

Environmental situation assessment in the area of the airport Bronka construction based on indicator-index approach

Julia Lednova * and Mikhail Shilin**

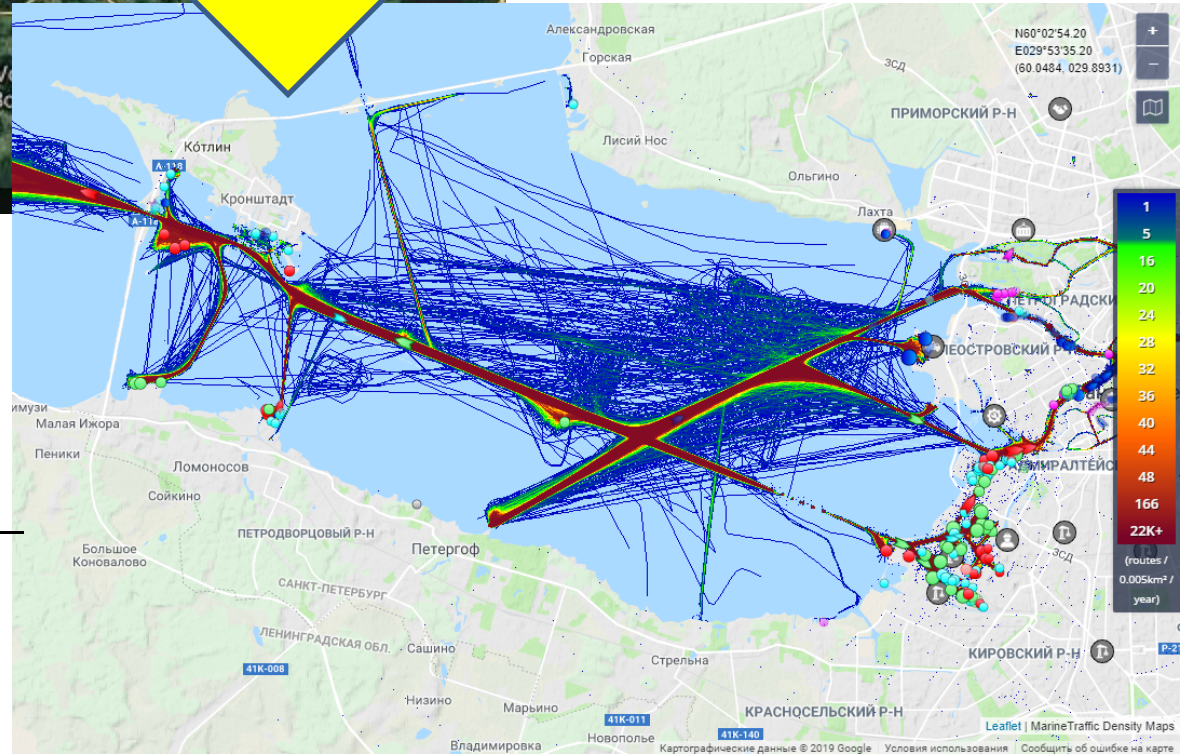
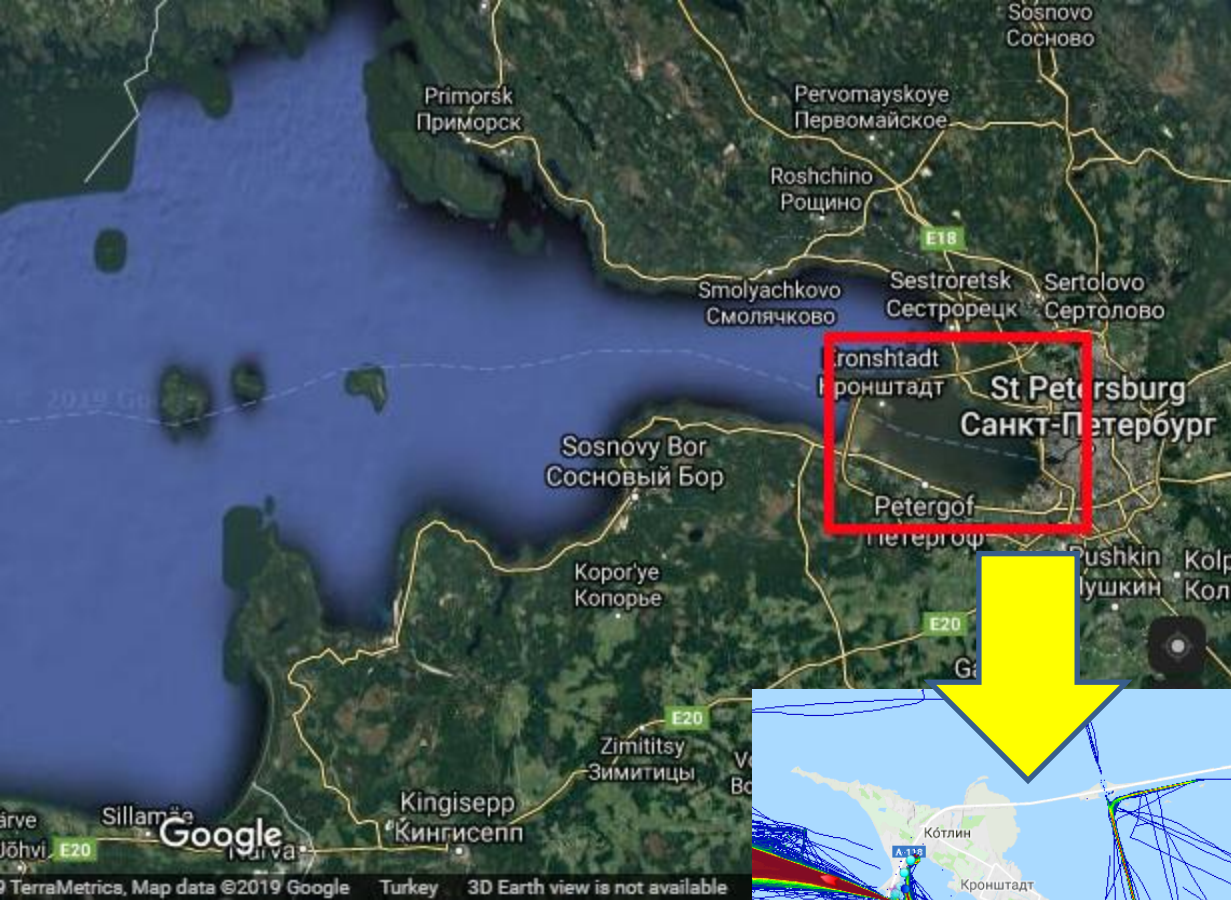
* Peter the Great Saint-Petersburg Polytechnic University

**Russian State Hydrometeorological University

St.Petersburg, 2021

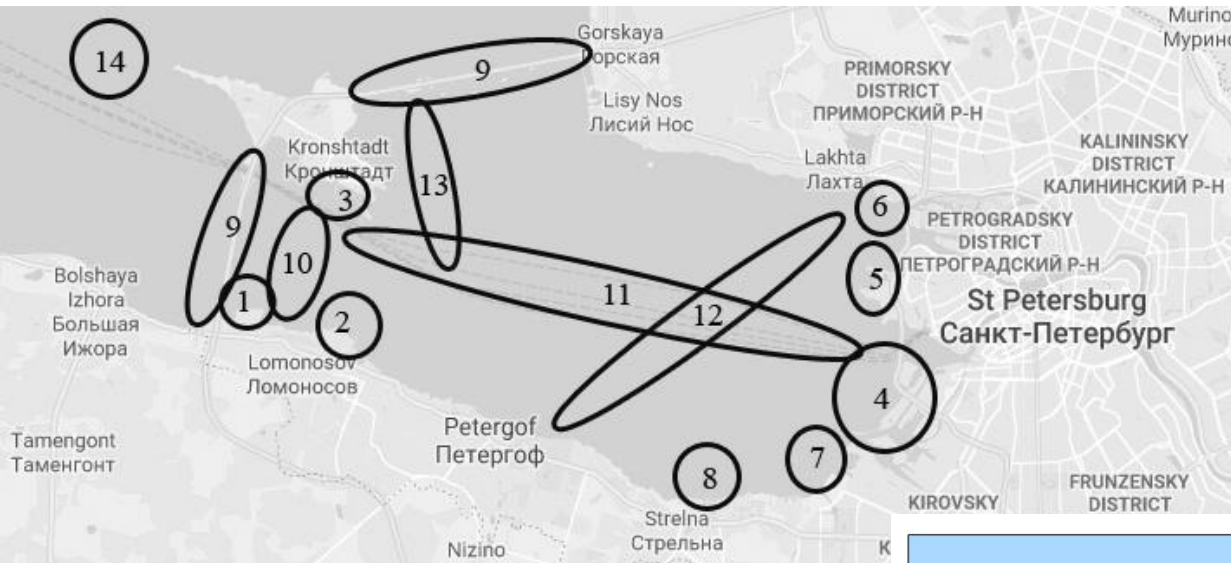
The Neva Bay

- length – 21 km
- width – 15 km
- area – 329 sq. m



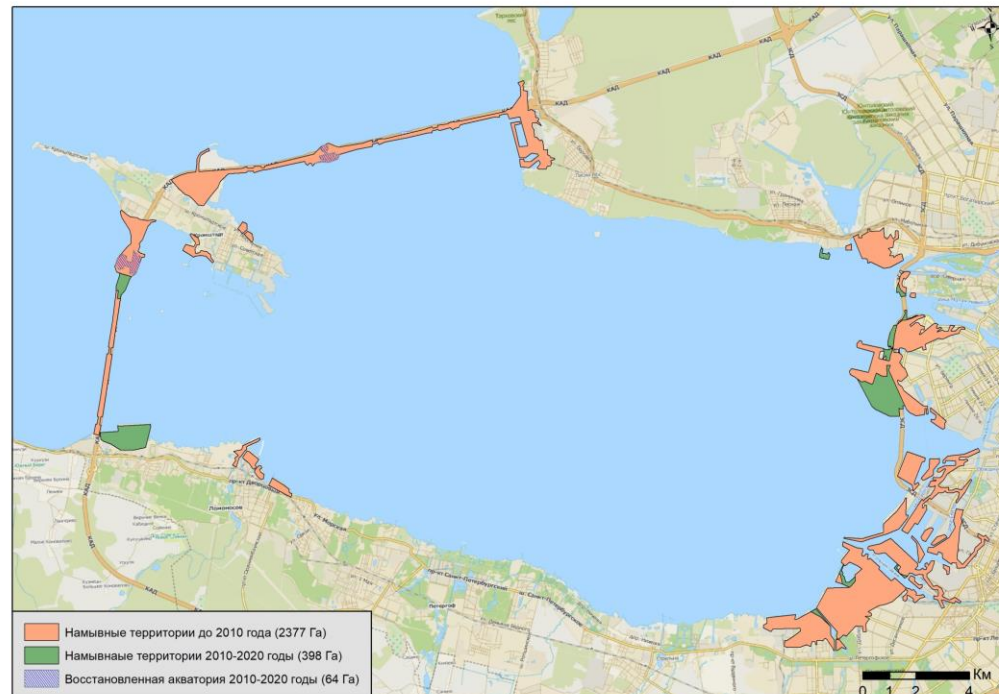
- average natural depth – from 3 to 5 m
- maximal depth – 6.4 m
- depth of marine channel – 12 m

Technospheric lagoon



- 1 – avanport “Bronka”;
- 2 – port in Lomonosov;
- 3 – port in Kronstadt;
- 4 – the main part of the Big port of St. Petersburg;
- 5 – passenger terminal;
- 6 – sand mining area and underwater deposit site “North Lakhta”;

- 7 – sand mining area and underwater deposit site “South Lakhta”;
- 8 – marina and approach channel in Strelna;
- 9 – Barrier flood Protection;
- 10 – approach channel on avanport “Bronka”;
- 11 – main approach channel;
- 12 – approach channel between Peterhof and the city center;
- 13 – approach channel between northern shipping passing and main approach channel;
- 14 – underwater deposit site Tolbukhin.

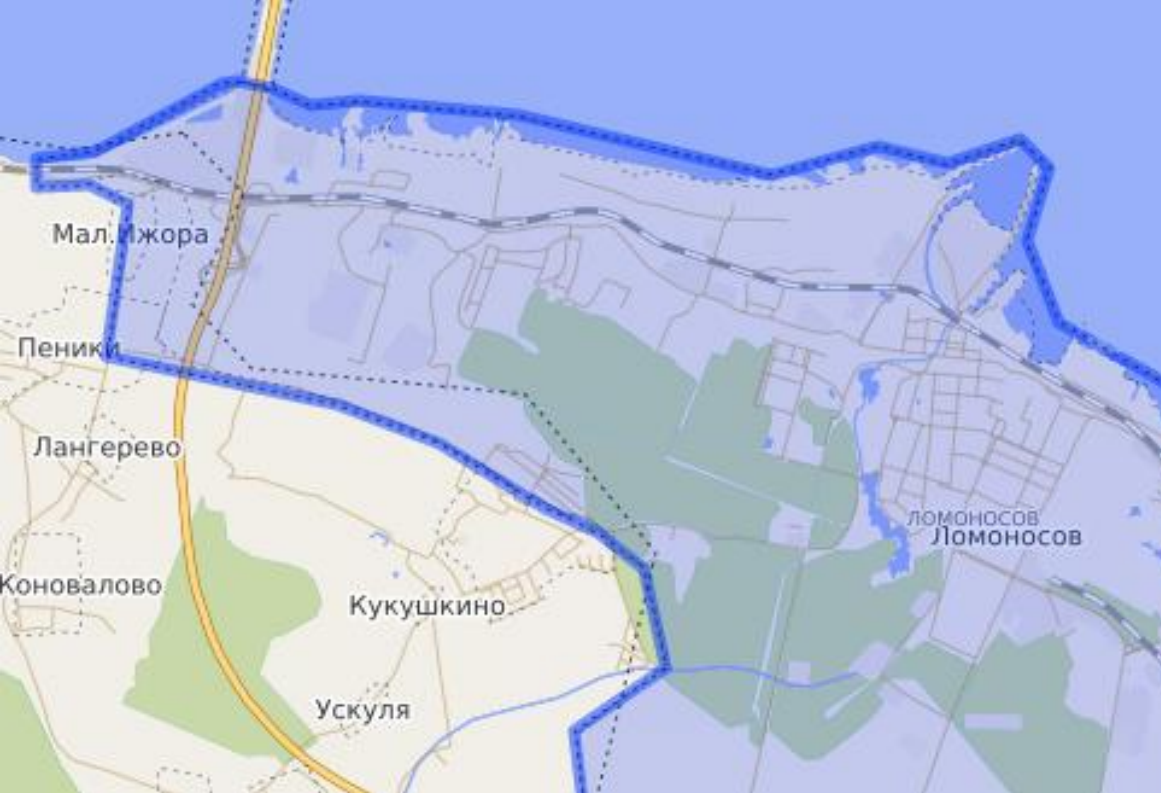


Avanport “Bronka”

- territory – 206.9 ha
- artificially reclaimed area – 97.37 ha

operational water area
and the approach
channel:

- total length – 6 km;
- width on II stage – 185 m;
- channel bottom mark - 14.4 m for II stage



Methodology for environmental situation assessment

The set of indicators and indexes



Additional environmental impact index:

- physical and chemical conditions:
 - 8 indicators;
 - 2 indexes;
- biological components:
 - 5 indicators;
 - 1 index.

Environmental impact assessment for coastal local municipalities:

- social, economic and environmental conditions:
 - 6 indicators;
 - 2 sub-index;
 - 1 complex index.

Indicators' scale

Value	Anthropogenic pressure	Compensation actions	Additional impact
[0.75; 1.00]	No negative impact	the highest positive impact	No negative impact
[0.25; 0.75)	low negative impact	high positive impact	within maximum allowable impact
[-0.25; 0.25)	medium negative impact	medium compensation actions	maximum allowable impact
[-0.75; -0.25)	high negative impact	low positive impact	within maximum allowable impact
[-1.00; -0.75)	the highest negative impact	No positive impact	the highest negative impact

Indicator for assessment additional environmental impact

The indicator of mechanical biotope disturbance

$$I_{BD} = 1 - (S_{DW}/S_{LW} + S_{PLC}/S_{LW})$$

The indicator of bottom recovery by suspended material

$$I_{BR} = 1 - ((S_{DR5} + S_{TC5})/S_{LW} + S_{DUM5}/S_{DUM})$$

Symbol	Unit	Description
S_{PLC}	m ²	constantly rejected water area for a dredging project
S_{LW}	m ²	local water area
S_{DR5}	m ²	area, covered by at least 5 mm of dredged material during dredging works
S_{TC5}	m ²	area, covered by at least 5 mm of dredged material during land reclamation
S_{DUM5}	m ²	area, covered by at least 5 mm of dredged material during dumping
S_{DUM}	m ²	total area of underwater deposit site

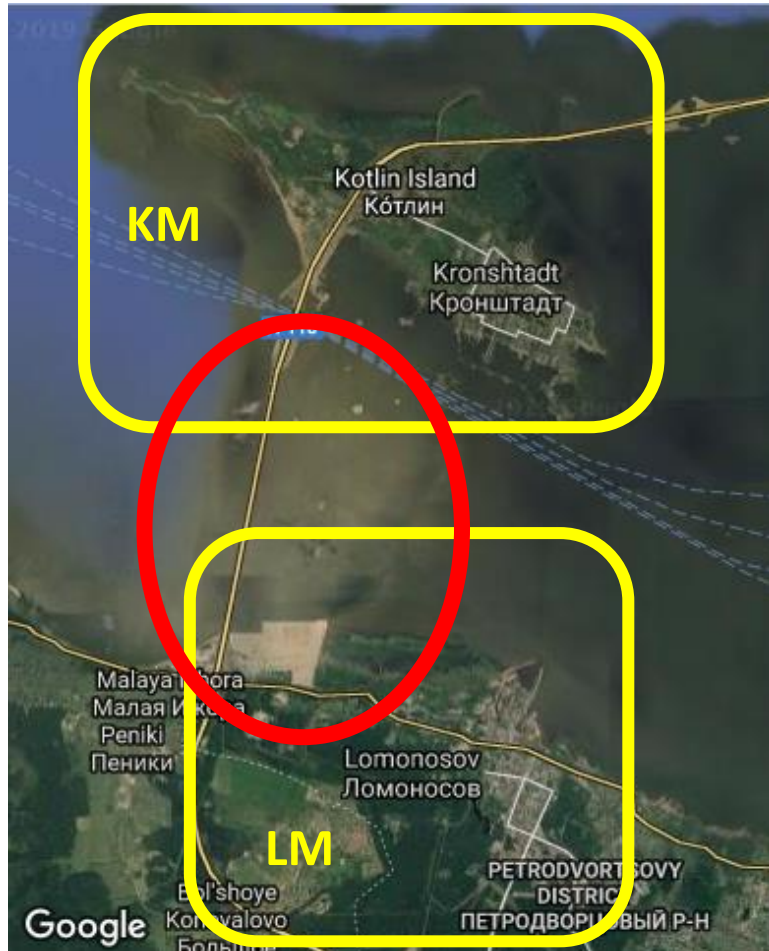
Physical and chemical indicators for avanport “Bronka”

Name of indicator / index	Indicator or index value, dimensionless		
	Land reclamation	1 st stage of dredging	2 st stage of dredging
Indicator on local short-term atmospheric pollution	5	5	5
Indicator of coastal line disturbance	3	5	5
Indicator of dredged material usage	5	1	1
Indicator of mechanical biotope disturbance	5	5	5
Indicator of bottom recovery by suspended material	5	1	3
Indicator of turbidity plume	2	1	1
Indicator of application of dredged soil by pollution level	5	5	5
Index of relative water pollution	1	1	1

Biological indicators and indexes for avanport “Bronka”

Name of indicator / index	Indicator or index value, dimensionless		
	Land reclamation	1 st stage of dredging	2 st stage of dredging
Indicator of macrophyte losses	3	3	2
Indicator of benthos losses	2	2	2
Indicator of phytoplankton losses	2	2	2
Indicator of zooplankton losses	4	4	4
Index of feeding sources losses	3	3	2
Indicator of fish resource losses	4	4	5
Complex index of additional environmental impact	4	3	2

Coastal local municipalities conditions (CLM)



CLM	Year		
	2008	2011	2016
Anthropogenic pressure			
KM	3	3	4
LM	3	3	3
Compensatory actions (positive impact)			
KM	1	1	3
LM	1	1	2

Conclusions

- The set of indicators divided into 3 main groups: physical and chemical, biological, social-economic and economic-environmental with a total amount it is 19;
- The methodology provides an opportunity for assessment environmental situation for coastal local municipality;
- the most significant additional impact on the environment of the coastal local municipalitites during dredging works came from emissions into the atmosphere;
- the biggest significant additional anthropogenic pressures on the marine environment were connected with:
 - sedimentation of resuspended matters;
 - possible secondary pollution of water column; and
 - losses of ecosystems' components and their feeding sources



Thank you for your attention!