Environmental and Social Impact Assessment

WHSD Central Section Construction

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ERM Eurasia Ltd confirms that this Report has been prepared with all reasonable skills, care and diligence and in conformity with the professional standards as may be expected from a competent and qualified consultant acting as an Environmental Consultant that has experience in providing services for projects with similar scope of work, complexity and scale.

This Report has been prepared in accordance with the terms of the contract concluded with the Client and the generally accepted consulting practices and for the intended purposes stated in the Contract. The conclusions and recommendations made in this Report are based on information obtained directly by *ERM Eurasia Ltd*, as well as on information provided by third parties, which we believe to be accurate.

This Report has been prepared for the *EBRD* and we accept no responsibility for third parties whatsoever who may use all or parts of the information contained in this Report.

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ABBREVIATION	DEFINITION
BAT	BEST AVAILABLE TECHNIQUES
BP	BANK PROCEDURE
CBD	CONVENTION ON BIOLOGICAL DIVERSITY
CJSC	CLOSED JOINT STOCK COMPANY
CITES	CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF FLORA NAD FAUNA
DBA	DECIBEL
EBRD	EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT
EIA	ENVIRONMENTAL IMPACT ASSESSMENT
EHS	ENVIRONMENT, HEALTH AND SAFETY
ERM EURASIA	ENVIRONMENTAL RESOURCE MANAGEMENT
ERP	EMERGENCY RESPONSE PLANS
ESIA	ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
ESAP	ENVIRONMENTAL AND SOCIAL ACTION PLAN
GIIP	GOOD INTERNATIONAL INDUSTRY PRACTICE
GHG	GREENHOUSE GASES
GRP	GROSS REGIONAL PRODUCT
IFC	INTERNATIONAL FINANCIAL CORPORATION
ILO	INTERNATIONAL LABOUR ORGANIZATION
IPPC	INTEGRATED POLLUTION PREVENTION AND CONTROL
JSC "WHSD"	JOINT-STOCK COMPANY "WESTERN HIGH-SPEED DIAMETER"
LLC	LIMITED LIABILITY COMPANY
MC "MARINE FAÇADE"	MANAGING COMPANY "MARINE FAÇADE"
MPC	MAXIMUM PERMISSIBLE CONCENTRATION
MPL	MAXIMUM PERMISSIBLE LEVEL
NGO	NON-GOVERNMENTAL ORGANIZATION
OHS	OCCUPATIONAL HELATH AND SAFETY
OP	OPERATIONAL POLICY
OVOS	ENVIRONMENTAL IMPACT ASSESSMENT IN ACCORDANCE WITH REQUIREMENTS OF RF LEGISLATION
PAP	PROJECT AFFECTED PEOPLE
PEE	PUBLIC ENVIRONMENTAL EXPERTISE
PPP	PUBLIC-PRIVATE PARTNERSHIP

PR	*PERFORMANCE REQUIREMENTS (EBRD)*
RAP	*RESETTLEMENT ACTION PLAN*
RDB	*RED BOOK DATA*
SANPIN	*SANITARY AND EPIDEMIOLOGICAL RULES AND NORMS*
SEP	*STAKEHOLDER ENGAGEMENT PLAN*
SPZ	*SANITARY PROTECTION ZONE*
TOR	*TERMS OF REFERENCE*
UICN	*INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE*
UNESCO	*UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION*
UNFCCC	*UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE*
VOA	*ALL-RUSSIAN ASSOCIATION OF AUTOMOBILE OWNERS*
WHSD	*WESTERN HIGH SPEED DIAMETER*
WHO	*WORLD HEALTH ORGANIZATION*

1 INTRODUCTION

1.1 OBJECTIVES AND SCOPE OF ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE WHSD CENTRAL SECTION CONSTRUCTION IN ST. PETERSBURG

The European Bank for Reconstruction and Development (hereinafter referred to as "EBRD") is considering providing finance to the construction of the Central Section of a new high-speed toll motorway designed to connect the northern and the southern districts of St. Petersburg. This motorway is known as the Western High-Speed Diameter (hereinafter referred to as "WHSD").

In accordance with the EBRD Environmental and Social Policy (2008), to be followed in case of bank-financed projects, the construction of the WHSD Central Section can be categorized as a Category A Project with respect to its scale and potential effects on the environment and the public. Consequently a complete set of environmental and social documentation should be prepared, including an Environmental and Social Impact Assessment (ESIA).

The EBRD has commissioned ERM Eurasia (hereinafter referred to as "ERM") to prepare an ESIA for the construction of the WHSD motorway, in accordance with EBRD requirements, based on the following data:

- results of previous environmental and social assessments conducted in the process of the preparation of the pre-project and the Project design documentation (in accordance with Russian requirements),
- results of investigations or calculations which are to be carried out in order to clarify certain aspects, that were not sufficiently addressed or investigated within the framework of the Project design documentation prepared in accordance with Russian requirements.

Based on the understanding that the Central Section, during the construction phase and especially during the subsequent operational phase of the Project, will be directly linked to the Southern and the Northern Sections of the new motorway and will also create its own potentially impacted zone, the EBRD pointed out that ERM shall take into account in the ESIA the basic environmental and social aspects associated with the facilities of the WHSD Central Section and the affected areas around it.

The EBRD asked ERM to assess with particular attention the impacts arising from the WHSD Northern Section, which runs in the vicinity of the Yuntolovsky wildlife reserve.

In accordance with the EBRD requirements, the ESIA should include the following sections:

- Review of the baseline environmental and social conditions;
- Impact assessment;
- Mitigation measures;
- Environmental and Social Monitoring Plan.

This Report presents the results of an Environmental and Social Impact Assessment of the WHSD Central Section construction Project to be implemented in St. Petersburg in accordance with the EBRD requirements.

The ESIA has been conducted with due consideration of the applicable regional, national and international environmental, health, safety and social requirements.

The legal framework applicable to the WHSD Central Section construction Project (hereinafter referred to as the Project), is based on the requirements of:

- National legislation of the Russian Federation;
- Applicable international conventions and the Convention on the Protection of the Marine Environment of the Baltic Sea Area in particular.

The following basic provisions, terms and conditions have been taken into account for the purpose of determination of the legal framework of the project:

- The need for construction of the Western High-Speed Diameter motorway was recognized more than 40 years ago. In 2005 the route of the motorway was officially included in the Master Plan of St. Petersburg;
- St. Petersburg is the second largest megalopolis in Russia suffering from severe traffic congestions. The new motorway is planned to improve the traffic conditions;
- The WHSD motorway is one of the first high-speed toll motorways in Russia;
- Commissioning of the WHSD along its entire route will not only allow the simplification of the transit traffic from the Scandinavia federal motorway to the southern exit of St. Petersburg in the direction of Moscow, but will also help to resolve the traffic problems in the Marine Port, Vasilievsky Island and the future business center "Marine Facade" and divert part of the transport streams from the central districts of the city, which are protected under the auspices of UNESCO;
- The WHSD route runs mainly through districts with a low population density, via industrial zones and across the Neva Bay;
- Almost all land plots required for the WHSD construction are the property of the City of St. Petersburg. The number and the size of the land plots intended to be acquisitioned from legal entities is minimal; land acquisition from private individuals is not required;
- The scale of resettlement of local residents, dismantling of private garages, acquisition of non-residential buildings, clearing of secondary vegetation (that has no conservation status) will be minimal taking into consideration the large scale of the construction project;
- The construction of the WHSD in the sea area, along Vasilievsky and Krestovsky Islands, is coordinated with the plans for the construction of new artificial areas;

- There are no specifically protected nature zones or cultural sites in the vicinity of the WHSD Central Section; however, the Neva Bay is a water body of top fishery category;
- In the process of the already completed construction of the WHSD Southern Section, specific information describing the actual environmental impacts and the efficiency of the adopted mitigation, protective and compensation measures was obtained. This information allows conducting a more accurate assessment of the future impacts arising from some of the construction activities.

1.2 ESIA METHODOLOGY

1.2.1 General

This ESIA Report has been prepared as a result of a systematic process of prediction and assessment of potential impacts of the Project on the environmental, biological and social/socioeconomic conditions. Within the framework of the ESIA, measures, which are required to ensure reasonable minimization, correction, compensation or neutralization of adverse impacts and obtain the expected benefits and advantages, have been defined. The overall general approach to an ESIA is presented schematically below (Figure 1.2-1).

An ESIA is a cyclic process, in the course of which the results obtained are subject to a revision and are updated as soon as the technical aspects of the Project design are elaborated and the ESIA is implemented.

1.2.2 Project Facilities

The Project includes all facilities and all types of operations constituting an integral part of the WHSD Central Section construction. Furthermore, the main environmental and social risks arising from the following activities were assessed:

- Completion of the construction and the subsequent operation of the Northern and Southern sections of the WHSD motorway, that will be directly connected to the Central Section and operated by the Partner;
- Impact of the associated facilities and the areas located in the vicinity of the WHSD Central Section.

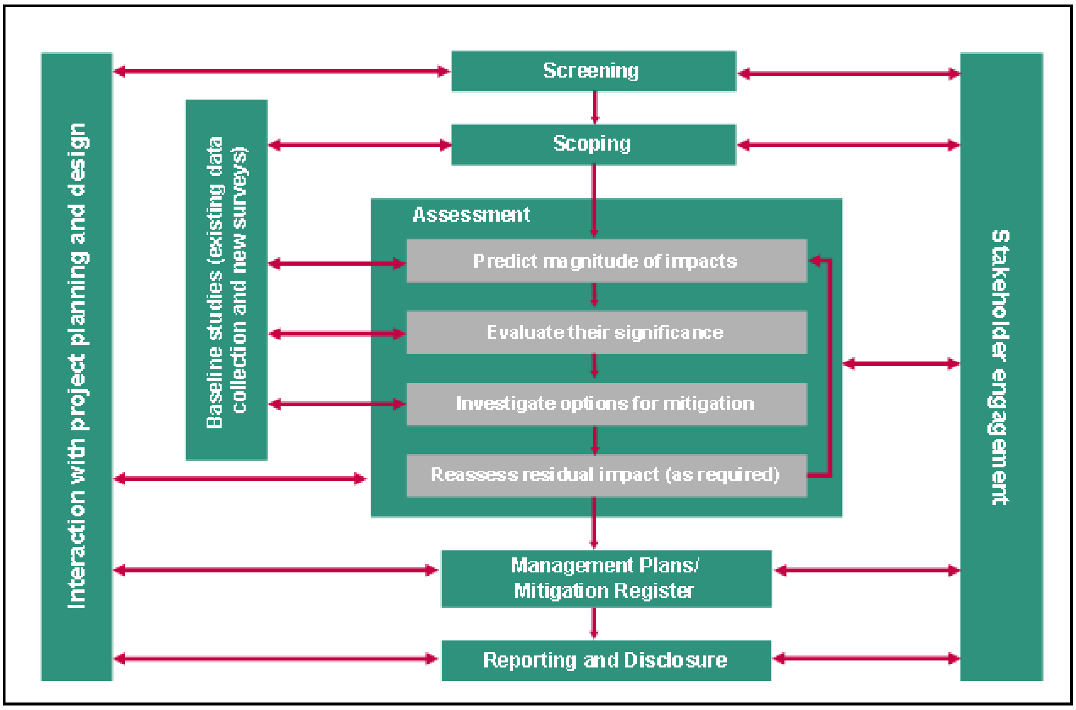
1.2.3 Screening

As mentioned above in Section 1.1, according to the EBRD procedure, an integrated Environmental and Social Impact Assessment (ESIA) should be conducted and its results presented for public consultation.

Screening is the first stage of an ESIA and is conducted in order to determine the level of the impact assessment for a specific project.

ERM Eurasia has already implemented the screening procedure as a stage preceding the ESIA of the WHSD Central Section construction Project.

Figure 1.2-1 Review of Approach to an ESIA



1.2.4 *Determination of the Scope or Work for ESIA (Scoping)*

The scope of work was determined by ERM Eurasia during the preparatory phase of the ESIA in a separate Report titled "Scoping Report" for WHSD Central Section construction.

1.2.5 *Description of Baseline Conditions*

This Report provides a description of the environmental, social and socioeconomic conditions, including information about recipients, which are expected to be exposed to significant impacts.

The information about the baseline conditions is provided with the following purpose:

- Identification of environmental, social and socioeconomic key aspects within the zone potentially affected by the Project and vulnerable conditions and objects;
- Provision of baseline data for subsequent prediction and assessment of possible impacts;
- Substantiation of conclusions related to importance, value, sensitivity/ vulnerability of the natural and social environment and the recipients.

In order to conduct this ESIA, the baseline data collection also included the following actions (in addition to the use of information obtained as a result of the surveys carried out in 1999-2000 and 2005-2006 and included in the Project design documentation):

- Collection of data available from different sources of information, such as:
  - Governmental agencies;
  - Scientific research institutions;
  - Published materials;
  - Experts;
  - Stakeholders;
  - Internet.
- Review of cartographic materials and aerial photographs;
- Review of the results of the field investigations of ERM;
- Review of the previously obtained environmental monitoring data by JSC "WHSD" in connection with the construction of the WHSD Southern and Northern Sections and the tentative operation of the completed portion of the WHSD Southern Section;
- Information gathered by JSC "WHSD" related to the experience of municipal authorities in addressing compensation claims for land plots/ garages/ buildings acquired/ already being acquired along the Southern and Northern sections of the motorway prior to the beginning of the construction.

The description of the baseline conditions within the area affected by the implementation of the Project is presented in Section 3 of this Report.

1.2.6 Implementation of Impact Assessment

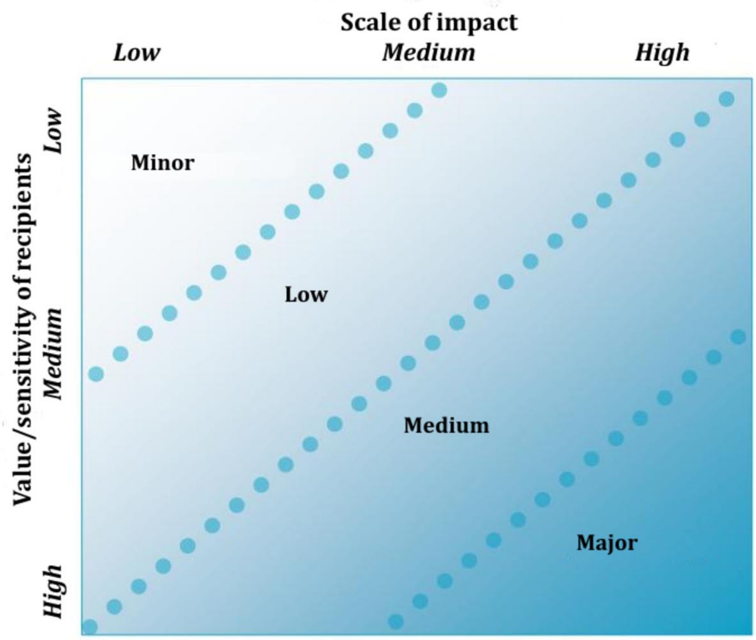
The potentially significant impacts identified during the scoping stage were subject to a full-scale appraisal in the process of the ESIA. The impact assessment follows a consistent process for the consideration of the following four aspects:

- **Prediction.** In the process of the ESIA the scale of impacts was predicted and their quantitative appraisal was made to the furthest possible extent depending on a particular issue to be assessed. The term "scale" is used for a conditional designation of all aspects of a predicted impact, including the character of changes (what is affected an in what way); dimensions, scale or intensity; geographic extent and occurrence frequency; duration, periodicity and reversibility; in specific cases also probability of impacts in case of accidental or emergency situations. When predicting any impacts, mitigation measures foreseen in the Project design have been taken into consideration, as well as any uncertainties related to the scale of impacts expressed in terms of ranges, confidence intervals or probability levels.
- **Assessment.** During this stage, the information about the scale of impacts was interpreted from the viewpoint of their significance for the public and the ambient environment to help decision-makers and stakeholders understand the importance of the issue. The purpose of this stage is the assessment of the significance of the impacts. For the purpose of this ESIA, ERM defines it as

follows: "*An impact is significant if the ESIA team believes that this impact alone or in combination with other impacts should be included in the ESIA report so that other stakeholders can take them into consideration when making Project-related decisions*". This definition recognizes that an assessment requires decision making based on judgment; however, the opinion of the participants of the process can differ from each other. The impact assessment presented in this ESIA Report is based on the judgment of the ESIA team defined with due consideration of the applicable legal norms, the policy of the Russian Government, the EBRD requirements, international standards of best practices and the opinion of the stakeholders.

The significance of impacts is assessed as an integral indicator taking into account the data related to the scale of the impact and the value/ sensitivity of the recipients. The approach to the assessment of impact significance is represented in Figure 1.2-2.

Figure 1.2-2. The schematic approach to the assessment of impact significance



An assessment of the identified impacts has been carried out for all phases of the Project implementation, including the preparation of the construction sites for the WHSD Central Section, the construction phase, and the operational phase of the entire new motorway along its full length. Decommissioning related matters have not been considered as motorways are constructed for long-term use.

- **Mitigation measures.** The impact assessment aims to support decision making related to the Project based on the provision of comprehensive information related to the potential impacts of the Project on the ambient environment and the population. An essential stage of this process is the planning of mitigation measures to reduce the level of impacts. In some cases mitigation measures were planned in the Project design development phase, but in some other cases the required measures were proposed by the experts of ERM in the course of this ESIA. Such measures have been included in the proposals concerning the Project implementation and in the Environmental and Social Action Plan (ESAP) in the form of clearly defined and unambiguous obligations.

- **Residual impacts.** All residual impacts are presented in this ESIA Report with due consideration of their significance:
  - *Significant residual impacts*, both positive and negative, have been considered in the ESAP to determine their values, in comparison with other environmental, social or economic costs and benefits, as information required for decision making with regard to the Project; it is assumed that conditions would be provided to ensure strict control of adverse impacts and their monitoring, as well as to take full advantage of all the benefits.
  - *Moderate residual impacts* will be considered as less important for decision making, but requiring attention for their mitigation and control to ensure the use of best available techniques in order to keep adverse impacts within acceptable limits and to take advantage of positive effects.
  - *Insignificant residual impacts* will be brought to the attention of decision-makers, but will be considered only as unimportant or not essential for the decision making process; their mitigation will be achieved by common best practice; they will be monitored to verify that the particular impacts do not exceed the predicted level.

In the process of the ESIA procedure, some uncertainties have been identified potentially resulting in impacts/consequences, which cannot be quantified at this stage of the Project by using the accessible prediction methods and assessments. In case of any uncertainties, ERM Eurasia identified gaps/drawbacks in the baseline data and determined additional scope of work, to be carried out during the subsequent phases of the project implementation, in order to eliminate those uncertainties.

1.2.7 Public Consultations and Community Relations

The international practice for the implementation of an ESIA and the requirements of the international financial institutions provide for the basis to conduct active consultations with the competent supervisory agencies, experts, affected local communities and other stakeholders. This is undertaken in order to understand their views of the Project and its impacts and to take these into account in the prediction and the evaluation of the impacts and the corresponding mitigation measures. Consultation is also valuable for the identification of data and information in the studied area.

Within the framework of this ESIA a Stakeholder Engagement Plan (SEP) was developed (including a grievance mechanism) in order to be used, as a structured and systematic approach for stakeholder engagement, during all phases of the implementation of the Project.

1.3 BASIC ASPECTS OF THE FUTURE MOTORWAY ROUTE

The crossing point of the Southern section of the motorway with the city's Ring Road is considered to be the reference point for measuring the mileage. The WHSD Southern Section begins at this point (as of May 2011, construction has been completed and most of this section has been commissioned). The length of this section is approximately 8.7 km.

The first 5 km section of the motorway runs northward along the right-of-way of the railway line, with the Kubinskaya Street and dwelling houses at its left (a street with rather high traffic intensity). Since here the motorway route crosses a densely built-up district, this section has been constructed as a flyover structure.

The WHSD route turns north-westwards, crosses the Marshall Govorov Street and the Stachek Avenue and enters the industrial zone of the Kirov Factory. Here the road is constructed as a two-tier structure instead of a single-tier one.

The WHSD Southern Section ends after its crossing of the Ekateringofka River via a bridge.

The Southern Section will incorporate two exit/entry ramps (currently under construction) crossing the Ekateringofka River to connect the WHSD motorway with the embankment of the Ekateringofka River.

Two more exit/entry ramps of the same interchange, as well as a toll collection terminal will be constructed within the framework of the WHSD Central Section construction Project.

The WHSD Central Section starts at the Ekateringofka River and ends at the northern bank of the Bolshaya Nevka River. Its length is 11.7 km.

The route of the Central Section the WHSD runs as follows:

- The first 1.4 km runs within the industrial zone of the St. Petersburg Seaport and up to the Marine Canal;
- It crosses the Marine Canal via a bridge with a 168m span and leads to Kanonersky Island;
- A 330m long section on a high two-tier flyover (approximately 42m above the ground level) crosses the residential area of Kanonersky Island and approaches the Neva Bay with a gradual decrease of height;
- Over the Neva Bay water area the motorway smoothly changes its direction from north-westwards to north-north-eastwards. The motorway, having the same two-tire flyover configuration, runs at a distance of approx. 60m from the western edge of Bely Island (where St. Petersburg's Central Aeration Station is located) and changes over to a single-level design version. A number of facilities of the WHSD motorway to the west of Bely Island are planned to be constructed on a new hydraulically filled site (Figure 1.3-1); however, the plan for the construction of that site is not interrelated with the WHSD motorway construction Project;

- After a northward turn, the motorway, in the form of a one-tier flyover, approaches the Korabelny waterway, across which a cable-stayed bridge on two piers is planned to be constructed;
- The bridge has a 300m long span;
- After the bridge the height of the single-tier flyover will gradually decrease and reach the ground level at the south-western end of Vasilievsky Island; then it will run in an excavated trench. The length of this portion of the motorway above the Neva Bay water area, from Kanonersky Island to Vasilievsky Island, is approx. 3.5 km, including the flyover section and the bridge;
- On Vasilievsky Island the motorway will run in a trench (the road surface is 6m below the ground level of the surrounding area; the walls will be sloped) at a distance of about 150m west of the nearest residential buildings located at the seaside embankment. Behind the motorway route within the Neva Bay water area, a hydraulic fill is being constructed for the Marine Facade of St. Petersburg; the area of the site is planned to be approximately 470 ha (Figure 1.3-2);
- From the middle of the western coastline of the Vasilievsky Island the motorway will run in a 402m long tunnel. An artificial riverbed will be constructed above the tunnel for the Smolenka River;
- After exiting the tunnel, the motorway will run along the western coastline of Vasilievsky Island in a trench and then over a soil embankment and a flyover in front of the bridge crossing the Petrovsky waterway. The total length of the motorway in the trench and the tunnel along Vasilievsky Island is approximately 2.7 km;
- Four driveways will be constructed on Vasilievsky Island above the WHSD motorway to connect Vasilievsky Island with the new artificial site being constructed to the west of the island for St. Petersburg's Marine Facade;
- A major interchange on the WHSD motorway will be constructed at the north-western end of Vasilievsky Island (with a further interchange to the Makarov Street). In the future it will include eight exit/entry ramps (four ramps on both Vasilievsky Island and at the Marine Facade) – another motorway will run between Vasilievsky Island and the Marine Facade under the WHSD flyover – but the Project design of the WHSD Central Section includes the construction of only four exit/entry ramps in the direction of the Makarov Embankment;
- The WHSD motorway will run across the Petrovsky waterway as a single-tier flyover and cross it via a bridge. The total length of the flyover, including the bridge across the Petrovsky waterway, will be approximately 700m. The bridge span will be 220m long;
- After having crossed the Petrovsky waterway, the motorway will run as a single-tier flyover above the Neva Bay water area right along the edge of Krestovsky Island. The area to the west of Krestovsky Island is planned to be used for the construction of an artificial site related to the extension of a sports complex (Figure 1.3.1), but the latter is not associated with the WHSD project;

- Reaching the end of the western edge of Krestovsky Island, the WHSD motorway will turn toward north-east and run across the Srednaya Nevka and the Bolshaya Nevka Rivers (Elaginsky waterway) as a single-tier flyover with a bridge to the land-based part of St. Petersburg;
- At a distance of approximately 300m from the coastline, the WHSD Central Section ends with the motorway continuing in a northern direction.

As a continuation the longest section of the WHSD, the 26.2 km long Northern Section begins.

Its initial section of approximately 5.3km runs along the Planernaya Street. Residential districts are located mainly to the east of the motorway route at a distance of not more than 100m. Industrial zones prevail to the west of the initial section of the route.

Taking the north-western direction and leaving the Planernaya Street corridor, the WHSD route runs within the residential area of Kamenka that has undergone significant development during the past 15 years. In the vicinity of this residential area, which is located to the north-west of the motorway route, the motorway comes close (about 180 m) to the border of the protected area of the Yuntolovo wildlife reserve. The Project design provides for the construction of this section of the motorway over an embankment. The protected status of the Yuntolovo nature reserve will not be disturbed by the motorway.

Behind the residential area of Kamenka, the WHSD motorway enters a territory which is mainly used as urban forests and farming land. Running further north-westwards it is finally connected to the federal "Scandinavia" highway in the vicinity of the settlement of Beloostrov.

This implies that despite the fact that this ESIA is made for the WHSD Central Section, it also takes into consideration the main environmental and social risks associated with the construction and the operation of the entire WHSD motorway including its Southern and Northern Sections, as well as certain associated facilities, such as:

- St. Petersburg's Marine Facade;
- A new hydraulically filled artificial area planned to be constructed to the west of Krestovsky Island;
- The area of the present-day western part of Vasilievsky Island (it exists since the 1960s) including the residential zone at the Marine Embankment and the Shkipersky dump site at the south-western end of the island;
- The new hydraulically filled artificial site planned to be constructed to the west of Bely Island.
- The Neva Bay water area.

1.4 *LIMITATIONS FOR ESIA PREPARATION*

The development of the Project design documentation for the WHSD Central Section construction was completed by the Main Design Development Contractor – StroyProject Company – in 2007. This design documentation was used by ERM as a basis for the preparation of this Environmental and Social Impact Assessment in the format required by the EBRD.

At the same time, since the completion of the development of the project design, the following significant events took place:

- Enactment of St. Petersburg's Law No.29-10 of 04.20.2009 "On Rules for Land Use and Urban Development of St. Petersburg";
- Amendments adopted in RF Law "On Internal Sea Waters, Territorial Sea and Contiguous Zone of the RF";
- Changes in the Russian legislation related to water protection zones;
- Changes in the baseline levels of atmospheric air pollution in the areas where the route of the WHSD Central Section is passing through;
- Neva Bay has undergone an increase in the impact associated with the release of suspended matter as a result of the construction of the hydraulic fill for the Marine Facade;
- The flood protection facilities in St. Petersburg have not been put into operation. Although the elevations of the temporary islands to be built in the Neva Bay water area for the construction of flyovers and bridges of the future motorway, had been designed for the conditions of the flood protection facilities operation;
- JSC"WHSD" decided to modify the design of the bridge to be constructed across the Marine Canal;
- JSC "WHSD" decided to give up the construction of a road maintenance base and a snow collection site within the framework of the WHSD, and to commission sub-contractors to provide the respective services;
- Actual data is now available with regard to the levels of harmful physical impact factors arising from the construction process of the WHSD Southern and Northern Sections and in the process of the operation of the first stage of the Southern Section;
- Approaches to resolve the legal aspects of the removal of private garages located within the motorway right-of-way and the payment of compensations to their owners have been developed and relevant experience gained.

ERM made all possible efforts to take into account in its assessments and conclusions the above changes / additional information. Nevertheless, due to the fact that there was no opportunity provided to clarify all problematic issues with the Main Design Development Contractor and its subcontractor, certain aspects of the expected impacts of the WHSD construction were adopted in this ESIA on the basis of experts' judgments and not on the basis of the design development materials.

Furthermore, since the future Partner is entitled to modify some of the design related solutions of the WHSD Central Section in the course of the preparation of the Working Engineering Documentation, the assessments made by ERM within the framework of this ESIA shall not be considered as ultimate.

1.5 *PROJECT HISTORY*

The historic layout of St. Petersburg encompasses, like a horseshoe, the Neva Bay from the north, east and south. During the recent decades the northern and southern districts of the city have undergone significant development..

The road network of St. Petersburg was originally designed in the direction of the historic center of the city, located at a distance of 3km to 4km to the east of the Neva Bay. As a result, in the early 1960s, the city encountered serious difficulties associated with the inadequacy of the transport connections between the northern and southern districts of the city. The cargo turnover of the Seaport was growing and the majority of the goods were delivered to and from the Seaport by trucks. This has resulted in a critical level of traffic intensity on roads leading to the Seaport.

Due to such circumstances, a tentative route for the future motorway was selected, as far back as in 1966 in the Master Plan of St. Petersburg (former Leningrad), to connect the northern and southern parts of the city via the shortest possible route bypassing the city center and running in the vicinity of the Seaport.

However, this intention was not implemented until the mid-1990s, when practical steps were taken in order to carry out the Project:

- In 1996 an action plan for the Project design development was introduced and approved by the St. Petersburg Committee for Urban Development and Architecture with the objective to construct a new high-speed motorway, namely "Western High-Speed Diameter" (WHSD). It was designed to start from the federal highway "Scandinavia" in the north and run toward the new southern section of the Ring Road, which was already under construction at that time;
- In 2007 the St. Petersburg Government established the Joint-Stock Company "Western High-Speed Diameter" (JSC "WHSD" and hereinafter "the Company") with the objective to organize the development of the Project design and to make the necessary preparations for the construction of the new motorway.

As a next step the Company began its pre-project activities for the construction Project.

In February 2000, after having agreed with all relevant supervisory agencies and involved urban municipalities, housing and community services organizations, transport and urban improvement departments (65 organizations in total), the Governor of St. Petersburg issued a Decree approving the decision of the Commission for the selection and the approval of the WHSD motorway route. The WHSD location route is shown in Figure 1.5-1.

Pursuant to the Decree:

- The Committee for Urban Property Management was assigned to make the necessary steps to gradually terminate the contracts with the lessees of the property located within the WHSD right-of-way along the approved motorway route;
- The sectoral and territorial divisions of the St. Petersburg Administration were assigned to terminate the lease of estate property and any legal actions that

could cause encumbrance of any property, including land plots owned/managed by the St. Petersburg Administration and located within the WHSD right-of-way.

In 1998-1999 preliminary surveys were carried out within the WHSD right-of-way and the pre-project design documentation for the motorway construction was prepared. That documentation was approved by the relevant supervisory agencies and its environmental sections (preliminary Environmental Impact Assessment according to the Russian format) were disclosed for public hearings and then approved in May 2000 by the Federal State Environmental Review Department.

In 2004 the St. Petersburg Government issued a decree (No.70-rp) "Organization of the Western High-Speed Diameter Motorway Construction" and later (August 2005) the RF Government adopted a resolution (No.2005-r) pointing out that it would be reasonable to design, construct and operate the WHSD motorway as ***a toll highway***.

The terms of reference and the technical specifications for the Project design development were obtained from the respective involved organizations in 2005-2006. During the same period of time basic surveys were carried out as required for the motorway construction and civil-engineering designs were developed for five separate stages of the WHSD construction (the Russian legislation allows the development of separate project documentations for the individual sections of a highway to be constructed).

Independent sets of Project design documentation were prepared for the two stages of the construction of the WHSD Southern Section, for the two stages of the construction of the Central Section and for the one stage of the construction of the Northern Section.

All five project designs obtained positive statements from the Main State Project Review Department (GlavGosExpertiza) of Russia in 2005-2008. According to the final design solutions, the overall length of the WHSD motorway is 46.6 km.

In 2006 the St. Petersburg Government enacted Law No.627-100 "Participation of the City of St. Petersburg in the Public-Private Partnerships (PPP)".

At the same time, a tender procedure was initiated for the conclusion of a concession agreement for the design development, the construction, the financing and the operation of the WHSD motorway; however, the tender procedure was not finalized.

As a result, the construction of the first stage of the WHSD Southern Section was initiated in 2006 under the supervision of JSC "WHSD" and financed by the St. Petersburg city budget with additional subsidies from the federal budget. The construction of the second stage of the Southern Section and the construction of the Northern Section started in 2009 and 2010 respectively.

As of May 2011, the status of the WHSD construction Project is as follows:

- The construction of an approximately 6 km long motorway section (1st Stage) has been completed, tested and officially commissioned in April 2011. Starting from May 2011, it has been operating as a toll motorway;
- The construction of the 2nd Stage (a 2.7km long motorway section) is near completion;

- The construction of the 3rd Stage (a 26.3 km long motorway section) has been launched between Partizansky and Bogatyrsky Avenues.

On 07 February 2011, the St. Petersburg Government and JSC "WHSD" announced an open tender procedure with the objective to construct and operate the WHSD toll motorway on the basis of a public-private partnership (PPP).

It is planned that based on the outcome of the competitive bidding process, a trilateral PPP agreement will be concluded between the St. Petersburg Government, the JSC "WHSD" and the selected Partner for a term of 30 years.

In conformity with the planned agreement:

- The Partner will carry out the construction of the WHSD Central Section. The Partner will be entitled to make certain modifications in the solutions used during the process of the preparation of the working engineering documentation of the construction Project;
- The JSC "WHSD" will be the owner of the entire WHSD motorway (i.e. the Southern, the Central and the Northern Sections);
- The Partner will be authorized by the JSC "WHSD" to operate and manage the entire motorway. This will allow the Partner to have the ownership right for the collection of the revenues obtained from the operation of the toll road;
- The Partner will also be responsible for any major repairs that may need to be carried out on the WHSD Central Section and, in addition, will pay the rent to the JSC "WHSD" on the basis of a lease agreement including all three sections of the WHSD.

The Agreement will also foresee the financing of a part of the expenses of the Partner incurred during the construction phase of the Central Section.

In March 2011, the preliminary qualification stage of tendering process has been completed. As a result, applications from three potential partners have been obtained.

It is expected that the winner will be selected in summer 2011 and the PPP agreement will be signed by the end of 2011.

The construction work on the WHSD Central Section will start in 2012 and will last for 41 months.

2 ENVIRONMENTAL AND LEGAL PROJECT FRAMEWORK

2.1 ENVIRONMENTAL POLICY OF THE COMPANY

The construction Projects for the WHSD Southern and Northern Sections were implemented by the JSC "WHSD", while for the WHSD Central Section Project a Partner company will be selected. The same Partner will be in charge of the operation of the entire WHSD motorway.

The JSC "WHSD" adopted in 2011 its own Environmental, Occupational Health and Safety Policy.

In this Policy it is stated that the Company's management admits that the construction and the operation of the motorway can cause some adverse effects on the road operating personnel and the surrounding environment. According to the Policy, in order to minimize such potential negative impacts the Company's management is committing to:

- Comply with the RF legislation, national norms and the stakeholders' requirements related to occupational health, industrial safety and environmental protection in the process of the Project implementation;
- Develop and implement appropriate occupational health, safety and environmental protection measures;
- Provide training for the personnel in Environmental, Health and Safety (EHS) issues.

Within the framework of its Policy, the Company has defined mechanisms and procedures for:

- The compulsory preliminary environmental and EHS risk assessment with respect to any of its activities related to the Project design development, the construction and the implementation of advanced technologies;
- The ongoing supervision of the condition of the personnel protection equipment, the collective protection equipment and the environmental protection facilities.

The Company will control the efficiency of these mechanisms by carrying out continuous environmental monitoring and by taking into consideration the results to ensure continuous improvement.

JSC "WHSD" has declared that it is willing to carry out an open dialogue with the relevant authorities, the general public, the consumers and the suppliers on EHS related issues.

In order to pursue its EHS Policy, the Company has established the appropriate divisions within its structure and has commissioned expert environmental organizations on a contractual basis.

Since the Partner has not been selected yet, it does not seem to be possible to assess, as of June 2011, the existence of an EHS Policy in the Partner.

At the same time, PPP agreement will contain special conditions obliging the Partner to comply with the relevant EHS requirements.

The reputation of the companies that are bidding to become the Partner, with regard to their compliance with EHS and social requirements during previously implemented projects, will be one of the essential criteria in the process of the final selection of the Partner.

2.2 *NATIONAL ENVIRONMENTAL LEGISLATION APPLICABLE TO THE PROJECT*

2.2.1 *General Environmental and Public Health Requirements*

The basic law laying down the rights of the RF citizens for "favorable ambient environment, reliable information on its conditions and compensation for damage inflicted to health or property through environmental violations" is the ***Constitution of the Russian Federation*** (Article 42).

The RF Urban Development Code, No.190-FZ dated 29.12.2004 (as amended on 21.04.2011) specifies the requirements to engineering surveys, preparation of Project design documentation for construction and expansion of buildings and structures, and outlines the procedure for approval of Project design documentation and implementation of supervision over construction by competent governmental agencies.

According to Article 47 of the Urban Development Code, it is required for the preparation of the design documentation for a construction or expansion project to carry out engineering surveys (including an engineering environmental survey) in the subject area selected for the construction. The prepared design documentation and the results of the engineering surveys are subject to state review aimed at assessing their compliance with the sanitary, epidemiological and environmental requirements, as well as requirements to state protection of cultural heritage sites, fire safety, industrial safety and other safety requirements.

State review of Project design documentation shall be conducted by the Main Project Review Department (*GlavGosExpertiza*) and no other types of review are required (with an exception of industrial safety review of design documentation for hazardous industrial facilities and approval by the fishery protection agency for projects affecting any water bodies).

Federal Law No. 7-FZ of 10.01.2002 "On Environment Protection" (as amended on 29.12.2010)

This Law provides a list of bodies to be protected: land, subsoil resources, soil, surface and underground waters, forests and other types of vegetation, animals and other organisms and their gene pools, atmospheric air, ozone layer of the atmosphere, and circumterrestrial space.

The Law specifies the general environmental requirements related to design development, construction and operation of any commercial facilities and compliance of activities with the environmental protection requirements. According to the Law, measures will be provided to ensure the ambient environment, the restoration of the natural environment, the sound and consistent usage and reproduction of natural resources and environmental safety.

Environmental impact assessment should be conducted for any planned commercial/industrial or other activities, which can impose direct or indirect impact on the ambient environment. Environmental impact assessment should be made in the process of the development of any alternative versions of pre-project and Project design documentation substantiating planned commercial/industrial or other activities with the involvement of non-governmental organizations.

Federal Law No. 52-FZ of 30.03.1999 "On the Sanitary and Epidemiological Welfare of Population" (as amended on 28.12.2010)

In accordance with Article 11 of this Law any legal entity is obliged to:

- ensure safety for human health in the process of the performance of the work and provision of services, as well as safety of industrial products in the course of their manufacturing, transportation, storage and sale to customers;
- carry out routine monitoring and control, including laboratory investigations and testing, to verify compliance with the applicable sanitary rules and take appropriate sanitary and anti-epidemiological (preventive) measures in the process of work performance and provision of services, as well as manufacturing, transportation and sale of products;
- inform on time the population, the local self-government authorities and the sanitary and epidemiological inspection agency about any accidental situations, shutdown of production processes, any violations of technological procedures and specifications posing a threat to the sanitary and epidemiological welfare of the population.

2.2.2 *Atmospheric Air Protection*

Federal Law No.96 of 04.05.1999 "On Atmospheric Air Protection" (as amended on 27.12.2009)

This law outlines the legal framework for atmospheric air protection, including requirements to atmospheric air protection in the course of the execution of various types of industrial operations.

According to Article 16 of this Law, in the process of design development and site selection, it is required to ensure compliance of atmospheric air quality with the applicable environmental, sanitary and hygienic norms and rules.

In order to protect the atmospheric air in residential areas, any industrial facility (or a group of facilities) should have a sanitary protection zone, the dimensions of which are determined in accordance with the sanitary classification of industrial enterprises and substantiated by the calculation of the dispersion of harmful substances (pollutants) in the atmospheric air.

A construction Project design for any industrial or other facilities, which might have a harmful impact on the atmospheric air quality, should provide for mitigation measures to reduce the emission of pollutants and ensure their neutralization.

Sanitary and epidemiological rules and norms SanPiN 2.2.12.1.1.1200-03 "Sanitary Protection Zones and Sanitary Classification of Industrial Enterprises, Installations

and Facilities", approved pursuant to Decree No.74 of 25.09.2007 by the Chief Sanitary Physician of RF (as amended on 09.09.2010)

These Rules specify an approximate size of sanitary protection zones (SPZ) depending on the hazard classification of the facility.

Sanitary and epidemiological rules and norms SanPiN 2.1.6.1032-01 "Hygienic Requirements to Atmospheric Air Quality in Residential Areas", approved pursuant to Decree No.14 of 17.05.2001 by the Chief Sanitary Physician of RF

In the process of the site selection, the design development, the construction and the commissioning of new facilities, any legal entity is obliged to take measures to reduce as far as possible the emissions of pollutants by the application of low-waste and waste-free technologies and the integrated utilization of natural resources, as well as to take measures to recover, decontaminate and utilize harmful emissions and waste.

It is prohibited to plan, construct and operate facilities, which are the sources of air pollution, in areas with pollution levels exceeding the established hygienic norms.

The Project design and cost estimate documentation should be prepared in conformity with the solutions adopted to ensure adequate ambient air quality and approved as compliant with the relevant sanitary rules and hygienic norms. Any modification of such solutions requires additional approval prior to the completion of the Project design documentation. It is also prohibited to make any changes or supplements in the Project design materials without their approval by the sanitary and epidemiological inspection agency and verification of the compliance with the applicable sanitary rules.

The Project design and the cost estimate documentation should, among other data, include materials substantiating the adopted design solutions related to the production technology with regard to minimizing the generation and the emission of pollutants and a comparison with the best available Russian and international practices.

Legal entities responsible for operating sources of harmful air emissions should ensure laboratory investigations to assess atmospheric air pollution within the zone affected by the air emissions of the concerned facilities.

Hygienic Norms GN 2.1.6.1338-03 "Maximum Permissible Concentrations of Pollutants in Atmospheric Air in Residential Areas", approved pursuant to Decree No.114 of 30.05.2003 by the Chief Sanitary Physician of RF (as amended on 19.04.2010)

This document specifies the MPC values for pollutants in atmospheric air in ***residential areas*** to be complied with at the boundary of a sanitary protection zone of any enterprise or its individual industrial facilities.

2.2.3 Hazardous Waste Management

Federal Law No.890-FZ of 24.06.1998 "On Production and Consumption Wastes" (as amended on 30.12.2008)

In case of construction of new facilities this Law (Article 10) obliges a customer to:

1) comply with the environmental, sanitary and other requirements established by the RF legislation with respect to the protection of natural environment and human health; and

2) have the relevant technical and technological documentation related to the utilization and the neutralization of the generated waste.

Waste management measures should be developed taking into account the hazard classification of waste and in accordance with the regulatory requirements related to their safe disposal and utilization/ recycling.

2.2.4 *Protection of Water Bodies*

RF Water Code, No.74-FZ of 03.06.2006 (as amended on 28.12.2010)

In accordance with Article 11 of the Water Code, when a water body is used for road construction, it is not required to conclude an agreement for water usage or to permit the use of the water body.

According to the main law defining the procedure for the use and the protection of water bodies in the Russian Federation, it is required to plan and implement, in due time, the measures for the protection and the conservation of water resources, as well as of biological resources and other elements of wildlife and vegetation, in the planning, construction, extension and operation process of any hydro-engineering facility (Article 42).

With regard to the protection of water bodies against pollution and contamination the RF Water Code requires that in the process of the execution of any work within the water body resulting in the generation of solid suspended particles, the impacts of hydro-engineering facilities on the condition of the water body should be taken into account (Article 56) and compliance with the relevant permissible impact levels ensured (Article 60).

Construction and other types of work entailing modifications of the river bed and the banks/ shores of a water body should be performed in conformity with the requirements of the national environmental and urban development legislation.

A water protection zone should be established in areas adjoining the banks or the shoreline (Article 65) with special conditions for any commercial/ industrial activities in order to prevent the pollution, the contamination and the silting of water bodies, as well as the depletion of aquatic biological resources. Within the outlines of such water protection zones, riverside/ shore protection belts are to be established with additional limitations for any commercial/ industrial or other activities.

2.2.5 *Protection of Land Resources*

RF Land Code, No.136-FZ of 25.10.2001 (as amended on 05.04.2011)

According to the RF Land Code, land owners, land users and land lessees are obliged to:

- Take measures for land protection and ensure protection from chemical contamination, production and consumption wastes and other adverse (harmful) impacts entailing land deterioration;
- Eliminate the consequences of land pollution and contamination;

- Remove, stockpile and use fertile topsoil for the improvement of low-productivity of the land in the process of any construction work associated with the disturbance of the topsoil layer.

RF Government's Decree No.717 of 02.09.2009 (Revision of 11.03.2011) "On the Norms for Land Allocation for Construction of Motorways and/or Road Maintenance Facilities"

The use of the land of residential areas for motorway construction should comply with the urban development regulations related to the zones of engineering and transport infrastructure (Article 85).

Sanitary Rules SanPiN 2.1.7.1287-03 "Sanitary and Epidemiological Requirements to Soil Quality", approved by the Chief Sanitary Physician of RF pursuant to Decree No.53 of 17.04.2003

These sanitary rules specify the requirements related to soil quality in different areas depending on their functional designation and use and taking into account the specific features of soils and climatic conditions, as well as the baseline concentrations of chemical compounds and elements. This document also specifies requirements to the assessment of soil quality, the use of soils and the implementation of soil quality monitoring.

Land for construction can be allocated only if a relevant positive statement issued by the sanitary and epidemiological inspection agency is in place (i.e. RosPotrebNadzor Agency and its territorial divisions).

The Project design documentation for construction of any facility should foresee, if required, land reclamation measures and provide guarantees for their implementation.

Soil quality monitoring should be carried out at all stages of planning and construction of any facility. After the commissioning of a facility, the customer should ensure the laboratory investigation of the quality of soils in areas with elevated risk levels.

2.2.6 *Labor Protection and Industrial Safety*

Federal Law No.116-FZ of 21.07.1997 (as amended on 27.12.2009) "On the Operating Safety of Hazardous Industrial Facilities"

This Law outlines the basic legal economic and social framework for ensuring the safe operation of potentially hazardous industrial facilities. According to the classification given in Annex 1 to this Law, the planned motorway is not rated as a hazardous industrial facility. Accordingly, the safety of the motorway construction and operation is subject to the requirements specified in the following regulatory acts.

Federal Law No.257-FZ of 08.11.2007 "On Motorways and Motorway Operation in the Russian Federation" (with amendments of 13.12.1010)

This Law regulates any relations in connection with the use of motorways, including toll highways, as well as motorway maintenance and management in the Russian Federation. The design development, the construction, the extension, the major repairs and the maintenance of motorways shall be carried out in conformity with the RF Urban Development Code.

Federal Law No.196-FZ of 10.12.1995 "On Road Traffic Safety" (with amendments of 21.04.2011)

In the process of design development, construction and extension of motorways it is not allowed to reduce the capital expenses by applying engineering solutions, which have a negative effect on the road traffic safety.

The responsibility for the compliance of the planned motorways with the road traffic safety requirements lies within the respective design development organization at the stage of the Project design development and within the respective construction organization at the stage of the motorway construction or extension.

RF Labor Protection Code, No.197-FZ of 30.12.2001 (with amendments of 29.12.2010)

Protection of life and health of employees in the process of fulfillment of their occupational duties should be ensured by means of compliance with the applicable rules, procedures, criteria and regulatory norms specified in the relevant laws and other regulatory documents and legal acts of the Russian Federation and its member territories.

The regulatory occupational health and safety requirements are compulsory for any legal entity, including those involved in the design development, the construction and the operation of any facility.

Federal Law No.68-FZ of 21.12.1994 "On the Protection of the Population and Lands against Emergencies Caused by Technical Accidents and Natural Hazards" (as amended on 19.05.2010)

This Federal Law obliges any legal entity to:

- Plan and implement the required measures to protect employees, production and social facilities against impacts of emergency situations;
- Plan and implement measures aimed at improving the stability of the functioning of organizations and the vital functions of employees in case of emergency situations;
- Ensure availability, preparation and preparedness for application of resources and means for prevention of and response to emergency situations and training of employees to use protective means in case of emergencies;
- Make arrangements and carry out emergency response and rescue operations and other urgent actions at production and auxiliary social facilities at the industrial sites and in adjacent areas in accordance with the emergency prevention and response plans;
- Finance measures aimed at the protection of employees at production and associated social facilities in case of emergencies;
- Provide relevant information in accordance with the established procedure with respect to the protection of local communities and their territories in case of threat of emergency or in case of emergencies.

2.3 *INTERNATIONAL CONVENTIONS, REQUIREMENTS OF INTERNATIONAL FINANCIAL INSTITUTIONS AND BEST AVAILABLE PRACTICES APPLICABLE TO THE WHSD PROJECT*

2.3.1 *International Conventions*

The following international conventions listed in Table 2.3.1 are applicable to the WHSD construction Project:

Table 2.3-1 International Conventions

Date of signature	Name	Comments on applicability to the Project and brief description of requirements
Marine Environment Protection		
1992, Helsinki	Convention on the Protection of the Marine Environment of the Baltic Sea (HELCOM)	It is applicable to the Project because the Convention covers the whole area of Baltic Sea, including inner waters (such as the part of Neva Bay affected by the Project). General principles of the Convention: - prevention and elimination of pollution; - use of best environmental-oriented practices and best available techniques; - application of the polluter-pays-principle; - conduction of metering and accounting of discharges and emissions of pollutants in order to estimate marine environment condition; - prevention of transboundary contamination of the area, located around the Baltic Sea.
Conventions on Flora and Fauna Protection		
1992, Rio de Janeiro	Convention on Biological Diversity (CBD)	It is applicable to the Project because within the zone affected by the future road the natural ecosystems of the Neva Bay are located.
Conventions on Climate		
1992, New York	UN Framework Convention on Climate Change (UNFCCC)	It is applicable to the Project because of the relation of road traffic to GHG emissions. The operation of this road will lead to the reduction of GHG emissions in the city of St.-Petersburg.
1997, Kyoto	Kyoto Protocol	
Social Issues, Consultations		
1998, Aarhus	Convention on Access to Information, Public Participation in Decision Making and Access to Justice for	This Convention is applicable to any type of activity having an environmental impact. The Russian Federation guarantees access to information and public participation in decision-making and access to justice for

	Environmental Matters	environmental matters.
Occupational Health and Safety		
1977, Geneva	ILO Convention No.148 "Working Environment (Air Pollution, Noise and Vibration) Convention"	This Convention is applicable to all branches of economic activities. It requires that a set of measures should be taken to prevent and limit occupational risks associated with air pollution, noise and vibration at workplaces, as well as protection against such risks.
1978, Geneva	ILO Convention No.150 "Labor Administration Convention: Role, Functions and Organization"	This Convention states that measures should be taken to regulate labor issues at the national, regional and local levels, as well as at the level of various sectors of economic activities. The Russian Federation ensures that there is an efficient system in place for the regulation of the labor issues of any facility operating within its territory.
1981, Geneva	ILO Convention No.155 "Occupational Safety and Health Convention"	This Convention applies to all branches of economic activities and to all employed persons. Each Member should formulate, implement and periodically review a coherent national policy on occupational health & safety and the working environment in order to prevent accidents and injuries that may occur in the course of work, by minimizing the causes of inherent hazards in the working environment.

2.3.2 *Applicable Guidelines of International Financial Institutions*

According to the classification used by the international financial institutions, including the EBRD classification, the planned Project related to the construction of the central Part of the Western High Speed is rated as a Category A project.

It is compulsory for Category A projects to carry out an Environmental and Social Impact Assessment.

The basic documents of the international financial institutions applicable to this Project are listed in Table 2.3.2.

Table 2.3-2 Basic guidelines of International Financial Institutions

Date of issue	Description	Brief contents and comments
European Bank for Reconstruction and Development		
April, 2003	Natural Resources Operations Policy	The document states the general principles and tasks of the EBRD Policy in terms of natural resources operations. According to this policy, the projects funded by EBRD have to pass an ecological attestation in order to support decisions on the funding of some business activities and the definition of certain ecological issues that have to be considered by funding, planning and implementation of the project. EBRD claims that the projects that pretend to be funded were designed in accordance with advanced international practices.

		The Project design structure should comply with: 1) current national environmental legislation; 2) environmental norms and standards of EU as far as they can be implemented for the project.
May, 2008	Environmental and Social Policy	The policy states the social aspects of priority: 1) labor standards and working conditions including occupational health and safety; 2) community impacts such as public health, safety and security, gender equality, impacts on Indigenous People and cultural heritage, involuntary resettlement, and affordability of basic services. The Bank has defined specific Performance Requirements (PRs) for key areas of environmental and social issues and impacts as listed below: PR 1: Environmental and Social Appraisal and Management; PR 2: Labor and working Conditions; PR 3: Pollution Prevention and Abatement; PR 4: Community Health, Safety and Security; PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement; PR 6: Biodiversity Conservation and Sustainable Natural Resource Management; PR 7: Indigenous Peoples; PR 8: Cultural Heritage; PR 9: Financial Intermediaries; PR 10: Information Disclosure and Stakeholder Engagement.
Leading financial and banking organizations		
June 2003 (amended in July 2006)	Equator Principles	The Equator Principles were adopted by a group of major financial institutions and are based on the policy and guidelines of the International Financial Corporation (IFC) The Equator Principles are applied by the world's leading financial institutions when making decisions related to project financing. They constitute a system of indicators and assessment criteria used for identification, assessment and prevention of potential environmental and social risks. By adopting the Equator Principles a financial institution undertakes to provide loans for project implementation of over US$ 50 million only if the project under consideration complies with the defined principles or in case of justified incomplete compliance.
World Bank		
January 1999	Environmental assessment. Operational Policy (OP 4.01) and Bank Procedure (BP 4.01) for environmental and social assessment of projects	This standard for environmental assessment of projects includes the following main requirements: - Scale and methods are dependent on the potential environmental impacts of the proposed project (4 categories of projects reflecting the potential environmental risk); - It is required to consider project alternatives; - Among priorities is search for Project design solutions aimed at prevention, minimization, mitigation of or compensation for negative environmental impacts and enhancement of favorable effects on the environment; - Environmental assessment should take into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement,

		indigenous peoples; and physical cultural resources; and transboundary and global environmental aspects). Natural and social aspects shall be considered in an integrated way.
International Finance Corporation		
April 2006	IFC Social and Environmental Sustainability Policy and Performance Standards	The IFC Social and Environmental Sustainability Policy and Performance Standards are applicable to all project financed with participation of the IFC. - Performance Standard 1: Social and Environmental Assessment and Management System; - Performance Standard 2: Labor and Working Conditions; - Performance Standard 3: Pollution Prevention and Abatement; - Performance Standard 4: Community, Health, Safety and Security; - Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management.
July 2007	Guidelines on Social and Environmental Sustainability Performance Standards	The IFC Guidelines are applicable to all projects financed with participation of the IFC. The following aspects are covered: - Environmental protection; - Occupational health and safety; - Public health, safety and security of local communities; - Construction and closure; - Adverse sector-specific impacts and mitigation measures; - Performance indicators and monitoring of efficiency.
April 2006	IFC Environmental, Health and Safety General Guidelines	
April 2006	IFC EHS Guidelines for Toll Roads	

2.3.3 *Best Available Toll Road Practices Applicable to the Project of Construction of Central Part of West High Speed Diameter*

The main EU Directive related to monitoring and control of environmental impacts is the EU Directive No. 96/61/EC from 24.09.1996, Integrated Pollution Prevention and Control (IPPC).

A new Directive with the same title was issued as 2008/1/EC, which is an update of the previous document.

The IPPC Directive constitutes a regulation system based on an integrated approach to control and reduction of environmental impacts of industrial operations.

The IPPC Directive does not specify any fixed values of the parameters to be monitored and controlled, but it provides a recommended scheme for design development and operation of facilities to ensure environmental protection by using Best Available Techniques (BAT).

There is a series of reference documents developed in the EU and describing BAT for different sectors of industry. Depending on the date of issue they refer to the respective provisions of the IPPC Directive of 1996 or 1998.

Among named reference documents the IPPC Reference document of BAT on the General Principles of Monitoring (July, 2003) is applicable to the planned Project for the construction of the Central Section of the Western High Speed Diameter.

The most detailed provisions for the consideration of ecological and social issues by toll road construction and maintenance are developed by the International Finance Corporation within the Environmental, Health and Safety Guidelines for Toll Roads issued on 30 April, 2007.

In these guidelines the industry-specific standards and examples of Good International Industry Practice (GIIP) are listed. The EHS Guidelines for Toll Roads include information relevant to the construction, the operation and the maintenance of large sealed road projects including associated bridges and overpasses:

1) Environmental issues: habitat alteration and fragmentation, storm water, waste, noise, air emissions, wastewater;

2) Occupational Health and Safety issues: physical hazards, chemical hazards, noise;

3) Community Health and Safety issues: pedestrian safety, traffic safety, emergency preparedness.

In addition, this document specifies certain norms for emissions and discharges, as well as environmental monitoring and the monitoring of occupational health and safety conditions.

2.4 *ENVIRONMENTAL STANDARDS APPLICABLE TO THE CONSTRUCTION AND OPERATION OF THE WHSD CENTRAL SECTION*

For the evaluation of the permissible environmental impact of the WNSD Central Section during the construction phase and later on during the operation of the entire motorway, the following environmental norms and standards are applicable:

- Maximum permissible concentrations (MPC) established in the RF for pollutants in different environment media;
- Maximum permissible concentrations of pollutants in different environment media recommended by the World Health Organization (WHO);
- Maximum permissible level (MPL) of pollutant concentration in air emissions recommended by the relevant directives of the European Union;
- IFC standards for emissions and discharges for toll road facilities;
- IFC Recommendations related to the quality of treated sanitary wastewater;
- Maximum permissible noise levels established by the national legislation of the RF and the normative documents of international organizations (WHO, World Bank Group);

The Russian norms for ambient air quality in residential areas specify two indicators: maximum permissible one-time (simultaneous) and average daily (24-hour) concentrations of pollutants.

Table 2.4.1 presents a comparison of the WHO, EU and Russian norms and standards for ambient air in residential areas.

Table 2.4-1 MPC values of pollutants in residential areas according to WHO, IFC, EU and Russian Norms

Requirements of standards Pollutant, (mg/m^3)	Russian norms		WHO/IFC			European Union		
	Maximum one-time	Average daily	1 hour	24 hours	1 year	1 hour	24 hours	1 year
Nitrogen dioxide	0.2	0.04	0.2	-	0.04	0.2*	0.125**	0.020
Carbon monoxide	5	3	30	10 per 8 hours	-	-	10 per 8 hours	-
Suspended matter	0.5	0.15	-	-	-	-	-	-
Particulate matter ($PM_{2,5}$)	0.16	0.035-	-	0.025	0.01	-	-	-
Particulate matter (PM_{10})	0.3	0.06	-	0.050	0.02	-	0.05***	0.02

* - shall not be exceeded more then 18 times per year;
** - shall not be exceeded more then 3 times per year;
*** - shall not be exceeded more then 3 times per year.

Air quality standards for motor roads have to be observed on the borderline of the roadside clear zone (the size of the zone is established for each part of the motor road individually depending on the measures for reduction of the impact on adjacent territories).

Table 2.4.2 presents the levels of the concentration of pollutants in water bodies of commercial fishery importance. As the Neva Bay is a water body of higher fishery significance category these standards are applicable to the Project. The same table reflects the relevant EU limitations for pollutant concentration in surface water bodies.

Table 2.4-2 Norms for water quality in water bodies of fishery significance established in the RF

Parameters (pollutants)	RF Norms for bodies of water rated as of Higher Fishery Significance Category, mg/l		EU Norm for surface water bodies, mg/l
	For inner waters	For seas and segments of them*	
pH	6.5-8.5		6.5-8.5
Total content of suspended matter	An increase in comparison with baseline conditions by not more than 0.25	10	50-60
Oil and oil products in dissolved and emulsified condition	0.05	0.05	
COD+BOD	32-33		150-400 (only COD)

Copper	0.001	0.005	0.1-4
Lead	0.006	0.01	0.2-1
Arsenic	0.05	0.01	-
Nickel	0.01	0.01	0.5-3
Zinc	0.01	0.05	0.5-7
Mercury	Absence (less then 0.00001)	0.0001	-

* These standards are applicable to the Project due to the Convention on the Protection of the Marine Environment of the Baltic Sea

For the water bodies that have fishery significance the above listed standards have to be observed in discharged (after sewage disposal) waters as well.

Standards related to permissible noise levels foreseen in the relevant RF legislation and the guidelines of international organizations are presented in Table 2.4.3.

Table 2.4-3 Maximum permissible noise levels established by the RF legislation and normative documents of international organizations

Designation of affected areas		IFC & World Bank	WHO Norms	RF Norms
		Maximum permissible noise level, dBA		
Residential area	At daytime	55	55	55
	At night	45	35	45
Commercial or industrial zone	Office buildings	70	70	60
	Production facilities			80

For motor roads, which are characterized as sources of steady state noise, the RF norms have to be lower by 5 dBA than it is depicted in the table above (2.4.3.) In case of urban built-up areas these standards are to be observed inside housing units located nearby the road.

2.5 *PUBLIC PARTICIPATION AND DISCLOSURE OF THE PROJECT-RELATED INFORMATION*

2.5.1 *Requirements of the National Legislation Related to Public Participation in Decision Making on Environmental Matters*

2.5.1.1 *Provisions of Regulatory and Legal Acts of Federal Level*

The RF legislation, the regulatory and the legal acts related to projects require the disclosure of project-related information to the public and to provide an opportunity to make comments on the accessible information in the process of the Project design development and the related discussion.

The requirements related to public consultations are defined by Federal Law No.7-FZ of 10.01.2002 (with amendments of 29.12.2010) "On Environmental Protection" and the Regulation on Environmental Impact Assessment of Planned Industrial and Other Activities in the Russian Federation (Order No.372 of 16.05.2000 by the RF State

Committee for Environment Protection, registered by the RF Ministry of Justice under No.2302).

More specifically, the Law "On Environmental Protection" requires that:

- Any industrial and other activities causing an impact on the ambient environment should be performed according to the principles of the participation of citizens in decision making, based on their right for favorable a ambient environment (Article 3);
- In case of site selection for facilities, which can inflict damage to the ambient environment, a decision related to the site selection should be taken with due consideration of the attitude of the local communities or of the results of a referendum (Article 13).

Section IV of the EIA Regulation deals with the disclosure of project-related information and with public participation in the discussion process of the Russian EIA, with special attention paid to the following aspects:

- Disclosure of project-related information to the public and public participation should be ensured at all stages of the Environmental Impact Assessment;
- Public participation in the development and the discussion process of the EIA should be guaranteed by the developer, as an integral part of the EIA process;
- Public engagement should be organized by the relevant authorities with the support of the Project initiator, including the following:
- Disclosure of the Terms of Reference (ToR) for the EIA and the consideration of the comments in the process of the preparation of the EIA document;
- Access to the TOR of the EIA should be ensured from the date of approval and until the completion of the EIA document preparation process ;
- Disclosure of the draft EIA report for discussion and provision of information to the public through mass media to be held not later than 30 days ahead of the date of the public hearings;
- The draft EIA report is subject to public discussion in the course of the public hearings;
- After the completion of the public hearings it is required to prepare a document summarizing the discussed issues (brief minutes). This document should be signed by the representatives of the executive authorities and the local administration, the citizens, public organizations and the Project initiator. The brief minutes are to be attached to the final EIA report;
- The draft EIA report should be made available for further comments for 30 days after the completion of the public hearings. Any comments received should be documented and considered by the Project design developers in the course of the preparation of the final EIA report.

The RF Urban Development Code (No.190-FZ of 29.12.2004, with amendments of 22.11.2010) requires that a list of environmental mitigation measures should be included in the Project design documentation for any capital construction facility.

An environmental action plan should be prepared based on the EIA materials, with public hearings being an integral part of the EIA procedure.

Article 28 of the Urban Development Code lays down the requirements for conducting public hearings.

2.5.1.2 *Requirements of Regulatory and Legal Acts of Regional Level*

The process of public participation for the discussion of a project at the regional and local level is regulated by the provisions of the RF Urban Development Code and the relevant regulatory documents adopted by the respective local authorities.

The Urban Development Code specifies that public hearings should be organized and held by the local authorities, who are entitled to approve Project design documentation or to issue permitting documents.

St. Petersburg's Law No.400-61 of 20.07.2006 (with amendments enacted in 2010) "On the procedure for the organization of public hearings and information disclosure for the public in the process of urban development activities in St. Petersburg" and the Order issued on 14.12.2004 by the Leningrad Oblast Committee for Natural Resources and Environment Protection "On the Methodological Guidelines for Public Engagement in the Discussion Process and for Solving Environmental Safety Issues" establish well-defined procedures for the notification of the public about the planned project and for the organization of public hearings in the process of the construction design development. The aforementioned laws also establish a procedure for the consideration of comments made by the public.

2.5.2 *EBRD Requirements Related to Stakeholder Engagement and Information Disclosure*

In conformity with the Environmental and Social Policy adopted by the EBRD in 2008 and applicable to the Project, it is required to ensure compliance with all national and international requirements with regard to consultations with stakeholders, including the relevant EBRD requirements. EBRD considers stakeholder engagement as an essential part of corporate responsibility in relation to the society, as well as a way to improve the quality of projects. In particular, efficient stakeholder engagement and disclosure of project-related information play a key in the management of the risks associated with a project's impact on the communities and to ensure maximum benefits of a project for the local communities.

1. Commitment to International Standards

The Bank supports the approach of the Aarhus Convention concerning access to information, and the approach of treating the ambient environment as a public good. The Convention confirms the right of the public to be aware of the status of the environment and the right for clear and precise consultations on proposed projects or programs, implementation of which can impose adverse impact on the ambient environment, as well as the right to file complaints if the public believes that environmental issues have not been addressed in an adequate way in such projects and programs.

2. Engagement during Project Preparation

Stakeholders Identification and Analysis

The first step in a successful stakeholder engagement process is for the Project initiator to identify the various individuals or groups who (a) are affected or likely to be affected (directly or indirectly) by the project ("affected parties"), or (b) may have an interest in the project ("other interested parties").

Stakeholder Engagement Plan (SEP)

The Project initiator should develop a Plan describing a procedure for the engagement of the identified stakeholders during the Project preparation and implementation phases, including a grievance mechanism.

Information Disclosure and Consultations on Category A Projects

Projects classified as Category A (including the Project under consideration) require a formalized and comprehensive assessment. Disclosure and consultation requirements are built into each stage of this process.

Information Disclosure

Disclosure of the meaningful project-related information helps the stakeholders understand the risks, impacts and benefits associated with the Project.

Meaningful Consultations

Where workers and/or affected communities are, or may be, subject to significant risks or adverse impacts from a Project, the Project initiator will undertake a process of meaningful consultation in a manner that provides the affected parties with opportunities to express their views on project risks, impacts, and mitigation measures, and allows the project initiator to consider and respond to them.

3. Engagement during Project Implementation and External Reporting

Throughout the life of the Project, the Project initiator will provide ongoing information to identified stakeholders, which is commensurate with the nature of the project and its associated environmental and social impacts, and the level of public interest.

4. Grievance Mechanism

The Project initiator will need to be aware of and respond to stakeholders' concerns related to the project in a timely manner. For this purpose, the Project initiator will establish a grievance mechanism to receive and facilitate the resolution of stakeholders' concerns and grievances about the Project initiator's environmental and social performance.

2.5.3 Results of already conducted Public Discussions of the Project

Within the framework of the Project design development and the implementation of the WHSD construction Project the following stakeholder engagement measures have been taken.

EIA Public Hearing at the Stage of Investment Feasibility Study

In accordance with the requirements of the Russian legislation, the JSC "WHSD" organized in 1999-2000 public hearings during the phase of the feasibility study for the substantiation of investments for the construction of the WHSD. Within the framework of these public hearings, the materials of the conducted Environmental Impact Assessment (EIA) were disclosed and opened for discussion. However, no complete and timely access to the documents of the Terms of Reference for the EIA has been provided to the stakeholders.

After the completion of the public hearings procedure, the JSC "WHSD" did not allow the access of the general public to the project-related information and to the information about the further elaboration of the planned Project.

Public Hearings on Materials Related to the 3rd Stage of Project Implementation (the WHSD Northern Section)

Separate public hearings were held with regard to the materials related to the 3rd stage of the Project implementation. They were organized by the JSC "WHSD" in December 2006. Brief Minutes were prepared based on the outcomes of the hearings, including the comments made by representatives of the public and the corresponding responses.

The issues raised by the public at the hearings included the following:

- Alternative routes for the WHSD Northern Section;
- Potentially negative impact of the Project on the residential areas directly adjacent to the construction sites;
- Inadequate elaboration of mitigation measures for environment protection within the affected area;
- Dismantling of the garage structures;
- Impact on the recreational areas used by the nearby local communities and adjoining the Yuntolovo nature reserve;
- Insufficient access to Project-related information.

Public Environmental Expertise (PEE)

In 2006 Members of the NGO "Save Yuntolovo" have initiated the PEE of the 3rd phase of the WHSD motorway construction (the Northern Section) and invited the St. Petersburg Society of Naturalists to carry out the review of the project. The PPE was financially supported by the "Bellona" association. The PEE expert commission included 12 experts.

The objective of the public environmental review was to assess the environmental impacts of the motorway construction and to protect the civil and the environmental rights of the citizens. The Project documentation for the area between Bogatyrsky Avenue and the interchange to E-18 "Scandinavia" federal highway has been assessed.

In October 2007, an environmental statement prepared by the PPE was presented to the public and its text and a summary were loaded on the Internet.

However, there is no evidence in place that the PEE Statement has been approved by the relevant federal or regional authorities, i.e. that it has legal force.

Furthermore, the WHSD construction design was discussed within the framework of a series of public hearings related to other urban construction Projects conducted during the 2005-2010 period:

1. Public hearings on the St. Petersburg's Master Plan (2005, 2007 and 2010) and St. Petersburg's Land Use and Urban Construction Plan (2008)

The adoption and the further amendments of the Master Plan (2005) and the Land Use and Urban Construction Plan (2009) of Saint-Petersburg were preceded by extensive and comprehensive public hearings. As the WHSD Project is of federal and international significance and one of the important infrastructure developments incorporated into the above Plans, issues related to the WHSD motorway construction were discussed during the public hearings.

2. Public hearings on the "Marine Facade" Project

The Central section of the toll motorway will run along the Marine Embankment on Vasilievsky Island, connecting the currently existing territory of the Island with the newly created site of the Marine Facade development. The bridges that are planned to be constructed near the Marine Facade site and that are incorporated in the WHSD design, are considered to be an integral part of this new district of the city and one of the visual elements of the new landscape. In addition, hydraulic filling of the Marine Facade site is being carried out in a manner to reduce the volumes of earthmoving works in the WHSD section running along the Vasilievsky Island edge.

In 2007, a series of public hearings on the "Marine Facade" Project were held, where the participants expressed many times their concern about a cumulative impact that would be caused jointly by the Marine Facade and WHSD Projects.

In addition to the public hearings, the JSC "WHSD" has implemented the following measures aimed at strengthening interrelations with stakeholders (until now - mainly in relation to the WHSD Northern and Southern Sections):

- Establishment of Community Liaison Offices to consider issues of compensations for demolition of garages within the right-of-way for the WHSD motorway construction;
- Technical formalities for conclusion of compensation agreements with regard to the garages;
- Notification through the local authorities about the timeframe for demolition of the garages and the compensation procedure;
- Negotiations and conclusion of compensation agreements with the owners of land plots and property to be acquired for the WHSD construction;
- Information about the tariffs and rules for use of the high-speed toll motorway through mass media and Telephone Service for customer support;
- Non-technical Summary of Environmental and Social Aspects of the WHSD Project made available at the company's website in 2007;

- Information about the tender procedure for the WHSD Central Section construction circulated via mass media and a seminar organized for tender bidders;
- Regular interaction with the relevant authorities and local self-government bodies.

2.6 OBTAINED ENVIRONMENTAL APPROVALS AND PERMITS FOR THE IMPLEMENTATION OF THE WHSD CENTRAL SECTION CONSTRUCTION PROJECT

The Environmental Impact Assessment in Russian format (OVOS) for the WHSD motorway construction for its entire length was made at the pre-design stage (i.e. over 10 years ago). It included an assessment of the risks for public health associated with the operation of the WHSD motorway under the design traffic conditions. This documentation was approved in 2000 by the State Environmental Review Department.

In 2007 the approval procedure was completed for the fifth and fourth stages of the WHSD motorway construction Project (i.e. the stages related to construction of the WHSD Central Section). The following environmental agencies participated in the approval process:

- Neva-Ladoga Basin Department for Water Protection (Letter No.R6-18-5138 dated 28.12.2007);
- Russian Academy of Medical Sciences (Experts' Hygienic Statement No. 5/31/07);
- Committee for Urban Improvement and Road Maintenance of the Urban Parks Management Department of St. Petersburg Government (Letter No.1154 dated 23.03.2007).

The main approvals referred to the Project design documentation for construction of the WHSD Central Section, including the Volume "Environmental Protection Measures", obtained from the Main Project Review Department of the RF (*GlavGosExpertiza*). The following positive environmental statements were obtained from the federal agency:

- Statement dated 14.02.2008 for the fourth stage of the WHSD motorway construction – from the Ekateringofka River to the south-western end of Vasilievsky Island;
- Statement dated 20.03.2008 for the fifth stage of the WHSD motorway construction – from the south-western end of Vasilievsky Island to the right-hand bank of the Bolshaya Nevka River.

The GlavGosExpertiza statements are valid for a period of five years. They serve as a basic document required for the Project Partner to obtain a Construction Permit (provided that any modifications adopted in the process of development of the working design documentation would not be significant and thus would not require a repeated review to be conducted by RF GlavGosExpertiza; in addition, approval from Fish Protection Agencies in the course of designing the Project documentation).

After having obtained a Construction Permit for the WHSD Central Section, the Partner should:

- obtain Resolutions for water use (in relation to the construction of temporary islands in the Neva Bay and provisional flyovers connecting them, with regard to the discharge of water from pits and trenches excavated in the process of the WHSD Central Section construction);
- make sure that the contractors of the construction have obtained Air Emission Permits for all construction sites;
- make sure that the contractors have obtained a document specifying the permitted limits for waste disposal (Waste Disposal Limits Document) with regard to the amount and the type of the waste, that is expected to be generated in the process of the WHSD Central Section construction;
- obtain the approval of the relevant supervisory agencies for its environmental and operational monitoring program for the period of the WHSD Central Section construction.

3 MAIN CHARACTERISTICS OF THE CONSTRUCTION AREA

3.1 CLIMATE CONDITIONS

The climate conditions at the Neva River mouth, within the Neva Bay and the coastal areas of the urban agglomeration of St. Petersburg are determined by the prevailing influence of the Atlantic air masses and are considered as moderately cold, humid and transitional from marine to continental.

Information on the basic climatic parameters for the subject area selected for the construction of the WHSD Central Section, determined on the basis of long-term available monitoring data, is outlined in Appendix 3.1 (Tables 1-7).

Air Temperature

The coldest months of the year are January and February with an average monthly temperature of —7. ºC and a recorded absolute minimum air temperature of —36ºC. The warmest month is July with an average monthly temperature of +17.8ºC and an absolute maximum of +34ºC. The absolute annual air temperature amplitude is 70ºC.

The period with average daily air temperatures above freezing point is on average 218 days.

Seasonal Phenomena

The first half of winter in St. Petersburg is characterized by prevailing prolonged inclement weather with rain and sleet. Thawing periods are typical for the cold period of the year. Sharp changes in ambient air temperatures from consistent frost to thawing and vice versa are **a factor causing glaze phenomena and ice-covered ground, which is an important aspect to be taken into consideration in the process of the future operation of the motorway.** The average number of days of thawing periods is 7 to 12 days during winter months and it increases up to 15 to 20 in November and March.

In spring the transition of the daily air temperature to above the freezing point takes place on average on 3rd to 5th of April, with a subsequent short snow-melt period of 7 to 10 days; at the same time, after that period, cold weather and even formation of a snow cover is reported rather frequently (see below).

In summer, temperatures above +15ºC are recorded starting from mid- June until mid-August.

Air Humidity and Atmospheric Precipitation

Air Humidity

Elevated air humidity is a typical factor for the subject area throughout the year. The average relative air humidity is 79%. Cloudy weather prevails throughout the year; the average annual occurrence of clear sky does not exceed 21% during winter months and is up to 30% in summer.

Atmospheric Precipitation

The area for the WHSD motorway construction is rated as a zone with a high atmospheric precipitation rate. According to the data recorded during many years of observation, the average annual precipitation rate is 620 mm. Over 60% of the precipitation is reported during the warm period of the year. August is the month with the maximum precipitation rate averaging 82 mm.

Snow Cover

On average the snow cover appears on 31 October and a consistent snow cover is formed by December.

The snow cover begins to melt in March-April. On average the snow cover fully disappears by 16 April.

The maximum snow cover thickness reported at the end of winter was 64 cm; the average snow cover thickness during winter is 33 cm. **For the future motorway this data is essential for determining both the snow load on the structures and the volume of snow to be removed.**

Blizzards are typical in winter: on average 4 to 18 days per months with an average duration of a blizzard of 4.9 hours per day.

Wind

The average monthly wind velocity is within 2.2 to 3.2 m/s. But gusts are common with an average velocity of 17 m/s and with a maximum of up to 30 m/s.

The direction of prevailing winds during the annual cycle is westerly (20%) and south-westerly (17%) - **which is very favorable for the WHSD area** - as well as southerly (16%).

According to the data of many years of observations the average occurrence of calms, during which the air pollution level rises very fast, is 11% per year.

During the warm period of the year, monsoon wind conditions are typical, with a high occurrence rate of calms and with breeze circulation (offshore breeze by day with high wind velocity and land breeze at night).

Meteorological Potential of Atmospheric Air Pollution

Taking into consideration the combination of wind conditions in the subject area and the occurrence rates of surface and raised inversions, the atmosphere pollution potential for the St. Petersburg region is rated as low. This is one of the reasons due to which St. Petersburg is considered to be the least polluted cities among the largest cities of Russia.

3.2 *AMBIENT AIR QUALITY*

3.2.1 *Baseline Air Quality in the Designed Construction Area of the WHSD Central Section*

St. Petersburg is the second largest air polluters among the cities of the RF with regard to volumes of air emissions from vehicles (annual gross emissions of over 530,000 tonnes).

Industrial enterprises annually release over 35,000 tonnes of pollutants or approximately 7% of the air emission volume from vehicles.

As a result, most districts of the city are rated, with regard to the air quality, as highly polluted (Figure 3.2-1).

In the area of the construction of the WHSD Central Section, the air pollution level is considered to be moderate due to the following factors:

- Prevailing intrusion of clean air masses from the Gulf of Finland to the western border of St. Petersburg;
- A rather remote location of Vasilievsky and Krestovsky Islands in relation to the city's industrial zones of the city (for the WHSD section from Ekateringofka River to the Marine Canal the air emissions from the operations at the Seaport affect already the air quality, but there are no residential zones in the vicinity of the WHSD);
- Low road traffic intensity within a zone located at a distance of more than 1 km from the future highway route.

The actual average air pollution levels on Vasilievsky Island in 2007-2010, with regard to the pollutants emitted from vehicles, are presented in Table 3.2-1.

Table 3.2-1 Average concentrations of pollutants in the ambient air in the area of Vasilievsky Island (based on the monitoring data from the permanent monitoring station of Roshydromet)

Ser. Nos.	Pollutants	Average concentrations (mg/m^3):				MPC (daily average)
		2010	*2009*	*2008*	*2007*	
1	Nitrogen dioxide	0.063	0.051	0.074	0.071	0.04
2	Carbon monoxide	0.8	1.1	0.8	1.0	3.0
3	Particulate matter	0.046	0.072	0.078	0.076	0.15
4	Formaldehyde	0.003	0.003	0.005	0.005	0.003

Based on the above, the following conclusions can be made:

- The most problematic pollutant for the air quality in the area of the WHSD route is nitrogen dioxide, the actual concentration of which exceeds the maximum permissible daily average level by more than 50%;
- A general trend related to the improvement of the air quality in the area of Vasilievsky Island has been recorded during the past 4 years.

It should be considered that the standardization for air emissions in Russia is not established on the basis of the criteria related to the above average daily concentrations, but on the basis of the criteria for compliance with the maximum permissible one-time (instant) concentrations recorded within a period of any 30 minutes. In 2010, such maximum one-time concentrations exceeded the established limits ($MPC_{inst.}$ = 0.20 mg/l) by up to 4.7 times; however, the frequency of such cases with the exceedence of nitrogen dioxide concentrations was less than 5%, which is considered to be permissible.

In general, in comparison with the other (more polluted) districts of St. Petersburg, with regard to the ambient air quality, the Neva Bay coast is the most acceptable area for the construction of a new motorway, although all possible measures shall be taken in the Neva Bay coastal area to minimize the nitrogen dioxide emissions.

3.3 GEOLOGICAL CONDITIONS

3.3.1 Geology and Geomorphology

From a geological and a geomorphologic perspective, the area selected for the construction of the WHSD motorway is located within a depressed lacustrine-glacial plain (the Neva Lowland) crossed by riverbeds of the Neva River and its tributaries and accommodating the Neva Bay water area. This valley is bordered to its north by the projection of the Toksovskaya upland and to its south by the Baltic-Ladoga terrace. The deposits of the lacustrine-glacial were accumulated over the roof of the extensive ancient sedimentary formations altered to a significant degree by the historic glacial activity.

The overall thickness of the Quaternary sediments is 35m to 40m; the thickness of the underlying Proterozoic sediments is over 150 m.

Since the subject area for construction of the WHSD Central Section is located within the outlines of the city of St. Petersburg and the Neva Bay is used in an intensive way for navigation, the upper layers of soil/ bottom sediments contain virtually everywhere (both on the land and at sea) sediments and surface relief forms of man-made origin (filled soils on the land, and waterways and underground soil dumps within the sea area).

3.3.1.1 *Specific Geological and Geomorphologic Features of the Water Areas Crossed by the Motorway Route*

Based on to the findings of the engineering geological surveys, the area where the motorway route is planned to cross the Neva Bay water area can be described as follows:

- Bottom sediments of man-made origin - sandy and sandy-silty sediments with interbeds of gravel and sandy silt mixed with domestic and construction wastes, in some places - with petroleum products, with an observed thickness of up to 6.3 m;
- Natural marine sediments - sandy (silty and fine-grained sands) and silty (silts and in some places silty sand) sediments with interbeds of sand and with vegetative residues; the overall observed thickness of sands and silty sediments is up to 17.5m and up to 12.5m, respectively;

- Upper Quaternary lacustrine-glacial sediments - bandy clays and sandy silts (fluid and fluid/high plasticity silts) and silts with poorly defined layering; the overall observed thickness is up to 9.8 m;
- Upper Quaternary glacial sediments - moraine sandy silts with lenses of silty sands, tough and plastic, with inclusions of boulders, pebble and gravel and interlayers of sands; the overall exposed thickness is up to 20m to 22m;
- Upper Proterozoic sediments - consolidated and semi-consolidated clays, dislocated, with highly uneven top of the bed; the overall observed thickness is up to 25.5m. In the vicinity of the Smolenka River a sharp fall of the elevation of the sediments layer was recorded (i.e. it was not observed in boreholes).

The Neva Bay water area is shallow; the seabed surface has been significantly modified by the dredging of waterways and ground dumping.

3.3.1.2 *Specific Geological and Geomorphologic Features of Land Areas Crossed by Motorway Route*

Approximately 40% of the total length of the Central Section of the WHSD motorway will be constructed within the coastal land area or along the current coastline particularly:

- At the beginning of the section to be constructed (i.e. on Gutuyevsky and Kanonersky Islands);
- Along the western edge of Vasilievsky Island and Dekabristov Island in front of St. Petersburg's Marine Facade;
- Along the right-hand bank of the Bolshaya Nevka River after crossing of the Neva Bay water area.

Within the above three sections, the WHSD motorway crosses the surface of the Quaternary lacustrine-glacial plain. Lower Cambrian sediments were also identified in the geological cross-section of this area.

Marine plain sediments are also present in the coastal land area having a gentle slope toward the sea with bedded and bandy sandy silts.

According to the findings of the engineering geological surveys, the geological structure of the area between the Ekateringofka River and Kanonersky Island comprises the following formations:

- Bottom sediments of man-made origin - sandy and sandy-silty sediments with interbeds of gravel and sandy silt mixed with domestic and construction wastes, in some places with petroleum products, with an observed thickness of up to 4.6 m;
- Upper Quaternary lacustrine-glacial sediments - bandy clays and sandy silts (fluid and fluid/high plasticity silts) and silts with poorly defined layering; the overall observed thickness is up to 11.2 m;
- Upper Quaternary glacial sediments - moraine sandy silts with lenses of silty sands, from those with soft plasticity (observed thickness of up to 12.8m) to semi-consoliated (observed thickness of up to 8.0m), with inclusions of boulders, pebble and gravel and interlayers of sands and silty sands;

- Lower Cambrian sediments - consolidated and semi-consolidated clays with an overall observed thickness of up to 9.2 m.

The geological structure within a section along Vasilievsky Island and on the right-hand bank of Bolshaya Nevka River, as well as within the water area, comprises present-day natural marine sediments.

The lacustrine-glacial sediments are thinning out with an increase of the distance from the Neva Bay coastline. The Quaternary deposits there are underlaid by the Upper Paleozoic deposits stratum.

The ground surface from the Ekateringofka River to the Marine Canal is slightly dissected, with elevations varying from 6.8m to 13.1m above sea level. It is occupied mainly by industrial sites.

On Kanonersky Island the ground surface is predominantly even and is densely built up with dwellings. The elevations on Kanonersky Island are up to 3.0 m above sea level.

There is an unauthorized beach zone in the northern part of Kanonersky Island; the water edge zone is littered with construction waste, with boulders and in some places with fragments of concrete.

The elevations of the ground surface on the right-hand bank of the Bolshaya Nevka River vary within the motorway right-of-way from 1.3m to 3.15m. Most of the surface is undeveloped (wasteland, disturbed land, unauthorized beaches).

3.3.2 *Hazardous Geological Processes*

The WHSD Central Section route runs primarily across the water area or coastal areas with thick stratas of Quaternary marine and terrigenous sediments. In this respect, the following unfavorable geological phenomena and processes can potentially take place:

- Waterlogged sandy alluvial and marine sediments rated as quick ground;
- Silty marine and lacustrine-glacial sediments are thixotropic and their condition and bearing properties deteriorate significantly when under conditions of dynamic stresses;
- Moraine sediments with inclusion of large boulders are common; numerous fragments of construction debris are observed on the ground surface and in dumps (concrete, steel structures, etc.). This can hinder the process of drilling of boreholes for supports of flyovers and bridges;
- The roof of the hard rock and consolidated ground layer has higher bearing capacity, and can be used for fixing the base of future supports, however it is uneven and with different elevations and non-uniform with regard to their spread and depth;
- Ancient Proterozoic clays tend to be prone to slaking and heaving, but at the same time they are rated as difficult for piling due to their solidity.

3.3.3 *Seismicity*

According to the general seismic zoning the area of the WHSD Central Section belongs to the tectonically stable zones with a seismic activity of **less than magnitude 5**. This means that the risk of earthquakes in this area is minimal. Under such conditions, no additional anti-seismic reinforcement is required for the structures of the future motorway.

3.4 HYDROGEOLOGICAL CONDITIONS OF THE LAND AREAS OF THE WHSD CENTRAL SECTION

The hydrogeological conditions of the section from the interchange at the embankment of the Ekateringofka River to Kanonersky Island and on Kanonersky Island comprise a shallow groundwater layer (0.2m to 2.3m below the ground surface), associated with the anthropogenic or lacustrine-marine and lacustrine-glacial deposits.

This groundwater has a calcium-magnesium hydro carbonate composition. Since it has hydraulic connection with the waters in the Neva Bay, its salinity is as high as 880 to 2,600 mg/l.

The amplitude of the seasonal variations in the groundwater level is approximately 1.5 m. The groundwater layer is charged by the infiltration of water coming from atmospheric precipitation and snow-melting.

The groundwater layer is hydraulically (through lithologic openings) connected in some areas with the second (from the ground surface) aquifer occurring in sand lenses over the roof of the clay stratum (at depths of 28m to 35m). The water in that aquifer is confined; the head pressure is up to 26.0m. With regard to its chemical composition it belongs to a mixed type. Its salinity is lower, i.e. approx. 330 mg/l.

The groundwater layer along the western edge of Vasilievsky Island is unconfined and associated with sandy soils hydraulically filled in the 1950-60s along a strip approximately 700m wide and covered earlier by the waters of the Neva Bay. The groundwater level in the area of the future WHSD motorway route coincides mainly with the water level in the Neva Bay. It is mainly unconfined water of mixed composition: sodium sulfate - hydro carbonate, sodium-calcium sulfate and calcium sulfate hydro carbonate facies.

The second water-bearing horizon has approximately the same characteristics as that along the section between Ekateringofka and Kanonersky Island.

The discharge of the two water-bearing layers (i.e. groundwater and the second from the ground surface aquifer) is from the Gulf of Finland, to which they have a hydraulic connection.

No data is available in the Project design documentation with regard to contents of chemical substances in groundwater. Since the soils close to the day surface have visual signs of pollution with petroleum hydrocarbons according to the findings of the engineering geological surveys, it is not unlikely that the groundwater occurring close to the ground surface can be contaminated with petroleum hydrocarbons to a degree exceeding the regulatory norms (i.e. more than 0.3 mg/l).

3.5 *RADIOLOGY*

Radiological surveys of the ground surface were carried out throughout the areas allocated for construction of the WHSD Central Section.

The surveys did not reveal any radiological indicators exceeding the respective regulatory norms. A more detailed description of the findings is provided below.

However, it should be taken into consideration that some industrial facilities using radioactive materials were operated in St. Petersburg for a long period of time. The WHSD Central Section will cross the Vasileostrovsky and the Petrogradsky Districts , that have the highest density of identified areas with historic local radioactive contamination.

According to the findings of the previous radio-ecological investigations, up to 80 areas of radioactive contamination were identified on Vasilievsky Island, including 7 areas with an exposure gamma-radiation dose rate of over 10 mR/hour. All those areas were decontaminated. But there was a risk that migration of radionuclides with groundwater to the WHSD right-of-way could take place in the vicinity of the No.6 military compound located in Block No.5 of Vasilievsky Island (Figure 3.5-1).

3.5.1 *Measurements of Gamma-Radiation Dose Rate*

In the course of an environmental radiometric investigation of the WHSD right-of-way, the exposure gamma-radiation dose rate was measured with the use of highly sensitive scintillation radiometer of SRP-97 type and the ambient gamma-radiation dose rate was assessed with the use of a dosimeter of DRGB-01 type.

As a result of the survey showed that the values of the exposure gamma-radiation rates and the ambient radiation rates varied in the right-of-way of the WHSD Central Section mainly within the baseline range characteristic of the loose bottom deposits in the Neva Delta:

- the exposure gamma-radiation dose rate varied from 6 to 50 μR/hour;
- the ambient gamma-radiation dose rate varied from 0.05 to 0.19 μSv/hour.

Three areas with elevated values (over 30 μR/hour) of the exposure dose were identified in Table 3.5-1 and Figure 3.5-1:

- Two areas, where a relatively high value of the background radiation was attributed to the presence of natural radionuclides in the granite slabs located in those areas;
- One area, where a relatively high value of the background radiation was attributed to the presence of natural radionuclides in the slag used earlier as filling material.

Table 3.5-1 Areas with elevated levels of gamma-radiation rates

Area No.	Maximum measured values		Coordinates (degrees)		Identified source of radiation
	Exposure gamma-radiation, µR/hour	Ambient gamma radiation, µSv/hour	Northern latitude	Eastern longitude	
No.1	50	0.10	59.98135	30.22775	Granite slab
No.2	38	0.09	59.94631	30.20517	Slag
No.3	32	0.06	59.9313	30.21396	Granite slab

To assess the possible migration of radionuclides from the No.6 military camp to the Gulf of Finland, a special detailed radio-ecological investigation was carried out. The results of the survey were as follows:

- the average exposure gamma-radiation dose rate near the No.6 military camp did not exceed 12 µR/hour and the average ambient gamma-radiation dose rate was 0.07 µSv/hour.
- The gamma-radiation intensity at a depth down to 0.6m along the coastline did not exceed the regulatory norms.

3.5.2 *Contents of Radionuclides in Soils*

Soil sampling to a depth of 1m and the analysis of the soil to determine its radionuclide composition was carried out in Area No.2 located near the No.6 military camp.[1]

The specific activity of gamma-nuclides (A_{eff}) in the soil from Area No.2 was 429 ±57 Bq/kg, which permits to classify the revealed slag as Class II of construction materials that may be used for road construction in residential areas.

In the area adjacent to the No.6 military camp it was found that:

- the collected soil samples did not contain any radionuclides of man-made origin; and
- β-spectrometric analysis did not reveal any content of Sr-90 in quantities exceeding the threshold limit of 5-6 Bq/kg.

This means that the soils near the No.6 military camp are safe in the radiological respect down to a depth of 1m. However, there is no clarity on the status of this problem at the depth exceeding 1 m.

[1] Additional investigations are compulsory in accordance with the Radiological Safety Norms NRB-99 and MU 2.6.1.2398-08 "Radiological monitoring and sanitary/epidemiological assessment of land plots for construction of residential houses, public and industrial buildings with regard to their radiological safety"

3.5.3 *Measurements of Radon Flux Density*

Since according to the sanitary zoning data the area where the WHSD Central Section is crossing is considered to be radon-safe and taking into consideration the fact that the risk factor related to the impact of radon does not require monitoring in the process of road construction, no assessment of radon exhalation from the ground was carried out at the stage of the preparation of the Project design documentation.

3.6 *BASELINE LEVEL OF HARMFUL PHYSICAL IMPACT FACTORS*

In the historic center of St. Petersburg and along its main intercity traffic routes the noise levels exceed the regulatory levels, i.e. the equivalent noise level at daytime is as high as 55 to 68 dBA as compared with the sanitary norm of 55 dBA. As a result, a considerable part of the population of St. Petersburg lives in zones with high levels of noise pollution.

The residential zone on Kanonersky Island, which will be crossed by the new motorway, as well as the houses along the Marine Embankment on Vasilievsky Island located at a distance of 150-200m from the new motorway route are currently among the best districts in St. Petersburg with regard to their ***noise exposure level***:

- The road traffic on Kanonersky Island is only occasional; there are no other significant noise sources at a reasonable distance with an exception of ships moving along the shipping canal;
- The traffic along the seaside embankment is of low intensity. There are no other significant noise sources in this district.

Although there is no data in the WHSD Central Section Project design documentation referring to the actual noise level in the above two residential areas, it may be assumed with a high degree of confidence that the current noise level exposure (especially during night hours) in this area complies with the applicable sanitary norms.

No facilities that can be sources of elevated vibration levels at a reasonable distance from the future WHSD Central Section route on Kanonersky and Vasilievsky Islands were identified.

3.7 *HYDROLOGIC CONDITIONS OF THE NEVA BAY CROSSED BY WHSD MOTORWAY*

3.7.1 *Hydrology Data Related to the Neva River Mouth Area*

3.7.1.1 *Water bodies and hydro-engineering facilities within the zone affected by the WHSD construction*

The Neva River delta is formed by the branching of the main riverbed into the river arms of the Bolshaya Neva, the Malaya Neva and the Bolshaya Nevka. From those main river arms deviate some branches: the Srednaya Nevka and the Malaya Nevka, as well as a number of minor river branches (first of all the Smolenka).

In the Neva Bay all major river arms have a prolongation under water in the form of waterways (Figure 3.7-1).

To the west of the coastline there is a river mouth bar[2], divided by waterways into individual shoals. The bar is 3km to 5km wide from east to west and 12km to 15km long. The depth of the water on the shoals is 0.3m to 2m.

The Neva Bay is a transitional area from the Neva river branches to the eastern part of the Gulf of Finland. It is a wide water body (the maximum width is 15 km) with a flat bottom and with prevailing depths of 3m to 5m (maximum up to 8.5m). In its western area, the Neva Bay is outlined conditionally by a line - Lisiy Nos - Kronstadt (Kotlin Island) - Lomonosov. In 1979 the construction of a dam has started, virtually along that line, to protect St. Petersburg against floods. The construction Project is planned to be completed in 2012. Currently, the Neva Bay is connected to the Gulf of Finland via a gate in the dams of the protective facilities.

Dredging operations are carried out on a periodic basis to facilitate navigation in the Neva River delta and in the eastern part of the Neva Bay. A shipping channel – the Marine Canal - was constructed over 120 years ago to allow the access of deep-draft ships. It is 30 km long and 12 m deep. Along a stretch of 6 km in shallow waters it is enclosed by dams to prevent silting.

To improve the conditions for the reception of passenger vessels and the attractiveness of the city for tourists, a construction Project was launched in 2006 to construct a Marine Facade for St. Petersburg.

For this purpose, an artificial site with an area of 476 ha is being constructed to the west of Vasilievsky Island. As of May 2011 a major portion of that site (about 65%) was already constructed. A passenger ferry terminal constructed on that artificial area has been put into operation; the waterways providing access to the terminal have been deepened.

3.7.1.2 *Hydrologic and ice conditions of the water bodies in the area of the WHSD construction*

The Neva Bay is exposed both to the impacts of the discharge of the Neva River rising approximately 80km upstream in the Ladoga Lake and the impacts of the Gulf of Finland (especially in case of wind-induced surges).

The Neva River is a full-flowing watercourse with a rather uniformly distributed water discharge throughout its annual cycle (due to the positive effect of the Ladoga Lake).

Snow melting in the Neva-Ladoga Basin causes low spring floods on the Neva River. There is no low-water season at all in summer on the Neva River.

Every year The Neva Bay is covered with continuous motionless ice. The first appearance of ice along the coastline is reported on average during the first ten-days period of November. By the middle of December, with frosty and low-wind weather, the water in the Neva Bay freezes within 2 to 3 days; with windy and low-frost weather the freezing processes can continue for 2 to 3 weeks.

[2] A river mouth bar is elongated sand spit at the outlet of a river to the receiving water body located across the flow direction and formed as a result of sedimentation of river drifts, wave action, variations in the water level and other factors existing in the river mouth area.

There are three zones reported in the Neva Bay with respect to the ice cover thickness: coastal ice zone, bar ice zone and central ice zone.

The ice is the thickest in the coastal zone (50 to 70 cm under normal winter conditions and maximum 1.5 m in anomalously cold winters). In shallow waters the ice is thicker by 2 to 4 times than in waterways (10cm to 20cm) where the currents have higher flow rates and where relatively warm wastewater from the city is discharged.

The average date of ice breakage in the Neva Bay is 10th of April. Floating ice is observed in the bay from 5-8 to 15-20 days. Ice blockage in the Neva River seldom occurs - usually, in case of the accumulation of strong lake ice in river contractions and at bridges.

3.7.1.3 *Specific features of water level variations in the Neva Bay*

Serious floods were reported in St. Petersburg in the past; they were caused by wind-induced surge of water from the Gulf of Finland in case of persistent strong westerly winds.

The average water level in the Neva River mouth area is 11 cm above sea level (Baltic elevation system) for the entire observation period.

For 54% of the time the water level varies within ±20 cm of that level. In case of winds from the Gulf of Finland the level can rise rather significantly.

Table 3.7-1 contains the characteristics of the maximum average daily water levels during the observation period and under the conditions of the operation of the protective dam system.

Table 3.7-1 Maximum reported historic water levels in the Neva River mouth area and expected maximum levels after commissioning of the protective dam system

Historic maximum + 4.21 m (1824)	**Probability**		
	Occurrence once every 100 years	*Occurrence once every 50 years*	*Occurrence once every 10 years*
	+ 3.45 m	+ 3.20 m	+ 2.50 m
Predicted after commissioning of protective dam system (taking into account wind-induced impacts in the Neva Bay)	+ 2.10 m	+ 1.85 m	+ 1.75 m

The following factors also influence the water level variations in the Neva Bay:

- *Seiche level variations*[3] in case of the abrupt termination of the impact of wind or changes of wind direction. The amplitude of the water level variations

[3] Seiche is oscillating attenuating variations of water surface level expressed by changes in water level at opposite ends of bodies of water and caused by the termination of the impact of a factor bringing about a difference in water levels.

associated with the seiche phenomena average from 20cm to 50 cm and can only occasionally exceed 1 m.

- *Long waves* caused by cyclonic activity in the Baltic Sea, when the sea level in the center of a cyclone rises under the effect of pressure, and winds blowing toward the cyclone center. As a result, a long wave is formed (its length is comparable with the length of the sea), which is 30cm to 50cm high at the entrance of the Gulf of Finland and it is moving often with the atmospheric front. Due to the narrowing and the lower depths in the Neva Bay, such a wave can cause when approaching the city a rise in the water level by as much as 2m to 2.5m.

Most catastrophic floods are caused in case of simultaneous occurrence of long waves, seiche phenomena and wind-induced surges.

3.7.1.4 Water discharge and system of currents in the Neva River mouth area

The average water discharge rate at the Neva River delta apex has been, for many years of observations, 2,520 m^3/s. The minimum water discharge rate reported in winter is 1,500 m^3/s and the maximum water discharge rate is 3,330 m^3/s.

The water flow in the zone preceding the river mouth area is distributed in such a way that approximately 40% of water is discharged to the Neva Bay from the Malaya Nevka and Bolshaya Nevka rivers and the remaining part of the water is discharged to south of Vasilievsky Island. About 17% of the water discharged from the Neva River flows via the Marine Canal.

The average current velocity in the waterways is from 9 to 50 cm/s; in shallow waters it is from 5 to 48 cm/s.

At the seaside bar slope the current velocity decreases by 2 to 5 times and a slope current is formed, which is a continuation of the river.

Its velocity varies from 2 cm/s up to 12.5 cm/s.

Further to the west, the current follows mainly in the direction of the wind, but in the waterways it coincides with the direction of the slope current. The partial spreading of the water takes place from the waterways toward the shallow waters with a rapid decrease in the flow rate.

In case of westerly winds, the slope current is slowed down and if the wind velocity reaches 4 to 5 m/s then a counter-current is formed. If westerly winds persist for a longer period of time, a circulation system is formed in the Neva Bay with eastward currents at the coasts and westward currents in the center.

In case of the rise and the fall of the water level, currents are formed caused by the difference in the water levels in the Neva Bay and the Gulf of Finland.

The overall current pattern is characterized by the occurrence frequency of the currents of the different directions: it is 74% for currents from east to west in the center of the Neva Bay and 48% in the coastal zones. For the currents of the opposite direction it is 17% and 28%, respectively.

Wind waves of different character are formed in the Neva Bay itself. The waves consist of individual bores and wave crests; a number of small waves are followed by major waves. Their deformation in case of approaching the shore occurs gradually due to the gently sloping bottom. The maximum wave height, with a probability of once every 100 years, is 1.7m in the center of the Neva Bay and 1m at the river mouth bar. Complete calms are reported during 7% to 10% of time.

Wind waves cause significant transformation of unfortified coastline sections and active release of suspended matter.

3.7.2 *Water quality and dynamics of bottom sediments in the Neva Bay water area designed for the WHSD construction*

3.7.2.1 *Sedimentation conditions and turbidity regime in the Neva Bay*

The seabed of the coastal shallow waters of the Neva bar is composed of fine- and medium-grain sands. Further to the west the sediments of the Neva bar have a decreasing particle size down to as low as 0.05 to 0.005 mm with decreasing current rates.

The sedimentation conditions in the Neva Bay have changed considerably in the historic aspect. Since the 1920s and until now the area of slime accumulation located to the east of the modern protective dam system of St. Petersburg has increased by more than 5 times and it occupies currently almost 40% of the total Neva Bay area. The maximum slime thickness within that area is 44 cm.

The Neva River mouth area had formed mainly under the effect of water flow from the Neva River branches and wind-induced surge phenomena. Sedimentation and re-sedimentation of suspended matter in this complex hydrodynamic system result in a growing surface area of the islands. On the other hand, in case of floods, the lowering water deepens the river branches within the delta. In addition, ice removes from the shallow areas and from the shore a part of soil, impeding thereby the vertical growth of the shoals.

The direction of the deformation of the seabed and waterways in the Neva River mouth area determine the slope currents and the wind-and-wave impacts along with the man-made transformation of the seabed relief. This causes the following processes:

- Sedimentation of material transported by the watercourses of the delta;
- Formation of discharge troughs on the bar;
- Scouring / aggradation of the shore;
- Interception of drifts by canals and dredged ground, resulting in turn in scouring of aggraded areas not receiving the respective volumes of sediments;
- Fortification of the coastline and construction of artificial sites resulting in termination or (on the contrary) in intensification of scouring.

The water in the Neva River itself has a low content of suspended matter (7 mg/l).

For the Neva Bay the natural baseline content of suspended matter is assumed to be 10 mg/l.

A significant contribution to the formation of elevated water turbidity levels in the Neva Bay during the summer/autumn period and during spring floods is made by the Neva River's tributaries located upstream of the city of St. Petersburg, as well as by the discharge of treated wastewater from the Northern, Central and Southern aeration stations.

However, a particularly strong impact is imposed by storms on the Ladoga Lake causing the scouring of the bar at the head of the Neva River. In such cases, similarly to the cases of severe floods, the water turbidity in the Neva River, and as a consequence, in the Neva Bay can reach 100 mg/l or even 150 mg/l.

The mass of suspended matter transported by the Neva River to the Gulf of Finland amounts annually to approximately 510,000 tonnes.

The main factor related to the changes in the sedimentation and in the turbidity fields in the Neva Bay is dredging operations and construction of artificial sites by hydraulic filling.

The most recent significant impact has been imposed by the construction of the site for St. Petersburg's Marine Facade.

Figure 3.7-2 shows the satellite image with an increased turbidity field dispersed for a long distance from the already filled site of the Marine Facade to the Neva Bay.

The main sources of turbidity are located along the northern coast of the Neva Bay and associated with an abandoned quarry, which is used now for discharge of clay extracted in the process of offshore sand excavation for filling new artificial sites. Examples of turbidity fields in the Neva Bay recorded in 2006-2010 are demonstrated in Figure 3.7-3.

Investigations carried out by the EkoProject Company have indicated that the concentrations of suspended matter caused by hydro-engineering operations in the previous years were especially high in August - September. The maximum levels were reported in the northern part of the Neva Bay, i.e. 67 mg/l in 2006 and 77 mg/l in 2007. Concentrations of as high as 22 mg/l were observed within the range of the Marine Facade.

3.7.2.2 *Hydrochemical characteristics of water and bottom sediments in the Neva River mouth area*

The Neva Bay has a high degree of water exchange intensity with the Gulf of Finland (its duration is on average 5.5 days).

In case of persistent wind-induced surge periods, brackish water (salinity of 4-6 g/l) from the Gulf of Finland penetrates to the Neva Bay along the bottom of the Northern waterway and the Marine Canal, but it only very seldom migrates beyond the edge of the Canal.

In spring, the water salinity in the Neva Bay has a minimal value, which is attributed to the ice cover melting. During this period, the salinity at the water surface increases from east to west from 0.5-1.8 g/l near Kronstadt up to 4.5-4.7 g/l in the vicinity of Gotland Island.

The water salinity at the bottom increases in the same direction from 3.5 g/l up to 5-6 g/l.

The main sources of water contamination in the Neva Bay are the discharge of the Neva River (the water in the river is contaminated to a significant degree within the city outlines of St. Petersburg) and direct release of treated wastewater to the Neva Bay from three municipal aeration stations: the Northern aeration station, the Central aeration station (located on Bely Island) and the South-Western aeration station.

Figure 3.7-1 shows the location of the outlets from those aeration stations

The chemical composition of the water in Neva Bay is highly variable, as it depends on both the changing anthropogenic pressure and on the particular hydrometeorological conditions:

- The lead content increases sometimes up to 3 MPC values; copper, zinc, manganese and iron concentrations are also common, exceeding the respective regulatory MPC levels;
- During the period of 2001 to 2006 an increase by 1.5 to 2 times in the heavy metals content (cobalt, chromium, copper, zinc, vanadium, scandium) was reported, especially in the coastal zone of Vasilievsky Island.
- The content of petroleum hydrocarbons in the water in the central part of the Neva Bay varied from 0.07 mg/l to 0.1 mg/l, which exceeds the regulatory limit for water bodies having fishery significance (i.e. 0.05 mg/l).

According to the water quality monitoring results, conducted by the Federal Agency for Hydrometeorology and Environmental Monitoring, the following conclusions were made during the period of 2008-2010 for three stations on the exit from the delta to the Neva Bay (Figure 3.7-1),:

- The zinc content reached 22 – 26 mkg/l, and exceeded the normative MPC level (10 mkg/l) in all stations;
- In the offshore area of the Marine Port the copper content increased up to 5 mkg/l, exceeding the MPC level by fivefold;
- The lead content increased steadily (but didn't exceeded the MPC level) to 3,6 mkg/l (in the Petrovsky waterway); nickel – to 4 mkg/l (in the Bolshaya Neva mouth);
- A temporary two- five fivefold increase of the manganese content was recorded in 2009 in all stations;

- The petroleum hydrocarbons content during the entire period made up 20 mkg/l and was lower than the normative MPC level (50 mkg/l), except for the threefold increase in the Bolshaya Neva mouth in 2009.

In the bottom sediments:

- The highest concentrations of heavy metals were reported in the Marine Canal (zinc: up to 300 mg/kg). Contamination of bottom sediments with heavy metals reaches its maximum in the coastal zone of the Neva Bay and then it decreases in its western part. Most contaminated are the bottom sediments in the Smolenka River;
- Petroleum hydrocarbons in the open part of the Marine Canal were reported earlier in concentrations of up to 1,500 mg/kg;
- In 2009, a maximum contamination of the bottom sediments was recorded in the Lesnaya Harbor (concentrations exceeding the respective MPC values for a number of parameters by 16 to 18 times). The benz(a)pyrene concentration in the bottom sediments in the harbor was 12 times higher than the average level of the entire Neva Bay.

For a long period of time the Neva Bay has been affected by eutrophication.

3.8 BASELINE SOIL COVER CONDITION

3.8.1 Soil Cover Characteristics

The area of the WHSD Central Section is located within a zone of sod/gley soils formed under conditions of depressions and obstructed drainage in the areas adjacent to the Neva Bay. Fragments of natural fertile soil layer still exist only on the right-hand bank of the Bolshaya Nevka River and the central part of Kanonersky Island.

Virtually everywhere throughout the land allocated for the motorway construction, the natural fertile topsoil has been either disturbed or buried. "Urbanozem" (urbane soil) and other technogenic soil varieties have formed over filled ground. Filled ground has a highly variable mechanical composition and includes domestic and construction waste.

The fertile topsoil layer in some areas over "urbanozem" was formed as a result of secondary artificial soil filling. Its thickness does not exceed 30 cm. However, according to the Russian legislation, if the fertile topsoil is more than 20 cm thick, it should be stripped prior to the start of the construction work and stockpiled for subsequent use for land reclamation. In 2006 the boundaries of the areas were determined where topsoil had to be stripped and stockpiled for land reclamation.

Later the plotted maps were lost in the JSC "WHSD" Company and now it is required to carry out a new survey before the beginning of any earthmoving operation.

3.8.2 *Soil Cover Contamination*

In the course of the engineering environmental surveys within the land allocated for the WHSD Central Section construction, 18 soil samples were collected from the 0-20cm soil horizon and analyzed to determine the concentrations of heavy metals, petroleum hydrocarbons, benz(a)pyrene and PCBs.

In accordance with the Russian regulatory requirements, an assessment of soil contamination with ***heavy metals*** of Hazard Classes 1 to 3 (Hg, Pb, Cd, As, Zn – Hazard Class 1; Co, Ni, Cu, Cr – Hazard Class 2; and Mg – Hazard Class 3) was made on the basis of an integrated contamination indicator (Zc).

As a result, it was found that most of the areas to be used for future construction can be rated as *"uncontaminated"*.

However, the Zc values of two samples (Primorsky District and an area to the south of the Smolenka River mouth) were 96 and 105, respectively, and as a consequence, those areas are rated as moderately hazardous and hazardous.

In the Primorsky District the Cr, Pb, As and Zn concentrations exceeded the respective regulatory MPC levels by 5 to 16 times. The concentrations of Pb, Cu and Zn, in the soils to the south of the Smolenka River mouth, were by 5 to 10 times higher than the respective MPC values.

Table 3.8-1 Baseline metals concentrations in soils in Leningrad Oblast and actual concentrations for WHSD Central Section

Elements	MPC/ ODK values applicable in RF (mg/kg)	Baseline concentration for Leningrad Oblast (mg/kg)	Maximum measured value of concentrations in WHSD Central Section corridor (mg/kg)	Average concentrations in St. Petersburg (mg/kg)
Hazard Class 1				
Hg	2.1/-	0.03	2.0	0.38
Pb	32/130	19.11	**201.0**	**125.4**
As	2.0/10	**2.62**	**9.3**	**4.6**
Cd	-/0.5; 1.0; 2.0*	0.17	0.37	0.94
Zn	23/220	**43.1**	**192.0**	**393.0**
Hazard Class 2				
Ni	-/20; 40; 80	15.3	41.0	37.0
Cr	6/-	**12.5**	**99.0**	**66.0**
Cu	-/33; 66; 132	18.0	**1124.0**	**92.0**
Co	5/-	4.1	5.3	**9.7**
Hazard Class 3				
Mn	1500/-	117.7	331.0	337.0

Notes to the Table:

Asterix * refers to values adopted for sandy and silty sand soils, for acidic soils (pH < 5.5), sandy silt and neutral (pH > 5.5) and sandy silt soils.

Bold font indicates values exceeding the MPC level.

In the direct vicinity of the WHSD motorway, in the southern part of Vasilievsky Island, there is a historic waste dump site (the Shkiperskaya dump), which is potentially a significant source of pollution. The building of a provisional construction yard and the temporary roads is planned within the outlines of this dump site. There is no data available with regard to the degree and the character of the contamination of the waste mass (including any information about the generation of hazardous gases in the waste mass).

With respect to ***organic substances***, a hazardous level of contamination was recorded in a number of areas along the edge of Vasilievsky Island. The reported PCB and benz(a)pyrene concentrations were as high as 149 mg/kg and 0.16 μg/kg, respectively (1,490 and 8 times higher than the respective sanitary norm).

The overall area of land plots with hazardous and highly hazardous degree of soil contamination cannot be assessed because of the spot-like character of the investigation. Such an assessment should be made in the process of the elaboration of the Project documentation.

In general, the current soil contamination level at the WHSD Central Section corresponds to the indicators of the overall soil contamination in St. Petersburg or is somewhat lower, with an exception of some identified individual points of hazardous or highly hazardous soil contamination.

It should be also taken into consideration that the soil under the private garages located currently within the motorway corridor and subject to demolition, could not be investigated to assess the current level of soil contamination.

The level of soil contamination with petroleum hydrocarbons and heavy metals in such areas can be high, because those garages have existed for decades and could be potentially used for the unauthorized storage of petroleum products, spent lead batteries, as well as for the unauthorized maintenance and repair of private cars.

After the demolition of the garages the area should be investigated to assess the degree and the nature of the historic soil contamination.

3.9 BIOCHEMICAL GAS GENERATION IN SOILS

According to the Territorial Construction Norms TSN 50-302-2004 “Design Development for Buildings and Constructions in St. Petersburg”, one of the exogenous processes typical for the area of St. Petersburg is **biochemical gas generation**.

Microbial activities can result in the formation of biochemical gases generated by bacteria of different physiological groups in the process of transformation of organic substrates. Zones of buried swamps in St. Petersburg can be potentially hazardous with respect to biochemical generation not only of methane and carbon dioxide, but also hydrogen sulfide.

No major buried swamp areas have been identified in the area of the WHSD Central Section.

However, an increased level of risks associated with gas generation can be attributed to the presence of buried peats and sand-sludge formations, as well as dumped soils of man-made origin.

3.10 *BASELINE VEGETATION IN THE LAND AREAS WITHIN THE WHSD CENTRAL SECTION ROUTE*

A vegetation survey was carried out in 2006 within the right-of-way of the planned WHSD motorway by designated park and garden enterprises (the JSC "Narvskoye", the JSC "Primorskoye" and the JSC "Vasilievskoye") sub-contracted by the JSC "WHSD". The survey also covered the areas to be temporarily leased during the construction phase, the access roads, as well as the areas where any utility networks (electricity networks, water supply and gas pipelines) that hinder the construction process have to be relocated.

The results of the survey show that some areas covered with tree vegetation, shrubs or grass lawns exist at the following locations:

- In the area belonging to OAO "PetroLesPort" Company (Gutuyevsky Island);
- Kanonersky Island (along House No.17);
- In the Shkipersky Protok Street ("Priboy" factory site);
- In the area between the Smolenka River and Makarov Embankment.

There are 967 trees growing within those areas, an area of 2.763 m^2 is covered with shrubs and young trees and an area of 142.875 m^2 is occupied by grass lawns (Figure 3.10-1). The vegetation in those areas is of secondary origin and has no official status of park zones and recreational zones.

This means that the above vegetation has no protected status and does not belong to any biotopes with rare plant species. However, the areas on Kanonersky and Vasilievsky Islands are used in an active way by local communities for strolling and dog walking.

3.11 *HYDROBIONTS BASELINE CONDITIONS*

3.11.1 *Habitat Conditions of Hydrobionts*

The WHSD Central Section will cross the eastern part of the Neva Bay water area at the border to the Neva River mouth (Neva Delta) comprising a number of the natural river branches (Bolshaya Neva, Malaya Neva, Malaya Nevka, Srednaya Nevka and Bolshaya Nevka), relatively deep artificial waterways and extensive shoals (Neva coastal waters or a bar of the Neva River).

The Neva Bay is a shallow part of the Gulf of Finland with lower salinity of seawater; it is currently limited by a water-level controlling dam of St. Petersburg. The so called **coastal zone of the Neva Bay** has a depth of 0-1.5m and is considered to be one of the most valuable areas of the Gulf of Finland with regard to the specific features of the abiotic environment, the condition of hydrobionts, the quality of feed resources for fish and the diversity of ichthyocenoses (Figure 3.12-1).

The overall area of the shallow part of the Neva Bay, with depths of less than 1.5m, is 50 km^2. The eastern and northern shallow-water areas are located within the zone affected by the WHSD motorway Project.

The motorway will run directly along the coastline of the eastern shallow-water area, and it can also have a considerable impact on its northern part (The Northern Lakhta shoal). The Southern Lakhta shoal located at a distance of 4.5 км from the WHSD route would be potentially affected at a lower level.

The aquatic habitats in the area to be crossed by the WHSD Central Section have the following main characteristics:[4]

- The seabed of the Neva Bay is predominantly sandy; it is silty in deeper areas. The depth is 0.3m to 2m on shoals and 3m to 12m in river branches and waterways.
- The temperature of the water masses vary from 0.1-0.2ºC in winter to 14-22ºC in summer. Due to the high dynamics of the hydrologic regime (snow-melt floods, wind-induced surge phenomena) and typical extensive development of the phytoplankton in the Neva River mouth in early summer, the transparency of the water varies, depending on the season and specific periods, by 1.5 to 3 times.
- The oxygen content varies from the oversaturation in surface water layers (in early summer during the period of extensive plankton growth) to the normal level. Intensive wind-induced mixing of the generally shallow water mass ensures uniform distribution of oxygen throughout the water mass.
- The pH value of the water varies during the annual cycle from slightly acidic and neutral (6.9 to 7.6) to alkaline (8.2 to 8.6) during calms and extensive algae growth.

In general, the abiotic conditions of shallow waters ensure high productivity and diversity of hydrobionts, including also ichthyocenoses, especially in connection with favorable natural conditions for the formation of spawning grounds.

3.11.2 *Status of Hydrobionts as Food Resources for Fish*

Macrophytes

[4] More detailed hydrographic and hydrologic characterization of the subject area is presented in Section 3.7.1

In the eastern part of the Neva Bay, aquatic higher plants are concentrated on the shallow bar of the Neva River and in the coastal zone at depths of 0 to 1.3 m.

Macrophytes are used as shelter by young fish; they are also the basis for the formation of productive aquatic associations, including food supply resources for fish (in particular rotifers (*Rotatoria*) that are an essential component of food supply for fish larvae and young fish). The belt of water-air vegetation (bulrush (*Scirpus lacustris*), reed (*Phragmites commúnis))* at depths of 0.2 to 0.8 m (up to 1.3 m) is **the main zone for spawning of the phytophilous fish**.

Due to a strong current technogenic and municipal pressure, the shallow waters of the Neva Bay near the coastline are contaminated to a significant degree and the growth of macrophytes there is poor; the filamentous algae is prevailing, which is not involved in any food chain.

Phytoplankton

About 55 alga species of seven divisions have been reported in the coastal zones of the Neva Bay: blue-green algae (*Cyanobacteria)*, yellow-green algae *(Chrysophyta)*, diatoms *(Bacillariophyta)*, yellow-green algae *(Xanthopyta)*, cryptophytic algae (*Cryptophyta*), (*Euglenophyta)* and green algae *(Chlorophyta)*. Dominating with respect to the size of the populations are the filamentous colonial species of blue-green algae (80%).

The phytoplankton biomass amounts to 0.1 to 0.3 g/l. The dominating species are the diatomic algae (34% of the total biomass) and cryptophytic algae (33%).

Zooplankton

In the zooplankton composition the *Cladocera* is dominating (over 50% of the total population) due to the *Daphnia cristata*, species of *Bosmia,* the *Chydorus*, partially larger forms of the *Sida crystalline* and the *Limnosida frontosa*. The *Copopeda* prevails, in relation to biomass, in the more shallow areas.

In shallow waters of the Neva Bay, especially in zones with extensive aquatic vegetation, the size of the populations and the biomass of zooplankton have decreased considerably during the past 40 years. In the 1970-80s the biomass in the areas with abundant aquatic vegetation was as high as 10 g/m^3, but now, in shallow waters with poor vegetation, it is as low as 1.0 to 2.0 g/m^3. The extremely low zooplankton biomass values are the characteristic of open unprotected and disturbed shallow waters subject to the impact of waves.

Zoobenthos

In the coastal zone of the eastern part of the Neva Bay within the outlines of the city, 27 species and taxonomic groups of organisms have been recorded in the benthic associations. The maximum number of species was identified in the groups of *Oligochaeta* and *Chironomidae* (8 species each).

Six mollusk species were reported, of which 3 were species of mussels *(Bivalvia)* and 3 of *Gastropoda*. Most of the benthos invertebrates are common representatives of the bottom fauna characteristic of silty bottoms of flowing water bodies (i.e. those with oligo- and mesosaprobic conditions).

The number of benthic organisms varies from 1,500 to 4,000 per 1 m^2; the biomass varies from 0.68 to 2.32 g/m^2. In general, the quantitative zoobenthos indicators in open coastal waters are extremely low, which is a characteristic of low-productive water bodies with benthos feeding fish. The minimum values of biomass (0.1-1.0 g/m^2) have been reported for the clean sands free of vegetation, concentrated in the south-eastern part of the Neva Bay.

The low biomass values are also a characteristic of areas with depths of less than 1m (0.7 to 0.8 g/m^2). The benthos biomass increases with the growing depth of the water. Within the outlines of the macrophyte vegetation, the zoobenthos biomass reaches its maximum of 15 g/m^2.

In general, the Neva Bay water area, directly adjacent to the city of St. Petersburg, is much poorer with regard to all hydrobiont components than other shallow waters of the Neva Bay. This is caused by the negative impacts of a large city. In addition, a large-scale negative impact is currently imposed by the intensive dredging and dam-filling operations carried out in the eastern part of the Neva Bay (it has been ongoing for 4 years as a part of the formation of St. Petersburg's Marine Facade and the waterways providing access to the constructed passenger ferry terminal).

3.12 *FISH SPECIES DIVERSITY AND FISHERY CHARACTERIZATION OF WATER BODIES*

3.12.1 *Ichthyofauna Composition and Fish Population Characteristics*

The ichthyofauna in the eastern part of the Neva Bay (including the Neva River mouth) is characterized by instability of populations, biomass, species and age composition of fish due to the specific environmental conditions of habitats and the functional aspects of the river-sea border. Most of the fish species come to this area for spawning or spending the larva or the early phase of their life cycle.

In May-June are the maximum variety, size of populations and catches are recorded in this area.

The ichthyofauna in the subject area consists of 39 fish species of 18 families and lamprey.

The phytofilous fish species of the carp family are the most prevailing *(Cyprinidae)*: roach *(Rutilus rutilus)*, bream *(Abramis brama)*, silver bream *(Blicca bjoerkna)*, muvarica *(Alburnus alburnus)* and species of the perch family: pope *(Gymnocephalus cernuus),* perch *(Perca fluviatilis),* zander *(Lucioperca lucioperca).*

The three-spined and the nine-spined stickleback are common *(Gasterosteus aculeatus* and *Pungitius pungitis)* – small schooling fish, that have no commercial value.

The following fish species are reported during the spawning and the young fish migration periods: European smelt *(Osmerus eperlanus)*, Atlantic salmon (*Salmo salar*), European cisco (*Coregonus lavaretus lavaretus)*, European smelt (*Coregonus albula*) and *Cyclostomata* species *(Cyclostomata)*.

The smelt is a semi-anadromous fish species occurring in the Neva Bay. It is the most valuable commercial species there.

3.12.2 Characteristics of Spawning Grounds

Up to 50% of the fish resources of the eastern part of the Gulf of Finland are reproduced in the Neva Bay (38% of bream, over 40% of zander, approx. 50% of perch, 65% of roach, 88% of pope, 74% of three-spined stickleback and 98% of nine-spiked stickleback).

Commercial catches per 1 hectare of coastal shallow waters in the Neva Bay, serving also as spawning grounds for fish, vary within a wide range from 150 to 1,200 kg/ha, depending on their location and spawning efficiency.

In general, most of the spawning grounds of the eastern part of the Neva Bay are located along the southern coastline (they are virtually outside the zone affected by the future construction of the WHSD motorway), and in the area of the Northern Lakhta shoal.

The spawning grounds of the smelt are located predominantly in the Neva River and in the coastal shallow waters of the Neva Bay at depths of 0.8 m to 2.0-3.5 m. The most important ones are on the Southern and Northern Lakhta shoals (Figure 3.12-1).

The fish start to reach the spawning grounds in the third ten-day period of April at water temperatures of +1ºC to +2ºC; mass migration to spawning grounds is reported in May when the water temperature is +3ºC to +12ºC. The spawning period ends in early June at water temperatures of +16ºC to +19ºC. The total duration of the spawning migration is 30 to 40 days. The embryonal development lasts for 15 to 21 days.

The zones most suitable for spawning grounds of phytophilous fish species are located predominantly along the southern coast of the Neva Bay and at the eastern coast of Kotlin Island.

The spawning grounds of the zander are located in the areas with slow water flow rates (not higher than 0.2 m/s) at depths of 1.5m to 2.5m.

As a result of large-scale operations related to sand excavation and the construction of artificial sites in the southern part of the Neva Bay, for the smelt the access to its spawning grounds on the Southern Lakhta shoal has significantly been hindered and the quantity of smelt coming to those spawning grounds has sharply decreased, i.e. by 10 times during 1991-2004. While about 40% to 45% of the smelt resources were reproduced in that area, currently the catches do not exceed 10% of the total commercial catches. The spawning efficiency of the carp species has also been significantly affected.

The ongoing hydro-engineering work (excavation and dumping of ground) in connection with the construction of the Marine Facade along the western edge of

Vasilievsky Island, as well as the dredging/maintenance of the waterways to the already constructed passenger ferry terminal have negatively affected the spawning grounds in recent years (mainly in the northern part of the Neva Bay).

3.12.3 *Features of Commercial Fishery*

The commercial significance of the Neva Bay is predetermined by the following factors:

- Contribution to reproduction of fish resources;
- Quantities of commercial fish catches.

The entire eastern part of the Gulf of Finland, including the Neva Bay and the Neva River, falls under the category of water bodies of **top fishery significance**, as a natural habitat and spawning grounds of the smelt, the salmon, the brown trout and the cisco. Minor watercourses, as the Smolenka River, are rated as Fishery Category 2.

Currently, commercial fishing is carried out predominantly in spring time in the eastern part of the Neva Bay within the boundaries of the city of St. Petersburg. This involves mostly fishing for smelt and pope on the Northern and Southern Lakhta shoals and in the coastal zone of Vasilievsky Island.

Amateur fishing is very popular in a number of areas.

3.13 *CHARACTERISTICS OF POPULATION OF BIRDS AND MAMMALS WITHIN THE COASTAL ZONE OF THE NEVA BAY*

3.13.1 *Avifauna Conditions*

In general, the avifauna of the WHSD Central Section area includes up to 87 bird species. A list of bird species with the description of the specific characteristics of their occurrence and abundance (rarity) is given in Appendix 3-2.

Waterfowl and Wading Birds

Due to its geographic position, as well as natural and climatic conditions, the Neva Bay has historically been an area hosting large concentrations of many bird species both during nesting periods and during seasonal migrations (Figure 3.13-1). Over the past 100 years, numerous studies have been conducted to investigate the concentrations of migratory birds with respect to their size and diversity within the shallow waters and the coastal zone of the Neva Bay, as well as in the coastal meadows.

It has been demonstrated that the Neva Delta and the adjacent territories and water areas have the function of a key resting ground along Europe's largest flyway between the White Sea and the Baltic Sea. Hundreds of thousands of waterbirds, wading and shore birds find favorable conditions here for resting, feeding and the accumulation of energy resources in order to continue their migration flight.

It is particularly important that the Neva River mouth is free of ice by about 10 to 15 days earlier than the rest of the Neva Bay.

During the early spring period this area is of vital importance for most wading and shore birds inhabiting the north-western part of Russia.

As a result of intensive urban development, which has started in the 1960-70s, the Gulf of Finland in the vicinity of the Krestovsky and Sobakina shoals was deepened; soil was hydraulically filled over a large area of the Lakhta lowland and the area suitable for providing resting grounds for birds decreased significantly.

The number of migrating birds on the Krestovsky and Sobakina shoals decreased to a 15 to 20 times lower level. However, until the early 1990s, numerous resting grounds of ducks and swans continued to exist at the western end of Vasilievsky Island and on the shoals near Bely and Kanonersky Islands. During the early spring period (before the bay becomes free of ice), significant numbers of migrating geese, that stop at night to rest and to feed during daytime on the fields located to the south and south-west of St. Petersburg, were reported in the area to the south-west of Bely and Kanonersky Islands.

In 1997-1998 the eastern part of the Neva Bay was investigated as an initiative of Bird Life International. The data obtained made it possible to assign a status of ornithological kea area of global significance to the mass resting and nesting grounds in this area.

Out of the resting *anatides* birds, the most important bird species is the Bewick's swan, a species listed in the RF Red Data Book and in the Annex 2 to the Convention on International Trade in Endangered Species (CITES). Currently, the Bewick's swan is monitored carefully by European ornithologists; a special monitoring and protection program has been developed, including the protection of resting grounds (Beekman et al., 1996).

In 1975 up to 2,000 Bewick's swans resting on the water could be observed in the Smolenka River mouth during the period of 1st to 10th of May; the number of swans observed flying across that area was at least 7,000. In April-May 1991, up to 3,500 of swans were observed daily on the shoals located from the Pribaltiyskaya Hotel to the Smolenka River and the total number of swans observed during the spring period was estimated at 10,000 to 15,000.

In 1996-98 several hundreds of swans were recorded daily.

Taking into account that the total population of the Bewick's swans wintering in Europe is estimated at 20,000 to 30,000, about 20% to 50% of that number stopped for resting at Vasilievsky Island depending on the year. This means that the role of this area was highly essential for the conservation of this particular bird species.

Currently, the intensive work, including the hydraulic filling of the ground and the seabed deepening associated with the Marine Facade construction, is being continued in the area of construction of the WHSD motorway. This has a negative impact on the migration stops in the affected area.

The still resting grounds of swans and ducks at the south-western ends of Vasilievsky Island, on the shoals to the south-west of Bely Island and to the west of Kanonersky

Island, as well as on the rest of the shoal offshore Krestovsky Island (the so-called Krestovsky Shoal) are of special significance. The population of Bewick's swans stopping for rest there has been insignificant over the recent years. Not more than 1,000 to 1,500 swans of this particular species stop during the entire spring period.

Not only Bewick's swans, but also two other swan species continue to stop there for rest, i.e. the whooper swan and the mute swan. The most numerous species in that resting ground are diving ducks (tufted duck, greater scaup, black and velvet scoter, long-tailed duck) forming concentrations of up to a few tens of thousands in spring time.

Spring migrations of waterbirds across the Neva Bay are mainly of transit character. Only some particular bird species stop for rest in the Neva Bay: great crested grebe, Bewick's swan and whooper swan, mallard, Eurasian wigeon, tufted duck and greater scaup. During spring migrations, the resting grounds of those species in the Neva Bay are more populous than in autumn. The attractiveness of this area for waterbirds in autumn is lower, with an exception of mallards and Eurasian wigeons (the latter is not reported in the area every year).

The characterization of individual waterfowl species is presented below:

Great crested grebe

Grebes migrate above open waters and stop for rest when they reach the eastern part of the Neva Bay before crossing the Karelian Isthmus. Birds of this species use the Neva Bay for active feeding and due to this fact they do not form any dense accumulations. Individual birds are distributed in a rather dispersed way along the entire northern coastline within a sea strip 0.5km to 3km wide.

The size of their population is large and in some years it can reach 4,000 to 5,000 birds counted on a one-day basis. During spring the total number of grebes passing through the Neva Bay can be several tens of thousands. Migration with formation of concentrations of birds starts in the middle of April and lasts until the end of May, with a well-defined peak during the first and second ten-day periods of May. Individual birds of this species are reported at the WHSD route at the edge of the Neva Bay.

In autumn, the number of migrating birds is approximately half as large as in spring. Grebes are distributed over the water area in a less dispersed way and most significant concentrations tend to form in the areas adjacent to the southern bay coast (to the west of Peterhof). Migration lasts from the second half of September until early November with a peak of the populations at stopping grounds reported in the first half of October.

Bewick's swan and whooper swan

During recent years, longer periods of rest of swans were reported at a considerable distance to the west of the shoals of the Neva Delta in the area of Verpeluda Island (10 km to the west of the WHSD motorway). The size of populations varies from year to year: from two hundred birds during unfavorable years up to 1,000 or even 1,500 birds in springs with normal conditions. The number of Bewick's swans is lower approximately by three to four times than that of whooper swans. During the recent years, and in particular in 2011, not more than 500 birds of both species were reported here during the entire period of spring-time migrations.

During autumn migrations, swans do not stay for rest for longer periods of time in the Neva Bay. The overall number of swans staying for one to three days does not exceed 100 to 150 birds. In autumn, whooper swans migrate from late September until the middle of November with a peak in the middle of October, in the third ten-day period of October and in the middle of the first ten-day period of November. Bewick's swans migrate from the third ten-day period of September until the end of October with a peak at the end of September - early October and in the second ten-day period of October.

Puddle ducks

Puddle ducks do not form large concentrations during migration periods on shallow waters and along the banks of the Neva delta. Significant accumulations of the puddle duck species (mainly mallard and Eurasian wigeon) are reported in water areas far away westwards from the WHSD route. During the recent years, most of them concentrate in the vicinity of Lisiy Nos and Verpreluda Island.

Tufted duck

This bird species forms densely populated and extensive resting grounds mainly along the northern coast of the Neva Bay from Lisiy Nos to Lakhta. In the area crossed by the WHSD route to the west of Bely and Kanonersky Islands, concentrations of this bird species are on some days as numerous as 250 to 300 birds. Tufted ducks stay there for rest for longer periods of time.

The total number of this bird species at all resting grounds at the Neva Bay can reach 4,000 to 5,000. Such concentrations are reported mainly at the end of April - first half of May, but in general migrations last from the middle of April until the third ten-day period of May. Those roosting grounds are located outside the Neva River delta along the northern coast of the Neva Bay.

Greater scaup

Birds of this species do not form large concentrations. Only small flocks are reported staying for a short period of time among flocks of tufted ducks. According to the bird counts, not more than 1,500 birds accumulate within the entire Neva Bay water area; not more than 100 birds of this species stay in the Neva delta.

Other species of puddle and diving ducks

This refers first of all to the following duck species: middle-size and common merganser, long-tailed duck, pochard, shoveler, pintail, smew, and gadwall. None of them form larger concentrations. During an entire spring migration period their total number does not exceed one or two hundred.

The following species of mass transit migrants can make short stops (lasting for a few hours): sea ducks (**scoter, velvet scoter** and **long-tailed duck**) and geese (bean goose, greater white-fronted goose,) and brant geese (first of all barnacle goose). Similarly, random stops are also made by **divers** (black-throated and red-throated divers). Birds of these species stop for roosting more to the west and in offshore areas.

Small flocks of various sandpiper species are reported during spring migrations on shoals and at the coast of the islands (Krestovsky, Vasilievsky and partially Kanonersky Islands). They are mainly stints, dunlins and little stints).

Therefore, it may be concluded that in spite of the considerable anthropogenic impacts the Neva River mouth and the Neva Bay continue to play an important role as one of the key sections of the migration flyway of water birds between the White Sea and the Baltic Sea. This role lies within the maintenance of the populations of tens of species, which are nesting in the northern and north–western regions of Russia and wintering in Western Europe and Africa, as well as in the conservation of the biological diversity.

The eastern coast of the Neva Bay is also significant for the local and nesting birds. During the breeding period, at least 7 bird species belonging two four orders can be observed within the area crossed by the WHSD motorway. Along the WHSD Central Section route there are particularly large populations of shore birds. Such birds as little ringed plover, mew gull and silver gull are nesting here. The black-headed gull and the common tern use the offshore strip as feeding ground.

The following protected species can be reported here: little tern, lesser black-backed gull.

Land-based bird-species

Land-based birds reported in the area for the WHSD construction are represented predominantly by synanthropic species. The prevailing species are the rock pigeon, the hooded crow and the house sparrow. During the nesting period black swift and white wagtail are representative for the area concerned. Out of the reproductive period herring and common gulls are typical bird species. In addition, 10 singing bird species are common here (Appendix 3-2).

Ospreys were reported repeatedly during the recent years in the offshore zone at Krestovsky Island. Most probably these birds belong to the couple nesting in the Yuntolovo nature reserve.

3.13.2 *Status of Mammal Fauna*

No large wild mammals living in or entering the construction zone of the WHSD Central Section have been reported during the recent years.

Land-based mammals are represented by synanthropic species (Norwegian rat, house mouse), as well as squirrels and small weasel-like mammals (least weasel and polecat), which are common in urban parks and public gardens.

No web-footed mammals have been reported during the recent decades at the coasts of Vasilievsky, Kanonersky, Bely and Krestovsky Islands.

3.13.3 *Rare and Endangered Terrestrial Vertebrates*

According to the materials available in the Red Data Book of St. Petersburg (St.P. RDB), 13 land-based vertebrate species having a status of specially protected species may occur in the area of the WHSD Central Section. They include also for species listed in the Red Data Book of the Russian Federation (RF RDB).[5]

Birch mouse *(Sicista betulina)*

Status: St.P. RDB - Category 3 (NT) potentially vulnerable species; IUCN (LC) – lower risk. It occurs in St. Petersburg at edges of the park zone.

Least weasel *(Mustela nivalis)*

Status: St.P. RDB - Category 3 (VU) vulnerable species; IUCN (LC) – lower risk. In St. Petersburg it occurs in shrubs along ditches and on river floodplains.

Polecat *(Mustela putorius)*

Status: St.P. RDB - Category 3 (VU) vulnerable species; IUCN (LC) – lower risk. It occurs at edges of mixed forests (parks) and on river floodplains.

Little grebe (*Podiceps ruficollis)*

Status: St.P. RDB - Category 3 (NT) potentially vulnerable species.

St. Petersburg is located to the north of the zone of the regular nesting of this bird species and little grebes are only seldom reported during seasonal the migrations on shallow waters covered with vegetation in the Neva Bay.

Bewick's swan (*Cygnus bewickii)*

Bewick's swan has a protected status: St.P. RDB - Category 3 (VU) vulnerable species, RF RDB – Category 5 – recovering species; IUCN (LC) – lower risk.

Pintail (*Anas acuta)*

Status: St.P. RDB - Category 3 (VU) vulnerable species; IUCN (LC) – lower risk.

No nesting birds have recently been reported within the city's outlines time. During spring migrations small numbers of birds can be recorded in the Neva Bay water area and less frequently on urban bodies of water.

Osprey (*Pandion haliaetus)*

Status: St.P. RDB - Category 3 (VU) vulnerable species, RF RDB – Category 3 – rare species; IUCN (LC) – lower risk. This bird species is also included in Annex I to Convention on International Trade in Endangered Species (CITES).

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[5] St.P. RDB – Red Data Book of St. Petersburg; RF RDB – Red Data Book of the Russian Federation ; IUCN – IUCN Red List of Threatened Species)

In St. Petersburg this bird species is most frequently reported during its spring migration, usually in the coastal part of the city. Migrating birds were reported in the area of Kanonersky Island, in the mouth areas of the Malaya Neva and the Malaya Nevka rivers, above the Southern Maritime Park, in the Ugolnaya Harbor and along the entire northern coast of the Gulf of Finland.

White-tailed eagle (*Haliaeetus albicilla)*

Status: St.P. RDB - Category 3 (VU) vulnerable species, RF RDB – Category 3 – rare species; IUCN (LC) – lower risk. It is not nesting in St. Petersburg, but can be recorded in early spring and during autumn/winter season in the coastal zone of the Neva Bay and above its water area.

Common kestrel (*Falco tinnunculus)*

Status: St.P. RDB - Category 3 (VU) vulnerable species; IUCN (LC) – lower risk. It is nesting within the city's borders on tall buildings and on power transmission pylons. It is hunting above wastelands.

Merlin (*Falco columbarius)*

Status: St.P. RDB - Category 3 (NT) potentially vulnerable species; IUCN (LC) – lower risk. The population of merlins started growing in the urban environment in the 1980s and currently it occurs virtually throughout the city. Its nesting is reported in all biotopes, including also the urbanized part of the city: in urban and suburban parks, urban gardens with tall trees, as well as in cemeteries.

Lesser black-backed gull (*Larus fuscus)*

Status: St.P. RDB - Category 3 (VU) vulnerable species; IUCN (LC) – lower risk.
It is reported regularly in the Gulf of Finland and above the Neva River during seasonal migration periods; single birds are reported also during summer months. Most numerous concentrations are recorded in autumn, when they concentrate at accessible food sources together with other gull species, i.e. at municipal landfills, at slaughter houses, on fields in the southern part of the city and at the gulf coast.

Arctic tern (*Sterna paradisaea)*

Status: St.P. RDB - Category 3 (NT) potentially vulnerable species; IUCN (LC) – lower risk. It is reported predominantly during migrations; only a few couples are nesting in the Gulf of Finland and on the Ladoga Lake. In the city it can be observed during migrations in May-August above the Neva River and the Gulf of Finland.

Little tern (*Sterna albifrons)*

Status: St.P. RDB - Category 3 (VU) vulnerable species, RF RDB – Category 2 – a species with a decreasing population; IUCN (LC) – lower risk. It can be observed during seasonal and local migrations.

3.14 *CURRENT USE OF THE PROJECT AREA*

The entire Western High-Speed Diameter (WHSD) motorway is located within the outlines of the city of St. Petersburg. St. Petersburg has its own rules and regulations for land use and urban development, which are not contravened by the WHSD construction Project.

Within the ***WHSD Southern Section***, the construction of which is nearing completion and has been already partially commissioned, the area occupied by the motorway earlier belonged to the Baltic Railway Line right-of-way. There were numerous private garages within this zone, which were demolished prior to the beginning of the construction of the WHSD. The first 5km road section to the right of the motorway route (the starting point of the WHSD is assumed to be the junction with the southern segment of the Ring Road) runs through a residential zone, with some streets ahead of it. To the left of the WHSD route there are mainly industrial zones. When nearing to the Ekateringofka River, the WHSD route enters the industrial zone of the Kirovsky Factory. The WHSD Southern Section runs close to some cultural sites – the Kiryanovo mansion (about 30 m) and the Putilovsky Temple (about 70m). The Ekateringof Park, which also has a status of a cultural site, is located at a distance of approximately 700m from the WHSD motorway.

The first 1.4km of the WHSD Central Section runs through the St. Petersburg Seaport site also mainly within the railway line right-of-way. The conditions for motorway construction are rather restricted. About 411 private garages and two land plots owned by external organizations and including some warehouses are located along this initial part of the Central Section within the motorway right-of-way. Most of the land needed for the motorway construction is owned by the city. There are also extensive engineering and utility networks there which are to be relocated. A toll collection terminal to be constructed as a part of the Central Section will be located opposite to the Ekateringof Park (across the Ekateringofka River) at a distance of over 10m from the park.

The Marine Canal to be crossed by the WHSD motorway is approximately 130 m wide. It is used for the passage of especially tall ships. This fact was taken into account when the height of the bridge across the Marine Canal was determined: initially it was adopted to be 55m, but currently it is considered to be reduced to 45m by using an opening middle span.

The second portion of the Central Section starts behind the bridge across the Marine Canal, where a residential zone on Kanonersky Island (Figure 3.14-1) will be crossed by an approximately 42m high flyover. The buildings in this residential district were constructed in the 1930-40s and are in a rundown condition; some of the residents had already been relocated and resettled. But there are four apartment buildings with over 340 apartments in the direct vicinity of the WHSD motorway (at a distance of 18-40m); the residents of these buildings still live there. There is also a kindergarten building at a distance of approximately 40m from the future motorway route.

Behind the residential zone, closer to the coastline of Kanonersky Island facing the Neva Bay a multi-story Customs building was constructed already after GlavGosExpertiza had issued its positive statement for the WHSD construction Project.

Some of the premises in that building will be at a distance of approximately 25m from the motorway.

Between Kanonersky and Vasilievsky Islands, the WHSD motorway route, encompassing Bely Island to its west, runs above the Neva Bay water area as a flyover and a bridge (across the Korabelny waterway). Within the range of Bely Island it crosses the sewer line of the underwater outlet from St. Petersburg's Central Aeration Station located on that island. The construction of a new artificial area is planned by the hydraulic filling at the western coast of Bely Island, where some of the infrastructure facilities of the WHSD motorway will be installed (two transformer substations and on-site treatment facilities).

The plans of hydraulic filling of that site are not interrelated with the time schedule of the WHSD construction.

The area along the western edge of Vasilievsky Island, where the WHSD will run, currently constitutes a man-made canal formed by the coastline of Vasilievsky Island and the Marine Facade hydraulically filled site at a distance of about 60m to the west of the canal. The site was constructed taking into account the future WHSD motorway route to minimize excavation in the future. The elevation of the Marine Facade site is 2.9m, which is higher by 60 cm than the maximum water level in the Neva Bay predicted for floods, after the completion of the construction of the flood-preventing dam system.

The northern part of the Marine Facade site has not been filled yet; however, since the time schedules for the construction of the Marine Facade and the WHSD motorway are synchronized, the construction of the site along Vasilievsky Island in parallel with the Marine Facade border will be completed by the time when the construction of the WHSD section to the north of the Smolenka River will be launched. The construction of the business area and the residential districts within the Marine Facade outlines has not started yet. Only the passenger ferry terminal and the access road to it have been constructed and put into operation.

In the south-eastern part of Vasilievsky Island, the motorway will run near the Shkiperskaya waste dump site (at a distance of approx. 100 m). The dump site was operated until the mid-2000s. Its elevation is up to 9m above sea level. Hundreds of thousands of cubic meters of waste has been accumulated here. There are no plans in place for dump site remediation/reclamation/removal/protection of Baltic Sea waters.

Further to the north of the Shkiperskaya waste dump site, the motorway will run near the No.6 military camp. Regarding the radiological situation this area was earlier assessed (at deeper levels) as potentially hazardous.

The Galernaya Harbor, situated behind the No.6 military camp at a distance of over 200m from the motorway, is considered to be a cultural memorial.

Further on, there is a residential area along the Marine Embankment at 1,500m east of the motorway route. Currently, the Marine Embankment is an area used by the local community for outing. There are a number of pleasant cafes there.

In the north-western part of Vasilievsky Island, where the construction of an interchange is planned with an exit to the Makarov Embankment, some short sections of the coastline are used as beaches.

The beaches adjoin a large garage complex with a capacity of over 600 cars. Both the wild beaches and the garages are located within the land allocated for WHSD construction and should be removed.

Between Vasilievsky and Krestovsky Islands the WHSD motorway will cross the Petrovsky waterway (Malaya Nevka). St. Petersburg's major yacht marines are located on this branch of the Neva River upstream of the WHSD route.

The western end of Krestovsky Island, along which the WHSD motorway will run above the shallow waters, is supposed to be extended within the frame of the upgrade of the Central Stadium.

However, the schedule of that project is not synchronized with the WHSD construction timeframe.

In general, Krestovsky Island is a large recreational area with central sports facilities and with a prestigious residential area in its eastern part.

The Srednaya and Bolshaya Nevka rivers crossed by the WHSD route behind Krestovsky Island are not used intensively for water transport, but they are popular amateur fishing and water related outing areas. The WHSD route crosses the Elaginsky waterway and runs in the direction of the northern bank of the Bolshaya Nevka, which has not been built up or developed.

The final, about 300m long segment of the WHSD Central Section will run at a distance of approximately 150m to the east of a large apartment building currently under construction and at a distance of 40m from the backside of the "Lenta" supermarket.

The WHSD Northern Section will run for its first 5 km within a corridor between residential areas on its eastern side and residential areas and industrial zones on its western side. The motorway will cross three major roads connecting the Primorsky District and the center of St. Petersburg.

Following this the motorway will pass through a wooded area and enter into a rather narrow corridor between the residential district of Kamenka at its east and the Yuntolovo nature reserve at its west. The distance between the motorway route and the nature reserve border is 180 m, which does not contradict the applicable legislative requirements.

After this section (it is the most problematic due to its proximity to the protected area), the motorway route crosses the Ring Road (its northern segment) and runs through urban forests and farming land. At its final section the motorway crosses a residential area in the settlement of Beloostrov. There is a private dwelling house within the motorway right-of-way.

The WHSD motorway ends with an exit to the federal highway "Scandinavia".

3.15 *SOCIOECONOMIC BASELINE CONDITIONS IN THE PROJECT AREA*

3.15.1 *Administrative Structure and Affected Communities*

The city of St. Petersburg is divided into 18 administrative districts (*rayons*). The WHSD construction Project (all 46.6km of its length) is being implemented on the land of the following 7 districts: Moskovsky, Kirovsky, Vasileostrovsky, Petrogradsky, Primorsky, Vyborgsky and Kurortny.

The WHSD Central Section route runs across Kirovsky, Vasileostrovsky and Primorsky districts, affecting directly the following municipalities:

- Morskiye Vorota Municipality (Kirovsky District);
- No.11, Morskoy and Gavan Municipalities and the new artificial sites of the Marine Facade Project (Vasileostrovsky District);
- No.65 Municipality (Primorsky District).

The WHSD Central Section will also run along the western edge of Krestovsky Island belonging to the Petrogradsky District.

The construction and operation of the WHSD Central Section will cause the most significant impact on the communities of Kanonersky Island and the communities along the current western edge of Vasilievsky Island.

3.15.2 Demographic Situation

St. Petersburg is the second largest city of Russia (second only to Moscow) with regard to its political and economic significance and the size of population. As of 01 January, 2010, the population of St. Petersburg was 4.6 million with 45% of male and 55% of female inhabitants.

Starting from 1990s and until 2008, the population of St. Petersburg was decreasing, which was in line with the overall demographic trends in Russia. The main cause was the natural decrease in the population in combination with a relatively low immigration rate.

Starting form 2009, the overall population of the city began to grow due to a sharp decline in the natural population decrease and a relatively high immigration rate. According to forecasts, this trend will continue until 2020 (in spite of the continued demographic decline in Russia).

In 2010 the proportion of Petrogradsky, Vasileostrovsky, Kirovsky and Primorsky administrative districts in the overall population of St. Petersburg was 2.7%, 4.24%, 6.96% and 9.04%, respectively. It means that about one fifth of the city's total population lives in those districts.

The trends of changes in the national, urban and rural population figures during the period of 1990-2010 are presented in Table 3.15-1.

3.15-1 Population of Russia, St. Petersburg and its Administrative Districts affected by WHSD Project (thousands of people)

	1990	1995	2000	2005	2006	2007	2008	2009	2010
Russia	147,700	-	-	144,200	142,800	142,200	142,000	141,900	-
St. Petersburg	5,002.4	4,845.4	4,741.9	4,600.0	4,580.6	4,571.2	4,568.0	4,581.9	4,600.3
Vasileostrovsky	226.8	208.2	202.8	196.8	195.5	195.1	194.0	194.7	195.1
Kirovsky	387.6	359.8	345.9	332.4	328.6	325.2	323.3	321.2	320.1

Petrogradsky	167.5	152.4	140.6	128.5	126.3	124.2	123.1	123.8	124.8
Primorsky	236.5	341.4	381.3	401.6	405.0	409.0	412.2	414.0	415.8

The demographic trends inside the individual districts are in general similar to those existing at the city's level.

An exception is only the Primorsky District, where the population has grown since 1990 by 75% due to the natural growth of the population and high immigration rates. Primorsky District is the only district in St. Petersburg with a positive natural growth rate of the population (0.8 per 1,000 people), while in the Petrogradsky, the Vasileostrovsky and the Kirovsky Districts it is negative (–0.2, –1,7 and –4.5 per 1,000 people, respectively).

Despite the negative natural growth rate in the Vasileostrovsky District, the population density has increased in comparison with the year of 2000. This trend is likely to continue, taking into account the implementation of the Marine Facade Project, which includes also plans for construction of housing for 73,000 people.

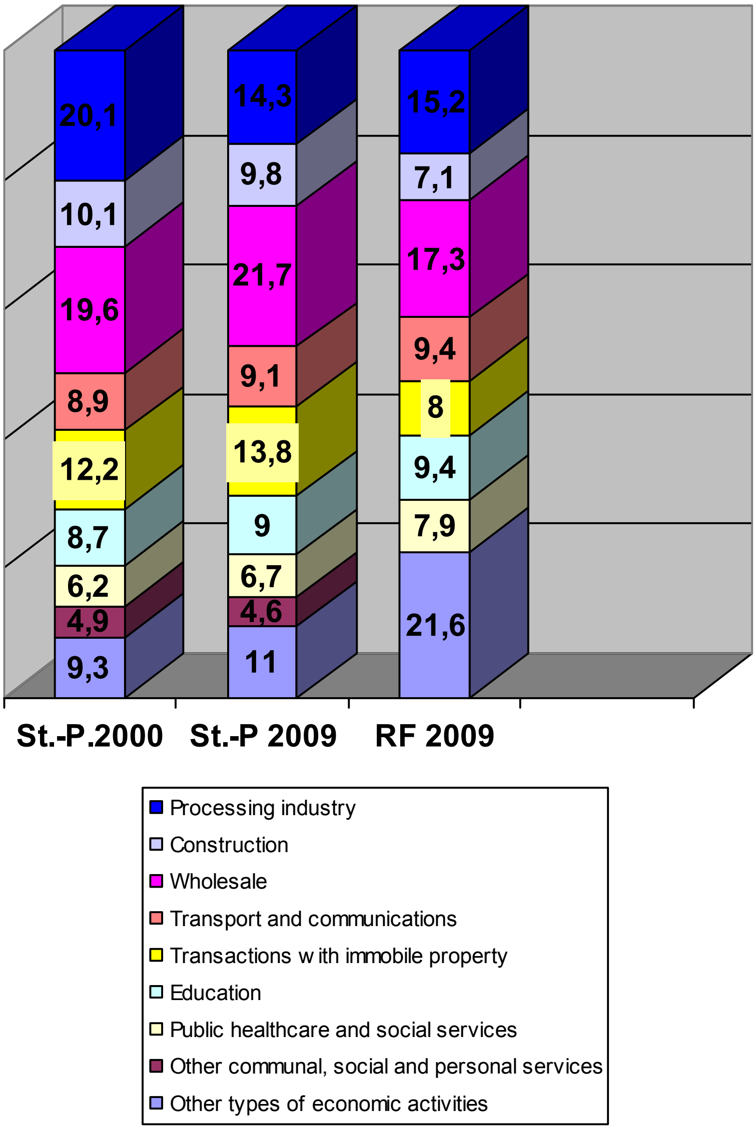
The lowest demographic indicators have been reported in the Kirovsky District, which is partially due to its historic role as an industrial enclave of the city.

3.15.3 Employment Situation

St. Petersburg is a city with a high level of urbanization and with employment trends typical of the developed urban agglomerations of Russia and the world. Starting from the 1990s and until the present, the number and the proportion of people employed in the tertiary sector has been increasing.

The structure of the average annual number of those employed in the different sectors of economy is shown in Figure 3.15-1.

Figure 3.15-1 Structure of average annual number of employed in various sectors of economy (%)



As it can be seen from the diagram above, the proportion those employed in the tertiary sector is in general higher than the Russian average.

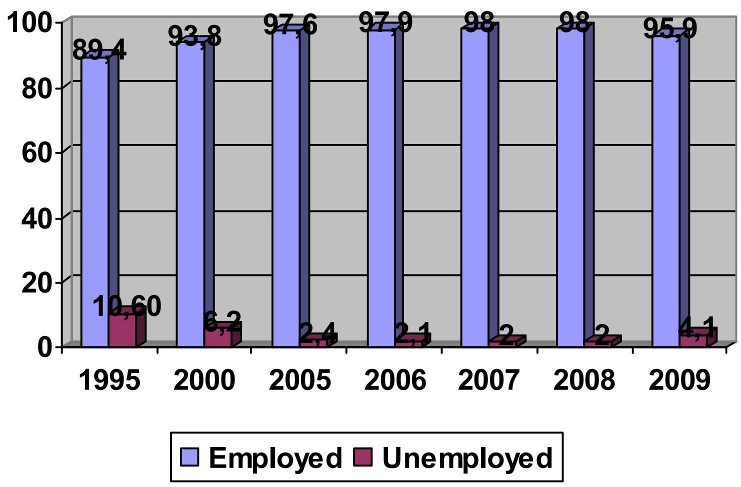
The level of employment in the construction sector within the economy of the city is also higher than the Russian average (9.8% as compared to 7.1% for Russia).

Despite the fact that the share of the 'Transport and Communications' sector with respect to the total employment is lower than the national level (9.1% as compared to 9.4% for Russia), there is a reported trend from the early 2000s showing growth in St. Petersburg in relation to the employment in this sector .

The registered unemployment rate in St. Petersburg in 2008 was significantly lower than in other regions of the North-Western Federal District of Russia. During the period starting from the mid-1990s until 2008, the employment rate in the city has consistently been decreasing with an overall rate of 8.6% (Figure 3.15-2).

An increase in the number of unemployed was only recorded in 2009 due to the consequences of the global financial crisis. In spite of that, the unemployment rate in St. Petersburg was twice as low as in Russia. It is assumed that the complete recovery of the economy of St. Petersburg will increase the proportion of those employed at an economically active age and will decrease the unemployment rate.

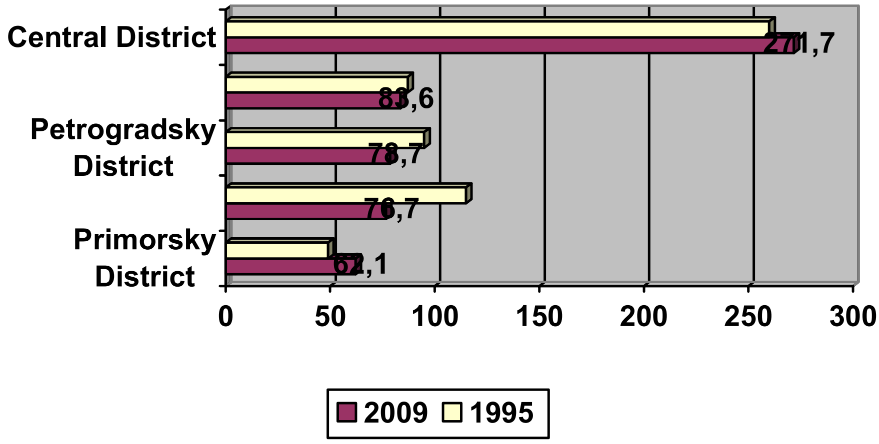
Figure 3.15-2 Ratio of employed and unemployed among the economically active population of the city (%)



The increase of the share of the tertiary sector in the structure of the economy of St. Petersburg has resulted in the concentration of labor resources in the Central District of the city and some other districts selected in the Urban Development Master Plan for intensive economic development (for example in the Primorsky District where starting from 1995 the employment rate has increased at the most significant level compared to the other administrative districts of the city).

The trends of the increasing number of employees in the organizations of the individual districts of St. Petersburg are illustrated in Figure 3.15-3.

Figure 3.15-3 Average number of payroll employees in the organizations of the administrative districts of St. Petersburg (in thousands of people)



The above data indicates that the most significant decrease in employment has been reported in the Kirovsky District, where a considerable part of the industrial sector of the city's economy was historically concentrated.

At the same time, the percentage of employment in relation to the total population of the Vasileostrovsky and the Petrogradsky Districts (42.8% and 63%, respectively), which are located closer to the Central District, is much higher than in more remote districts – Primorsky and Kirovsky (15% and 24%, respectively). It is expected that in connection with the implementation of the Marine Facade Project, the proportion of the employed people in the Vasileostrovsky District will increase, as the construction of public and business buildings with a total area of 1 million m^2 is planned within the framework of that project.

3.15.4 *Indicators of Quality of Life*

Incomes

A consistent growth of the financial income of the residents of St. Petersburg has been reported.

In relation to the economic crisis of 2008, the actual disposable income of the city's residents decreased, but in 2009 it began to grow again and the purchasing power of the population improved. During the same year, positive changes in the structure of expenditures were reported: the proportion of the incomes spent on the purchasing of foreign currency that was high at the beginning of the crises, decreased and the proportion of savings grew (a basis for an increase in the consumer demand and investments).

In 2009 the average monthly salary/wage in St. Petersburg amounted to RUR 23,884, which is higher than the Russian average (RUR 18,638).

The average monthly salary/wage in the Petrogradsky and Vasileostrovsky Districts was higher than the average for St. Petersburg by 4.4% and 1.6%, respectively. In

Kirovsky and especially in the Primorsky District this indicator was lower than the average for St. Petersburg (–2.9% and –9.1%, respectively).

The pension and the minimum subsistence level in St. Petersburg have been increasing since early 2000 and have also exceeded the respective national indicators.

In 2009 the consumer price index in St. Petersburg was lower than in Moscow and lower than the Russian average as well. The inflation growth rates for consumer goods and services fell during the same period 1.6 times lower in comparison with 2008 and for food products by 2.6 times lower.

In general, an increase in the salary/wage level (as well as pensions and the minimum subsistence level) in combination with a rather low rate of inflation during 2009 has ensured a stable improvement of the standards of living in recent years.

Housing Fund

St. Petersburg is a city with fairly good housing conditions. An overwhelming part of the city's housing fund (over 75%) is owned by individuals.

Petrogradsky District has had a high ranking in recent years with regard to per capita housing space (29.4 m^2). This indicator in the Primorsky and the Vasileostrovsky Districts is close to that of the Petrogradsky District and exceeds the average for the city as a whole.

The situation in the Kirovsky District with regard to the availability of housing is considerably less favorable than on average for St. Petersburg. There is a large number of families in this district in need of the improvement of their housing conditions.

At the same time, the number of families, who received new housing and improved their housing conditions, was the lowest in comparison with the other districts.

In three of the four districts, i.e. Petrogradsky, Vasileostrovsky and Kirovsky, 100% of the housing fund is provided with basic comfort conditions: centralized water supply, sanitation and heating. In the Primorsky District this indicator is 97.5%.

Education

St. Petersburg has an extensive network of educational institutions of all type: pre-school facilities, full-time and evening secondary schools, special and higher educational institutions.

In the Primorsky District, there are a relatively limited number of pre-school educational institutions in comparison with the other districts.

Taking into consideration that the Urban Development Master Plan of St. Petersburg foresees intensive housing construction in this district, it can be expected that the issue of the shortage of pre-school educational institutions can potentially become even more acute.

3.15.5 *Public Healthcare*

Starting from the year 2000, respiratory diseases have consistently taken the first place among the total number of cases registered in relation to the adult population. The proportion of the cases registered related to this category of diseases in 2009 was equal to almost half of all reported illnesses in the city (1,905,200 cases out of 4,204,200 cases) and has been growing consistently during the last decade (Figure 3.15-4).

The second place belongs to injuries and other consequences of external impacts, including road accidents. The number of cases registered has remained virtually unchanged since 2000.

In total, the respiratory diseases and the injuries account for 59% of the total number of cases registered in St. Petersburg.

At the same time, the number of oncologic diseases has almost doubled. Despite the fact that the total number cases registered with this kind of diagnosis is not high (60,300 persons in 2009), this category of sickness takes the second place (19.6%) with regard to the death rates (Figure 3.15-5).

Cardiovascular diseases account for 60.6% of total registered deaths.

Fatalities caused by road accidents account for 1.2% of total deaths, and are the most frequent cause of fatality caused by external impacts.

The highest number of medical institutions (hospitals, out-patients' clinics, etc.) and the largest number of hospital beds is reported in the Petrogradsky and the Vasileostrovsky Districts. The Kirovsky and especially the Primorsky Districts are lagging behind in this respect: the number of medical institutions is lower and the population is several times higher (this refers in the first place to Primorsky District).

The situation with regard to the number of medical doctors and paramedical personnel is similar. The respective indicators in the Primorsky and Kirovsky Districts are virtually two times lower as the average for St. Petersburg, although the number of doctors and paramedical personnel in the Petrogradsky District is 2.5 times higher than the city average.

It is assumed that with the further intensive development of the Primorsky District (as it is planned according to the Urban Development Master Plan of St. Petersburg), including intensive housing construction, the shortage of medical institutions and personnel can become much more acute.

Figure 3.15-4 Sickness rates of St. Petersburg's population with regard to the main categories of sicknesses (thousands of cases)

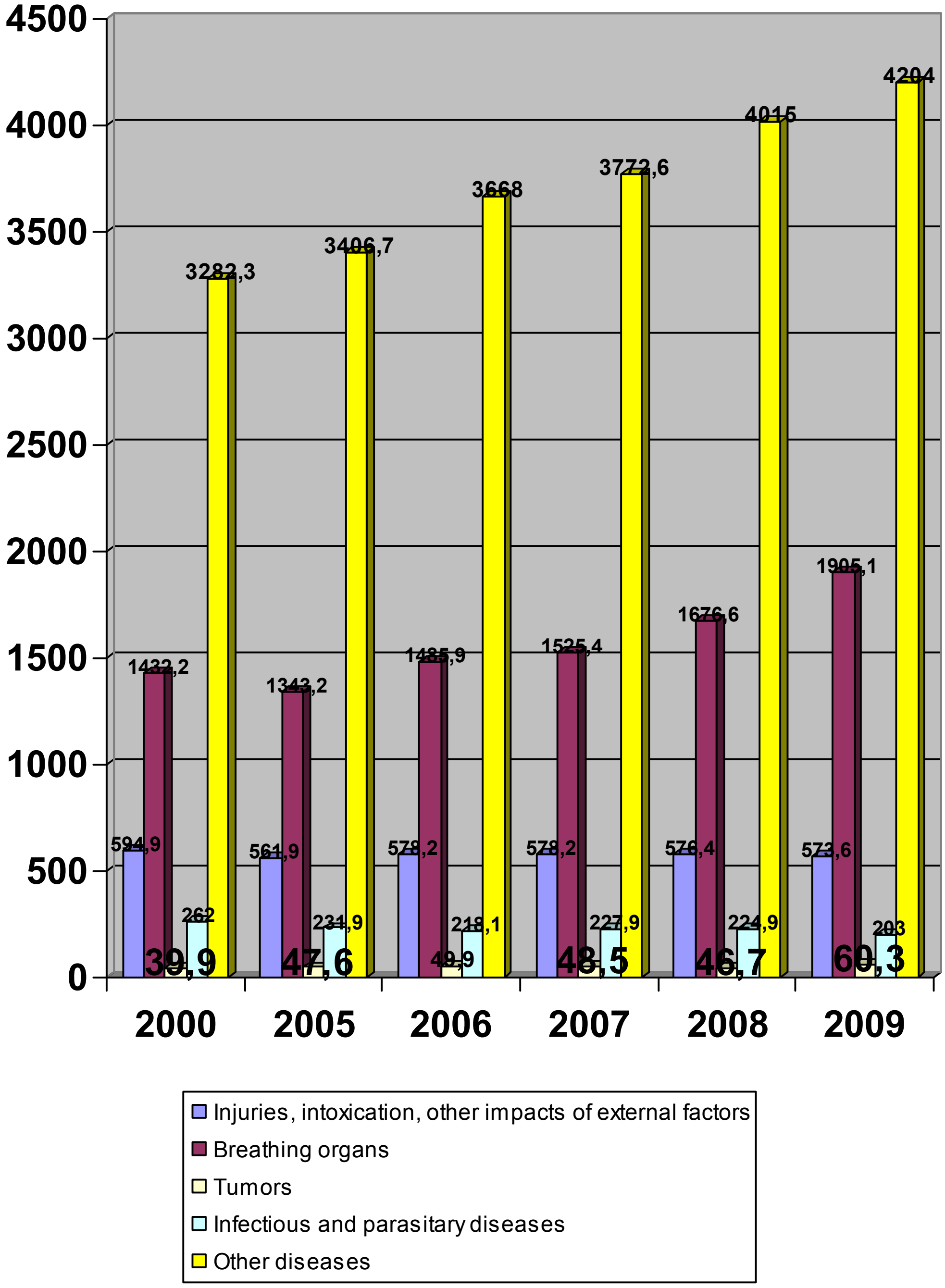
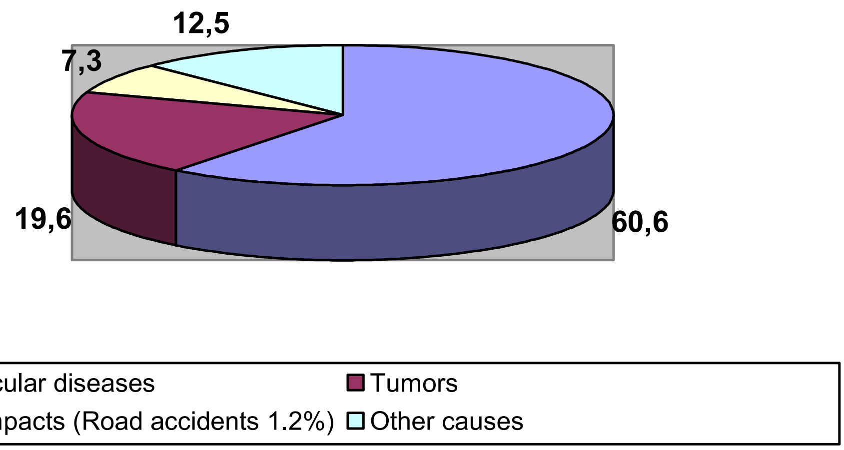


Figure 3.15-5 Percentage of lethal cases due to the main categories of diseases in 2009



3.15.6 *Economic Situation and Investments*

St. Petersburg is one of the major economic centers of Russia.

The gross regional product (GRP) in St. Petersburg had been growing at a consistent rate and traditionally exceeds the average Russian economic indicators.

In 2009, its growth slowed down to some degree due to the global financial crisis and it amounted to RUR 1,467 billion or 4% of the gross domestic product of Russia. According to the forecasts made by the St. Petersburg Committee for Economic Development, Industrial Policy and Trade, the city's GRP will grow annually by 12% and reach RUR 2,309 billion by 2013.

St. Petersburg's GRP structure coincides in general with the overall trends of the world's largest cities; the proportion of the processing sectors of the industry in the gross added value is decreasing in favor of the tertiary sector.

In 2010, the main areas of activities of the City Administration related to the stabilization and the modernization of St. Petersburg's economy were defined as follows:

- Promotion of employment;
- Efficient social protection;
- Development of the traffic and transport infrastructure;
- Expansion of housing construction;
- Improvement of investment activity of enterprises;
- Support for innovative businesses.

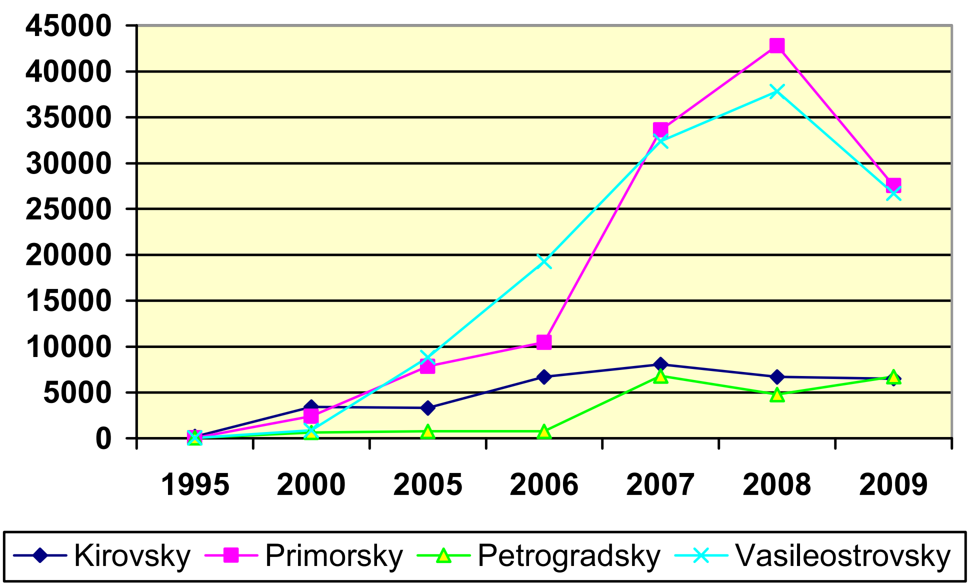
During the period of 1995-2008, the volume of fixed capital investments was growing in a consistent manner.

In 2009 it decreased to the pre-crisis level of 2007, but none of any significant investment projects has been given up.

Starting from 2007, the proportion of investments in fixed capital in the Primorsky and the Vasileostrovsky Districts has remained at a high level inferior only to that in the Central and the Admiralty Districts (Figure 3.15-6).

The Kirovsky and the Petrogradsky Districts are much less attractive for investment; however, Petrogradsky is one of the few districts where the proportion of investments in fixed capital was increasing during the period of the financial crisis.

Figure 3.15-6 Investments in fixed capital in administrative district s(millions of RUR)



St. Petersburg is one of the most dynamically developing cities in Russia with a significant investment potential. The volume of foreign investments to the city's economy during the crisis year of 2009 amounted to US $ 5.5 billion, an insignificant decrease of 6.8% in comparison with the 2008 level.

The most attractive sectors for foreign investments are the automotive industry and construction sector.

3.15.7 Transport Situation

St. Petersburg has a well developed transport infrastructure and is one of the most important centers of transport of goods by trucks.

In connection with the growing number of private cars and increasing demand for cargo transportation, motor roads have played an increasingly important role during the recent years (Figure 3.15-7 and Table 3.15-2).

Figure 3.15-7 Predicted increase in cargo transportation by trucks in St. Petersburg (millions of tonnes)

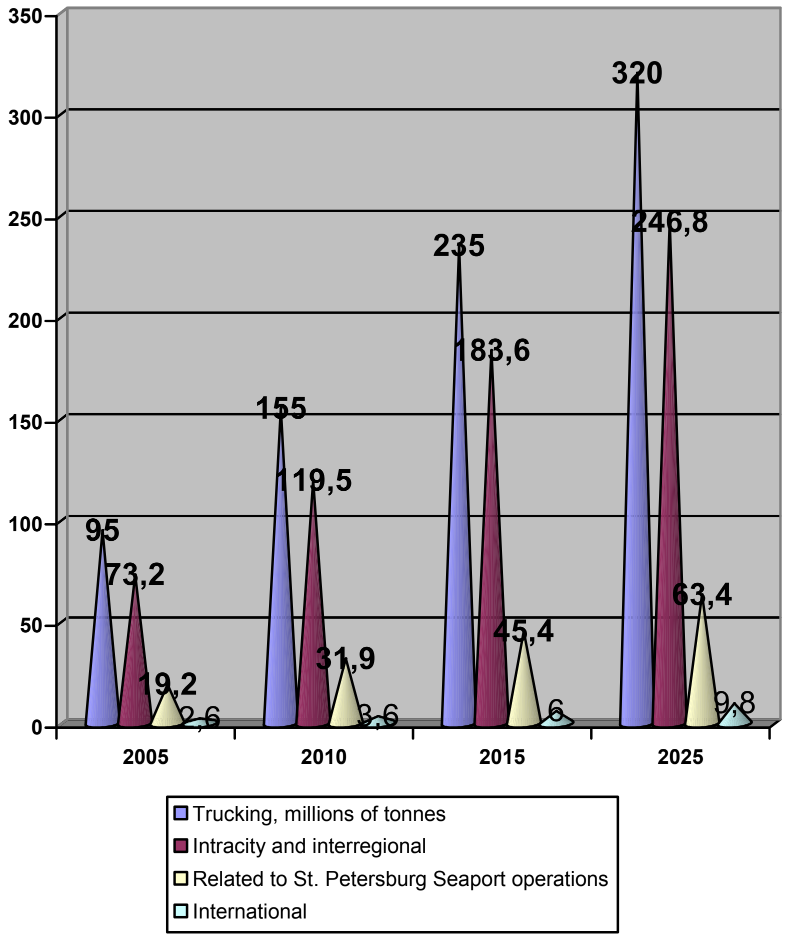


Table 3.15-2 Predicted number of vehicles in St. Petersburg until 2025

Parameters	Years			
	2005	2010	2015	2025
Cars	1,063,000	1,200,000	1,450,000	2,000,000
Trucks	106,000	130,000	150,000	195,000
Buses	19,600	20,000	21,000	23,000

The predicted almost twofold increase by the year 2025 in the number of vehicles will result in increasing traffic intensity within the networks of streets in St. Petersburg.

Currently, the pace of modernization and construction of motor roads is lagging behind the increase in the number of vehicles in the city. As a result, the streets are overloaded and the issue of traffic congestion has become increasingly acute not only within the outlines of the city but also at the exits of St. Petersburg.

Within the zone of the WHSD project implementation, the streets are especially overloaded in the area of Dvinskaya Street and the tunnel under the Marine Canal to Kanonersky Island (The Central Section), in the area of the Obvodnoy Canal and

Stachek Avenue (The Southern Section) and in the area of the Planernaya Street and the adjacent streets (The Northern Section).

3.15.8 Current Recreation Areas within the WHSD Central Section Route

Vasilievsky Island

The construction of the WHSD Central Section will affect several unofficial recreational zones located at the western edge of Vasilievsky Island.

Despite the fact that those areas along the Marine Embankment are not officially organized recreational zones, they are used in an active way by the residents of the nearby blocks for recreational purposes.

The first of those zones extends from the Place of Europe (opposite the aquatic part "Waterville" of the Park Inn Pribaltiyskaya Hotel) up to Michmanskaya Street.

The concrete pavement of the Place of Europe makes it popular for roller and board skating. There are cafes ("Umi" and "Morskoy Dvor") on the place itself and at the embankment front, with several kiosks near the "Morskoy Dvor" café used for seasonal (in summer) retail trading.

A partially improved area approximately 70m wide extends from the Place of Europe to the Michmanskaya Street with a promenade path with trees planted recently along it. This area is used by the residents of the nearby houses for walking and dog walking. A café ("Brig") is located at its end, opposite Michmanskaya Street.

This area, used as an unofficial recreational zone, is located fully within the area allocated for the WHSD right-of-way for the motorway construction.

Another recreational area is situated at the place where the WHSD motorway crosses the Smolenka River. It includes also the bridge across the river and an about 100m wide wasteland area. This area is used for dog walking, for amateur fishing and as a beach in summer.

In the area, where the exit ramps from the WHSD motorway to the Makarov Embankment will be constructed, there is a third recreational zone, which is the only place in the densely populated district providing access to the water front. That area is not large: only 100m to 130m long and 120m wide. The local residents use it as a beach, for sports, dog walking and other recreational purposes.

Krestovsky Island

According to the WHSD Project design, the motorway will run along the western edge of Krestovsky Island. The nearest facilities in that area are the Central Stadium currently in the process of modernization and the non-functioning Carillon constructed as a gift for the city's 300th anniversary.

The main recreational areas used by the local residents are located to the north and south of the motorway and to the east of the stadium, further away from the coast. Other facilities located near the future motorway are the Boat Racing Canal (a popular place for rowing sports) and the rowing club "Strela" at the northern side of the motorway, as well as a number of cafés and restaurants, an entertainment center and an equestrian sport club.

Recreational zone near the Yuntolovo Nature Reserve

It is officially prohibited to enter the territory of the Yuntolovo nature reserve.

However, a public urban park is located near the nature reserve and it is popular among the local residents as a recreational area. Residents of the nearest houses use the area to both sides of the Glukharka River for recreational purposes (walking, dog walking, etc.).

3.15.9 *Characteristics of Kanonersky Island*

Kanonersky Island belongs to the Municipality "Morskiye Vorota", which is integrated in the Kirovsky District.

This municipality is an isolated territory located on several islands. Most of the territory constitutes an industrial zone. A significant part (approx. 40%) of housing belonging to this municipality is located on Kanonersky Island.

As of 2010, the population of the municipality "Morskiye Vorota" is approximately 10,280. It is assumed that the population of Kanonersky Island will decrease, mainly as a result of the resettlement of residents from dilapidated apartment buildings. Residents of three buildings (Nos.19, 21 and 23) have already been resettled.

It is planned to resettle residents of four more buildings (two-entirely, two-partly, 140 flats).

The demographic structure of the active age population living in the municipality "Morskie Vorota" is presented in Table 3.15.3

Table 3.15-3 The demographic structure of the active age population living in the municipality "Morskie Vorota"

Proportion of people below the economically active age		**Proportion of people in an economically active age**		**Proportion of people older than the economically active age**			
				Total		**Not employed**	
Persons	%%	Persons	%%	Persons	%%	Persons	%%
1,840	17.9	5,931	57.7%	2,509	24.4%	2,100	20.4%

In general, the proportion of people younger than the economically active age in that area is larger than the average for St. Petersburg and the proportion of people in an economically active age and older is lower than the city's average.

There are over 2,000 enterprises registered in the municipality, most of them located on Gutuyevsky Island. The largest enterprises operating in the Municipality "Morskiye Vorota" are as follows:

- State Unitary Enterprise "VodoKanal" (Central Wastewater Treatment Facilities on Bely Island);

- JSC “Seaport of St. Petersburg”;
- JSC “PetroLesPort”;
- “Administration of Seaport of St. Petersburg”;
- LLC “Baltic Maritime Agency”;
- Baltic Customs Office, etc.

The Kanonersky Ship-repair Shipyard is located directly on Kanonersky Island.

Due to the remote location of the Municipality “Morskiye Vorota” in relation to the city's center and due to its industrial character, the social infrastructure on Kanonersky Island is relatively poorly developed.

Out of pre-school institutions there is only one kindergarten (No.74) of combined type for 200 children.

It is accommodated in two buildings, one of which is subject to restructuring within the framework of the WHSD Central Section construction Project.

There is only one secondary school (No.379) on Kanonersky Island and within the entire municipality; it is attended by 246 school-children.

That school is at the same time a sports center and artistic education facility; it incorporates a sports ground and a swimming pool (“Priboi”) located near the school building.

In the past a polyclinic was functioning on Kanonersky Island - Municipal Polyclinic No.23. Currently, its building accommodates the Department of General Practitioners. There is no police department on the island; if required, police is called from the city.

One of the most acute issues for Kanonersky Island is the condition of housing. Approximately half of the residential houses (3 or 4-story houses) were built in the 1930-1940s.

Taller buildings were constructed later.

A considerable part of the housing fund consists of hostels and shared apartments and is rated as lapidated housing, which has been partially already resettled.

A waste dump site is located in the western part of Kanonersky Island. Unauthorized stockpiling of large quantities of snow in winter causes pollution of the adjacent areas and the Neva Bay during the snow-melt period.

The only infrastructure facility connecting Kanonersky Island with Gutuyevsky Island and other parts of St. Petersburg is a 960-m long tunnel designed for single-lane traffic; there are no ventilation systems and emergency exits in the tunnel.

After commissioning of the mooring at the ship-repair shipyard, traffic congestion has become an issue on Kanonersky Island. A large number of trucks waiting for loading/unloading occupy driveways and streets used for public transport and by private cars and use the tunnel, which is not suitable for such intensive truck traffic.

In the future, according to the relevant federal and local programs (such as the federal objective-oriented program “Modernization of Transport System in the RF in 2002-2010”, “RF Maritime Doctrine”, “Scheme for Development of Urban Territories in the

Zone of the Seaport of St. Petersburg”, St. Petersburg's Urban Development Master Plan), Kanonersky Island is planned to become a part of the Seaport of St. Petersburg, which implies that there will be no housing construction on that island.

3.15.10 Characteristics of the Western Part of Vasilievsky Island

The western part of Vasilievsky Island is densely populated. Multi-story apartment buildings constructed after the 1960s are located along the Marine Embankment close to each other. The local residents belong predominantly to the category of population with a moderate income level. Due to the limited transport accessibility of Vasilievsky Island and unfavorable climatic conditions (high air humidity and open to winds) the western part of the island is rated currently as a “dormitory area” and non-prestigious. An exception is the housing complexes built after 2000 to the north of the Smolenka River and facing the Gulf of Finland.

Community and consumer facilities are well developed in this part of the island. There is a number of pre-school institutions, secondary schools, supermarkets and hospitals.

3.15.11 Characteristics of the Area of the WHSD Central Section in the Primorsky District

A multi-story apartment building is under construction at the northernmost end of the WHSD Central Section, at a distance of 150m west of the future motorway. This project has been designed taking into account the planned WHSD construction and complies with the requirements related to the sanitary protection distance approved for this motorway segment.

4 ENVIRONMENTAL LAYOUT LIMITATIONS OF THE PROJECT LOCATION AREA

4.1 *SANITARY RIGHT-OF-WAY AND SANITARY PROTECTION ZONES*

According to the Russian sanitary norms (SanPiN 2.2.1/2.1.1.1200-03 with Amendments 1-3) a sanitary protection zone (SPZ)[6] should be established around any industrial facility. Accommodation of residential areas, schools, kindergartens, hospitals and recreational zones within the boundaries of SPZ of industrial enterprises is prohibited.

For motorways a sanitary right-of-way should be established.

The width of a sanitary right-of-way is determined based on calculations of dispersion rates of pollutants and physical impact factors in atmospheric air. It is assumed that the sanitary right-of-way size is dependent on the minimal distance from the harmful impact source to the boundary of a residential area and recreational zone (after having taken all protective and compensating measures foreseen in the motorway construction design).

The same limitations are applicable to a sanitary right-of-way as to an SPZ, but it is not required to develop a sanitary right-of-way project design. Only substantiation of the sanitary right-of-way dimensions is subject to an approval by the sanitary inspection agency.

Since the WHSD motorway will run either across or near residential districts on Kanonersky Island and along the western edge of Vasilievsky Island, it is compulsory to substantiate the dimensions of the SPZ with calculated atmospheric air pollution harmful physical impact fields.

4.2 *PROTECTIVE FORESTS*

In conformity with Article 102 of the RF Forestry Code, all forest areas within the boundaries of the city of St. Petersburg and in the suburban zone are rated as forests of *Protective Forest Category of Urban Forests and Forested Park Zones*. However, directly within the WHSD Central Section route and its future sanitary right-of-way there are no forest areas; trees are growing there as discontinued forest plantations having no status of city parks or forest parks (see Section 3.10)

The nearest urban parks are located at some distance:

- 700 m to the north-east – Ekateringofsky Park;

[6] **Sanitary protection zone** (SPZ) - a buffer zone between the operating site and nearby residential areas. It is established for industrial facilities that emit pollutants into the atmosphere or have other environmental impacts. The purpose of the SPZ is to protect nearby people from harmful industrial impacts such as noise, dust and air emissions. According to the RF legislation, an industrial facility must ensure that the air quality at the boundary of the SPZ is in compliance with established Maximum Permissible Concentration levels for residential areas. The presence of residential areas, recreational zones, schools, hospitals or food production facilities is prohibited within the SPZ of an industrial enterprise. (SanPiN 2.2.1/2.1.1.1200-03 with Amendments 1-3)

- 1300 m to the east – Opochinsky Orchard (Vasilievsky Island);
- 1400 m to the east – Dekabristov Park (Dekabristov Island);
- 800 m to the east – Primorsky Park of Victory (Krestovsky Island);
- 500 m to the north-west (across the Neva Bay water area) – Park of 300th Anniversary of St. Petersburg.

They do not impose therefore any limitations for the WHSD Central Section route.

4.3 *WATER PROTECTION ZONES*

Water protection zones are established in accordance with the RF Water Code (No.74-FZ of 03.06.2006) for the Neva Bay and its minor tributary - Smolenka River - crossed by the WHSD Central Section.

According to Par. 14 of Article 65 of the RF Water Code, the boundaries of riverside protective zones in residential areas coincide with the parapets of embankments, provided that there is a stormwater runoff drainage system. The width of water protection zones in such areas is established from the embankment parapet as a reference point.

In accordance with Letter No.R6-18-5138 dated of 28.12.2007 by the Neva-Ladoga Basin Water Management Department, the WHSD Central Section route runs in the Neva River mouth area within the delta and shoals of the river mouth bar. In this connection, a water protection zone 200m wide and the riverside protective strip 50m wide have been established for the Bolshaya Neva River and river branches Smolenka, Malaya and Srednaya Nevka where there are embankments.

For the Marine Canal a 50m wide water protection zone has been established. The width of the riverside protective strip for the Marine Canal is also 50m.

According to Par. 16 of Article 65 of the RF Water Code, planning, site selection and construction of commercial and other facilities are allowed within the water protection zones provided that appropriate facilities are available, which ensure the protection of water bodies against pollution and littering.

This provision imposes certain limitations related to the construction and operation of temporary construction yards and temporary roads, virtually all of which will be located within the outlines of water protection zones.

4.4 *FISHERY PROTECTION ZONES AND FISHERY CATEGORY OF WATER BODY*

Pursuant to RF Government's Decree No.743 of 10.10.2008 "On Approval of the Rules for Establishing Fishery Protection Zones" and on the basis of Ordinance No.86 of 11.02.2010 by the Federal Fishery Agency "On Approval of a Procedure for Recognizing Zones with Special Conditions of Usage as Fishery Protection Zones and Fishery Reserve Zones" and Ordinance No.943 of 20.112010 "On Establishment of Fishery Protection Zones of Seas with Coastlines Fully or Partially Belonging to the Territory of the Russian Federation", the width of the fishery protection zone of the Baltic Sea as a fishery water body is 500m wide and the width of the fishery protection zone of the Neva River is 200m.

There are no areas with special conditions of usage - fishery reserve zones - within the area crossed by the WHSD Central Section route.

However, the Neva Bay is rated as a water body of top fishery significance. This means that the content of chemical substances in any wastewater discharged to the Neva Bay water area should comply with the regulatory maximum permissible concentrations adopted for fishery water bodies.

4.5 *RECOMMENDATIONS OF THE HELSINKI COMMISSION (HELCOM)*

The Neva Bay is a sea area under the jurisdiction and subject to the recommendations issued by the *Helsinki Commission* (*HELCOM*) (the provisions and a list of applicable recommendations are presented in detail in Section 2.2).

In conformity with the HELCOM Recommendations, it is required to comply within the Baltic Sea catchment area with the relevant environmental standards, in particular with those related to biodiversity conservation and organization of protected nature territories, prevention of oil spills and release of harmful emissions to the atmosphere. Implementation of the recommendations is subject to supervision of the respective natural supervisory agencies of the RF Ministry of Natural Resources and HELCOM's international groups.

4.6 *SANITARY PROTECTION ZONES OF THE WATER INTAKE FACILITIES*

Within the construction area of the WHSD Central Section there are no water intake facilities and water supply stations, the sanitary protection zones of which could impose any limitations in relation to the construction and the operation of the planned motorway.

4.7 *AREAS USED FOR HOUSEHOLD AND RECREATIONAL WATER USAGE*

The Neva Bay water area and the land on its shore, as well as the area of the Neva River mouth are used by local residents for recreational purposes (Category 2 of Water Use - bathing, aquatic sports activities)[7], as well as for amateur and sports fishing. They are rated therefore as water bodies for general and potable water supply and for recreational use.

According to Articles 50 and 51 of the RF Water Code and in conformity with the Federal Law "On Sanitary and Epidemiological Well-being of Population" (No.52-FZ of 30.03.1999), Sanitary Norm SanPiN 2.1.5.2582-10 "Sanitary and Epidemiological Requirements to Protection of Coastal Waters of Seas against Pollution in Areas of

[7] The requirements to water quality set for Category 2 of water use are applicable to **all areas of coastal sea waters located within the outlines of residential areas.**

Water Use by Population" and Hygienic Norm GN 2.1.5.1315-03 "Maximum Permissible Concentrations (MPC) of Chemical Substances in Water of Water Bodies Used for General and Potable Water Supply and Recreational Purposes", the applicable norms of water quality and the relevant requirements of sanitary protection of the coastal waters of seas should be complied with.

4.8 *CONDITIONS FOR THE CONSTRUCTION OF THE WHSD CENTRAL SECTION WITH REGARD TO POTENTIAL EMERGENCY SITUATIONS*

The area of the WHSD Central Section, similarly to the entire territory of St. Petersburg, is rated as an area with a high degree of probability of occurrence of explosive objects in the soil/seabed sediments, as it was a scene of heavy battles both during the Civil War and especially during the World War II.

Such explosive objects for the area of St. Petersburg can include mainly aerial bombs, rockets (warheads), bombshells, mortar ammunition, antitank rockets and bazooka ammunition, ammunition for automatic aircraft guns and for small arms, grenades, explosives, chemical weapons and special types of ammunition.

It is also possible that sea mines can be found within the Neva Bay water area.

During the previous stages of the project preparation, no surveys was carried out within the area allocated for the WHSD motorway construction for the identification any explosives objects in the soil / bottom sediments of the Neva Bay water area.

4.9 *SPECIALLY PROTECTED NATURAL AREAS*

There are no specially protected natural areas within the territory allocated for the WHSD Central Section construction.

The specially protected natural areas of regional significance located nearest to the WHSD Central Section route, within a zone potentially affected by the future WHSD motorway, include the following:

- State nature sanctuary "Yuntolovsky" (construction of the WHSD Northern Section is carried out within the protection zone of that sanctuary); it constitutes a wetland and a forest complex on the coast of the Lakhta lagoon. It is located at a distance of 4 km to the west-north-west of the WHSD Central Section;
- State nature sanctuary "Northern Coast of Neva Bay" located at a distance of 4 km to the west-north-west of the WHSD Central Section route (across the Neva Bay). The coast and the sea area adjacent to the reserve are a highly important migration route and an area for the formation of the seasonal congregations of migrating birds;
- State natural monument "Strelninsky Bor" located at a distance of 8 km to the south-west of the WHSD Central Section route (across the Neva Bay).

The following specially protected natural areas are planned or are in the process of establishment:

- Integrated reserve "Southern Coast of Neva Bay" located at a distance of 8 km to the south-west from the WHSD Central Section route (across the Neva Bay)
- Natural-historic Park "Elagin Island" that will be located at a distance of 700 m upstream of the combined river mouth of the Srednaya and Bolshaya Nevka Rivers.

4.10 *LIMITATIONS RELATED TO THE ARCHITECTURAL AND URBAN DEVELOPMENT ASPECTS AND THE PROJECT DESIGN*

The layout solutions related to the selection of the WHSD Central Section route, access roads, junctions, interchanges and exits are approved with respect to the provisions of the General Urban Development Plan of St. Petersburg and the relevant plans for the development of the street and road network and other transport infrastructure of the city, the residential areas and the industrial zones, the existing and planned engineering networks.

The construction of flyovers above water and bridges should ensure safe navigation and management of water ways and shipping; their height parameters should ensure navigation safety within the zone of responsibility of the North-Western Center for aeronautical information and data.

The Project design for the WHSD Central Section has all the required approvals related to architectural and urban development aspects of the Project obtained from the relevant supervisory agencies and administrative bodies and organizations.

4.11 *CULTURAL HERITAGE OBJECTS*

Neither cultural heritage nor archeological sites have been identified within the WHSD Central Section route. The nearest cultural site is the complex of buildings at the Galley Harbour at a distance of 200m east of the WHSD Central Section route on Vasilievsky Island.

However, the motorway route runs across a coastal area and a raised beach, which originally was a part of the shallow waters of the Neva Bay. In this respect, potential chance finds may occur in some water and land areas in the process of the motorway construction along the edge of Vasilievsky Island (e.g. shipwrecks). In such cases a chance find procedure is to be followed and rescue archeological work is to be carried out, if deemed necessary.

The Historic Centre of St. Petersburg and the associated group of memorials were included in 1990 in the List of Global Cultural Heritage of UNESCO under No.540 (540-001 Historic Centre of St. Petersburg, Russian Federation).

The Historic Centre in the area crossed by the WHSD Central Section route is located at the outer borders of the Petrogradsky and the Vasilievsky Administrative Districts, and the nearest objects of cultural heritage of the Historic Centre are situated at a distance of over 1 km from the WHSD Central Section right-of-way.

5 SUBSTANTIATION OF THE ADOPTED TECHNICAL SOLUTIONS

5.1 GENERAL DESCRIPTION OF TECHNICAL SOLUTIONS FOR THE WHSD CENTRAL SECTION

5.1.1 Characterization of the transport situation in the area crossed by the WHSD Central Section route

In the mid-2000s, when the construction Project design was developed, St. Petersburg accounted for about 20% of export and transit transportation of all Russian cargoes. About half of it was handled by the St. Petersburg Seaport.

About 84% of the city's population lives outside of the city's central districts where 40% of jobs are concentrated. This means that the WHSD motorway will be used not only for cargo transportation between Scandinavia and Moscow and from and to the Seaport, but also by the inhabitants of the residential districts with a misbalance of population and number of available jobs. In addition, the WHSD motorway will be the main highway of St. Petersburg's Marine Facade, currently under construction, as well as of Vasilievsky Island.

Within the framework of the WHSD construction Project a forecast was made to assess the traffic intensity of the WHSD Central Section up to 2025. The predictions indicate that if the new motorway was operated free of charge, the traffic intensity in both directions on its busiest section (i.e. from Vasilievsky Island to the beginning of the WHSD Northern Section) would be approx. 125,000 vehicles (of all types) per day.

For a toll motorway the predicted intensity along the Central Section until 2025 is much lower, i.e. up to 84,000 vehicles per day in both directions.

The number of traffic lanes for the WHSD Central Section was determined based on the predicted traffic intensity.

5.1.2 Technical Parameters of the WHSD Central Section

The planned motorway is categorized as a main high-speed highway.

The speed limit is to be set at 110 km/hour (with a speed limit of 80 km/hour in out-of-straight sections).

The motorway will have 8 lanes (four lanes in each direction).

The width of the traffic area in each direction along straight sections will be 14.5 m, including two lanes on the right 3.75m wide each and two lanes on the left 3.5m wide each. The lanes will be wider on interchanges to accommodate high-speed exit lanes. The lanes will be wider in out-of-straight sections).

A median strip between oncoming lanes for one-level sections will be 5 m wide; it will be 3 m wide in the trench along the western edge of Vasilievsky Island and on bridges with a single span structure.

The width of the safety strip will be:

- 1m within the median strip and 1.2m on bridges with a single span structure;
- 2m at passageways for maintenance personnel;

The width of the passageways for maintenance personnel (at the right-hand side) will be 0.75m.

No sidewalks for pedestrians are planned along the WHSD motorway.

5.1.3 *Motorway layout and longitudinal profile*

The following factors were taken into account when determining the position of the final motorway route approved in 2000:

- Synchronization with the development of the Marine Facade site;
- Prospects for development of Krestovsky Island and Bely Island westwards (by hydraulic piling of artificial sites) outlined in the St. Petersburg's Urban Development Master Plan;
- Maximum distance from residential buildings at the Marine Embankment on Vasilievsky Island;
- Shortage of space for motorway construction along the segment from the Ekateringofka River to the western end of Kanonersky Island;
- The need to comply with the requirements defined by the St. Petersburg Government's Committee for Urban Development and Architecture with regard to the establishment of a continuous urban development territory on Vasilievsky Island in connection with the implementation of the Marine Facade Project;
- Compliance with the pre-determined under-bridge clearance at each of the waterways crossed by the WHSD motorway;
- Compliance with the specified clearance under flyovers at junctions with urban streets and at exits, i.e. at least 5.25m, as well as above railway lines (at least 7.2m).

Based on the motorway's plan and longitudinal profile, elaborated with due considerations of the above factors, the following basic technical solutions were adopted for the Project:

- Construction of a two-tier flyover from the Ekateringofka River to the Neva Bay coast behind Kanonersky Island;
- Maximum height of the flyover at the bridge across the Marine Canal (45m above sea level);
- Crossing of all waterways by bridges complying with the pre-determined under-bridge clearance;
- Gradual change from two-tier to single-tier design in the range of Bely Island;
- Lowering of the motorway level behind the bridge across the Korabelny waterway from the flyover to an embankment and then into a trench;
- Construction of the motorway stretch along Vasilievsky Island coastline in an open trench partially covered by driveways and footways;
- Construction of a tunnel under the Smolenka River;

- Exit of the motorway at the north-western end of Vasilievsky Island from the trench to an embankment and then to a flyover;
- Construction of the motorway stretch from Vasilievsky Island to the end of the Central Section as a single-tier flyover.

5.1.4 Roadway

The WHSD Segment from the Ekateringofka River to the Marine Canal

Starting from the WHSD Southern Section, which ends as a two-tier flyover, the motorway segment behind the Ekateringofka River, and further on within the Seaport site, will also be continued as a two-tier flyover.

The span structures will be manufactured by using steel trusses. The overall width at the first span structure will change from 35m to 17.5m, because there will be exit ramps from this span structure to the Ekateringofka River embankment. Then the overall motorway width of 17.5m will be maintained for all span structures. The distance between the bearings on which the span structures will be installed will vary from 120m to 144m.

The bearings take the form of single-leg structures with a variable cross-section. They will be installed on a pile foundation. The piles are of drilled pile type with a diameter of 1.5m widening to 3m at a depth of 19 m, where they are supported on semi-consolidated sandy silts. The number of piles under each bearing is determined for each particular bearing, but in most cases it is 16.

A bridge across the Marine Canal

A final decision about the bridge design has not been made so far:

- The Project design approved by GlavGosExpertiza refers to a fixed bridge structure at an elevation of 55 m above the water level as a two-tier superstructure in the form of steel framework structures;
- An alternative has been discussed recently (engineering drawings prepared) referring to a bridge with a lifting central span. This will make it possible to decrease the bridge height (and as consequently the height of the flyovers connected to the bridge).

In case of both alternatives, the length of the main span is 168 m. The design approved by GlavGosExpertiza is similar to that adopted for the flyover planned for the initial segment of the WHSD Central Section.

A flyover from the right riverbank of the Marine Canal to the offshore point south of Bely Island

Its design is in general similar to that of the flyover in the first segment of the WHSD Central Section. The span length is:

- 144m on Kanonersky Island;
- 50 m above the Neva Bay water area.

The piles used in the Neva Bay will be longer by 25m.

The bearings are of a single-leg structure design.

A flyover linking the point offshore Bely Island and the bridge across the Korabelny waterway

The design of this motorway segment will be in the form of a flyover, but gradually it changes from a two-tier design to a single-tier motorway.

The bearings used are:

- In the section of the changeover - independent piers under each superstructure point. Span structures installed on such bearings will be connected by a steel frame to jointly impose their pressure onto the pile foundation;
- Within the single-tier stretch - two independent single-leg structures under each span structure. Span structures independent for each traffic direction will be in the form of continuous steel structures.

Piles will be driven to a depth of 25m and closer to the bridge across the Korabelny waterway to a depth of 30 m. The number of piles under each bearing will be reduced down to 6 or 8, but at a wider stretch (where the construction of an interchange ramp with an exit to the newly piled sites to the west of Kanonersky Island is planned) the number of piles under each bearing will be increased up to 16.

The maximum width of the roadway will be 30.2 m (curve + beginning of high-speed exit lanes of the future exit ramp).

A bridge across the Korabelny waterway

This is a cable-stayed two-pier bridge with a fan-like cable system with cables to be fixed at 12m intervals along the span.

The end bearings will be of double-leg and crossbar type, supported by a pile foundation (drilled piles with a diameter of 1.5m and 30m long, widening at the base to 2.5 m; the total number of piles for each foundation is 16).

The piers will be of reinforced concrete design with a box-like cross-section, 125 m high. The piers will be inclined toward the center of the bridge at an angle of 15^{o}. Each pier will have two legs combined by steel cross elements below the roadway level and within the cable fixation zone. The structure for cable fixation will be made of steel and reinforced concrete.

Cables will consist of several parallel strands (from 40 to 82 strands) with a diameter of 15.7 mm. Each strand consists of 7 wires enclosed in polyethylene sheathing. The spaces between the wires are filled with paraffin. The design life of the cables is 100 years.

The pier legs will be constructed on pile foundations. The pile field consists of 60 drilled piles 30 m long, with a diameter of 1.5 m and widening at the base up to 2.5m. A monolithic raft foundation having a size of 33.5m x 19.5m will be constructed on the piles; it will be located at a height of 5 m above the water level in the Neva Bay.

The superstructure will take the form of a continuous steel and reinforced concrete structure. The height and the length of the main span structure will be 35 m and 320m respectively.

At the ends of the superstructure, two reinforced concrete counterweights weighing 600 tonnes each will be installed.

Vibration absorbers will be installed between piers to damp vibration caused by wind load.

An underground sand slope will be piled to protect the piers against the erosion of the ground and the collision with ships, (at a distance of up to 18m from the pier socket). The surface of the slope will be covered with materials resistant to erosion; a concrete girth will be provided along the external bottom edge above the pier island.

A flyover between the Korabelny waterway and Vasilievsky Island

The flyover design is similar in many respects to that of the single-tier flyover from Bely Island approaching the Korabelny waterway. The spans will be up to 126m long.

The pier foundations will be in the form of raft foundations supported by piles of 1.5m diameter widening at the base up to 2.5m.

The bearings used are:

- Two independent single-leg piers under each superstructure; or
- Six independent double-leg piers under the main beam of the span structure; or
- Six independent single-leg piers under each beam of the span structure.

Span structures will be of the following design:

- At the beginning of the motorway segment – continuous box girders under each traffic direction;
- Ahead of Vasilievsky Island – continuous steel girders, independent for each traffic direction.

A motorway stretch along the western edge of the current configuration of Vasilievsky Island

Having approached the current south-western end of Vasilievsky Island, the motorway changes from the flyover (at elevations of +6m above sea level) to an embankment and to an open trench, where the roadway level is predominantly –3m below sea level. At the crossing of the present-day Smolenka River, the motorway will run in a 402m long tunnel with a roadway elevation decreasing to –5m at the portals and down to –11m in the central section of the tunnel. At the north-western end of Vasilievsky Island the motorway changes over from the trench first to an embankment and then to the flyover across the Malaya Nevka River.

The base of embankments will be reinforced by a pile field made of drilled piles of 0.6m diameter, 19m long and with a pattern of 2.5m x 2.5m, and a raft foundation made of crushed stone and three layers of geogrids. In case of over 1.0 m high embankments, they are designed without slopes, with the facing made of concrete blocks.

The road bed in the trench will be protected against flooding by groundwater cutoffs having a 'wall in the ground' design with the wall base semi-buried 3m in the bearing bass clay layer (elevations of –28m to –32m below sea level). The thickness of the walls made of reinforced concrete will be 0.5m. Drainage ditches will be provided at the external side of the wall facing Vasilievsky Island (i.e. to the north and south of the tunnel) with an outlet to the Smolenka River.

With a fenced and excavated space down to the required elevations of the future trench, a stress re-distribution platform will be provided composed of a crushed stone layer reinforced with three layers of geogrids. The upper crushed stone layer 0.75m thick will serve at the same time as a base for road pavement.

The trench slopes will have an angle of 1:2 made of draining soils.

The tunnel will consist of two separate compartments for opposite traffic directions with an evacuation compartment between them separated by concrete walls. The walls and the ceiling of the tunnel will be constructed of monolithic reinforced concrete. Hydraulic insulation will be provided along the entire perimeter of the structures.

The roadway in the tunnel will be 16.0m wide.

A flyover from Vasilievsky Island to the bridge across the Petrovsky waterway

It will be a single-tier flyover 19.1m wide in each direction. The spans will be from 42m to 45m long. The superstructure will be of continuous steel and reinforced concrete structures. Bearings will be of single-leg pier design. Piles of different designs will be used: most of the piles will be of 1.5m diameter widening up to 2.5m and from 23m to 25.5m long. From 2 to 4 piles will be driven for each pier.

A bridge across the Petrovsky waterway

The width is 16.5 m + 4.0 m + 16.5 m. The main span is 220m long and the access spans are 110m wide each. The height above the water level is 25m.

The bridge is of cable-stayed design constituting a continuous superstructure of monolithic reinforced concrete of box-type cross-section. The slab will be 450 mm thick. The foundation will be constructed on a pile base. Drilled piles will be 40 m long and have a diameter of 1.5 m.

A flyover along the western coastline of Krestovsky Island

The span structures are of continuous design with a steel plate connected to each other by stiffening ribs. The span length varies from 74m to 105m.

The piers will be of pier type: one pier for each direction. The piers will be installed on a pile foundation. Piles are of drilled pile type of 1.2m diameter, widening up to 2.3 m. Twelve 26m to 33.5m long piles will be driven for each pier.

A bridge across the Elaginsky waterway

It is similar in its design to the flyover approaching it from Krestovsky Island. It consists of several spans. The bridge elevation is 16m above the water level.

Tiers have been designed taking into account the direction of ice movement.

A flyover from the bridge across the Elaginsky waterway to the end of the WHSD Central Section

The flyover design is similar to that of the previous two segments of the motorway. When the motorway reaches the northern bank of the Bolshaya Nevka River, the span length will decrease down to 42 m. The piers will be of two-leg type, i.e. two legs for each direction. The bearing base will be constructed with the use of drilled piles of 1.5m diameter widening up to 2.5m and 23m to 25.5m long. Two piles will be driven for each support leg.

5.1.5 Intersections and Junctions

In addition to the bridge across the Ekateringofka River and the two exit ramps to the Ekateringofka River embankment integrated in the Southern Section, **two more exit ramps** will be constructed at the beginning of the WHSD Central Section. The exit ramps will be constructed in the form of flyovers 533m long and with an overall width varying from 16.45m to 14.5m.

The spans will be in the form of two main box-type girders (3m high) with cross beams at 3m intervals.

Piers will be of one-leg type made of monolithic reinforced concrete. The bearing base will be constructed of drilled piles up to 30m long with a diameter of 1.5m and widening up to 2.5m. The number of piles per one pier will vary from 4 to 6.

The next interchange foreseen in the Central Section Project design is located at the north-western end of Vasilievsky Island ("**Makarov Embankment Interchange**"). Also in the future this interchange is supposed to have eight exit ramps, the WHSD construction Project design that has passed experts review provides for the construction of only four exit ramps connecting the WHSD motorway with the Makarov Embankment (the other four exit ramps toward the Marine Facade are planned to be constructed later within the framework of a separate project).

The exit ramps to the Makarov Embankment constitute flyovers changing over to soil embankments. The length of the flyovers is from 159m to 494m; the overall roadway width is from 8.0m to 10.5m.

The span structures will be made of steel and reinforced concrete in the form of two continuous main girders. Piers will be supported by raft foundations on drilled piles 1.2m in diameter with a widening part. The piles are 36.5m to 39.0m long.

The construction of **four roads crossing the WHSD motorway at an elevated level** within the WHSD section running in an open trench along the present-day western coast of Vasilievsky Island is planned. All those roads (overpasses) are located to the south of the tunnel to be constructed under the Smolenka River.

The width of the roads will be ranging from 14.75 m to 37.75 m. This width includes sidewalks at both sides of the road (each 3.0 m wide). The length of the sections of those roads to be constructed within the framework of the WHSD Project is from 44 m to 66 m (connections to the urban transport networks will be made within the framework of other projects).

The span structures will be placed on bearings to be installed on the median strip. They will be in the form continuous ribbed structures made of reinforced concrete.

The bearings will be constructed as a wall for the entire span width and be supported on the basis of the 'wall in the ground' principle with their lower part buried in a bass clay layer.

5.1.6 *Road pavement*

Several types of road pavement will be used:

- The roadway on span structures with a steel plate at its base will be coated with two layers (each 45mm thick) of poured asphalt concrete over hydraulic insulation;
- The roadway on span structures with a reinforced concrete slab at its base will be coated with two layers of asphalt concrete of different grades (40mm thick lower layer and 70mm thick upper layer);
- The roadway on the cable-stayed bridge with a reinforced concrete slab will be paved with two layers (each 45 mm thick) of cast asphalt-concrete;
- The roadway in the trench along Vasilievsky Island, will include two base layers (asphalt-concrete over crushed stone) 56 cm thick and two coats of pavement (asphalt-concrete of different grades) 12 cm thick;
- On embankments the lower base layer will be thinner and constructed using a different technology and a different grade of crushed stone. But it will be underlain by an additional roadbed layer and a layer of sand.

5.1.7 *Roadway Drainage*

Road drainage will be ensured via open launders to be constructed at the right and left sides of the roadway and connected with transverse launders. Stormwater runoff from flyovers and bridges will drain by gravity to on-site treatment facilities. For the road sections in the trench and in the tunnel, stormwater runoff will be collected in accumulating manholes and pumped to the treatment facilities. There will be 14 on-site treatment facilities incorporated in the WHSD Central Section.

For the road sections in the trench and in the tunnel, an additional system of longitudinal and transverse drains will be provided to drain seepage water penetrating through micro-cracks in the pavement.

5.1.8 *Engineering Facilities*

A toll collection terminal with four lanes in each direction will be incorporated in the interchange at the Ekateringofka embankment. The toll collection booths will be located on safety islands. A shelter and an information board will be installed above the booths.

An **Engineering Building** 50m x 24m in plan will be constructed above the tunnel, to the south of the final riverbed of the Smolenka River enclosed in a concrete casing. The height of rooms in the building will be 3m. The walls and partitions will be made of reinforced concrete. The outside walls and floors will have hydraulic insulation. Two aboveground entrances to the building will be constructed of reinforced concrete structures.

Transformer substations will be installed along the motorway to supply electricity for lighting, alarms and automated traffic control systems, as well as for the WHSD maintenance service division.

A **technological road** with asphalt-concrete pavement will be provided along the WHSD route at the side of Vasilievsky Island, as well as sidewalks with crushed stone coating for pedestrians.

5.1.9 *Provision of Auxiliary Facility for the Motorway*

The Project provides for the following support and auxiliary facilities:

- Automated traffic control system;
- Information boards above the roadway;
- Installation of road guards, road signs, roadway markings;
- Lighting of the motorway and exit ramps;
- Anti-icing systems on bridges and on the road stretch in the open trench.

5.2 *STAGES OF THE SITE PREPARATION AND THE CONSTRUCTION OPERATIONS*

5.2.1 *Preparation of the Construction Site*

The St. Petersburg Government is responsible in many respects for the preparation of the construction sites, including the following:

- Financing and implementation of removal / relocation of any pipelines, underground and overhead cable lines located currently within the motorway route;
- Removal of buildings and structures from the construction sites, including apartment buildings and a kindergarten (Kanonersky Island), garages (Seaport area and the area of the interchange in Makarov Street), including resettlement of residents of municipal apartments or monetary compensations for private apartments/ garages;
- Coordination with the Marine Facade Project to ensure optimal conditions for the WHSD construction (compliance with the construction time schedule and elevation parameters of artificial sites at the western side of the future motorway);
- Arrangements for investigation of the motorway route to identify any potential explosive objects and their destruction, if detected.

The Partner to be selected will be responsible for the following issues and aspects:

- Development of the Project design documentation and obtaining an approval from the relevant supervisory agencies;
- Obtaining a Construction Permit;
- Removal of trees and shrubs within the motorway route;
- Removal and safe disposal of soils affected by historic contamination;
- Stripping and stockpiling for provisional storage of fertile topsoil, which can be used for subsequent land reclamation, provided that its chemical composition allows it;
- Preparation of construction sites and construction of temporary roads;
- Construction of a provisional flyover across the Neva Bay and the piling of temporary artificial islands for the construction of piers for the future motorway.

The final elevations of the Marine Facade sites along the western WHSD right-of-way line should be at least 2.9m and the elevation of the temporary islands should be at least 2.5 m. This will rule out the flooding of the above sites/islands in case of possible floods (after commissioning of the protective dam system of St. Petersburg).

5.2.2 *Supply of the Construction Materials and Structures*

Sand and stone for piling of temporary islands, as well as crushed stone and sand for road construction in the trench and on embankments will be delivered from licensed quarries operating in the Leningradskaya Oblast.

Asphalt and concrete mixture will be manufactured at plants in St. Petersburg.

5.2.3 *Preparation of the provisional construction sites and the construction of temporary roads*

There will be 16 provisional construction sites occupying a total area of 15.7 ha and required for the WHSD Central Section construction. Most of them will be located on the Marine Facade site near the area for the construction of the tunnel under the Smolenka River.

The site planned on Kanonersky Island will be located at a distance of approximately 40m from an apartment building. The site at the south-western end of Vasilievsky Island will be located within the outlines of the former Shkiperskaya waste dump site.

Construction sites intended for the reception of construction materials and structures will accommodate storage and auxiliary facilities, utilities and amenities for construction personnel, parking and maintenance areas for vehicles and machinery, sites of preassembly of structures. The provisional construction sites will be connected to the motorway construction areas by provisional access roads.

The ground surface of the sites and access roads will be paved with concrete slabs. Fencing will be provided along the site perimeters (in areas located at minimal distances from residential buildings fencing will be made of reinforced concrete slabs).

5.2.4 *Temporary Flyovers and Islands*

Temporary flyovers will be constructed for piling of small temporary islands in the Neva Bay water area and for delivery of machinery and materials to those islands. The flyover piers will be made of steel pipes of 53cm diameter. The pipes will be driven into the ground from a crane by means of a vibration-type pile driver and connected at the top with each other with a girder. Decking made of steel structures will be installed over it. Then the crane will move to a completed section and repeat the procedure for the installation of a next section.

Contact with water surface and stirring up of bottom sediments will be minimized by using this work procedure.

The total area of the **temporary islands** to be piled in the Neva Bay will be 31.2 ha. Preliminary erection of sheet pilling will be implemented only for four temporary islands with an area no less than 0.5 ha in the Petrovsky waterway.

A major part of the island volume will be filled with sand (the total sand requirement is over 700,000 m3 for the underwater part of the islands and approx. 440.000 m3 above the water level without preliminary sheet pilling). It may result in an active carrying-out of suspended matters to the water area.

Stone riprap will be provided along the edge of the islands. The islands will be 2.5m high above the water level in the Neva Bay.

The surface of the islands will be paved with reinforced concrete slabs. Driveways for vehicles and machinery will be adequately marked.

5.2.5 *Main Types of the Construction Operations*

Boreholes for piles will be drilled from graded sites, reinforced and filled with concrete by means of concrete pumps. The sludge displaced to the ground surface (up to 70 cm thick) will be removed.

Draft foundations for piers will be constructed under the protection of enclosing sheeting with an average length of 8m to 10m installed with the aid of a crane and a vibration-type pile driver. The foundation pit will be excavated with the aid of an excavator. Water will be continuously pumped out from the pits. Concrete will be delivered by concrete mixer trucks.

The **piers** for flyovers will be constructed within a steel sheathing.

Span structures of the flyovers will be constructed using the following techniques:

- Suspended by derrick-cranes (under confined conditions);
- With the use of self-propelled cranes on temporary supports (on exit ramps);
- By moving them in longitudinal direction from a sliding rack (above water in the Neva Bay).

Piers for the future cable-stayed bridges will be constructed on small islands, where tower cranes will be installed. Piles and raft foundations will be provided for them. The raft foundations will be covered with stone riprap.

Then **prestressed concrete pylons** will be constructed using the sliding shuttering. On islands in front of the bridge piers, racks will be constructed for preassembly of larger superstructure blocks.

The **preassembled superstructure blocks** will be installed with the aid of pontoon-type floating systems, tugboats and hoisting cranes with subsequent stretching of cable stays.

The tunnel under the Smolenka River will be constructed in an open trench. Prior to the construction commencement, the Smolenka riverbed, having currently an outlet to the Neva Bay via two river branches, will be closed in its southern branch.

The tunnel construction will be started in its central part, where later a permanent Smolenka riverbed will be developed. The construction will advance toward the southern portal.

The retaining structure of the tunnel, i.e. the so-called 'wall in the ground', will be 1.0 m thick. Soil excavation will be carried out by layers with reinforcement of the excavated pit. After the design elevation of the pit bottom will be reached, it will be graded and a hydraulic liner installed on the bottom.

The frameworks of the tunnel base will be installed over the cement-sand mortar poured over the hydraulic liner and then concreted. After that the walls and the upper section of the tunnel will be constructed using sliding shuttering.

The upper surface of the tunnel will be covered with hydraulic lining with subsequent backfilling of the tunnel with draining ground. The upper part of the 'wall in the ground' will be cut off to an elevation of -20cm below the water level in the Neva Bay. This will prevent flooding of the area in front of the tunnel portal in the direction from Vasilievsky Island.

Construction of the northern section of the tunnel will be carried out using the same procedure after diverting the Smolenka River to its new riverbed to be constructed in a concrete launder perpendicular to the central part of the tunnel.

5.2.6 Construction Organization and Time Schedule

It is planned to carry out construction in three shifts. Within the areas located close to the residential areas, the construction will be carried out in two shifts, with a break from 11:00 PM until 07:00 AM.

It is planned that an average of 1,250 employees, per shift, will be involved in the construction of the WHSD Central Section.

The total duration of the construction phase will be 41 months.

5.3 *ALTERNATIVES OF PROJECT IMPLEMENTATION*

5.3.1 *Selection of the Motorway Route for the Construction of the WHSD Central Section*

The need for construction of the WHSD motorway was recognized in St. Petersburg's General Urban Development Plan as far back as 1966. At the same time, a tentative motorway route was determined.

In September 1999, after having considered the descriptive materials for the future WHSD Project a Commission, consisting of 65 members, signed a Motorway Route Selection Act. This document was then approved by the Governor of St. Petersburg (Decree No.113-r dated 01.02.2000).

The procedure used for the final WHSD route selection fully complied with the applicable requirements of the RF legislation and has never been disputed by anyone.

Due to the high density of the built-up residential areas and public buildings, as well as the already existing transport facilities (railway tracks and main streets) there were only a few options to be considered for the WHSD **Southern Section**.

As a result, it was decided to select a motorway route for the Southern Section running along the eastern side of the Baltic Railway Line track between the railway track right-of-way and the corridor used for gas pipelines. Partially, the route crosses industrial zones and is located at a relatively short distance (100m and more) from residential areas.

For the WHSD **Northern Section** there were also a number of limitations to be taken into account, such as a short distance to the north-eastern border of the Yuntolovo nature reserve, which is a protected nature reserve of regional significance. As a result, the motorway route was moved for about 180m from the reserve border towards the residential district of Kamenka.

As the construction of the WHSD Southern Section has practically almost been finalized (completion scheduled for Q4 of 2011) and the construction of the Northern Section has already started (completion scheduled for Q4 of 2012), no basic changes in the WHSD **Central Section** route can be made. The Central Section route will run mainly across the Neva Bay water area along the western ends of Bely, Vasilievsky and Krestovsky Islands.

The final position of the Central Section route was officially adopted in 2005 in the new General Urban Development Plan of St. Petersburg (the Plan will be in force until 2025).

The WHSD Central Section construction Project design does not contradict any provisions of St. Petersburg's Law on Land Use and Construction enacted on 01.02.2009.

The following key aspects related to the WHSD Central Section construction should be pointed out:

- The Central Section route runs across some minor residential areas (with respect to their area), which do not include any sites of cultural and historic significance, and it will not affect any specially protected zones or cultural monuments;

- About 90% of the land required for the Central Section construction is owned by the city;
- The motorway right-of-way has been selected to minimize the demolition of as few private garages as possible;
- With regard to physical impact factors and visual aspects, the construction along the particularly densely populated Marine Embankment will be carried out in a trench, minimizing thereby the perception of the motorway by the residents of the nearest dwelling buildings located at a distance of 150-200m;
- On Kanonersky Island, resettlement of residents in connection with the motorway construction will be minimal with regard to its scale; in addition, only old run-down buildings will be involved in the resettlement program.

5.3.2 *Alternative Technical Project Design Solutions*

Based on the architectural layout and the technical studies, a number of alternative options for the WHSD Central Section construction were considered and discussed with regard to the following components and aspects:

- **Designs of Bridges or Bridge/Tunnel Options:**

a) Two basically different options were originally proposed for crossing the Marine Canal by the WHSD motorway: (1) a tunnel (to be constructed by underground tunneling method) and (2) a bridge.

Based on a detailed comparative study, the bridge option was selected for further elaboration as the most economically viable and efficient alternative. Three possible options of the structural design and architectural features for the bridge across the Marine Canal were analyzed and compared and finally a continuous beam bridge design was adopted, 55m high above the water level (to allow the passage of very tall ships under the bridge), as the most economically viable and architecturally acceptable alternative. The selected design does not create any adverse visual impacts and it fits harmonically into the surrounding landscape.

This alternative was incorporated in the project design documentation, which was later approved by GlavGosExpertiza. However, in 2011 JSC "WHSD" decided to adopt a different design for the bridge across the Marine Canal. Studies were carried out to construct a bridge with a lifting central span. This would permit a decrease in the bridge height by 10m as compared with the previously adopted option. Such a modification in the bridge design, if it will be adopted finally in the project design documentation, would require the submission of the updated project design documentation to GlavGosExpertiza for repeated consideration and approval.

b) When developing a bridge design across the Korabelny waterway, five alternatives were considered to ensure single-tier or double tier traffic organization and exit at one level to the artificial site at Vasilievsky Island. The proposed options differed from each other by the structural design and the construction cost of the bridges. The cable-stayed bridge design was finally approved as visually most attractive and fitting the architectural concept of St. Petersburg's Marine Facade and the city's image as a whole, despite the fact that the cost of its construction was the highest.

c) Three alternative single-tier bridge designs were proposed for crossing the Petrovsky waterway with different distances between bridge piers.
The bridge design with 60m high piers and with a 210m long central span was selected, as a structure fitting in the best way into the existing architectural landscape.

- **Alternatives for the construction of the motorway section along Vasilievsky Island, i.e. aboveground or as a semi-buried way**

Three alternatives were considered for the motorway section along Vasilievsky Island: (1) in a tunnel at a shallow depth; (2) in an open trench with vertical walls; (3) in an open trench with sloped walls protected by groundwater cutoffs.
Having compared the above three alternatives, it was recommended to select the third alternative. Its construction was the least labor-intensive and did not require a large number of auxiliary facilities and filling of large volumes of artificial ground (as was the case for the first two alternatives).

Furthermore, the selected alternative was visually more attractive for the residents of the dwellings along the Marine Embankment and simplified the construction of passageways/ motor roads between Vasilievsky Island and the Marine Facade.

- **Alternative Locations and Layouts of Interchanges (including those to be constructed in the future)**

Two alternatives were considered for the interchange at the junction with the Makarov Embankment: crossing at different levels with a specific cloverleaf interchange design and a three-tier interchange in the form of a system of semi-direct and loop-shaped exit ramps for each traffic direction. It was finally recommended to select Alternative 2 ensuring all traffic directions within an interchange and the shortest ways for exits to the urban street and road network.

The WHSD Central Section project design also provides for a possibility to connect the new motorway to the exit ramps of some interchanges planned to be constructed in the future (behind Kanonersky Island, at the Shkipersky river arm, at the junction with the Michmanskaya Street, four exit ramps to the Marine Facade at the Makarov Embankment interchange). The longitudinal profiles of the exit ramps are designed taking into consideration the elevations of the main traffic direction and the elevations of the roads in the existing streets and roads. Now when it has been decided that the Krestovsky Stadium will be used after its modernization for football matches of the 2018 World's Football Championship, the issue of the construction of exit ramps from the WHSD motorway to Krestovsky Island has been discussed extensively. However, no design development for such an exit ramp construction has been conducted so far.

- **Roadbed Materials to be Used**

Two alternative roadbed designs were analyzed in the process of the project design development for the motorway sections in trenches and on embankments with different materials for the road base, i.e. on the basis of black crushed stone and on the basis of crushed stone/sand mixture reinforced with cement. The second option was selected because of the lower requirement of inert materials and implying an economically more viable construction technology.

- **Auxiliary Facilities and Services**

The original project design that had passed the environmental review procedure provided for construction of the Project's own facilities for the motorway operation, maintenance and repairs. But later the JSC "WHSD" recognized that it would be optimal to commission specialist contractors for this purpose. Due to this reason, the construction of the required auxiliary facilities was given up and excluded from the Project design.

5.3.3 *Possible Development of the WHSD Central Section and the Associated Infrastructure Facilities*

The demand for transport services in St. Petersburg and Leningradskaya Oblast will depend in the future mainly on the following factors:

- The increasing population (it is expected that by 2025 the population will increase up to 5.3 million as compared with the current 4.84 million);
- Intensification of the economic activity in the city (the gross regional product is expected to grow by 2025 by a factor of 4.3 in comparison with the 2006 level);
- It is predicted that the volume of industrial production will increase by 5 times by 2025 in comparison with the 2006 level);
- An increase in the gross domestic product and in the proportion of services; a growth of the purchasing power of the population.

Taking into account the above factors, it is expected that the need for the WHSD motorway will continue to grow in the future.

Changes in the current functional usage of the areas within the zone directly associated with the WHSD Central Section will entail changes in the transport communications in the foreseeable future. The following factors will influence an increase in the transport streams via the WHSD motorway in the future:

- An increase in the scale of housing construction within the zone associated with the WHSD Central Section – by 2025 the housing area in the western part of the Vasilievsky Island District and in the Petrogradsky District will increase annually by up to 1,485,000 m^2 and 940,000 m^2, respectively.
- Development of the Petrogradsky District as a business, cultural and scientific research center;
- Development of the area of St. Petersburg's Marine Facade as a public, business and administrative zone, as well as an area of prestigious housing.

The construction of the WHSD Central Section will also promote the development of the transport infrastructure facilities within the zone associated by the motorway. The WHSD motorway will not only relieve the transport streams from the Seaport area, but also improve the efficiency of the road connections with the Moskovsky, the Vitebsky and the Baltic Railway Terminals attracting significant streams of private, cargo and public transport and improve also the functioning of the public transport networks. As a result, it will relieve the transport intensity in the historic center of St. Petersburg, which is protected under the auspices of UNESCO.

At the same time, transport connection will be provided from the passenger ferry complex, already constructed at the Marine Facade site, to the main touristic sites, as well as to the recreational and entertainment areas of the city.

6 IMPACT ASSESSMENT

6.1 IMPACT ON SOILS AND LAND RESOURCES

6.1.1 Land Allocation for the Construction of the Motorway and the Associated Infrastructure Facilities

A land area of 31.45 ha has been allocated on a permanent basis for the construction of the WHSD Central Section (roadway, wayside, auxiliary facilities and traffic control system).

In addition, 66.1 ha of the future "Marine Façade" area (used to be the lands of Water Fund) will be used for the WHSD Central Section construction.

Construction sites and temporary access roads will be prepared both within the land allocated on a permanent basis and the land made available for temporary use.

The area of land allocated on a temporary basis for the construction of the Central Section of the motorway is 4.4 ha.

6.1.2 Environmentally Significant Impacts in the Process of the Motorway Construction and Operation

Preparatory and Construction Phases

During the preparatory period all land areas will be cleared and graded, including the complete removal of the fertile topsoil and the filling of the road base in accordance with the technical specifications and regulations related to motorway constructions.

Operational Phase

In the process of the operation of the motorway, under normal conditions, no environmentally significant impacts on the soils are expected within any areas adjacent to the motorway route. This conclusion is based on the fact that the use of any lead-containing additives in fuel is prohibited in the RF. It is equally not expected that any other pollutants would precipitate from the atmosphere in critical quantities within the areas adjacent to the motorway.

As a preventive measure, it is planned to carry out the monitoring of the chemical composition of the soil in the areas adjacent to the future motorway central section in the same way as it has been done at the already completed sections of the WHSD.

The potential environmentally significant impact on the soil in the process of the operation of the motorway is usually caused by the following factors:

- possible wind and water erosion;
- contamination with stormwater and snow-melt water;
- migration of anti-icing reagents to the ground;
- leaks and accidental spills of polluting substances transported over the motorway.

To prevent the negative impact of such factors a range of appropriate measures has been developed (see Section 6.1.6).

6.1.3 *Topsoil Management*

Stripping and separate stockpiling of non-contaminated fertile topsoil suitable for further use will be ensured during the construction phase of the WHSD Central Section as an integral part of any earthmoving operation. Topsoil will be stripped to a depth of up to 20 cm and transferred to the urban parks management department or stockpiled on a temporary basis (up to three years). The overall volume of topsoil to be stripped within the framework of the Project has been specified in the project design.

But, there are no drawings in place with indication of the outlines of the areas where the topsoil is to be stripped. Unless the respective maps can be found in the archives of the organizations that carried out the environmental engineering surveys along the WHSD Central Section route, it will be required to repeat the surveys.

Given the construction timeframe (3 years), the parameters of the topsoil stockpiles should meet the following requirements:

- the maximum stockpile height should be 10 m;
- the slope angle should be determined depending on the properties of stockpiled soils and the natural conditions of a given site.

If it will be required to store topsoil in stockpiles for periods longer than 3 years, it will be necessary to specify in the working documentation that topsoil stockpiles may not be higher than 3 m.

The materials currently available in the JSC "WHSD" with regard to land allocation for construction do not include any maps indicating the areas to be used for temporary topsoil storage.

During the phase of the design the Project documentation by the Partner it will be required to determine the position and the dimensions of the sites designated for temporary topsoil stockpiling and, if required, measures are to be taken to ensure the legalization of the tenant rights for such sites.

6.1.4 *Contaminated Soil Management at the Shkiperskaya Waste Dump Site*

It is planned within the framework of this Project to construct one of the temporary construction yards within the outlines of the former Shkiperskaya waste dump site (located in the south-western part of Vasilievsky Island), which requires the removal/grading of considerable volumes of contaminated soils.

At the same time, the WHSD construction Project design does not address the following issues:

- soil removal procedure;
- hazard class of this types of waste;
- transportation routes and methods for repeated disposal/utilization of this waste type;

- protection of the adjacent part of the Neva Bay against intensification of migration of pollutants from the dump site body disturbed by earthmoving operations;
- land reclamation measures to make the area suitable for temporary accommodation of construction workers (in conformity with the applicable Russian regulatory documents).

In this connection, it is recommended that this intention should be given up and the temporary construction yard be constructed on an existing site of the Marine Facade area, with simultaneous changes in the location of the provisional access roads to the yard.

6.1.5 *Historically Contaminated Soil Management*

According to the data of soil point sampling carried out within the WHSD Central Section route in 2006, some areas are rated as zones of *moderately hazardous* and *hazardous* soil contamination.

The maps indicating the outlines of such areas and the depth of soil contamination are not available in the Project design documentation. Unless those maps are found in the archives of the organizations that carried out environmental engineering surveys along the WHSD Central Section route, it will be required to repeat the soil investigations.

The soils with a hazardous and highly hazardous degree of contamination should be removed and subjected to remediation or disposed of in a landfill for industrial waste disposal. In case of the removal of any soil from a construction site it is categorized as production waste and is to be handled after that in conformity with the applicable waste management rules:

- the procedure for obtaining a permit for soil removal requires the waste hazard class to be determined;
- if the waste is categorized as Hazard Class IV or higher, it is required to prepare a "Hazardous Waste Passport ";
- in addition to the disposal in a special landfill, it is more desirable to use appropriate treatment methods to remediate the contaminated soil to make it suitable for subsequent use in the process of construction work (for filling the roadbed).

In the process of the construction of the abutment walls in the ground and the deepening of a trench for the motorway, as well as the drilling of boreholes for piles on the temporary islands, several thousands of cubic meters of bottom sediments will be excavated. According to an analyses carried out earlier (although only on the basis of random sampling) the bottom sediments can be highly contaminated.

When handling excavated/drilled-out bottom sediments, it will be required to plan measures similar to those foreseen for the contaminated soil management, i.e. identify the waste hazard class and the opportunities/ways for their further utilization.

6.1.6 *Soil and Land Resources Protection Measures*

The design of the WHSD motorway in its Central Section (on flyovers and bridges or in a trench and tunnel) will ensure, in case of appropriate land reclamation after the completion of the construction, a significant reduction in the probability of wind and water related erosion of the soils in the adjacent areas.

In order to prevent any damage to land resources during the construction phase the following mitigation measures will be taken:

- Complete covering of the ground surface in temporary construction yards, as well as access roads to them, with concrete slabs to minimize the migration of pollutants to the ground;
- Proper equipment of parking and fuel filling areas for machinery and vehicles to prevent the migration of petroleum products into the ground.

After the completion of the construction work, land reclamation and revegetation is planned to be carried out in order to restore the disturbed areas of soils (delivery and filling of certified clean soil).

The final land reclamation plans will be drawn up prior to the completion of the construction.

Within the planned WHSD Central Section the scope of the earthmoving and the reclamation work will be minimal, as the land allocated for the construction of this motorway section falls mainly under the category of urbanized and industrial land, just as the newly filled Marine Facade site.

On the other hand, the scope of the earthmoving and the reclamation work at the motorway's northern section will be much more extensive, because the motorway will predominantly run on land earlier classified as farming and forest land.

Along the motorway's Southern Section, most of the reclamation work has already been completed and the reclaimed land has been found acceptable by the supervisory agencies. At the motorway's northern section, the process of topsoil stripping and stockpiling has been in progress, as of May 2011.

To prevent potential adverse impacts on soils during the WHSD operational phase, the following measures are planned:

- reinforcement of the roadbed slopes (along the short road segments running on the embankments);
- stormwater runoff drainage systems with appropriate treatment facilities, including head tanks capable to contain any volume of hypothetically possible spills of chemicals on the motorway;
- application of mechanical means (sand and gravel mixtures) to prevent icing and to avoid the contamination of the soils in the adjacent areas.

6.2 *IMPACT ON THE GEOLOGICAL ENVIRONMENT*

The construction of the WHSD Central Section predominantly consisting of flyover structures will not entail the creation of artificial surface relief forms over any extended stretches of the motorway, such as embankments and dams, and therefore does not require any special measures to be taken for the protection of the geological environment.

Embankments of limited length at transitions from the flyover to the trench at the south-western and north-western ends of Vasilievsky Island and at the exit ramps to the Makarov Embankment will be constructed on pile foundations. Their design incorporates several layers of geo-grids and their over 3 m high lateral sides will be made vertical as reinforced concrete structures. Only lower embankments will have slopes reinforced with geo-grids, covered with fertile soil and sown with grass. This will prevent the water erosion of the slopes.

Considerable amounts of soils/ bottom sediments will be excavated in the process of the construction of a trench for the motorway along the western edge of Vasilievsky Island. To prevent any quicksand phenomena, 'walls in the ground' will be constructed at the western and eastern sides of the future motorway prior to the excavation of the trench. The trench slopes will have a drainage system to drain any water migrating to the soils and will be reinforced with special geo-grids.

Provided that the applicable civil engineering regulations and technologies will be complied with, any significant impacts upon the geological environment will be associated with a rather limited disturbance of the geological environment and will only take place during the construction phase.

During the operational phase of the motorway no significant impacts on the existing geological environment are expected.

However, the construction of artificial structures and bridges within the Neva Bay water area requires that the complex engineering geological conditions be thoroughly taken into account due to the occurrence of weak waterlogged quicksand and thixotropic soils within the upper horizons of the Quaternary deposits.

In this connection, risks of negative impact on the properties of the geological environment, and as a consequence, impact of unfavorable engineering geological processes upon the main motorway structures can take place in case of deviations from the pertinent civil engineering regulations.

Stringent supervision over compliance with the civil engineering regulations is required in the process of construction, as well as the monitoring of the subsidence and the deformations of the bearing motorway structures after the completion of the construction.

6.3 *ATMOSPHERIC AIR PROTECTION*

6.3.1 *Introduction*

In order to clarify the Project decisions with regard to the WHSD Central Section construction, ERM has repeatedly assessed the potential atmospheric air pollution in the residential areas of Kanonersky Island and on the Marine Embankment of Vasilievsky Island (Figures 6.3-1 and 6.3-3).

Negative impacts on the atmospheric air quality were assessed both for the construction phase (construction machinery and mechanisms) and operational phase (road traffic streams) of the Project.

Calculations of emissions of pollutants and their dispersion in the atmosphere were made in conformity with the regulatory methodological guidelines currently applicable in the Russian Federation.

Table 6.3-1 contains maximum permissible one-time concentrations ($MPC_{ints.}$) of 22 harmful pollutants that will be released to the atmosphere as a result of the operation of construction machinery and later from the vehicles moving on the motorway.

The calculations of predicted atmospheric air pollution levels (maximum one-time concentrations as a mean of 20-minute periods) were made with the aid of a certified software program "Garant-Universal 3.0m" using the regulatory methodology specified in the regulatory document OND-86. This software was certified by Russia's GosStandard Standardization Committee and recommended for application by the RF Ministry of Natural Resources and RosPotrebNadzor Agency.

Table 6.3-1 Pollutants released during the construction and operational phases of the WHSD Project and their $MPC_{ints.}$ in the atmospheric air

Ser. Nos.	Description of pollutants	Ref.No. in CAS Register	Chemical formula	Hazard Class	MPC_{inst}, mg/m^3
1	Iron (II) (III) oxides	1309-37-1	FeO, Fe_2O_3	3	0.04
2	Management and its compounds (as MnO_2)	-	-	2	0.01
3	Nitrogen dioxide	10102-44-0	NO_2	3	0.2
4	Nitrogen oxide	10102-43-9	NO	3	0.4
5	Carbon black	1333-86-4	C	3	0.15
6	Sulfur dioxide	7446-09-5	SO_2	3	0.5
7	Carbon monoxide	630-08-0	CO	4	5.0
8	Gaseous fluorides	7664-39-3	HF	2	0.02
9	Inorganic fluoride compounds (as fluorine)	-	-	2	0.2
10	Kerosene (vapor)	8008-20-6	-	-	-
11	Particulate matter	-	-	3	0.5
12	Inorganic dust: 70-20% SiO_2	-	-	3	0.3
13	Particulate matter PM2.5	-	-	-	0.16
14	Benzene	71-43-2	C_6H_6	2	0.3
15	Benz(a)pyrene	50-32-8	$C_{20}H_{12}$	1	0.00001
16	Formaldehyde	50-00-0	CH_2O	2	0.035
17	Methyl benzene (toluene)	108-88-3	C_7H_8	3	0.6
18	Dimethyl benzene (xylenes)	1330-20-7	C_8H_{10}	3	0.2

19	Acrolein (porp-2-en-1-al)	107-02-8	C_3H_4O	2	0.03
20	Acetaldehyde	75-07-0	C_2H_4O	3	0.01
21	1,3-butadiene	106-99-0	C_4H_6	4	3.0
22	Ethylene benzene (styrene)	100-42-5	C_8H_8	2	0.04

Calculations of the atmospheric air pollution during the construction and operational phases of the WHSD Project were made for summer period as the most unfavorable season for pollutants dispersion in the atmosphere. Specific parameters of the atmosphere in St. Petersburg were taken into account in the calculations.

According to Roshydromet's data, the following baseline concentrations of pollutants, which are to be taken into account for the calculations, were adopted for the WHSD Central Section design:

- Carbon monoxide - 1.7 mg/m^3 or 0.34 MPC_{inst};
- Nitrogen dioxide - 0.124 mg/m^3 or 0.62 MPC_{inst};
- Formaldehyde - 0.009 mg/m^3 or 0.26 MPC_{inst}.

Calculations of pollutants dispersion in the atmosphere and plotting of maps of air pollution on Kanonersky Island were made for an area of 400m x 460m (Figure 6.3-4) at intervals of 20m along the X and Y axes. For Vasilievsky Island a larger area was considered with an interval of 50m.

6.3.2 *Construction Phase*

The overall duration of the construction phase for the WHSD Central Section will be 41 months.

The construction procedure consists of 20 different stages of construction operations. Table 6.3-2 presents the list of the construction machinery to be operated simultaneously in the course of those stages; Table 6.3-2 provides a list of the machinery to be operated at the temporary camp sites.

Table 6.3-2 A list of machinery to be used at the different stages of the construction of the flyover on Kanonersky Island and the motorway, the tunnel and the interchange on Vasilievsky Island

Ser. Nos.	Construction stages	Description of machinery	Model	Engine power, kW	Number of units
1.	**Preparatory period**				
1.1	Preparation of construction sites and provisional roads	Excavator	JCB 1CX, 0.25 m³	34,5	1
		Bulldozer	Komatsu D20P-7E	29,4	1
		Truck crane	Ivanovets KS-3577, 14 t	22,9	1
		Dump truck	KamAZ 5511	165	3 per hour
		Fork-lift truck	FR-130.2 Fiat Hitachi	41	1
		Compaction roller	HAMM HD 14 VV	34,6	1
2.	**Construction of flyover piers**				
2.1	Installation of drilled piles	Boring machine	KATO 50 THC-VS III	100	1
		Crawler crane	RDK-25	74	1
2.2	Construction of enclosing sheeting	Vibration-type driver	V-401B	8 (electric)	1
		Crawler crane	RDK-25	74	1
2.3	Excavation of foundation pits	Excavator	JCB 1CX, 0.25 m³	34,5	1
		Dump truck	KamAZ 5511	165	3 per hour
2.4	Concreting of foundations	Concrete mixer truck	SB-92B-2	37	3 per hour
2.5	Concreting of piers	Concrete mixer truck	SB-92B-2	37	5 per hour
		Concrete pump	BN-40	37	1
		Concrete pump	BSA-1400-HP-D	365	1
		Tower crane	Hoisting capacity 12 t, Potain	56 (electric)	1
3.	**Construction of abutment walls and bases**				
3.1	Installation of drilled piles	Boring machine	KATO 50 THC-VS III	100	1
		Crawler crane	RDK-25	74	1
3.2	Construction of enclosing sheeting	Vibration-type driver	V-401B	8 (electric)	1
		Crawler crane	RDK-25	74	1
3.3	Excavation of foundation pits	Excavator	JCB 1CX, 0,25 м³	34,5	1

		Dump truck	KamAZ 5511	165	3 per hour
3.4	Concreting of base foundation	Concrete mixer truck	SB-92B-2	37	2 per hour
3.5	Concreting of abutment was foundations	Concrete mixer truck	SB-92B-2	37	2 per hour
3.6	Concreting of base body	Concrete mixer truck	SB-92B-2	37	2 per hour
		Concrete pump	BN-40	37	1
3.7	Installation of abutment wall blocks	Crawler crane	RDK-25	74	1
4.	**Installation of flyover span structures**				
4.1	Installation of span structures	Liebherr truck crane»	LTM 1090/3, hoisting capacity 90 t	145	2
		Tower crane	MD-900	56 (electric)	1
		Derrick crane	MDK-63	52 (electric)	2
		Welding unit	TSD-500	20 (electric)	2
5.	**Tunnel construction**				
5.1	Construction of the 'wall in the ground'	Boring machine	Casagrande C90	104	1
		Concrete pump	BN-40	37	1
		Crawler crane	RDK-25	74	1
		Concrete mixer truck	SB-92B-2	37	2 per hour
		Bentonite pump	ZT-600/10	55	1
5.2	Installation of drilled piles	Boring machine	KATO 50 THC-VS III	100	1
		Crawler crane	RDK-25	74	1
5.3	Excavation of foundation pit	Excavator	JCB 1CX, 0.25 m^3	34,5	2
		Dump truck	KamAZ 5511	165	3 per hour
		Gantry crane with clamshell bucket	KKTS-20	80 (electric)	1
		Wheel loader	WA 150-5 Komatsu	73	2
5.4	Installation and concreting work	Truck crane	Ivanovets KC-3577, 14 t	22,9	1
		Gantry crane	KKTS-20	80 (electric)	1
		Welding unit	TSD-500	20 (electric)	2
		Concrete pump	BN-40	37	2
		Truck	ZIL 433360	110	2 per hour
		Concrete mixer truck	SB-92B-2	37	4 per hour
6.	**Road construction work**				

6.1	Construction of road base	Excavator	JCB 1CX, 0,25 м^3	34,5	1
		Bulldozer	Komatsu D20P-7E	29,4	1
		Compaction roller	HAMM HD 14 VV	34,6	1
		Dump truck	KamAZ 5511	165	3 per hour
6.2	Construction of road pavement	Asphalt-concrete spreading machine	DS-195	44,1	1
		Paver	DS-39Б	110	1
		Dump truck	KamAZ 5511	165	3 per hour
		Vibration-type pavement roller	ДУ-98	57,4	1
7.	**Site improvement**				
7.1	Site improvement and revegetation	Excavator	JCB 1CX, 0,25 м^3	34,5	1
		Fork-lift truck	FR-130.2 «Fiat Hitachi»	41	1
		Bulldozer	«Komatsu» D20P-7E	29,4	1
		Dump truck	KamAZ 5511	165	3 per hour
		Compaction roller	HAMM HD 14 VV	34,6	1

Table 6.3-3 A list of machinery to be used at the temporary construction yards

Ser. Nos.	Construction stages	Description of machinery	Model	Engine power, kW	Number of units
1.1	Warming-up of engines in parking areas and driving out of construction yard site	Excavator	JCB 1CX, 0.25 m^3	34,5	2
		Bulldozer	Komatsu D20P-7E	29,4	2
		Crawler crane	RDK-25	74	1
		Truck	ZIL 433360	110	1
		Concrete pump	BN-40	37	1
		Truck crane	Ivanovets KC-3577, 14 t	22,9	1
1.2	Work to be carried out at the yard site	Fork-lift truck	FR-130.2, Fiat Hitachi	41	1
		Welding unit	TSD-500	20 (electric)	1
		Truck crane	Ivanovets KC-3577, 14 t	22,9	1
		Diesel generator	FG Wilson P60 P3	60	1
		Dump truck	KamAZ 5511	165	3 per hour
		Compressor station	PV-10/M1	74	1

Some temporary construction sites, construction yards and temporary roads will be located in the direct vicinity of residential areas (Figures 6.3-4 – 6.3-6) and they will be the main sources of the emission of pollutants.

Calculations of air emissions were made for all construction stages and for each group of construction machinery. Then to assess the maximum impact on the atmospheric air, a construction scenario with a maximum air emission level was selected based on the construction time schedule. It turned out that it will be the drilling of boreholes for pile foundations for the flyover on Kanonersky Island and the interchange at the Makarov Embankment, as well as the construction of the "wall in the ground" in case of the Marine Embankment on Vasilievsky Island.

In construction yards, the worst situation with regard to air emissions is generated by operating machinery installed at the yard sites, including the diesel generator and the compressor station.

Tables 6.3-4 and 6.3-5 present the emission values for the most problematic substance, i.e. nitrogen dioxide (NO_2).

Table 6.3-4 Maximum instantaneous nitrogen dioxide emissions in the process of the motorway construction on Kanonersky Island

Construction stages	NO_2 emissions, g/s
Operation of machinery at construction camp site	0.023
Installation of drilled piles	0.0068
Pier concreting	0.022
Installation of enclosing sheeting	0.0034
Excavation of foundation pit	0.004
Traffic of vehicles of provisional road	0.00053
Traffic of vehicles of provisional road	0.0009
Traffic of vehicles of provisional road	0.001

Table 6.3-5 Maximum instantaneous nitrogen dioxide emissions in the process of the motorway construction on Vasilievsky Island

Construction stages	NO_2 emissions, g/s
Operation of machinery at construction camp site	0.023
Installation of the 'wall in the ground'	0.134
Installation of drilled piles	0.007
Traffic of vehicles of provisional road	0.015
Traffic of vehicles of provisional road	0.0035
Traffic of vehicles of provisional road	0.0023
Traffic of vehicles of provisional road	0.0011

The results of calculations of the atmospheric air pollution levels with regard to the most problematic pollutants (i.e. nitrogen dioxide and carbon monoxide) in the residential area during the construction phase are presented in Tables 6.3-6 and 6.3-7. Figures 6.3-7 – 6.3-9 demonstrate the prognosticated field of the atmosphere pollution with respect to nitrogen dioxide.

Table 6.3-6 Expected maximum levels of atmospheric air pollution (taking also into account the baseline pollution) at the facades of the residential buildings located in the direct vicinity of the WHSD construction zone on Kanonersky Island

Reference points	**House Nos.**	**Atmospheric air pollution level at facades of buildings, portion of MPC_{inst}**	
		Nitrogen dioxide	Carbon monoxide
PT1	School, House 32B	0.75	0.353
PT2	Customs Office, House 32	0.84	0.365
PT3	Kindergarten, House 18	0.88	0.369
PT4	House 19	0.81	0.361
PT5	House 16	0.74	0.354
PT6	House 14	0.82	0.363
PT7	House 12 / Building2	0.85	0.367

Table 6.3-7 Expected maximum levels of atmospheric air pollution (taking also into account the baseline pollution) at the facades of the residential buildings in the first line of buildings at the Marine Embankment on Vasilievsky Island during the WHSD construction

Reference points	**House Nos.**	**Atmospheric air pollution level at facades of buildings, portion of MPC_{inst}**	
		Nitrogen dioxide	Carbon monoxide
PT1	House35/ Building 3	0.66	0.35
PT2	House31	0.71	0.36
PT3	House23	0.70	0.36
PT4	House34 / Building 1	0.78	0.37
PT5	House30 / Building 5	0.63	0.36
PT6	House17	0.70	0.37
PT7	House15	0.76	0.38
PT8	Aquapark	0.72	0.36
PT9	House9/ Building 2	0.75	0.37

The calculation results, referring to the pollutants dispersion in the atmospheric air during the motorway construction phase, suggest the following conclusions:

1. A negligible level of air pollution (<0.01 MPC_{inst}) is expected with regard to pollutants such as manganese, fluorine and kerosene vapors.

2. A low level (up to 0.1 MPC_{inst}) of atmospheric air pollution with regard to pollutants such as iron oxides, carbon black particles, inorganic dust and nitrogen oxide. The contribution of construction machinery to air pollution with carbon monoxide will be insignificant, i.e. not more than 0.03 MPC_{inst}.
3. Atmospheric air pollution with particulate matter in the process of the foundation pit excavation is not expected to exceed 0.15 MPC_{inst}.
4. The MPC_{inst}. of nitrogen dioxide (including the baseline level) will not exceed 0.9 MPC_{inst} on Kanonersky Island and 0.8 MPC_{inst} on Vasilievsky Island.

This means that during the construction phase there will be no risks for public health in terms of atmospheric air pollution.

6.3.3 *Motorway Operational Phase*

The maximum design traffic intensity on the motorway in both directions is 10,800 vehicles per hour. The design speed on the interchange at the Makarov Embankment (Figure 6.3-12) is 40 to 60 km/hour and the traffic intensity on certain road sections (including those planned to be constructed later, i.e. not within the framework of the WHSD Central Section project) will be as follows:

- Exit ramp 1 - 720 vehicles per hour
- Exit ramp 2 - 50 vehicles per hour
- Exit ramp 3 - 450 vehicles per hour
- Exit ramp 4 - 200 vehicles per hour
- Exit ramp 5 - 950 vehicles per hour
- Exit ramp 6 - 530 vehicles per hour
- Exit ramp 7 - 650 vehicles per hour

Table 6.3-8 indicates the design vehicle types for the motorway. The proportion of passenger cars in the overall traffic stream will be 88.7%. The same table provides a forecast for 2016 (i.e. after commissioning of the WHSD Central Section) with regard to the environmental classification of each type of the vehicles.

Table 6.3-8 Composition of traffic streams on the motorway

Type of vehicles	Proportion in traffic stream, %	Environmental category of vehicles, %			
		EURO 0	EURO I	EURO II	EURO III-V
Passenger cars	88.7	12	20	29	39
Trucks with gasoline engines, capacity <3.5 t	2.7	10	30	36	24
Trucks with diesel engines, capacity <3.5 t	0.6	7	18	40	35
Trucks with gasoline engines, capacity >3.5 t	1.8	14	28	38	20
Trucks with diesel engines, capacity >3.5 t	5.1	8	20	39	33
Buses	1.1	12	25	32	31

It is expected that the exhaust gas released from the motorway will contain 14 pollutants: nitrogen oxide and dioxide, sulfur dioxide, carbon monoxide, particulate matter PM2.5 and a extensive group of organic compounds including formaldehyde and benz(a)pyrene.

Emissions of such harmful pollutants as carbon monoxide and nitrogen dioxide released in large quantities from one vehicle in terms of g/km (as a weighted mean of the traffic stream composition) at an average traffic speed of 80 km/hour are 3.6 g/km of CO and 1.3 g/km of NOx. The following coefficients characteristic for St. Petersburg's conditions were assumed to take into account nitrogen oxides transformation: 0.53 for NO_2 and 0.3 for NO.

The subject areas of the motorway were assumed for the purpose of pollutants dispersion calculations to be straight aerial emission sources. The emission sources on Kanonersky Island will be 45m high (flyover). On Vasilievsky Island 42 air pollution sources were incorporated in the calculations (for this purpose the motorway was divided into individual sections), including tunnel portals and emission sources of different height at the interchange at the Makarov Embankment.

Calculations of the dispersion of pollutants released from the motorway on Kanonersky Island have indicated that nitrogen dioxide will make the most significant contribution to atmospheric air pollution. However, since the flyover will be elevated to a considerable height above the ground level (it will be higher by 30m than the tops of buildings), additional pollution of ambient air at the residential buildings due to the traffic on the flyover will be equal to only 0.2 of the regulatory $MPC_{inst.}$ value. Taking into account the existing baseline pollution level the maximum one-time nitrogen dioxide concentrations will not exceed 0.82 $MPC_{inst.}$ (see Figure 6.3-10).

The carbon monoxide concentration in the ambient air due to the emissions from the flyover will not exceed 0.04 MPC_{inst} and taking into account the current baseline pollution level the overall carbon monoxide concentration will be no more than 0.38 $MPC_{inst.}$

The contribution of the motorway to the air pollution with formaldehyde will be negligible and amount to a maximum of 0.015 $MPC_{inst.}$, and the overall formaldehyde concentration with the existing baseline level will be 0.26 $MPC_{inst.}$

The expected air pollution with other pollutants will be insignificant, i.e. less than 0.01 $MPC_{inst.}$

On Vasilievsky Island, where the motorway will run in a trench, the situation will be different. The computed values of the atmospheric air pollution with nitrogen dioxide and carbon monoxide along this motorway segment are given in Table 6.3-9 (reference points) and illustrated in Figures 6.3-11 and 6.3-12.

Table 6.3-9 Expected maximum air pollution levels (including baseline pollution levels) at the facades of the nearest residential buildings at the Marine Embankment on Vasilievsky Island during WHSD operational phase

Reference points	**House Nos.**	**Atmospheric air pollution level at facades of buildings, fraction of MPC_{inst}**	
		Nitrogen dioxide	Carbon monoxide
PT1	House 35/ Building 3	1.11	0.50
PT2	House 31	1.15	0.52
PT3	House 23	1.06	0.49
PT4	House 34 / Building 1	1.03	0.48
PT5	House 30 / Building 5	1.18	0.53
PT6	House 17	1.06	0.49
PT7	House 15	1.08	0.50
PT8	Aquapark	1.09	0.50
PT9	House 9/ Building 2	1.04	0.48

An analysis of the results obtained indicates that under the worst possible conditions the maximum one-time nitrogen dioxide concentrations in the ambient air at the facades in the nearest line of residential buildings at the Marine Embankment will exceed the regulatory limit by 5% to 15%. The contribution of the motorway to the overall air pollution with nitrogen dioxide will be 40% to 47%.

In the area of the interchange (see Figure 6.3-12) several buildings in the second line of residential buildings will also be within the zone of non-compliance with the regulatory $MPC_{inst.}$ values.

For interpretation of the obtained assessments it should be taken into consideration that for low emission sources, including the tunnel portals and traffic streams on the motorway, the adverse wind velocity is 0.5 m/s. Furthermore, adverse weather conditions for such emission sources also include lower inversions, and as a consequence, poor vertical mixing of the atmosphere.

The frequency of occurrence of such weather conditions in St. Petersburg for all wind directions does not exceed 3% or 11 days per year. Pollutants from the motorway to the Marine Embankment will be transferred by westerly winds (the total occurrence frequency is 46%). Taking into account the fact that intensive traffic will last for maximum 14 hours per day, the total duration of adverse situations with an elevated level of air pollution with nitrogen dioxide in the residential areas at the Marine Embankment will only be about 70 hours per year.

The contribution of the traffic stream on the motorway to the air pollution with carbon monoxide in the residential areas of Vasilievsky Island can be as high as 35%. However, even taking into account the existing baseline pollution level, the overall maximum one-time carbon monoxide concentrations will not exceed 0.55 $MPC_{inst.}$

It is expected that the air pollution with formaldehyde during the motorway operational phase will be insignificant, i.e. an increase by not more than 0.08 $MPC_{inst.}$

Taking into consideration the baseline level the maximum one-time formaldehyde concentrations can reach a level of 0.34 $MPC_{inst.}$

It is predicted that the atmospheric air pollution at the Marine Embankment with other pollutants will be insignificant.

It may be therefore concluded that during the WHSD operational phase:

In the residential zone on Kanonersky Island the Russian sanitary requirements related to the atmospheric air quality will be met;

Sanitary requirements for nitrogen dioxide concentrations along the motorway segment at the western edge of Vasilievsky Island will exceed the limits during certain periods (not more than 70 hours per year).

The expected non-compliance with sanitary requirements (although only during short periods of time) will be a negative factor for the residents of that district, because currently the western part of Vasilievsky Island is one of the most favorable parts of St. Petersburg with regard to atmospheric air quality.

In the course of time (by 2020-2022), when the proportion of the vehicles of the environmental classes Euro 0 to Euro 2 will decrease, an improvement of the ambient air quality can be expected within the residential areas on Vasilievsky Island adjacent to the WHSD motorway helping to ensure consistent compliance with the applicable sanitary norms.

In spite of this an automated monitoring system should be set up to monitor nitrogen dioxide concentrations at the Marine Embankment by the time of the commissioning of the WHSD; this system should ensure appropriate traffic control measures, such as the limitation of the traffic stream on the WHSD motorway /temporary restriction of lower environmental class vehicles.

6.4 *PREDICTED REDUCTION IN GREENHOUSE GAS EMISSIONS (GHG) FOR ST. PETERSBURG DUE TO THE WHSD MOTORWAY OPERATION*

The WHSD Central Section will connect the WHSD motorway to the other motorway sections constructed earlier. It is expected that the traffic intensity on the new motorway will be up to 80,000 vehicles per day (in both directions).

It is expected that the traffic in the following parts of the city will be relieved as indicated in table 6.4-1 below.

Table 6.4-1 Expected traffic retargeting with regard to the WHSD Central Section operation

Description of motorway section	Current daily throughput capacity	Relieve (%) due to WHSD	Traffic stream expected on WHSD (vehicles per day)
Ring Road	80,000	20%	16,000
Seaport zone	15,000	80%	12,000

Vasilievsky Island	50,000	40%	20,000
Primorsky District	100,000	15%	15,000
Yuzhny (Southern) District	100,000	15%	15,000
Other districts of the city	100,000		2,000

The overall reduction of the travelled distance in kilometers by vehicles due to the use of the WHSD motorway is 7 km throughout the city, and 15 km in relation to the Ring Road.

The average fuel requirement per vehicle is 12 liters per 100 km under the traffic conditions within the city, and 9 liters per 100 km in case of the Ring Road.

As a result, due to the change in the traffic routes of the vehicles in favor the WHSD motorway (similar to that on the Ring Road) optimally the average daily fuel requirement will decrease by 75,400 ltr.

The combustion of this quantity of fuel would result in the release of approximately 170 tons of CO_2 per day.

By calculating the annual reduction of the CO_2 emissions due to the operation of WHSD motorway and by using a factor of 0.8 to take into account the seasonal incomplete usage of roads, it may be assumed that it amount to approximately 50,000 tonnes of CO_2. This value, although very low in scale (the permissible increase in GHG emissions for Russia is more than 1 billion tonnes), is still significant as a positive contribution of the WHSD motorway to the reduction of GHG emissions in St. Petersburg.

6.5 PHYSICAL IMPACT FACTORS

6.5.1 Noise impact

6.5.1.1 Introduction

An assessment of variable noise levels (noise generated by construction machinery or by road traffic during the operational phase) to verify their compliance with the permissible values was made both on the basis of equivalent and maximum noise levels. Exceedence of any of the two parameters was considered as non-compliance with the regulatory norms.

The permissible values of equivalent and maximum outdoor and indoor noise levels of residential and public buildings of various functional uses, according to the Sanitary Norm SN 2.2.4/2.1.8.562-96 "Noise levels at workplaces, in residential and public buildings and outdoors in residential areas", are provided in Table 6.5-1.

Table 6.5-1 The permissible values of equivalent and maximum outdoor and indoor noise levels of residential and public buildings of various functional use

Description of parameters	Noise level L_A and equivalent noise level, $L_{Aequiv.}$, dBA	Maximum noise level, L_{Amax}, dBA
Outdoors in areas directly adjacent to residential		

buildings, buildings of polyclinics, outpatients' clinics, dispensaries, recreational facilities, boarding houses, pre-school educational institutions, schools and other educational institutions, libraries:		
• from 07:00 AM until 11:00 PM	55	70
• from 11:00 PM until 07:00 AM	45	60
Recreational areas within residential districts and groups of residential houses, recreational facilities, pre-school educational institutions, schools and other educational institutions	45	60
Residential rooms in apartments, sleeping rooms in pre-school educational institutions and in boarding schools:		
• from 07:00 AM until 11:00 PM	40	55
• from 11:00 PM until 07:00 AM	30	45

The noise generating characteristic of construction machinery and road traffic is the maximum and equivalent noise level determined at a distance of 7.5 m from the noise source. For construction machinery this parameter has been determined on the basis of the data provided by the respective machinery manufacturer, as well as on the basis of the measurements made earlier, within the frame of an assignment, by the JSC "WHSD"" during the monitoring process of the construction of the WHSD Southern and Northern Sections.

For future road traffic streams on the WHSD motorway this parameter has been calculated based on the design traffic speed, the traffic type and intensity, the slopes, the types and conditions of roadway pavement (dry or wet).

Calculations of the noise levels imposed on residential areas have been made using the calculation module of the software package "Garant-Universal". This software is recommended for use by the RosPotrebNadzor Agency of Russia. The calculations were made with due consideration of the built-up areas, which serve as noise-attenuating barriers.

6.5.1.2 *Construction Phase*

Similarly to air emissions, it has been found that the worst scenario with regard to noise related impacts is associated with the drilling of boreholes for pile foundations on Kanonersky Island and with the construction of the "wall in the ground" on Vasilievsky Island.

The combined effect of mutually superimposed noise levels generated at the construction yards by operating machinery, including a diesel-driven power generator and a compressor station, was taken into account in the calculations.

The noise levels that will be generated at different stages of the construction operations on Kanonersky and Vasilievsky Islands are given below in Tables 6.5-2 and 6.5-3.

Table 6.5-2 Main noise sources during the motorway construction on Kanonersky Island

Construction stages	Noise levels	
	L_{Amax}, dBA	$L_{Aequiv.}$, dBA
Machinery operation at construction yard	85.6	84.5
Driving of drilled piles	93.7	91.8
Concreting of piers	95.1	90.1
Construction of enclosing sheeting	91.8	91.0
Excavation of the pit	71.0	66.5
Provisional road	79.0	74.0
Provisional road	80.4	75.4
Provisional roads	81.5	76.5

Table 6.5-3 Main noise sources during the motorway construction on Vasilievsky Island

Construction stages	Noise levels	
	L_{Amax}, dBA	$L_{Aequiv.}$, dBA
Machinery operation at construction yard	85.6	84.5
Construction of "wall in the ground"	99.9	97.9
Driving of drilled piles	93.7	91.8
Provisional road	83.0	78.0
Provisional roads	80.8	75.8
Provisional roads	81.8	76.8
Provisional roads	79.0	74.0

The results of the equivalent and maximum noise levels, during the noisiest phase of the construction, imposed on the nearby residential areas are given in Tables 6.5-4 and 6.5-5.

Table 6.5-4 Predicted equivalent and maximum noise levels during the bridge construction on Kanonersky Island

Ref. point	House Nos.	Maximum noise level, $L_{Amax.}$, dBA	Equivalent noise level, $L_{Aequiv.}$, dBA	Required reduction, $L_{Amax.}$, dBA	Required reduction, $L_{Aequiv.}$, dBA
PT1	School, House 32B	77.9	73.1	7.9	18.1
PT2	Customs Office, House 32	85.7	83.7	15.7	28.7
PT3	Kindergarten, House 18	81.1	78.3	21.1	33.3

PT4	House 19	69.7	65.0	-	10.0
PT5	House 16	66.8	61.8	-	6.8
PT6	House 14	71.2	66.6	1.2	11.6
PT7	House 12, Building 2	75.7	73.6	5.7	18.6

Table 6.5-5 Predicted equivalent and maximum noise levels during the motorway construction on Vasilievsky Island

Ref. point	House Nos.	Maximum noise level, L_{Amax}., dBA	Equivalent noise level, L_{Aequiv}., dBA	Required reduction, L_{Amax}., dBA	Required reduction, L_{Aequiv}., dBA
PT1	House 35 к.3	68.6	65.4	-	10.4
PT2	House 31	75.9	73.7	5.9	18.7
PT3	House 23	78.1	75.8	8.1	20.8
PT4	House 34 к.1	81.0	79.4	11.0	24.4
PT5	House 30 к.5	84.7	82.8	14.7	27.8
PT6	House 17	73.9	70.6	3.9	15.6
PT7	House 15	74.9	72.0	4.9	17.0
PT8	Аквапарк	75.2	72.2	5.2	17.2
PT9	House 9, Building 2	75.0	71.7	5.0	16.7
PT10	House 22, Building 2,(Kindergarten)	45.3	40.7	-	-
PT11	House 22, Building 3 (Kindergarten)	45.0	40.6	-	-
PT12	House 15, Building 2 (School)	43.3	38.8	-	-

The permissible noise levels were determined based on the daytime limits because the construction work near the residential areas will be carried out, according to the WHSD Project design, during daytime and suspended for the period from 11:00 PM until 07:00 AM.

According to the calculations, the equivalent and maximum noise levels in the areas adjacent to the construction sites will exceed the sanitary norm of 55 dBA applicable to areas directly adjacent to residential buildings. The actual level can exceed the limits for the maximum and equivalent noise levels by up to 16 dBA and 29 dBA, respectively.

The situation will be the most problematic on Kanonersky Island. As a solution the WHSD construction design provides for the following measures (Figure 6.3.1):

- Resettle the residents of Houses 15 and 17, two sections of House 12/Building 2 and three sections in House 16;
- Close the kindergarten in House 20 and construct a new kindergarten at an appropriate distance from the WHSD route;
- Install sound-proof window frames in three residential buildings with passive ventilation reducing the noise level by 32 dBA;

- Construct fencing made of 3m high concrete slabs at the construction camp located near House 12 / Building 2.

However, as it can drawn from the data in Table 6.5.5 and 6.5.1, there are more than three residential buildings located within the zone where the noise level will exceed the allowed limit (assessed as part of the Construction Project Design) that require resettlement. Based on the listed data there are at least seven residential buildings that do require resettlement, as well as School No.379 and the Customs Office building.

This means that in addition to the measures foreseen in the WHSD Construction Project Design, prior to the start of the construction it will be required on Kanonersky Island to install soundproof window frames in order to ensure a noise level reduction of up to 38 dBA.

On Vasilievsky Island all kindergartens are located behind a line of multi-story apartment buildings, and therefore the noise level within the kindergarten sites will not exceed the allowed sanitary and hygienic limits.

However, for the first line residential buildings on the Marine Embankment, the noise level during the construction phase will exceed the regulatory limit.

Due to this reason, as it is taken into account in the Project documentation, the existing window frames in the apartments facing the Marine Embankment will be replaced with soundproof window frames (reducing the noise exposure by 32 dBA).

Furthermore, it is also recommended to:

1) Consider the possibility to carry out construction operations involving the use of construction machinery only during the period from 08:00 AM until 09:00 PM;

2) Use advanced machinery and mechanisms with a low sound power level.

6.5.1.3 *Operational Phase*

The main noise level indicator for the traffic stream during the operation of the WHSD motorway will be the equivalent noise level.

For the calculation of the equivalent noise level the traffic intensity, the traffic composition and the average traffic speed were taken into account for the different sections of the WHSD, as well as for the slope of the road and for the type of road paving. It was also taken into consideration that adverse weather conditions (rain, snow, dirt) enhance the noise level caused by moving vehicles by 2 dBA.

It was assumed that the average traffic speed will be 80 km/hour on the motorway and 60 km/hour on the exit ramps and the interchanges.

When calculating the acoustic conditions on Kanonersky Island, it was taken into account that the traffic related noise sources will be located on a 45-m high two-tier flyover.

When calculating the noise pollution level on Vasilievsky Island it was considered that two motorway segments will be located in a trench with lateral slopes partially covered by four driveways and with the central segment being constructed in a tunnel. It was also taken into account that the jet-type ventilation system in the tunnel can also cause some noise from time to time. The noise level of an operating fan is 75 dBA. The total noise impact level from each tunnel portal will be 81 dBA.

The traffic intensity during night hours (i.e. from 11:00 PM until 07:00 AM) was assumed to be 5 times lower than during daytime.

To assess the noise impact caused by traffic streams, the motorway and the exit ramps of different height were divided into areal noise sources: two for Kanonersky Island and 47 for Vasilievsky Island.

The noise level was calculated for each areal source during day time and night time.

Figure 6.5-2 gives the calculated equivalent noise levels for the locations adjacent to the motorway on **Kanonersky Island**. The noise levels in Table 6.5-6 are given as reference points located at the facade of the nearest buildings.

Table 6.5-6 Equivalent noise levels caused by traffic streams at reference points during operation of the flyover on Kanonersky Island

Ref. point	House Nos.	Equivalent noise level, $L_{Aequiv.}$, dBA		Required reduction, $L_{Aequiv.}$, dBA	
		Daytime	Night hours	Daytime	Night hours
PT1	School, House 32B	70.2	63.2	15.2	18.2
PT2	Customs Office, House 32	74.5	67.5	19.5	22.5
PT3	Kindergarten, House 18	72.1	65.1	27.1	20.1
PT4	House 19	72.3	65.3	17.3	20.3
PT5	House 16	69.5	62.5	14.5	17.5
PT6	House 14	71.7	64.7	16.7	19.7
PT7	House 12, Building 2	68.9	61.9	13.9	16.9

The calculations have indicated that a required noise level reduction is 13 to 23 dBA for the residential area and 27 dBA for the playgrounds for children.

As noise impact mitigation measure the Project design provides for the installation of a soundproof screen – 3 m high and 650 m long – both on the right side and the left of the motorway.

In spite of this, some additional calculations indicated that in this case part of the residential area located along the Neva bay will be exposed to the noise impact caused by traffic streams from behind Kanonersky Island above the Neva Bay water area. The noise level in the residential zone will exceed the regulatory limit by 5-6 dBA (Figure 6.5-2).

In order to eliminate this non-compliance it will also be required to install soundproof windows, with a sound insulation of R_{Atran} ~ 20 dBA, in some of the residential buildings of Kanonersky Island, located further from the WHSD motorway, where it was originally not foreseen according to the Project design.

A more efficient solution for the protection of the yard areas within the residential zone could be to extend the soundproof screens along each motorway tier toward the Neva Bay for another 300 m. In this case the noise level throughout the entire residential area (taking into account the planned resettlement) would virtually not exceed the sanitary and hygienic norms (Figure 6.5-2).

The noise level at the reference points will be about 52 to 54 dBA during daytime and 45 to 46 dBA at night (as compared to the maximum permissible level of 55 dBA and 45 dBA respectively for yard areas) thus complying with the regulatory norms for noise penetrating into dwellings.

Figures 6.5-3 and 6.5-4 show the equivalent noise levels obtained, by using the computational method, for the areas adjacent to the motorway at the southern and northern parts of the western edge of **Vasilievsky Island,** before noise abatement measures will be taken.

Table 6.5-7 lists the noise levels at the reference points located at the facades of the residential buildings and at the playgrounds for children. In the process of the calculations it was taken into account that the noise level will be reduced due to the fact that the motorway runs in a trench. However, the noise reduction related to the trench is only effective for the first two stories of the buildings and there are many multi-story buildings in the adjacent areas. Therefore, the noise levels in the table are calculated for a height of h=1.5m and h=20m. The required noise reduction was determined with reference to the higher value; for the reference points PT10 and PT11 it was determined for the daytime for a height of 1.5m.

Table 6.5-7 Equivalent noise levels caused by traffic streams at the reference points during the operational phase of the motorway on Vasilievsky Island

Ref. point	**House Nos.**	**Equivalent noise level at a height of 1.5m, $L_{Aequiv.}$, dBA**		**Equivalent noise level at a height of 20m, $L_{Aequiv.}$, dBA**		**Required reduction, $L_{Aequiv.}$, dBA**
		Daytime	Night hours	Daytime	Night hours	
PT1	House 35, Building 3	64.9	57.9	65.0	58.0	13.0
PT2	House 31	67.5	60.5	67.8	60.8	15.8
PT3	House 23	66.9	59.9	67.1	60.1	15.1
PT4	House 34, Building 1	65.3	58.3	66.0	59.0	14.0
PT5	House 30 к.5	62.6	55.6	65.2	58.2	23.4
PT6	House 17	66.8	59.8	75.4	68.4	20.7
PT7	House 15	63.3	56.3	72.7	65.7	11.3
PT8	Aquapark	66.1	59.1	72.9	65.9	22.1
PT9	House 9, Building 2	69.4	62.4	72.8	65.8	20.8
PT10	House 22, Building 2, (Kindergarten)	46.7	39.7	49.6	42.6	1.7
PT11	House 22, Building 3 (Kindergarten)	47.2	40.2	49.3	42.3	2.2

PT12	House 15, Building 2 (School)	46.6	39.6	49.4	42.4	-

The acoustic calculations made have indicated that the noise level at the building facades facing the motorway will be 63 to 75 dBA during daytime and 56 to 68 dBA at night.

To ensure the acoustic comfort for all indoor premises, with the windows facing the Marine Embankment, it is foreseen in the Project design to install soundproof windows with sound insulation efficiency, R_{Atran}, of at least 33 dBA. In this case the noise level penetrating into indoor premises will not exceed 37 dBA at daytime and 30 dBA at night (as compared with the regulatory permissible limit of 40 and 30 dBA, respectively).

It is expected that the noise level within the districts protected against the noise exposure from the motorway by multi-story buildings will comply with the sanitary norms and be about 40 to 50 dBA.

The noise levels at playgrounds of the kindergartens (PT10 and PT11) exceeding the permissible limit by 1 to 2 dBA will be easily reduced by fences protecting the playgrounds against noise exposure.

The project design for the WHSD Central Section construction provides for the installation of a continuous 4-m high acoustic screen along the Vasilievsky Island to protect the planned residential area at the left side of the motorway against noise exposure (as well as the promenade area of the Marine Facade site) and a 5-m high acoustic screen at the right side along the motorway segment running on an embankment.

The calculated values of the equivalent noise levels in the southern part of Vasilievsky Island in case of acoustic screen installation are given in Figure 6.5-4. The efficiency of a screen varies from 3 to 15 dBA depending on the distance between the screen and the reference point and between the motorway center line and the screen.

In any case it is insufficient to ensure compliance with the regulatory noise level limits in yard areas and in the future promenade zone.

It may be concluded, therefore, that the additional noise abatement measures foreseen in the Project design will make it possible during the WHSD operational phase to:

1) ensure compliance with the regulatory noise level limits in the apartments on Kanonersky and Vasilievsky Islands;

2) ensure compliance with the regulatory noise level limits in the yard areas adjacent to the residential zones on Kanonersky Island (including the area in front of the school building).

At the same time, the non-compliance with the regulatory noise level limits during the WHSD operational phase would not be eliminated in the yards at the Marine Embankment and in the future promenade zone of the Marine Facade site.

6.5.2 *Vibration Impact*

In the process of the WHSD construction Project development in 2006-2007 the potential impact of vibration during the motorway operational phase was assessed on the basis of practical experience gained from similar motorways operated at that time in other districts of St. Petersburg.

The monitoring data obtained at similar motorways indicated that vibration impacts were limited with regard to their propagation range and would not exceed the sanitary norms at distances of 20m to 30m.

The WHSD Southern Section was supposed to be run at a distance of 20-30m from an architectural site, i.e. Dashkova's Dacha (a rural mansion in Kiryanovo). In addition, the specific design of the WHSD motorway (many of its segments were supposed to be built on a pile foundation as deep as 25m to 35m) did not meet the technical characteristics from similar motorways in St. Petersburg.

Due to these circumstances the issue related to the impact of the actual vibration that could potentially be imposed during the WHSD operational phase remained open.

The decisive criteria for final the conclusions concerning this issue were the results of the monitoring carried out during the operation of the first segment of the WHSD Southern Section. The measured values indicated that the actual vibration level at the foundations of the nearest buildings complied with the applicable sanitary norms.

Therefore, it may be concluded with a high level of accuracy that at the WHSD Central Section, with the nearest residential buildings at a distance of approximately 40m (Kanonersky Island), will comply with the sanitary norms related to the vibration in residential premises.

However, this conclusion should only be fully confirmed on the basis of the monitoring to be conducted on a periodic basis until the WHSD motorway will reach its design capacity.

Special attention should be paid to the vibration monitoring at the Baltic Customs Office building on Kanonersky Island, because one of the motorway piers will be constructed at a distance of only 15 m from that building.

6.5.3 *Expected Impact of Night-time Illumination*

The residential buildings on Kanonersky Island will not be exposed to any illumination impact, because in this area the motorway will run on an elevated flyover (25m and more above the top of the buildings) and the entire motorway segment will have sound-proof screens preventing the penetration of light flux into the residential zone.

The motorway segment along Vasilievsky Island will run in a trench 6m deep below the surrounding ground level. The light flux caused by vehicles will not reach outside the edge of the trench.

At the exit ramps to the Makarov Embankment the nearest residential areas will be protected against the light flux by the sound-proof screens to be installed along the entire length of the exits.

At the northern end of the WHSD Central Section the installation of seven sound-proof screens is also planned, which will limit the exposure of the adjacent areas to the impact of the illumination (this concerns in particular the apartment building under construction at a distance of 130m to the west of the WHSD motorway).

Therefore, it may be concluded that the future traffic streams on the WHSD Central Section will cause no negative impacts on the living conditions of the nearest residential areas.

To enhance the scenic skyline of St. Petersburg from the Neva Bay at night, it is planned to install a night-time illumination system on the bridges across the Korabelny and Petrovsky waterways.

This alternative has not been discussed with the local communities. The response of the communities to such a change in the illumination conditions is not known.

It is advisable to collect comments from the local residents with regard to the planned changes in the bridge illumination conditions and take them into account when making the final decision.

6.6 *IMPACT ON SURFACE WATERS*

6.6.1 *Water Consumption*

6.6.1.1 *Construction Phase*

The following amounts of water will be used during the construction phase:

- For drinking and general needs of the construction personnel at a rate of 25 liters per person per day or for approximately 7,000 employees about 175 m^3/day;
- For industrial needs (make-up water for water recycling systems for wheel washing of vehicles leaving construction yards) approximately 18 m^3/day;
- For industrial needs (for two concrete mixing plants to be operated at two construction yards on the Marine Facade site) – the water requirement for this purpose has not been determined in the Project design.

The water balance in the WHSD Central Section construction design does not take into account the water required for spraying the construction yard sites and temporary roads during the warm period of a year.

In general, the overall water requirement during the construction phase will be relatively low, but in the process of the designing the Project documentation it is required to provide an accurate estimate in order to conclude an agreement with St. Petersburg's "VodoKanal" Company for a specific volume of water supply.

Bottled drinking water of guaranteed quality will be purchased from certified suppliers.

Water for general and industrial needs will be provided from the municipal networks. For construction sites not connected to the municipal water mains, water will be delivered by special vehicles and kept in distribution tanks.

The condition of the water storage tanks for water delivered by tank trucks and the microbiological composition of the water should be monitored on a periodic basis.

The Project design does not foresee abstraction of water from natural water sources (the Neva River or Neva Bay, underground water).

6.6.1.2 *Operational Phase*

During the WHSD operational phase the raw water requirement of the Partner Company will be minimal, i.e. only for drinking and general needs of the Company's own personnel. All operational motorway control and toll collection facilities will be connected to the municipal water supply networks.

The WHSD construction design does not contain any estimate of water requirement for the motorway operational phase. But taking into account the predicted number of personnel to be approximately 300 persons (for operation of the entire 46.6km long WHSD motorway and associated infrastructure facilities) and a daily water consumption norm of 25 liter per person it may be expected that the total water requirement of the Partner during the operational phase will be about 75 m^3/day. This is a very small quantity and without doubt the Partner will be able to obtain an approval from "VodoKanal" for water supply.

The final water requirement of the Partner Company during the operational phase should be determined at least 1 year before the completion of the WHSD Central Section construction.

Contractor organizations commissioned to carry out the washing of the WHSD roadway and structures will use water on the basis of their own agreements with the municipal "VodoKanal" Company for raw water supply.

6.6.2 *Wastewater Disposal*

6.6.2.1 *Construction Phase*

Concrete mixing plants and water spraying of sites are not taken into account in the outflow part of the water balance, because the water used for these facilities / purposes is irretrievable.

Wastewater from wheel washing will not be discharged from the respective systems (only sludge saturated with water will be removed on a periodic basis, but its total water content will be negligible, not more than 1,000 m^3 per year). It will be recycled, reducing thereby the environmental impact associated with wastewater release.

The total volume of ***sanitary wastewater*** from all 14 construction yards will be approximately 175 m^3/day.

Sanitary wastewater will be removed in two ways:

- From construction yards connected to the municipal sewerage networks directly to those networks;
- At construction yards not connected to the municipal sewerage networks, biotoilets and wastewater accumulating tanks will be used. Their maintenance

will be carried out by specialist. Wastewater will be periodically pumped out by means of special trucks and transported to the municipal wastewater treatment facilities.

No problems are expected with regard to environmentally safe sanitary wastewater removal during the construction of the WHSD Central Section.

The maximum total volume of ***stormwater runoff*** from 14 construction yards at the WHSD Central Section will be 800 m^3/day.

Stormwater runoff from 12 construction sites will be collected in underground accumulating tanks installed at each site and removed daily to the municipal wastewater treatment facilities.

> It is recommended that in the course of the elaboration of the Project documentation the capacity of underground accumulating tanks will be specified more accurately for each of the 12 construction yards to ensure that it will match the volume of maximum possible stormwater runoff inflow within the perimeter of each particular site.

Two construction yards having the largest site area, planned to be constructed on the Marine Facade site for the construction of the tunnel and the road segment in a trench, will be connected to the municipal sewerage networks. Surface runoff, water from foundation pits to be excavated for motorway construction along Vasilievsky Island, will be treated preliminarily at onsite treatment facilities to reduce the content of petroleum hydrocarbons and suspended matter.

During the construction phase it will be required to pump out ***drainage water from foundation pits*** to be excavated for concrete pier sockets. It will be discharged directly to the Neva Bay, although the suspended matter content of that water can be very high.

No solution related to this issue has been provided in the WHSD Central Section Project design.

> Due to this reason, it is recommended that in the process of the elaboration of the Project documentation technical solutions will be elaborated to bring the quality of water, from foundation pits released to the Neva Bay, in compliance with the permissible levels applicable to bodies of water of the highest fishery category.

6.6.2.2 Operational Phase

Sanitary wastewater from all infrastructure facilities permanently attended by operating personnel will be discharged to the municipal sewerage networks. No problems are expected with regard to the conclusion of service agreements with "VodoKanal".

Stormwater and washing water runoff from the roadway is expected to contain about 30 to 70 mg/l of petroleum hydrocarbons and 500 to 2000 mg/l of suspended matter.

It is planned in the WHSD construction design to divide the Central Section into 14 segments each with an independent system for collection and drainage of the entire volume of stormwater and roadway washing water runoff.

This water will be treated at 14 onsite water treatment facilities, each comprising:

- Regulating and accumulating reinforced concrete tank;
- Pumps for pumping the water after settling to a treatment facility;
- A facility for physical and mechanical treatment (sand trap and oil separator) with an activated carbon unit for final treatment (manufacturer: Labco Company; capacity 30 l/s).

The WHSD Project design specifies that after final the onsite treatment, the concentrations of petroleum hydrocarbons in stormwater should be max. 0.05 mg/l. However, the available experience of operation of similar treatment facilities at the WHSD Southern Section shows that the concentration of petroleum hydrocarbons is reduced only down to 0.1 mg/l.

This level is quite acceptable for subsequent release of stormwater to the municipal sewer networks. But in case of six these treatment facilities it is planned to release the treated stormwater directly to the Neva Bay and the concentration of petroleum hydrocarbons may not exceed 0.05 mg/l.

To ensure compliance with the applicable norms of the quality of treated stormwater to be released to the Neva Bay, it is recommended that in the process of the elaboration of the project documentation the following measures are taken:

- Ensure discharge of all treated stormwater streams from the WHSD motorway to the municipal sewer networks of St. Petersburg; or
- Install additional more efficient units for final treatment of stormwater runoff to reduce petroleum hydrocarbons down to the acceptable level.

A ***groundwater drainage system*** will be constructed in front of the "wall in the ground". It is expected that the drained water will not be contaminated. The drained water will be pumped to the municipal sewer networks and its direct drainage to the Neva Bay will be avoided.

One of the issues related to wastewater management during the operational phase might be the fact that one of the treatment facilities is planned to be constructed on an artificial site in the vicinity of Bely Island, which ***has not been filled yet***. It is not known who will implement the project related to the filling of the site .

There is a risk that in 2014-2015 some adjustments will have to be made in the Project design documentation with regard to the location and the design of the stormwater treatment facilities to be constructed in the Neva Bay water area.

6.6.3 *Changes in the hydrologic characteristics caused by construction of the temporary islands and subsequent presence of piers of WHSD bridges and flyovers*

During the WHSD construction phase, the Neva River streambeds will be blocked to a significant degree by the construction of temporary artificial islands (Figure 6.6-1). This will affect adversely the ice conditions and will probably cause the flooding of the temporary islands located upstream.

Engineering calculations have indicated that in order to facilitate the unobstructed movement of ice on the Neva River the degree of the streambed narrowing may not exceed 50%.

At the point of the Petrovsky waterway crossing, the streambed will be narrowed along 47% of the total length of the section. This means that no considerable ice dams will form in that area.

Ice dam formation may occur at the Korabelny, and especially at the Elaginsky waterways crossings (Figure 6.6-2), where the streambed narrowing will be 62% and 69%, respectively. As a result, heaps of ice can pile up and the ice field will impose high pressure on the slopes of the temporary islands. This might results in the damaging of the construction machinery operating on the islands and of some structures under construction.

This issue has not been considered from an engineering perspective in the construction design of the WHSD Central Section. For the adopted configuration and location of the planned temporary islands of the WHSD Central Section it is required to carry out additional studies and hydrodynamic modeling.

After the completion of the construction of the piers for the WHSD Central Section and the removal of temporary islands, the new motorway structures (piers of bridges and flyovers) will cause much less resistance in the river flow within the current streambeds of the Neva River branches. The water level in the Neva Bay which is 0.11m according to the Baltic elevation system and is considered as a normal level, the degree of narrowing will be as follows:

- for the Marine Canal 1.84%
- for the Bolshaya Neva River (Korabelny waterway) 7.1%
- for the Malaya Neva and Smaller Nevka mouth (Petrovsky waterway) 3.7%
- for the Bolshaya Neva and Smaller Nevka moutn (Elaginsky waterway) 15.8%

This means that the most significant narrowing during the WHSD operational phase will be in the Elaginsky waterway, but it is not considered to be critical, i.e. the maximum rise of the water level in the Elaginsky waterway (at a maximum flow rate) will not exceed 5 mm.

When the water stream will flow around the bridge piers it will cause the partial erosion of the bottom, increasing thereby the cross-sectional area. In the course of time this will level the changes in the water flow rate caused by the presence of the piers.

6.6.4 *Impact of the temporary islands hydraulic filling process and the erosion of their shoreline on the level of water turbidity and the erosion of bottom sediments in the Neva Bay*

During the WHSD construction phase, temporary artificial islands will be constructed in the Neva Bay along the future motorway route to facilitate the construction of piers for the flyover and the bridges. The location and the configuration of the islands is shown in Figure 6.6.1

According to the Project design, there are two main technologies for the construction of temporary artificial islands:

- Four artificial islands across the Petrovsky waterway are framed by enclosing sheeting on their perimeter. Then the 26x26 m large enclosed space is filled with sand. Such a technology does not cause the suspended matters to be significantly carried over to the Neva Bay;
- At the section from Kanonersky Island to Vasilievsky Island, and –along Krestovsky Island, across the Elaginsky waterway, up to the Bolshaya Nevka northern shore, sand is piled at the entire area of future artificial island at a height of 2.5m above the water level. Following the sand filling the external edge of the island will be covered with stone riprap, designed for protection against erosion throughout the entire period of use of the island.

According to the Project design, the total area of the islands designed by the second technology described above will be approximately 31.2 ha. About 700,000 m^3 of sand will be required to fill the island bases located under the water level.

6.6.4.1 *Assessment of zones with an increased content of suspended matter in the Neva Bay water caused by the construction of temporary islands during the WHSD construction phase*

In general, sand filling will be carried out in up to 1 m deep areas with slow current velocities. It is expected that the zones with elevated water turbidity caused by the island construction process will be relatively small.

However, at the designated sites for the construction of supports across the waterways (primarily supports for bridges) the depth of the water is more than 4 m and the velocity of the current is 0.6 to 0.8 m/s. It is expected that the entrainment of find-grain sand fraction to the aquatic environment of the Neva Bay will be significant in the waterway areas.

Calculations of turbidity fields within the Neva Bay have been made for water areas, where the construction of temporary islands is planned, taking into account the characteristic parameters of the selected areas, namely:

- Hydrodynamic conditions of the aquatic environment (including also wind and wave conditions);
- Seabed topography;
- Position of the coastline;
- Adopted intensity scenario of filling process.

Since there was no data available in the Project design, with regard to the particle size distribution in the sand to be used for the construction of the temporary islands, it was assumed that medium-grain category will be used, which is the most common along the coast of the Baltic Sea. Its particle size distribution characteristics, listed in Table 6.6-1 below, were adopted as the baseline parameters.

Table 6.6-1 Particle size distribution of sand to be used for construction of temporary islands

Fraction size, mm	Content in sand, %	Content in water at the time of filling, % of filled mass
< 0.005	2	4
0.005 – 0.01	3	3
0.01 – 0.05	7	2
0.05 – 0.1	15	1
0.1 – 0.2	44	1
0.2 – 0.5	24	1

Since there was no detailed description of the work procedure in the Project design, it was assumed that sand will be unloaded from dump trucks, with a truck body volume of 10 m^3, at 5 minute time intervals.

Calculations of the slope current velocity in the Neva River mouth area and in the Neva Bay were made based on the given conditions. It was taken into account that this component of the current velocity is most stable and is present only if there is no considerable wind component, which is important for assessing the degree of water contamination in the Neva Bay with suspended matter in summer (i.e. during and after the spawning period).

Furthermore, the hydraulic parameters (velocity of gravitational settling) and the initial concentrations of components of suspension were calculated for a depth of sand discharge of 4 m.

It was assumed for the calculations that since the bottom of the Neva River mouth area is mainly composed of three first fractions of suspension (finer fractions), the contact of discharged material with the bottom would results in the additional release of predominantly the same fractions, of which the bulk of discharged material consists. It was also taken into account that release of bottom sediments and discharged material (i.e. sand), as a result of contact with the bottom, would propagate up to a level of not more than 4m above the bottom.

The suspended matter concentration in the water of the Neva Bay was calculated by a simulation method – method of wandering particles or tracers.

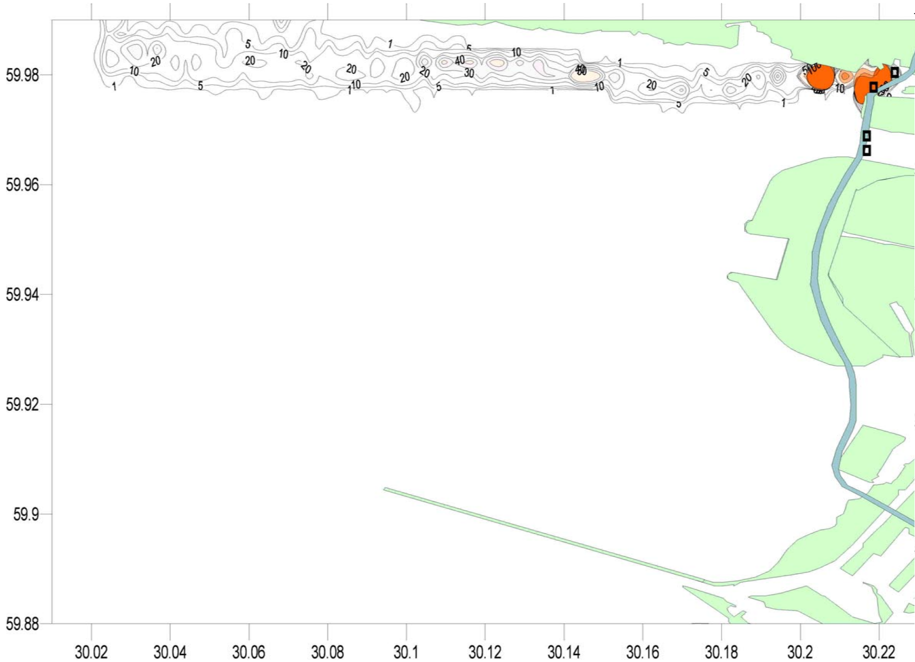
This method is described in detail in the pertinent scientific literature and is applied extensively, including practical calculations of propagation of pollutant particles from various types of artificial sources.

The calculation was made successively for each discharge operation taking into account gravitational settling of particles of different fractions and random spatial dispersion by currents. Particles reaching the bottom, are fixed and considered later only for the calculation of secondary agitation caused by a joint effect of currents and wind-induced waves.

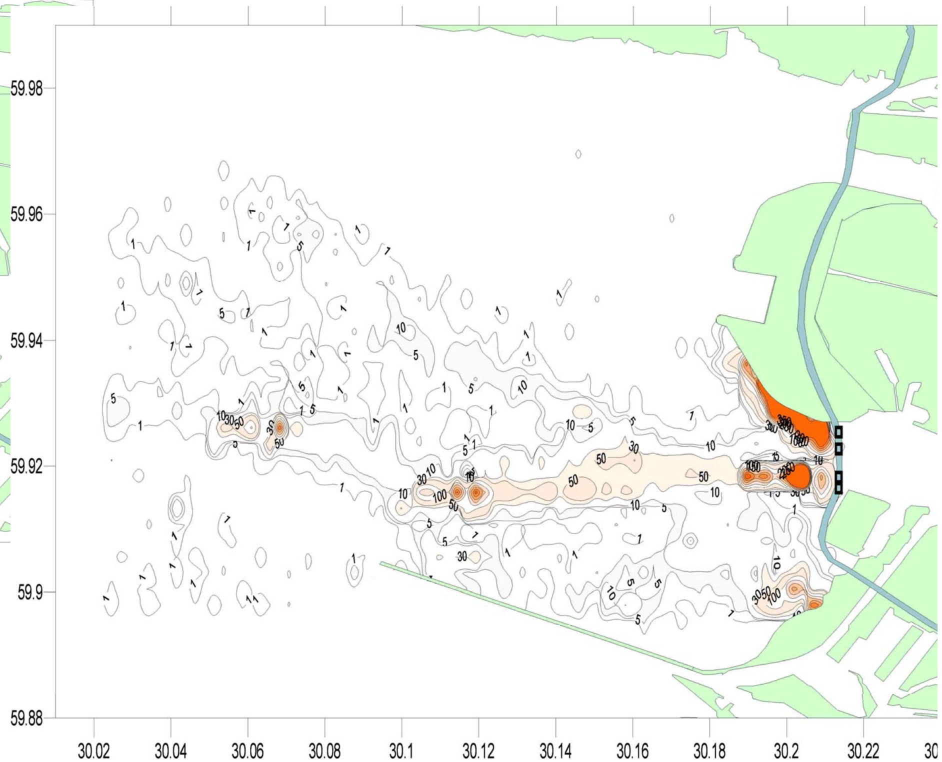
The maps of suspended matter concentration fields in the Neva Bay water area, plotted on the basis of the results obtained (without taking into account the background conditions), are presented in Figure 6.6.3.

Figure 6.6-3 (A and B) Calculated suspended matter concentration fields (mg/l) generated in the Neva Bay water as a result of the construction of temporary islands required for WHSD construction

A) Along the route across Elaginsky Waterway



B) Along the route from Kanonersky Island to Vasilievsky Island



According to the RF norms for water bodies of fishery significance in case of sand discharge to the Neva Bay an increase of only 0.25 mg/l is permitted in addition to the baseline concentration (assumed to be 10 mg/l) at a distance of 500m from the discharge point. The modeling results indicate that this limitation for solids discharge will not be complied with in the process of the WHSD construction (in case of use of the adopted technology for construction of temporary islands).

Zones with an increase in the suspended matter concentration by over 10 mg/l in addition to the baseline level will be recorded at a distance of up to 5 km from the temporary islands' construction sites. At a distance of up to 3 km this increase can be as high as 100 mg/l or more.

As a result of the work associated with the construction of the temporary islands, the water surface area with the average suspended matter concentration over 0.25 mg/l above baseline level will be 58.6 km^2, over 10 mg/l – 24.9 km^2, 50 mg/l – 6.4km^2, and 100 mg/l – 2.8 km^2 respectively.

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6.6.4.2 *Assessment of lithodynamic processes on the Neva Bay bottom caused by fill discharge*

Not only water turbidity is important for the biota in the Neva Bay, but also the settling of suspended matter to the bottom. Numerous studies conducted earlier have demonstrated that an additional bottom deposit of 5mm thickness can be critical for the benthos, which is the main food source of a number of fish species.

Due to this reason, model calculations were made for zones where an additional layer of bottom sediments will be formed as a result of both the construction of the temporary islands and the process of erosion of the coast of these islands until covered with stone riprap.

The transport of particles under the current conditions happens in two ways:

- in connection with the movement of solid material in the bottom area of a stream, where deposited particles move over the bottom by rolling, sliding or saltation, staying in permanent contact with the underlying surface. This form of movement is normally called 'bottom sediment transport';
- with an increase in the stress values on the stream bottom up to a level commensurable with the value of the hydraulic size of the bottom sediment particles, the latter, when detached from the bottom, are able to float during a relatively long period without touching the bottom. In such a case, it is considered that the bottom sediment material is in a suspended state and its movement within the water is defined as the "transport of suspended particles".

Taking into account the above two ways of solid particle transport, the calculations of the transfer of drifts and modification of the bottom topography in the Neva Bay, under the effect of the filling process of the temporary islands and the erosion of their coastline, were made in two ways:

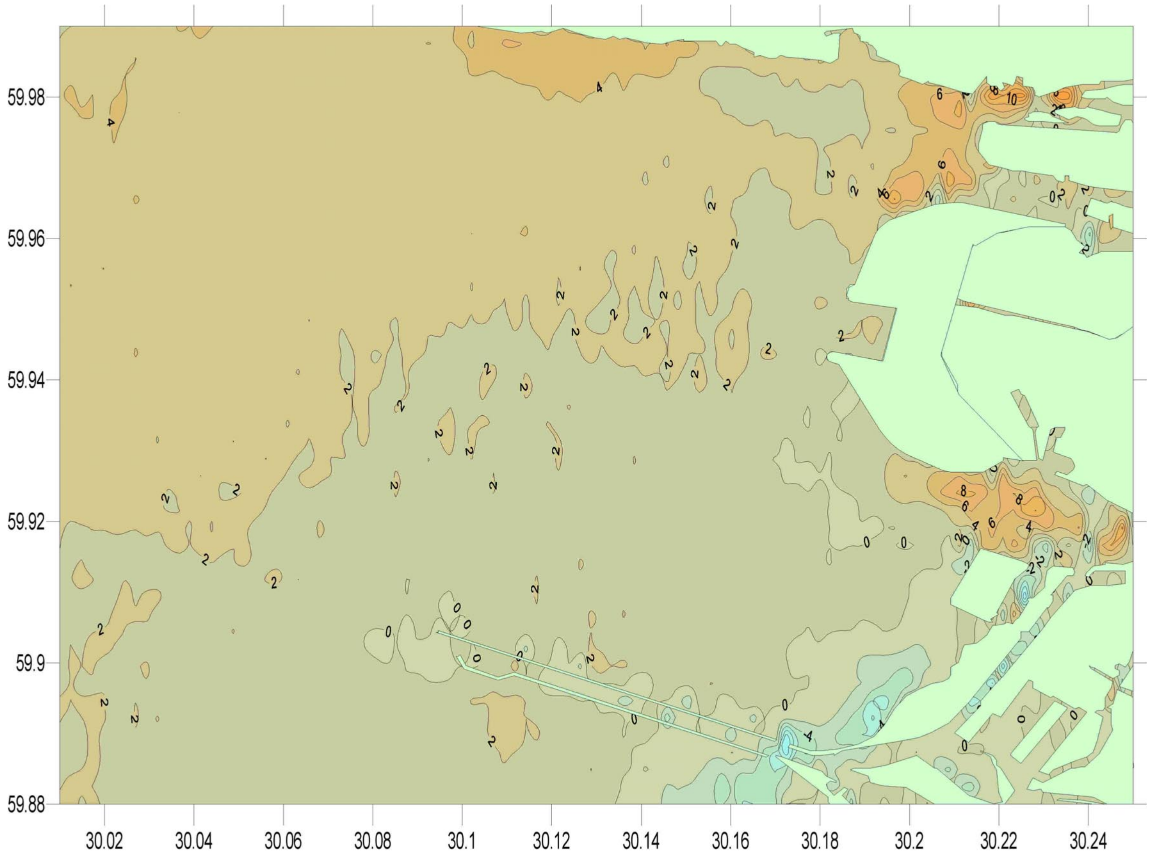
- for natural conditions without the effect of temporary island filling (Figure 6.6-4);
- for additional contribution to the processes of temporary island filling / erosion of the coastline of the island before covered with stone riprap (Figure 6.6-5).

The calculation algorithms in the form of integrated software programs were used earlier for design development of a large number of hydro-engineering facilities, including approach channels and port protection structures at the Azov Sea, Baltic Sea, Bering Sea, Sea of Okhotsk and other seas. The same method was used for modeling and preparation of recommendations for design development and construction of hydro-engineering facilities at the nuclear power plant at Kudankulam (India).

When calculating the lithodynamic processes in the Neva River mouth, the data referring to the bottom sediments in that area was used. The average diameter of bottom sediment particles was selected within a range of 0.01mm to 0.5mm.

The values of specific volumetric drift velocities and the relative bottom deformation per one year (for natural conditions without taking into account the effect of temporary island filling) were calculated on the basis of an assumption that the total annual duration of storms in the Neva Bay is 25 days per year.

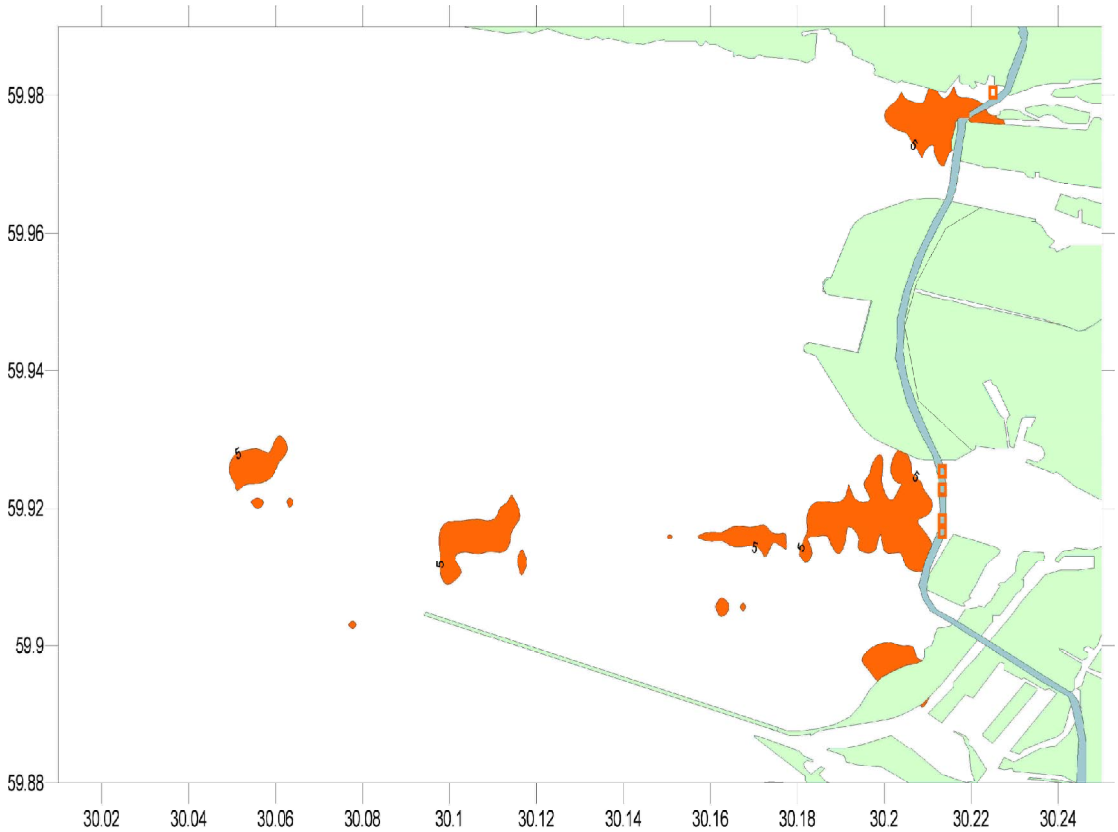
Figure 6.6.-4 Overall relative deformations of the bottom (mm) under the natural conditions (during 1 year with a probability of storms of 1% with the distribution of duration of wind activity effects typical of the Neva Bay)



The modeling results indicate that the layer of bottom sediments added as a result of temporary island construction using the technology adopted in the Project design will exceed 5 mm over an area of 4.7 km². This means that the living conditions for the benthos within this area will become critical.

To minimize the size of the zones with elevated turbidity of water and silting of the bottom sediments, it is recommended to modify the technology used for the filling of the temporary islands and their subsequent removal in the process of the elaboration of Project documentation, A possible environmentally efficient technique could be to fill the perimeter of a future island with gravel and subsequently fill the internal space with sand ("atoll principle"). The removal of the islands should be carried out in the inverted order.

Figure 6.6-5 Zones in the Neva Bay where the thickness of the added bottom sediments layer will exceed 5 mm (as a result of the filling of the temporary islands required for WHSD construction),



6.7 *IMPACT ON GROUNDWATER*

The construction and the operation of the flyover segments of the WHSD Central Section will not impose any significant impact in terms of **flooding of the areas adjacent to the WHSD motorway**.

The pile foundations of the flyover piers will not create any obstruction for groundwater flow.

Along the segment of the WHSD to be constructed in a trench and in the tunnel along the western edge of Vasilievsky Island, the natural groundwater stream moving westwards will be crossed by an abutment wall in the ground, which is to be constructed for the protection of the motorway against flooding. In order to prevent the formation of a barrage effect in front of the "wall in the ground" two types of solutions are foreseen by WHSD Project design:

- Along the northern and southern segments of the motorway running along Vasilievsky Island in a trench, a drainage system will be provided at the side of the island for groundwater interception. Drained water will be collected in several accumulating manholes and pumped automatically to the stormwater runoff drainage system and released to the Neva Bay;

- Along the motorway segment in the tunnel, the upper portion of the "wall in the ground" (both to the east and west of the tunnel) will be cut off to allow the groundwater stream to pass readily within an at least 1 m thick coarse-grained sand bed.

These solutions will prevent the water saturation of the ground in the areas adjacent to the WHSD motorway on Vasilievsky Island.

Potentially, issues of changing the hydrogeological conditions can become acute along the segment of the WHSD Central Section running in the vicinity of the Yuntolovo nature reserve. Earlier it was planned to construct it on an embankment.

Later the JSC "WHSD""Company modified the motorway design along this segment to take into account the opinion of the public.

Since the embankment would not only prevent the free access of residents to the urban park zone located to the west, but also affect the conditions for groundwater and stormwater migration toward the Yuntolovo reserve, new design solutions were officially approved in 2011 with regard to the motorway segment running over a flyover along the Yuntolovo nature reserve. The flyover solution would eliminate any risks of negative impacts on the hydrogeological conditions in that area.

Thus, it may be concluded that in the process of construction of the WHSD the Project design solutions, valid as of June 2011, ensure the maximum possible protection of the areas to the west of the WHSD motorway against flooding and water saturation of the ground and also maintain the natural level of stormwater and groundwater inflow to the Yuntolovo nature reserve.

No inspection is carried out related to the deterioration of the **groundwater chemical composition** in the course of the construction and the operation of the WHSD motorway because of the following planned measures:

- All areas used for fuel filling of the machinery involved in the motorway construction will have hard pavement. In the process of fuel filling, secondary containment trays will be used to localize minor amounts of incidental spills;
- Reserves of absorbing agents will be kept at the temporary construction yards to ensure containment and elimination of potential spills/leaks of chemicals in order to prevent their migration to groundwater;
- Stormwater runoff from all temporary yard sites will not be released to the ground. It will be collected in underground storage tanks, pumped out as required and removed to the municipal wastewater treatment facilities;
- Areas designated for short-term waste accumulation will be equipped in accordance with the applicable regulatory requirements (containers with secondary containment trays and barriers);
- No provisional cesspools at the temporary construction yards will be installed; the amenities will be either connected to the municipal sewerage networks or equipped with biotoilets/accumulating tanks for wastewater from wash basins and shower rooms;

- All stormwater from the future motorway surface will be drained to the local treatment facilities (there will be 14 facilities along the entire Central Section of the motorway) and then released either to the municipal stormwater drainage networks (provided that adequate quality of treatment will be ensured) or directly to a body of water. No contaminated wastewater from the motorway during the operational phase will be released to the ground.

6.8 *WASTE MANAGEMENT*

6.8.1 *Introduction*

Two phases can be distinguished with regard to waste management:

- Construction phase of the WHSD Central Section;
- Operational phase of the WHSD Central Section.

These two phases have significant differences related to both the nomenclature of generated wastes and waste generation amounts. The amount of wastes generated for the central motorway section has been determined for the entire construction phase, i.e. for a period of 41 months.

For the operational phase the waste generation amounts are determined for an annual cycle.

When estimating the amounts and types of generated wastes, the experience gained in the process of construction of the WHSD Southern Section and the tentative operation of its initial portion was taken into account.

6.8.2 *Construction Phase of WHSD Central Section*

Prior to the construction commencement it is planned to carry out some preparatory work, including clearing of vegetation, removal of the fertile topsoil layer, relocation of engineering and utility networks, demolition of buildings, constructions and driveways within the Project's right-of-way. Although this work is to be performed by the city's organizations, the wastes expected to be generated have been included in the total amount of wastes generated during the WHSD construction.

According to the experience gained during the WHSD Southern Section construction, the following types of wastes will be generated:

- Wastes generated in the process of clearing of trees and shrubs;
- Cuttings of natural wood (not contaminated);
- Contaminated soil generated in the process of earthmoving operations;
- Asphalt-concrete waste and asphalt and concrete mixture in lump form;
- Steel scrap, non-sorted;
- Construction-grade crushed stone not suitable for further use;
- Broken reinforced concrete structures, reinforced concrete waste;
- Waste of wires and cables with insulation;

- Construction debris generated in the process of demolition of buildings.

The overall amount of wastes generated in the process of relocation and installation of engineering and utility networks has been estimated at 56,210 tonnes.

The construction of the capital facilities of the WHSD Central Section will be performed using prefabricated modules (e.g., steel and reinforced concrete bridge span structures, reinforced concrete slabs for traffic area) or modules manufactured directly at the construction site (e.g., monolithic reinforced concrete piles, supports, raft foundations).

Due to especially strict requirements related to the prevention of environmental pollution at 16 temporary construction sites to be set up within the right-of-way, a concrete mixing plant will be installed at one of the sites, i.e. at the construction site of the tunnel under the Smolenka River. The asphalt-concrete and the bulk of concrete will be delivered from various plants of the construction material industry located in the city of St. Petersburg and in Leningraskaya Oblast, as far as required for the construction work at a particular site.

Prefabricated modules will be manufactured according to specific designs and if required pre-assembled into larger structures directly at the construction site.

The scope of the construction work has been estimated as follows:

- Concrete and reinforced concrete structures - 842,000 m^3;
- Steel structures - 181,000 t (without taking into account retrievable piles, enclosing sheeting, provisional structures);
- Asphalt concrete - 28,400 m^3.

It is planned that the construction work will be performed in three 8-hour shifts (in two shifts in the vicinity of residential areas). The maximum number of personnel involved in the WHSD Central Section construction will be 8,452 persons.

Meals for the employees will be provided in the public catering facilities outside of the construction sites. Drinking water will be delivered to the construction sites.

Biotoilets for construction workers will be installed at construction sites.

To minimize the contamination of the nearby areas, units for washing the wheels of vehicles and the construction machinery will be installed at the exits of the construction sites. In the process of their operation the oil film will be collected in an oil trap (100 tonnes during the entire construction phase), and residue at the wastewater treatment facilities (2,390 tonnes).

Surface runoff from construction yards will be drained into the hydraulically lined accumulating tanks installed at each site and removed on a daily basis to the aeration station on Bely Island. The total amount of such wastewater is expected to be 104,230 tonnes during the entire construction phase.

In the process of the construction of the tunnel under the Smolenka River, the surface runoff will be treated at an onsite treatment facility of USV type prior to its release into the municipal networks. The amount of wastes generated at that facility during the entire construction phase is expected to be as follows:

- Oil film collected from oil traps - 2.28 tonnes;

- Residue from treatment facilities - 27.04 tonnes;
- Spent filtering material - 11.51 tonnes.

The soil to be removed from the construction sites (both the contaminated and the excess soil) will account for the bulk of generated wastes (87.6%). This type of waste will be generated in the process of site grading, drilling operations, construction of the tunnel, groundwater cutoffs, bridge supports and flyovers, removal of embankments of temporary roads and temporary artificial islands in the Neva Bay water area. The amount of soil to be disposed of will be 1,297,660 m^3 or approximately 2,270,910 tonnes.

It is required to confirm the hazard class of both the waste soil removed as contaminated soil and the bottom sediments to be excavated for the construction of the motorway in the trench along Vasilievsky Island.

The most significant amount of wastes (other than soils) will be:

- Not-usable construction-grade crushed stone (107,390 tonnes or 4.1% of the total waste amount generated during construction phase);
- Waste reinforced concrete (57,880 tonnes or 2.2%).

The proportion of other waste types will not exceed 1% of the total amount.

Crushed stone waste will be generated mainly in the process of the demolition of the existing buildings, the removal of temporary roads, the removal of crushed stone bed from construction and technological sites after the construction completion.

Reinforced concrete waste will be generated as a result of the demolition of buildings and constructions, as well as the planned stripping of the sludge layer in the process of the manufacture of structures for the planned motorway.

The following types of waste, generated in minor amounts (0.1% to 1% of the total quantity), can be mentioned:

- Asphalt-concrete waste generated as a result of the removal of the existing paving and the trimming of the edges of the newly constructed road bed (3,896 tonnes/0.15%);
- Domestic solid waste generated by the construction personnel (3,121 tonnes/0.12%);
- Sewage from biotoilets (15,809 tonnes/0.61%);
- Cutting down of natural wood in the process of the demolition of the existing buildings and the manufacturing of shuttering, platforms, fencing (2,482 tonnes/0.1%);
- Unsorted steel scrap generated in the process of the welding of concrete reinforcement structures, the installation of steel structures of bridge spans and pipelines, the installation and the dismantling of enclosing sheeting and borehole casing (taking into account recycling), etc. (8,767 tonnes/0.34%);
- Construction debris generated in the process of the demolition of buildings (4,231 tonnes/0.16%).

In addition, the following types of wastes will be generated during the construction phase:

- waste paint – in the process of the painting of steel and reinforced concrete structures;
- oily wiping materials – in the process of the maintenance of construction machinery and vehicles;
- waste of hydro-insulating material - in the process of hydraulic insulation of structures and roadbed;
- residues of welding electrodes – in the process of welding;
- broken brick — in the process of brickwork construction;
- contaminated polypropylene containers used for paints;
- bentonite contaminated with soil, sand and clay – in the process of bentonite regeneration when constructing the "walls in the ground";
- spent rubber-metallic parts (from moving joints and elastomeric supports for provisional flyovers);
- old working clothing;
- old working footwear.

In general, the overall amount of wastes generated during the construction phase of the WHSD Central Section is expected to be 2,592,120 tonnes.

Data referring to waste generation during the construction phase of the WHSD Central Section is presented in Table 6.8-1. All calculations have been made in conformity with regulatory civil-engineering documents applicable in the RF and the officially approved methodology on the basis of the data available in the Project design with regard to the scope of work and the materials required.

The experience gained in the process of the construction of the WHSD Southern and Northern Sections indicates that there are ways for safe removal, processing, treatment and decontamination of all types of wastes generated in the process of the construction work by the commissioning of specialist contractors, as well as disposal where unavoidable (mainly for low-hazardous waste types).

All permits for waste disposal will be obtained by the contractors prior to the commencement of the WHSD Central Section construction.

6.8.3 *Operational Phase of the WHSD Central Section*

The following types of wastes will be generated during the operational phase:

- Spent mercury-containing bulbs and tubes of DNaT type;
- Floating film from oil traps for treatment of surface runoff from the motorway;
- Residue from treatment of stormwater runoff from the motorway;
- Spent filtering material for treatment of stormwater runoff from the motorway;

- Contaminated snow from the motorway in winter;
- Sweepings from the motorway during warm seasons;
- Domestic waste from the dispatcher centers and toll collection terminals.

About 3,860 mercury-containing bulbs of DNaT will be used for the illumination of the motorway. As a result of their replacement about 0.16 t of spent mercury-containing bulbs will be generated annually. This type of waste is rated as Hazard Class I (highly hazardous).

The treatment of stormwater runoff from the WHSD Central Section will be performed at 14 on-site treatment facilities. The total amount of the three types of waste generated at those facilities will be approximately 1,506.75 t/year.

The amount of contaminated snow removed from the motorway will be approximately 170,000 m^3 per winter. The contaminated snow contains 3,000 kg/m^3 of suspended matter and 25 kg/m^3 of petroleum hydrocarbons. At an average density of the snow removed from the motorway of 0.2 t/m^3, the amount of this type of waste will be 34,000 tonnes per winter.

The amount of sweepings generated by the motorway will be 2,259 t/year.

About 11.5 tonnes of domestic waste will be generated annually at the dispatcher control centers and at the toll collection terminals (Ekateringofka and Makarov Embankment).

In general, it is expected that about 37,800 tonnes of waste will be generated annually in the process of the operation of the WHSD Central Section. Contaminated snow will account for a major part of wastes generated, i.e. 90% of the total amount (in terms of weight), followed by sweepings (6%) and residue from the on-site stormwater treatment facilities (3.8%).

The proportion of all other waste types will be less than 0.5% of the total amount of wastes generated.

The list of the main waste types, which are expected to be generated in the process of the operation of the WHSD Central Section, is given in Table 6.8-2.

The system for the collection and the removal of all types of wastes generated by urban motorways is well proven in St. Petersburg. The contractors to be commissioned for the maintenance/repair of the motorway and the associated infrastructure will be responsible for the management of the generated waste.

6.8.4 Requirements for the Short-term Waste Accumulation

Wastes will be accumulated on a short-term basis in specially designated and adequately equipped areas within the territory of the WHSD Central Section. n this respect, compliance with following conditions is required:

- The content of harmful substances in ambient air in such areas at a height of 2 m above the ground surface may not exceed 30% of MPC for working areas;
- Efficient protection should be provided against exposure to atmospheric precipitation (shelters, covers on containers, etc.);

- Open areas should be located leeward of the site and paved with asphalt-concrete impermeable for toxic substances;
- In areas for short-term storage of wastes prone to dusting it is required to ensure the protection of the ambient environment against the release of pollutants to the atmosphere;
- Areas for installation of storage tanks for liquid wastes (surface runoff during construction phase) should have appropriate hydraulic lining preventing the migration of wastes into the soil;
- Access roads to areas for short-term waste storage should be illuminated during dark hours.

Part of wastes will be promptly removed from the sites as soon as they are generated without accumulating them (this refers to excavated soil, waste asphalt-concrete, reinforced concrete and concrete wastes, large steel structures and waste crushed stone during the construction phase and street sweepings during the operational phase).

Wastes from on-site wastewater treatment facilities (including wastewater from wheel washing) will be removed directly from the tanks of the respective systems.

The main requirements for short-term waste accumulation for the construction and operational phases are described in Tables 6.8-1 and 6.8-2, respectively.

The number and the final location of the areas to be used for short-term waste accumulation will be determined in the Project design documentation, which will be prepared after the selected Partner will start fulfilling its functions.

Steel and iron scrap, cuttings of copper and aluminum wires, residues of welding electrodes, polyethylene and polyvinyl chloride waste, asphalt-concrete and bitumen waste, spent rubber-metallic parts, part of wooden waste and construction-grade crushed stone are valuable secondary raw materials. They will be accumulated, therefore, in separate areas to prevent mixing with other waste types.

Some waste types (spent filtering material from on-site wastewater treatment facilities, excavated soil, domestic waste, street sweepings, spent bentonite, construction waste and debris, waste of asbestos-cement, old working clothing and footwear, waste of hydraulic isolation material in rolls, broken brick, glass-fiber plastic and part of wooden waste, as well as waste of reinforced concrete, concrete and construction-grade crushed stone) are subject to disposal in municipal landfills.

Such wastes will be accumulated in steel containers provided with adequate marking and their mixing with other types of wastes will be ruled out.

Certain types of wastes, which have no value as secondary resources and may not be disposed of in municipal landfills, will be removed by specialist contractors for treatment, processing, decontamination, etc. This goes for spent mercury-containing bulbs and tubes, oil-polluted sludge from on-site wastewater treatment facilities and wheel washing units, spent paints, oily wiping materials, packaging contaminated with paints.

Residue from the on-site treatment facilities and wheel washing units for construction machinery and vehicles, as well as waste from biotoilets will be removed to the aeration station located on Bely Island.

Contaminated snow removed from the motorway will be sent to the municipal snow-melting plants, the effluents of which are subject to treatment.

Table 6.8-1 A list of waste generation during the construction phase of the WHSD Central Section

Ser. Nos.	Description of waste	Hazard Class	Waste generation source	Assessment of expected waste generation during the construction phase, tonnes	Requirements to areas for short-term waste accumulation	Location of final waste disposal (processing, recycling, decontamination)
1	Floating film from oil traps (gasoline traps)	3	Treatment of wastewater from wheel washing, surface runoff at tunnel construction site under the Smolenka River	102,165	Tanks of water recycling systems of wheel washing units; tanks of the on-site wastewater treatment facilities	Waste incinerator
2	Residue from mechanical and biological wastewater treatment	4	Treatment of wastewater from wheel washing, surface runoff at tunnel construction site under the Smolenka River	2413,175	Tanks of water recycling systems of wheel washing units; tanks of the on-site wastewater treatment facilities	Aeration station on Bely Island
3	Spent filtering and absorbing mass contaminated with hazardous substances	4	Treatment of wastewater from wheel washing, surface runoff at tunnel construction site under the Smolenka River	11,510	Tanks of the on-site wastewater treatment facilities	Municipal waste disposal landfills
4	Other solid mineral waste	4	Soil excavation	2270906,990	Removal as soon as generated; partially – provisional dump areas at the construction sites	Municipal waste disposal landfills
5	Waste of asphalt-concrete and/or asphalt and concrete mixture in lump form	4	Removal of the existing roads, trimming of roadbed edges	3895,740	Removal as soon as generated; partially – provisional dump areas at the construction sites	Asphalt-concrete plants
6	Waste bitumen, solid asphalt	4	Construction of hydraulic insulation	3,086	Marked steel containers in paved areas. Fire suppression means should be provided in waste accumulation areas	Asphalt-concrete plants
7	Waste paints	4	Painting operations	14,596	Marked steel containers in paved areas. Fire suppression means should be provided in waste accumulation areas	Waste incinerator

Ser. Nos.	Description of waste	Hazard Class	Waste generation source	Assessment of expected waste generation during the construction phase, tonnes	Requirements to areas for short-term waste accumulation	Location of final waste disposal (processing, recycling, decontamination)
8	Oil-polluted wiping materials (oil content less than 15%)	4	Maintenance of construction machinery and vehicles	10,780	Marked steel containers with lids installed on secondary containment trays made of oil-resistant material. Fire suppression means should be provided in waste accumulation areas	Waste incinerator
9	Garbage from amenity rooms of organizations, un-sorted (except for bulky waste)	4	Vital functions of construction personnel	3212,800	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
10	Residue from cesspools and sanitary wastewater	4	Vital functions of construction personnel	15809,466	Accumulating tanks of biotoilets	Aeration station on Bely Island
11	Surface runoff	4	Surface runoff from construction sites	104230,000	Tanks with hydraulic insulation at construction sites	Aeration station on Bely Island
12	Spent bentonite	4	Regeneration of bentonite when constructing 'walls in the ground'	1260,143	Marked steel containers on secondary containment trays with raised edge	Municipal waste disposal landfills
13	Construction debris from building demolition	4	Demolition of existing buildings and constructions	4231,480	Removal as soon as generated; partially – stored in bulk in paved areas	Municipal waste disposal landfills
14	Waste asbestos-cement in lump form	4	Installation of engineering and utility networks	2,332	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
15	Waste of solid polyvinyl chloride and foam plastics on its basis	4	Installation of engineering and utility networks	3,223	Marked steel containers. Fire suppression means should be provided in waste accumulation areas	Plastics processing plant
16	Polypropylene containers contaminated with	4	Painting operations	49,930	Marked steel containers. Fire suppression means should be provided in waste accumulation	Waste incinerator

Ser. Nos.	Description of waste	Hazard Class	Waste generation source	Assessment of expected waste generation during the construction phase, tonnes	Requirements to areas for short-term waste accumulation	Location of final waste disposal (processing, recycling, decontamination)
	paints				areas.	
17	Working footwear made of leather not suitable for further use	4	Replacement of old footwear	46,193	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
18	Cuttings of fabrics	5	Replacement of old working clothing	110,734	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
19	Hydraulic insulation material in rolls	5	Installation of hydraulic insulation	69,822	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
20	Residue from clearing of trees and shrubs	5	Preparation of the construction sites	740,500	Removal as soon as generated; partially – stored in bulk. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
21	Broken reinforced concrete structures, waste reinforced concrete in lump form	5	Dismantling of existing structures, manufacture of reinforced concrete elements	57882,780	Removal as soon as generated; partially with intermediate accumulation: small-size waste in marked steel containers; bulky waste in paved areas	Municipal waste disposal landfills
22	Broken concrete structures, waste concrete in lump form	5	Dismantling of existing structures, manufacture of concrete elements	8372,638	Removal as soon as generated; partially with intermediate accumulation: small-size waste in marked steel containers; bulky waste in paved areas	Municipal waste disposal landfills
23	Residues of welding electrodes	5	Welding operations	30,921	Marked steel containers	Metal scrap recycling plants

Ser. Nos.	Description of waste	Hazard Class	Waste generation source	Assessment of expected waste generation during the construction phase, tonnes	Requirements to areas for short-term waste accumulation	Location of final waste disposal (processing, recycling, decontamination)
24	Broken construction-grade brick	5	Construction of brickwork	1,243	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas.	Municipal waste disposal landfills
25	Cuttings of clean natural wood	5	Demolition of existing structures, manufacture of shuttering, platforms, fencing	2481,665	Small-size waste in marked steel containers; bulky waste in paved areas. Fire suppression means should be provided in waste accumulation areas.	Municipal waste disposal landfills, wood-working plants
26	Steel wire, not contaminated, not suitable for further use	5	Installation of networks	0,015	Marked steel containers.	Metal scrap recycling plants
27	Waste wires and cables with insulation	5	Installation of cable lines	6,375	Marked steel containers.	Metal scrap recycling plants
28	Aluminum wire, not contaminated, not suitable for further use	5	Installation of cable lines	4,726	Marked steel containers.	Metal scrap recycling plants
29	Polyethylene waste as scrap	5	Installation of engineering networks	5,232	Marked steel containers. Fire suppression means should be provided in waste accumulation areas.	Plastics processing plants
30	Waste of solidified glass-fiber plastics	5	Installation of engineering networks	0,839	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas.	Municipal waste disposal landfills

Ser. Nos.	Description of waste	Hazard Class	Waste generation source	Assessment of expected waste generation during the construction phase, tonnes	Requirements to areas for short-term waste accumulation	Location of final waste disposal (processing, recycling, decontamination)
31	Unsorted steel scrap	5	Welding of reinforcement of the body and supports of flyovers, installation of steel structures of bridge spans and pipelines, installation and dismantling of enclosing sheeting and borehole casing	8766,916	Small-size waste in marked steel containers. Bulky waste to be removed as soon as generated; partially - accumulated in bulk in paved areas	Metal scrap recycling plants
32	Unsorted cast-iron scrap	5	Installation of engineering networks	0,019	Small-size waste in marked steel containers. Bulky waste accumulated in bulk in paved areas	Metal scrap recycling plants
33	Construction-grade crushed stone, not suitable for further use	5	Demolition of existing structures; removal of provisional roads and crushed-stone beds at construction sites after completion of construction	107385,608	Removal as soon as generated; partially – accumulated in bulk or in steel containers	Municipal waste disposal landfills, plants manufacturing reinforced concrete structures
34	Spent rubber-metallic parts	5	Dismantling of moving joints and supports of flyovers of provisional access roads	55,520	In bulk or in steel containers	Metal scrap recycling plants
Total for construction phase: 2592119,162						

Table 6.8-2 A list of the main waste types expected in the process of operation of the WHSD Central Section

Ser. Nos.	Description of waste	Hazard Class	Waste generation source	Assessment of expected waste generation during the construction phase, tonnes	Requirements to areas for short-term waste accumulation	Location of final waste disposal (processing, recycling, decontamination)
1	Mercury lamps, spent and rejected luminescent mercury-containing tubes and bulbs	1	Illumination of traffic area of the motorway	0,158	Special steel containers in a locked room. Prevent access of unauthorized persons to the area used for storage of mercury-containing waste	Organization specializing in mercury recovery from mercury-containing wastes
2	Floating film from oil traps (gasoline traps)	3	Treatment of surface runoff	26,913	Process tanks of the on-site wastewater treatment facilities	Waste incinerator
3	Spent filtering and absorbing mass contaminated with hazardous substances	4	Treatment of surface runoff	73,662	Process tanks of the on-site wastewater treatment facilities	Municipal waste disposal landfills
4	Residue from mechanical wastewater treatment	4	Treatment of surface runoff	1443,089	Process tanks of the on-site wastewater treatment facilities	Aeration station on Bely Island
5	Contaminated snow	4	Cleaning of traffic area of the motorway	34000,000	Provisional dump areas along the motorway, on hard paving	Snow-melting stations
6	Street sweepings	4	Cleaning of traffic area of the motorway	2259,200	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
7	Garbage from amenity rooms of organizations, un-sorted (except for bulky waste)	4	Vital functions of personnel at dispatcher stations and road toll collection terminals	11,550	Marked steel containers for domestic waste in paved areas. Fire suppression means should be provided in waste accumulation areas	Municipal waste disposal landfills
Total: 37814,572						

Waste tracking will be performed by records in the log book for recording of waste generation, accumulation and removal for processing (recycling), decontamination and disposal. Waste will be removed by contractor organizations only after they confirm that they have a License in place entitling them to carry out this type of operations and on the basis of appropriate agreements and acceptance documents.

It is not planned to organize any areas for permanent waste disposal within the land allocated for the WHSD Central Section construction.

6.8.5 *General Conclusion*

In general, it may be concluded that all prerequisites are in place to ensure an efficient waste management system for the WHSD Central Section.

Its main objective will be to make arrangements for the safe short-term accumulation and storage of wastes, their timely removal from the site in strict compliance with the requirements specified by the organizations finally responsible for waste processing, decontamination or disposal.

Since a considerable part of the planned motorway section runs above water, special attention will be paid to the prevention of waste discharge or migration to the body of water.

6.9 *RESERVING OF BIODIVERSITY, ON-LAND ECOSYSTEMS*

6.9.1 *Impact on Land Vegetation during the Construction and Operational Phases of the WHSD Central Section*

According to the federal environmental legislation, as well as St. Petersburg's Law No.254-38 of 12.05.2004 on "Protection of green plantings", any urban green plantings are subject to protection.

Any work aimed at the removal of vegetation and measures for the restoration of green plantations are regulated by Annex 1 of the "Rules and Procedure for execution of work in any zone of green vegetation in St. Petersburg and in areas under St. Petersburg's jurisdiction" (Decree No.442-r of 15.06.1993 of the Mayor of St. Petersburg, as amended by Resolution No.65 of 09.12.2003 of the Government of St. Petersburg and Decree No.848-pg of 05.10.2004 of the Governor of St. Petersburg).

Any work to be carried out within greenery zones is subject, in accordance with the existing regulatory legal framework, to the approval of the St. Petersburg Administration Committee for Land Improvement and associated agencies.

In the process of the *preparatory and construction work* at the WHSD Central Section the following measures are to be taken:

- Cutting of trees and shrubs should be performed only when they have no leaves, with simultaneous removal of all felling residues;

- If required, trees and shrubs should be re-planted only within an adequate agrotechnical timeframe and with a written permit issued by the Urban Parks Management Department;
- If a fertile topsoil layer is available, it should be excavated separately prior to the commencement of the construction work and handed over to the parks management department of the respective district;
- It is prohibited to store any construction materials, felling residues, soil, as well as to park any vehicles and machinery near trees and shrubs and in greenery zones outside of the construction site;
- Any access roads to the construction zones should be designed in areas free of any greenery. Trees and shrubs in the direct vicinity of the access roads should be protected by boards and a fence made of wire mesh;
- After the completion of the construction work, any construction waste, debris and soil should be removed and the area graded.

All the above requirements should be met in the Project design documentation for the WHSD Central Section construction.

Within the **zone of direct impacts** during the ***preparatory phase*** any trees and shrubs, which are of secondary origin and have no protection status, will be completely removed within the motorway route and the area designed for the provisional facilities. In the process of topsoil excavation, all lawns will be removed.

In the process of the WHSD Central Section construction it is planned to cut down 967 trees and 2,763 m^2 of shrubs and remove lawns within an area of 142,875 m^2.

This scope of work has been approved by the Parks Management Department.

The main factors related to the indirect impacts of the construction phase of the motorway affecting the diversity of the species and the status of the vegetation within the sanitary right-of-way at a distance of up to 200m can be:

- Contamination of lawns and trees with dust-polluted air masses from the land areas disturbed by the construction work and the handling of cement (performed at the construction camp to be set up for the construction of a tunnel under the Smolenka River);
- Exhaust gas related air pollution from operating vehicles and construction machinery at construction sites.

Since all vegetation in areas within a range of up to 500m from the construction zone of the WHSD Central Section is composed of weeds and ruderal species, as well as the man-made plantations of low value, and no rare and endangered plant species have been identified there, no significant negative impact on wild flora is expected within the zone affected by the project in a direct and indirect way.

During the ***operational phase*** in case of repairs (e.g. motorway paving, curbstones, within the greenery zone, etc) it will be necessary to plan the reclamation of greenery/ lawns within the adjacent areas.

To prevent any negative indirect impact on the lawns and the tree vegetation the following measures are planned:

- After the completion of the construction, compensation planting of species tolerant to the exhaust gas and the dust content of ambient air and soil will be carried out;
- The maintenance regulations for the WHSD Central Section should provide for the seasonal and the timely watering of the trees planted along the motorway, including spraying of the tree crowns with water;
- Timely planting and seeding should be carried out.

Exhaust gas emissions from vehicles will cause an indirect impact on the vegetation within a range of 200m from the motorway during the operational phase.

Many years of operation of motorways in St. Petersburg with high traffic intensity indicates that the existing vegetation is not stunted by atmospheric air pollution along such motorways.

Compensation measures to compensate for inflicted damage

In conformity with Par. 3 of Article 6 of St. Petersburg's Law No. 254-38 of 12.05.2004 "On the Protection of green plantings" and the Decree of the Government of St. Petersburg No.1644 of 04.10.2004 "On the Amounts and the Procedure for payments of expenses for the restoration of greeneries in St. Petersburg and other land improvement measures in urban parks, public gardens, boulevards, play grounds for children and sports facilities in St. Petersburg", in case of the re-classification of land covered with greeneries, a financial compensation is to be provided corresponding to the amount which is sufficient to cover the costs of the restoration of greeneries.[8]

Damage inflicted upon greeneries by the WHSD Central Section is determined by the regulations issued by the Parks Management Department on 10.11.2006 (for the fourth stage of the construction) and on 16.11.2006 (for the fifth stage of the construction) and has been estimated at RUR 5,151,925 and RUR 20,274,401 respectively (in 2006 prices). Damage will be fully compensated by the time of the start of the preparatory work.

The disturbed land and greeneries in the areas adjacent to the motorway and the interchanges will be improved and covered with vegetation in compliance with the appropriate landscape design.

At the current stage of the WHSD Project implementation, the landscape design has not been developed yet. However, the experience gained in the process of the construction

[8] The amount of restoration expenses includes the cost of removal of vegetation, re-planting of trees and shrubs, removal of lawns and disturbance of path paving.

of the WHSD Southern Section indicates that good quality re-vegetation has been fully carried out providing an attractive view to the areas adjoining the motorway.

6.9.2 *Impact on Land Fauna*

The WHSD Central Section construction Project will be implemented within a highly urbanized environment. The ecosystems in this area have been and are being exposed to the intensive impacts of various factors of man-made origin (urban development, industrial and transport operations), as well as to the disturbance factor.

The impact of the construction of the WHSD Central Section on the fauna and more specifically on the populations of animals of terrestrial ecosystems and urban territories, as well as on wading birds and birds living near water, will not be a decisive man-made factor in the given area. It will be of secondary significance in relation to the existing impacts (this primarily refers to the construction of the artificial Marine Facade site) and anticipated future impacts (construction of artificial sites to the west of Krestovsky and Bely Islands).

For example, the resting grounds of the migrating waterfowl and of the wading birds in the vicinity of Krestovsky shoal are already virtually non-existent. Navigation activities and construction work performed at the western end of Krestovsky Island (modernization of the soccer stadium) have sharply increased the disturbance factor for the birds in this sea area. During the past two years no considerable concentrations of migrating birds have been reported in this area.

Currently, the hydraulic filling of the Marine Facade site imposes a strong impact on the water areas located to the west of Vasilievsky Island, where consistent concentrations of waterfowl and wading birds were reported in the past during migration periods.

Water areas to be used for the planned artificial islands that are needed for the construction of flyovers and bridges, will be exposed to direct impacts during the construction phase of the WHSD Central Section.

No significant concentrations of water birds have recently been reported in the direct vicinity of the WHSD route.

The resting grounds of diving ducks on shallow waters to the west of Bely Island and gulls on the shoals currently in the process of formation to the south-west of the Marine Façade will most probably not be significantly modified during the WHSD construction phase. This is due to the fact that the decisive factors in this area are the availability of unfrozen patches of water in winter and during transitional seasons, as well as a relatively high trophic level of the water at the underwater outlets of the municipal wastewater treatment facilities.

Following the construction of the WHSD facilities, when the hydraulic filling of the artificial sites will be finished, birds will be able to use the shallow waters to stop for rest during their seasonal migration.

Wintering and migrating puddle and diving ducks sporadically distributed around the Neva River mouth area are able to adapt under the urban conditions to noise and vibration, to the activities of people, as well as to other factors caused in the process of the construction work.

The populations of synanthropic birds and mammals, as well as domestic animals (dogs, cats) can increase due to the potentially growing food resources as a result of the generation of food by-products at the construction yards. It happens often that people feed animals at construction sites, allow them to breed and keep them later as pets.

During the WHSD *operational phase*, the disturbance factor caused by vehicle lights and the outdoor illumination of the motorway could have a significant negative impact. Under conditions of limited visibility, the death of birds as a result of their collision with obstacles (flyovers and bridges) is possible. Attempts of migrating birds to stop directly on the roadway may also occur.

Birds of prey can use lightning pylons to roost along the motorway.

It is possible that some weasel species living in burrows (polecats) can use the technical rooms of the tunnel under the Smolenka River; technical rooms of flyovers and bridges and sewers can serve as habitats for rats and house mice.

Periodic rodent extermination measures will be required from time to time during the WHSD operational phase.

In general, the most significant impact will be a westward shift of the flyways of waterfowl and wading birds as a result of cumulative impacts of construction work within the framework of the WHSD and Marine Facade Projects and the construction of other artificial sites in St. Petersburg. As a result, a major flyway and concentrations of migrating birds can be formed along the flood-protection dams of St. Petersburg (including also the shallow waters in the vicinity of Verperlud).

No significant changes are expected in the local fauna composition as a result of the WHSD Central Section construction.

There are no areas with highly sensitive biodiversity of terrestrial ecosystems within the motorway corridor and its direct vicinity.

6.9.3 Mitigation Measures on Land Fauna

To mitigate the adverse impacts of the Project on the wildlife, a range of environmental mitigation and compensation measures have been planned.

The impact of certain factors can be minimized by means of special organizational and preventive measures.

During the *construction phase* the anthropogenic impacts will be minimized by means of the following measures:

- Limitation of the work associated with the filling of the temporary islands and with the construction operations on the land allocated for the Project;
- Application of technologies and working conditions preventing the dispersion of suspended matter in water (preliminary placement of stone riprap / driving of sheet piling to minimize erosion of fine-grained soil by waves;
- Prohibition to feed dogs at construction sites.

During the *operational phase* the motorway route will be illuminated during the dark time of the day; the bridges across the Korabelny and Petrovsky waterways will also be illuminated from outside to ensure an impressive view from the sea toward St. Petersburg. This will minimize the risk of birds' collision with man-made obstacles.

It is recommended as a compensation measure that the Partner, who will be in charge of the WHSD Central Section construction and the operation of the entire WHSD motorway, should install bird-boxes repeating this operation periodically in the future and provide floating platforms for water and wading birds within the Yuntolovo nature reserve.

6.10 IMPACT ON AQUATIC BIOLOGICAL RESOURCES

6.10.1 Introduction

There are two main categories of spawning grounds in the Neva Bay (Figure 3.12-1):

- The first group of spawning grounds is associated with coastal shallow waters well warmed and with abundant aquatic vegetation;
- The second group of spawning grounds is associated with shoals with sandy ground and scattered gravel and boulders.

The size of spawning grounds of the first category, some of which are located within the WHSD corridor, has shrunk significantly in recent decades as a result of a decrease in the area covered with vegetation due to the negative impact of the general pollution of bottom sediments and water in the Neva Bay on the aquatic vegetation.

A substantial damage to those spawning grounds has been inflicted, starting from 2005, also by the construction of new artificial sites within the framework of the Marine Facade Project, resulting in the irrecoverable destruction of extensive areas of shallow waters with abundant aquatic vegetation.

Spawning grounds of the second category have been damaged seriously as a result of underwater excavation of sand for the construction of new artificial sites and for the fulfillment other construction needs.

The use of water areas, where some spawning grounds of the second category are located, for ground dumping in the process of seabed deepening carried out in 2005-2008, resulted in a substantial fall of their fish-reproducing potential.

In general, the subject area of the Neva Bay is currently characterized as an area with poor food resources for benthophage fish species. The main cause of the low productivity of the benthic fauna within the subject area appears to be an increasing anthropogenic pressure imposed on the ecosystem of the Neva Bay as a whole and in particular its eastern part.

Filling of temporary islands in the area of the Petrovsky waterway will be carried out by the initial installation of enclosing sheeting along an island’s perimeter using vibration method for sheet-pile driving. This approach will prevent the entailment of considerable amounts of suspended matter from zones where the construction of temporary islands will be carried out in the area of the Petrovsky waterway.

In other parts of the Neva Bay affected by the WHSD construction, i.e. from Kanonersky Island to Vasilievsky Island and from Krestovsky Island to the northern bank of Bolshaya Nevka, the construction of temporary islands is planned using a different procedure: filling of a site with sand directly in water without preliminary sheeting of the area. After an island is filled with sand, stone riprap (stones of up to 20 cm in size) will be provided along the edge of the island.

As mentioned earlier in Section 6.6.3-6.6.4, considerable areas with highly turbid water are reported in the process of sand filling and the settling of suspended matter transferred by currents forms a significant layer (over 5 mm thick) deposited on the seabed.

These two factors will have a negative impact on the aquatic biological resources of the Neva Bay.

Furthermore, after the removal of the temporary islands, there will be a part of the seabed and water layer under the base of the piers not involved in productive processes. This will also result in a loss (although a small one) of the bioproductivity of the Neva Bay.

6.10.2 Baseline Data for Estimating Damage Inflicted to the Biological Resources in the Neva Bay

Execution of the hydro-engineering work foreseen in the Project design in the Neva Bay water area will cause disturbance of the normal living conditions of all hydrobionts, including fish and invertebrate organisms constituting food resources for fish.

The impact of the planned operations on the aquatic bioresources will be of both permanent and temporary character.

Adverse impacts on the aquatic biota will be imposed due to the following factors:

- Irreversible alienation of part of the bay for the construction of permanent piers;
- Temporary withdrawal of part of the bay for the construction of temporary islands;
- Increase in the water turbidity within a certain area in the process of the construction of temporary islands as a result of the suspension of ground particles within the construction zone;
- Acoustic impact (a disturbance factor).

The main parameters of the zones of adversely affected bioresources and their habitats are expected to be as follows (according to the WHSD construction design):

• Area of the Marine Canal withdrawn for construction of permanent piers	270 m^2

• Area of the Neva Bay withdrawn for construction of permanent piers along the motorway segment from Kanonersky Island to the northern bank of Bolshaya Nevka River	15.785 m^2
• Area of the Marine Canal withdrawn temporarily (for 2 years) for construction of a pier with filling of a temporary island	660 m^2
• Area of the Neva Bay withdrawn temporarily (for 4 years) for construction of temporary islands at the motorway segments from Kanonersky to Vasilievsky Island, from Vasilievsky to Krestovsky Island, a dam at the edge of Krestovsky Island with transition to islands and dams across Elaginsky Island up to the northern bank of Bolshaya Nevka River	Total of 31.2 ha or 312.000 m^2
• Zones with an increase in suspended matter content in water up to 1 mg/l and more in relation to the baseline value will exist within a range of up to 10 km from the location of temporary islands and within a range of up to 3 km with an increase in suspended matter contents of 100 mg/l and more	
• Area of seabed covered with a sediment layer more than 5 mm thick	4.7 km^2 (4,700,000 m^2);
• Total area in Neva Bay with an elevated degree of water turbidity caused by construction of the temporary island:	
– with concentrations of over 0.25 mg/l above baseline level	58.6 km^2 (58,600,000 m^2)
– with concentrations of over 10 mg/l above baseline level	24.9 km^2 (24,900,000 m^2)
– with concentrations of over 50 mg/l above baseline level	6.4 km^2 (6,400,000 m^2)
– with concentrations of over 100 mg/l above baseline level	2.8 km^2 (2,890,000 m^2)
• Accordingly, the area of zones with elevated water turbidity within the following ranges of suspended matter concentrations caused by the construction of the temporary islands:	
– from 0.25 to 10 mg/l	33,700,000 m^2
– from 10 to 50 mg/l	18,500,000 m^2
– from 50 to 100 mg/l	3,600,000 m^2
– over 100 mg/l	2,800,000 m^2

For the estimation of the damage that can be inflicted on fish resources in the Neva Bay, it was assumed, based on the literature data and local fishery monitoring results obtained by the GosNIORH Institute, that an increase in the water turbidity (i.e. an increase in the concentration of mineral suspended matter in comparison with the baseline level) would result in the death of plankton organisms (as percentage of the total population):

- at concentrations from 0.25 to 10 mg/l 10%
- at concentrations from 10 to 50 mg/l 35%
- at concentrations from 50 to 100 mg/l 75%
- at concentrations >100 mg/l 100%

Recovery of zooplankton during the year following the work completion.

Within the zone of increased water turbidity, the mineral suspended matter settling on the bottom buries the benthic biotope resulting in complete or partial death of benthic organisms.

It was identified earlier that when the bottom (i.e. the biotope of benthic invertebrates) is covered with a not less then 5 mm thick sediment layer, 100% of benthic organisms inhabiting the bottom biotope die at high concentrations of suspended soil particles.

Benthic filterer organisms, similarly to plankton organisms, play an important role in the process of self-purification of a body of water. Stunting of their vital functions, and especially their death, affect sharply the ability of a body of water for self-purification.

Recovery, or to be more precise, formation of new benthic cenosis proceeds slowly and is accompanied by the loss of some species and a reduction of their original biomass by more than half.

Under the conditions of the Neva Bay, the zoobenthos recovery takes on average of up to 5 years from the time of work termination.

When estimating the damage, the annual partial recovery of zoobenthos is assumed to be 20%. Thus, the death of benthic organisms is differentiated by years as a fraction of a unity in the following way: 1 + 0.8 + 0.6 + 0.4 + 0.2.

A high concentration of a fine mineral suspended matter affects fish, reducing the rate of fish growth and spawning efficiency, hindering the normal development of fish roe and larvae and causing their death. Furthermore, due to high water turbidity, natural movements and migration are hindered and the access to food resources is limited.

As a result, the spawning and feeding conditions for fish are affected within the zone of hydro-engineering works; the fish species composition and quantitative structure of the ichthyocenosis is deteriorated and the overall fish resources diminish.

An analysis of the technical data available in the Project design and an assessment of the biota status in the project implementation area have resulted in the following conclusions:

1) The implementation of the hydro-engineering works planned in the Project design will have both permanent and temporary negative impacts on the aquatic biological resources (fish resources). Accordingly, two kinds of damage will be inflicted on the fish resources, i.e. permanent and temporary.

2) The zone affected by the planned operations (unless the adopted work procedures are modified) includes the following spawning grounds of freshwater fish species and semi-anadromous smelt:

   a) in the area of the Northern Lakhta shoal – at the western end of Krestovsky Island and to the south of the Park of the 300th Anniversary of St. Petersburg - the total area is 0.60 km^2 or 60.0 ha, of which the area of a temporary island is 2.5 ha;

   b) on the Kanonersky shoal of a total area of 0.71 km^2 or 71.0 ha.

3) Despite the fact that the temporary islands will be constructed for a limited period of time, spawning grounds will not recover after their removal, which is attributed not only to the nature of the hydro-engineering work, but also to the subsequent intensive WHSD motorway operation. This means that the fish spawning grounds at the western end of Krestovsky Island will be lost irrecoverably.

4) There will be no impact on the spawning grounds of the Southern Lakhta shoal located south of the Marine Canal.

The main components of the damage inflicted on fish resources are as follows:

- irrecoverable loss of spawning grounds in the Neva Bay and the Marine Canal in the areas used for the WHSD motorway piers;
- irrecoverable loss of a spawning ground at the western end of Krestovsky Island to be used for the construction of temporary islands;
- temporary withdrawal of some feeding grounds used by fish in the Neva Bay (for a period of 4 years) and in the area of the Marine Canal (for a period of 2 years);
- sliming of spawning grounds within the zone of settlement of suspended matter, which would be covered with an over 5 mm thick layer of sediments at the western end of Krestovsky Island, to the south of the Park of the 300th Anniversary of St. Petersburg and on the Kanonersky shoal;
- death of plankton and benthos organisms or disturbance of their vital functions resulting in a decrease in the productivity of food supply resources for fish within the zone of high water turbidity created in the process of construction and removal of temporary islands.

The damage mentioned in the first two items is rated as permanent; the other three items belong to the temporary damage category.

The period of adverse impact of the temporary factors will include the time required for the work execution and the time needed for recovery of the hydrobiont communities.

Permanent damage:

The total area of the irrecoverably lost fish feeding grounds (there are no spawning grounds in the area of the piers) will be 15,785 m^2 in the Neva Bay and 270 m^2 in the area of the Marine Canal; the respective volumes of water will be 63,140 m^3 at an average depth of 4m in the Neva Bay and 3,240 m^3 in the Marine Canal area at an average depth of 12m.

The area of the spawning grounds that will be lost at the western end of Krestovsky Island will be 25,000 m^2 (2.5 ha).

Temporary damage:

1) In areas used for temporary islands:
   - The area of fish feeding grounds (less the areas of spawning grounds within the outlines of temporary islands) will be 287,000 m^2 in the Neva Bay (for 4 years) and 660 m^2 (for 2 years).
2) In case of sliming of the Neva Bay bottom:
   - the area of spawning grounds lost for a certain period of time will be 1,285,000 m^2 (128.5 ha), including:
     a) 575,000 m^2 (57.50 ha) at the western end of Krestovsky Island and to the south of the Park of the 300th Anniversary of St. Petersburg;
     b) 710,000 m^2 (71.00 ha) on the Kanonersky shoal
   - the area of the feeding grounds of the benthophage fish species lost for a certain period of time will be 3,415,000 m^2.
3) The volume of water in the high water turbidity zone, where the productivity of the food supply resources for planktonphage fish will be affected, has been estimated taking into account that part of the water area within the high-turbidity zone is used by fish as spawning ground. Accordingly, to avoid double counting, that area has been deducted from the total area of the high-turbidity zone taking into account that the maximum amount of settling suspended matter will be recorded in zones with concentrations from 50 to 100 mg/l and over 100 mg/l.

The volumes of water with a breakdown by suspended matter concentrations will be as follows:

Concentration, mg/l	Area, m^2	Area less spawning ground area, m^2	Volume, m^3
0.25-10	33,700,000	33,700,000	134,800,000
10-50	18,500,000	18,500,000	74,000,000
50-100	3,600,000	3,216,670	12,866,680
> 100	2,800,000	2,608,330	10,433,320

6.10.3 *Estimation of Predicted Damage to Fish Resources*

The estimation of damage to fish resources inflicted by the WHSD construction operations has been performed with differentiation by categories of damage (i.e. permanent and temporary) and taking into account the specific character of the impact.

The estimation of damage to fish resources (**N**, t) in real terms due to loss or disturbance of spawning grounds is made by the formula:

$$\mathbf{N = P_o \times F_1/F_o\, q \times S \times 10^{-3}}, \qquad (1)$$

where:

P_o is the fish productivity of spawning grounds in terms of kg/ha;
F_1 is the area of spawning grounds having lost their fishery significance, ha;
F_o the total area of spawning grounds, ha;
q correction coefficient taking into consideration the varying quality of spawning grounds (to be determined based on comparison of the relative quantities of born young fish);
S is the area of spawning grounds having lost their fishery significance, ha;
10^{-3} is a multiplier for conversion of kilograms to tonnes.

The estimated production return from 1 ha of spawning grounds ($P_o \times F_1/F_o \times q$) will be 215.5 kg/ha in the area of the Northern Lakhta shoal (at the western end of Krestovsky Island and to the south of the Park of the 300th Anniversary of St. Petersburg) and 262.6 kg/ha on Kanonersky Island.

The estimation of the damage inflicted on fish resources (N, tonnes) in real terms due to the loss or temporary deterioration of the productivity of food supply is made by the formula:

$$\mathbf{N = n \times S \times P/B \times 1/K_2 \times K_3/100 \times 10^{-6}}, \qquad (2)$$

where:

n is the average biomass of food organisms, g/m^3 or g/m^2;
S is the area of food supply grounds (m^2) or volume of water (m^3) exposed to adverse impacts;
P/B is the coefficient for conversion of the biomass of food organisms to their products;
K_2 is the food supply coefficient for conversion of the product of food organisms to fish products;
K_3 is an indicator of maximum permissible use of food supply resources (%);
10^{-6} is a multiplier for conversion of grammes to tonnes.

6.10.3.1 *Estimation of Predicted Permanent Damage to Fish Resources*

Damage caused by the loss of spawning grounds

Damage caused by loss of spawning grounds situated at the western end of Krestovsky Island has been estimated at:

$N = 215.5\ kg/ha \times 2{,}50\ ha \times 10^{-3} = \underline{0.539\ t}$

Damage due to the loss of feeding grounds

Damage to fish resources caused by the loss of feeding grounds in the Neva Bay will be as follows:

– with regard to resources of planktonphage fish (for zooplankton):

$N = 0.23\ g/m^3 \times 63{,}140\ m^3 \times 15 \times 0.13 \times 0.6 \times 10^{-6} = 0.017$ t;

– with regard to resources of benthophage fish (for zoobenthos):

$N = 2.53$ г$/m^2 \times 15{,}785\ m^2 \times 3 \times 0.17 \times 0.6 \times 10^{-6} = 0.012$ t;

It results in a total of 0.029 t of fish.

Damage to fish resources caused by the loss of feeding grounds in the Marine Canal will be as follows:

– with regard to resources of planktonphage fish (for zooplankton):

$N = 0.23$ г$/m^3 \times 3240\ m^3 \times 15 \times 0.13 \times 0.6 \times 10^{-6} = 0.0009$ t;

– with regard to resources of benthophage fish (for zoobenthos):

$N = 2.53$ г$/m^2 \times 270\ m^2 \times 3 \times 0.17 \times 0.6 \times 10^{-6} = 0.0002$ t;

It results in a total of 0.0011 t of fish (rounded to 0.001 t of fish).

In general, the permanent damage to fish resources will be **0.569 t.**

6.10.3.2 *Estimation of Predicted Temporary Damage to Fish Resources*

Damage due to the Sliming of the Spawning Grounds

The damage to fish resources due to the sliming of the spawning grounds in the area of the Northern Lakhta shoal will be:

$N = 215.5$ kg/ha $\times$ 57.50 ha $\times 10^{-3} = 12.391$ t.

The damage to fish resources due to the sliming of the spawning grounds at the Kanonersky shoal will be:

$N = 262.6$ kg/ha $\times$ 71.00 ha $\times 10^{-3} = 18.645$ t.

The total damage due to the sliming of the spawning grounds will be 31.036 t.

Taking into account that the spawning grounds are located in the transit zone of the Neva River, the productivity recovery period is assumed to be 1 year. However, due to the fact that the impact will not only made during the construction of the islands, but also during their removal, the damage will be:

31.036 t $\times$ 2 = 62.072 t.

Damage due to the temporary withdrawal of feeding grounds for temporary islands

Damage to fish resources as a result of the temporary withdrawal of feeding grounds for temporary islands will be:

– with regard to resources of benthophage fish (for zoobenthos):

$N = 2.53\ g/m^2 \times 287{,}000\ m^2 \times 3 \times 0.17 \times 0.6 \times 10^{-6} = 0.222\ t$;

Taking into account the period of the existence of the islands in the Neva Bay (4 years) and the time required for zoobenthos recovery:

0.222 t × (4 + 1 + 0.8 + 0.6 + 0.4 + 0.2) = 1.554 t of fish.

Damage to fish resources as a result of temporary withdrawal of feeding grounds in the Marine Canal will be:

– with regard to resources of benthophage fish (for zoobenthos):

$N = 2.53\ g/m^2 \times 660\ m^2 \times 3 \times 0.17 \times 0.6 \times 10^{-6} = 0.001\ t$;

Taking into account the period of the existence of the islands in the Canal (2 years) and the time required for zoobenthos recovery:

0.001 t × (2 + 1 + 0.8 + 0.6 + 0.4 + 0.2) = 0.005 t of fish.

The total amount will be 1.559 t of fish.

Damage due to the temporary decrease in the productivity of food resources for the benthophage fish within the zone of construction and the subsequent removal of the temporary islands

Damage to fish resources due to a temporary decrease in the productivity of food resources will be:

– with regard to resources of benthophage fish (for zoobenthos):

$N = 2.53\ g/m^2 \times 3415000\ m^2 \times 3 \times 0.17 \times 0.6 \times 10^{-6} = 2.644\ t$.

Taking into account that the zoobenthos will die both during the period of island construction and then during the period of removal of the islands and that during the intermediate period (4 years) and after the completion of all works, the process of recovery of the benthos will take certain time, the damage to benthophage fish will be:

2.644 т × (1 + 0.8 + 0.6 + 0.4 + 0.2) × 2 = 15.864 t of fish.

Damage due to the temporary decrease in productivity of the food resources of the planktonphage fish within the zone of construction and the subsequent removal of the temporary islands

Damage to fish resources due to a temporary decrease in the productivity of food resources will be:

– with regard to resources of planktonphage fish (for zooplankton):

$N = 0.23\ g/m^3 \times (134800000 \times 0.10 + 74000000 \times 0.35 + 12866680 \times 0.75 + 10433320)\ m^3 \times 15 \times 0.13 \times 0.6 \times 10^{-6} = 16.002\ t$.

Taking into account that the death of zooplankton will take place both during the period of island construction and then during the period of removal of the islands, the damage to planktonphage fish will be:

16.002 t × 2 = 32.004 t of fish.

The overall temporary damage to fish resources will be: 62.072 + 1.559 + 15.864 +32.004 = **111.499 t.**

6.10.4 Determination of compensation measures and estimation of approximate expenses

In accordance with the Recommendations of the Federal Fishery Agency (No.1692-ВБ/Sek of 31.03.2010) "On Application of Provisional Methodological Guidelines for Estimating Damage Inflicted on Fishery", the required compensation measures were designed and their approximate costs estimated.

The objective of the compensation measures is to compensate for the damage that might be inflicted by the planned commercial activity on fish resources in a body of water of fishery significance.

In conformity with the Annex to Order No.417 of 01.10.2010 issued by the North-Western Territorial Department "Compensation Measures for Artificial Reproduction of Aquatic Biological Resources in Bodies of Water of Fishery Significance in 2011", it was proposed that **yearlings of Ladoga cisco** (*Coregonus lavaretus* L.) should be hatched and released into the **Ladoga Lake and its tributaries** as compensation for damage inflicted to fish resources in the eastern part of the Gulf of Finland as a result of construction of the WHSD Central Section.

In this case it is recommended to do it in the Ladoga Lake, rather than in the Neva Bay, where damage is expected to take place. This is in good agreement with the above "Provisional Guidelines …" (Section 4.4).

6.10.4.1 Estimation of Amounts of Ladoga cisco yearlings to be hatched

The amount of cisco yearlings to be produced (**N_M, number of yearlings**) is determined by the formula:

$$\mathbf{N_M = N_B / p \times s,} \quad (4)$$

where:

- **N_B** is the amount of reproduced aquatic bioresources equivalent to the cost of the quantity (N, t) of lost aquatic bioresources, t;
- ***p*** average mass of one reproduced fish (or other fishery objects) in production return;
- ***s*** Coefficient of production return or replenishment of production resource (as a fraction of a unit).

The amount of cisco yearlings of 15 g weight has been calculated taking into account the following factors: ratio of wholesale to retail price (reducing coefficient for cisco to the overall catch) = 4.3; average weight of cisco in a catch (p) = 580 g; production return coefficient (s) for yearlings (of 15 g weight) = 5% (Letter of FGNU "CUREN" No.02-2/990 dated 17.12.2010).

The damage to fish resources that cannot be prevented by means of special measures will be as follows:

1. Permanent damage = **0.569 t**

Taking into account the ratio of wholesale to retail price calculated for cisco reproduction, the damage will be:

N_B = 0.569 t : 4.3 = 0.132 t.

The number of Ladoga cisco fish larvae to be hatched as a compensation measures will be:

N_M = 132 kg : (0.580 kg/yearling × 0.05) = 4,552 per year;

or during the entire operational period (assumed to be 100 years long) = 455,200.

***2. Temporary damage* = 111.499 t**

Taking into account the ratio of wholesale to retail price calculated for cisco reproduction, the damage will be:

N_B = 111.499 t : 4.3 = 25.930 t.

The number of Ladoga cisco fish larvae to be hatched as a compensation measures will be:

N_M = 25930 kg : (0.580 kg/yearling × 0.05) = 894,138 per each operation.

6.10.4.2 *Estimation of the Approximate Cost of the Compensation Measures*

The operating cost is estimated by the formula:

$$F_3 = N_м \times F \times t, \quad (2)$$

F_3 is the overall operating cost;

F is the unit operating cost;

N_M is the number of yearlings put into a body of water.

In case of a one-time damage reduced to one year **t =1**.

The unit cost of reproduction of yearlings of European cisco in 2010 were assumed in accordance with the recommendations issued by FGNU "GosNIORH" (No.114/1 of 12.02.2010) to be RUR 36 per a yearling (weight from 15 g).

The approximate cost of cisco yearling production is as follows:

1. **For compensation of *permanent damage*:**

RUR 36 per fish × 4552 = RUR 163872 annually during a period of facility operation (assumed to be 100 years) or in case of a one-time release:

RUR 163,872 × 100 years = RUR 16,378,200

2. **For compensation of *temporary damage*:**

RUR 36 per fish × 894,138 = RUR 32,188,968

According to the Recommendations by the Federal Fishery Agency (No.1692-ВБ/ Sek of 31.03.2010) "On Application of Provisional Methodological Guidelines for Estimating Damage Inflicted on Fishery": "*If a compensation measure is implemented as a one-time release of hatched fish without any additional measures requiring capital investments, the cost of the compensation measure is estimated on the basis of an agreement (cost estimate) on its implementation by a specialist organization specializing in the reproduction of aquatic resources*".

Since in our case the proposed measure does not require any capital investments, its approximate cost in case of a one-time release of the entire number of cisco yearlings as a compensation for the damage inflicted on fish resources by the WHSD Central Section construction is assumed to be equal to RUR 48,567,168, including RUR 16,378,200 and RUR 32,188,968 as compensation for permanent and temporary damage, respectively.

6.10.5 *Recommendations for the minimization of the negative impacts on aquatic bioresources imposed by the planned activity*

To avoid an increase in the possible damage to fish resources, the Partner Company should undertake the following:

1) In order to protect resources of fish spawning in spring it is required to comply with the prohibition of any work within the water area of a body of water during the period of spawning migrations and spawning (from 15 April until 20 June) and take measures to reduce the noise generated by construction tools, machinery and vehicles operating on the coast.
2) In order to mitigate the adverse impact on the Neva salmon resources it is required to suspend any work in the water area for the period coinciding with the peak of salmon spawning migration.
3) For the construction of temporary islands it is recommended to use the "atoll'" technology (installation of sheet piling and filling of gravel or laying bags of sand along the perimeter of a future island) to radically reduce entrainment of suspended matter to water.
4) If such technologies cannot be applied, it is advisable to use clean coarse-grained sand (with a minor content of dust-like particles) in the areas of the construction of temporary islands for piers to avoid an increase in water turbidity.
5) When executing any work in a water area or on the shore it is required to take measures preventing of the contamination of the water body with construction materials, garbage, petroleum products and other pollutants.
6) After the completion of the work it is required to remove construction debris and waste from the coastal zone, as well as any provisional structures and appliances.
7) Provide structural and technological solutions ensuring the execution of hydro-engineering work within the shortest possible time.
8) The WHSD construction should be accompanied by the monitoring of the quality of water in the adjacent waters.
9) As an efficient compensation measure it is recommended to release yearlings of European cisco *Coregonus lavaretus* L (freshwater species) to the Ladoga Lake.

6.11 *IMPACT ON CULTURAL HERITAGE*

In accordance with Federal Law No.73-FZ of 25.06.2002 "On Objects of Cultural Heritage (Historic and Cultural Memorials) of the Peoples of the Russian Federation" (with amendments of 23.07.2008), cultural heritage includes physical objects (historic and archeological sites, natural historic objects) or remarkable sites (landscapes).

The historic center of St. Petersburg and the associated group of memorials are part of the Global Heritage recognized by UNESCO and protected by the federal and local legislation.

There are no architectural, religious or other remarkable sites listed in the united state register of cultural heritage memorials directly within the WHSD Central Section area.

However, the motorway route runs through some coastal areas and the filled shore sites of Vasilievsky and Krestovsky Islands, which were originally shallow waters of the Neva Bay. In the process of the excavations, occasional finds of artifacts may occur, especially ship wrecks that sunk in the 18th century.

An important factor of the impact that can potentially affect cultural heritage objects during the WHSD motorway construction and operation is increased vibration levels.

More specifically the following potentially exposed architectural and religious memorials exist along the already constructed and operating section the WHSD Southern Section:

- Dashkova's Dacha (Kiryanovo Mansion) - an architectural memorial of classical style located at a distance of 30 m from the motorway;
- St. Nicholas and Czarina Alexandra Church (Putilovsky Temple) built in 1906. This building was modified during the Soviet period and its original architectural features have been virtually lost (only some elements of the interior design and the basement, i.e. the lower St. George's Temple have been partially preserved). Currently, the church is part of the Russian Orthodox Church (Putilovskaya Church Community). It is located at a distance of 70m from the motorway.

Measurements made within the framework of the environmental monitoring, after the commissioning of the first 6km long section of the motorway, demonstrated that the vibration level at a distance of 20m from the motorway supports at a traffic intensity of approx. 20,000 vehicles per day is several times lower than the maximum permissible level.

6.11.1 Mitigation Measures

To minimize any negative impacts on objects of cultural heritage objects, the following measures are foreseen in the course of Project design development, the construction and the operation of the WHSD Central Section:

- In compliance with the federal requirements, in case of any occasional archeological finds in the process of the construction work, any operations should be suspended until the assessment of the finds is carried out by archeologists.
- A chance find procedure, adopted by the JSC "WHSD" is to be followed in such a case. If required, additional archeological rescue operations shall be organized.

In order to reduce the vibration level in the adjacent areas, the following measures are planned to be implemented:

- The bases of the motorway supports will be constructed at a depth of 30-35m below the ground surface and will be placed on relatively foul clays, which prevent the propagation of the vibration from the supports;
- The high quality of the road bed and paving, as well as the fact that there are no joints, will ensure the smooth motion of vehicles over the WHSD motorway.

As a result, the WHSD motorway construction Project will not have any negative impacts on the cultural heritage objects.

6.12 *VISUAL IMPACT ASSESSMENT*

6.12.1 *Current Situation, Expected Impacts and Scale of Impacts*

Visual impacts on the surrounding landscapes potentially caused by the WHSD Central Section have been assessed from the perspective of the conservation of the esthetic, cultural and historic sites and the formation of a new skyline within the architectural environment of St. Petersburg.

The special regulatory limitations which are specifically applicable for St. Petersburg with regard to the architectural aspects, the height parameters and the compositional characteristics of new structures, as well as the visual impacts related to the perception of the existing landscape have been considered.

The cultural heritage objects in the protective zone of St. Petersburg, as defined by the relevant legislation of St. Petersburg[9], are located at distances of over 1 km from the planned motorway route. Particularly valuable fragments of the historic, urban and architectural environment, within the zones subject to construction regulations in the historic central districts of St. Petersburg, are located at distances of over 300 m from the planned motorway route.

The existing visual landscape of the areas crossed by the WHSD Central Section can be divided into three main parts with the following specific features:

- The southern segment of the motorway is adjacent to the industrial zone of the Kirovsky District of St. Petersburg with elements of industrial facilities and the infrastructure of the Seaport; the residential buildings constructed in the middle of the 20th century and some individual office buildings exist on Kanonersky Island;
- A rather long central segment of the motorway route runs along the western border of the residential building along the coast of Vasilievsky Island and the

[9] St. Petersburg's Law No. 728-99 of 22.12.2005 "On St. Petersburg's Urban Development Master Plan" (Revision No. 412-93 of 30.06.2010) and Law No. 820-7 of 19.01.2009 "On outlines of protection zones around objects of cultural heritage within the territory of St. Petersburg and land management requirements within the above zones and amendments to St. Petersburg's Law "On St. Petersburg's Urban Development Master Plan".

sports complex on Krestovsky Island. The formation of new territories has already been started on Vasilievsky Island, and is planned to the west of Krestovsky Island. On Krestovsky Island it will be an area for public use within the frame of the sports complex. The Marine Facade constructed to the west of Vasilievsky Island over an area of approximately 470 ha will comprise a business center, a new residential zone with a high level of comfort for its residents and a passenger ferry terminal. These facilities will be the dominating elements of the skyline of Vasilievsky Island from the sea. The current architectural landscape of the blocks located along the Marine Embankment on Vasilievsky Island, with dominating residential multi-story apartment buildings constructed in the 1970-90s, as well as the existing office buildings and hotels, will be hidden behind the facilities of the Marine Facade. The elements of the WHSD in combination with the facilities of the Marine Facade located at the south-western end of Vasilievsky Island will form a screen for the Shkiperskaya dump site rising to a height of 8-9m above the Neva Bay.

- A short motorway segment on the coast to the north of the Bolshaya Nevka River, where some residential and public buildings are currently under construction west of the motorway.

In the process of the design development for the bridges across the Korabelny and Petrovsky waterways and the flyovers, the future architectural image of the Marine Facade as a whole was taken into account. Both appropriate architectural and engineering design solutions for those two bridges and offshore flyovers were selected with due consideration of the overall planned landscape (Figures 6.12-1, 6.12-2).

In general, the new bridge outlines and their night-time illumination will considerably improve St. Petersburg's skyline as seen from the sea.

However, in the mean time, it should be taken into consideration that the adopted solutions have not been discussed extensively with the general public. Therefore, the possibility of the expression of concerns and objections of the public, with regard to certain visual impact issues associated with the motorway construction (this refers to the segment comprising bridges and flyovers), should be considered. Night-time illumination might be considered by certain groups of residents as a disturbance factor.

6.12.2 Mitigation Measures

In order to minimize the visual impacts of the project the following measures will be foreseen in the process of the Project design development, the construction and the operation of the WHSD Central Section:

- Additional plantings, trees and shrubs in the areas adjacent to the new motorway within the framework of the site improvement and revegetation program;
- Timely land reclamation of areas temporarily disturbed during the construction phase;

- Continuous management of site improvement and vegetation at the wayside within the sanitary distance range during the WHSD operational phase in accordance with the landscape architectural master plant;
- Issues of the visual aspects of the night-time illumination of bridges and flyovers should be discussed with the general public and, if required, illumination should be minimized to a level needed to ensure traffic safety on the motorway.

6.13 SOCIOECONOMIC IMPACTS

6.13.1 *Expected Impact of the WHSD Construction and Operation on the Socioeconomic Situation*

The WHSD construction Project is of importance not only at the city's level, but also at the federal level, because it corresponds to the priorities of the socioeconomic development of the transport infrastructure of both St. Petersburg and Russia.

Its implementation will have a positive macroeconomic effect on the city's development as a major trading and transport center of international significance as a result of achieving the following objectives:

- Provision of access roads to the Big Seaport of St. Petersburg – a leader in container transportation of cargoes, ensuring thereby an increase in freight turnover of the Seaport;
- Simplified transport connections between major ports, railway, trucking and air terminals of St. Petersburg with exits to the federal and regional highway network of Russia. This will contribute to an increase in the amount of cargo transported via St. Petersburg and through the contiguous territories;
- Connection to the passenger ferry terminal being constructed on the artificial site of the Marine Facade. The ferry terminal having a capacity of over 12,000 persons per day will provide access to the main tourist attractions of St. Petersburg;
- Creation of transport infrastructure required for the development of the north-western part of the city, where the construction of residential districts, industrial facilities and logistic complexes is planned.

At the federal level the WHSD motorway will facilitate:

- The expansion of the international transport corridor "North-South";
- The improvement of the efficiency of cargo transportation systems reducing thereby transport costs in the production cost of products;
- The creation of favorable conditions to enhance the mobility of the population.

In addition to the above long-term economic effects, the benefits related to the implementation of the Project will the include taxes to be paid by the Partner Company operating the WHSD motorway. The Partner will pay taxes to different budget levels in conformity with the tax rates and conditions established by the applicable RF legislation.

On a short-term basis the WHSD Project implementation will have a positive effect on the development of the construction sector both in the city and in the region as a whole. It will also affect positively the tertiary sector and the material supplies, because the commissioning of local contractors and suppliers is planned during the construction phase (and also later in case of major repairs of the motorway).

At the microeconomic level, it is expected that the toll motorway will have an influence on the differentiation of prices for services provided by the city's taxis. If a passenger selects a route including the use of the WHSD motorway, the fare will automatically increase to include also the toll to be paid for the use of the motorway. This means that the cost of the taxi services will increase.

However, passengers will have the opportunity to select an alternative route bypassing the WHSD motorway, i.e. longer in terms of time, but cheaper.

A potential negative microeconomic factor can be the decrease in the market value of real estate as a result of the implementation of the Project.

This primarily refers to the residential buildings along the Marine Embankment. The expected cumulative impact caused by the WHSD Central Section construction and the Marine Facade Project implementation (higher noise level and atmospheric air pollution, visual obstruction of the panoramic view of the Neva Bay for the residents of the buildings at the Marine Embankment) have already caused a fall in the value of the apartments facing the Marine Embankment.

This factor plays a significant role in formation of a negative attitude of the local communities towards the plans for the construction of the WHSD motorway and towards the development of the Marine Facade.

6.13.2 *Impact on Transport Infrastructure*

6.13.2.1 *Construction Phase*

The construction phase of the WHSD Central Section can temporarily affect the transport conditions in the area of Kanonersky Island. The tunnel under the Marine Canal is the only way connecting Kanonersky Island to the other districts of St. Petersburg.

After the commissioning of the mooring facility at the dockyard on Kanonersky Island, the tunnel became overloaded and hinders the normal functioning of public transport.

Additional transport load on the only available road during the construction of the WHSD Central Section can have an adverse impact on the transportation and the travelling conditions of the people living or working on the island.

It is also expected that during the construction of the flyover across Kanonersky Island the blocking of the street traffic will be required.

Similar experience in the Stachek Avenue (the WHSD Southern Section) has shown that it the blocking of the traffic for certain periods is required (for about 3 days, including weekends) in the process of the installation of flyover piers.

This factor would not impose any significant impact on the living conditions of the communities living on Kanonersky Island.

At the stage of the elaboration of the Project documentation by the Partner, the solutions related to the access roads, the temporary interruption of the traffic streams and the use of the existing transport infrastructure for detour routes will be updated keeping in mind the need to reduce and minimize adverse impacts.

6.13.2.2 *Operational phase*

Generally speaking, the construction of the WHSD motorway will have a positive long-term effect on the transport conditions of the city of St. Petersburg.

In particular, the new high-speed motorway will:

- Ensure transport connection between the north-western, central and southern districts of the city;
- Resolve the issue of the isolation of Vasilievsky Island from the rest of the city in summer when the bridges are open to allow navigation;
- Relieve traffic on the city's street network; currently, the heavy traffic and the related congestions prevent the efficient operation and development of industrial, trading and transport organizations and the tertiary sector. In particular, the transit traffic within the city will become less intensive; the same goes for the traffic stream going through the central part of St. Petersburg;
- Partially resolve the problem of traffic jams at the exits of the city to recreational areas, summer dachas, etc.

After the completion of the WHSD Southern Section construction the opening of an exit ramp for trucks to the Ekateringofka River embankment is planned. This will allow avoiding the traffic of heavy-duty trucks via the Dvinskaya Street, in the direction of the tunnel - the only route on land for the residents of Kanonersky Island to reach other districts of the city.

The operation of the WHSD motorway will also relieve the traffic going through the currently critical parts of the city in the vicinity the Obvodnoy Canal, Stachek Avenue (the WHSD Southern Section), as well as the Planernaya Street and the adjoining streets (the WHSD Northern Section).

6.13.3 *Impact on Demographic Situation*

Based on the assessment made in the WHSD Central Section construction Project design, it was planned to re-classify 140 apartments in four residential buildings on Kanonersky Island into non-residential category and resettle the residents living in these apartments.

The final number of residents to be resettled and the number of apartments to be re-classified will finally be determined in the process of elaboration of the Project documentation taking into account the updated assessments related to noise levels generated by construction activities and the WHSD motorway operation, as well as the efficiency of possible noise abatement measures.

During the construction phase of the WHSD Central Section project, the overwhelming majority of the contractors' employees will be recruited from the local labor market.

The number of workers recruited from other regions and countries is expected to be very low and will have no serious impact on the demographic situation in the subject area and especially no impact on the city as a whole.

The number of employees involved on a permanent basis in the operation of all WHSD sections will also have no significant impact on the demographic situations in the respective districts of the city.

The main impact on the demographic situation in the Project area will be associated with the construction of major residential areas on the artificial sites near the WHSD motorway within the framework of the Marine Facade Project. It is assumed that the overall floor area of the residential areas will be 1.5 million m^2 with a total population of over 73,000 people, or approximately 37% of the current population of Vasilievsky Island.

The availability of the WHSD motorway as an efficient transport artery will enhance the attractiveness of the new artificial sites for permanent dwellings and for interurban labor migration.

6.13.4 Impact on Employment Level in Local Communities

During the construction phase of the WHSD Central Section Project, the duration of which will be 41 months, it is planned to employ on average 6,270 people (with a maximum number of 7,220 employees at a time).

It is expected that the prevailing part of contractor organizations during the construction phase will be companies based in St. Petersburg and Leningradskaya Oblast.

Taking into account the total number of people employed in the city's construction sector (approx. 240,000), recruitment of labor resources for the WHSD construction will not cause any perceptible changes in the labor market (the proportion of the construction sector is less than 10% of the total number of people employed in St. Petersburg's economy).

It is assumed that the staff of the Partner Company involved in the toll motorway operation along the entire length of the WHSD motorway will be not more than 400 people, which is negligible in comparison with the total number of employed persons in St. Petersburg.

However, the operation of the WHSD Central Section will have a long-term positive effect (although indirectly) on creation of new jobs. The Marine Facade Project implementation is closely related to the WHSD construction as one of the main transport arteries essential for the functioning of the Marine Facade facilities.

The total floor area of the public and business buildings with offices, hotels, shopping centers, etc. on the Marine Facade site will be 1 million m^2. The success of the recruitment of labor resources for the new facilities will be dependent, among other things, on the availability of an appropriate transport infrastructure, including the operating WHSD motorway.

6.13.5 *Impact on Public Health*

In 2000 an assessment of the impact on the public health was performed for the predicted traffic intensity on the WHSD motorway and associated air pollution and noise levels in the adjacent areas. The results obtained indicated that no significant risks for the public health were expected, provided that residents of the four houses on Kanonersky Island would be resettled, the nearby kindergarten relocated and planned noise protection measures taken.

Later, some more accurate calculations, made in the course of preparation of this ESIA showed that to prevent any risks for the public health with regard to the communities on Kanonersky Island, the scope of noise protection measures should be extended.

6.13.6 *Impact Associated with Land Acquisition for the WHSD Construction*

6.13.6.1 *Resettlement of the Residents of the Buildings on Kanonersky Island*

The WHSD Central Section construction Project provides for the construction of a bridge across the Marine Canal with a flyover exit to Kanonersky Island. The flyover at this place will be approx. 45m high. Four apartment buildings on Kanonersky Island will be exposed there to high-level noise impact caused by the WHSD motorway. For this reason it was decided as early as in 2007 to resettle all residents of two buildings and some residents of two other buildings (two sections in one building and three sections in the second building).

According to a resolution passed by the Interdepartmental Commission of the Kirovsky District Administration (No.1317/25 of 15.08.2008) those buildings (apartments) were rated as unsuitable for dwelling and subject to resettlement and reclassification to the category of non-residential buildings. All residents of those apartments were notified about the decision.

In total, 140 apartments are subject to resettlement, and namely (Figure 6.3.1):

- 70 apartments in the building at the address: Kanonersky Island, House No.15 (the entire building);
- 15 apartments in the building at the address: Kanonersky Island, House No.17 (the entire building);
- 40 apartments in the building at the address: Kanonersky Island, House No.12, Building 2;
- 16 apartments in the building at the address: Kanonersky Island, House No.16.

Out of the above apartments, 75 apartments are privately owned by individuals and 87 apartments are occupied by tenants.

The total number of residents to be resettled will be determined at a later stage of the Project.

Taking into consideration the isolated location of Kanonersky Island, as well as the fact that some of the affected buildings subject to resettlement are rated as dilapidated housing, an opportunity to move to more dynamically developing districts of the city and improve their housing conditions will be a positive factor for the inhabitants of the apartments subject to resettlement.

According to the obligations to be included in the PPP Agreement, the measures to be taken for the preparation of the land for the construction of the WHSD Central Section will be performed at the expense of the city of St. Petersburg.

The Kirovsky District Administration has prepared the required information about the buildings to be resettled (No.2769/22 of 22.06.2006).

Furthermore, the LLC "Evaluation Center Avers" made a rough estimate of the approximate value of the apartments to be resettled within the framework of the WHSD Central Section Project (Information Letter dated 25.05.2007).

In conformity with the regulatory norms for the provision of housing in St. Petersburg, it is required in case of resettlement from ***social apartments*** to provide a floor area of 18 m^2 per each member of a family or 33 m^2 per a single person. In addition, compensation should be paid to each tenant to cover the expenses for moving to another apartment.

In case of a privately owned apartment the owner is entitled to obtain a monetary compensation of an amount equal to the average market price of his/her apartment.

In general, based on the character and scope of the above compensation measures in case of resettlement/housing acquisition, the potentially adverse impact associated with the resettlement of the residents from 140 apartments is to be considered as long-term and significant with respect to the scale of impact, because the compensation measures currently foreseen in St. Petersburg's legislation do not provide the following benefits:

- Additional assistance for vulnerable groups of people in case of resettlement, such as single mothers, senior people, physically disabled persons;
- Compensations and/or additional support (including also medical support) in the process of movement of the owners' or tenants' family members;
- Additional measures to ensure social adaptation of displaced residents at a new location (e.g. assistance/ priority with regard to employment, legal assistance, etc.).

Financing of the WHSD Central Section construction by the European Bank for Reconstruction and Development (EBRD) requires compliance of the borrower with the EBRD Performance Requirements (PR), including measures aimed at the mitigation and the minimization of impacts caused by resettlement and including development and implementation of a Resettlement Action Plan (RAP).

As a preliminary RAP drawn up on the basis of the EBRD requirements a Resettlement Framework Document defining the principles and procedures has been elaborated. RAP should be elaborated and implemented with regard to these principles and procedures. It is expected that in the process of implementation of the Framework Document by the city's authorities and the Partner, the probability of negative social impacts associated with the resettlement will be minimized.

6.13.6.2 *Land Acquisition*

An overwhelming proportion of the land (over 90% of the total area) allocated for the WHSD Central Section construction is considered to be within the category of land for settlements and is owned by the city of St. Petersburg.

The only privately owned land plot within the allocated land (technical zone) for motorway construction is the land owned by CJSC "Farvater" with an area of 2.89 ha. Its rent for the needs of the Project is not associated with any significant socioeconomic risks and impact due to the following reasons:

- This land is located in the city's industrial zone;
- Negotiations about the rental of the land from the CJSC "Farvater" were conducted in advance;
- It is assumed than an agreement referring to the compensation payment related to the use of the land plot will be concluded on the basis of mutual consent following the approval of the budget for the WHSD Central Section construction.

There are seven other land plots to be rented from other organizations on the basis of long-term lease agreements. Their total area is 1.5 ha. Five of the land plots are rented by LLC "Seaport", the other land plots are rented by JSC "Russian Railways" and LLC "Baltic Customs Office".

Conclusion of lease agreements for those land plots will not entail any socioeconomic risks.

Virtually the entire WHSD section along the western edge of Vasilievsky Island designed for the "Marine Façade" construction Project will cross the land given to the "TerraNova" Company by the city. These lands used to belong to the lands of Water Fund and hydraulic filling wasn't implemented here only because of reduction of the future soil excavation scale for the WHSD construction. The total area of that land, which will be reclassified from the water fund category to the land category for transport facilities and will be rented by the Partner on a long-term basis, is 66.1 ha.

Garage cooperatives are located in the area allocated for the motorway construction between the Ekateringofka River and the Marine Canal, as well as along the north-western edge of Vasilievsky Island. The land occupied by the garages is owned by the city and it is rented by the respective district divisions of the All-Russian Association of Automobile Owners (VOA) on a short-term basis. The VOA Society provides land plots for individual garages.

The VOA district divisions were notified well in advance that the lease agreements will be terminated. The agreements will be terminated after signing of the PPP Agreement.

According to the similar experience related to land acquisition for the WHSD Southern and Northern Sections, the main risks associated with the termination of agreements with the VOA district divisions are related to potential litigation if a garage cooperative files a claim in court against the Committee for Municipal Property Management.

The risk of such litigation in connection with the WHSD Central Section construction can be considered low.

Within the WHSD Northern Section, Mr. Varfolomeyev owns a land plot rated as land of urban settlement in the settlement of Beloostrov. As a result of an evaluation of the market value of the land and the constructions located on it, an agreement was reached that alternative housing will be purchased for Mr. Varfolomeyev at an expense corresponding to the updated evaluation.

This means that the land acquisition with respect to this plot of land has been virtually completed and will not entail any further adverse social consequences.

6.13.6.3 *Demolition of the Buildings and Impact on Income Sources*

During the preparation stage for the construction phase, a warehouse is to be demolished, which is owned by CJSC "Farvater" Company.

It is assumed that an agreement on compensation payment will be concluded between the Committee for Urban Improvement and Road Maintenance of St. Petersburg and the CJSC "Farvater" Company in connection with the warehouse demolition. The building has been evaluated by an independent organization and the CJSC "Farvater" Company agreed with the results. The model agreement, on the basis of which compensations were paid for the demolition of warehouses at the WHSD Southern Section, also provides for a compensation for lost profit. This minimizes the negative impact of the Project in connection with the demolition of buildings.

The most significant impact associated with the preparation of the corridor for the motorway construction will be associated with the demolition of numerous garages located on the city's land rented by the VOA district divisions in the Kirovsky and Vasileostrovsky Districts.

About 2,000 garages are located at the Marine Embankment on Vasilievsky Island; they are planned to be demolished within the framework of the city's programs for the improvement of the urban territories of St. Petersburg. Out of this number, 654 garages will be demolished for the WHSD Central Section construction. In addition, 411 garages will be demolished along the motorway section between the Ekateringofka River and the Marine Canal.

Monetary compensations for garage demolition will be paid on the basis of the Methodological Guidelines to be developed by the Department for Immobile Property Inventory and Valuation of St. Petersburg specifically keeping in mind the WHSD Central Section construction Project.

It is assumed that special public reception offices will be set up at the WHSD Central Section by the Partner, as it was earlier the case with JSC "WHSD" at the Northern and Southern Sections, to discuss issues related to compensations, organize consultations and receive documents from garage owners for compensation payment.

The experience of demolition of over 9,000 garages at the Southern Section indicates that approximately 20% of all compensation payments were made on the basis of decisions taken by legal courts. This is attributed to the fact that in many cases garage owners did not have properly legalized ownership documents for their garages and it was not possible for the city's administration to pay compensations in a direct way.

Furthermore, 36 claims related to disputed amounts of compensation were filed in court during 2009-2010 (Plaintiffs believed that the offered compensation was insufficient because the compensation calculated on the basis of the Department for Immobile Property Inventory and Valuation Guidelines was much lower than the actual market price for garages in St. Petersburg. The proportion of such claims was less than 1% of the total amount of compensation payments.

Taking into consideration the practice of demolition of a much larger number of garages at the WHSD Southern Section, it may be concluded that the level of social impact in connection with garage demolition at the Central Section can be considered as medium.

However, the overall social tension in connection with the demolition of a large number of garages within the framework of St. Petersburg urban development programs can potentially results in risks of social unrest and discontent.

At the Marine Embankment there are three cafés located on the land allocated for the WHSD construction: "Brig", "Umi" and "Morskoy Dvor". The latter two cafés were functioning as of April 2011. The land is owned by the city, but the cafés were not identified in the process of the land plot formation and they are not, therefore, entitled to claim a compensation for demolition and lost profit.

Within the framework of the Resettlement Action Plan it will be required to determine the ownership rights of the cafés and legitimacy of their claims for compensations in connection with the planned demolition and loss of business opportunities in order to minimize the adverse socioeconomic impacts of the Project.

6.13.7 *Impact on Social Infrastructure and the Adjacent Areas*

6.13.7.1 *Social Infrastructure on Kanonersky Island*

Within the future sanitary right-of-way of the WHSD motorway there is a kindergarten (No.74) at the address: Kanonersky Island, House No.20. This area is subject to reclassification and should be used for construction of public and business buildings.

Currently, the No.74 kindergarten is accommodated in two buildings (Houses Nos.20 and 18) and is the only pre-school institution on Kanonersky Island.

It is planned that before the start of the WHSD construction, the kindergarten facilities currently located in House No.20 will be moved to another building on Kanonersky Island. However, no decision has been taken so far about the building to be provided/ constructed for the kindergarten.

No decision has been made about whether the second part of the kindergarten (House No.18), situated directly at House No.20, will be continued to be used as a kindergarten.

In addition to the No.74 kindergarten, a sports ground belonging to the No.379 secondary school is also located within the motorway's sanitary distance zone. It should be also relocated.

The kindergarten and sports ground are of high social significance for Kanonersky Island.

It will only be possible to assess the scale of the impact on the island's social infrastructure, in connection with the relocation of these facilities, once the city's authorities make a decision about their new location.

There are a number of other social infrastructure facilities within a range of 100m to 150m from the future motorway on Kanonersky Island, including the No.379 secondary school, the "Priboi" swimming pool, a grocery shop and a household chemicals store, as well as a number of playgrounds for children. The school and the swimming pool, similarly to the kindergarten, are of critical social significance for the community on Kanonersky Island, taking into account that a considerable part of the population has not reached the economically active age.

The Baltic Customs Office building is located in the direct vicinity of the planned motorway; specific sanitary norms apply to office buildings with regard to noise impact exposure.

A potentially negative impact on the above infrastructure facilities will be imposed during the motorway's construction phase (first of all with regard to the noise level factor and hindered access to the respective facilities). Provided that sound-proof windows will be installed in the buildings and reliable access for vehicles and pedestrians will be provided to the above facilities, it will be possible to minimize the adverse impacts.

Both during the construction and operational phase it is planned to ensure permanent access to the social infrastructure facilities for the residents of the houses located on both sides of the future motorway.

Specific measures and conditions for ensuring such access will finally be determined in the working design documentation.

Under similar conditions during the construction of the motorway's southern section, the urban traffic was interrupted only for short periods of time (i.e. 2 to 3 days, predominantly on weekends) with the prior notification of the communities, thus not resulting in any long-term negative impact on the access to social infrastructure facilities.

6.13.7.2 Unauthorized and Authorized Recreational Zones

Vasilievsky Island

The implementation of the WHSD Central Section construction Project will impose significant impact on the unofficial recreational zones located along the Marine Embankment on Vasilievsky Island. Almost all the recreational zones will cease to exist. Nevertheless, after the completion of the construction the areas on both sides of the motorway will be improved.

To connect Vasilievsky Island with the new artificial site of the Marine Facade with new recreational zones, pedestrian overpasses and motor roads will be constructed across the WHSD motorway.

This means that after the planned improvement measures will be implemented, the areas along the WHSD motorway will also include new promenades for walking and other recreational needs.

Krestovsky Island

It is assumed that the WHSD construction and operation will not impose any impact on the recreational areas located on Krestovsky Island located mainly behind the stadium (the stadium will be the second most important stadium for the Football World Cup to be held in Russia in 2018).

However, potentially it will be possible to construct in the future an interchange with an exit from the WHSD motorway to the stadium. Such a solution, which has not been foreseen in the originally approved WHSD construction Project design, can affect the recreational areas on Krestovsky Island. This includes the Carillon, part of the Boat Racing Canal, a number of cafés and the equestrian sports base. Furthermore, Krestovsky Island is a residential area where many well-off and influential people of St. Petersburg live, due to the favorable environmental conditions similar to that of suburban areas.

Recreational Zone near the Yuntolovo Nature Reserve

As a result of the WHSD Northern Section construction located to the north-east of a protected area, i.e. the Yuntolovo nature reserve, a recreational urban park area popular among the local residents can be affected.

A small part of this area is included in the land allocated for the WHSD construction. In order to ensure the access of the local communities to the urban park area, some modifications were made in the WHSD construction Project design (after its approval by the supervisory agencies). Accordingly, the motorway segment running along the urban park area will be constructed on a flyover rather than on an embankment, as it was originally planned.

However, the urban park area will not be affected most of all by the WHSD motorway, but by the construction of a zoo over an area of 83 ha.

The zoo construction scheduled for 2012-2014 will hinder significantly the opportunities for the local communities to use and have access to a major part of the urban park zone.

6.13.8 *Mitigation Measures Associated with Socioeconomic Potential Risks and Impacts*

A number of measures will be taken during the WHSD construction and operational phases to minimize the adverse socioeconomic impacts of the Project.

In order to control potential reputational and financial risks, it will be required to carry out an assessment of the devaluation of the housing at the Marine Embankment, as well as to monitor the intentions and actions of local residents claiming compensation for the decreasing value of their housing.

To reduce the traffic via the tunnel under the Marine Canal and within the street network of Kanonersky Island, it is planned that the Partner will prepare a solution for arranging access roads in the course of the elaboration of the Project design documentation. Furthermore, it is also required to:

- minimize the use of the existing transport infrastructure on the island and the tunnel under the Marine Canal, especially during rush hours;

- rule out simultaneous blocking of the traffic along the entire WHSD route on Kanonersky Island;
- ensure timely and complete warning of the local residents (by notices, the Project's website, radio and local newspaper) about the planned restrictions/ provisional blocking of the traffic in relation to the WHSD motorway construction.

Timely and complete warning of the local residents and users of the existing transport infrastructure about any temporary blockage of the traffic in connection with the WHSD construction is planned at all motorway sections.

To ensure a positive effect on the employment situation in St. Petersburg in the course of the Project implementation it is planned to recruit local labor resources during both the construction and operational phases of the WHSD Central Section Project. In conformity with PR 2 (Labor and Working Conditions) of the EBRD Environmental and Social Policy (2008), a grievance mechanism will be elaborated for the Company's employees.

Adverse impacts on the public health during the motorway construction and operation will be minimized by taking the following measures:

- replacement of the existing windows in affected buildings along the motorway central section route with soundproof windows before the construction commencement;
- installation of acoustic screens at different levels along the motorway route on Kanonersky Island and at individual segments on Vasilievsky Island before the construction commencement;
- prohibition to carry out construction work in the vicinity of residential buildings during the period from 11:00 PM until 07:00 AM;
- additional coordination of the time schedule of the construction work associated with the generation of high noise levels with representatives of the adjacent social infrastructure facilities (No.379 school, No.74 kindergarten - House No.18) on Kanonersky Island.

Taking into consideration the updated assessment presented in this ESIA the Partner will extend the scope of the noise-protection measures on Kanonersky Island at the stage of the elaboration of the Project documentation.

To mitigate the long-term negative impact of the Project on the residents of Kanonersky Island to be resettled, it will be required to take the following steps:

- conduct a census of the affected residents and draw up the final list of the residents to be resettled in accordance with the provisions of the Resettlement and Compensation Framework Document;
- develop a Resettlement Action Plan (RAP), including the grievance mechanism, consultation schedule and other measures aimed at adequate relationships with the residents to be resettled, in conformity with PR 5 and on the basis of the Resettlement and Compensation Framework Document, as well as a system for monitoring the RAP implementation.

The Action Plan should provide for additional measures to support vulnerable groups of residents in the process of resettlement, additional assistance for resettled families and measures facilitating social adaptation of resettled residents at new locations.

In case of renting land plots for technical zones required during the WHSD Central Section construction, the following measures are to be taken:

- conduct in advance negotiations with the current lessees of the land plots;
- conclude an agreement on compensation in connection with the temporary use of the land plots, including a compensation for lost profit;
- reclamation and improvement of the temporarily rented land for technical zones during the WHSD Central Section construction.

In connection with the demolition of buildings and constructions, the following measures will be taken to minimize adverse impacts in the process of preparation of sites for the WHSD Central Section construction:

- Signing of an agreement on compensation for demolition of the warehouse building of CJSC "Farvater", including a compensation for lost profit;
- Development of Methodological Guidelines for valuation of a single garage unit (for the WHSD Central Section);
- Timely and comprehensive notification of garage owners and VOA district divisions about the plans for garage demolition;
- Setting up of public reception offices to receive the required documents for compensation payment and provision of information support;
- Organization of a hot line for consultations on issues associated with garage demolition and compensation payments;
- In the process of the RAP implementation, the legal status of the cafés "Brig", "Umi" and "Morskoy Dvor" will be determined and a procedure for compensation payment established in connection with their demolition.

It is also recommended to consider joint actions together with the city's authorities with the objective to organize alternative parking lots in the vicinity of the area, where garages will be demolished.

To minimize impacts on the social infrastructure on Kanonersky Island in the course of the Project implementation (No.74 kindergarten, No.379 school, "Priboi" swimming pool, sports ground, the Department of General Practitioners, etc.) the following measures will be taken:

- Full-scale functioning of the above facilities (including the kindergarten and the sports ground after their relocation);
- Uninterrupted access for all residents of the island to the above facilities both during the construction and operational phases of the WHSD Project;
- Site improvement.

Negative impacts on the existing recreational zones in the vicinity of the WHSD route will be ensured by means of the following measures:

- Improvement of the areas allocated for the WHSD motorway construction after the construction completion;
- Planning of pedestrian footways, passageways (at least four) and bridges in the area of Marine Embankment with due consideration of the requirements for disabled persons;
- Provision of access to the recreational zones of the Marine Facade site adjacent to the WHSD motorway;
- Provision of access for local residents to the urban park zone in the vicinity of the Yuntolovo nature reserve during the WHSD construction and operational phase by constructing the motorway on a flyover, rather than on an embankment;
- Provision of transport and pedestrian connection to the future zoo to be constructed in an area adjacent to the Yuntolovo nature reserve by providing an exit from the WHSD motorway;
- Development of design solutions eliminating or minimizing the use of the recreational zone located in the western part of Krestovsky Island in case of potential construction of an exit from the WHSD motorway.

6.14 *ENVIRONMENTAL MONITORING AND SUPERVISION*

6.14.1 *Planned Environmental Monitoring and Supervision Actions during the Construction Phase*

Construction contractors will be responsible to a significant degree for environmental monitoring and supervision during the construction phase.

Construction contractors shall:

- Ensure every six months checking of the engines of machinery and equipment operated by them to verify compliance with the environmental requirements applicable in the RF;
- Make sure that any natural construction materials delivered to the construction sites has been produced only by duly licensed quarries;
- Supervise earthmoving operations to prevent any land deterioration outside the right-of-way allocated for the construction;
- Ensure that their vehicles move only over the existing municipal roads or over provisional roads constructed specially for the construction phase;
- Ensure in conformity with the applicable sanitary rules periodic chemical and microbiological monitoring of drinking water delivered to the provisional camps for construction workers;
- Ensure supervision over compliance with the procedures for washing the wheels of vehicles and machinery at exits from construction sites and camps;

- Ensure compliance with the rules for stockpiling of fertile topsoil stripped from the sites used for provisional and permanent facilities of the future motorway;
- Measure the CO_4 emissions emanating from soil as a result of drilling and excavating operations, radiation monitoring of the soils excavated in line of military camp № 6 on Vasilievsky Island.

The environmental protection division of the Partner Company must:

- Ensure compliance with the prohibition to carry out any construction work near residential areas during a period from 11:00 PM until 07:00 AM, as well as any work in the Neva Bay water area during periods specified by the Fishery Protection Agency;
- Ensure ongoing monitoring of dust and nitrogen dioxide concentrations in the ambient air in residential areas nearest to the construction sites;
- Ensure periodic noise level measurements at residential houses and school buildings, in residential, educational and office premises on Kanonersky Island and at the Marine Embankment;
- Monitor the compliance of construction contractors with the rules and procedures for arrangements and housekeeping in the areas designated for the accumulation of construction waste, as well as in the areas for the storage of fuel and lubricants;
- Ensure compliance with the dimensions of land areas declared in the Project design and allocated on a provisional and permanent basis for construction needs;
- Make sure that construction contractors have valid agreements for pumping out and removing for treatment the sanitary wastewater and for removing by specialist organizations, the wastes from construction sites/construction yards for subsequent processing/disposal;
- Ensure periodic monitoring of the chemical composition of the water pumped out from foundation pits and released after treatment to the Neva Bay;
- Ensure the measurements of water turbidity in the Neva Bay at frequent intervals of time at stations located at a distance of 500m from areas designated for the construction of temporary islands;
- Monitor compliance of the construction contractors with the land reclamation designs in areas used during the construction phase for the provisional facility and along the routes of the provisional roads.

6.14.2 *Monitoring and Supervision of the Actions to be Taken by the Partner after the Completion of the Construction and the Start of the Operation of the Motorway*

The environmental protection division of the Partner Company should ensure implementation of the following measures with the assistance of commissioned environmental contractor organizations:

- Continuous monitoring of nitrogen dioxide concentrations in the atmospheric air at houses facing Marine Embankment on Vasilievsky Island;
- Periodic measurements of concentrations of harmful chemical substances in the ambient air at workplaces at the toll collection terminals in accordance with a time schedule to be approved by the sanitary supervision agency;
- Periodic measurements of the levels of harmful physical impact factors in the yards and indoors in apartments, in educational and office premises in the buildings located at distances of up to 200m from the motorway in accordance with a time schedule to be approved by the sanitary supervision agency;
- Monthly monitoring of the efficiency of stormwater treatment facilities for runoff from the WHSD motorway;
- Periodic monitoring of process of subsidence/ deformation of flyover and bridge structures;
- Regular monitoring of the chemical and microbiological composition of drinking water used by the WHSD operating personnel in accordance with the procedure approved by the sanitary supervisory agency;
- Provision of a network of benchmarks on the roadway and at the road embankment slopes, as well as periodic geodetic surveys to monitor the roadway and slope stability.

Furthermore, the Partner Company's environmental protection division should ensure the following:

- Supervision on an ongoing basis over the conditions in areas designated for short-term waste accumulation and compliance with the limits for short-term waste accumulation;
- Episodic audits of contractors with regard to waste removal and processing/ disposal to assess their compliance with the applicable requirements of the environmental legislation;
- Current supervision over the condition of plants, trees and shrubs in the areas subjected to land reclamation after the WHSD motorway construction completion;
- Systematic monitoring of the efficiency of bird control on the motorway during the periods of spring and autumn migrations;
- Systematic control of synanthropic animal species (house mouse, Norwegian rat) – potential carriers of diseases. If required, measures are to be taken in time to exterminate such rodents;
- Episodic monitoring of the populations of wild animals in the adjacent urban areas and within a zone affected by the WHSD (in the first line, populations of rare and endangered animal species within the protection zone surrounding the Yuntolovo nature reserve);
- Episodic assessment of settlement of bird boxes installed within the framework of compensation measures in areas adjacent to the WHSD motorway.

The planned environmental monitoring and supervision system will allow the collection of sufficient data and information required for the efficient environmental management of the WHSD motorway and for the regular preparation of reports for stakeholders about the environmental status of the WHSD motorway and the zone potentially affected by it.

6.15 SAFETY AND SECURITY ISSUES

6.15.1 Infrastructure Facilities and Equipment Safety

Safety of the infrastructure facilities and equipment of the WHSD motorway is ensured by commissioning of specialist contractors for design development and construction operations with many years of experience in the implementation of similar projects.

The Project design for the new motorway was developed on the basis of the applicable Russian civil-engineering norms, standards and requirements, including the requirements related to the safety of the project facilities. The Partner selected at the stage of the elaboration of the project documentation will verify compliance of the design with the applicable international requirements related to safety of construction and operation of the WHSD motorway (including the designs of the flyovers, bridges and tunnels).

In the process of the construction, the design development organizations will supervise the construction operations carried out by construction contractors.

All machinery and equipment to be used will be certified and all technical devices to be employed at the hazardous industrial facilities will undergo a verification of industrial safety by safety experts; permits are to be obtained for their operation.

Construction materials to be used will have appropriate safety certificates, as well as sanitary and hygienic certificates.

6.15.2 Traffic Safety and Preparedness for Emergency Response

Uninterrupted and safe traffic of vehicles over the WHSD motorway after its commissioning will be ensured on the basis of the following measures:

- Compliance with the technical solutions proposed in the Project design, such as median dividing strips between the lanes of opposite directions; road guards, road signs, electronic information boards, fog and signal lamps; road marking; construction of safe exit and entry ramps; selection of appropriate paving materials; on bridges - automatic deicing systems;
- Installation at minimal intervals (not more than 1km) of emergency phone units;
- Timely receipt and appropriate use of information from the central control station about possible weather changes, road paving condition and traffic situation;
- Installation in the tunnel of exhaust gas concentration sensors and emergency ventilation system, as well as provision of emergency exits;

- Timely and adequate execution of road maintenance work to ensure compliance with stringent operational requirements;
- Appropriate strategy of road maintenance in winter based on preventive measures rather than response to negative impacts of weather factors on the operational condition of the motorway and associated facilities.

Traffic control will be performed with the use of a system for informing the drivers about the traffic situation, as well as about any potential occurrence of accidents or existing accidental situations.

In case of an accident on a motorway section, the relevant information will be communicated by drivers to the Central Control Station via the emergency phone system. A video surveillance system to be installed along the motorway and connected to the Central Control Station can be also used to identify emergency situations.

The Central Control Station dispatcher has direct connection to the Emergency Situations Control Center of the Main Department for Civil Defense and Emergency Response of St. Petersburg.

For the operational traffic control at the planned motorway section it is intended to use additional mobile detachments and resources of the Road Patrol Service with required information support.

In case of accidental situations the following operational control measures will be taken:

- Mobilization of emergency response and rescue services – prompt warning of dispatchers of the emergency response and rescue services and road traffic control services about any accidental situation with indication of its classification;
- Warning of traffic participants about a dangerous road situation along the traffic route with the aid of on-board, external and personal technical communication means;
- Ensuring first-priority movement of the emergency response and rescue services to the accident location;
- Ensuring support in case of special transport missions (transportation of children, escort of vehicle convoys and processions, designation of a special road lane.

6.15.3 Traffic Safety in the Tunnel

The Project design provides for emergency exits for evacuation of people from the traffic zone of the tunnel to an evacuation compartment and further to the surface, as well as for access of emergency response crews to the tunnel. The distance between emergency exits is not more than 150m. All emergency exits will have fire doors with a fire resistance degree required by the applicable regulations.

In order to control traffic streams and prevent access of vehicles to the tunnel in case of emergency situations, it is planned to install appropriate signals prohibiting entry into the tunnel, street lights with an illuminated display panel “Accident in the tunnel” and automatic entrance barrier. The signals are controlled by the tunnel dispatcher from the control center located in the engineering building.

To ensure adequate quality of ambient air in the tunnel and safety in case of fire, a longitudinal ventilation system will be installed with forced air flow by means of reversible fans that are switched on by a signal from gas analyzers, or manually.

Fire safety will be ensured by installing automatic fire alarms and an automatic fire suppression system using powder or gas for fire suppression.

The communication means to be provided (radio, telephone and loud-speaking systems) will facilitate safe traffic in the tunnel and timely warning in case of any emergency situations.

6.15.4 *Safe Handling of Hazardous Materials*

<u>Measures for the prevention of spills of hazardous substances and their migration to the natural environment during the construction phase</u>

The following measures are planned to prevent the release or the spills of hazardous substances in the process the WHSD Central Section construction:

- To prevent accidental spills of petroleum products in the process of the filling of vehicles or machinery a containment tray will be installed under a respective construction machinery unit or vehicle. Any operations with petroleum products on temporary islands in the Neva Bay will be performed only with visual supervision by the personnel responsible for such operations;
- Maintenance of construction machinery will be carried out only at permanent bases or in special areas designated for this purpose having pavement preventing the migration of spilled fuel or lubricants to the ground and groundwater;
- Containers will be installed at construction sites for the collection of construction waste, metal scrap, wooden waste, as well as special containers for oily wiping materials and oil-polluted soil; all wastes will be disposed of separately depending on their hazard classes;
- Measures will be taken to prevent the release or migration of binding materials, activating agents and surfactants into soils/water in the Neva Bay in areas adjacent to the construction sites.

<u>Safety measures to be taken when transporting hazardous materials on the WHSD motorway</u>

An analysis of emergency situations recorded in the process of transportation of hazardous materials has shown that the most dangerous accidents are those that involve the transportation of ammonia, chlorine and inflammable liquids (petroleum products). To minimize the risk of such accidents, the regulations applicable in the RF list the following precaution measures:

- Carry out scheduled testing and systematic checking of vessels, cylinders and containers designed for transportation of hazardous chemicals, inflammable and combustible liquids by trucks;

- Only persons who receive special training and are duly authorized will be permitted to drive vehicles used for transport of hazardous substances;
- The preliminary approval of transportation routes and the timeframe for the transportation of hazardous substances on the roads are to be obtained from the emergency response agency and the traffic police;
- Strict compliance with the approved route and speed limits;
- Use of video surveillance systems to monitor vehicles and traffic situation in the particularly hazardous sections of the transportation routes.

In order to prevent the migration of hazardous chemicals, inflammable and combustible substances in case of accidental spills to stormwater drainage networks along the entire WHSD motorway it is planned to install large-volume settling chambers in the stormwater drain manholes (as a head element in the local stormwater treatment system). Hazardous substance will be removed from such a settling chamber after the accident localizing with the aid of special equipment.

6.15.5 Requirements for Security Service

Security will be ensured at individual motorway facilities by a licensed security company with specially trained personnel to be commissioned by the Partner.

A security company will be selected on the basis of a competitive bidding procedure in order to assess the experience, qualification, reputation and other features of such a company and its personnel.

In case of any complaints related to the security officers, the Partner shall be entitled to terminate the contract on a unilateral basis and file a complaint with the licensing agency.

6.15.6 Compliance of the Project with the Requirements of EBRD PR4 "Community Health, Safety and Security"

The Project design for the WHSD Central Section construction complies in general with the EBRD requirements related to the industrial safety of projects accepted for financing.

The Project design contains an analysis of major risks for construction and operational personnel as well as for communities associated with hypothetically possible safety issues related to the WHSD facilities.

The safety measures foreseen for the operation and the functioning of the motorway, as well as for the prevention of accidents on the motorway, with its equipment and engineering facilities, have been properly substantiated and it can be stated that they comply with both the RF legislation and the EBRD requirements.

6.16 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

6.16.1 The Company's OHS Policy

The Partner to be selected on the basis of the competitive bidding during the second half of 2011 will be responsible for the Occupational Health and Safety (OHS) management in the process of the WHSD Central Section construction and operation. The tender documentation prepared by the JSC "WHSD" for the selection of a Partner specifies that the Partner will be responsible for all OHS related issues in terms of its own personnel and the construction contractors' personnel, as well as the specially employed operating personnel. It is expected that the Partner will have or will adopt within the shortest possible time its own OHS Policy.

It is also expected that the Partner will ensure within a reasonably short time the preparation and the implementation of an OHS management system in accordance with the international standard OHSAS 18001.

6.16.2 Basic OHS Measures

The following main OHS measures are to be taken by the Partner in conformity with the relevant RF legislation:

- Development and approval of its own OHS regulations and instructions for different types of work/ checking that contractor organizations have such instructions in place and apply them;
- Supervision over contractors' operations to ensure safe working conditions, development and implementation of measures aimed at reducing the exposure of its own personnel to harmful impacts;
- Briefing and training of its own employees and checking of their knowledge, as well as supervision over compliance with the adopted procedures in contractor organizations;
- Provision of its own personnel with special working clothing in accordance with the prescribed norms, as well as with appropriate personal protection equipment; supervision over compliance with the respective regulations in contractor organizations;
- Recording and investigation of occupational accidents and incidents occurred through the fault of its own personnel; analysis of the causes of accidents in contractor organizations and implementation of measures to eliminate the identified causes;
- Attestation /certification of workplaces to assess their compliance with sanitary and hygienic regulations and norms with regard to the workplaces of its own personnel; supervision over fulfillment of this function in the contractor organizations ;
- Primary and periodic medical examination of its own personnel; supervision over fulfillment of this function in the contractor organizations.

The above measures will be implemented by the Partner in the process of the WHSD Central Section construction and the operation of the Southern Section. After the commissioning of the Central Section, those measures will be taken at all facilities and in the process of any work to be carried out on the WHSD motorway.

6.16.3 *Working Conditions during the Construction Phase*

The construction and the installation work will be carried out by contractor organizations in conformity with the approved construction and working designs.

Construction work will be performed by shifts; the working schedule and rest breaks will be organized with due consideration of natural and climatic conditions and the difficulty of a specific working process, as well as limitations with regard to the noise impact imposed upon the adjacent areas. 16 construction yards will be constructed along the Central Section route for parking of construction machinery and vehicles, storage of materials, foremen's offices and general amenities. It is not planned to accommodate construction workers in those yards.

The general amenities in the construction yards will comprise internal water supply, sanitation and heating systems, shower rooms, toilets, change and locker rooms; there will be adequate medical first-aid kits provided.

During the construction phase, bottled drinking water will be delivered for the personnel.

6.16.4 *Identification of Negative Impact Factors Affecting the Health and Safety of Personnel in the Process of Construction and Erection Work*

Construction sites will be organized in conformity with the civil-engineering and working designs. Construction sites on land will be fenced, with signs and marking of detour routes for transport vehicles and passageways for pedestrians (pedestrian galleries, decks, railings, bridges, detour routes, road signs, etc.). On the provisional flyovers and artificial islands that will be constructed as provisional structures in the Neva Bay water area, particularly stringent measures will be developed and implemented to mark dangerous zones and traffic routes.

The commissioned construction organizations will be responsible for OHS measures to be taken with regard to their personnel, including the development of OHS instructions for workers and for dangerous types of work, training and briefing of employees and checking of their knowledge of OHS rules; use of intact construction machinery, tools, appliances and personal protection equipment.

Prior to starting the construction work, zones dangerous for people will be identified, i.e. zones where hazardous factors exist or can exist permanently. The outlines of such danger zones shall be determined in each particular case.

Such zones with permanent hazardous impact factors include, among others:

- Areas near non-insulated conductor parts of electrical installations;
- Areas near a drop in level elevations of 1.3m or more without railings;
- Areas where concentrations of harmful substances in the ambient air in working

zones exceed the regulatory maximum permissible levels.

The following areas should be rated as a zone with exposure to potentially hazardous impact factors:

- Areas near facilities under construction;
- Levels of facilities, above which installation (or dismantling) of structural elements or equipment is carried out;
- Displacement zones, where machinery, equipment or parts thereof or machine parts are used.
- Areas, above which loads are handled by hoisting cranes.

Protective fencing will be provided at the boundaries of zones with permanent hazardous industrial factors and zones affected by potentially hazardous impact will be marked with signals, warning and safety signs.

Areas where workers will stay temporarily or on an ongoing basis will be located outside of any hazardous or dangerous zones.

A work permit will be issued for any work to be carried out within zones of hazardous industrial factors, which are not related to the character of the work to be performed, as well as for any work with an increased degree of hazard (work at height, in confined spaces, electric and gas welding, etc.). The work permit should indicate the area where the work is to be carried out, description of work in a hazardous/dangerous zone, conditions for safe execution of work, the time of beginning and completion of the work, the list of team members and persons responsible for safety in the process of the work.

The persons entitled to issue work permits shall decide whether there is a need for such work and a possibility for its safe execution; they shall be responsible for the accuracy and completeness of the precaution measures mentioned in the work permit. A job description should be developed for each type of work.

In the process of execution of the work associated with an increased degree of hazards or to be performed in hazardous zones, specific negative factors are attributed to the nature of the work performed. Such factors are, in particular:

- Increased dust and gas content in the ambient air in working zones;
- Increased temperature of equipment surfaces;
- Increased vibration levels;
- Moving machinery or its moving parts;
- Risk of falling rocks;
- High or low ambient air temperature in the working zone.

The main mitigation measures aimed at abating the identified negative impact factors and risks are presented below in Table 6.16-1.

Table 6.16-1 Major risks for health and safety of personnel in the process of construction and erection work at the WHSD Central Section

Occupational Health and Safety of Personnel			
Types of work	**Existing factor, source of risk**	**Mitigation measures**	**Probability* / Significance of impact**
Work at low ambient temperatures	Ambient temperature stress	Provision of special working clothing, adequate schedule of work and rest	L/M
Work in trenches and excavations	Fall of object, ground/rock failure	Development of special instructions for a particular work type; use of a system of work permits to ensure safe execution of work; safety briefings and checking of knowledge of safety rules and regulations	M/ M
Work at height	Fall from height, injuries		H/ H
Work in confined space	Harmful chemical substances		M/ M
Electric/gas welding	Harmful chemical substances, electric current		H/ H
Work in areas with high dust content in ambient air	Inhalation, contact with skin	Dust suppression measures, use of PPE, shorter working day	L/M
Work under exposure to harmful physical impact factors	Exposure to noise, vibration	Provision of PPE, МИЗ, shorter working day, periodic medical examination	L/L
Work with use / under condition of emission of harmful substances (gases, vapors, liquids)	Inhalation of harmful substances (gases, vapors, liquids)	Installation of adequate general ventilation system and exhaust ventilation at workplaces; provision of PPE, shorter working day	M/ H
Work in direct vicinity of operating motor roads or railway tracks	Moving vehicles, railway trains	Limitation or complete suspension of traffic on roads and railway tracks.	M/H
Moving parts of equipment	Moving unprotected parts of machinery and equipment	Use of certified equipment; development of instructions and manuals; safety briefing and training; checking of knowledge of safety rules and regulations.	M/ H
Work with electric equipment or installations	Electrocution	Development of special instructions for work procedures; training and briefing of personnel and checking of knowledge of safety rules and regulations; use of certified equipment	M/ M
Transport / traffic safety	Traffic accidents	Adequate organization of traffic on construction site; briefing and training of personnel; medical testing of drivers	M/M

* Probability of risk: **H** – High; **M** – Medium; **L** – Low.
Significance of risk: **H** – High; **M** – Medium; **L** – Low.

6.16.5 *Working Conditions during the Operational Phase*

During the operation of the WHSD motorway the Partner will create workplaces at toll collection terminals, at two traffic control centers and in the control room of the engineering building.

Specialist organizations will be commissioned to carry out repairs, maintenance and cleaning of the motorway and infrastructure facilities.

In order to control the traffic along the entire WHSD motorway it is planned to install two traffic control centers: at the Southern and Northern motorway sections.

Toll Collection Terminals consist of buildings, structures and special equipment for road toll collection and for traffic control, video monitoring and security systems, etc., and in particular:

- Office building with an office room, a room for security personnel, a room for recreation of personnel, toilets, etc.;
- Entry and exit areas with traffic lanes and appropriate marking;
- Parking area (including an area of detained and intact vehicles);
- Cabins for toll collection operators.

The workplace for toll collection is located in a toll collection cabin having an approximate size of 1.5m x 3m and installed on safety islands at the left side of each traffic lane. Each cabin is equipped with heating, ventilation, electricity supply, fire suppression and alarm systems.

Toll collection terminals will operate on a round-the-clock basis in three 8-hour working shifts of the toll collection operators.

An engineering building comprises the following premises: tunnel security station; central control room, main power supply installations, as well as various technical, service and amenity rooms of the operating organization.

The service and amenity rooms in an engineering building are equipped with heating, forced inflow and exhaust ventilation systems, air conditioning split system and air humidifiers. Dispatchers will work on a round-the-clock basis in three 8-hour working shifts.

6.16.6 *Compliance of the Project with EBRD PR2 "Labor and Working Conditions"*

Working Relationships

Employment of workers on a permanent basis will be performed in compliance with the Labor Code of the Russian Federation, which provides for the conclusion of employment agreements, specifies the requirements for hours of work and rest, social guarantees and paid vacations.

Workers' Associations

In accordance with the RF legislation, an employer will not discourage workers from forming or joining workers' organizations. Establishment of trade organizations should be initiated by workers.

Child and Forced Labor

The Russian legislation prohibits the use of child and forced labor.

Non-Discrimination

The Russian legislation prohibits any forms of discrimination.

Grievance Mechanism for Employees

The WHSD motorway construction Project does not provide for the establishment of a grievance mechanism for employees. Measures for the establishment of such a mechanism are included in the Stakeholders Engagement Plan (SEP) developed by ERM Eurasia for the JSC "WHSD". After the selected Partner will start carrying out its functions, the Stakeholders Engagement Plan will be applicable to the Partner.

6.16.7 Industrial Safety

According to the criteria specified in the RF Law No.116-FZ of 21.07.1997 "On Operating Safety of Hazardous Industrial Facilities", the following main sections and facilities associated with the WHSD motorway construction will be rated as hazardous industrial facilities:

- Areas where hoisting mechanisms and devices are used;
- Tunnel construction sections;

In conformity with Federal Law No.116-FZ "On Operating Safety of Hazardous Industrial Facilities", the following requirements are set for the operation of hazardous industrial facilities:

- Construction contractors should have a License for activities in the field of industrial safety;
- The Partner should issue a declaration of operating safety for each hazardous industrial facility
- The Declarations of Industrial Safety, as well as any technical devices used at hazardous industrial facilities should be reviewed by experts;
- Technical devices used at hazardous industrial facilities should be certified;
- Hazardous industrial facilities should be recorded in the State Register of Hazardous Industrial Facilities;
- Civil liability for any damage inflicted in the process of operation of any hazardous industrial facility should be insured.

The hazardous industrial facilities will be operated by contractor companies during the construction phase and by the Partner during the operational phase and they will be responsible for:

- Planning and implementation of measures for response to and containment of consequences of any accidents at the hazardous industrial facilities, including:
- Development of Emergency Response Plans (ERP) for all areas of underground

work operations (tunneling, etc.);

- Development of Oil Spills Response Plans for facilities containing large quantities of petroleum products;
- Conclusion of agreements for services with professional emergency response and rescue organizations or with professional emergency response and rescue units;
- Maintain financial reserves and material resources required for response to accidents and containment of accident consequences in conformity with the RF legislation;
- Training of employees in actions to be taken in case of accidents or incidents at a hazardous industrial facility;
- Creation of a system for monitoring, warning, communications and support actions in case of accidents and maintenance of such a system in operational condition.

When concluding contracts with any contractors, the Partner should make sure that the contractors have in place all compulsory documents listed above.

6.17 ENVIRONMENTAL IMPACTS ASSOCIATED WITH POTENTIAL ACCIDENTS AND EMERGENCY SITUATIONS

According to the available practical experience, the following most typical accidental situations might occur in the process of construction and operation of motorways incorporating flyovers and bridges:

1. Flyover/ bridge failure in the process of work execution;
2. Flooding of construction sites, landslides in excavated pits, and fires;
3. Road accidents entailing significant expenses; accidents with vehicles transporting toxic or flammable substances.

The main causes of accidental situations are:

- Failure of a structure or its bearing elements as a result of design mistakes, low construction quality or high loads exceeding the respective rated design loads;
- High wear degree of structures affecting their operating properties as a result of longer intervals between repairs, low quality of construction and operations;
- Traffic accidents;
- Loss or release of hazardous (toxic, inflammable, explosive) substances in the process of transportation on the road;
- Accidents at utility lines (power supply lines, pipelines, communication lines, etc.) running parallel to or crossed by the WHSD motorway;
- Natural disasters (freshets, floods, landslides, etc.).

The first group of potentially occurring accidents is associated with the reliability of structures of the flyovers/bridges/tunnel. An assessment of risks of failure of bridge structures is included in the methodology of their design calculations applied for the Project. Safety of structures and facilities is achieved by applying a certain safety factor at all stages of the design development and this factor is 0.99 for bearing structures and 0.95 for auxiliary structures and technological operations. The required reliability is ensured by applying appropriate safety factors.

Technical reliability can be sharply affected in case of non-compliance with or deviations from the applicable technical regulations. To rule it out it is planned to commission specialist bridge construction organizations with a high level of qualification for implementing construction and installation work at the WHSD Central Section so that the probability of technical accidents will not exceed the design reliability.

The second group of potential accidents is associated with difficult to predict natural factors, usually related to weather and climatic conditions.

No such factors as seismic activity or serious geological anomalies are present along the entire WHSD route, which could potentially result in any accidental situations.

The specific geological features of the subject areas along the motorway route have been taken into account in the process of the Project design development (the piers will be supported by formations, the bearing capacity of which has been proven on the basis of survey data; the trench for the motorway construction along Vasilievsky Island will be protected by abutment walls in the ground).

The probability of most of the other hazardous natural phenomena (hurricanes, torrential rains, etc.) does not exceed the reliability factors adopted for the design calculations.

Wind and snow loads, ice-up, floods (the scale of which is expected after commissioning of St. Petersburg's flood protection dam system) have been taken into account in the Project design with a sufficient level of probability.

The issue of risks of adverse ice processes in the Bolshaya and Malaya Nevka River mouths is still open. The mouths would be narrowed by 70% during the construction phase as a result of the construction of temporary islands and dams. It is required to carry out some additional calculations and define the appropriate organizational procedures related to the ice processes and measures to prevent their critical development (rafting of ice over temporary islands; spreading of water out from ice dam zones to adjacent areas).

The probability of accidents and the scale of resulting damage inflicted to the WHSD motorway and adjacent areas depends to a considerable degree on the level of preparedness for emergency response.

The operational divisions involved in the construction will have appropriate emergency response plans, required technical means, emergency communication systems, appropriate vehicles, etc.

The third group of possible accidents on the future WHSD motorway is related to the traffic. The frequency of this type of accidents will depend mainly on the traffic conditions on the WHSD motorway. Due to this reason, in addition to the measures foreseen in the Project design with regard to traffic control, roadway quality, lighting, roadway marking, and signal systems, it will be required to ensure ongoing supervision over the motorway condition.

Special attention will be paid to the facilities designed to ensure traffic safety while accessing the motorway (fencing, exit ramps, roadway marking, etc.). Traffic safety will be ensured by compliance with the regulatory requirements, use of advanced structural solutions for road crossings, exit ramps and in other areas where accidents can potentially occur.

The most dangerous potential accidents during the WHSD operational phase, which can cause emergency situations, are associated with the transportation of hazardous chemicals: ammonia, chlorine and inflammable liquids (petroleum products).

The probability of such accidents has been estimated in the WHSD construction design at 10^{-6}.

Accidents associated with spills of hazardous chemicals (chlorine, ammonia), can potentially affect an area with a population from 45,000 to 18,000 (depending on the amount of spilled chemicals, location of the spills and the density of the population in the vicinity of the accident spot, which vary in case of the WHSD Central Section from 2,500 to 1,000 inhabitants per 1 km^2).

In case of a hypothetical accidental spill of 25 t of petroleum products, the range of the affected zone can be as follows:

- In case of fire related to the spilled product the zone of irrecoverable losses will be 11 m;
- In case of explosion of a tank truck the zone affected by shock wave with complete destruction will be 53 m; with severe damage 64 m; with medium-scale damage 108 m and the zone of spill spreading will be 862m wide.

Other possible consequences may be:

- Pollution of atmospheric air with combustion products and vapor of hazardous chemicals;
- Pollution of surface and underground waters and soils with spilled substances (petroleum products, hazardous chemicals);
- Destruction of buildings and constructions;
- Death and poisoning of personnel and local residents.

Accident prevention and response plans for the above types of potential accidents are to be drawn up. The Plans will provide for the following:

- Ongoing maintenance of the roadway and associated auxiliary facilities in proper condition;
- Functioning of the warning and alert systems;
- Provision of required human and material resources within a distance ensuring their prompt mobilization on the accident spot. It is also required to keep a reserve of reagents for response to spills of up to 25 tonnes of petroleum products.

It has been assessed in the Project design that potential accident during the construction phase can affect only minor areas, without any serious consequences for the ambient environment. An exception could be the fall of bulky structures obstructing shipping or the spilling of substances polluting the water. For example, large non-floating objects (structural elements, debris, wastes, etc.) contaminating a waterway and the banks (sheathing, various types of wastes).

In such situations, the damage to bodies of water will be minimal because mainly inert materials will be used for the construction of bridges and flyovers. However, elimination of consequences of such accidents might entail significant expenses.

The accidental release of spilled petroleum products to bodies of water (in the process of their transportation to the temporary islands for filling machinery operating at construction sites) would be environmentally hazardous.

The Project design foresees that this type of incidents and accidents will be prevented by strict compliance with the specified procedures and safety regulations. During the work to be performed on temporary islands, in addition to the measures to be taken for spill prevention (use of secondary containment trays), any operations with petroleum products will be duly supervised and monitored and communication means will be available to alert an organization having technical resources for oil spill response.

Internal procedures at all construction sites will provide for a warning system to inform the employees in charge about any incidents or emergency situations by means of internal communication networks, emergency alarms, etc. Emergency response plans will be developed for various types of emergencies, including the procedures to be implemented by the on-site personnel and for mobilization of specialist organizations (for fire suppression and response to other accidental situations).

It may be concluded that an overwhelming majority of potential accident scenarios for the construction and operational phases of the Project have been covered in the Project construction design. Measures have been foreseen to preclude accidental situations and emergencies; adequate engineering solutions have been elaborated in the project design; managerial, logistic and technical aspects of those measures will be implemented by the Partner and its subcontractors.

In addition to the existing Project design, it is required to address the risks associated with adverse ice processes in the mouths of the Bolshaya and Malaya Nevka Rivers, which could become more active because over 70% of the riverbed cross-sections of those rivers will be blocked by the temporary islands and dams in the process of the WHSD construction.

7 REVIEW OF EHS COMPLIANCE OF EHS ASPECTS OF WHSD CENTRAL SECTION CONSTRUCTION PROJECT WITH THE IFC GUIDELINES

The solutions adopted in the Project design for WHSD Central Section construction with regard to environmental, health and safety (EHS) issues have been reviewed to verify their compliance with the best available technologies (BAT) and the requirements applicable to road and bridge construction projects.

The provisions of the IFC Environmental, Health and Safety Guidelines for Toll Roads have been used as criteria of best available technologies / requirements.

The results of such a comparative analysis are presented in Table 7.1.

Such a comparison suggests a conclusion that most of the aspects, which could create EHS issues, have been addressed in the Project Design for the WHSD Central Section construction in conformity with the provisions of the above IFC Guidelines.

However, there are two groups of issues requiring the additional engineering and technical measures and the managerial decisions to be taken during the preparatory stage and at the stage of the tentative operation of the motorway:

- During the preparatory it is required to elaborate the technology for the construction of the temporary islands in the Neva Bay , to address the issues of a high-level noise pollution on Kanonersky Island and to bring the chemical composition of water released to the Neva Bay into compliance with the requirements applicable to the fishery water bodies;
- During the stage of the tentative operation of the motorway it is required to develop and implement the managerial solutions aimed at the operation of the WHSD motorway in full compliance with the international EHS requirements for toll roads.

The measures for addressing the above issues have been defined in the Environmental and Social Action Plan (ESAP) for the construction of the WHSD Central Section and the operation of the entire WHSD motorway.

Table 6.17-1 Analysis of the solutions adopted in the WHSD Project design with regard to EHS issues in compliance with the best available technologies (BAT) and the requirements applicable to road and bridge construction projects

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
1. Environmental Issues				
Habitat alteration and fragmentation	**Road construction – Project design solutions**	Laying of roads and support the additional facilities to avoid the impact on the terrestrial and aquatic habitats; utilizing, the existing transport corridors whenever possible	Full compliance	The WHSD Central Section will run predominantly over future artificial sites of the Marine Facade area and on flyovers above the Neva Bay water areas, many of which were selected also in the City's Urban Development Master Plan for the construction of new artificial sites (to the west of Bely and Krestovsky Islands). There are virtually no native vegetation associations along the motorway segments to be constructed on the land within the urban territory. Thus, the Project design ensures minimization of the adverse impacts on the terrestrial biotopes, while the aquatic biotopes will be affected only to a limited extent
		Design and construction of the wildlife access to avoid or minimize habitat fragmentation. Possible techniques for the aquatic species include bridges, fords, open-bottom or arch culverts, box and pipe culverts	Full compliance	There is no need for the construction of any structures to provide the wildlife access within the urban territory. The motorway segment in the vicinity of the Yuntolovo nature reserve will be constructed in the form of a flyover, ensuring thereby the unobstructed migration of wild animals under it. The motorway will cross the Neva River branches via bridges, which ensures compliance with the applicable requirements
		Preventing the short and long term impacts to the quality of aquatic habitats by minimizing the clearing and disruption of riparian vegetation; providing the adequate protection against scour and erosion; and giving the consideration to the onset of the rainy season with respect to the construction	Partially implemented, additional measures are required in order to minimize the	Maximum impact on the aquatic habitats (i.e. direct alienation of habitats and formation of extensive water areas with a high water turbidity in the Neva Bay) will be imposed during the construction phase. It is recommended to take some additional measures in the process of the construction of the temporary islands in

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		schedules	impacts	order to minimize carry-over of suspended matter to the Neva Bay. During the WHSD operational phase it is recommended to improve the efficiency of the onsite wastewater treatment facilities, from which the treated wastewater will be released directly to the Neva Bay. The construction time schedule complies with the requirements of the fishery protection agency prohibiting execution of hydro-engineering work in the Neva Bay during the certain periods of time
		Minimizing removal of native plant species, and replanting of native plant species in disturbed areas	Full compliance	During the stage of the *preparation work*, vegetation will be cleared only within a narrow right-of-way strip. After the completion of the construction phase, land reclamation will be carried out in the disturbed areas, including planting of trees and shrubs and sowing of lawns.
		Exploring opportunities for habitat enhancement through such practices as the placement of nesting boxes in rights-of-way, bat boxes underneath bridges, and reduced mowing to conserve or restore native species	Not foreseen in the Project Design. Recommended as an additional measure.	It is recommended to place nesting boxes within the Yuntolovo nature reserve territory.
	Road construction – Construction planning	Prevention of soil erosion: • Scheduling to avoid heavy rainfall periods; • Contouring and minimizing length and steepness of slopes; • Mulching to stabilize exposed areas; • Designing channels and ditches for post-construction flows;	Full compliance	To minimize land deterioration in the process of the construction work it is planned to pave the entire area of the construction yards with the concrete slabs. The roadbed slopes along the segments constructed in a trench and on the embankments will be reinforced with special materials and sown with grass.

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		• Lining of slopes		
		Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds	Partially addressed in Project Design Additional measures recommended	Issues of stormwater runoff containment and treatment at the construction yards and within zones of earthmoving operations on Vasilievsky Island have been addressed to the full extent Some additional measures have been recommended to reduce entrainment of suspended matter in the process of construction of temporary islands and in connection with water pumping from foundation pits on the temporary islands.
		Road design: • Limiting access road gradients to reduce runoff-induced erosion; • Providing adequate road drainage based on road width, surface material, compaction, and maintenance.	Full compliance	Stormwater runoff will be drained along the entire motorway length via open launders to accumulating tanks. Optimal roadside slope angles are adopted in the Project Design for the motorway segments to be constructed in a trench or on an embankment; they will be reinforced by means of geogrids and grass sowing
		For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water	Partially addressed in Project Design. Additional measures recommended.	It is planned to install enclosing pile sheeting prior to the construction of the temporary islands in the Petrovsky waterway to minimize substantial carry-over of suspended matter to the Neva Bay. For the construction of the temporary islands in other areas of the Neva Bay it is recommended to foresee some solutions for the preliminary enclosure along the perimeter of future temporary islands in the Project documentation.
	Right-of-way maintenance	Implementation of integrated vegetation management From the edge of the road area to the boundary of the right-of-way, vegetation should be structured with smaller plants near the road and larger trees further away to provide habitats for a wide variety of plants and animals.	The intention is recorded in the Project Design documentation, but it will be specified in detail prior to the	At this stage of the Project implementation, designs for compensation tree planting have not yet been developed for construction of the WHSD Central Section. However, the experience gained in the process of the WHSD Southern Section construction has indicated that by the time of commissioning of the motorway for the tentative operation the compensation planting had been completed

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		Vegetation maintenance includes the following techniques: • Mowing; • Herbicides (to control fast-growing weed species); • Trimming and pruning; • Hand weed removal or removal of vegetation (if the use of machinery is difficult or dangerous).	construction completion	with a good quality and to the full extent and provided an attractive appearance of the areas adjacent to the motorway.
		Planting of native species and removal of invasive plant species		
		Use of biological, mechanical, and thermal vegetation control measures to avoid use of chemical herbicides		
Emergency preparedness and response	**Road construction and operation – emergency situations, spills (release) of hazardous pollutants**	Coordination of planning process - Procedures should be prepared for: • Informing the public and emergency response agencies; • Documenting first aid and emergency medical treatment; • Taking emergency response actions; • Reviewing and updating the emergency response plan to reflect changes, and ensuring that employees are informed of such changes.	Full compliance	Traffic control will be performed with the use of the system to inform motorists about the road and traffic conditions, as well as about a danger of accidents or any emergency situations. In case of a traffic accident, the Traffic Control Center will be informed by motorists through the emergency phone system. A system of video cameras will be installed along the WHSD motorway permitting traffic conditions monitoring at the Traffic Control Center. To ensure operational traffic control on the motorway it is also planned to provide additional mobile resources and mobilize the Road Patrol Service with adequate information support.
		Emergency Equipment: Procedures should be prepared for using, inspecting, testing, and maintaining the emergency response equipment	The intention is recorded in the Project Design documentation, but it will be implemented later	The Contractor will prepare an Emergency Response Plan (ERP) incorporating cooperation with the city's emergency response services. For the WHSD operational phase, an ERP will be prepared not later than 1 year prior to the beginning of the motorway operation. It will also be based on the cooperation with the traffic police, emergency medical aid services and emergency situations department.

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		Training: Employees and contractors should be trained on emergency response procedures	The intention is recorded in the Project Design documentation, but it will be implemented later	The Partner Company to be selected on a competitive basis in the second half of 2011 will be responsible for OHS issues during the WHSD Central Section construction and in the process of operation of the entire WHSD motorway. It is specified in the tender documentation that the Partner Company will also ensure compliance of the construction contractors, its own personnel and the commissioned operating personnel with the entire range of OHS issues. It is expected that the Partner Company will have or adopt its own OHS Policy. It is expected that the Partner Company will develop and implement within a reasonably short time an OHS management system in conformity with the international standard OHSAS 18001.
Stormwater drainage	**Road construction and operation – design solutions**	Storm water management practices should be used that slow peak runoff flow, reduce sediment load, and increase infiltration, including vegetated swales (planted with salt-resistant vegetation); filter strips; terracing; check dams; detention ponds or basins; infiltration trenches; infiltration basins; and constructed wetlands	Full compliance	Fourteen accumulating tanks will be installed along the motorway to collect stormwater runoff from the roadway and to send it to treatment facilities. No stormwater runoff from the roadway will be drained to the ground. Stormwater runoff from under the flyovers will be drained via reinforced concrete launders and stormwater manholes to the stormwater sewer networks.
		Where significant oil and grease is expected, oil / water separators in the treatment activities should be used	Not applicable	No significant contamination with oil and grease is expected during the construction phase and in the process of the normal motorway operation
		Regular inspection and maintenance of permanent erosion and runoff control features should be conducted	Full compliance	It is planned to carry out regular inspection of the runoff control facilities to make sure they are free of such faults as: standing water at culvert heads; sliming of culverts; scour of streambeds at culvert heads; snow and ice accumulation inside culverts before the beginning of spring floods exceeding 1/3 of their diameter; grass more than 15cm tall, trees and brushes at culvert heads; local damage of the embankment slopes at culverts. The drainage trenches and launders on the embankment

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
				slope should be free of: accumulated snow and ice preventing surface runoff flow during periods of active snow melting; dirt and waste obstructing the water drainage; trees, shrubs and grass more than 15cm tall; local damage of reinforced launders; leaking joints between launder elements
	Construction planning	Segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release.	Full compliance	Stormwater runoff and wastewater is collected in the accumulating tanks and then transported to the on-site treatment facilities.
		Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas and fuel storage areas.	Full compliance	No refueling stations have been planned in the Project Design. Fuel and lubricants will be stored during the construction phase in covered vessels ruling out their migration to the soil. Secondary containment trays will be used in the process of construction machinery refueling. Spent oil will be collected in special vessels preventing its migration to the soil
	Road paving	Paving in dry weather to prevent runoff of asphalt or cement materials	The intention is recorded in the Project design documentation, but it will be implemented later	The construction contractor will develop and submit for the approval to the Partner Company a Road Paving Procedure
		Covering storm drain inlets and manholes during paving operations.	Not applicable	No such situations are expected during the WHSD construction
		Use of proper road construction machinery and equipment to reduce the spillage of paving materials during the repair of potholes and worn pavement.	Full compliance	It is specified in the Project Design that machinery and equipment complying with the relevant European standards will be used for the WHSD construction and later for the road repairs and maintenance.
		Reducing the amount of water used to control dust, and using sweeping practices rather than washing.	The intention is recorded in the Project design	The road cleaning contractor will develop and submit for the approval to the Partner Company a Road Cleaning Procedure, including substantiation of water volumes to

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
			documentation, but it will be implemented later	be used for the motorway cleaning.
		Avoiding the generation of contaminated runoff from cleaning of asphalt equipment by: • substituting diesel with • vegetable oil as a release and cleaning agent; containing cleaning products and contaminated asphalt residues;; • scraping before cleaning; • conducting cleaning activities away from surface water features or drainage structures.	Partially implemented	Equipment will be cleaned in the special areas designated for this purpose with sealed pavement to prevent direct migration of runoff to the ground. Washing effluents will be collected in accumulating tanks and removed from time to time to treatment facilities. Since all construction sites are located within water protection zones, the procedure of collection and removal of contaminated water will be strictly supervised.
	Road deicing	Primary use of mechanical deicing methods (e.g. sweepers and plows) complemented by chemical means if necessary	Full compliance	It is planned to use mechanical deicing methods (sand and gravel mixtures), which will not affect the soils in the adjacent areas
		Pre-treating of pavement surfaces with anti-icing methods prior to the onset of snow or ice to reduce the need for subsequent applications and allow for easy removal	Full compliance	Preventive measures against the slippery road conditions in winter will be taken on the basis of the weather forecasts and information about the possible changes in the roadway surface condition. Pre-treating of pavement surfaces with anti-icing methods will be carried out, including use of anti-icing systems to be installed on bridges
		Designing roads and bridges to minimize the accumulation of drifting snow on the roadway	Full compliance	Drifting snow accumulation on the roadway will be minimized due to the fact that the motorway will consist predominantly of flyover segments
Waste	**Construction planning**	Handling of excavated soil at construction sites: - topsoil and overburden should be stripped in an appropriate way and stockpiled in the vicinity of the site for subsequent use for land reclamation; - application of a strategy to reduce risks associated with reduction of contamination	Full compliance	Stripping and separate stockpiling of uncontaminated topsoil suitable for subsequent use will be performed during construction of the WHSD Central Section in connection with any kind of earthmoving operations. Topsoil will be put at disposal of urban park management departments or stored in stockpiles on a short-term basis (for up to 3 years).

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		sources and concentrations of hazardous substances		Contaminated soils with hazardous or highly hazardous degree of contamination are subject to the compulsory removal and treatment or disposal in a landfill for industrial waste disposal. When soils are transported to outside of construction sites, they are considered to be industrial waste and their further handling should be performed in compliance with the relevant waste management regulations
		During the stage of design development and planning it is required to develop plans for collection and removal of hazardous and non-hazardous wastes	Full compliance	Prior to the start of the construction, the construction contractor should obtain Waste Disposal Limits from the RosPrirodNadzor Agency. There are possibilities available for safe removal and transfer for subsequent processing/treatment to specialist organizations with regard to all types of wastes generated in the process of the WHSD construction. Waste disposal will be applied as an ultimate measure (mainly for low-hazard wastes). All types of wastes generated in the process of the motorway operation and maintenance will be typical for any urban motorway. A system for their collection and removal has been well established and proven in St. Petersburg. Most types of wastes will be transferred to the contractor organizations specializing in cleaning / repairs of the motorway and the associated infrastructure facilities.
	Road Resurfacing	Maximizing the rate of recycling of road resurfacing waste either in the aggregate (e.g. reclaimed asphalt pavement or reclaimed concrete material) or as a base	Not addressed in the Project design so far	Repair work is planned to be started not earlier than 5 years after the WHSD motorway commissioning.
		Incorporating recyclable materials (e.g. glass, scrap tires, certain types of slag and ashes) to reduce the volume and cost of new asphalt and concrete mixes	Not addressed in the Project design so far	Recommended for implementation
	Miscellaneous wastes	Collecting road litter or illegally dumped waste. Provision of bottle and can recycling and	Partially implemented	Zones for waste collection will be designated only in the areas where the WHSD personnel is present on the

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		trash disposal receptacles at parking lots to avoid littering along the road		permanent basis. Neither stop points nor waste collection areas have been foreseen in the Project Design along the motorway route Occasional road litter and waste will be removed in the process of regular roadway cleaning
		Manage herbicide and paint inventories to avoid having to dispose of large quantities of unused product. Obsolete products should be managed as a hazardous waste.	Full compliance	Use of pesticides will be excluded. Road signs, barriers roadway markings and other objects will be painted once every year during the warm season. There is no need for storage of the full amount of required paints.
		Collecting animal carcasses in a timely manner and disposing through prompt burial or other environmentally safe methods	Not applicable	A protective wire mesh fencing will be installed at both sides of the motorway along the road segments running on embankments or in a trench to prevent access of animals to the motorway.
		Composting of vegetation waste for reuse as a landscaping fertilizer	Not applicable	It is planned to mow the grass on slopes with its direct mulching.
		Managing sediment and sludge removed from storm drainage systems maintenance activities as a hazardous or non-hazardous waste depending on the assessment of their characteristics.	Full compliance	Residue generated in the process of wastewater treatment is classified in the Project Design as waste of Hazard Class 4 (low-hazardous waste) and will be removed to the municipal wastewater treatment plant
	Painting Activities	Management of all removed paint materials suspected or confirmed of containing lead as a hazardous waste	Full compliance	It is not planned to use any lead-containing paints
		Grinding of removed, old road surface material and re-use in paving, or stockpiling the reclaim for road bed or other uses. Old, removed asphalt may contain tar and polycyclic aromatic hydrocarbons and may require management as a hazardous waste.	Not addressed in the Project design so far	Recommended for implementation
Noise	**Road operation and maintenance**	Consideration of noise impacts during road design to prevent adverse impacts at nearby properties through the placement of the road right-of-way and / or through the	Partially implemented. Additional measures	The noise impact during the motorway construction and operational phase will be achieved by: • Replacement of the existing windows facing the motorway with sound-proof window frames and

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		design and implementation of noise control measures described below. For example, the U.S. Federal Highway Administration has established noise impact criteria, such as L10 (sound level exceeded 10 percent of the time) ≤ 70 dBA for residential land use. A new road project should not cause a significant increase in existing noise levels at nearby properties	proposed	glazing (including also some additional buildings on Kanonersky Island where elevated noise exposure levels are expected); • Installation of acoustic screens at different levels along the motorway on Kanonersky Island and along some motorway segments on Vasilievsky Island (including additional screens about 300m long on Kanonersky Island); • Prohibition to perform the construction work in the vicinity of the residential buildings during a period from 11:00 PM until 07:00 AM; • Additional coordination with representatives of the affected social infrastructure facilities (No.379 School, No.74 kindergarten/House 18) on Kanonersky Island with regard to the time schedule for the construction work generating the increased noise levels.
Air Emissions	**Construction phase (dust)**	Prevention and control of dust emissions during construction and maintenance activities	Full compliance	Atmospheric air pollution with particulate matter during the earthmoving operations is expected not to be more than 0.15 MPC_{inst}.
	Construction phase (exhaust from construction machinery)	Regardless of the size and type of vehicles and machinery the operator should comply with the engine maintenance schedule recommended by the respective manufacturer	Full compliance	Technical maintenance and repair of machinery and equipment will be performed in the strict compliance with the manufacturers' specifications and in accordance with the Guidelines for Organization and Execution of Technical Maintenance and Repairs of Construction Machinery (VSN-79) issued by the RF Ministry of Motor Roads (Minavtodor).
		Briefing of drivers on advantages of driving techniques aimed at reducing fuel requirement	Not addressed in the Project design so far	Recommended for implementation
	Construction phase (exhaust from vehicles)	Consideration of design options for the reduction of traffic congestion, including:		
		• Automated toll charging systems	Partially implemented	Initially a combined toll collection system will be used: - manual toll collection;

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
				- semi-automatic toll collection (contact-less smart cards) - automatic (electronic) toll collection (transponders) Later, it will be converted to a fully-automated system
		• Availability of high-occupancy vehicle lanes;	Full compliance	An automated traffic control system will be used on the WHSD motorway. One of its objectives is to improve the motorway's throughput capacity, and as a consequence, to reduce exhaust gas emissions.
		• Minimizing grade changes, at-grade crossings, and sharp curves which can promote congestion;	Full compliance	There will be no crossings at the same level along the entire length of the WHSD motorway
		• Design of roadway to shed water, and prompt removal of snow to minimize rolling resistance, as well as to enhance safety	Full compliance	The roadbed has been designed to ensure fast runoff drainage from its slope surface and convenience for snow plowing. Snow removal is planned to be implemented not later than two hours after the end of a snowfall or blizzard
		2. Occupational Health and Safety Issues		
Physical Hazards	**Moving Equipment and Traffic Safety**	IFC Requirements related to occupational health and safety in the process of toll road construction (In accordance with the IFC "Environmental, Health and Safety Guidelines for Toll Roads")	Not addressed in the Project design so far	The Partner Company to be selected on a competitive basis in the second half of 2011 will be responsible for the the OHS issues during the WHSD Central Section construction and in the process of the operation of the entire WHSD motorway. It is specified in the tender documentation that the Partner Company will also ensure compliance of the construction contractors, its own personnel and the commissioned operating personnel with the entire range of OHS issues. It is expected that the Partner Company will have or adopt its own OHS Policy and will develop and implement within a reasonably short time an OHS management system in conformity with the international standard OHSAS 18001 and take into account the relevant IFI requirements
	Elevated and Overhead Work			
Noise	**Road construction and maintenance**			
		3. Community Health and Safety		

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
Pedestrian Safety	**Road construction**	Provision of safe corridors along the road alignment and construction areas, including tunnels and bridges and safe crossings (preferably over or under the roadway) for pedestrians and bicyclists during construction and operation. Crossing locations should take into account community preferences, including those related to convenience or personal safety	Full compliance	There will be no sidewalks along the motorway. Footways will be constructed either under a flyover or above the motorway running in a trench. Pedestrian access for the local residents to essential social and recreational facilities will be ensured during the entire construction phase on a permanent basis via the temporary footways equipped in conformity with the relevant pedestrian safety requirements
		Installation and maintenance of all signs, signals, markings, and other devices used to regulate traffic	Full compliance	The Project design includes installation of fencing along the motorway and warning signs for pedestrians
Traffic Safety	**Road operation**	Installation and maintenance of all signs, signals, markings, and other devices used to regulate traffic	Full compliance	The Project design includes installation of safety barriers, signs, electronic information boards, anti-fog and signal lamps and provision of the roadway markings
		Setting of speed limits appropriate to the road and traffic conditions	Full compliance	
		Targeting the use of a real-time warning system with signage to warn drivers of congestion, accidents, adverse weather or road conditions, and other potential hazards ahead	Full compliance	
		Maintenance of the road to prevent mechanical failure of vehicles due to road conditions	Full compliance	The strategy of the WHSD maintenance is aimed to implement the measures focused on preventing negative impacts of adverse weather factors affecting the road conditions and support the facilities, rather than response to the impacts
		Construction of roadside rest areas at strategic locations to minimize driver fatigue	Not applicable	Since the WHSD motorway has a relatively short length, no rest areas will be provided at the roadside. Exits from the motorway will lead to the municipal parking lots
Emergency preparedness	**Road operation**	Road operators should prepare an emergency preparedness and response plan in coordination with the local community and local emergency responders to provide timely first aid response in the event of accidents and hazardous materials response	Full compliance	Emergency management will incorporate the following actions: • Informing of emergency responders: prompt informing of dispatchers of accident response and thr rescue organizations and traffic control services

EHS issues	Stage of Project implementation	IFC Requirements applicable to the Project	Degree of implementation	Compliance of the Project with the applicable requirements
		in the event of spills		about any accident with indication of its classification; • Warning of motorists about the dangerous traffic situations downstream the motorway by means of appropriate on-board, external and personal technical devices; • Priority access for emergency response and rescue services to be mobilized for emergency response (provision of a free traffic line); • Support for special missions (transportation of children, escort for convoys and motor vehicle processions, provision of a free traffic lane) All these aspects will be elaborated in detail in the ERP for the WHSD operational phase subject to approval by the relevant supervisory agencies during the final year of the construction phase

8 OVERALL ASSESSMENT OF POTENTIAL ENVIRONMENTAL AND SOCIAL RISKS

The overall assessment of the impact of the WHSD Central Section construction (and operation of the entire WHSD motorway with regard to the main aspects) on the following main elements of the surrounding environment has been made in accordance with the commonly adopted methodology based on a numerical score:

- Atmospheric air;
- Aquatic environment;
- Geological environment;
- Hydrogeological conditions;
- Soils and land;
- Ecosystems: habitats, plant and animal associations;
- Living conditions for local communities.

For the purpose of this assessment, impacts and their consequences were ranked in accordance with the selected criteria (indicators).

The predicted condition was assessed with regard to the loss of spatial (territorial) resources by an environment component or the loss of initial properties as a result of the project implementation, as well as with regard to the presence/ absence of any adverse impacts on the communities.

The following four types of consequences will be possible with regard to their *duration and direction of action* under the specific conditions of the WHSD construction and operation:

- **Short-term negative reversible impacts** for areas and components exposed to temporary impacts and subject to reclamation and restoration will take place only during the period of the work implementation;
- **Long-term negative reversible and potentially reducible impacts** associated with the motorway operation in accordance with the design conditions;
- **Permanent negative irreversible impacts** caused by negative changes in the urban environment, liquidation of ecosystems, and risks of accidents with significant environmental consequences will take place with regard to components and areas, the original condition of which cannot be restored;
- **Positive effects.**

With regard to the scale of impacts the following groups of impacts can be distinguished in the case of the WHSD Project:

- **Onsite impacts** limited to the outlines of the area allocated for the given project;
- **Local impacts** create zones of direct and indirect impacts outside the sanitary distance zone of the motorway;
- **Regional impacts** entailing long-term consequences for St. Petersburg and the entire region as a whole.

The most important and sensitive parameters of the natural and social environment that will be affected by both direct and indirect impacts of the WHSD Project include the following (with a breakdown by environment components):

- **Atmospheric air:**
    - o Degree of ground-level pollution of atmospheric air with gases as a result of construction work and traffic intensity during the operational phase;
    - o Greenhouse gas emissions (GHGs);
- **Aquatic environment:**
    - o Water regime, chemistry of aquatic environment and quality of bottom sediments in the Neva River mouth and in the Neva Bay;
- **Geological environment and topography:**
    - o Creation of man-made facilities within the urban environment;
- **Hydrogeological conditions:**
    - o Condition of underground water-bearing horizons;
- **Soils and land:**
    - o Withdrawal of areas covered earlier with vegetation;
- **Land-based ecosystems:**
    - o Bird fauna; condition of nesting populations and migration routes of water and wading birds in the eastern part of the Neva Bay;
- **Aquatic ecosystems:**
    - o Ichthyofauna and fish resources;
    - o Condition of communities of invertebrate organisms, algae, higher aquatic plants in the waters directly or indirectly affected by the Project;
- **Urban environment of St. Petersburg:**
    - o Noise exposure and its impact on public health in the residential areas directly adjacent to the WHSD motorway;
    - o Public health in St. Petersburg as a whole;
    - o Transport infrastructure in the city and in the region as a whole;
    - o Socioeconomic conditions of the urban population, including limited involuntary resettlement, ownership rights for housing and garages, and other buildings and compensations paid for them, the facilities of social infrastructure, including the access to them and compensatory measures;
    - o Land acquisition and temporary land plots occupation for the purposes of the WHSD Central Section construction and appropriate compensatory measures and payments;
    - o Recreational resources of micro-districts adjacent to the motorway;
    - o Visual properties of urban landscapes;

- **Status of protected areas:**
    - State nature reserve of Yuntolovo;
    - Protected area"Neva Bay's Northern Coast".
- **Cultural and Historic Heritage:**
    - Archeological sites that can be potentially identified on the land allocated for the WHSD Project;
    - Memorials of cultural heritage in the historic part of St. Petersburg.

A scale for assessment of the status of ecosystem components and socioeconomic living conditions of the local communities is presented below in Table 8-1.

Table 8-1. Scale for the assessment of threats to the status of ecosystem components and the social environment

Environmental condition of components	**Points**
Complete destruction	1
Direct threat	2
Serious threat	3
Endangered condition	4
No threat	5

The resulting assessment of the predicted condition of individual components of the ecosystems, as well as health and economic living conditions of the population within the areas directly and indirectly affected by the WHSD Central Section construction and the WHSD motorway operation as a whole is given in Table 8-2.

Table 8-2. Main anthropogenic impacts and predicted environmental status of ecosystems and the population in the area potentially affected by the WHSD Central Section

Natural and social components	Duration and direction of impact	Scale of impact	Threat to the status of ecosystems and social conditions	Remarks
Atmospheric air				
Ground-level pollution of atmospheric air as a result of the construction work and the traffic in the process of the WHSD motorway operation	Short-term reversible impact	Local	4-5	During the WHSD construction
	Long-term potentially reducible impact	Local	4	During the WHSD operation for residential areas at the Marine Embankment
GHGs emission	Positive effect	Regional	5	Due to teh reduced urban traffic during the WHSD operation
Aquatic environment				
Chemistry of aquatic environment and quality of bottom sediments in the Neva River mouth and in the Neva Bay	Short-term potentially reducible impact	Onsite	3	During the construction and removal of temporary islands
	Long-term reversible impact	Onsite	4-5	In the process of the operation of onsite stormwater treatment facilities with outlets directly to the Neva Bay
	Long-term reversible impact Short-term reversible impact	Local Onsite	3-4 2-3	In case of potential accidental situations associated with transportation of hazardous cargoes on the WHSD motorway
Hydrologic conditions	Short-term reversible impact	Local	3	Deterioration of conditions for ice moving as a result of construction of temporary islands
Geological environmental and topography				
Creation of man-made facilities in the urban environment	Long-term irreversible impact	Local	4-5	During the WHSD construction and operation
Hydrogeological conditions				

Natural and social components	Duration and direction of impact	Scale of impact	Threat to the status of ecosystems and social conditions	Remarks
Condition of underground water-bearing horizons	Long-term irreversible impact	Local	4-5	In the process of the operation of drainage system to the west of the WHSD motorway on Vasilievsky Island
Soils and land				
Withdrawal of land plots covered earlier with vegetation	Short-term potentially reducible impact	Local	4-5	During the construction of the WHSD Central and Northern Sections
Loss of considerable areas of land used earlier for agricultural purposes	Long-term irreversible impact	Onsite	3	During the construction of the WHSD Northern Section
Land-based ecosystems				
Bird fauna, condition of nesting bird populations and migration ways of water and wading birds in the eastern part of Neva Bay and in Yuntolovo nature reserve	Permanent potentially reducible impact	Local	4	During the WHSD construction and operation
Aquatic ecosystems				
Ichthyofauna and its food resources	Short-term irreversible impact	Onsite	2-3	As a result of consequences of the construction and removal of temporary islands
	Long-term potentially reducible impact	Local	4	In the process of the normal WHSD operation
	Short-term reversible impact	Local	3	In case of the accidental situations
Urban environmental of St. Petersburg				

Natural and social components	Duration and direction of impact	Scale of impact	Threat to the status of ecosystems and social conditions	Remarks
Public health in residential micro-districts directly adjacent to the WHSD motorway	Short-term potentially reducible impact	Local	3-4	During the WHSD construction (with regard to noise impact factor)
	Long-term potentially reducible impact	Onsite	4-5	In the process of the normal WHSD operation (with regard to noise impact factor + for the Marine Embankment with regard to atmospheric air pollution)
	Short-term reversible impact	-	3-4	In case of accidental situations
Public health in St. Petersburg as a whole	Positive effect	Regional	No threats	In the process of the normal WHSD operation
Transport infrastructure in the city and the region as a whole	Positive effect	Regional	No threats	In the process of the normal WHSD operation
Transport infrastructure on Kanonersky Island	Short-term reversible impact	Local	3-4	In the course of the WHSD Central Section construction
Socioeconomic living conditions of the urban population	Positive effect (for a major part of population)	Regional	4-5	In the process of the normal WHSD operation
	Short-term irreversible impact for owners of garages to be demolished, for displaced apartment owners, owners and employees of the Cafes on Marine Embankment, kindergarten № 74, for the sport filed to be displaced	Local	3	Prior to the WHSD construction commencement
Land acquisition and the temporary land plots occupation for the purpose of the WHSD Central Section construction	Permanent potentially reducible impact for the CSJC "Farvater" while dismantling its warehouse	Local	3-4	Before the the WHCD construction

Natural and social components	Duration and direction of impact	Scale of impact	Threat to the status of ecosystems and social conditions	Remarks
	Short-term reversible impact (while renting out the land plots for the technical zones during the WHSD Central Section construction)	Local	3-4	
Recreational resources of the micro-districts adjacent to the motorway	Permanent potentially reducible impact	Local	4	In the process of the WHSD construction and normal operation
	Short-term reversible impact	Onsite	3-4	In case of accidental situations
Visual properties of urban landscapes	Permanent irreversible impact	Local	4-5	In the process of the normal WHSD operation
Protected nature territories				
State nature reserve of Yuntolovo	Permanent potentially reducible impact	Local	4-5	In the process of the WHSD construction and normal operation
Protected area "Northern coast of Neva Bay"	Permanent potentially reducible impact	Local	4-5	In the process of the normal WHSD operation
	Long-term reversible impact	Local	3-4	In case of accidental situations
Cultural and historic heritage				
Archeological sites that can be potentially identified on the land allocated for the WHSD Project	Short-term potentially reducible impact	Local	3-4	In case of non-compliance with the applicable regulations during the WHSD construction
Memorials of cultural heritage in the historic part of St. Petersburg	Permanent irreversible impact	Local	4-5	In case of non-compliance with the applicable regulations during the WHSD construction

*Note: Color scale of threats to the status of ecosystems and social environment

	1, 1-2 – maximum and direct threats		2, 2-3, 3 – direct and serious threats		3-4, 4 – serious threats and		4-5, 5 – remote and insignificant threat,

					endangered status		positive effects

The conducted analysis indicates that any significant onsite and **local short-term irreversible impacts** on ecosystems and **onsite negative impacts** on public health in residential areas directly adjacent to WHSD construction sites can be imposed during the construction phase in the process of earthmoving operations (first of all during construction / removal of the temporary islands in the Neva Bay), in the process of construction and erection work and installation of engineering networks. Such impact will result in the loss of the natural habitats of aquatic ecosystems and insignificant loss of recreational properties of the urban environment, as well as in high-level noise impact on the residential districts on Kanonersky Island directly adjacent to the construction zone.

During the WHSD operational phase, significant **onsite permanent, but potentially reducible impact** on atmospheric air quality, biota and public health will be imposed in connection with the predicted transport traffic intensity.

In general, the effects of the WHSD Project will be positive for St. Petersburg due to re-distribution of traffic streams and mitigation of traffic congestion in the central districts of the city.

Significant environmental risks (direct and serious threats to the environment and public health) caused by WHSD construction and operation may be caused by accidental situations and spills of petroleum products. Such risks have been assessed as **short-term onsite reversible**.

The effects of the WHSD motorway during the entire period of its operation will be **positive** for the socioeconomic situations and for meeting the expectations of the population of St. Petersburg as a whole.

However, some minor groups of people (residents of apartments to be resettled, owners of garages to be demolished) will be exposed to **short-term negative impacts**.

It may be therefore concluded that an integral assessment of the impacts caused by the construction of the WHSD Central Section and operation of the entire WHSD motorway has revealed predominantly **reversible and potentially reducible onsite and local impacts on the ecosystems and the public health, as well as a positive socioeconomic effect for the urban environment of St. Petersburg and the entire region**.

In order to minimize, and in some cases to eliminate the negative impacts from the WHCD Central Section construction as well as from the WHSD operation as a whole, the following documents are considered to be implemented:

- Environmental and Social Action Plan (ESAP);
- Resettlement and Compensation Framework;
- Stakeholder Engagement Plan (SEP).