

Surface wastewater in Samara and their impact on water basins as water supply sources

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Abstract. The paper gives an overview of surface wastewater outlets in Samara through the rainwater sewer system into the Saratov water reservoir and the Samara river. The rainwater sewer system in Samara is designed and executed according to a separate scheme, except for the old part of the city, where surface run-off is dumped into the sewer system through siphoned drain. The rainwater system disposes of surface, drainage, industrial clean-contaminated waters, emergency and technology discharges from the city's heat supply and water supply systems. The effluent discharge is carried out by means of separate wastewater outlets into ravines or directly into the Samara river and the Saratov water reservoir without cleaning. The effluent discharge is carried out through the rainwater sewer system with 17 wastewater outlets into the Saratov water reservoir. In the Samara river, surface runoff drainage and clean-contaminated water of industrial enterprises is carried out through 14 wastewater outlets. This study emphasizes the demand to arrange effluent discharge and construction of sewage treatment plants to prevent contamination of water objects by surface run-off from residential areas and industrial territories. Key words: surface waste water, rainwater drainage, sewage treatment facilities.

1. Introduction

Surface wastewater in Samara flows through the rainwater sewer system [1-15] and is transferred into the Saratov water reservoir and the Samara river (see Figure 1).

The rainwater sewer system in Samara is designed and executed according to a separate scheme, except for the old part of the city (Frunze, Kuibyshev, Leningradskaya, Ventseka, Pionerskaya, Leo Tolstoy, Nekrasovskaya streets), where surface run-off is dumped into the sewer system through siphoned drain.

The rainwater system disposes of surface, drainage, industrial clean-contaminated waters, emergency and technology discharges from the city's heat supply and water supply systems.

The effluent discharge is carried out by means of separate wastewater outlets into ravines or directly into the Samara river and the Saratov water reservoir without cleaning.

Depending on the topography of the terrain, Samara is divided into 15 sewerage basins to collect and divert surface run-off from the territory of the city. The effluent discharge is carried out through the rainwater sewer system with 17 wastewater outlets into the Saratov water reservoir. In the Samara river, surface runoff drainage and clean-contaminated water of industrial enterprises is carried out through 14 wastewater outlets.



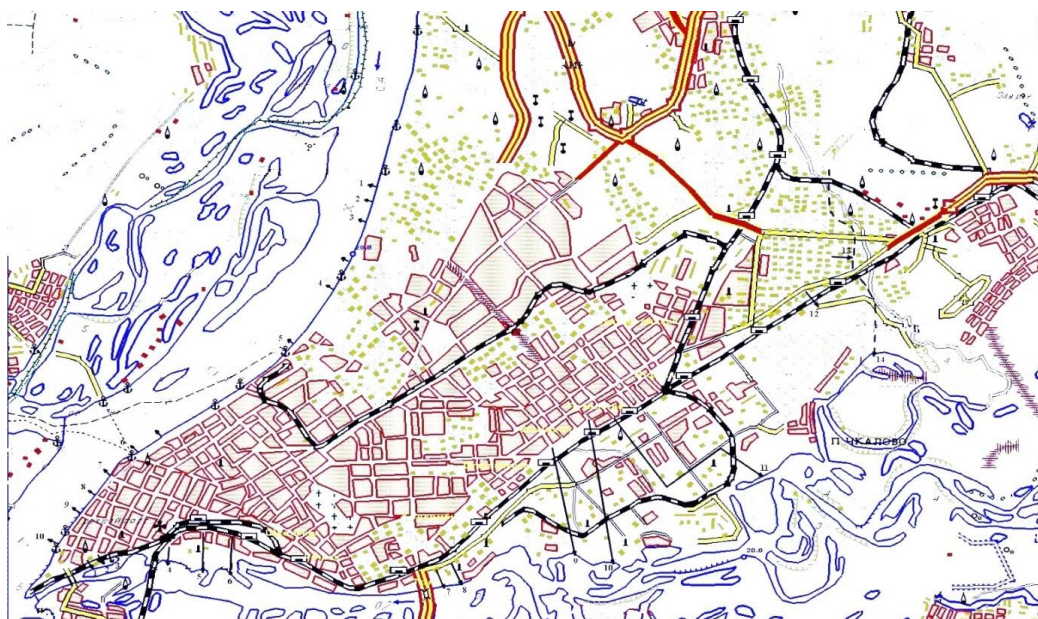


Figure 1. Wastewater outlet into the Saratov water reservoir:

1 – Barboshin Ovrag; 2 – 8th proseka; 3 – Solnechniy; 4 – Sovetskoy Armii; 5 – Postnikov Ovrag; 6 – Ulyanovskiy; 7 – Vilonovskiy; 8 – Nekrasovskiy; 9 – Leningradskiy; 10 – Komsomolskiy.

Wastewater outlets into the Samara river:

1 – Khlebnaya square 2 – Kruskoy; 3 – Sudoremontniy plant; 4 – Goryachiy Kluch; 5 – Depovskiy; 6 – Lutskiy; 7 – Belskiy; 8 – Russian; 9 – 22nd Partsejzd; 10 – prospekt Kirova; 11 – Zavodskoy; 12 – Metallurgicheskii; 13 – Chekistov; 14 – Orlov Ovrag

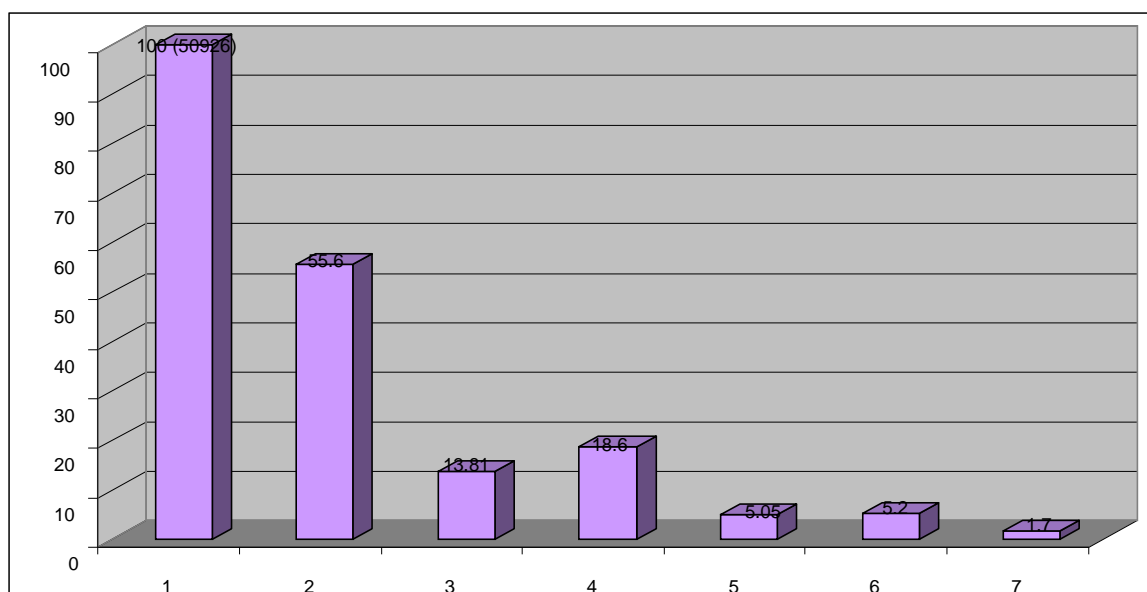


Figure 2. Distribution of surface wastewater in Samara:

1 – total surface run-off; 2 – surface run-off from residential areas; 3 – volume of effluent and drainage groundwater from residential areas; 4 – drainage effluent of heating network; 5 – surface run-off from industrial sites; 6 – other.

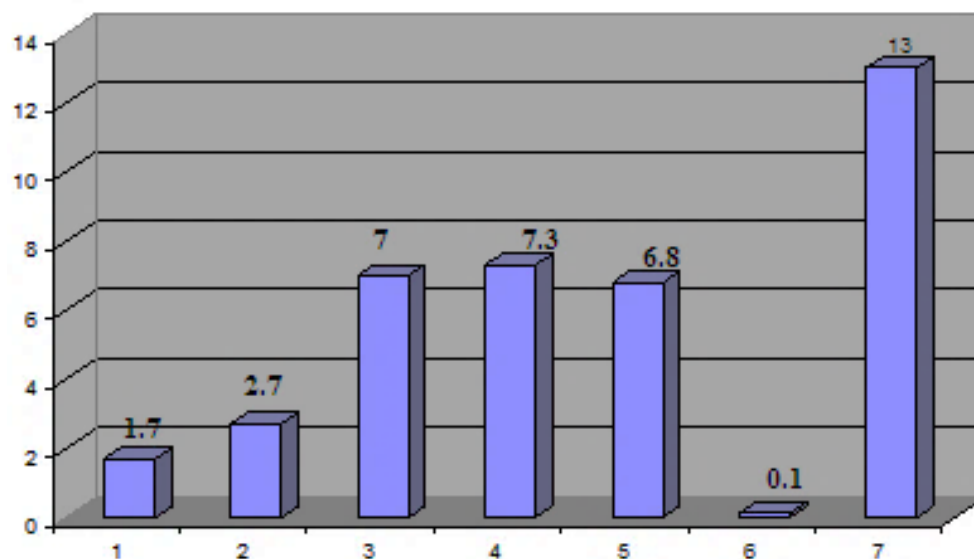


Figure 3. Allowable Discharge Standards (ADS) exceeding by type of pollution (wet period) in the Saratov water reservoir:

1 – suspended substances; 2 – nitrogen nitrate; 3 – Fe₂O₃; 4 – petroleum products;
5 – Synthetic Surfactants; 6 – aluminium; 7 – copper.

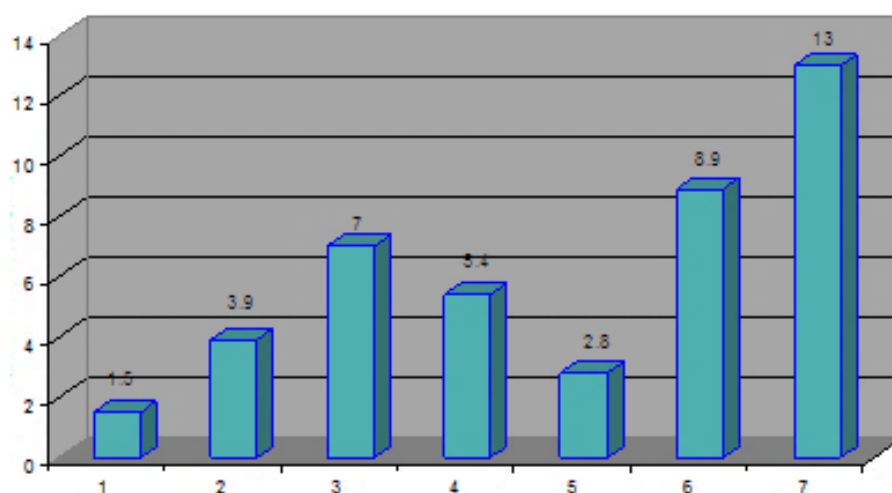


Figure 4. Allowable Discharge Standards (ADS) exceeding by type of pollution (wet period) in the Samara river:

1 – suspended substances; 2 – nitrogen nitrate; 3 – Fe₂O₃; 4 – petroleum products;
5 – Synthetic Surfactants; 6 – aluminium; 7 – copper.

2. Materials and methods

Table 1 shows costs of sewage flowing into open water bodies. According to the table data, the annual amount of run-off transferred into the Saratov Reservoir is 14492 thousand m³, into the Samara river – 36434 thousand m³. Out of this volume, 9962 thousand m³ and 18343.4 thousand m³ respectively are runoff from the residential area of the city, i.e. the surface runoff from the residential area into the Saratov Reservoir is approximately 69% and into the Samara river – 50%. The average volume of

surface run-off from the residential area into the ponds is 55.6% out of the total volume (see Figure 2-4).

Laboratory control of the quality of effluent streams through wastewater outlets is carried out by Samara Chemical Laboratory MP (small enterprise) "Engineering systems". The federal "Centre for Hygiene and Epidemiology in Samara Region", Department of Samara, supervises the bacteriological contamination of effluent streams.

An analysis of the physico-chemical composition of run-off effluents showed that the quality of effluents discharged into water bodies was by every measure higher than discharge limits.

Table 1. Discharge of sewage flowing into the Saratov water reservoir and the Samara river, thousands m³

	Period	Surface run-off from the territory		Effluent	Drainage effluent of heating network	Drainage of groundwater from the territory		Operating requirements MP "Engineering Systems"	Irrigation Flow	Total
		Residential	Industrial			Residential	Industrial			
Saratov water reservoir	warm	9961.724	622.148	51.53	598.710	1503.797	34.898	12.941	144.978	12930.734
	cold	-	-	36.345	427.650	1069.067	24.690	3.860	-	1561.614
	annual	9961.724	622.148	87.881	1026.360	2572.864	59.588	16.802	144.978	14492.348
Samara river	warm	18343.394	1950.316	4072.814	940.232	6078.627	60.682	46.097	516.721	32008.887
	cold	-	-	2873.808	671.594	823.181	42.817	13.751	-	4425.152
	annual	18343.394	1950.316	6946.622	1611.826	6901.809	103.499	59.849	516.721	36434.039
	warm	28305.121	2572.464	4124.350	1538.942	7582.425	95.579	59.038	661.700	44939.621
	cold	-	-	2910.153	1099.244	1892.248	67.508	17.612	-	5986.766
Total	annual	28305.121	2572.464	7034.503	2638.185	9474.674	163.088	76.651	661.700	50926.387

3. Results

3.1 The Saratov water reservoir

The maximum amount of suspended materials accompanying effluents during the wet period is 1.7 times greater than discharge limits. When taken separately, nitrogen nitrate is 2.7 times higher than discharge limits; the content of iron is 0.7 mg/l, which is 7 times higher than the normative value; the content of petroleum products is 7.3 times higher; synthetic surfactants – 6.8 times, the content of aluminum is within discharge limits, copper is 13 times higher than discharge limits, lead is almost non-existent.

The most detrimental (for the environment) releases into the Saratov water reservoir during the wet period are wastewater outlets in Krasnaya Glinka district – "Komsomolsk" and "Postnikov Ovrag".

3.2 The Samara river

The maximum amount of suspended materials accompanying effluents during the wet period is 35.7 mg/l which is 1.5 times greater than discharge limits. When taken separately, nitrogen nitrate is 3.9 times higher than discharge limits; the content of iron is 7 times higher than the normative value; the content of petroleum products is 5.4 times higher; synthetic surfactants – 2.8 times, the content of aluminum is 8.9 times higher, copper is 13 times higher than discharge limits.

Averagely, every year the Saratov water reservoir receives the following amounts of: suspended substances – 324.6 tonnes; petroleum products – 5.07 tonnes; total ferrum – 8.19 tonnes; synthetic surfactants – 4.26 tonnes.

Into the Samara river, with surface run-off from the rainwater sewer system, the average weight substances dropped annually amounts to 747 tonnes of suspended substances; 7.25 tonnes of petroleum products; 19.8 tonnes of total ferrum; 3.24 tonnes of synthetic surfactants; 2.44 tonnes of aluminium.

4. Conclusions

1. Surface wastewater is disposed through the rainwater sewer system into the Saratov water reservoir without cleaning in the second zone of the surface water supply area.

In accordance with Article 44,60 of the Water Code of the Russian Federation of 3 June 2006, No. 74-FZ it is prohibited to dump untreated wastewater into water objects.

2. In order to prevent contamination of water objects by surface run-off from residential areas and industrial territories, it is required to arrange sewage disposal and to construct waste-disposal plants. The General Plan of Samara provides six sites for surface waste-disposal plants:

- | | |
|-----------------------------|---------------------------------|
| 1. Krasnoglinskiy district; | 4. Kirovskiy wastewater outlet; |
| 2. Postnikov Ovrag; | 5. Orlov Ovrag; |
| 3. Goryachiy Kluch; | 6. Kuibyshevskiy District. |

3. At the moment, a site has been allocated for water-purification plants in Postnikov Ovrag. It is being designed now, with operation schemes and dimensions of structures defined [1, 2, 3].

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