral suspended materials when arranging the trench and gravel-stone supports, and soil dumping. The suspended material concentration in the sea water will also increase as a result of the dyke construction in the nearshore area.

The suspended material spread was mathematically modeled to evaluate the impact caused by dredging operations. In accordance with the received results, the cloud formed during dredging operations and contaminated with suspended materials is drifting in the direction and with the speed determined by the sea currents. The distances from the trench edge up to an isoline with concentration of 100 mg/l do not exceed 31 m, up to an isoline with concentration of 50 mg/l – 83 m, up to an isoline with concentration of 20 mg/l – 275 m and up to an isoline with concentration of 10 mg/l – 765 m.

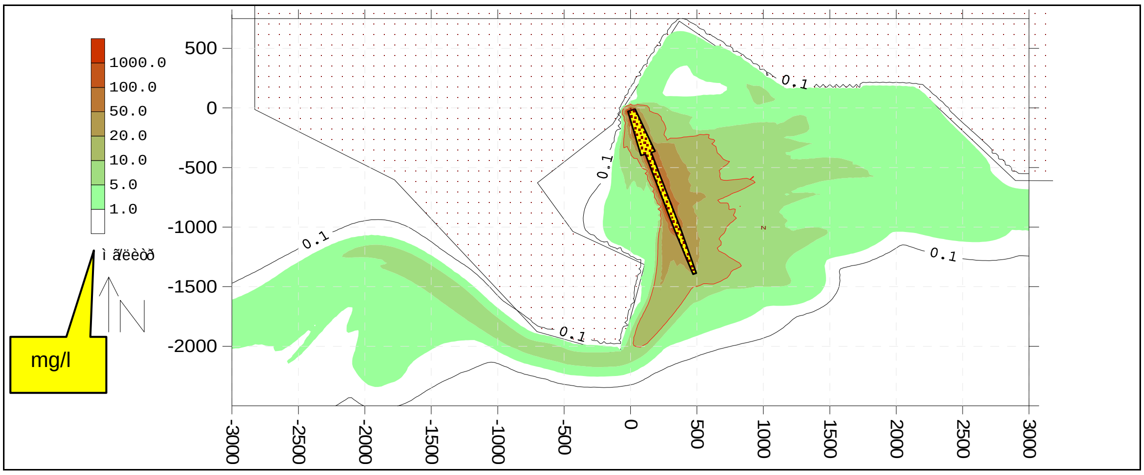

Figure 8.3 Field of maximum received concentration (mg/l) during dredging operations in the offshore section of the Nord Stream offshore gas pipeline Russian sector

When arranging gravel-stone supports, 42,588 tons of soil will pass into suspended state. The superimposed suspended matter concentrations equal to 10 mg/l can be observed at the distances of up to 2 km from the source in specific cases. The prevailing direction of suspended matter spread is along the pipeline route as it coincides with the prevailing current direction in this area. Therefore, 10 mg/l concentration isoline does not extend beyond 300-500 m across the pipeline route. Waters to the north of Gogland Island will be impacted with concentrations up to 5-10 mg/l.

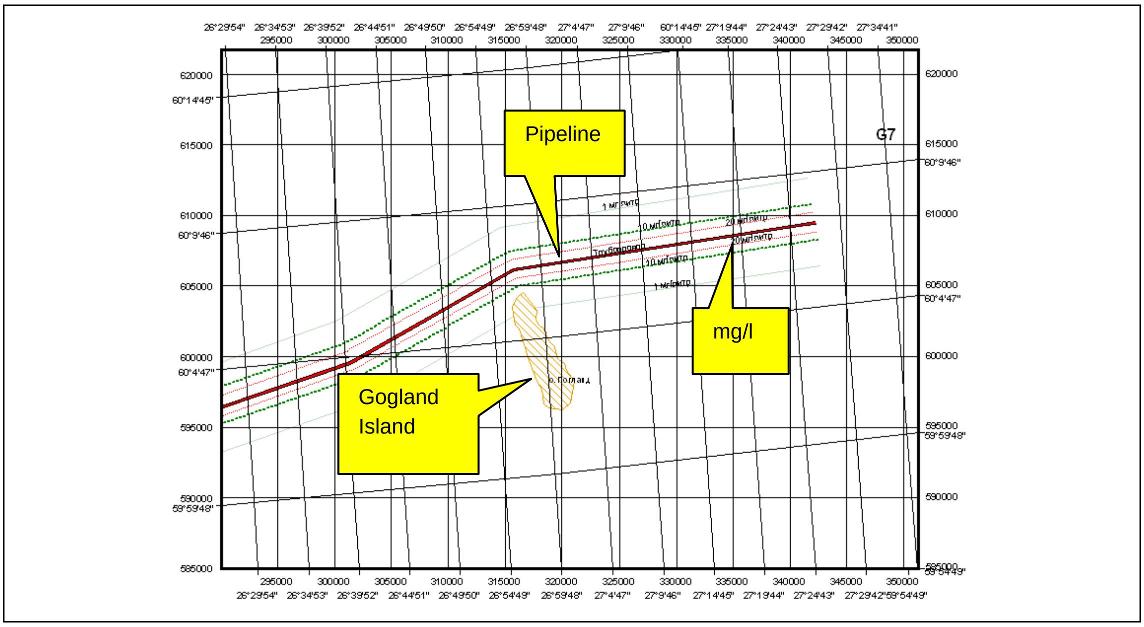

Figure 8.4 Field of suspended matter characteristic concentrations in the area of Gogland Island

A very insignificant part of heavy metals contained in the seabed deposits will pass to the dissoluted form during soil roiling – some percent tenth fractions. Such insignificant concentration increase exists only within the suspended matter cloud, and heavy metal concentrations will return to the initial level after suspension sedimentation. Thus, practically no impact on the water composition at the seabed deposit roiling is observed.

Additional impact on the marine environment is exerted by the pipeline laying vessels. Oily bilge water and fuel wastage are generated inevitably when operating vessel power units. In addition to bilge water due to vessel power unit operation, oil product wastes are generated during filtration, separation, overfilling, oil change, repair operations, etc. These contaminations (mainly bilge and flushing water from vessels) can get to the marine environment. The mandatory collection and disposal of all oily waste water and domestic wastes using special plants shall be provided when performing construction work in the Gulf of Finland water area in compliance with the Russian and international regulatory documents (International Convention for the Prevention of Pollution from Ships – MARPOL 73/78). Owing to this fact no sea water pollution with petroleum products is expected during construction.

The marine environment will be impacted with sea water intake during hydraulic testing. The gas pipeline offshore section will be tested in several stages.

Water intake for hydraulic testing is envisaged near the Portovaya Bay, which is located in the Russian sector of the Gulf of Finland. To test the offshore sections in two stages 2,578,400 m^3 of sea water will be required. Filtered and chemically treated sea water will be used. Some special chemical additives are used to prevent corrosion in the pipeline (sodium hydrosulfide (NaHSO3) – for oxygen absorption, sodium hydroxide (NaOH) – to reach the required pH value).

The controlled water discharge after hydraulic testing (2,566,400 m^3 in total) will be carried out to the superficial layers of the Portovaya Bay water area in the Gulf of Finland in 750 m from the shore. The total amount of flush water after flushing of two lines will be approximately 12,000 m^3. All flush water shall be collected in a settling pit on the German shore. Waste water from pig receiving after the pipeline salt cleaning shall be treated in a settling pit of 3000 m^3 capacity located in the Russian sector.

To prevent contamination of soil the bottom of the pit shall be covered with polyethylene membrane. Water shall be pumped from the pit to the Portovaya Bay via the temporary pipeline after contamination settling at the end of the first and the second testing stages (1,774 m^3 of water at the of each stage). The settled water is conditionally clean, treated up to a concentration not exceeding MAC value for fishery waters.

The impact on the marine environment due to substance emission from sacrifice anodes will be insignificant when operating the pipeline with passive corrosion protection system.

Physical Factors

The Russian part of the Nord Stream offshore gas pipeline is an area of intensive marine traffic and therefore the local ecosystems are adapted to the increased physical background (noise, vibrations, EM-waves).

The noise impact on marine ecosystems will depend on the water body background noise depending on metocean conditions and depths. Besides, the background noise in the water area will depend on working machinery and other jobs performed near the pipeline route.

According to studies performed for similar projects, potential noise impact from any vessel will be observed in any point where the vessel noise level exceeds the natural background noise more than by 20 dB (@ max. 1 kHz). The size of environmentally hazardous noise area around the source depends on the background noise of the water area as well as on hydrology and bathymetry of the given pipeline route section. The noise level impact will fall to the background level at 10-12 km from construction objects.

The evaluation showed that the temperature impact from the gas pipeline on the environment will be low. The temperature of the alluvia around the buried pipeline sections will be a bit increased in 10-20 cm layer around the pipe. The maximum temperature increase just at several centimeters from the pipe can reach 40°C (at the distance of up to 10 km from the dry section). The same parameter can reach 25-30°C at the distance of 20 km, 18-22°C – at the distance of 30 km and 12-17°C – at the distance of 40 km.

8.3 Impact on Landscapes, Soils, Flora and Fauna in the Dry Section

The design technical solutions provide for short-term and long-term lease of two land plots on the Portovaya Bay shore.

The total area of soil to be disturbed at the long-term deployment of the gas pipeline facilities is 3.36 ha. The predicted factor of landscape and soil disturbance within these plots is equal to 1. Packed earth fills of inert construction materials covering and compacting the earth surface shall be arranged within these plots. Natural soils and ground vegetation shall be buried with construction grounds. The canopy vegetation cover shall be fully removed (cut over) in advance. Thus, vegetation, soil and landscapes of these plots fully seize to function naturally and shall be recultivated at the end of the gas pipeline operation and long-term land plot lease period.

The total area of soil to be disturbed at the short-term deployment of construction and auxiliary machinery for the trunk pipeline laying is 14.51 ha. The predicted factor of soil and vegetation disturbance within these plots is equal to 0.8. Packed earth fills of inert construction materials covering and compacting the earth surface shall be arranged on separate parts within these plots. Natural soils and vegetation shall be buried with construction grounds. Thus, soil and vegetation of these disturbed plots fully seize to function naturally and shall be recultivated (in the total area of 12.09 ha) at the end of the short-term land plot lease period and after construction and auxiliary machinery removal.

Sanitary (environment-oriented) and forestry-based recultivation shall be carried out. The disturbed soil of the pipeline linear part shall be subject to sanitary recultivation as the buried pipelines are the protected hazardous (declared) facilities. The development of fire hazardous vegetation cover (stocking and bushing), littering with brushwood and inflammable vegetative tree waste is not allowed in the right-of-way allotted for the pipeline linear part construction. Its disturbed soil (surface) shall be subject to grassing with perennial grasses to increase the soil erosion resistance. The disturbed soils of the gas pipeline temporary process sites and a camp for construction personnel shall be subject to forest-based recultivation for the fullest possible recovery of their initial natural state corresponding to the term “forest grounds”.

Natural soils and vegetation covers adjacent to the pipeline facility construction sites are not significantly impacted by technogenic factors.

The construction work in the dry section will result in full or partial destruction of habitats of many animals. In this connection, the spatial population structure of some species will be changed and animals will move to the adjacent areas with similar habitat characteristics. However, the quantity reduction in the construction site area can be predicted for some species in the case of insufficient land capacity.

The areas of impacts vary depending on the impact type and animal species. The greatest impact will be exerted on the quantity and state of amphibian and reptilian populations both in the construction area and in the adjacent territories. The amphibian life cycle is closely connected with aquatic environment. They use permanent or temporary shallow-water well warmed up water bodies for shedding the eggs and larvae development. The area of water-boggy habitats used by amphibia for offspring will be reduced due to the pipeline laying. Lowering of ground water level resulted from the earthwork in the right-of-way area will lead to reduction of the quantity and area of water bodies located in the adjacent territories and suitable for amphibia breeding. In general, these processes will have banded and localized pattern of distribution; their spread beyond the right-of-way area is not expected.

A positive effect can be expected for amphibia upon construction work and recultivation completion: water can stay and accumulate in the microrelief lows formed during construction along the gas pipeline route, which can create places suitable for amphibia breeding.

Talking about the reptiles inhabiting the construction area, the most adverse impact will be exerted on the anguine lizard as this species is very sensitive to habitat destruction. At the same time the viviparous lizard successfully inhabits the pipeline corridor in the conditions of European south taiga practically immediately upon construction completion before recultivation.

And during construction this species will inhabit the peripheral areas of the land plots allocated for construction.

The mortality of the following animals having small individual habitats in the right-of-way area: e.g., murine rodents, amphibia and some insect-eaters, which often can not leave the construction territory speedily.

Big mammals and birds try to avoid the areas with permanent noise irritants where possible. The impacts on them are expected in the habitats adjacent to the construction area (in the radius of 2 km). The greatest impact is expected in the radius of 500 m from the construction area, medium impact is expected in the radius of 500 m – 1 km and low impact – in the radius 1.5 – 2°km.

As a rule, the animal quantity restores in the areas at the distance exceeding 2 km from the impact source. A part of habitats having a considerable importance for animal biological diversity preservation are located in the noise emission and anxiety factor impact area: in particular, the edge of Konskoe bog and a part of old-age spruce forest, where gray crane, European curlew and greenshank nesting is possible; wood grouse and crane displays are located here; wild boars, moose deers and brown bears (singular) are encountered. In addition, it must be noted that the great impact will be exerted on the birds in the shore habitats when performing construction operations in the Portovaya Bay water area.

At the same time, considering the short period of civil and erection work it can be said that adverse noise impacts on fauna are time-limited.

8.4 Impacts on Biotic Components of Marine Ecosystems

8.4.1 Impact on Benthos

Primarily, the mechanical impact will be exerted on benthic organisms, which will result in the seabed organism habitat destruction in the impacted area (trench and ground dumping areas; areas under the pipeline; grave-stone support areas) when excavating a trench in the coastal line crossing area, laying the pipeline and eliminating free pipeline spans. It will result in a full or partial demise of benthic organisms. The greatest losses of benthic organisms will be observed in the nearshore area (in the trench area) as this is a place where bottom macrophytes create the habitats suitable for phytophilous fish breeding (Baltic herring primarily) and the nearshore habitats have the highest values of zoobenthos biomass, which forms feeding base for fish (juvenile fish primarily). It will take a considerable time to form the conditions suitable for seabed plants and animals upon the impact termination: 3 to 8 years. Most probably that a new habitat will differ from the initial one.

If all hydraulic construction activities mentioned above are carried out, it will inevitably lead to water turbidity increase, which will result in the changes of benthos habitat physical and chemical properties. Water turbidity increase is negative both for seabed plant communities and bottom animals.

In addition to direct destruction in the trench and ground dumping areas, the macrophytes in the shallow-water area of the Portovaya Bay will be adversely impacted by suspended solids. According to the studies performed in several areas of the eastern part of the Gulf of Finland, higher submersible plants are very sensitive to increased long-term turbidity. Thus, there were plants that grew in a relatively low turbidity and did survive after the hydraulic construction activities. However, they were not able to offshoot in the next year. This occurred because of suspended solids – they settled on the plants' leaves and prevented photosynthesis. Therefore the plant root system had to hibernate before it could accumulate the amount of nutrients for vegetation in the next season.

Suspended minerals settling down to the bed will cover the existing habitat of bottom invertebrates causing a full or partial demise of the latter. The majority bottom animals consume respectively suspended and sedimentary live (bacterial plankton and phytoplankton) and dead (detritus) organics. In terms of nutrition, these organisms pertain to filterers and sedimentators. When water turbidity increases due to suspended ground solids, this will form adverse conditions for bottom invertebrates. A great suspension concentration increase will result in filtration apparatus clogging for living organisms, and eating and breathing malfunction. The increase of suspended mineral solids concentration against the background level during hydraulic construction activities is a temporary impact. However it will cause a partial or complete demise of seabed organisms and thus decrease the overall fish food reserve and impact the normal conditions of fish reproduction.

In high turbidity areas as well as in dredging or dumping areas the number of zoobenthos species will significantly decrease. The first animals to demise are shellfish and postprimary animals e.g. Chironomidae. There were areas where the level of suspended mineral solids reached its maximum, only Oligochaete could survive there. In high turbidity areas, the quantity of zoobenthos will usually slightly differ from the background level. This is because the demised organisms will mostly be the largest organisms but they are usually not numerous. However the benthos biomass will become 5-15 times smaller.

In accordance with Russian regulations for shelf zones deeper than 8 m, the level of natural mineral suspended solids shall not exceed 10.0 mg/l. This limitation pertains to the underwater ground dumping site.

Benthic organisms practically will not be impacted during hydraulic testing as water intake will be carried out from the subsurface water layer, which excludes benthos suction. Water will be discharged after hydraulic testing in such a way as to exclude turbidity. The chemicals added during hydraulic testing consist of ions, which are available in sea water in great numbers and relate to principal ions of sea water composition. In accordance with the performed calculations, the water discharge will not result in exceeding of maximum allowable concentrations of these substances and, consequently, in any noticeable change in sea water composition.

There are no data that the noise level variation impacts on benthic organisms. Based on benthos physiological features it shall be considered that benthic organisms are not impacted by noise.

The total impact on benthic organisms depends on the speed of inhabiting the disturbed areas and newly created stone ridges. Based on monitoring observations on these processes, the period of initial benthos biomass recovery in the similar conditions will be equal to 5 years. Benthos composition will be changed slightly. The increase of the seabed areas occupied by high-producing macrophyte communities and bivalve mollusks is expected.

In normal operating conditions (without upsets or emergencies), no impact to the aquatic biota will be created.

8.4.2 Impact on Fish Fauna

The proposed hydraulic construction activities (trench excavation, pipe laying, soil dumping and hydraulic testing) and their consequences will influence the fish fauna both directly and indirectly. Ground excavation (trenching) and disposal in the water area (trench backfilling and dumping) will bring changes to physical and chemical conditions of the water environment (washout of contaminants from the ground, degradation of gas characteristics in the water, high turbidity, etc.). These factors will directly exchange the fishes, reduce the gas exchange rate and slow the fish growth and development down. The maximum adverse effect occurs at early stages of their ontogenesis. Besides, in the construction area, production of food organisms will be lower and if the water area becomes irreversibly separated, the fish spawning and feeding areas will be also reduced.

One of the most significant negative factors is increase of water turbidity. The high concentration of mineral suspended solids will bring negative changes in breathing and feeding areas (lower feed availability) as well as direct injuries. The fish growth rate will also slow down. Besides, spawning effectiveness will also slow down and conditions for caviar and fries development will be adverse and therefore will promote their demise. High water turbidity creates problems for natural transfer and migration processes. Also it restricts feed availability. The quantity of fish in the hydraulic construction areas will be reduced and the number of their species as well as dimensional structures of their population will also change. Fish caviar and fries will be most sensitive to the adverse effect.

Water intake in the Portovaya Bays during hydraulic testing will result in caviar and fries death in the specified water volume due to hydraulic shock and mechanical damages. A fish protection system used during water intake in accordance with Russian regulations will exclude the death of fishes exceeding 12 mm in size, but ichthyoplankton (caviar and fries at early development stages) death in the pumped water volume is inevitable.

Acoustic Impact

The noise generated by machine operations at the time of construction will also impact fish behavior and disturb their natural migrations (spawning and feeding migrations, young fish migration down).

Local changes in fish habitat density due to man-made impact usually imply changes in fish fauna species composition. It should be noted that seasonal changes in species composition (as well as fish distribution density) are more meaningful than fish fauna changed caused by dredging.

On the other hand, structural analysis of fish community in the high-turbid areas and outside of them can help tracing significant changes in the fish fauna species structures caused by a high suspended solids concentration. These changes include a severe reduction of Percidae population (perch, ruff and pike-perch), though bream population will remain relatively stable. When shallow jobs are performed, the roach and lookup population density will often decrease, though dredging in deeper areas imply a growth of these species' population and biomass in the contaminated area.

Thus, the future construction including hydraulic construction activities in the area will negatively influence the fish reserves mainly as follows:

- Indirectly – through decrease in fish feeding reserve productiveness and
- Directly – through decrease of spawning effectiveness and disturbances in natural fish migration.

In normal operating conditions (without upsets or emergencies), no impact on the fish fauna will be created.

8.4.3 Impact on Mammals

The impact on marine mammals during the gas pipeline construction will result in temporary change of the habitat quality (suspended solids and their spread in water) as well as in acoustical effect from working machinery and the presence of humans.

This effect will appear both when working on the shore and carrying out the offshore operations. The noise from working machinery frightens the animals and forces them to leave the work area. The noise impact during the offshore pipe laying can result in deterioration of feeding conditions due to feeding base (fish) lowering. Marine mammals will avoid the work area. But considering the fact that the marine mammal population is not so big in this sector of the Gulf of Finland, it can be expected that the gas pipeline construction operations will not damage the marine mammal population in the Russian sector of the Gulf of Finland.

In normal operating conditions (without upsets or emergencies), no impact on the marine mammals will be created.

8.4.4 Impact on Birds

The noise effect from working equipment will be the main impact on birds when laying pipes. This effect will appear both when working on the shore and carrying out the offshore operations. The noise from working machinery frightens the animals and forces them to leave the work area. The noise impact during the offshore pipe laying can result in deterioration of feeding conditions (locally) due to fish concentration reduction – sea bird feeding base.

The impact on sea birds during trench excavation and soil dumping will result in suspended solids appearance and spreading, which will lead to temporary change in fish and plankton (main feeding base for sea birds) distribution. In addition, vessels transporting soil to the dumping sites will flush birds within the water area along vessel routes. But considering the fact that this part of the Gulf of Finland is a heavy sea traffic area, the largest and permanent migrating bird rafts are located far from the main vessel routes.

When the Nord Stream gas pipeline is operated in normal conditions (without upsets and emergencies) and when the current process and environmental requirements are met, its impact will not change ecology around the gas pipeline.

At the time of gas pipeline operation, the number of birds in the pipeline area will be typical for the natural conditions in that area. The density of seagulls and ducks at the time of operation will almost be the same as their natural density in the sea.

8.5 Environmental Protection Measures

The project provides for the following measures to mitigate the impact on the environmental components:

- Strict compliance with the requirements of Russian legislation and International Convention for the Prevention of Pollution from Ships – MARPOL 1973/78
- Compliance with the requirements of regulatory documentation in relation to ensuring safe navigating conditions for all types of vessels and floating crafts during the gas pipeline construction (sizing of water areas, moorage zones, safety areas, etc.)
- Appropriate coordination of routes, navigation areas and anchor holds for all types of vessels within the gas pipeline construction areas
- Selection of optimal gas pipeline route alternative based on minimization of possible soil filling capacities, preservation of the Baltic Sea ecosystems, and avoidance of Specially Protected Natural Reservations and objects featuring special historical value
- Usage of specialized mechanisms and equipment to arrange the nearshore trenches and gravel-stone supports, which ensure minimum soil roiling during excavation and backfilling
- Prohibition against operation of vessels used for the gas pipeline construction without collection systems for bilge water, waste and trash generated on the vessels; collection of domestic effluents and bilge water from vessels used for the gas pipeline construction by means of a special collecting vessel with subsequent delivery to the onshore treatment facilities
- Water pumping into the pipeline during hydraulic testing is carried out through special head walls equipped with fish protection systems excluding the suction of fish fry in accordance with SNiP 2.06.07-87; water, which can contain suspended solids, is discharged through settling pits
- Construction work monitoring under the Marine Environment Monitoring Program at the gas pipeline construction stage
- Operational monitoring, gas pipeline and environment conditions control

8.6 Impact on Socio-Economic Environment

8.6.1 Fishing Industry

The gas pipeline construction will result in temporary deterioration of fishery conditions. The damage to fishery industry will include the damage to fish resources resulted from water pollution with suspended solids during trench excavation and backfilling, dyke construction, gravel support arrangement for free span elimination, etc., as well as hardly calculated damage due to troubles for fishing vessels resulted from temporary water area alienation around pipe-laying vessels. At the same time it should be noted that based on practical experience of the underwater gas pipeline construction and operation in the North Sea and other water areas, new substrates (pipe surfaces, gravel fills, etc.) created as a result of construction are subject to quick oecizing by benthic organisms and macrophytes. In turn, it creates favourable conditions for bottom-feeding fish and, consequently, influences on fishery industry in a positive way.

8.6.2 Navigation (routes, anchor holds)

Notwithstanding that the Gulf of Finland is an area of active navigation, the main navigation routes are passing to the south from the designed gas pipeline route. In this respect, creation of the safety area around pipe-laying vessels (where the navigation of other floating crafts is prohibited) and the safety area along the operated gas pipeline (where anchorage is prohibited) will not impact on navigation.

8.6.3 Tourist Industry and Recreation Areas

The noise created by machinery and equipment during construction and commissioning (hydraulic testing) will impact on recreation in the nearshore recreation to some extent. Considering the fact that there are no any objects of tourist infrastructure (rest homes, hotel complexes, etc.), only unorganized recreation – rest of Vyborg and Saint-Petersburg residents in Bolshoy Bor village – will be adversely impacted. The same factors will impact on the residence comfort of permanent residents of this village (13 persons), although the insignificant impact force (acoustic, chemical, etc.) allows concluding that the construction process will not threaten sanitary safety both of local residents and people having rest.

8.6.4 Objects of Cultural Heritage

Some archaeological objects – sunken ship wrecks and separate rigging parts – are encountered in the construction area at the bottom of the Gulf of Finland. To prevent possible adverse impact on these objects of cultural heritage and cultural artifact destruction the construction corridor was preliminary examined using magnetometry method by means of side-scan sonar (SSS); the discovered objects were examined with ROV (video recording from remote operated vehicle). The archaeological expertise carried out by the Institute of the material culture history of the Russian Academy of Sciences confirmed the status of the discovered objects. Based on the expertise results the pipeline route was agreed with the Committee on Culture of the Leningrad Region Government provided that the distance from the centerline of each pipe line to the discovered objects will not be less than 100 m and 50 m in the relief areas, where the greater distances are impossible. The requirement of the Committee on

Culture was met as a result of the gas pipeline route correction: the distance from the pipeline to the discovered objects of cultural heritage is not less than 100 m is all cases except the only case, where the topography conditions did not allowed transferring the pipeline to the distance exceeding 50 m from the discovered wooden ship. Super precision pipe-laying (no dredging and other earthwork) will be used to exclude negative impacts on the cultural heritage objects during the pipeline construction. Hence, the cultural heritage objects will not be impacted during the gas pipeline construction. It should be also noted that the surveys carried out within the Nord Stream project implementation allowed discovering unknown archaeological sites featuring both cultural and scientific importance.