

Summary of the diploma thesis

"Feasibility study on wastewater disposal in the rural county of Galati (Rumania)"

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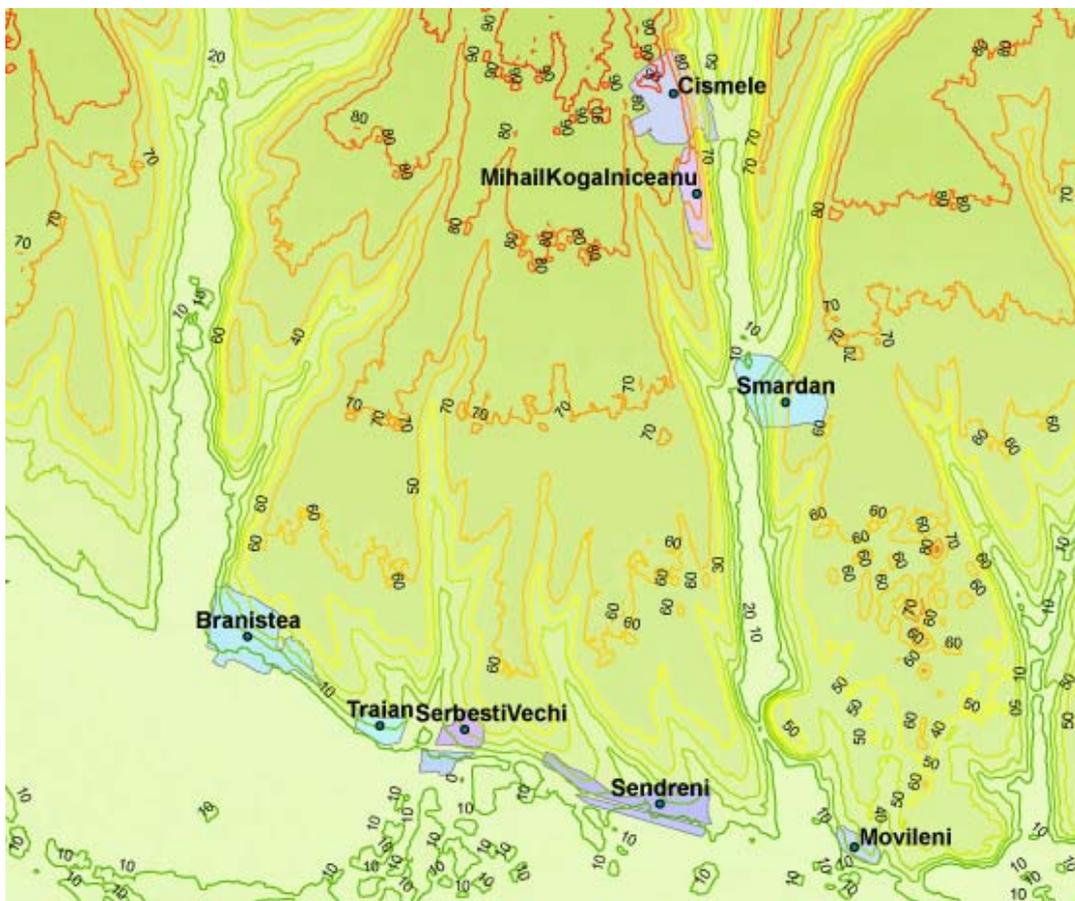


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Introduction

The commitment, which Rumania signed within the scope of the accession negotiations with the European Union regarding the implementation of the requirements as per Council Directive 91/271/EEC, makes it necessary to carry out investments in the areas of development, improvement and modernisation of communal sewage treatment plants and sewage systems in the period up to 2018.

A large part of the Rumanian population is living in rurally structured areas and has neither access to the public drinking-water supply nor an infrastructure in wastewater technology that includes a sewage system followed by wastewater treatment. With regard to the EU Directives 98/83/EU and 91/271/EEC, there is a substantial need for action for which synergies could be explored.

In the rural area of the town of Galați (in the county of Galați / Rumania), drainage concepts for eight residential areas were examined and a drainage concept for the disposal of wastewater was formulated in a comparison of wastewater technologies.

The applied variants are modified drainage methods.

In future, the rainwater will be drained on site or fed into the nearest body of water.

For the disposal of wastewater, the following drainage concepts were examined:

- **Concept 1:** Disposal of wastewater in a centralised system
 - via a drainage network, all residential areas will be connected to the sewage treatment plant in Galați

- **Concept 2:** Disposal of wastewater in a semi-centralised system
 - the drainage systems of the residential areas will be developed, interlinked and receive their own wastewater treatment facility

- **Concept 3:** Disposal of wastewater in a decentralised system
 - each property cleans its own wastewater in a domestic sewage treatment system

The concepts will be reviewed monetarily in a cost comparison based on the guidelines of the Federal Committee for Economic Issues in the Water Sector. In addition, non-monetary assessment criteria, such as implementation time, space conditions, environmental protection and job creation will be compared and taken into account.

This is followed by the recommendation of a drainage method for the rural area of Galați.

Description of the current situation

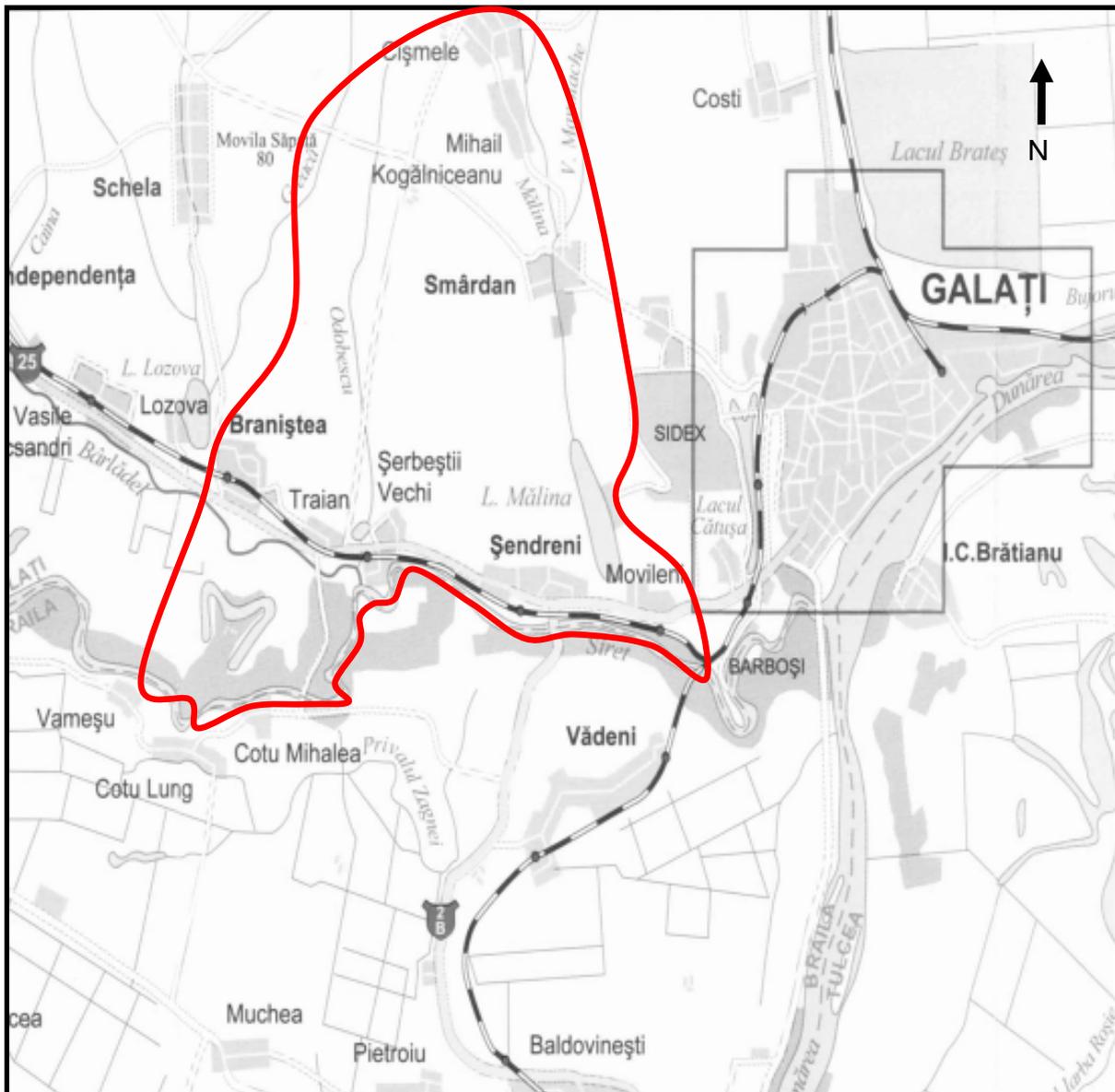


Figure 1 Investigated drainage area

The investigated rural area is situated approximately 14.5 km eastwards from the town of Galați.

The areas of Branistea and Traian fall under the community of Branistea and Șerbeștii Vechi, Șendreni and Movileni belong to the community of Șendreni.

The areas Branistea and Traian are located along the river Bârlădel.

Șerbeștii Vechi lies in the catchment area of the river Bârlădel, which in turn flows into the Siret. Șendreni and Movileni are situated on the Siret. The Siret River forms the southernmost border of the investigated areas and drains the catchment area.

The five areas are located within the high-water levels of the rivers Bârlădel and Siret. The northernmost border of the investigated catchment area is the location of Cișmele.



Figure 2 Roads in the investigated residential areas

The residential areas Mihail Kogălniceanu and Smârdan follow towards the southern edge of town. The three areas fall under the community of Smârdan.

Over the entire catchment area, there are stretches of land between the locations that are under cultivation or used as grazing grounds.

The properties have several hundred square meters of agricultural land and it is common practice to grow fruit and vegetables for personal consumption.

Due to their topographic differences, the considered areas are divided into two sectors, which are numbered individually:

Sector 1 (to the west of town)	Area designation
Movileni	1
Şendreni	2
Şerbeştii Vechi	3
Traian	4
Braniştea	5
Sector 2 (to the north of town)	Area designation
Smârdan	6
Cişmele	7
Mihail Kogălniceanu	8

Table 1 Structure of the areas

The rural area in the north-west of the town of Galaţi, upstream of the Danube and the Siret, has not been developed from a drainage perspective.

There are no existing drainage networks, and faecal water is disposed of via private soakaways. The soakaway is a hole dug into the ground, above which a toilet hut is placed.

In the hole, the faecal water is collected and composted. The wastewater drains into the ground passage or flows into the existing drainage, ditches, rainwater channels or road surface drains.

The production of domestic wastewater, excluding faecal water, is very low because water usage is not yet available over a wide area via a centralised public supply network. It is disposed of either in the garden or in the road.



Figure 3 Wastewater disposal in the rural area

Due to the trend of an increasing population density in the rural area as well as the development of public drinking water supply, a rise in the production of wastewater can be expected. The sanitary facilities of new buildings are equipped with showers, bathtubs and flush toilets, and the kitchens are furnished with modern appliances.

The supply technology of developing areas is being upgraded without the parallel installation of an adequate infrastructure for wastewater treatment.

The alternative drinking water supply in the rural residential areas is currently the public well. Frequently, the wells are situated only a few meters from the properties and the stored ground water varies with the seasons.

Along the area of the main roads, the rainwater is collected and drained in ditches.

The part of the ditches situated along the main road is made of concrete and discharges the outflow of the rainwater into the next body of water. Due to the smooth surface of the profiles, the kinetic energy of the drainage increases and the inlet points of the drainage systems are hydraulically overloaded.

The water pollution is recognisable in the form of debris accumulation, undercutting and washouts.



Figure 4 Rainwater drainage in the rural area

On secondary roads, the rainwater is drained into unsurfaced ditches. Due to the natural soil zone of the ditch, a large part of the rainwater can seep away. In order to maintain such a rainwater drainage system properly, the unsurfaced ditches must be excavated and mown at regular intervals. The drainage ditches must be upgraded and further secured with hydraulically insulating measures.

Dimensioning of the wastewater disposal

For the current situation, the drinking water consumption and the resulting wastewater were calculated according to the average water consumption of the last four years.

For the prognosis state, the decisive amount of wastewater for the drainage network has been calculated with a net coverage of 100 %.

An annual population growth of 6% for rural areas has been added to the area-wide drinking water network. The prognosis state is determined for the year 2018. This is the year in which the Directive 91/271/ EEC is to be implemented in Rumania.

The amount of wastewater is determined at 90 % of the drinking water consumption in order to allow for the irrigation.

In the prognosis state, a wastewater load of 180 l/d per inhabitant is assumed.

For rural areas, this is a rather high value. However, due to the development of this catchment area, it is quite realistic. Settlement of trade and industry will increase in order to take advantage of the optimum economic location, which is the result of the favourable transport infrastructure.

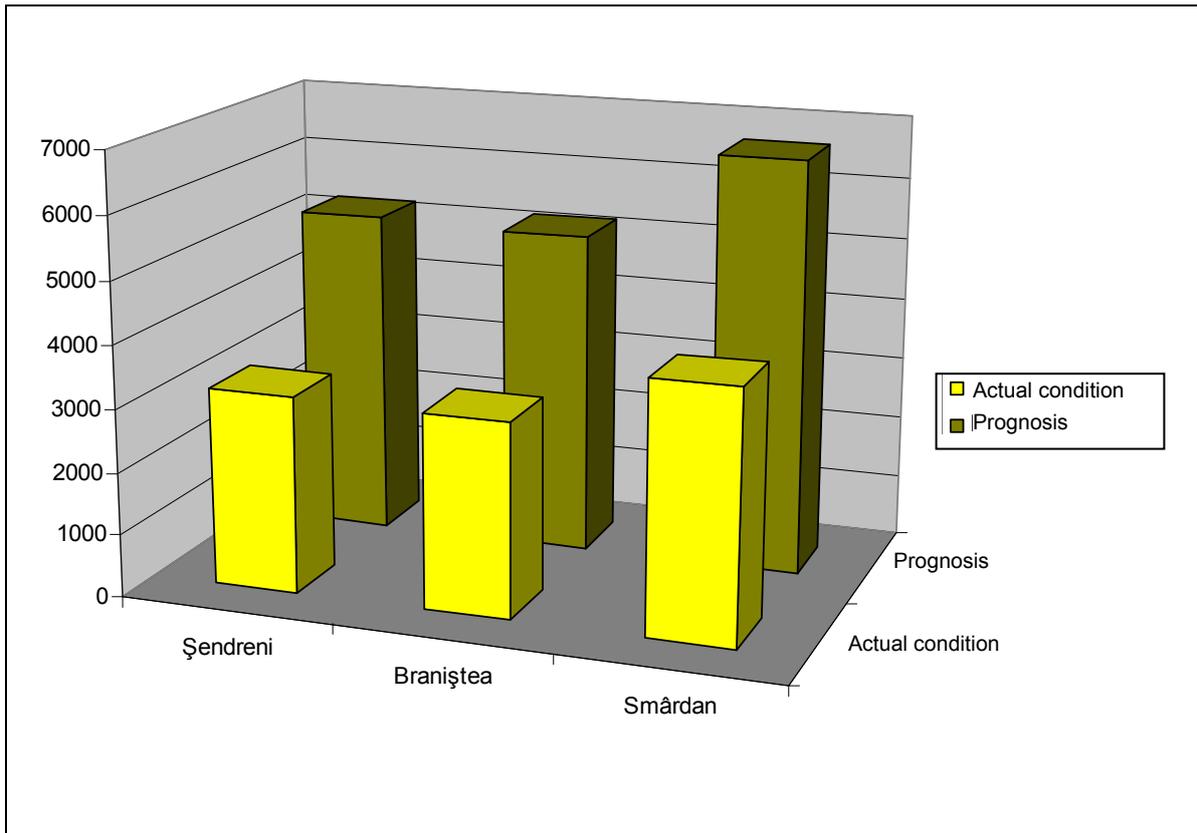


Table 1 Population development in the rural area

The proposed drainage method is a modified separation system. The rainwater will be drained locally or fed into the nearest body of water.

The dry-weather flow of the contiguous subareas is shown in the following table:

No.	EW	A_{EK} [ha]	BFG %	A_u [ha]	Q_{h24} [l/s]	Q_h [l/s]	Q_f [l/s]	Q_{t24} [l/s]	Q_t [l/s]
5 - 1	10431	357.0	20	71.4	21.7	65.2	3.6	25.3	68.8
8 - 6	6648	319.6	20	63.9	13.9	38.9	3.2	17.1	42.1

Table 4: Area data for contiguous subareas – prognosis state

The amount of wastewater during dry weather in the prognosis for 2018, Q_t , is the flow according to which the channels, pipes, ducts, pump stations as well as the wastewater treatment facilities have to be scaled.

Comparison of the concepts

The comparison of the concepts contains the technical development of the wastewater systems for the periphery of the town of Galați. During the selection of

the drainage method, economical and ecological sustainability must be taken into account.

The catchment area should be drained in a modified method. The occurring rainwater will be drained locally and is fed into the nearest body of water. Should it be too contaminated by the drainage process, it will be discharged and treated together with the wastewater.

Three concepts are being investigated, with which the targets of the European Directive 91/271/EEC could be met by 2018.

In **concept 1**, the wastewater of the catchment areas will be collected and routed to the central sewage treatment plant in Galați.

In **concept 2**, the infrastructure of the drainage systems of the residential areas will be developed and connections to individual central sewage treatment plants will be established.

Concept 3 is a decentralised option and could be implemented with very little delay to allow the disposal of the population's wastewater in the rural area.

In concept 1 as well as in concept 2, the local development of the drainage systems in the residential areas is indispensable. Only in the decentralised concept, the development of the drainage network in the area can be dispensed with.

The examination period of the concepts is 60 years and it is assumed that the effective annual interest is 3%. Price increases are not included in the calculation.

Based on the considered examination period, the decentralised wastewater disposal system, concept 3, will be the most cost-intensive solution, because the system components must be replaced more often and require frequent maintenance in order to ensure flawless operation of the domestic sewage treatment systems.

The sewage sludge produced by the system represents an additional problem and proper disposal must be ensured. The comparison indicates that, in the present example, the connection to the central sewage treatment plant in Galați as well as the semi-centralised solution with joint sewage treatment plants is less expensive than the use of domestic sewage treatment systems.

The result of the cost comparison is shown in the following graph:

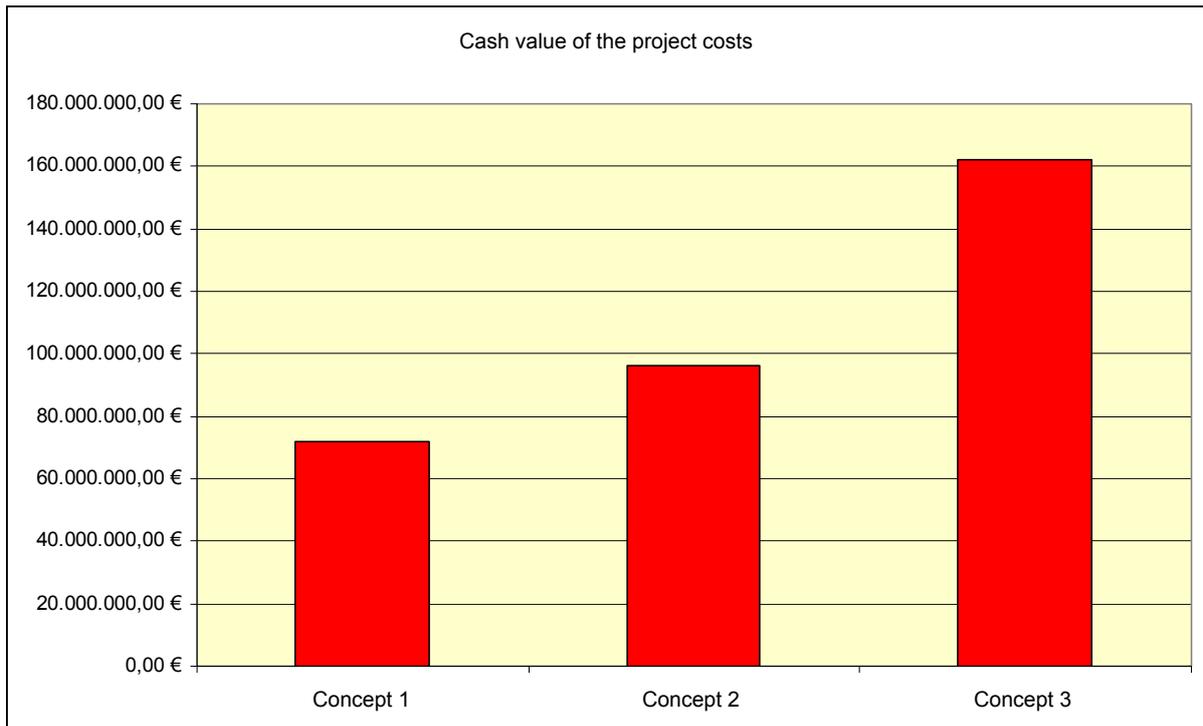


Table 4 Cash value of the project costs for the three examined drainage concepts

Based on their economic figures, the concepts 1 and 2 are not far apart. The calculation of the study is based on cost assumptions and, therefore, only an indication.

The pure monetary assessment would be supplemented by a non-monetary comparison, including the following criteria:

- Time of the implementation
- Area/position
- Environmental protection
- Job creation

The overall examination led to the result that concept 2 presents clear advantages in comparison with concept 1 and 3.

The construction of semi-centralised sewage treatment plants for the rural areas in the form of modified and smaller separation systems or proportioning systems can reduce the production of infiltration water.

The areas 2 to 4 are drained in a pressure system. A pressure collection line will be installed in the residential areas and pressure drainage ducts as well as ventilation units will be fitted on the properties.

The wastewater of the areas in the north of the town can be discharged by a gravity drainage system.

During the detailed planning stage, it must be verified whether the pump stations included in the calculation will be required for concept 1 and 2. In this case, the central as well as the semi-centralised system would have an additional cost advantage.

The residential areas should consolidate the facilities for wastewater disposal and aim for a community solution.

Conventional biological sewage treatment plants with a capacity for 10,000 to 15,000 inhabitants are cheaper and more reliable because the wastewater load of the systems is more stable.

The power supply of the wastewater treatment facility must be self-contained, e.g. via a generator, or the facility must not be sensitive to power failures. In this case, the near-natural wastewater treatment facilities have been shortlisted. Anaerobic sewage sludge treatment for the generation of biogas could be integrated into the semi-centralised concept.

Smaller wastewater treatment units can respond flexibly and adjust quicker to the increasing or decreasing number of residents.

The inlet volume of the water treated in the sewage treatment plant will be regulated according to the conditions of the catchment area.

Smaller central systems can be adapted easier to the requirements and ambient environmental conditions. The issue of the type of wastewater could be addressed specifically. Pre-treatment, biological treatment and final treatment facilities will be built according to the characteristic problem situation of the area.

Recommendation

In order to comply with the specifications of the Directive concerning urban wastewater treatment [91/271/EEC] by 2018, the communities and towns must determine the development in the infrastructure of their drainage systems in the developing as well as in the established areas by adopting a consistent plan.

The communities must administer their areas, and building land must only be designated if, in addition to the infrastructure of technical supply facilities, disposal facilities are available or at least in the planning stage.

A wastewater disposal concept for the rural area must be prepared and has to be upgraded as well as updated within the next five years.

By means of a priority list, the disposal of wastewater in the rural areas of Galați could be implemented gradually as follows:

Priority list	Action
Step 1	Communities and towns have to develop bases for the planning work: <ul style="list-style-type: none"> • Regional planning • Area utilisation plan • Construction management plan • Wastewater disposal concept
Step 2	Parallel development in the infrastructure of the technical supply and disposal in developing areas and development of the drainage systems in the existing areas of the periphery, including a modular connection to the semi-centralised sewage treatment plant
Step 3	Development of the drainage systems and connection to the semi-centralised sewage treatment plant for the remaining areas, where no constructional extensions have been planned

Table 2 Priority list

Catchment areas such as the peripheries of Galați, which will expand during the next few years and in which individual residential areas will grow together, can base their planning and design of the draining systems on a small central system.

The local development of the residential areas through a drainage network must take place parallel to the connection of the developing areas to the public water supply.

Through a modular design of the components of the sewage treatment plants, the wastewater treatment system can grow with the gradual development of the supply and discharge technology of the developing areas and the connection of the developed areas to the drainage system.