



TEMERNIK  
— PARK —

## THE PROJECT CONCEPT

REHABILITATION OF THE  
TEMERNIK RIVER WITH THE  
REORGANIZATION OF COASTAL  
AREAS TO A MUNICIPAL  
ECOLOGICAL PARK

ROSTOV-ON-DON  
2019

The current edition is the revised version of the project concept “Rehabilitation of the Temernik River with the reorganization of coastal area for municipal ecological park” published in 2016.

The concept is up-to-date (August 2019) and considers the new implementation approaches that have appeared over the past few years, according which ANO “Park Temernik” operates.

Edited by **Britvin N. N.**

Authors: **Schneider S.B., Yelva V.V.,  
Poteryahin A.V., Strelchenko A.S.,  
Ignatova Y.S.**

---

*The e-version of the editions (including the concept and newsletters about project implementation progress), prepared by the action group of ANO “Park Temernik” are available on [parktemernik.ru](http://parktemernik.ru).*





***«All projects have to be done well, in order not to burden the treasury and not to harm Fatherland. Those who will be irresponsibly doing their projects, they will lose their titles and will be whipped».***

*Peter the Great*



## CONTENT

PROJECT OVERVIEW.....	2
1. BACKGROUND.....	3
2. DESCRIPTION OF THE RIVER .....	9
3. WATER MANAGEMENT SYSTEM OF THE TEMERNIK RIVER .....	13
4. ECOLOGICAL RISKS .....	16
4.1. RIVER POLLUTION AND EPIDEMIOLOGICAL RISKS .....	16
4.2. RISK OF CONTINUED ACCUMULATION OF BOTTOM SEDIMENTS .....	19
4.3. FLOODING AS A RESULT OF FRESHEST .....	22
4.3.1. FLOODING AS A RESULT OF FLOOD EVENTS .....	22
4.3.2. FLOODING AS A CONSEQUENCE OF TECHNOGENIC FACTORS .....	24
4.4. RISK OF RISING GROUNDWATER AND SUBSIDENCE .....	27
4.5. RISK OF WATERLOGGING OF THE RIVERBED DUE TO THE LACK OF NATURAL PERMANENT FLOW .....	30
5. IMPLEMENTATION OF MEASURES REGARDING ENVIRONMENTAL ENHANCEMENT OF THE TEMERNIK RIVER .....	32
5.1. THE ROLE OF THE TEMERNIK RIVER IN ENVIRONMENTAL ENHANCEMENT PROGRAMM OF THE LOWER DON ASIN .....	32
5.2. IMPLEMENTATION OF THE SECOND AND THE THIRD STAGES OF THE TEMERNIK RIVER TARGETED ECOLOGICAL PROGRAMM REGARDING ENVIRONMENTAL ENHANCEMENT .....	37
5.3. EXPERT EVALUATION OF THE ONGOING WORK .....	41
6. INTERNATIONAL AND RUSSIAN EXPERIENCE IN ECOLOGICAL REHABILITATION OF SMALL RIVERS .....	46
7. REHABILITATION STRATEGY OF THE TEMERNIK RIVER BASIN. IMPLEMENTATION SCHEDULE .....	53
7.1. STATEMENT OF PROJECT MISSION AND OBJECTIVES .....	53
7.2. STRATEGIC PLAN OF THE PROJECT IMPLEMENTATION .....	57
8. PROJECT IMPLEMENTATION STATUS .....	60
CONCLUSION .....	65
<i>Appendix №1 Regarding the necessity of the development of the ecological and hydrometeorological monitoring system of the Temernik River (FSBSI «RusRIPLR» proposal) .....</i>	<i>66</i>
<i>Appendix №2 Decree of the Rostov Region Government regarding «Approval of regional program "Ecological enhancement of the Temernik River basin and improvement of the coastal region" of March 28, 2019 N 199 .....</i>	<i>70</i>
<i>Appendix № 3 Founders of ANO «Park Temernik» .....</i>	<i>87</i>
<i>Appendix № 4 Honorary members of ANO «Park Temernik» .....</i>	<i>89</i>



## PROJECT OVERVIEW

The current concept is based on the attempt of comprehensive study and generalization of the main problems and risks regarding the present condition of the Temernik River, and on this basis to develop short-term and long-term measures to enhance the riverside and its integration with architectural and landscape design of the Roston-on-Don.

The aim of the Temernik River rehabilitation project is to improve the quality of life of the citizens by enhancing the source of environmental pollution into a citywide level recreational zone.

Originally, the idea was suggested by an architect of the Rostov Region Polyanskiy A.E., who showed the outline of architectural planes, made on his own initiative, to make a river clear in order to attract city's infrastructure.

This proposal was discussed on different platforms of city and federal levels, where it was approved by society.

The initiative group under the direction of the chairman of the Board of Directors of OJSC "Rostovskoe" Britvin N.N was created to implement previously made decisions. The group was consisting of representatives from government, business and expert community that was associated with the concept development.

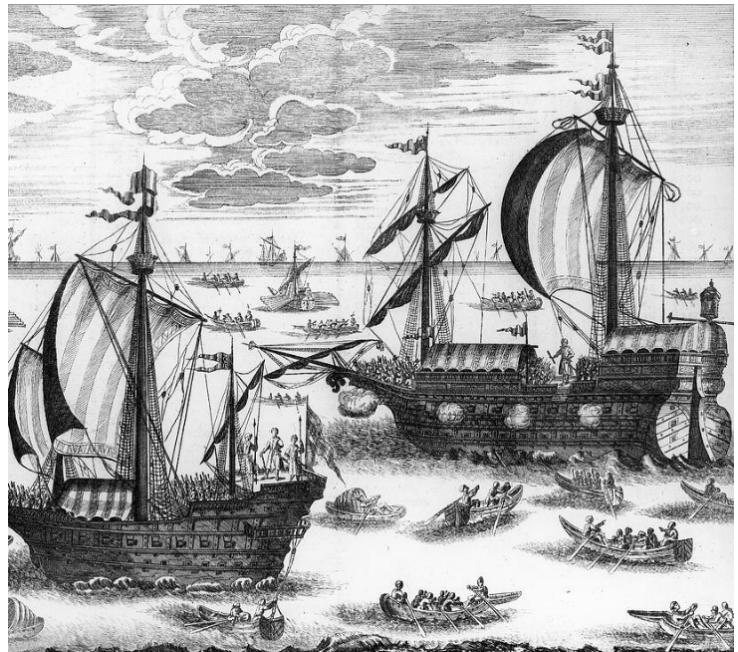
On November 2016, the project was supported by the government of Rostov Region, which approved corresponding "Roadmap" for 2 year period. On December 2017, the document was updated for a 5 year period. On March 2019, the regional program "Ecological enhancement of the Temernik River and improvement of the coastal area till 2022" was approved with a total budget of 1,57 billion rubles.

***The aim of the revised edition of the concept is to update the strategic document of the project taking into account all up and downs for the past three years.***

## 1. BACKGROUND

The name of the Temernik River originates from Turkic word "iron". There is also another theory, which suggests that the river was named after great Mongolian conqueror Tamerlan, whose name can be translated from Turkic language as "iron lame man". Thereby, our river owes its name to one of the most difficult periods in Russian history, defined as the Mongol-Tatar yoke.

The city was founded as a result of a Peter the Great's decree in 1695 regarding the arrangement of a small shipyard for equipping and



*Figure 1. Kerch campaign of the Azov fleet (1696).  
Engraving by an unknown author*

repair the ships of the Azov Flotilla. The decision was justified according to two factors: by the presence of a wide and deep backwater<sup>1</sup>, the confluence of the Temernik and the Don rivers, as well as a nearby source of drinking water<sup>2</sup>.

After the defeat of Russia in the Russian-Turkish War and the conclusion of the Prut Peace, in 1711 the Temernik River became the western border of the country. At the site of the former shipyard, border and customs posts were arranged.

These settlements became the starting point of fortress construction, which laid the foundation of the city. Upon the decree signed by Empress Elizaveta Petrovna on September 13, 1761, the fortress was named as Fortress of St. Dmitry of Rostov "to protect people from Turks, Tatars, and Nogais" and "to keep Don Cossacks at bay".

The further development of the city at an early stage is interrelated to the development of the territory limited by the left bank of the Temernik River on the west and the forstadt of the fortress on the east.

<sup>1</sup> Prior to the commissioning of the Volga-Don Shipping Canal, the annual spills of the Don and its tributaries (including the Temernik River) occupied large territories.

<sup>2</sup> Tract «The Rich Well»

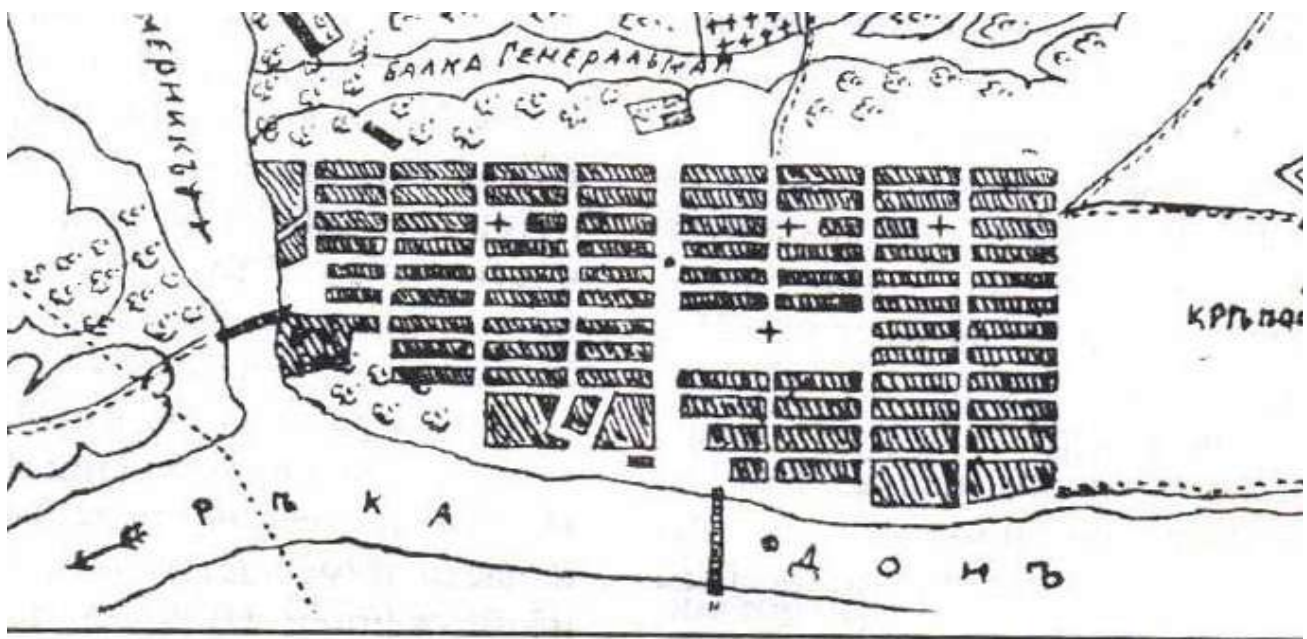


Figure 2. The first plan for the development of the settlement in the western forstadt of the fortress named after St. Dmitry of Rostov *План г. Ростова-н/Д. 1781 г*

20 years later, after the victory of Russia in the Russian-Turkish War, the river lost its border status, while continuing to maintain the potential of internal transport, freight traffic, and biological diversity<sup>3</sup>. At the same time, the active usage of the coastal areas and river tributary, the General's Branch, as a natural canal for liquid and solid waste discharge.

In the XIX century, Rostov was growing dynamically in the northern and western directions. At that moment, various plants and factories were built at the left bank of the Temernik River, while the right bank was allocated for residential buildings. In 1865, the first water supply system using the „Rich Well“ tract as a source of drinking water was built and started to function on a concessional basis. At the same time, the role of the city drainage system permanently goes to the General's branch and the Temernik River.

<sup>3</sup> According to the AzRIF data, up to the 50s of the 20th century, pikes, boomers, rams, roaches, perches, hives, and rudd could be found in the river



Figure 3. The main sewer (1998)

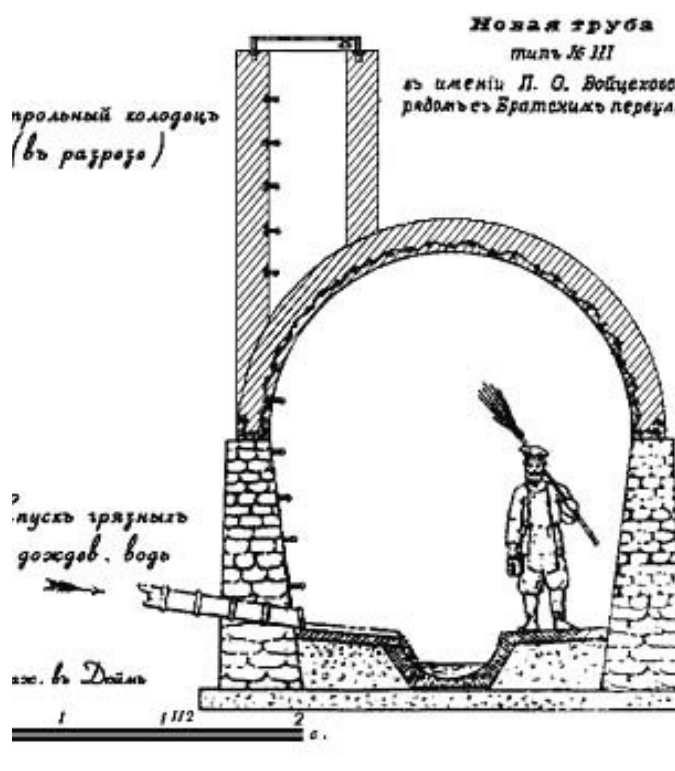


Figure 4. The General sewer in cross section. Drawing of the XIX century

This was the period when the first evident water deterioration symptoms such as unpleasant odors, waterlogging and soil erosion appeared. The city government concerned about the problem developed a plan about organizing urban storm sewers. The construction of the first 1.7 km long underground water sewer below the General's branch covered by the earth was the first sign of governmental plan execution.

This facility was commissioned in 1893, which allowed organizing the discharge of stormwater and household wastes from the entire central part of the city (from the modern Voroshilovsky Avenue to the Temernik River). At the same time, for some reason, the sewer was named the General, instead of the General's.

It should be noted that due to reconstruction works in 2010 the general sewer is successfully functioning.



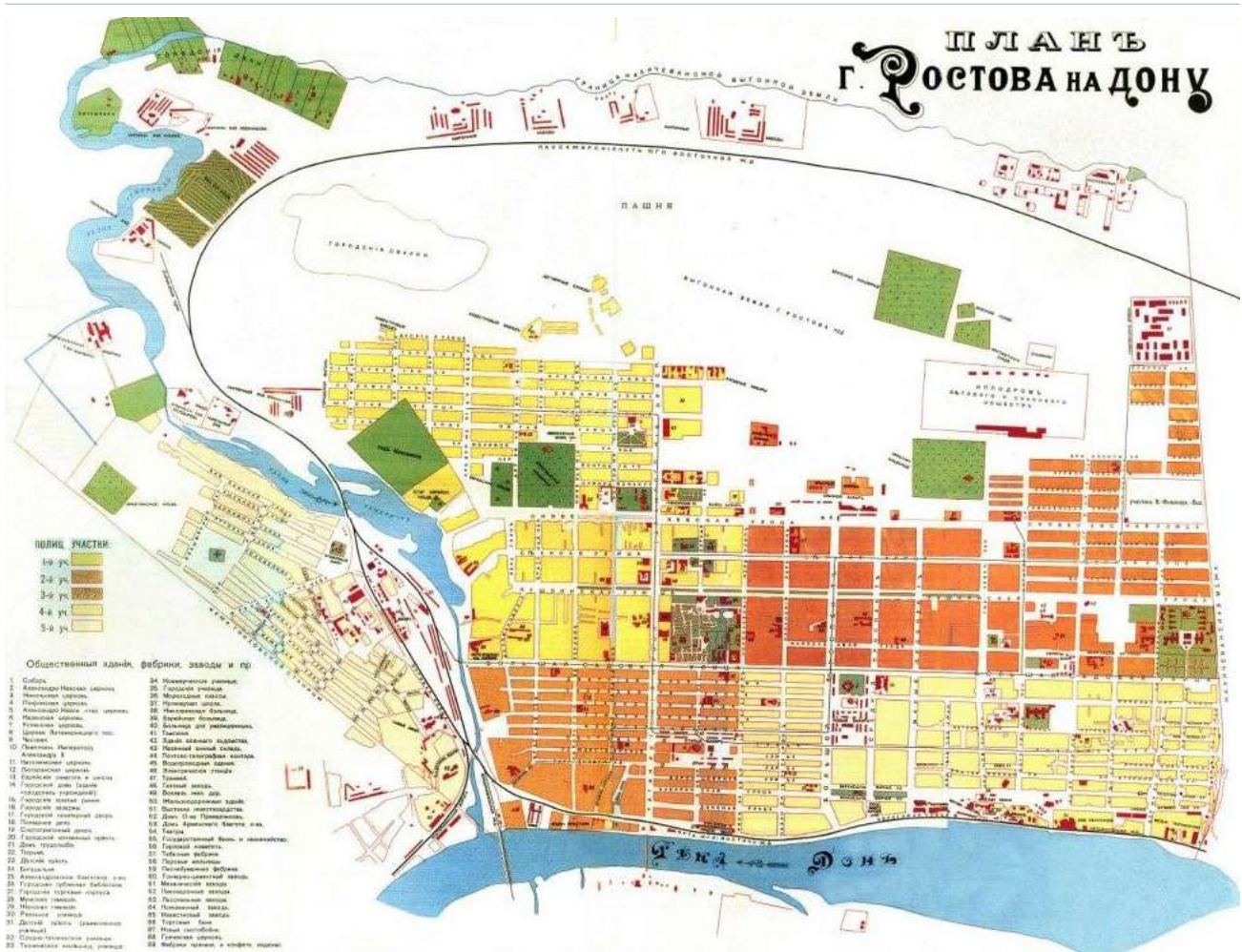


Figure 5. Rostov-on-Don on the plan of the land surveyor Mamontov, 1913

At the beginning of the XX century, the number of people in the urban settlement was already more than 100 t<sup>4</sup>. According to the factory inspection as of January 1, 1914, there were 153 factories and plants subjected to governmental supervision, with 11,799 workers.

The development of the metropolis in the XX century highly influenced on the southern part of the Temernik River, which was gradually occupied by new factories, plants and city blocks. As a result, more than half of the entire catchment area of the river was within the city limits. It must be noted, that the anthropogenic impact of the growing metropolis during this period was largely offset by two major events that were of crucial importance in the formation of the habitat.

The first, it's the development of transportation and wastewater treatment system in 1973-1975<sup>5</sup>.

4 According to the First General Census of the Russian Empire in 1897, there were 116.2 thousand people in Rostov

5 Начать их строительство подтолкнули заболевания холерой в соседствующих с Доном волжских городах, отдельные случаи эпидемии были зарегистрированы и в донской столице, правый берег Дона стал запретной зоной для купания

By the end of the century, the length of urban wastewater sewerage network was 1.2 thousand km. This helped to organize central waste discharge of the most biologically active household wastes bypassing the Temernik River through a complex of wastewater treatment facilities located on the left bank of the Don.



*Photo 1. Sewage treatment plant of the city of Rostov-on-Don. Technological threads of the first stage*

At the moment, the city drainage system covers 87% of households.

The second, the crisis in the economy of the 90s contributed to a sharp decrease in city manufacturing, and the market reforms in the property and land policy pushed a large number of enterprises and organizations beyond city limits, the activities of which were accompanied by significant pressure on the Temernik basin ecosystem.

At the same time, large-scale transformations took a place in the upper tributaries, river branch, and gullies that form the headwaters of the river in the north, to use natural watercourses for agricultural needs. Authorized and unauthorized bridges, crossings, hydraulic structures, artificial reservoirs, reclamation facilities, ponds, canals for dumping liquid waste from agricultural facilities were built. The main sources of pollution are the mineral fertilizers and pesticides that get to the riverbeds from the soil in rural areas as a result of overland flow, as well as the violation of the rules for aerial processing of crops, transportation control, storage and use of fertilizers and pesticides. This leads to eutrophication of the reservoir - an increase in its biological productivity due to an accumulation of biogenic substances in the water (nitrogen



and phosphorus). The physicochemical properties of water are deteriorating. The physiochemical properties of water are deteriorating. It becomes muddy, green, it acquires unpleasant taste and smell, and acidity increases. Due to massive algae death, their decomposing residues accumulate at the bottom of the river. Decay products of algae absorb oxygen in the water, whereas some of them are toxic to the environment.

All of these factors negatively influencing on the general condition of the river basin, disturbing the natural flow of water and natural organization of flushing regimes during freshets.

## CONCLUSIONS

- 1. The current condition of the river is the result of three-century long usage of it as a city drainage pit during the development of the city's infrastructure.*
- 2. In order to overcome all the negative consequences of such exposure and associated epidemiological, technogenic and other risks is possible only after realizing the necessity to form a new image of the Temernik River as an ecological park within its original location.*



## 2. RIVER DESCRIPTION

The Temernik River is a small river in the Rostov Region. It is a right tributary of the Don River. The length of the river is 35.5 km, of which 18 km runs through the city Rostov-on-Don, and it has a catchment area of 293 km<sup>2</sup>.

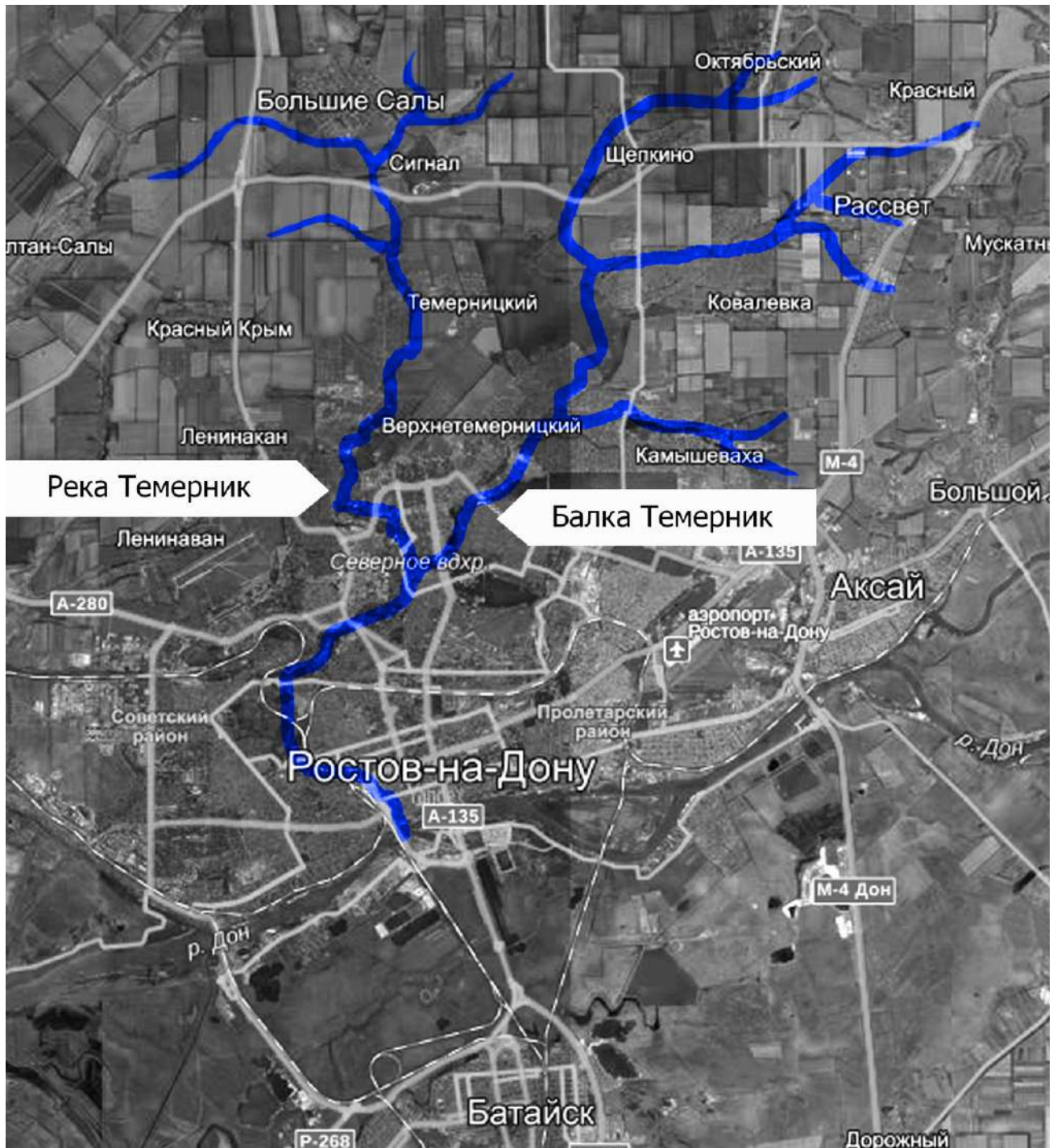
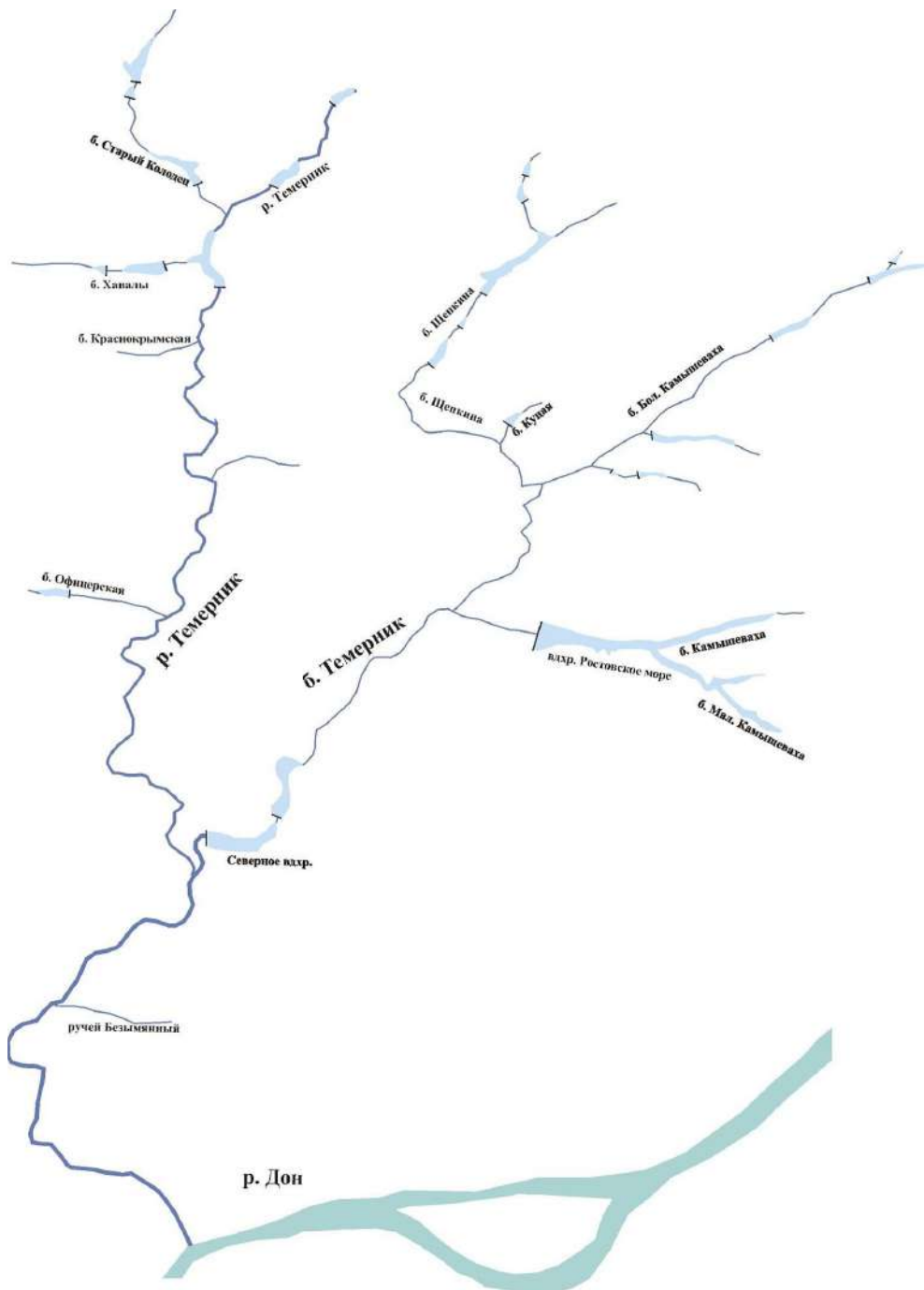


Figure 6. The Temernik River and the Temernik branch on a city map



The headwater of the Temernik River is located 2.5 km east of the settlement Big Salas of the Myasnikovsky district. From the right catchment side, there are four branches flowing into the Temernik River. They are Old Well, Hawali, Krasnokrymsk, and the Officer's.

The continuous river flow starts below the village of Big Salas due to groundwater outlets. From the side of the Aksaysky district, which is located on the left catchment side, the Temernik branch flows into the Temernik River and it is appeared to be the largest tributary.



Scheme 1. Scheme of the Temernik River Basin



On the territory of the city, several creeks flow into the Temernik. The largest is Kamyshevakha, which forms several dams before flowing into the river on the Northern housing estate territory.

Kamyshevakha flows from the largest dam, called the Rostov Sea. A highway has been arranged along a dam laid with concrete slabs, and controlled drainage has been established. Further, the watercourse is narrow, passes through an afforested area surrounded by gardening associations. The watercourse of Kamyshevakha in the territory of the Temernik micro-district was artificially altered to make several turns at the right angles. The water level is low in this area, there is a swamp with picturesque near-water vegetation, frogs, and kingfishers.

Further, the tributary turns to the south, and pass round the hill on which the Northern housing estate is located. A cascade of ponds with special adjustable dams crossing the river was built in the south-east and south-west directions. The common name for this cascade of ponds is the Northern Reservoir. Dams separate the reservoir into the Upper and Lower parts.

Both reservoirs have an influx from two large springs that collect water from a hill on the right bank. Both springs have swimming and recreational areas. The first spring flows into the reservoir before it turns to the south from under the hill on which the Surb Khach church is located. Further, along the shore, there is a recreational area with a water park. The second spring flows into right in front of the bridge of Cosmonauts Ave. After the bridge on the right bank, there is a park with a beach.

These reservoirs are the most well-developed sections of the tributary. The banks overgrown with reeds are well defined, although the reservoirs are not deep. Once in several years, special dry out of reservoirs can be arranged, when it has done there is only a small rivulet remains at the center of the watercourse. During the winter, reservoirs often freeze, with the exception of a narrow stream in the middle. The ducks, coots, and waterhens that stay here for a wintering in these frost-free areas with a stronger current. During the warm seasons, people do fishing – the main fish caught is rudd.

After the dam on a street Bodryi, the river flows like a stream running along a gully between the quarters of the private sector. At this point, the Kamyshevakha tributary merges with a watercourse of the Temernik River, which originates in the Myasnikovsky District of the Rostov Region. Here, the floodplain of the river is very wide and includes the whole territory of the Kamenka micro-district. Near the "Rostselmash" sanatorium, along the banks of the river, there are very picturesque places, and several pedestrian



and automobile bridges cross the river at this place. Starting from the Kamenka, the river makes a zig-zag. At this point, the river is clogged, the right bank is more gently sloping and there is the Oktyabrsky Park located on it adjacent to the military hospital.

The further watercourse of the river, after the Bezymyanny stream flows into it, is silty (no more than 1-2 m in width), it passes along the northern part of the zoo, where pedestrian bridges are built over the stream. The system of the swan ponds of the zoo is not included in the Temernik's watercourse. The river at the end of the zoo widens, become shallow and has an unpleasant smell within the limits of the Zmiev branch.

In the area of the Botanic Garden, the river is clogged again and, starting from this point, it flows in a southeast direction passing industrial zones along railways.

In the area of the Main Railway Station, up to the confluence with the Don, running water flows through a concrete riverbed, for which a special "accelerating" tray was laid along the bottom. For effective water treatment at the Temernik mouth, a biological module has been created - a floating structure consisting of pontoons, between which a special grid was placed. The pontoon is planted with Eichhornia, a which was imported from South America. The five-meter root of this plant actively absorbs salts of heavy metals and other toxic substances.

The main structures regulating the flow of watercourses of the entire Temernik river basin are 48 ponds and reservoirs with a total capacity of 5.94 million m<sup>3</sup> and a free surface area of 220 ha. The largest of the ponds are the Verkhovy, Nizovy and Rostov Sea, and they account for 66.9% of the total water volume in the river basin. Geographically, only a one-third of all hydraulic structures are located in the city of Rostov-on-Don, rest of them are located in Aksaysky (25) and Myasnikovsky (7) districts<sup>6</sup>.

---

<sup>6</sup> According to OJSC "Rostov Vodokanalproekt" "Justification for maintaining the ecological balance of the Temernik River after its treatment within the city limits «, 2002.



### 3. TEMPERIK RIVER WATER MANAGEMENT SYSTEM

Evaluation of the water management system of a particular river leads to the conviction that there are serious organizational and legal problems associated with the lack of an informational and analytical basis for water use, the incompleteness and inconsistency of the regulatory framework, and the lack of interaction between executive authorities.

Taking into account that all water-bodies are state property, there are eight federal ministries and departments with their sub-departments in the constituent entities of the Russian Federation that are responsible for managing, monitoring and controlling the water management system.

At the same time, a departmental approach prevails in this structure, focused more on the realization of the potential of water-bodies for national and economic purposes than on activities related to the safety of the environment.

Form this point of view, the value of the river can be measured by its ability to be used as the following:

- as a source of drinking or industrial water supply;
- as a transportation artery;
- as a source of biological diversity.

Considering that the Temernik River has lost all these potentials, the lack of interest from the federal department's side to this object seems quite understandable. This can explain the near absence of comprehensive monitoring and control system of water management in the basin of the river. Occasional studies and analyzes carried out by federal departments as a part of ongoing monitoring are partial and primarily aimed at predicting the risks associated with the possibility of hydraulic structures failure, the occurrence of infectious diseases, or possible negative impact on the Don River, as a source of drinking water.

Federal departments carry out more or less in-depth surveys at certain places as a part of the implementation of local land reclamation projects, organization of fish ponds, construction of hydraulic structures, overpasses, and bridges.

Ministry of Natural Resources and Ecology of the Rostov Region functions as a state environmental supervision department at the regional level. "Preservation strategy of





ROSTEKHNAZOR		<p>SOUTH INTERREGIONAL TERRITORY AUTHORITY ON NUCLEAR AND RADIATION SAFETY</p> <p>NORTHERN CAUCASUS DEPARTMENT OF ROSTEKHNADZOR</p>		
(ROSPOTERBNADZOR)		<p>CENTER OF HYGIENE AND EPIDEMIOLOGY OF RR</p> <p>ROSPOTREBNADZOR ADMINISTRATION IN RR</p>		
MINSTROY			MIN OF HOUSING AND UTILITIES SECTOR OF RR	
MIN OF TRANSPORT	FA OF MARITIME AND RIVER TRANSPORTATION	SOUTHERN UGMRN ROSTRANSNADZOR	MIN OF TRANSPORT OF RR	
MIN OF INDUSTRY AND TRADE	FA ON TRM	SOUTH INTERREGIONAL ADMINISTRATION OF ROSSTANDART TERRITORIAL AUTHORITY IN	MIN OF INDUSTRY AND ENERGY OF RR	ROSTOV DEPARTMENT OF STATE SUPERVISION
MIN OF HEALTH	FS FOR HEALTHCARE SUPERVISION	ROSDRAVNADZOR TERRITORIAL AUTHORITY IN RR	MIN OF HEALTH OF RR	
MIN OF AGRICULTURE	<p>FA OF FISHERY</p> <p>ROSSELKHOZNADZOR</p>	<p>AZOV-BLACK SEA TERRITORIAL ADMINISTRATION OF ROSRYBOLOVSTVO</p> <p>ROSSELKHOZNADZOR ADMINISTRATION IN RR AND VR IN KALMYKIA</p>	MIN OF AGRICULTURE OF RR	
MINISTRY OF NRE	<p>ROSVODRESURSY</p> <p>ROSPRIRODNADZOR</p> <p>ROSHYDROMET</p>	<p>DON BVU</p> <p>ROSHYDROMET DEPARTMENT IN SFD</p> <p>ДЕП. РОСГИДРОМЕТА ПО ЮФО И СКВО</p>	<p>DON BVU DEPARTMENT IN RR</p> <p>MINISTRY OF NRE OF RR</p>	
	FEDERAL LEVEL	FEDERAL DISTRICT/ INTERREGIONAL LEVEL	SUBJECT LEVEL	CITY LEVEL

Scheme 2. Management, monitoring and regulatory structures in the water management system of the Russian Federation\*



*\* List of used abbreviations:*

Ministry of NRE – Ministry of Natural Resources and the Environment

Min of Agriculture – Ministry of Agriculture

Minstroy - Ministry of Construction Industry, Housing and Utilities Sector

Rospotrebnadzor - The Federal Service for Supervision of Consumer Rights Protection and Human Well-Being

Rostekhnadzor - Federal Service for Ecological, Technological and Nuclear Supervision

Roshydromet - The Federal Service for Hydrometeorology and Environmental Monitoring

FA – federal agency

TRM - Technical Regulation and Metrology

Rosprirodnadzor – Federal Nature Management Supervision Service

Rosvodresursy – Federal Agency for Water Resources

Rosselkhozadzor - Federal Service for Veterinary and Phytosanitary Supervision

Rosrybolovstvo - Federal Agency for Fishery

BVU – Basin Water Management

RR – Rostov Region

VR – Volgograd Region

UGMNR – SOUTH DEPARTMENT OF STATE

MARINE AND RIVER SURVEILLANCE

SFD – Southern Federal District

NCFD – Northern Caucasus Federal District

the environment and natural resources of the Rostov region until 2020<sup>7</sup>», has been adopted in the Rostov Region, and it offers specific measures to improve small rivers, including monitoring of water resources' condition of the Temernik River, cleaning its watercourse, stocktaking and restoring the functionality of hydraulic structures.

There is a municipal enterprise in the city of Rostov-on-Don, that functions as customer-developer of hydraulic structures utilization on the Temernik River<sup>8</sup>.

<sup>7</sup> Approved by the Decree of the Government of the Rostov region dated 05.02.2013 No. 48 as amended by the resolution dated 15.05.2014 No. 349, dated 12.08.2015 No. 515

<sup>8</sup> Previously, this work was performed by the RR State Unitary Enterprise "Temernik". Later, the property and functionality of this enterprise were transferred from the regional to the municipal level. (Decision of the City Council of 02.28.2006 No. 108)



## 4. ECOLOGICAL RISKS

Considering the fact that currently there is no permanent system for the monitoring the Temernik River's ecological condition, the recognition of risks due to river's current condition for metropolis citizens is possible based on the use of general data from geological, biochemical and other studies of various departments conducted at different periods, that more or less address the river's basin. These risks are listed below.

### 4.1. RIVER POLLUTION AND EPIDEMIOLOGIC RISKS

Water pollution means any changes in the physical, chemical or biological properties of water in water-bodies, associated with liquid, solid and gaseous substances discharge into water, which cause discomfort by making it dangerous to use, which results in a negative effect on households, health, and public safety.

The first systematic approach for epidemiological monitoring, including laboratory studies of environmental entities due to cholera situation, was organized in the late 60s and early 70s of the last century due to local incidences and outbreak of the disease in the city of Rostov-on-Don. During the epidemiological investigations, it was found that 80% of infection incidence is associated with the use of water from the Don River and its tributaries, including the Temernik River<sup>9</sup>.

The leading role of the water factor in the distribution of cholera has determined the priority of the studies focused on establishing the influence of water-body components on the preservation period and properties of *Vibrio cholera*. At the same time, there is a clear association between *Vibrio cholera* release with ammonia nitrogen and surfactant content in the water and the number of blue-green algae and diatoms<sup>10</sup>.

The monitoring program of surface water bodies in the Lower Don basin for the presence of *Vibrio cholera*, conducted by the Federal Health Institution "Rostov-on-Don Anti-Plague Institute" of Rospotrebnadzor, includes twelve investigation points, two of which are located in the Temernik River basin. Annually, from May to September, 22 samples are taken at the mouth of the river, at its confluence with the Don and in the Botanical Garden area.

<sup>9</sup> Proceedings of the VIII Russian Scientific and Practical Conference on the Cholera Problem, Rostov-on-Don, 2003, "Epidemic Monitoring of Cholera in the Rostov Region". Aydinov G.T., Schwager M.M., Simonenko A.A.

<sup>10</sup> Data from the interdepartmental scientific council on sanitary and epidemiological protection of the Russian Federation. E. A. Moskvina, Yu. M. Lomov, V. I. Prometnoy, V. M. Ostroukhov, P. M. Lurie, V. Ya. Zhigalenko, S. I. Fedoruk, S. A. Nenadskaya et al., 1999, "The study of the relationship of several environmental conditions of the Don River and epidemiological manifestations of cholera in Rostov-on-Don." Issue No. 12. Rostov-on-Don.



In 2014, the presence of **V.cholera O1** serotype was detected in the Botanical Garden area, thus the **real danger of this reservoir as a source infection was determined**<sup>11</sup>. Therefore, the reservoir needs special preventive measures to eliminate the circulation of toxigenic clones.

The results of long-term biological testing studies (1992-2007) of the Temernik estuary indicate that the toxicity level of the river as class 4-5, which qualifies as extremely and very toxic, and the ecological status as poly- and hypertoxic<sup>12</sup>.

Data analysis of bio testing conducted in 2011-2012 by the Southern Department of the Institute of Water Problems of the Russian Academy of Sciences, the Southern Federal University and the FSBI "Hydrochemical Institute" of Roshydromet showed that the toxicity of water and bottom sediments of the Temernik River is heterogeneous both in degree and in spatial aspect. Thus, throughout the investigated sections of the river (from the mouth to the sanatorium „Nadezhda“), there were highly toxic zones, as well as non-toxic. Separate local toxicity points identified<sup>13</sup>.

The modern chemo-analytical studies of the selected samples carried out by the Federal State Budget Scientific Institution „RusRIPLR“ in 2015, which covered the determination of the hydrogen concentration (pH) of water, indicated that the water pollution is highest in the urban part of the Temernik River.

---

11 OF CHOLERA MONITORING RESULTS IN WATER BODIES OF THE ROSTOV REGION IN 2014 G.I. Yezhova, I.V. Arkhangelskaya, V.D. Kruglikov, S.V. Titova, D.A. Zubkova, R.V. Pisanov FHI Rostov-on-Don Anti plague Institute of Rospotrebnadzor, Rostov-on-Don, 2015.

12 IGNATOVA NADEZHDA ANATOLIEVNA. Evaluation of waters toxicity and bottom sediments of anthropogenically polluted ecosystems by biotesting method (on the example of the Lower Don basin). Abstract of dissertation for the degree of candidate of biological sciences, Rostov-on-Don, 2009.

13 UDC 504.453: 574.64 TOXICITY OF WATER AND BOTTOM SEDIMENTS OF THE URBANIZED AREA OF THE TEMERNIK RIVER (ROSTOV-ON-DON, Southern Federal District) Bakaeva E.N., Ignatova N.A., Chernikova G.G., Rud D.A..

Characteristics of toxic effects for a number of indicators are shown in Table 1<sup>14</sup>.

Component being identified	MPC excess ration		
	Upper par of the river, Myasnikovsky district, length – 12.5 km	Area under influence of Northern cemetery of the Rostov-on-Don, the length – 3.6 km	Within the city limits, length – 4.7 km
Sulfate ion	4,34	2,88	3,29
Ammonium ion	1,61	8,80	3,63
Nitrate ion	0,21	0,79	1,14
Chemical oxygen demand	1,42	3,19	1,78
Biochemical oxygen demand	1,38	0,64	1,17
Cadmium	1,0	3,0	1,0

**Table 1. Exceeding the MPC of pollutants in individual zones of influence**

A number of studies<sup>15</sup> have shown a decrease in the level of toxicity of the reservoir at the sites river water treatment and bottom sediment removal. At the same time, there is no complete picture of the Temernik River basin biological condition, despite the studies performed at a different point and at a different time period. Moreover, it not possible to track any positive or negative dynamics of river condition based on the mentioned studies.

It should be noted that the left tributary of the river, the Temernik branch, originating in the Aksai district, and flowing into the main watercourse through the Northern Reservoir, left beyond the attention of researchers and environmental monitoring experts. At the same time, visual monitoring of the river at the site B. Kamyshevakha branch, located on the north-eastern border of the city, shows (see diagram and photos 2,3,4) that there are sources of significant pollution and potential sanitary and the epidemiological danger posed by from promising construction zones.

14 TECHNICAL REPORT of the Federal State Budget Scientific Institution "RosNIIPM on Engineering and Environmental Surveys for the Facility:" Survey and calculation of the throughput capacity of the Temernik river bed in the area from the source (47°23'31,47 "NL; 39°44'0,96" VD) to the Lower Reservoir (47°16'19 , 44 " NL; 30°42'10,49" VD) "Novocherkassk 2015

15 IGNATOVA NADEZHDA ANATOLIEVNA. Evaluation of toxicity of waters and bottom sediments of anthropogenically polluted ecosystems by biotesting method (on the example of the Lower Don basin). Abstract of dissertation for the degree of candidate of biological sciences, Rostov-on-Don, 2009;



*The place on the map and photos 2,3,4 characterizing the ecological condition of the tributaries of the Big and Small Kamyshevakha, located above the confluence of the Rostov Sea.*

## 4.2. RISK OF CONTINUED ACCUMULATION OF BOTTOM SEDIMENTS

Bottom sediments are one of the most informative entities during the ecological assessments of water systems. Due to accumulating contaminants, that has been entering the water for many years, bottom sediments can serve as an indicator of the ecological condition and give a general idea about pollution level in a given area.

Bottom sediments are a complex of minerals and an aqueous solution that saturates the sediments. This very aqueous solution combines physically and chemically discrete grains, mineral phases, and organic residues into an integrated system. In this system, various chemical reactions and redistribution of dissolved components occur. The aqueous solution and the surface of the grains are inhabited with bottom microflora, which has an important influence on the course of chemical reactions in bottom sediments and the activity of other organisms.

Technogenic deposits at the initial stages of pollution sort of neutralize the toxic man-made emissions by accumulating the contaminants. However, the buffer capacity of sediments is limited, which is not the case with pollutants. Even though the



wastewater discharge terminates completely, the previously accumulated sediments become a secondary source of pollution of water bodies, biota, and floodplain landscapes. Whereas chemical reactions and microbiological processes that occur in sediments contribute to the formation of mobile and toxic compounds from pollutants.

The lower section of the Temernik River, which receives water and solid discharges from the Bezymyanny stream, Zmeevskaya branch and directly from adjacent streets and ravines, is exposed to the greatest contamination associated with accumulation bottom sediments. According to the experts' estimation, the volume of sediment in this area is about 600 thousand cubic meters<sup>16</sup>. The most unfavorable sanitary and environmental conditions developed in the zoo area and the mouth of the Zmeevka branch, where the riverbed is completely filled with sediments. The thickness of sediment deposits here exceeds 5-6 meters. The downstream area is also full of sludge sedimentation.

The presence of a significant amount of unauthorized discharges of untreated and non-disinfected domestic wastewater by private households located in non-canalized territories leads to microbial as well as to parasitic pollution of water and, consequently, the bottom sediments too. In November 2013, The Federal State Health Institution "Center for Hygiene and Epidemiology in the Rostov Region" performed a study of sediment samples from the zoo area and the Lower Reservoir. According to the results of laboratory tests, the sediment samples from the Temernik River contained helminth eggs in enough amount to classify silt sediments as an epidemically "extremely dangerous"<sup>17</sup>.

---

16 TECHNICAL REPORT of the Federal State Budget Scientific Institution "RusRIPLR on Engineering and Environmental Surveys for the Facility:" Survey and calculation of the throughput capacity of the Temernik river bed in the area from the source (47°23'31,47 "NL; 39°44'0,96" VD) to the Lower Reservoir (47°16'19 , 44 "secondary school; 30°42'10,49" VD) "Novocherkassk 2015.

17 «Expert opinion on the results of laboratory tests of the Temernik River bottom sediments «No. 03.02-37-10 / 198 dated 05/21/2014, Federal State Health Institution» Center for Hygiene and Epidemiology in the Rostov



*Photo 5. Siltation of the river bed in the lower reaches (Lendvovets district)*

The loss of waterway capacity leads to flooding of the urban area with minor rain floods with a water flow rate of 40-50 m/s. In case of more significant floods with a water flow rate of 100-150 m/s, there is a huge risk of excessively activated sludge entering the Don River, which can cause an environmental disaster in the entire basin, including the Taganrog Bay of the Sea of Azov.

The siltation of the Temernik riverbed significantly reduced its drainage capacity. Groundwater flow impedes the processes of infiltration into the mainstream and spreads over the water-bearing soil layers, contaminating groundwater in a large area, making them unsuitable for household and drinking purposes.

It is generally accepted that there is no alternative way to the physical removal of silt deposits to improve the sanitary and environmental condition in the urban part of the river basin.





## 4.3. RISK OF FLOODING OF EXTENSIVE URBAN TERRITORIES

### 4.3.1. FLOODING AS A RESULT OF FLOODING

Freshet is a sudden rise in water level in a river. Basically, it describes the process when a river or lake after rain or rapid snow melting spills over its banks. Regardless of the causes (there may be several), the phenomenon is notable for its short duration and suddenness. The meaning of the word (in Russian) quite accurately defines the essence of the process.

There can be several preceding events that may result in this phenomenon. The first one is prolonged heavy rain, which causes the waterbody to spill over its banks. The second one is excessive snowmelt in winter and spring. The freshet period after heavy rainfall is usually very short and lasts only several hours. However, due to its swiftness, even in such a short period of time it a cause severe damage. In the case of repeated rainfalls in the same area, multi-peak freshets can be observed. This event is characterized by periodic spills of water bodies with flooding of nearby territories.

The loss of waterway capacity of the Temernik River due to the high degree of siltation of its riverbed, as well as technical deficiency and deterioration of hydraulic structure parts, creates a threat of flooding of the city zones even with minor freshets.

According to data based on the records and observations by the Department for the Prevention and Elimination of Emergencies of the city of Rostov-on-Don from 2009, during freshets of 10-25% of coverage, the flooding zone of the Temernik River includes vast urban areas in Voroshilovsky, Zheleznodorozhny, Leninsky , October and May Day districts, with a total area of up to 360 ha.



*Scheme 3. Possible flooding zones during freshets on the river and Temernik branch*

Entities that are in flooding zone with the freshet coverage of 10-25% in the Temernik River basin	Flood area, ha
183 residential buildings and infrastructure entities	19,60
Industrial and public enterprises, facilities and structures (including the Northern cemetery, zoo, sanatorium «Rostovsky»)	0,02
Communication, engineering, and other facilities	26,00
Arable land, gardens, (including 254 individual residential houses in horticultural partnerships)	314,20
<b>Total:</b>	<b>359,2</b>

*Table 2. The list of objects of possible flooding during floods*



According to the MGO „Department of Civil Defense and Emergency Management“ of the city of Rostov-on-Don, from September 2014 to the present there have been 5 cases of flooding of established city regions along the Temernik River waterway and Bezymyanaya stream as a result of heavy rainfall<sup>18</sup>.

Nº п/п	Date	Adress	Notes
1	08.09.2014	GNP Avangard	The Temernik riverbed
2	08.09.2014	GP Neftyanik	The Temernik riverbed
3	08.09.2014	Private housekeeping, Uzbekskaya ave. 29, st Gurevskaya 4	The Bezymayanaya stream riverbed
4	15.02.2015	Private housekeeping, Starocherkasky ave. 1	The Bezymayanaya stream riverbed
5	19,21,28.06 2015	Private housekeeping, st Vodnikov 5, 14, 18, 16, st Selskaya59	The Bezymayanaya stream riverbed

**Table 3. Facilities at risk of flooding during the heavy rainfall**

#### 4.3.2. FLOODING AS A RESULT OF TECHNOGENIC FACTORS

According to the official data, currently there are located 48 hydraulic structures (ponds)<sup>19</sup> and 23 bridges cross the Temernik River<sup>20</sup>.

An examination of some of these structures was performed by FSBI RusRIPLR within the scope of the Terms of Reference issued by the Ministry of Natural Resources and Ecology of the Rostov Region for designing "Preparation of project documentation for: "Ecological rehabilitation of the Temernik River from its source to the Lower Reservoir". A wide range of problems has been identified in technical condition, maintenance, property and actual capacity of the 4 examined pond retaining structures and 11 bridge crossings with culverts. According to the results of the analysis, it was concluded that most of them (except for 2 bridges) classified as partially working with a **negative**

Region

18 Letter to the Director of the Department for the Prevention and Elimination of Emergencies of the Rostov Region S.P. Panov, signed by the head of the department A.Yu. Khvostov "On the provision of information" dated 09.09.2015.

19 According to OJSC "Rostov Vodokanalproekt" «Justification for maintaining the ecological balance of the river. Temernik after its clearing within the city limits», 2002

20 TECHNICAL REPORT of the Federal State Budget Scientific Institution «RusRIPLR» on engineering and environmental surveys on the site: «Survey and calculation of the throughput of the Temernik River bed in the area from the source (47°23'31,47" NL; 39°44'0,96 "VD) to the Lower Reservoir (47°16 ' 19.44 "NL; 30°42'10.49" ID) "Novocherkassk 2015



## **prognosis for the further progression into an inoperative or emergency condition<sup>21</sup>.**

According to the results of the examination, the institute performed a hydrodynamic digital computer modeling taking into account the hydraulic structures available on the examined section of the Temernik River with the prediction of possible scenarios of hydrodynamic accidents at ponds and cascades of ponds.

Based on the analysis of the obtained model, they established the followings in the case of 1%, 5%, 10%, 25% chance of drainage increase:

- the maximum water levels and flow rates in the Temernik riverbed and adjacent branches;
- retaining hydraulic structures on which a breakthrough occurs (due to excess of the water level above the dam crest);
- structures that impede the movement of the flow and create a backwater level;
- the boundaries of floodplain territory in case of maximum flow rate during freshets of 1%, 5%, 10%, 25% chance of drainage increase.

According to the simulation data, the total area of the flooded area can range from 0.7 to 2.77 km<sup>2</sup>, the flooding of which will have a particularly negative impact on the area of the Northern cemetery, and two summer cottage zones in the city. The maximum rise in water level may vary from 1.7 m (the area of the Northern Cemetery) to 3.79 m (the cottage zones PC 20412).

It is important to note that the examined area covers only part of the river basin and the above calculations do not consider the data from the left tributary – branch of the Temernik River, which is also rich for hydraulic structures. Their technical condition and capacity are also associated with obvious risks.

There is also a piece of information about a significant number of unauthorized ponds and crossings over the river branches, streams, and ravines that form the upper reaches of the basin in Myasnikovsky and Aksai districts.

---

<sup>21</sup> TECHNICAL REPORT to the Federal State Budget Scientific Institution « RusRIPLR » justification and lists of activities that must be carried out in the channel of the Temernik River for environmental rehabilitation and accident-free passage of flood waters, Novochoerkassk 2015



*Photo 6. Organization of a crossing for cars in the area of the Malaya Kamyshevakha tributary*

Thus, without detracting the importance of the studies performed<sup>22</sup>, we can conclude that there is no general information about the risks of flooding associated with the technical condition and actual capacity of all (including unauthorized) hydraulic structures and bridges located in the Temernik river basin.

---

<sup>22</sup> In this case, the studies were carried out to justify technical solutions related to the design of a culvert, to eliminate the risks of flooding and the negative impact on the ecological system of the river in the territory of the Northern cemetery, located in the protected area of the Temernik river.



#### 4.4. RISK OF UNDERGROUND WATER LEVEL ELEVATION AND GROUND SUBSIDENCE

Ground subsidence belongs to the group of natural and technogenic geological processes that inevitably accompany urbanization processes. They negatively affect the conditions of human life through deformations and complications in the operation of buildings and engineering structures, in addition, they decrease the quality of the resource of the geological environment.

Ground subsidence can be classified as natural, occurring during natural moistening and man-made, arising as a result of human activities. The latter is associated with the leaks from plumbing, intensive watering of parks, gardens and vegetable gardens, construction of reservoirs, irrigation systems, violation of the evaporation regime and moisture migration under shielding. These listed reasons can act both independently and at different combinations. Soaking can be various durations and local or cover a wide area. Short-term local soaking extends only to the upper part of the subsidence thickness, while long-term soaking extends to the entire subsidence thickness.

The transformation of the natural topography of the urban territory, in combination with changes of the soil and vegetation cover, alters the system of surface and underground drains, enhances the processes of infiltration, raises the groundwater level and floods the established city zones.

The main anthropogenic impact is associated with the transmission of static and dynamic pressure to the ground from buildings and structures of the city.

Groundwater receives additional nourishment due to an increase in infiltration of atmospheric precipitations through anthropogenic disturbances of the Temernik river basin, whose ability to divert meltwater and rainwater into the Don River was significantly limited.

The first signs of the flooding were recorded in the 30s of the XX century on the territory of Proletarsky and Pervomaisky districts of the city of Rostov-on-Don. The groundwater level observation system created established in 1938, gave an opportunity to trace the long-term dynamics of this process, even though it existed for only two years.



The results of monitoring of regular observations in subsequent years allowed to identify city areas that are most susceptible to flooding (shown in the table below).

Observation point	Observation years				Total raise, m
	1930-1938	1960-1964	1972	1998	
Bank	17,5	-	7,7	6,75	10,75
"Rostov" cinema	11,35	6,6	6,4	3,0	8,35
"Intursit" hotel	18,0	-	4,6	3,0	15,0
Theater of M. Gorkiy	17,5	1,2-2,5	1,9-2,5	-	15,0
Temernik River watershed (working area)	29,6	-	22,3	11,0	18,6
Temernik River watershed (bakery)	15	-	9,6	2,8	12,2

**Table 4. Dynamics of the groundwater level in distinct urban areas in 1930-1998.**

Flooding of the territories contributes to the weakening of the bearing capacity of soils, the formation of landslides and waterlogging of the terrain. Buildings in the areas of historical development have especially high risks of violation due to having mostly strip foundations.

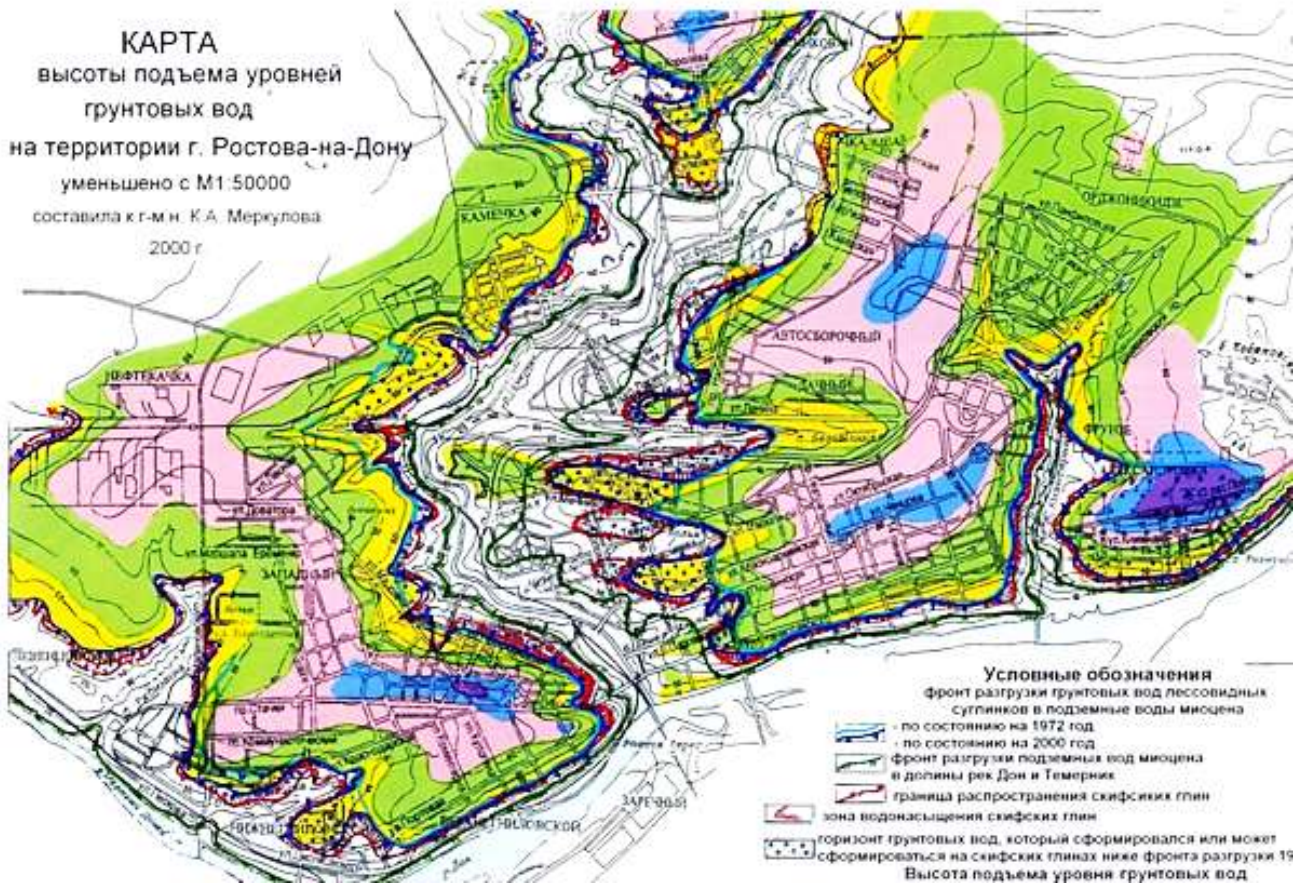
Analysis of hydrogeological materials (1972-2000) indicates that the anthropogenic pressure on the environment is increasing. On the hydrogeological map of the city (Scheme 4), made by professor and geologist K.A. Merkulova<sup>23</sup>, it is clearly seen that the flooded areas with groundwater depth up to 4 meters have already accounted for half of the city. Taking into account the fact that we are not able to change the geological conditions, the main efforts of the city community should be focused on reducing the anthropogenic pressure.

In 1938, the Rostov Hydrogeological Station expressed the causes of the flooding, after which they were written in detail in the report of the Department of Engineering Geology of the Russian Institute for Strategic Studies<sup>24</sup>.

23 Merkulova K.I. Engineering and geological surveys in the Rostov-on-Don.-Rostov n / a; Publishing House of the Russian State Pedagogical University, 2006.-132 pp.

24 Ananyev V.P. Investigation of the reasons for the rise in groundwater level in the city of Rostov-on-Don. RISI, 1962.

Besides the leakage in water supply networks, one of the most important cause is the clearing and improvement of small rivers, gullies, and springs. It should be noted that natural drainage, unlike man-made, has unique properties of self-restoring of environmental systems, and does not lose its effectiveness over the years.



*Scheme 4. Map of the groundwater level elevation in the city*

Therefore, considering the obvious influence of the Temernik River's current condition on the increase of groundwater levels, it seems impossible to assess the level and extent of this influence, as well as the effectiveness of measures taken to clear the main waterway, due to lack of a constant hydrogeological monitoring of the entire river basin.





## 4.5. RISK OF WATER STAGNATION DUE TO THE ABSENCE OF CONTINUOUS NATURAL DRAINAGE

Ponds and reservoirs are the main structures regulating river watercourses, the Rostov Sea, the Verkhovy and Nizovoe are the largest among them (up to 70% of the total volume). Ensuring the water passage, they also contribute to increased water losses due to evaporation from the water bodies' surfaces. Artificially created ponds and reservoirs significantly changed the natural regime of surface and underground drainage and contributed to the reduction of the flow rate, which on the other hand led to siltation of the reservoirs and deterioration of the sanitary-hygienic regime in the river basin.

As a result, during the floods and heavy rainfall, the river is unable to wash its riverbed, which leads to siltation and shallowing. In 2002, there was an attempt to measure the water balance of the Temernik River due to the beginning of the new project. The aim of the project was to implement the measures focused on river treatment and design of an underground sewer from the zoo to the siphon's chamber on the right bank of the Don River. The establishment of the sewer was necessary to prevent the discharge of a significant amount of wastewater into the riverbed due to insufficient capacity of the sewage pumping station (SPS) "Severnaya-1". That time it was believed<sup>25</sup>, that wastewater constitutes a significant part of the watercourse and their cessation will create an irreplaceable water balance deficit that can lead to river degradation.

This belief was confirmed through a study conducted by OJSC "Rostov Vodokanalproekt"<sup>26</sup>. The Institute analyzed the water supply capabilities of water bodies, underground and artificial water sources<sup>27</sup>, and the possibility of exclusion of unorganized sewages' water volume from the river water balance. Based on that analysis they made the following conclusions: **Based on the data presented, the Temernik River's own drainage, taking into account the capturing of spring water, is so small that after the complete elimination of untreated sewage discharges the river will not be able to exist during the offseason without passage from the Rostov Sea.**

25 Bezuglova O.S., Gorbov S.N., Morozov I.V., Privalenko V.V. The soil cover of the city as an indicator of its sustainability, Ecopolis 2000: ecology and sustainable development of the city, Moscow, 2000.

26 OJSC «Rostov Vodokanalproekt» Justification for maintaining the ecological balance of the river. Temernik after its clearing within the city limits, Rostov-on-Don, 2002

27 Up to 2007, in order to maintain the water balance of the Temernik River, raw water from the Don River was supplied through the pipeline to the Rostov Sea via the so-called. «Temernitsky tract» with a water intake from the floating pumping station «Proletarka».



***According to the Yuzhgiprovdokhoz Institute, to ensure the flow of the river and life maintenance, as well as to avoid further siltation it is necessary to carry out a sanitary passage from the Rostov Sea with a flow rate of at least 3.0 m<sup>3</sup> /sec.***

The arguments and conclusions mentioned above clearly illustrate the existence of the water balance problem in the Temernik River. At the same time, the lack of special hydrogeological studies, conflicting data regarding the number and capacity of underground springs, the volumes of discharges from urban sewers<sup>28</sup>, enterprises, and households do not allow us to judge the degree and possible consequences of this problem. Moreover, as for today, we can state that the river continues to exist, despite the complete prevention of discharges from city sewers in the zoo area and the cessation of water supply to the Northern Reservoir via the "Temernitsky Trakt" since 2007.

#### **PART 4 CONCLUSION**

***1. The absence of the monitoring system for the Temernik River's ecological condition has the following consequences:***

- Undefined problems to identify the real risks associated with the river's current condition;
- It is difficult to assess the effectiveness of rehabilitation measures;
- He does not make it possible to develop a competitive program to prevent risks and minimize the associated negative impact.

***2. There was a significant number of different studies that more or less involve different sections of the river. Despite that fact, we do not have complete and reliable information about the real condition of its basin that could make helped us to diagnose the current condition and ability of river self-purification, and to determine the ways and sources long-term rehabilitation measures.***

---

<sup>28</sup> According to various sources, the volume of untreated sewage discharged into the Temernik district of the Severnaya SPS was 7 to 17 thousand cubic meters per day (O.S. Bezuglova, VP Ananiev, OJSC Rostov Vodokanal Project). At the same time, it is known for sure that the Severnaya -1 pumping station was not equipped at that time with an accounting device capable of providing objective data.



## 5. IMPLEMENTATION OF MEASURES REGARDING ENVIRONMENTAL ENHANCEMENT OF THE TEMERNIK RIVER

### 5.1. THE ROLE OF THE TEMERNIK RIVER IN ENVIRONMENTAL ENHANCEMENT PROGRAMM OF THE LOWER DON BASIN

In 2000, the Committee for Environmental Protection and Natural Resources of the Administration of the Rostov Region<sup>29</sup> develop the project "Focused Ecological Program for the Recovery of the Temernik River". The main advantage of this project was a comprehensive approach to the problem. The project laid the foundation for actual rehabilitation of the river and made it possible to identify its negative impact on the entire basin of the Lower Don, and to substantiate the risks of water supply to the cities of Azov and Taganrog.

The proposed measures partly complemented the wider range of measures to improve the Lower Don Basin carried out by the Ministry of Natural Resources of the Russian Federation in the framework of the international program of the Azov-Black Sea cooperation in the field of environmental protection (the project "Bolshoi"). The undoubted merit of the coordinator (the Regional Committee of Environmental Protection), headed by V.M. Ostroukhova, was a high level of cooperation between federal, regional and municipal departments that have authority in various areas of environmental and economic practices. Such cooperation made it possible to obtain and accumulate federal, regional, and municipal budget funds for the main areas of environmental protection programs, and then to attract a number of international investors for cooperation.

The development of the program was preceded by an in-depth analysis of available studies on contamination foci of the Don River, ranking their negative impact to prioritize measures for their localization. Studies (1998-2000) of contamination concentrations, taking into account integral toxicity, certainly indicated the two most threatening points - the mouth of the Temernik River and the place of the main outlets of urban sewage, which is 6 km downstream of the Don<sup>30</sup>.

<sup>29</sup> The committee was established in 2000. Prior to this, the city committee of the State Committee for Ecology of the Russian Federation was engaged in environmental problems of the city.

<sup>30</sup> A.M. Nikanorov, T.A. Horuzhaya, L.I. Minina, T.V. Mironova. Influence of a megalopolis on the water quality of a large river (on the example of the city of Rostov-on-Don).



**Limit values of concentration of pollutants**

CU <sup>2+</sup>	Fe <sub>общ</sub>	НПФР	SO <sub>4</sub> <sup>2-</sup>	NO <sub>2</sub>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #c8e6c9; border: 1px solid #000; margin-right: 5px;"></span> - background indicators (conditional norm)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #fff9c4; border: 1px solid #000; margin-right: 5px;"></span> - average</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #ffcdd2; border: 1px solid #000; margin-right: 5px;"></span> - above the average</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #f44336; border: 1px solid #000; margin-right: 5px;"></span> - maximum (emergency)</li> </ul>
CU <sup>2+</sup>	Fe <sub>общ</sub>	НПФР	SO <sub>4</sub> <sup>2-</sup>	NO <sub>2</sub>	
CU <sup>2+</sup>	Fe <sub>общ</sub>	НПФР	SO <sub>4</sub> <sup>2-</sup>	NO <sub>2</sub>	
CU <sup>2+</sup>	Fe <sub>общ</sub>	НПФР	SO <sub>4</sub> <sup>2-</sup>	NO <sub>2</sub>	

CU<sup>2+</sup> Fe<sub>общ</sub> НПФР SO<sub>4</sub><sup>2-</sup> NO<sub>2</sub> - compounds of copper (CU2 +), iron (Feotal), petroleum products (NPFR), sulfates (SO2-4), nitrite nitrogen (NO-2)

- assessment of toxic water pollution by chemical indicators (medium, high)

- water pollution (medium, high)



**Figure 7. Sampling locations and Threshold limit value characteristics based on 1998-2000 studies**

Therefore, the logic of the project "Bolshoi" was based on the need to implement a whole range of short-term and long-term measures to modernize and develop the urban water supply and drainage system as the main source of anthropogenic impact on the Lower Don basin.



*Photo 7. Aeration tanks of the first line sewage treatment facilities in the city of Rostov-on-Don after reconstruction*

*At the first stage, in 2000-2006*, , technical and organizational decisions related to the elimination of the most dangerous sources of pollution were implemented:

- reconstruction and modernization of the 1st line of sewage treatment facilities in the city of Rostov-on-Don was carried out, which allowed to significantly improve the quality of treatment of effluents discharged into the Don river;
- - underground gravity sewer No. 68 was built by the method of shaft sinking, which allowed eliminating direct emissions of a significant amount of untreated sewage into the Temernik River in the zoo area due to insufficient capacity of the sewage pumping station "Severnaya-1";
- the first stage of the Temernik River treatment was completed, which includes treatment of 2.017 km long riverbed in the chute part of the river, creating a landfill for sediment burial (PZDO), and constructing a biological module for cleaning the water flow coming from the untreated headwater part.



**Photo 8. A cleared and well-maintained section of the Temernik River in the vicinity of the Main Railway Station**



**Photo 9. Sewage treatment plant visit by the President of the Russian Federation V.V. Putin in the city of Rostov-on-Don in 2003**

All of the work processes of the first stage was financed from the regional budget and was carried out by the contractor "Vector-2000". Water treatment was performed mechanically with the export of the most toxic soils to the landfill; a significant part of the silt removed from the riverbed was stored nearby, in the floodplain of the river, after preliminary disinfection and covering the dumps with plant soil. The work process was complicated by the presence of household and industrial wastes in the riverbed, a large number of unauthorized storm drains were, and the discovery of unexploded ammunition left from the war period.

The successful implementation of above-mentioned measures was highly appreciated by the government. In September 2003, at a field meeting of the Presidium of the State Council of the Russian Federation held in Rostov-on-Don regarding the problems of water treatment, the interim results of the program's first phase implementation were presented.

During the visit, the head of the State Council of the Russian Federation, President of the Russian Federation Putin was familiarized with the interim results of the implementation of all environmental rehabilitation measures for the Lower Don basin. He also visited the sewage treatment facility, where a complex of modernized facilities of the first line biological treatment was commissioned shortly before. Facilities consist of four technological complexes with a total capacity of 200 thousand m<sup>3</sup>/day. The most important outcome at this



stage of reconstruction was the construction of mechanical sludge dewatering<sup>31</sup>, on the site of the manufactory and infrastructure, which allowed to sufficiently reducing the volume excessively activated sludge accumulations formed during the biological treatment process in the floodplain of the Don River<sup>32</sup>.

*At the second stage* it was planned to complete the reconstruction and modernization of sewage treatment facilities. Moreover, to create a citywide system of gravity sewers that would centralize the drainage of the northwestern part (No. 53) and the industrial and recreational zones of the left-bank (No. 62), as well as to continue treatment process of the Temernik River upstream to its source.

The most important outcome of the Big Project was a synergistic effect, expressed in obtaining large-scale state, private and international financial support for further long-term programs in the field of implementing environmental initiatives in the region:

- the project „Comprehensive program for the construction and reconstruction of water supply and drainage in the city of Rostov-on-Don and the south-west of the Rostov Region“ (2006-2021) for a total amount of 37 billion rubles with financial support from the federal, regional and municipal budgets, and private investor using World Bank loans<sup>33</sup>;
- -the project “Clean Don” with a total value of 4.3 billion rubles with the financial support from federal, regional and municipal budgets, and private investor using a grant from the Global Environmental Fund to develop a feasibility study for the reconstruction of the 2nd line sewage treatment facilities in the city of Rostov-on-Don;
- the second and third stages of the “Focused Environmental Program for the Recovery of the Temernik River” with the support from the federal and regional budgets.

---

31 The construction of the manufactory and the supply infrastructure was carried out at the expense of a World Bank loan No. 4009RU in a framework of the project «Support Project for Regional Social Infrastructure» for a total of 4.0 million USD.

32 Z.I. Akopov, B.P. Persidsky, Water canal is our destiny, Rostov-on-Don, 2001

33 A number of project components were implemented using a loan from the World Bank’s Urban Water Supply and Sanitation Project for a total of USD 25 million.

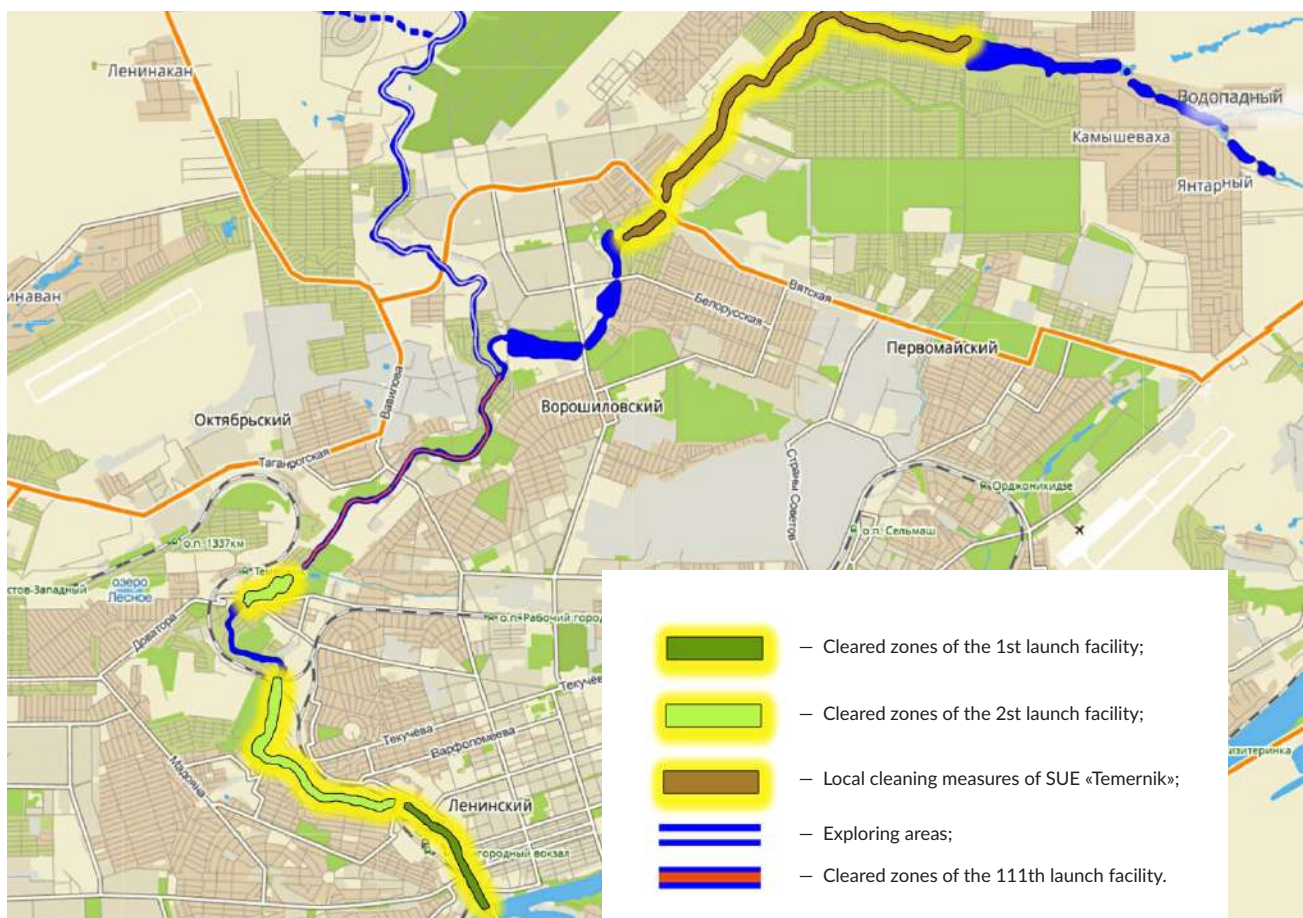


## 5.2. IMPLEMENTATION OF THE SECOND AND THE THIRD STAGES OF THE TEMERNIK RIVER TARGETED ECOLOGICAL PROGRAMM REGARDING ENVIRONMENTAL ENHANCEMENT

In 2005, "Cascade" LLC developed all necessary documentation for the 2nd launch facilities "Clearing the riverbed of the Temernik River from the end of the chute section to the SPS "Severnaya". The length of his clearing was 6 km and it was funded from the federal budget, which accounted for 2/3 of the total estimated cost of the launch facilities. The remaining funds allocated for other activities (disinfection and burial of the soil, demining the riverbed, access road, etc.) were allocated from the regional budget.

FSI "Donvodinformtsentr" was the state customer for the federal budget development in accordance with the order of the Federal Agency for Water Resources.

The Ministry of Construction, Architecture and HCS of the region was the state customer for the works financed from the regional budget. In 2006, the Ministry held competitive bidding for the entire volume of work. The winner of the contest was the company „Vector-2000».







In 2007-2009, the company has had great difficulty cleaning the 1.2 km long section and approach the border of the Botanical Garden. The complications, as with the first stage, were in unfavorable conditions that did not allow the use of high-performance equipment, the presence of a large number of unauthorized drainages (for each of which it was necessary to take either administrative or compensatory measures), and the need to transport and disinfect the removed silt sediments. In the process of clearing the lake, located in the area of the Botanical Garden, a significant amount of additional work was performed due to inaccuracies in determining the depth of siltation and the need to perform flood control measures.

In February 2010, a major technogenic accident occurred; sewer No. 68 collapsed on the st. Nansen, which resulted in contamination of the Temernik River by a significant amount of untreated sewage. This event forced customers and constructors completely stop the implementation of the second stage of the river treatment.

Despite the strategic measures, re-preservation of the Severnaya-1 pumping station, the introduction of restrictions on the supply of water to the northern regions of the city<sup>34</sup>, and the redirection of drains to other highways, direct sewage discharges into the river was terminated only after 4 months. During this time, a bypass sewer<sup>35</sup>, was built and commissioned, redirecting sewage from the Severnaya-1 pumping station to the nearest receiving chamber of the active part of underground sewer No. 68, which continued to transport sewage below the damaged part.

The issue of preventing sewage discharges into the river in the Zoo area permanently was solved only by 2015. By this time, at the expense of the investment program of the city water management department, the second (backup) line of the bypass sewage was built, and the "Severnaya-1" was reconstructed with an increase in capacity at the expense of the city budget.

In 2014, it was decided to proceed with the 2nd stage of the program. The design estimates for clearing a 7-kilometer section from the Botanical Garden to the Lower Reservoir were developed. The customer of this project phase was the Ministry of Natural Resources and Ecology of the Rostov Region.

In 2017, environmental rehabilitation of the Temernik River section from the Lower Reservoir of the Voroshilovsky District to Zarechnaya Street, with a length of 7.6 km was accomplished.

---

<sup>34</sup> Department of the city water supply management established restrictions in order to reduce the volume of emergency sewage discharges to the Temernik, due to the limited ability of city sewers to accept the whole amount of the additional volume.

<sup>35</sup> The sewer was built by the city in emergency mode.



The clearing was performed by the means of excavation and removal of bottom sediments to a special landfill in the Myasnikovsky district in order to form the main riverbed with a width of 10 to 28 m and a depth of 0.5-4.0 m.



In order to create a flow in the riverbed, measures were taken to eliminate the backwater level by taking down trees and shrubbery debris, removing hazardous trees growing near the water edge, and clearing the river from bulky objects (sunken wood, tires of trucks and cars, containers), water vegetation.

Despite the obvious positive effect of these measures, they cannot be considered sufficient, because the contract did not cover the elimination of contamination sources and the strengthening of coastlines, which had already resulted in repeated siltation of the reservoir and the need for repeated clearing of the channel.



The disposal methods of sludge deposits are controversial due to being chosen just on the deliberate assumption of their toxicity, not confirmed by objective data, raise questions. Meanwhile, selective studies of stored sediments, performed at the initiative of the Myasnikovsky District Administration, did not reveal significant deviations in the maximum permissible concentration of harmful substances. This means that there is a possibility of depositing a significant part of the sludge removed from the reservoir within the coastlines or using them to form soil of parks and lawns in the city. Anyway, the inclusion chemical composition analysis of silt sediments and soil coverings to the general environmental monitoring system is a necessary element to achieve optimal design decisions related to the cleaning of the reservoir.

In April 2019, the Ministry of Natural Resources selected a contractor to perform the next stage of the river clearing - from the source to the lower reservoir. However, the winner of the contract CJSC "SMU-DONAERODORSTROY" cannot yet begin to proceed with the work due to the obstacles associated with the presence of numerous crossings over the riverbed, unowned hydraulic structures and inaccurate information about other facilities.

From the perspective of achieving the long-term goals of the project related to the organization of ecological linear park, it is obvious that the final clearing of the riverbed can be done only after the huge amount of work directed to identification and complete elimination of pollution sources. Meanwhile, the clearing process should be performed in combination with shoreline protection and vertical planning, consistent with the architectural and landscape concept of park areas.

As part of the third stage of the river rehabilitation program, the Ministry of Natural Resources and Ecology of the region initiated exploration works of the watercourse from the Upper to the Lower Reservoir.

The purpose of the task is to perform an analysis of the ecological condition and throughput of the riverbed of Temernik. It includes development and justification of measures for accident-free passage of the snow and rain floods for the subsequent development of project documentation for the ecological rehabilitation of the Temernik River starting from the source to the Lower Reservoir. In essence, this task was the first attempt to organize a comprehensive study of a significant portion of the river basin, including an analysis of all archival materials, stocktaking and status assessment of the existing hydraulic structures, and engineering, chemical and hydrogeological studies with the development of the Temernik River digital model.



The most valuable outcome from the work done by FSBI RusRIPLR was the proposal "Regarding the necessity to create environmental and hydro-meteorological monitoring system of the Temernik River" (Appendix 1). This proposal was developed out of the scope of the assignment, reflecting the professional position of developers who believe that the effectiveness of measures taken for river rehabilitation directly depends on the level of awareness of the city community about the river activity in the conditions of civilizational pressure of the metropolis.

### 5.3. EXPERT EVALUATION OF THE ONGOING WORK

Clearly, the measures that have been taken and measures that are being implemented currently to clear the Temernik riverbed from bottom sediments help to reduce the risk of environmental contamination of the Don River and extensive city areas. In a meantime, these measures barely can be called as rehabilitation, since it mostly focused on reducing the rate of deterioration of isolated sections of the river and localizing the processes that have a negative impact on the urban environment, instead of restoring the natural potential of the river basin.

There is no access to the information on assessing the effectiveness of the measures taken on the first launch facilities. It was expected due to the absence of a system and indicators of environmental monitoring that would allow comparing objective data about the condition of isolated sections of the river before and after the work is done. Results of a number of studies show a decrease in the level of toxicity in the reservoir at places where river treatment and bottom sediments removal were performed. However, no studies performed at different points of the river and at different periods can provide a complete picture of the biological condition of the entire river system, therefore it is not possible to track dynamics and duration of positive or negative changes associated with it.

In 2008, the quality of performed measures regarding riverbed treatment became the subject of non-governmental inspection, performed by a public organization with the involvement of scientists and students of SFU<sup>36</sup>.

---

<sup>36</sup> Report on «Inspection of the site of the Botanical Garden of SFU, which was damaged during the cleaning of the Temernik River ...», contractor company «Ekomost», customer of ANO «Biosphere»..



The initiator, ANO „Biosphere“, claimed that the work carried out to remove silty sediments caused ecological damage to the green plantings of the Botanical Garden (an area of 9 ha), which has the status of a specially protected natural area of federal significance. According to the experts' opinion, it was a result of project design miscalculations and lack of control from the customer's site over the contractor's work quality and methods used.

There is also a conclusion about this project done by an expert, Privalenko V.V., who is a leading researcher at the Southern Scientific Center of the RAS, professor at the Department of Botany at the School of Biological Sciences of SFU, Doctor of Biological Sciences, candidate of geological and mineralogical sciences. He pointed out that the project design lacks any comprehensive evaluation of influence to the environment, questions the ways the riverbed was cleared, also he mentioned about miscalculations and limitations during the process of floodplain landscapes enhancement. He concludes the following: *... a significant improvement of the Temernik valley ecological condition is possible only after a full impact assessment of the project on the environment, taking into account all the negative factors of household activities in the basin of this long-suffering river.*

It should be noted that the mentioned above evaluations cannot be considered as absolutely objective since they are mainly based on emotional factors and ignore the positive conclusions of state experts on the project reports about the work performed and preventing any specific actions of the authorities (and customers) to clear the river. At the same time, those expert opinions are the *only available published reports in the public domain with an assessment of the implemented measures outcome as a part of Focused comprehensive program of the Temernik River for all years of its implementation.*

Therefore, it would be fair to say that the authorities do not pay enough attention to the process of monitoring the effectiveness of the work done and to inform the public about the main outcomes and achievements in this subject.

At the same time, it seems obvious that without extensive preparatory work on elimination of all sources of anthropogenic pollution of all watercourses, branches, and streams that form the Temernik River basin, all taken measures to clear isolated areas appear to be local and relatively short-lived. Previously cleared areas are exposed to repeated pollution and siltation, which will require another round of water treatment measures in the future.



The results of a visual examination of the first cleared area (photo 10,11,12,13) clearly demonstrate a high degree of repeated silting of the reservoir, which will require clearing activities in the nearest future.



**Photo 10,11,12,13. Siltation of the first cleared section of the Temernik River from Lendvovets to the border of the Botanical Garden as of October 2015**



## CONCLUSIONS:

### **1. The implementation of the activities of the "Focused comprehensive program for the rehabilitation of the Temernik River" has positive effects in:**

- reduction of the risk of entering into the Don River of the significant amount of toxic bottom sediment that accumulated at the mouth of the Temernik River;
- river flow increase and reduction of the level of risks associated with flooding of urban areas during the heavy rainfalls and freshets;
- stimulating the processes of integrated ecological studies of the main riverbed and existing hydraulic structures in the territory of the Myasnikovsky district and the city of Rostov-on-Don;
- gaining real experience in clearing the watercourse of a small river in constrained conditions, decontamination and dewatering of silt sediments, and restoration of coastlines;
- gaining experience in the creation and functioning of the State Unitary Enterprise „Temernik“ (since 2001 - the municipal enterprise „Rostovvodstroiekspluatatsiya“), which deals with the implementation of water management measures aimed at improving the environmental and sanitary-epidemiological condition of the river.

### **2. Measures that have been implemented and those that are currently implemented allow us to acquire only local and time-limited positive effects since they do not consider a number of factors necessary to achieve long-term results associated with the launch of the natural self-cleaning processes of the Temernik River:**

- the necessity to organize an environmental monitoring system of the entire river, including the Temernik branch and its source;
- the necessity for large-scale measures to terminate unauthorized discharges of liquid and solid wastes into the river from households and enterprises in the city of Rostov-on-Don, Myasnikovsky and Aksaysy districts<sup>37</sup>;
- the necessity to improve city storm sewage system with the installation of treatment facilities at drainage points, as well as the construction of centralized household sewage in several places adjacent to the Temernik River;
- the necessity to develop a hydrodynamic model of the entire river basin;
- the necessity to restore hydraulic structures and ensure the safety of these structures, bridges with culverts;

<sup>37</sup> The clearing activities of the river were not accompanied by elimination of unorganized releases. As a result of the inspection of the cleaned area from the mouth of the river to the st. Sheboldaev, initiated by the Regional Committee for Nature Protection in May-June 2007, there were identified 59 issues on the left, and 37 on the right bank. Moreover, according to the results of laboratory and instrumental control in the area of the flourmill,



- the necessity for a complex of geological studies;
- the necessity to develop architectural and landscape models of the linear ecological park as the main reference during designing the projects and programs for clearing riverbed, streams, and tributaries of the Temernik river.

*3. The implementation of the "Ecological Enhancement Program of the Temernik River" can be considered as the first (initial) stage of a huge process focused on the actual enhancement of the entire river basin, with the goal of making a potential focal point of environmental pollution into a recreational linear park complex of a citywide significance.*

---

the TLV for petroleum products was exceeded by 58 times





## 6. INTERNATIONAL AND RUSSIAN EXPERIENCE IN ECOLOGICAL REHABILITATION OF SMALL RIVERS

The Rostov-on-Don is not the only city in the world to encounter the problem of rehabilitation of a city-forming small river. Throughout the history of humankind, people founded their settlements near rivers, and used them as a source of food and drinking water, a natural resource for the development of agriculture, water transport routes, and served as a natural barrier from enemies.

Developing large cities, in the 19th century, faced with the problems of small river pollutions, therefore, people developed the concept of urbanization based on the need to protect the cities from floods, unpleasant odors and other negative consequences of industrialization pressure. At this time, the main solutions to the problems were to straightening riverbeds of rivers, branches, and streams, putting them into canals and pipes, which resulted in the destruction of a large number of small rivers.

In the middle of the 20th century, they realized the obvious fact that the rivers should not be considered only as a potential threat to the growing population of cities. People realized that rivers can have a beneficial effect on the environment, and can be used as recreational areas.

According to the available data<sup>38</sup> that summarizes the experience of different countries, the best results are achieved when the restoration of river watercourses starts before the industrial development of a certain area. Moreover, the rehabilitation programs of small rivers are aiming not only restoring the viability of the river but also at creating new natural recreational zones on their territory, which will enhance the functionality of urbanized spaces and create aesthetic and investment attractiveness of coastal areas.

Nowadays, there are special UN and EU directives defining the principles of international water policy for large rivers, whose basins cover the territories of two or more countries. As a part of these initiatives, intercountry networks of organizations have been established in dealing with the river conservation issues<sup>39</sup>. The most famous of them are the International Rivers Network, the European Rivers Network, the World Wide Fund for Nature, the Global Water Partnership, the World Water Council, the European Center for River Restoration. These organizations function as non-governmental non-profit organizations. In addition to the development and implementation of rehabilitation programs for large rivers (Danube, Rhine, Maas, etc.),

38 YES. Kramer, M. Neruda, I.O. Tikhonova "European experience of revitalization of small rivers", journal BIOLOGY, ECOLOGY, NATURAL SCIENCE, EARTH SCIENCES, issue "2/2012

39 Marushevsky G.B. "International Experience in River Conservation: Public Participation," Wetlands International



these organizations are engaged in the publication of special reports in order to spread their experience in this area.

There are also non-governmental organizations functioning at the national level, that already have experience in successfully implementing environmental rehabilitation programs for a number of large rivers, such as the Thames, Laura, Oder, etc..

In 1990, in the big cities of the Volga region, a public auction of musicians and ecologists in defense of the Volga River "Rock of Pure Water" had started. Since the October of the same year, with the support of the regional administration, the annual inter-regional conference "Volga Days" has been held in Nizhny Novgorod. Currently, this initiative has transformed into a powerful social movement "Let's Help the River", which includes about 200 groups from all Volga regions that are constantly participating during the actions.

Since 1993, the "Let's Help the River" project has received support from a Dutch non-governmental organization, which for 3 years conducted environmental monitoring of the Volga River in the cities of seven Volga regions. Based on the results of this work, a number of projects to clear the Volga River with the involvement of the regional budget and support from Ministry of Natural Resources of the Russian Federation have been developed and are being implemented.

Almost all major cities of Russia (Moscow, Nizhny Novgorod, Samara, Perm, Novokuznetsk, etc.) to some extent are involved in the environmental rehabilitation of small rivers, while the described Rostov project is one of the largest and most significant among them.

*Unfortunately, we do not have information about any similar successful projects in Russia that has been implemented without any obvious shortcomings, in order to copy and apply to the Temernik.*

Analyzing European experience, it is suggested to pay attention to the outcome of one of the successful modern rehabilitation projects of a small river, in the scale and essence of problems similar to the rehabilitation of the Temernik River.

The Panke River, a tributary of the Spree River, flows through the territory of Berlin. Its total length is 27 km, 18 km of which flow through the city. In the 60s of the XIX century, the river condition was classified as critical.

In the scope of the federal law on the regulation of the water regime (WHG), by the end of the 20th century, large-scale governmental measures were taken in all lands of



Germany (including the former eastern territories) to eliminate unorganized discharges of wastewaters into water bodies from enterprises and households<sup>40</sup>. The Panke River rehabilitation project was launched in 2008 after stating that there were no sources of technogenic contamination along the entire river basin.

The river basin rehabilitation project consists of three stages:

1. **2008-2009** гг. – research and concept development;
2. **2010-2013** гг. – architectural planning;
3. **2014-2017** гг. – implementation.

During the process of research and concept development, it was realized that the complete restoration of the river basin to its original state is impossible. This required ranking the river sections depending on the possibility to fulfill its environmental potential. Meanwhile, a natural riverbed with sandy shores, islands for vegetation, stone blockages is restored in the countryside, as an alternative to dams. In the urbanized zone, a full range of works is carried out to clear the riverbed from bottom sediments and strengthening the coastline, with the reclamation of adjacent territories with proper designing to suit the architectural appearance of city blocks.

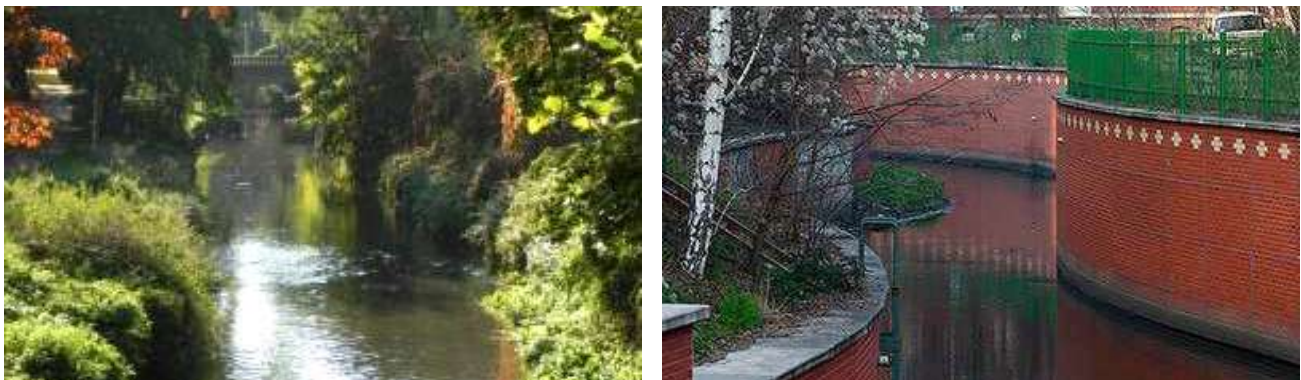
The current condition of rehabilitated areas in the countryside and cite areas are shown on photos.

---

<sup>40</sup> "The water sector in Germany. Methods and experience. « German Federal Environmental Protection Agency Umweltbundesamt, Berlin, Bonn, 2001. The webpage <http://www.umweltbundesamt.de>



**Photo 14.15. Satellite view of well-maintained sections of the Panke River in rural and urban areas**



**Photo 16.17. Landscape architecture designing of a distinct cleared sections of the river in rural and urban areas**

European experience in the rehabilitation of small rivers makes it possible to formulate the following ideological priorities in the complicated relationship between a large city and a small river:

- 1. The systematic management of the entire natural complex of the metropolis should begin with the restoration of small rivers.**
- 2. Recovery of the river's natural condition creates opportunities to use the riverside as recreational areas.**
- 3. The implementation of such projects allows us to set and effectively solve the problems of environmental education of the urban population.**

Significant experience has been gained in Europe and the USA in preserving and restoring the viability of rivers. Managers implementing rehabilitation projects for specific river basins can be interested in lessons published by the World Wide Fund for Nature (WWF)<sup>41</sup>, on integrated management based on successful projects for 14 river basins.

<sup>41</sup> WWF is the largest independent environmental organization in the world. It was created in 1961. The headquarter is located in Switzerland. Website: [www.panda.org](http://www.panda.org)



**Lesson 1.** *Sustainable results can only be achieved through an integrated approach to the development and implementation of programs, based on a clear understanding of natural, social and economic values<sup>42</sup>.* However, it should be noted that integrated river basin management would require long-term efforts and long-term financial investments. It is necessary to create dedicated management structures focused on interaction with governmental, regional, municipal authorities and other stakeholders in order to achieve a sufficient level of trust.

**Lesson 2.** *The key to the success of river basin management is the ability to ensure broad public participation, establish partnerships with all stakeholders.* The main aspects of public participation in decision-making on water management issues are informing people, public consultations, discussions and active involvement of non-governmental organizations working on environmental protection, experts and volunteers. The communication strategy of this management requires an advanced website, where most of the project documents are publicly available and feedback tools can be used.

**Lesson 3.** *The concept of river basin rehabilitation programs should agree with the priorities of socio-economic development of territories, listed in the form of territorial planning documents.* Given the fact that boundaries of river basins, as a rule, do not coincide with the city limits, the boundaries of management for ecological rehabilitation are formed within the scope of a unified protection zone, and must comply with the general plans of all affected territories, and be balanced with territorial development plans on a higher level. Commonly, the management of the basin management acts as an initiator and coordinator of such changes.

Sirsi Monteiro, the professor of the University of Pernambuco (Brazil) participated in the forum "Small rivers in big cities: the evolution of coexistence", held on the initiative of ANO "Park Temernik" in Rostov-on-Don, October 2018. There she presented an interesting practice of small ponds rehabilitation and the creation of park zones in the city of Recife. According to her, our projects are very similar, and the geoinformation model presented by the FSBI "Research and Design Institute for Land Reclamation" significantly exceeds the similar model of her local colleagues and, in her opinion, it can be used globally. Sirsi Monteiro notes that the most difficult and time-taking process is the identification and elimination of contamination sources of water bodies, which requires the organization of public support and administrative regulations. She also reported that in the city council is working on the creation of a special project management company.

<sup>42</sup> The basin approach is a fundamental principle of Russian water legislation, insufficiently implemented in practice.



*From the materials of the report of S. Monteiro at the Forum "Small Rivers in Big Cities: Evolution of Coexistence", Rostov-on-Don, October 5-6, 2018*

Summarizing the foreign and domestic experience of river rehabilitation and arrangement of coastal zones, and studying the positive and negative feedback on the practices of their implementation, ANO „Park Temernik“ came to the following conclusions:

- The effectiveness of the project can be achieved concentrating the functionality in the hands of a single structure empowered with both authority and responsibility;
- The legal status of the territory on which the project is being implemented should be optimized within the scope of possibilities provided for by the legislation, taking into account the need for its protection, preservation, and improvement.

Newsletters No. 1 and 2 of the 2017 and 2018 editions about the implementation of the project "Rehabilitation of the Temernik River with the Transformation of Coastal Territories into a Citywide Ecological Park" describe the process of searching for a model that takes into account both of these conditions.



As a result, the universal model for the project was the formation of a specially protected natural area of regional significance within the coastal zone of the Temernik River (taking into account the current legislation, the category of protected areas - "natural park"<sup>43</sup> is more suitable) and the creation of a state institution to manage the corresponding protected areas.

This approach was peer-reviewed and supported by leading Russian experts: V. Stepanitsky, Chairman of the Expert Council on Protected Areas under the Ministry of Natural Resources of the Russian Federation; Kreindlina ML, Program Manager for Protected Areas "Greenpeace"; Soboleva N.A., member of the Committee of Experts of the Council of Europe on environmental territories and ecological networks, representative of the Institute of Geography of the Russian Academy of Sciences; Volkova LB, representative of the Institute of Ecology and Evolution A.N. Severtsov RAS; Okorokova A.V. and Putrik Yu.S., doctors of sciences representing the Russian Research Institute of Cultural and Natural Heritage named after D.S. Likhachev; Mingazova N.M., an expert who participated in the implementation of a similar project in Tatarstan, doctor of biological sciences, professor of the SAEI of HPE Kazan Federal University; the staff of the NPO "Verkhovye" Environmental Fund, one of the leaders in establishing of protected areas.

---

<sup>43</sup> On [parktemernik.ru](http://parktemernik.ru) you can find electronic versions of the designated publications.



## 7. REHABILITATION STRATEGY OF THE TEMERNIK RIVER BASIN. IMPLEMENTATION SCHEDULE

### 7.1. STATEMENT OF PROJECT MISSION AND OBJECTIVES

It is obvious that the vast majority of the population of our city are interested in environmental rehabilitation of the Temernik River, regardless of age, gender, political or religious beliefs, social and material status. However, the action directed on the execution of the project will inevitably encounter resistance from households and enterprises whose activities contribute to the pollution of the river and its tributaries. Therefore, one of the main tasks of such a project is the coordination of various and partially conflicting interests. Mission development is the starting point of any management system improvement, as it allows you to determine the main goal of the project, to outline short and long-term plans.

Based on the summarized data and international experience provided in this Concept, it is proposed to formulate the mission, goal, and objectives of the project as follows:

#### Mission

*Ensure a new environmental quality through ecological rehabilitation of the Temernik river basin and transforming the point of environmental pollution into a recreational space of city-wide significance, in harmony with nature and the laws of the society development.*

#### The project goal

*Establishment of a landscape linear ecological park in the urban part of the Temernik river basin after implementation of measures to prevent further anthropogenic pollution and restore its viability.*



Generally, the hierarchy of goals and objectives is presented in the form of a "tree of goals".



Figure 9. Hierarchy of project goals and objectives



To achieve the goal, three tasks have to be solved:

**1. To conduct a complete inventory of the river basin with the aim of identifying all sources of pollution and their owners without any exceptions; study technical certification of all authorized and unauthorized hydraulic structures and bridge crossings, with the inclusion of all the information received into the geoinformation model of the Temernik River basin. Within the scope of this task, it seems appropriate to carry out a soil-ecological examination of the water surface and coastlines in the context of each cadastral section.**

At this stage, it is important to develop a project for planning and land surveying linear space. This allows to determine the boundaries and method of using coastal territories, create the citywide ecological park, and offer architectural and landscape concepts for the urban and rural parts of the Temernik river basin.

**2. Preparation of the river basin for environmental rehabilitation includes a set of measures aimed to establish and formalize the boundaries of the protected zone of the future linear park, within the scope of the territorial planning documents of all three municipalities<sup>44</sup>.**

There is a lot of work has to be done to eliminate sources of anthropogenic pollution, including compensatory and administrative measures related to households, enterprises, and organizations whose activities are accompanied by unorganized waste dumping into the river basin. A separate direction of the project will be the provision of centralized household and storm sewers for a large number of households, horticultural cooperatives, enterprises, and organizations. This kind of programs (such as the canalization program of the areas adjacent to Bezymyannaya stream) that are implemented in the river basin should be integrated into the socio-economic development programs of all three municipalities. Moreover, they should be reflected in regional and federal targeted programs, investment programs of public complex organizations and plans for integrated development of territories, as well as in relevant documents for the development of enterprises and organizations operating in the Temernik river basin and its branches.

At the same time, within the scope of solving the general problem, it is necessary to perform geological and hydro-technical investigations in order to create a hydraulic model of the Temernik River basin, based on accurate knowledge of the potential of

---

<sup>44</sup> The boundaries of the park should be reflected in the master plans for the development of the city of Rostov-on-Don, territorial development schemes of the Myasnikovsky and Aksai districts. At the same time, rural areas can offer their own concepts for using the sources of the Temernik River and stream outside the city, taking into account the restrictions established by the protection zone of the entire basin.

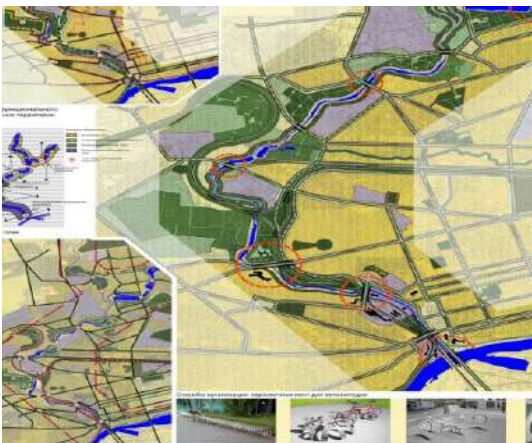
surface, underground and other water sources<sup>45</sup>, which would allow optimizing the process of hydro-technical regulation of its watercourse. Based on this model, it is necessary to modernize the entire hydraulic control system in order to eliminate the risks of flooding and technological accidents.

It is clear that the complete implementation of this task will take a lot of time. The checkpoints that will allow us to track the dynamics of positive changes in this direction, would be objective monitoring data obtained from the digital geoinformation model of the river network that is in the process.

### **3. River clearing and organization of a linear ecological park in the urban part of its basin.**

*The complete implementation of the two mentioned above tasks would make it possible to start the actual work on the rehabilitation of the river basin. Meanwhile, all the planned activities, such as clearing of bottom sediments, expanding the channels, strengthening*

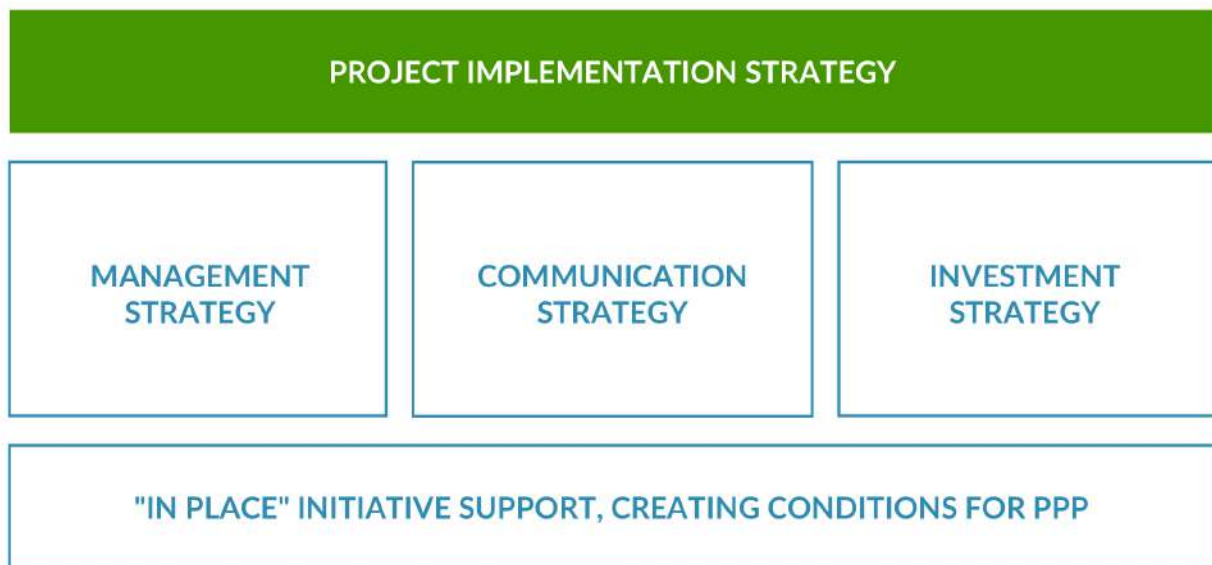
*coastlines and subsequent enhancement should be subordinated to formalized architectural and landscape concept of a linear park. A modern idea of this concept within the city is presented in the figure. In order to implement the task completely, the concept of landscape design of the Temernik River basin should also include architectural and planning solutions for countryside sections of coastlines in the Myasnikovsky and Aksai districts.*



**Figure 11. Preliminary architectural plan of the linear spaces of the main channel and tributary of the Temernik River within the city limits**

<sup>45</sup> For example, organized discharges of treated wastewater from local sewage treatment plants of the Suворovsky integrated development area

## 7.2. STRATEGIC PLAN OF THE PROJECT IMPLEMENTATION



**Management strategy** involves the delegation of functions related to the rehabilitation of the Temernik river basin and the creation of a linear park, an allocated project structure in the form of a state institution (SI). This kind of structure empowered with authority of the chief manager of budgetary funds (CMBF), will allow overcoming interdepartmental and inter-level barriers of interaction, accumulate budgetary and extra sources of financing for solving the problems of the project and solve land management issues within the established boundaries.

Taking into account the fact that the boundaries of the river basin are located in three municipalities, the river basin should be managed at the regional level by the Ministry of Natural Resources and Ecology, and all authorities related to the transformation of coastal spaces into a linear ecological park should be transferred to the SI.

To accomplish this task, two conditions must be met:

1. implementation of a coastal space planning project, which will set the boundaries of the future linear park;
2. outsourcing-based special environmental examination, which will allow the establishment of linear park as a specially protected area of regional significance in scope of the project, the legal status of which corresponds to the level of the project's objectives.



In order to implement this kind of management strategy, it was proposed to amend the law of the Rostov Region dated March 11, 2003, N 316-3C "On Protection of the Environment in the Rostov Region". The proposal suggested the inclusion of a section determining the status of the SI, as well as the procedure for concluding government contracts for the provision of services for state needs of the Rostov region for the implementation of large environmental projects. It is also necessary to determine the procedure for using mechanisms for attracting extrabudgetary investments for the implementation of rehabilitation and monitoring programs, with the possibility of using public-private partnership mechanisms.

**Communication strategy** is aimed at achieving the necessary level of trust from society.

The main directions of activities on the implementation of the communication strategy can be formulated as follows:

- formation of a solid public opinion on the need for a governmental, comprehensive, systemic, scientific and transparent approach to the issue of environmental safety in the area of the Temernik river basin.
- mass media involvement in order to popularize the issue of ensuring ecological balance in urbanized territories in general and in the city of Rostov-on-Don, in particular;
- organization of broad public debate and political agenda involving young scientists, experts, and politicians, as well as deputies of all levels;
- participation in scientific and educational activities of students and graduate students of regional universities and research organizations and encourage them to do researches;
- the formation of an informational database of scientific research and innovative ideas in the field of technological, technical and architectural planning decisions to ensure the environmental sustainability of urbanized territories and water bodies;
- construct proposals to public authorities about planning and implementation of measures aimed at ensuring environmental balance and environmental development in urban areas;
- public control of the ecological situations and organization of communities in social networks regarding the issues of the ecology of urbanized territories and



water bodies;

- organization of interregional and international cooperation and information exchange regarding issues of ensuring the ecological balance of urbanized territories and water bodies.

**Investment strategy** includes a set of measures for the formation of justifications and applications for federal support funds through state targeted programs, international loans and grants, and the organization of public-private partnership projects to attract extra-budgetary investments.

**„In place“ initiative support and creating conditions for PPP.** The “River People” is a separate group of active supporters of the project, they are business representatives and operate on coastal areas. Most of them did not wait for complex design solutions and began large-scale work on arranging coastal spaces, planting valuable tree species, laying pedestrian and bicycle paths. In cooperation with the city administration, very important work has begun on transferring of the coastal municipal areas to the “River People” for temporary long-term use in order to enhance the area. Thus, the organization of practices that can implement the principles of public-private partnership in the scope of major projects on environmental protection has begun.

## 8. PROJECT IMPLEMENTATION STATUS<sup>46</sup>

At the start of 2019, the project has already acquired significant inertia and has become almost irreversible.

There are some undoubted and visible achievements of this project:

- Construction of STP in a village Kovalevka, Aksaysky district, which started in November 2018 by LLC "Don Construction Company"
- Expected to start activities on clearing 8.5 km long portion of the river from the Suvorovsky residential complex to the Lower Reservoir, carried out by JSC "Donaerodorstroy".



<sup>46</sup> The section provides summarized data on the main achievements and challenges gained over 3 years. A detailed statement of all stages of the project implementation is given in the Newsletters published annually by ANO «Park Temernik», posted on the website «parktemernik.ru» in the section «About the project»



The State Autonomous Institution of the Rostov Region „Regional Research and Design Institute of Urban Planning“ continues to develop a project for the planning of the coastal areas of the Temernik stream with the designation of promising sites for linear park facilities, landscaping, and residential development.

The most important innovation of 2018 was the initiative to equip the “first mile” of the coastal area from the zoo to the October park, carried out by the Regional Development Corporation, which has already prepared for approval the corresponding roadmap and developed an architectural concept.

There are also partially working environmental monitoring of the river, a multilayer geoinformation model has been developed and is functioning on a voluntary basis, which allows analyzing and archiving data, including data obtained using 4 automated hydrological complexes “Emersit M35”.

In March 2019, the Government of the Rostov Region approved the regional program „Ecological Enhancement of the Temernik River Basin and the Improvement of its Coastal Area“<sup>47</sup> for 2019-2022, consisting of 13 events with a total budget of 1.57 billion rubles. (Appendix 2).

Considering that, this program is based only on activities with confirmed sources of financing, it cannot be considered as an exhaustive project document describing an integrated approach to river rehabilitation and park arrangement. The fate of the previous “Road Map”, approved in December 2017, containing 22 events, 9 of which were excluded from the work program for the coming years without any justification, remains unclear.

Unfortunately, the costs of implementing the Road Map for the establishment of the “first mile” were also not included in the regional program.

When developing this document, public proposals focused on a comprehensive environmental exploration, an inventory of pollution sources, the organization of a project management system, etc., were not taken into account.

It can be felt that the project management system is fragmented, there are several decision-making centers, and there is a lack of constant communication with the public.

---

<sup>47</sup> Decree of the Government of the Rostov Region dated March 28, 2019 No. 199 “On approval of the regional program“ Ecological rehabilitation of the Temernik river basin and the arrangement of its coastal territory”. The full text of the program is given in Appendix 2.





***Project implementation schedule.*** Given the fact that the task is complicated and multi-level, the horizon of long-term planning of measures for the implementation of the project, the actual state of work on individual components, as well as the adoption of new strategic planning documents, it is proposed to adopt the planning period<sup>48</sup>, in accordance with the development plans of the city and regions, i.e., until 2035 of the year.

In general terms, the project implementation schedule is as follows:

---

48 Strategy for socio-economic development of the Rostov region until 2030; The strategy of socio-economic development of the city of Rostov-on-Don until 2035; Strategy for socio-economic development of the Myasnikovsky district until 2030; The strategy of socio-economic development of the Aksay region until 2030.



## PROJECT IMPLEMENTATION SCHEDULE

Objectives/years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Identification and including of coastlines borders of linear park areas into the master plans for the development of the Rostov-on-Don, Myasnikovsky and Aksai sky districts until 2025	█																			
Development of the project planning regarding the main riverbed of the Temernik river		█	█																	
Plan development for the Temernik stream				█	█															
Establishment of protected areas and project management					█	█														
Stocktaking of the river basin					█	█														
Preparation of the river for rehabilitation			█	█	█	█	█	█	█	█	█	█	█	█	█	█				
Arrangement of coastal zones in scope of local enhancement project and support from "People of the river"			█	█	█	█	█	█	█	█	█	█	█	█	█	█				
River treatment and continuous linear park establishment																	█	█	█	█



The proposed sequence of actions consists of the following main stages:

**1. Initial stage (2015-2020).** Formalization of linear park zones in the territorial planning documents to specify the boundaries of an impact associated with the implementation of the project. Development of a design for the linear park of the main channel and Temernik stream (including the Rostov Sea, as well as the main tributaries).

**2. Organizational stage (2020-2021).** Formation of the legal and substantive design concept of the project management structure. Conducting a comprehensive environmental study. Establishment of a specially protected natural area (SPNA) and State Institution (SI) to manage the rehabilitation and arrangement project of the Temernik River. Amendment of regional legislation.

Work on the inventory of the river basin with the identification of all sources of pollution, examination and certification of hydraulic structures and bridges with the formation of a multilayer geoinformation system that allows real-time monitoring of the river environment and track changes associated with the implementation of individual stages.

**3. Preparatory (2022-2031).** Multifaceted, complex and conflicting work on elimination of all sources of pollution should include interconnected practical measures at all governmental, enterprises and household levels within the scope of various departmental programs. The most important part of this work will be the implementation of the program focused on the prevention of untreated stormwater discharges into the river and the streams. In the meantime, a hydraulic model of the river is being formed, on the basis of which the entire complex of hydraulic structures and bridges are being modernized. At the final stage of the preparatory phase, when the environmental monitoring data will clearly indicate the effectiveness of the measures taken, then the process of preparing specific architectural and landscape solutions for coastlines and development of design estimates for the river and park areas would start.

**4. Practical implementation phase (2023-2025).** Arrangement of park zones carried out by contractors in two stages: clearing the river from bottom sediments and garbage with the formation of a channel and coastline strengthening from the mouth of the river to the confluence with the Don River; sequential arrangement of park areas on a cleared areas, in accordance to a single architectural concept.



## 9. CONCLUSION

The proposed river basin rehabilitation project is a continuation and development of the Focused Environmental Program for the Recovery of the Temernik River, which is currently realized. The implementation of this project will allow achieving a new higher-level relationship between the urban community and the river. The task of overcoming the negative impact of the river on the city carried out in recent years, is being transformed into a strategy of integrating its basin into the architectural and landscape framework of the city as a citywide ecological park.

The project initiators realize that achieving the goal of the project is impossible without support from all governmental levels and the local society as a whole. Therefore, the main elements of the implementation strategy are openness, transparency, and professionalism at all stages of practical work.





## Appendix №1

### Regarding the necessity of the development of the ecological and hydrometeorological monitoring system of the Temernik River

(FSBSI «RusRIPLR» proposal)

Work on the "Inspection and calculation of the throughput capacity of the Temernik riverbed in the region from the source (47°23'31.47" NL; 39°44'0.96 "VD) to the Lower Reservoir (47°16'19,44" NL; 30°42'10, 49 "VD) allowed to explore the following.

Analysis of possible negative impacts of surface waters shows that during the passage of floods and freshets of rare recurrence it is possible that about 40 hectares of built-up areas of the city of Rostov-on-Don would be flooded.

An analysis of the environmental situation shows that the amount of contamination present in the bottom sediments and in the water of the Temernik River are exceeding the threshold limit value by 1.5–4 times. Continuous discharge of domestic wastewater into the river channel and low flow rates in the offseason period contribute to the accumulation of pollutants in the river bed sediments.

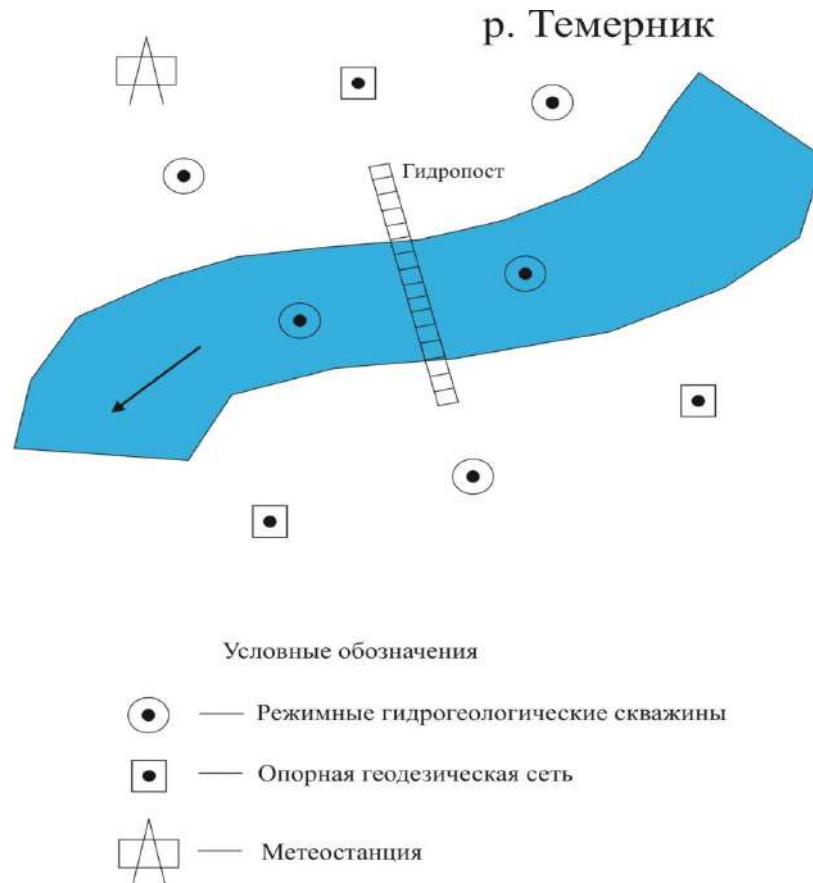
It is necessary to mention that currently, continuous monitoring of the ecological, hydrological and hydrogeological condition of the Temernik river basin is unavailable. Even though the information is currently available on some issues related to the analysis of surface run-off and determination of certain chemicals, the hydrogeological study of the river basin is at a very poor level (it should be noted that there is some experience in monitoring of hydrogeological indicators. The hydrogeological monitoring system was operating successfully in the USSR. Information on the organization and the work principles of this network is contained in the appendix).

Hydrometric observations in the Temernik river station are also not carried out due to the lack of permanent observational posts. There is no continuous monitoring of chemical indicators and geodetic control of morphometric changes in the riverbed. As a result, there is no complex understanding of the dynamics of natural and anthropogenic processes occurring in the river basin. The lack of objective scientific information reduces the effectiveness of long-term planning for the development of the territories of the city of Rostov and increases the risk of inaccurate decisions during the project work.

#### ***Environmental and hydrometeorological monitoring system elements***

Therefore, it is necessary to build a network of observation boreholes in the Temernik river stations. In addition, it is necessary to create a network of geodetic reference points linked to existing systems of rectangular and altitude coordinates. In certain sections, it is required to arrange gauging stations (at least 2) to monitor the water regime of the Temernik River (a passage, levels, and flow rate). It is also necessary to carry out water and bottom sediment sampling on a regular basis to conduct a chemical examination of contaminant concentrations.

An important requirement for the organization of a monitoring system (Figure 1) is to provide automatic control of the measured parameters and their transmission to a single server in real-time. The operation of the system will allow accumulating a significant amount of data on various monitoring indicators (groundwater levels, water levels in the channel, water discharge in the channel, data on precipitation, temperature, wind speed, and direction, etc.). The obtained data will allow us to study and analyze the actual processes of formation of subsurface and surface runoff, to determine the impacts of anthropogenic factors, and to provide hydrological and hydrogeological knowledge of the river basin. This, in turn, will allow determining directions for improving environmental safety in the Temernik River basin, to develop scientifically based measures to prevent the negative impact of water bodies, to plan and implement measures for the city of Rostov improvement.



**Figure 1. The layout of the observation network of ecological and hydrometeorological monitoring**

It is reasonable to divide the implementation of measures of system establishment into several stages:

### **Stage 1. Predesign examinations and justifications.**

At stage 1, it is necessary to analyze existing and stock materials describing the geological, hydrogeological and hydrological knowledge of the Temernik River basin. In addition, it is necessary to develop a requirement for technological and constructive decisions of system elements, justify the location and number of system elements, develop requirements for the element architecture of automated measurement and data transmission system, and develop software requirements. It is also required to develop sketch drawings and conduct trials of automation elements. Moreover, we need to develop and justify the estimated financial calculations of the project design and prospecting operations.

### **Stage 2. Design and prospecting operations.**

At stage 2, it is necessary to carry out the necessary complex of engineering prospecting and design operations that are focused on developing design estimates for the implementation of measures to establish an environmental and hydrometeorological monitoring system for the Temernik River basin, including a section of its operation.

### **Stage 3. Construction and installation work.**

At the third stage, it is necessary to implement measures to establish an environmental and hydrometeorological monitoring system for the Temernik river basin and carry out launching and adjustment work on its commissioning.



### ***Form of organization of the environmental and hydrometeorological monitoring system operation of the Temernik river basin.***

It should be noted that the expected system will require a separate organization that will operate and maintain the elements of the system, as well as carry out scientific analysis of the received data; provide methodological and metrological provision of activities; coordinate the processes with scientific, design, construction and educational institutions; develop proposals to expand the covered area and increase the efficiency of the monitoring system; accomplish the development of proposals to improve the environmental situation; participate in the development of long-term plans for social and economic development of Rostov; participate in university study programs.

Thus, it would be reasonable to discuss the necessity of establishment of an institution of ecology in Rostov with the subsequent expansion of the environmental and hydrometeorological monitoring system for all water bodies in Rostov.

### ***Organization and production of hydrogeological observations***

Until the 90s of the XX century, systematic observations of the groundwater regime were performed by the Ministry of the geology of USSR using special integrated hydrogeological observation network, which consisted of around 28 thousand observation points.

Assessment of the current condition of the groundwater regime indicates the need for its restoration and improvement.

The necessity to organize an observational network is associated with the urge to obtain baseline data on the regime and balance of groundwater. These data required to study the processes and patterns of formation of their quantity and quality in natural and disturbed conditions, to monitor changes in the environmental conditions of the territories in association with economic activity, and to forecasts of these changes.

An observational network is built and located in places with natural and anthropogenic conditions based on data about the geological structure, geomorphology, hydrology, meteorology, and hydrogeology of location, taking into account the assessment of artificial factors.

The information from the observational network should be sufficient to draw up a balance of substance and energy in specific areas, in order to identify processes and mechanisms that influence the quantitative composition of water and formation of water level patterns.

According to its purpose, the observation network can be general and special.

- General observational networks are intended for a long-term regional study of typical patterns of the formation of the groundwater regime and balance elements both in natural and in disturbed conditions over large areas.
- A special observational network is designed for the local study of the groundwater regime and balance in association with the solutions of specific problems, for example, determination of hydrogeological parameters.

For a more detailed study of local patterns of disturbed groundwater regime, boreholes of a special monitoring network are located in strict accordance with the hydrodynamic structure of groundwater flow. Their main task is studying the local disturbed regime and groundwater balance under the influence of anthropogenic factors

The specialized monitoring network includes single borehole, planned groups of a single borehole, short sections of observation wells (with distances between wells are 50, 100, 200, 300 m), experimental balance sections, gauging stations and water gauging posts on water bodies and waterways.

Observation points are can be found in all main geomorphological locations - interfluves, slopes, terraces, and riverine areas. The specific location of observation boreholes is determined by the



formation of groundwater flows and the estimation method used to interpret the results.

In order to study a one-dimensional flow, it is common practice to locate the sections along with the groundwater flow with the number of wells 2-3. In order to observe flows of considerable length, when the two-dimensional movement of groundwater is observed, it is recommended to locate the boreholes in the form of a square grid (envelope) with the number of wells in the „envelope“ - 4-5.

The stations along the way of groundwater flow located normally relatively to straight portions of the watercourses and reservoirs.

Borehole spacing in sections and "envelopes" may vary from 100 m to several kilometers, depending on the type and stability of the hydrogeological conditions and the geological section. The optimal distance between the wells is determined by the need to obtain a sufficient levels difference in the direction of groundwater flow to ensure minimal errors during the calculation of infiltration, lateral slope and hydrogeological parameters associated with an inaccuracy of measurements. Thus, in case of errors in determining the level differences of 5-10 % and accuracy of measurements  $\pm 1$  cm, the required value of level differences in neighboring boreholes should be not less than 0.2 m.

Detailed definition of parameters and peculiarities of construction of the observation network and work performance during the implementation of regime observations is laid down at the design stage





## Appendix №2

### **Decree of the Rostov Region Government regarding «Approval of regional program "Ecological enhancement of the Temernik River basin and improvement of the coastal region" of March 28, 2019 N 199 <sup>1</sup>**

GOVERNMENT OF THE ROSTOV REGIONAL

DECREE

dated March 28, 2019 N 199

On approval of the regional program „Environmental rehabilitation of the Temernik River basin and improvement of its coastal area“

In order to organize inter-municipal and interdepartmental cooperation in the scope of measures to improve the Temernik River basin and the improvement of its coastal area, the Government of the Rostov region decides:

1. To approve the regional program „Ecological rehabilitation of the Temernik river basin and improvement of its coastal area“ according to the appendix.
2. This decision shall enter into force on the date of its official publication.
3. The First Deputy Governor of Rostov Region V.G. Goncharov shall be responsible for the control over the implementation of this resolution.

Governor of  
the Rostov Region  
V. Yu. Golubev

The Decree is introduced by  
The ministry of natural resources  
and ecology of the Rostov Region

<sup>1</sup> Source:// <http://docs.cntd.ru/document/553230716>



**The appendix. The regional program „Ecological rehabilitation of the Temernik River basin and improvement of its coastal area“**

Annex to the resolution of the Government of Rostov region from 28.03.2019 N 199

**Regional Program Passport „Ecological rehabilitation of the Temernik River basin and improvement of its coastal area „**

<b>Name of the regional program</b>	The regional program «Ecological rehabilitation of the Temernik River basin and improvement of its coastal area» (hereinafter - the Program)
<b>Program Executive</b>	Ministry of Natural Resources and Ecology of the Rostov Region (hereinafter - minprirody of the Rostov Region)
<b>Program Participants</b>	the Ministry of Construction, Architecture and Territorial Development of the Rostov Region (hereinafter - the Ministry of Construction of the RR); the ministry of housing and communal services of the Rostov region (hereinafter - the ministry of HCS of the region); State Autonomous Institution of the Rostov Region «Regional Research and Design Institute of Urban Planning» (hereinafter - GAU RO «Regional Research and Design Institute of Urban Planning»); Administration of the city of Rostov-on-Don (as agreed); Administration of Aksay district (as agreed); Myasnikovsky district administration (as agreed)
<b>Program Purpose</b>	Improvement of the Temernik River water basin, creation of a continuous ecological park in the coastal zone
<b>Program Objectives</b>	ensuring the restoration and environmental rehabilitation of a water body that has lost the ability to self-purification; State monitoring of the water basin; improving the operational safety of hydraulic structures by returning them to a safe technical condition; ensuring compliance with the established regime of the Temernik River water protection zone (identification and elimination of landfill sites, unauthorized discharges of wastewater)); enhancement of the coastal area of the Temernik River with the creation of a continuous ecological park



<b>Program indicators</b>	<p>the length of the Temernik River sections where restoration and environmental remediation activities have been carried out; rehabilitated area of the water body (Temernik River); the population of the Rostov region, which has improved environmental conditions near the Temernik River; Number of constructed and reconstructed public facilities; the number of completed topographic plans of the Temernik coastal territories located in Rostov-on-Don, Myasnikovsky and Aksaysky districts; the number of developed planning projects and surveying projects of Temernik coastal territories located in Rostov-on-Don, Myasnikovsky and Aksaysky districts; number of research projects developed «Formation of a general concept of arrangement of the Temernik River coastal territories»; the number of design documents developed for the construction of treatment facilities at the outlets of the storm sewage system to water bodies; the number of constructed treatment facilities at the outlets of the storm sewage system to water bodies; number of ownerless storm systems transferred into municipal ownership; the number of operational treatment facilities at the outlets of the stormwater drainage system to water bodies as they are constructed; number of water bodies located in the Temernik River basin where monitoring of water bodies within the authority of Rostov region; number of investigated hydraulic structures in the Temernik River basin; the ratio of the number of resolved violations of environmental legislation requirements to the violations that have to be eliminated, which would be identified during the inspection of the water protection zones of the Temernik river; the number of community workdays spent on the banks of the Temernik river</p>
<b>Stages and timeframes of the Program</b>	2019 - 2022 Program implementation stages are not highlighted



<b>Resource Support Programs</b>	<p>the total amount of funding for the Program in 2019 - 2022 from all sources - RUB 1573614.1 thousand, including by year of implementation: 2019 - RUB 425516,7 thousand; 2020 - RUB 1097609,6 thousand; 2021 - RUB 23743,9 thousand; 2022 - RUB 26743,9 thousand.</p> <p>The amount of financing from the regional budget - RUB 1255131.3 thousand, including the years of implementation: 2019 - RUB 322877,8 thousand; 2020 - RUB 930765,7 thousand; 2021 - RUB 743,9 thousand; 2022 - RUB 743,9 thousand.</p> <p>The amount of financing from the federal budget - RUB 81870.0 thousand, including the years of implementation: 2019 - RUB 50000,0 thousand; 2020 - RUB 31870,0 thousand.</p> <p>The amount of financing from local budgets - RUB 236612,8 thousand, including the years of implementation: 2019 - RUB 52638,9 thousand; 2020 - RUB 134973,9 thousand; 2021 - RUB 23000,0 thousand; 2022 - RUB 26000,0 thousand</p>
<b>Expected Results of the Program</b>	<p>reduction of anthropogenic load on the water body; restoration and environmental rehabilitation of a water body; increasing the safety of the population, economic and social objects from the negative effects of water; improving the recreational potential of the water body</p>

### Description of the scope of the Program

The Temernik River is a small river flowing through the territory of the Rostov Region and is the right tributary of the Don River. The length of the river is 35.5 kilometers, of which 18 kilometers flow through the territory of the city of Rostov-on-Don. The Temernik River is a natural receiver of surface runoff from urban areas, including untreated stormwater. The average slope of the river is 2.3 %, the average channel width is 10 meters, and the depth is 0.3-1.2 meters. The total catchment area of the Temernik River is 293 km<sup>2</sup>, including 177 km<sup>2</sup> - in rural areas (Myasnikovsky and Aksaysky areas).

The main water bodies of the basin:

- the Temernik River, the source of which is located in the Myasnikovsky and Aksai districts;
- the Kamyshevakh stream (with the Verkhovyi and Lower Reservoirs and the Rostov Sea located in it) with the length of 17 km, including 5 km within the city of Rostov-on-Don;
- the Bezimyannaya stream with the length of 6.55 km (starts on the territory of the Soviet Country Square in Rostov-on-Don)).

The riverbed is subjected to significant anthropogenic load, as a result of which it is silted with long-term bottom sediments, overgrown with reeds, hornbeams, bushes, littered with solid municipal waste, large-size objects. The area adjacent to the river is swampy in many areas.

The main cause of siltation and overgrowth of the riverbed is the construction works in the area of the basin catchment. This has an impact on the hydrological parameters of water discharges in the Temernik River, and also leads to an increase in the volume of pollutants, including untreated



stormwater and other discharges from industrial and municipal facilities.

### **Objectives, indicators, main expected outcomes, terms and stages of the Program implementation**

The purpose of the Program is to improve the water basin of the Temernik River, to create a continuous ecological park in the coastal zone of the water body.

In order to achieve the objective, the following main tasks are considered:

- ensuring the restoration and environmental rehabilitation of a water body that has lost its self-purification abilities;
- state monitoring of the water body basin;
- improving the operational safety of hydraulic structures by returning them to a safe technical condition;
- ensuring compliance with the established regime of the Temernik River water protection zone (identification and elimination of landfill sites, unauthorized discharges of wastewater));
- improvement of the coastal area of the Temernik River with the creation of a continuous ecological park.

In order to solve accomplish the task „Ensuring restoration and environmental rehabilitation of a water body that has lost its ability to purify itself“ following measures need to be applied:

- cleaning of the Temernik River from the source (47°23'31,47" NL; 39°44'0,96" EL) to the Lower Reservoir (47°16'19,44" NL; 30°42'10,49" EL);
- reconstruction of the STP of Aksay in the village Kovalevka;
- development of project documentation for the construction of treatment facilities at the outlets of storm sewerage system to water bodies;
- construction of treatment facilities at the outlets of the storm sewage system to water bodies;
- complete the procedure of transferring ownerless storm systems into municipal ownership;
- running of treatment facilities at the outlets of the storm sewage system as they are constructed.

The indicators of the resolution of the problem are:

- the length of the Temernik River sections where restoration and environmental rehabilitation activities have been carried out;
- rehabilitated area of the water body (Temernik River);
- the population of the Rostov region, which has improved environmental conditions near the Temernik River;
- the number of constructed and reconstructed public facilities;
- number of developed project documentation for the construction of treatment facilities at the outlets of the storm sewerage system;
- number of treatment facilities constructed at the outlets of the storm sewerage system to water bodies;
- number of ownerless storm systems transferred into municipal ownership;
- the number of operational treatment facilities at the outlets of the stormwater drainage system to water bodies as they are constructed.



Solving the „State monitoring of the water body basin“ task requires the government to monitor water body basin, including monitoring of the bottom, shores, changes in morphometric features, the condition and use of water protection zones located in the Temernik River basin.

An indicator of the problem solution is the number of water bodies located in the basin of the Temernik River, where monitoring of water bodies within the authority of the Rostov region is carried out.

Solving the problem of „Improving the operational reliability of hydraulic structures by bringing them to a safe technical condition“, imply on implementation of measures to inspect hydraulic structures in the Temernik River basin.

An indicator of problem resolution would be the number of examined hydraulic structures of the Temernik river basin.

The solution of the task „Ensuring compliance with the established regime of the water protection zone of the Temernik River (identification and elimination of landfill sites, unauthorized wastewater discharges)“ implies the performance of the following actions:

- inspection of water protection zones of the Temernik River and its tributaries for the presence of unauthorized waste disposal sites, discharges of untreated wastewater;
- clearing the banks of the Temernik River within the scope of all-Russian actions: „Water of Russia“, „Green Russia“, as well as within the scope of actions campaign dedicated to environmental dates.

The indicators for solving the problem are:

- the ratio of the number of resolved violations of environmental legislation requirements to the violations that have to be eliminated, which would be identified during the inspection of the water protection zones of the Temernik river;
- the number of community working days spent on the banks of the Temernik river.

The solution of the task „The arrangement of the coastal territory of the Temernik River with the creation of a continuous ecological park“ involves for the following activities:

- development of topographic plans for the coastal territories of the river Temernik located in Rostov-on-Don, Myasnikovsky and Aksaysky districts;
- development of planning projects and surveying projects of the coastal territories of the Temernik River located in Rostov-on-Don, Myasnikovsky and Aksaysky districts;
- performance of research studies on the formation of a general concept for the arrangement of coastal territories of the river Temernik.

The indicators for solving the problem are:

- the number of completed topographic plans of the coastal territories of the Temernik River located in Rostov-on-Don, Myasnikovsky and Aksaysky districts;
- the number of developed planning projects and surveying projects of coastal territories Temernik located in Rostov-on-Don, Myasnikovsky and Aksaysky districts;
- the number of research projects developed on the topic of „Formation of a general concept for the arrangement of coastal territories of the Temernik River „.

Information on the indicators of the Program is presented in Appendix N 1 of this Program.

As a result of the implementation of the Program, the environmental recovery of the Temernik River basin is expected.



The current Program will be implemented in 2019 - 2022. The implementation of the program does not divide into stages.

### **Description of the Program activities**

The program will be implemented through the following activities:

1. Cleaning of the Temernik River from the source (47°23'31,47" NL; 39°44'0,96" EL) to the Lower Reservoir (47°16'19,44" NL; 30°42'10,49" EL).

The riverbed of the Temernik River is subjected to significant anthropogenic pressure, therefore contaminated with solid public waste and large objects, which affects the hydrological parameters of water runoff in the river, and also leads to an increase in the number of contaminants. The clearing of the riverbed will improve the sanitary, ecological and recreational conditions of the water body.

The program executor is minprirody of the Rostov Region.

2. Reconstruction of the STP of Aksai city in the village of Kovalevka.

Reconstruction of the STP of Aksai city in the village of Kovalevka will ensure the necessary treatment of wastewater and significantly reduce the flow of contaminants into the water body.

The executors of this program are the ministry of HCS of the region and the administration of the Aksay region.

3. Development of project documentation for the construction of treatment facilities at the outlets of the storm sewage system to water bodies.

Construction of storm sewerage outlets by means of treatment facilities through construction and installation works (including the development of design and estimate documentation) will allow to treat wastewater and stop water body pollution.

The executor of this event is the administration of Rostov-on-Don.

4. Construction of treatment facilities at the storm sewage system outlets to water bodies.

Construction of storm sewerage outlets by means of treatment facilities through construction and installation works (including the development of design and estimate documentation) will allow to treat effluents and stop water body pollution.

The executor of this event is the administration of Rostov-on-Don.

5. Accomplishing the procedure of transferring of ownerless rainwater systems into municipal ownership.

The procedure of transferring of ownerless stormwater systems into municipal ownership is necessary to maintain these facilities and providing treatment facilities for outlets at the expense of budget funds.

The executor of this event is the administration of Rostov-on-Don.

6. Operation of treatment facilities at the storm sewerage system outlets to water bodies as they are constructed.

Regular implementation of measures to ensure the operation of local treatment facilities will significantly reduce the penetration of contaminants into the water body.

The executor of this event is the administration of Rostov-on-Don.

7. Conducting governmental monitoring of the water body basin.

Monitoring of the water body will allow assessing the effectiveness of water protection and water management measures (including cleaning) and timely identify and predict the development of negative processes at the water body.



The executor of this event is the minprirody of Rostov-on-Don.

#### 8. Inspection activities of hydraulic structures in the Temernik River basin.

Implementation of this measure will allow to organize the accident-free passage of spring floods, collect information about potentially dangerous hydraulic structures, in case of an accident on which an emergency situation may arise.

The executor of this event is the minprirody of Rostov-on-Don.

9. Exploration of water protection zones of the Temernik River and its tributaries for the presence of unauthorized waste disposal sites, discharges of untreated wastewater.

Regular implementation of measures to identify and eliminate unauthorized discharges of wastewater, landfills located in the water protection zone will reduce the anthropogenic impact on the water body, preventing the entry of various contaminants, garbage, and other wastes.

The Minprirody of Rostov-on-Don is the coordinator of this event and conclude the results of performed activities.

10. Temernik Riverbank clearing measures as part of the All-Russian actions: "Water of Russia", "Green Russia", as well as part of actions dedicated to environmental dates.

Implementation of the measure will require sanitary cleaning of the banks of the Temernik River in Rostov-on-Don, Myasnikovsky and Aksai districts, as well as the involvement of the general public in environmental protection activities.

The Minprirody of Rostov-on-Don is the coordinator of this event and conclude the results of performed activities.

11. Development of topographic plans for the coastal territories of the Temernik River located in Rostov-on-Don, Myasnikovsky and Aksaysky districts.

Development of a topographic plan is an integral part of any construction or improvement in a certain area. The topographic plan shall reflect all significant relief elements, natural and artificial, with an indication of their characteristics - height or depth, exact coordinates, as well as technical data.

The executor of this event is the ministry of construction of the RR.

12. Development of the project of planning and surveying of coastal areas of the Temernik River, located in Rostov-on-Don, Myasnikovsky and Aksai districts.

The development of the planning and surveying project will ensure the sustainable development of the coastal areas of the Temernik River and the establishment of parameters for its development. Establishing the boundaries of the public area along the coastlines will help with the development project, and will also determine the planning possibility of creating a continuous linear park within the boundaries of the coastlines.

The executor of this event is the ministry of construction of the RR.

13. Research study on „Formation of a general concept for the arrangement of coastal territories of the Temernik „.

Implementation of this measure will allow forming the concept of transformation of the existing coastal space on the basis of existing priorities of architectural and of the landscape components interaction and will ensure the effective use of coastal areas of the river Temernik.

The executor of this event is the ministry of construction of the RR.

The list of activities of the regional program „Ecological rehabilitation of the Temernik River basin and improvement of its coastal area“ is presented in Appendix N 2 of this program.





## **Program Resource Information**

The sources of Program funding are federal, regional and local budgets.

Financial support of the Program activities at the expense of the federal and regional budgets is carried out within the scope of the state program of the Rostov region „Environment protection and rational use of natural resources“, approved by the resolution of the Rostov Region Government from 15.10.2018 N 638, the state program of the Rostov region „Territorial planning and provision of affordable and comfortable housing for the population of the Rostov region“, approved by the resolution of the Rostov region Government from 17.10.2018 N 642, the state program of the Rostov region „Provision of quality housing and public services to the population of the Rostov region“ approved by the resolution of the Rostov region Government from 17.10.2018 N 650.

Local budget funds are reflected in the Program after they have been included by local self-government bodies of municipal entities in the relevant municipal programs. Financial support for the Program's activities from local budgets is provided under the following municipal programs:

- The municipal program „Development and Operation of Transport Infrastructure and Passenger Transport in Rostov-on-Don“ approved by the resolution of the Administration of Rostov-on-Don dated 28.12.2018 N 1376;
- The municipal program „Provision of quality housing and communal services to the population of Aksai district“ approved by the resolution of the administration of Aksai district dated 29.12.2018 N 882;
- The municipal program „Environmental protection and rational use of natural resources“ approved by the resolution of the administration of Myasnikovsky district dated 29.12.2018 N 1629.

It is planned to use funds from the federal budget within the scope of the federal project „Preservation of unique water bodies“, the national project „Ecology“, the subprogram „Use of water resources“, the state program of the Russian Federation „Reproduction and use of natural resources“, approved by the Resolution of the Government of the Russian Federation of 15.04.2014 N 322.

## **Project implementation mechanism**

The minprirody of the Rostov region together with the Ministry of Construction of the RR and the Ministry of HCS of the RR manage the Program within their competence and are responsible for its implementation, outcomes, rational use of funds allocated for the of the Program, and for they also determine the forms and methods of the Program management.

The minprirody Rostov region together with the Ministry of Construction of the RR and the Ministry of HCS of the RR during the implementation of the Program:

- plan, organize and control the implementation of the Programme;
- submit to the Government of the Rostov region draft legal acts that are necessary for the Program implementation;
- within the limits of their authority to develop and adopt the normative legal acts necessary for the implementation of the Program;
- submit proposals to the Rostov Region Government on adjustment and extension of the Program implementation period or early termination of its implementation (if necessary), as well as proposals on the specification of indicators and costs of the Program implementation, on the improvement of the Program implementation mechanism.



Executors of the Program activities take personal responsibility for the implementation and use of financial resources allocated for this project.

The minprirody of the Rostov Region publishes information about the implementation of the Program for the fiscal year in the newsletter dedicated to the environmental issues of the Don „On the state of the environment and natural resources of the Rostov region„.

#### Notes.

List of abbreviations used:  
STP - sewage treatment plant.

Head of Documentation  
Management Department of  
the Rostov Region Government

Rodionchenko T.A.



## Appendix N 1. Information on the indicators of the regional program „Ecological rehabilitation of the Temernik river basin and the arrangement of its coastal territory,,

### Appendix N 1 to the regional program „Environmental Rehabilitation of the Temerniki river basin and arrangement of its coastal territory

N	Number and name of the indicator	Unit of measurement	Indicator value			
			2019	2020	2021	2022
1	Length of the Temernik River sections where restoration and environmental rehabilitation activities were carried out	km	4,3	4,2	-	-
2	Area of the restored water body (Temernik riv.)	ha	4,5	7,2	7,2	7,2
3	Population of the Rostov region that has improved environmental conditions near the Temernik River	individuals	30000	30000	30000	30000
4	Number of constructed and reconstructed public facilities	units	-	1	-	-
5	Number of developed design documentation for the construction of treatment facilities at the storm sewerage system outlets to water bodies	units	2	2	2	2
6	Number of treatment facilities constructed at the outlets from the storm sewerage system to water bodies	units	2	2	2	2
7	Number of ownerless storm systems transferred into municipal ownership	units	36	-	-	-
8	Number of operated treatment facilities at from the storm sewerage system outlets to water bodies as they are constructed	units	4	6	8	10
9	Number of water bodies located in the Temernik River basin where monitoring of water bodies is carried out within the authority of Rostov region	units	3	3	3	3
10	Number of investigated hydraulic structures in the Temernik River basin	units	10	10	10	10



11	The ratio of the number of resolved violations of environmental legislation requirements to the violations that have to be eliminated, which would be identified during the inspection of the water protection zones of the Temernik river	percent	70	70	70	70
12	Number of community work days held on the banks of the Temernik River	units	8	8	8	8
13	A number of completed topographic plans for the coastal areas of the river. Temernik, located in Rostov-on-Don, Myasnikovsky and Aksai districts	units	1	-	-	-
14	A number of developed planning and surveying projects for coastal areas of the riv. Temernik, located in Rostov-on-Don, Myasnikovsky and Aksai districts	units	1	-	-	-
15	A number of developed research studies on «Formation of the general concept of coastal areas development of the riv. Temernik»	units	1	-	-	-

#### Notes.

List of used abbreviations:

riv. - river.



**Appendix N 2. List of activities of the regional program „Environmental rehabilitation of the Temernik River basin and improvement of its coastal are,,**

Appendix 2 to the regional program  
„Environmental rehabilitation of the Temernik River basin  
and the improvement of its coastal area“

Name of the event	Executor	Source of financing	Expenses, total (RUB thousand)	Including by year of implementation (RUB thousand)			
				2019	2020	2021	2022
The regional program «Environmental rehabilitation of the Temernik River basin and improvement of its coastal area	Minprirody of the RR; Ministry of construction of the RR; Ministry of HCS of the RR; GAU of RR « Regional Research and Design Institute of Urban Development;»; Administration of Rostov-on-Don city; Aksai district administration, Administration of the Myasnikovskiy Region	total	1573614,1	425516,7	1097609,6	23743,9	26743,9
		regional budget	1255131,3	322877,8	930765,7	743,9	743,9
		federal budget	81870,0	50000,0	31870,0	-	-
		local budget	236612,8	52638,9	134973,9	23000,0	26000,0
Events 1. Clearing of the Temernik River from the source (47°23'31,47» NL; 39°44'0,96» EL) to the Lower Reservoir (47°16'19,44» NL; 30°42'10,49» EL)	Minprirody of the RR	total	397561,8	153840,4	243721,4	-	-



		regional budget	315691,8	103840,4	211851,4	-	-
		federal budget	81870,0	50000,0	31870,0	-	-
		local budget	-	-	-	-	-
Event 2. Reconstruction of the STP in Aksai in the village of Kovalevka	Ministry of HCS of the RR; Aksai district administration	total	1070736,9	237592,6	833144,3	-	-
		regional budget	920124,1	201953,7	718170,4	-	-
		federal budget	-	-	-	-	-
		local budget	150612,8	35638,9	114973,9	-	-
Event 3. Development of design documentation for the construction of treatment facilities at the storm sewerage system outlets to water bodies	Administration of Rostov-on-Don city	total	20000,0	5000,0	5000,0	5000,0	5000,0
		regional budget	-	-	-	-	-
		federal budget	-	-	-	-	-
		local budget	20000,0	5000,0	5000,0	5000,0	5000,0
Event 4. Construction of treatment facilities at storm sewerage system outlets to water bodies	Administration of Rostov-on-Don city	total	24000,0	6000,0	6000,0	6000,0	6000,0
		regional budget	-	-	-	-	-
		federal budget	-	-	-	-	-
		local budget	24000,0	6000,0	6000,0	6000,0	6000,0



Event 5. Carrying out the procedure ownerless rainwater systems transferring into municipal ownership	Administration of Rostov-on-Don city	не требует финансирования					
Event 6. Operation of treatment facilities at storm sewerage system outlets to water bodies as they are constructed	Administration of Rostov-on-Don city	total	42000,0	6000,0	9000,0	12000,0	15000,0
		regional budget	-	-	-	-	-
		federal budget	-	-	-	-	-
		local budget	42000,0	6000,0	9000,0	12000,0	15000,0
Event 7. Conducting governmental monitoring of the water body basin	Minprirody of the RR	total	2975,6	743,9	743,9	743,9	743,9
		regional budget	2975,6	743,9	743,9	743,9	743,9
		federal budget	-	-	-	-	-
		local budget	-	-	-	-	-
Event 8. Inspection of hydraulic structures in the Temernik River basin	Minprirody of the RR	No need for funding					



<p>Event 9. Exploration of water protection zones of the Temernik River and its tributaries for the presence of unauthorized waste disposal sites, discharges of untreated wastewater</p>	<p>Minprirody of the RR; Administration of the city of Rostov-on-Don; Administration of the Aksai Region; Administration of the Myasnikovskiy Region</p>	<p>No need for funding</p>					
<p>Event 10. Clearing Measures of the Temernik Riverbanks as part of the all-Russian actions: "Water of Russia", "Green Russia", as well as part of actions dedicated to environmental dates</p>	<p>Minprirody of the RR; Ministry of HCS of the RR; Administration of Rostov-on-Don city; Administration of the Aksai Region; Administration of the Myasnikovskiy Region</p>	<p>No need for funding</p>					
<p>Event 11. Development of topographic plans for the coastal territories of the riv. Temernik located in Rostov-on-Don, Myasnikovsky and Aksaysky districts</p>	<p>Ministry of construction of the RR</p>	<p>total</p>	<p>4200,0</p>	<p>4200,0</p>	<p>-</p>	<p>-</p>	<p>-</p>
		<p>regional budget</p>	<p>4200,0</p>	<p>4200,0</p>	<p>-</p>	<p>-</p>	<p>-</p>
		<p>federal budget</p>	<p>-</p>	<p>-</p>	<p>-</p>	<p>-</p>	<p>-</p>
		<p>local budget</p>	<p>-</p>	<p>-</p>	<p>-</p>	<p>-</p>	<p>-</p>





Event 12. Development of the project of planning and surveying of coastal areas of the riv. Temernik, located in Rostov-on-Don, Myasnikovsky and Aksai districts	Ministry of construction of the RR; GAU of RR «Regional Research and Design Institute of Urban Planning»	total	3122,5	3122,5	9000,0	12000,0	15000,0
		regional budget	3122,5	3122,5	-	-	-
		federal budget	-	-	-	-	-
		local budget	-	-	-	-	-
Event 13. Performing the research study on «Formation of the general concept of the coastal areas development of the riv. Temernik»	Ministry of construction of the RR; GAU of RR «Regional Research and Design Institute of Urban Planning»	total	9017,3	9017,3	-	-	-
		regional budget	9017,3	9017,3	-	-	-
		federal budget	-	-	-	-	-
		local budget	-	-	-	-	-

**Примечание.**

1. Local self-government bodies participate in the following coordination activities as agreed.

2. List of used abbreviations:

riv. - river;

GAU of RR „Regional Research and Design Institute of Urban Planning“- State Autonomous Institution of the Rostov Region „Regional Research and Design Institute of Urban Planning“;

Minprirody of the RR - Ministry of Natural Resources and Ecology of the Rostov Region;

Ministry of construction of the RR - Ministry of Construction, Architecture and Territorial Development of the Rostov Region;

Ministry of HCS of the RR - Ministry of Housing and Communal Services of the Rostov Region;

STP - sewage treatment plant.



## Appendix № 3

### Founders of ANO «Temernik Park»



Шнейдер С.Б.



Бритвин Н.Н.



Погребзиков Ю.Б.



Глотов С.А.



Стрельченко А.С.



Лазуренко В.Н.



Баштавая М.М.



Елева В.В.



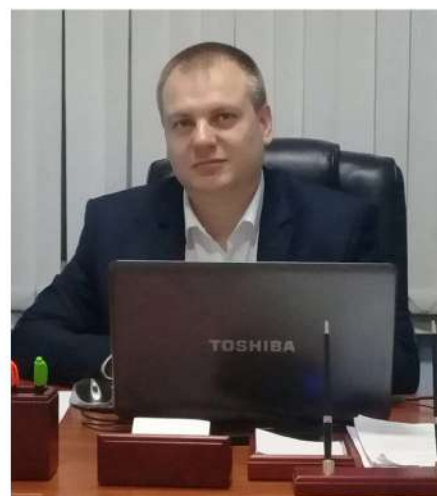
Шустов Е.А.



Наумов Г.Е.



Анисимов А.Н.



Тарасов А.В.



Анопченко Т.Ю.



Королев В.С.



Замиховский С.В.



Векленко М.Г.



Гейер В.А.



Горбов С.Н.



## Appendix № 4

### Honorary members of ANO «Temernik Park»



Месхи Б.Ч.



Скрябин А.Ю.



Потеряхин А.В.



Полянский А.Э.



Курочкин Д.Н.



Беспалов В.И.



Острохова В.М.



Сенчуков Г.А.



Морозова Т.Г.



## **Dear Readers!**

*For more detailed information about the Temernik River rehabilitation project with the transformation of coastal areas into a city-wide ecological park " is invited to visit the official website of ANO " Park Temernik " – [parktemernik.ru](http://parktemernik.ru).*

*On this webpage you will find information about the project, the progress of its implementation, you can download the project concept and all published newsletters. You can also read the latest news and find relevant official documents.*

*We are open to communication and cooperation with constructive people. You can contact us by phone +7 (863) 268 76 23, +7 (918) 529 24 84 and e-mail [sustdevel@gmail.com](mailto:sustdevel@gmail.com) and [sbs@tppro.ru](mailto:sbs@tppro.ru).*



Representatives of ANO «Park Temernik» from left to right: Strelchenko A. S., Lazurenko V.N., Bashtavaya M.M., Schneider S.B., Britvin N.N., Eleva V.V., Pogrebschikov Yu.B.

**344022, Rostov-on-Don, Kirovsky ave 40A, office 305**



**PARKTEMERNIK.RU**  
**2019**