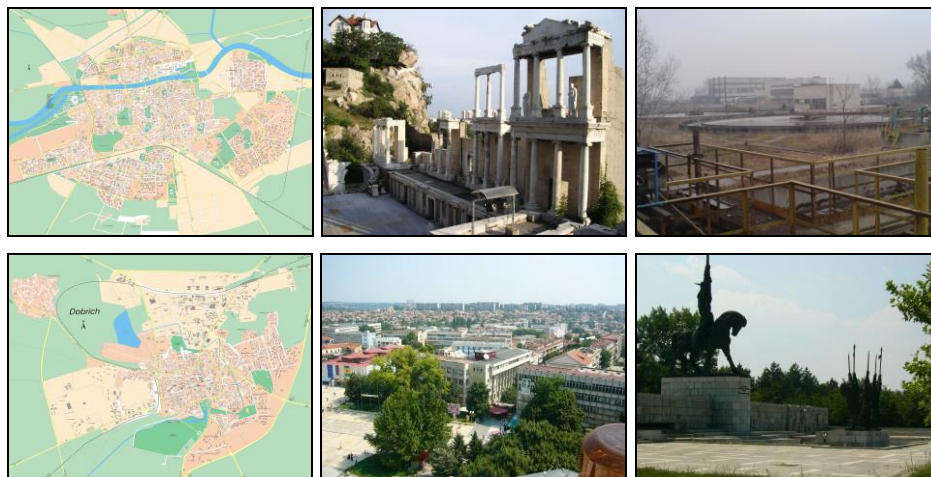




Volume V – Environmental assessment  
Final Feasibility Study Plovdiv

03/2011



**Technical Assistance for  
Preparation of Integrated Water Measures  
in Plovdiv and Dobrich**

**EuropeAid/124488/D/SV/BG**

**Volume V**

**Environmental Assessment  
Final Feasibility Study Plovdiv**

**FINAL VERSION**

**PUBLISHED UPON APPROVAL BY PROJECT STEERING COMMITTEE ON 08.04.2011**

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Annexes

## 1. Objectives of the investment project

The implementation of a modern integrated water cycle in Plovdiv is one environmentally friendly project that will help improve the quality of life of the population of Plovdiv and the quality of local environment.

*The main objectives of the Feasibility Study for Plovdiv* are related to the main objective of the policy for waters, the protection of water resources. As per Directive 91/271/EEC, the measures are aimed at improving the quality of water resources.

Funding under Operational Programme Environment 2007-2013 in Stage I is necessary to ensure the quality of waste water discharged into water bodies to meet European requirements. This is achieved with integrated measures, related with management of the water cycle in urban areas:

- Rehabilitation, reconstruction and extension of the water supply system and the facilities, associated with its functioning. Reduction of losses in the water supply network and securing the population with sufficient quantity of drinking water with good quality at reduced operating costs. Indirect contribution to the reduction of infiltration into the sewer system.
- Rehabilitation and reconstruction of the sewer system and the facilities associated with its functioning. Collection of all wastewaters and bringing them to the UWWTP for treatment up to specified requirements. Not allowing direct discharge into the water bodies, so as not to pollute the receiving water. The development of the ecosystems should not be adversely affected, neither the development of biodiversity in the designated areas, respectively. Reduction of infiltration thus securing more efficient operation of the UWWTP. Prevention of health risk to the population in the area.
- Reconstruction and extension of existing UWWTP Plovdiv by construction of new facilities, replacement of morally and physically obsolete equipment in some technological units. Increasing the degree of purification in terms of nutrients N and P. Upgrade of the sludge management facility by commissioning modern equipment for anaerobic stabilization of the sludge, generated in the process of treatment and subsequent dewatering. Suggestions for effective management of the sludge from UWWTP. Achieving treated water parameters that meet the requirements of the permit for

discharge into the Marishki Collector water body (South outflow channel). Reducing the conditions for eutrophication. Improving the quality of irrigation water and ensuring compliance with the regulatory requirements. Ensuring sustainable development of the aquatic ecosystem of Maritsa water body. Achieving good imission status of the waters. Raising the self-purification ability of the Maritsa river and creating a positive effect on its cross-border impact, respectively.

- The projected process scheme for reconstruction, upgrade and expansion of the existing UWWTP Plovdiv is modern in design, it meets the EU requirements and will ensure that the wastewaters, treated in UWWTP Plovdiv will meet the individual emission limits, stipulated in the Permit for use of surface water body for discharge of wastewater into surface water bodies, issued by EAS RBD (East Aegean Sea River Basin Directorate), seated in Plovdiv.

## 2. Need for investment project

*The Feasibility Study – Volume 1 – Report – identifies the shortcomings and problems of the water supply and sewage systems and their facilities, and the measures, provided for their elimination.*

### ✓ Water supply networks and facilities

**General information about the condition of the water supply network and the associated facilities:** The water supply system of Plovdiv is supplied by 5 groups of wells (South I, South II, North, East 1, East 2).

Apart from that, parts of Plovdiv supply drinking water from Tamrashka River, after the waters pass through Hrabrino drinking water treatment plant.

The existing water mains, which are in operation in Plovdiv water supply system, have a total length of about 53 km. The length of the distribution network is about 560 km. In 2007 the losses in the distribution network were about 63%. (real losses 45%).

#### **Problems:**

- considerable losses in the water supply network,
- in certain sections the pipes have smaller diameters than required.
- reduce the volume of infiltration into the sewer system.

#### **Measures:**

**Reconstruction, rehabilitation and extension of the water supply network in some sections and the associated facilities.**

Some sections of the water supply network require reconstruction, rehabilitation and extension in short term perspective.

Stage I provides the replacements of 14 km. of water pipes, running in parallel with the sewers (dA 110 to DN600 and 1310 house connections, which are eligible for financing from the Cohesion Fund (CF) under Operational Program

Environment 2007-2013 (OPE). This is going to reduce the losses in the water supply network in the northern part of Plovdiv.

Additionally, further measures are projected in Stage I, that will be implemented in this stage by other funding.

In order to solve the problem with pressure in the southern part of Plovdiv and to reduce water losses and operation and maintenance costs, measures are foreseen in Stage II, distributed across the entire city of Plovdiv, which affect only transmission mains with a length of 25.0 km. The measures will ensure cost-effective operation of the water supply network and the associated facilities.

The main objective of the long-term planning is the reduction of water losses, as well as the expansion of the water supply area through replacement of water mains and laying new pipelines.

✓ **Sewer networks and facilities**

**General information about the condition of the sewage network and the associated facilities:** The sewage system of Plovdiv is completely of mixed type. Its construction began in 1935 and was expanded mainly before 1970. The existing sewage system consists of seven collectors with a total length of 93 km and 386 km of secondary sewers. The collectors are made of concrete pipes with round, egg-shaped, pentagonal and mouth-shaped section. Diameters range from 150 mm to 1500 mm, and non-round collectors up to mouth-shaped section 4 400 / 2 750 mm. Most sewers are concrete and reinforced concrete. Only a small number of high density polyethylene pipes (PE-HD) have been laid. The sewer network in Plovdiv serves 375,749 inhabitants. The percentage of connectivity is 98%.

**Problems:**

- The main reason for the large quantity of infiltrated water is the high groundwater level and the proximity of the collectors to Maritsa River.
  - Small diameters of many sewage pipes.
-

- Bad condition of many sections of Plovdiv sewerage system – blocked and silted sections, damaged and collapsed sections.
- Many manholes are in bad structural state, with missing or corroded parts.
- A number of manholes cannot be located, covered with asphalt and soil.
- No regular maintenance, repair and cleaning of sewage is performed.
- Large quantity of infiltration water (broken or damaged water pipes, inlet chambers, house sewer connections and other abnormalities, infiltration of groundwater).
- Exfiltration of wastewaters into the ground through broken pipes or broken links between the pipes. This leads to contamination of groundwater and the water bodies, associated with them.
- Due to channel siltation or broken pipes after the existing spillways, wastewaters flow into rivers even in dry weather.
- Insufficient number of inlet chambers, many of the existing inlet chambers are not functioning properly (silted up or placed inappropriately).
- No sewer network in some areas.
- No information for the systems – “as is” documentation, pipes composition, years of construction, details of facilities.
- Conditions for negative impact on environmental components are created (mostly negative impact on the sustainability of aquatic ecosystems and the development of biodiversity, respectively) and health risk to population in the area.

**Measures:****Reconstruction, rehabilitation and extension of the sewage network and the associated facilities.**

The investment project involves the following measures on Stage 1, which would provide sufficient hydraulic capacity to the system in the north part of Plovdiv and will contribute to reduce the infiltration flow to UWWTP:

- Rehabilitation and construction of new collectors with a length of 6.4 kilometers, which includes:
    - Rehabilitation of Collector VII - 1 - 2.8 km.
-

Construction of Relief Collector VII - 1 to 3.6 km.

- Replacement of the secondary sewage network around 16.5 km, which includes:

Northeast - 12.503 km.

Northwest - 3.617 km.

### **Location of the rehabilitated sections of the sewage and water supply systems in Stage I:**

- Section 1-1: Fifth town area of Plovdiv
- Section 1-2: Fifth town area of Plovdiv
- Section 2: Fifth town area of Plovdiv
- Section 3: "Sugar Factory" Plovdiv district
- Section 10 – "Dunav" Blvd. – "Brezovsko Shosse" Blvd.

*It is necessary to perform an immediate reconstruction, rehabilitation and extension of the water supply network, the sewer network and the related facilities in Plovdiv to reduce the loss of drinking water, reduce the infiltration and transfer all wastewaters, generated on the territory of Plovdiv to the existing UWWTP Plovdiv to ensure:*

- environmental protection and reduction of health and environmental risk in the region
- water management for sustainable development on the territory of the three populated areas.

### ✓ **Waste water treatment plant UWWTP Plovdiv**

#### **General information on the condition of UWWTP Plovdiv**

UWWTP Plovdiv is situated in the southeast part of town, about 1.5 km outside the city limits, at an area of 23 hectares. It treats wastewater from industry and the population of Plovdiv (as well as 80-100 m<sup>3</sup> of infiltrate per day from the "Tsalapitsa" landfill).

The waters treated at UWWTP are discharged into the Maritsa River through an open channel with a length of 2.6 km.

The UWWTP was designed in 1973 by Vodokanalproekt, Sofia, built in the period 1975 – 1982 and put in operation in December 1984, excluding the sludge treatment facilities, i.e. anaerobic digesters, biogas tanks and vacuum filters.

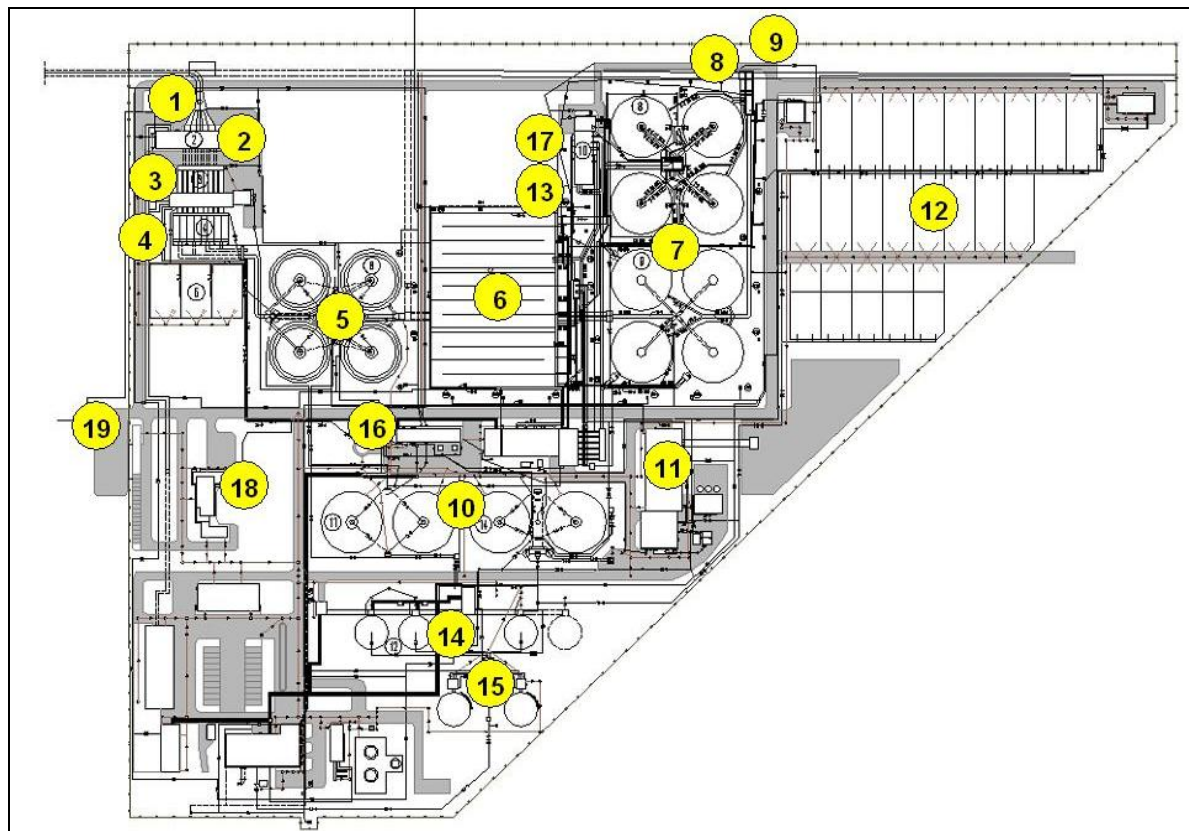
UWWTP Plovdiv is designed for treatment of domestic and industrial wastewater from Plovdiv. Until 2008, the WWTP treated wastewater only from the southern part of town (about 70% of the total flow of town). Wastewater from the north were collected and discharged directly into the Maritsa River without treatment.

Currently, all wastewater is collected through a combined sewage system and enters the UWWTP for treatment. (In July 2008 a pumping station and a main north collector entered into service to bring wastewater from the northern part of town to UWWTP).

**The existing UWWTP Plovdiv has a design capacity of BOD<sub>5</sub> 35.78 tons/day 596 333 PE and Q<sub>day aver.</sub> = 213,000 m<sup>3</sup>/d (daily average water quantity).**

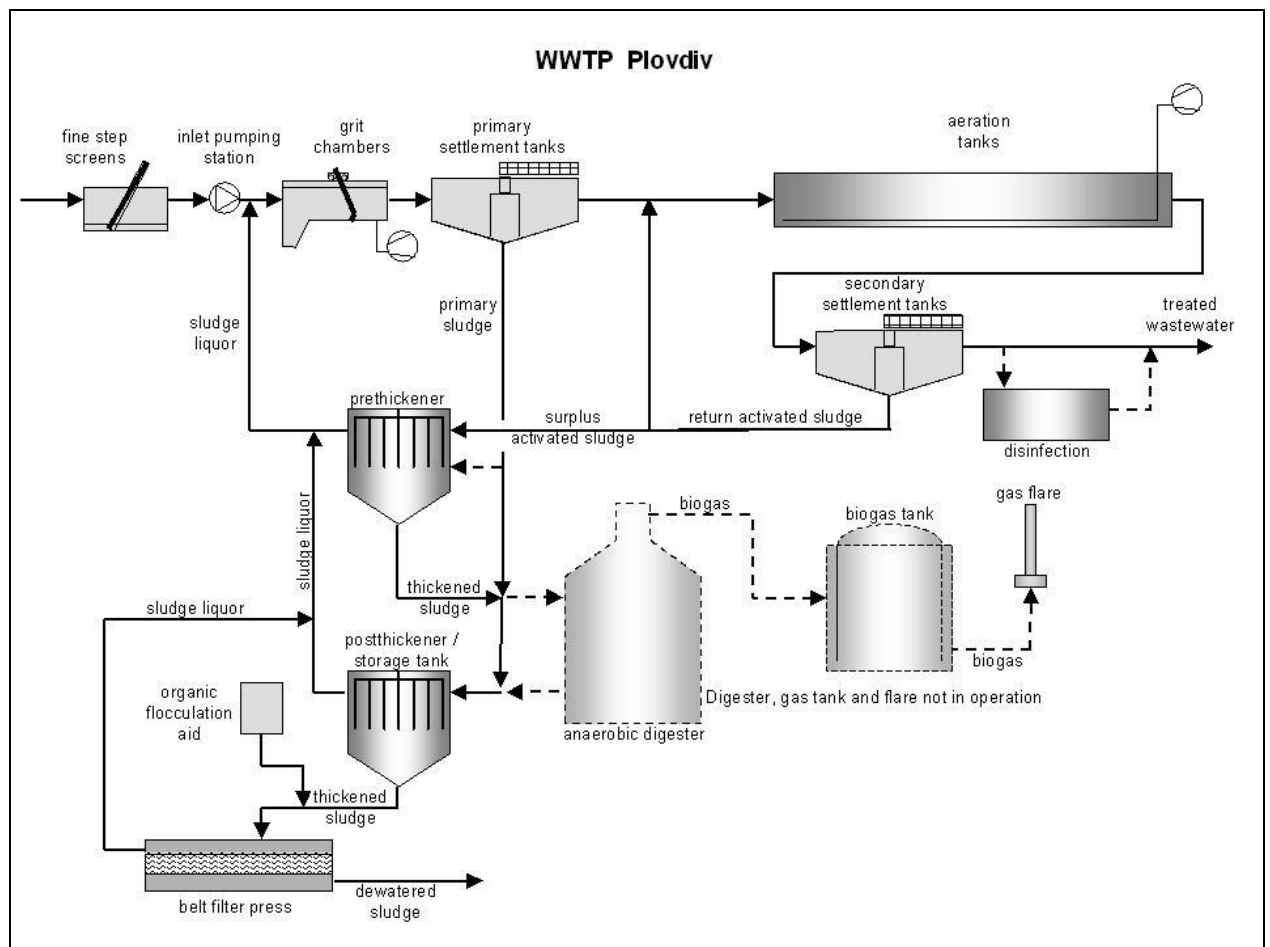
The WWTP project was developed in accordance with the standards for construction and design into force in 1984. The plant is designed for mechanical and biological treatment for removal of carbon up to the requirements for treated water to meet the Bulgarian standards for discharge into category III receiving water, the Maritsa River. The process scheme and the existing facilities are not intended for a higher level of wastewater treatment in terms of nutrients (N and P). Much of the equipment is *morally and physically obsolete*.

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Legend: (1) Inlet channel; (2) Building fine screens; (3) Inlet Pumping Station; (4) Aerated grit chamber; (5) Primary settlement tanks; (6) Aeration plant; (7) Secondary settlement tanks; (8) Disinfection tank; (9) Final effluent; (10) Sludge thickeners; (11) Sludge dewatering; (12) Sludge drying beds; (13) Building with air blowers; (14) Digesters (not in operation); (15) Biogas tanks (not in operation); (16) Transformers; (17) Sludge pumping station; (18) Administrative and operation building; (19) Entrance

**Figure 1 Layout of the Existing WWTP Plovdiv**



**Figure 2 Process Scheme of the Existing WWTP Plovdiv**

The wastewater treated in UWWTP Plovdiv amounts between 145 000 and 202 000 m<sup>3</sup>/d, i.e. it does not currently exceed the design capacity (1984) - 213 000 m<sup>3</sup>/d (daily average water quantity). The proposed dimensional water quantities in this project are Q<sub>day av.</sub> = 200 000 m<sup>3</sup>/day (level 2038 Q<sub>day av.</sub> = 173,937 m<sup>3</sup>/day - forecast).

UWWTP performs self-monitoring. The laboratory at UWWTP Plovdiv performs daily laboratory analyses of pH, dissolved oxygen, suspended solids, BOD<sub>5</sub>, COD, NH<sub>4</sub> and PO<sub>4</sub> before and after the mechanical step and after the secondary settlement tank before the point of discharge. The total nitrogen and phosphorus are analyzed each month, and heavy metals - every three months.

Data for the measurements in 2009 and 2010 of the main parameters at UWWTP inlet and final effluent are as follows:

**Table № 1 Self-monitoring data of UWWTP Plovdiv**

№	Parameters	Unit	2009				2010			
			min.	max	aver.	E %	min.	max	aver	E %
1	<b>UWWTP inlet</b>									
1.1	BOD <sub>5</sub> at 20 <sup>0</sup> C	mg/dm <sup>3</sup>	81	130	99		77	96	79	
1.2.	COD	mg/dm <sup>3</sup>	154	421	294		227	321	252	
1.3.	Total suspended solids /TSS	mg/dm <sup>3</sup>	88	257	122		72	119	98	
1.4.	Total Nitrogen / Nt	mg/dm <sup>3</sup>	22	36	28		23	33	30	
1.5.	Total Phosphorus/Pt	mg/dm <sup>3</sup>	3,0	4,4	3,5		2,7	4,4	3.4	
2	<b>UWWTP Plovdiv final effluent</b>									
2.1.	BOD <sub>5</sub> at 20 <sup>0</sup> C	mg/dm <sup>3</sup>	4	11	6,4	93,5	4	10	6	92,4
2.2.	COD	mg/dm <sup>3</sup>	26	54	34	88,4	26	44	34	86,5
2.3.	Total suspended solids /TSS	mg/dm <sup>3</sup>	5	11	6,6	94,6	5	10	7	92,9
2.4.	Total Nitrogen / Nt	mg/dm <sup>3</sup>	8	17	9,4	66,4	9	14	12	60
2.5.	Total Phosphorus/Pt	mg/dm <sup>3</sup>	1,8	2,6	2,2	37,1	1,7	2,7	2,1	38
3	<b>Admissible emission standards</b>									
3.1	BOD <sub>5</sub> at 20 <sup>0</sup> C	mg/dm <sup>3</sup>			25				25	
3.2	COD	mg/dm <sup>3</sup>			125				125	
3.3	Total suspended solids /TSS	mg/dm <sup>3</sup>			35				35	
3.4	Total Nitrogen / Nt	mg/dm <sup>3</sup>			10				10	
3.5	Total Phosphorus/Pt	mg/dm <sup>3</sup>			1				1	

\* The results of the self-monitoring show that currently the parameters of treated water do not meet in some cases the requirements of the Discharge permit in terms of content of nutrients, mainly Pt (parameter is exceeded from 1,8 to 2,7 times, 2 times in average) and Nt (parameter is exceeded 1.7 times in certain cases, 1.2 times in average in 2010).

The relatively high efficiency of the existing UWWTP Plovdiv is due to the highly diluted inlet flow. After upgrade of the existing sewerage system, dilution would be much less and the quality of effluent and effectiveness of treatment will decrease. Due to lack of phosphorus removal, the plant achieves relatively small reduction of phosphates.

#### Problems:

- The existing UWWTP Plovdiv does not meet all requirements of current legislation and cannot achieve the desired conditions for achieving individual emission limits. The flowchart and the existing facilities are not intended for a higher level of wastewater treatment in terms of nutrients (N and P).

- Much of the equipment of the existing facilities at UWWTP Plovdiv is morally and physically obsolete.
- After rehabilitation, reconstruction and expansion of the water supply and sewerage systems and the related facilities, the infiltration is expected to decrease to a rational minimum, which, as a result, will increase the concentration at the inlet of UWWTP Plovdiv and will therefore require an improved treatment effect to achieve the parameters for treated water, set in the permit for discharge into a "sensitive area" receiving water.
- The sludge, generated in the treatment process is not stabilized and not sufficiently dewatered. The sludge is temporarily stored and its subsequent treatment is problematic (depositing, utilization, disposal). Under the new trends of using sludge for reclamation, rehabilitation of disturbed lands, use in agriculture as fertilizer, etc., the sludge needs to be highly stabilized and dewatered. The flowchart of the future reconstruction of the UWWTP is required to implement and expand the sludge management facility.

### Measures

The priority measures of the Master Plan include the rehabilitation, upgrade of the wastewater treatment plant so that European standards in accordance with EU UWWTD 91/271/EEC for treatment and discharge are met. The sludge treatment and disposal has been considered a priority measure

*It is necessary to perform a reconstruction and upgrade of the existing UWWTP Plovdiv in the short term to achieve:*

- *quality of treated wastewater that meets the requirements of individual emission limits of the Discharge permit*
- *quality of sludge, generated in the treatment process that meets the requirements for its subsequent treatment (depositing, utilization)*

The main objective of the rehabilitation of the UWWTP is to reduce the inflow of harmful substances, organics and nutrients in the water body. Refitting of individual facilities aims to improve the treatment effect at reduced operating costs for meeting the European requirements for water treated in urban

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wastewater treatment plants (Council Directive 91/271/EEC) on economically favorable terms.

Rehabilitation and upgrading of UWWTP Plovdiv is proposed, taking into account the changed condition of the inflow as a result of the implemented measures for rehabilitation and extension of the water supply and sewerage networks and associated facilities. To meet the requirements of the EU Directive, the mechanical step, the biological step and the sludge treatment should be upgraded for the future condition. Those eligible investment measures are proposed for financing by the Cohesion Fund under Operational Programme Environment 2007-2013 for implementation in the period 2011-2013.

### **3. Reconstruction, upgrade and extension of the existing UWWTP Plovdiv**

#### **3.1. Dimensioning parameters of the reconstruction, upgrade and extension of the existing UWWTP Plovdiv.**

The parameters for the dimensioning of the reconstruction, upgrade and extension of the existing UWWTP are based on the following:

- Inventorying, analysis and assessment of existing information on population (data from recent years and forecasts for development of town), quantity and physico-chemical composition of wastewater from the existing UWWTP Plovdiv (database from treatment plant laboratory analyses, self-monitoring data, data from performed studies, data from studies on wastewater from industrial plants, etc.).
- Forecast for the water quantities and the pollution load of wastewater for year 2013, 2038 based on the forecasts for economic development perspective of Plovdiv and the region.
- The assumed capacity of the future UWWTP is based on the adopted summarized data

The forecast of the inlet parameters of the rehabilitated UWWTP Plovdiv is made on the basis of the ongoing monitoring and foreseen rehabilitation, upgrade and completion of some process units of UWWTP Plovdiv.

The dimensioning parameters of the rehabilitated UWWTP Plovdiv for end stage in 2038 are set based on the performance indicators of the equipment at the time of the monitoring and forecast and evaluation of the foreseen rehabilitation, upgrade and completion of some process units at UWWTP Plovdiv.

One of the main objectives, apart from raising the level of nutrient reduction, is the construction of a modern sludge management facility for anaerobic stabilization of sludge (methane tanks), biogas utilization (methane gas) for

heating and optimization of the stabilization process and subsequent effective mechanical dewatering of the sludge stabilized up to specified requirements.

**Table № 2 Current and Forecasted Wastewater Load (UWWTP Inlet)**

Indicator	Unit	Project 1984	Target (2013)	Target (2038)	Assumed project parameters of UWWTP
Total Biological load (BOD <sub>5</sub> )	kg BOD <sub>5</sub> /d	34 220	32 468	31 050	<b>33 000 kg/d</b>
	%	100	100	100	
Population equivalent	number	570 333	541 133	517 500	<b>550 000</b>
Percent from domestic customers	%	65.9	67.6	62.9	
Percent from commerce and public service entities	%	18.2	21.7	26.4	
Total wastewater with the characteristics of domestic	%	84,1	89,3	89,4	
Percent from industry	%	15.9	10.7	10.6	
COD	kg/d	66 896	63 093	59 364	<b>66 000 kg/d</b>
Suspended solids	kg/d	35 911	33 313	30 752	<b>34 000 kg/d</b>
Total nitrogen	kg/d	5 634	5 232	4 872	<b>5 300 kg/d</b>
Total phosphorus	kg/d	948	884	822	<b>900 kg/d</b>

**Table № 3 Forecasted inflow quantities and design capacity of UWWTP Plovdiv**

Parameter	2013	2038	Design parameters
<b>Water quantities</b>			
Average daily flow	197 418 m <sup>3</sup> /d	173 937 m <sup>3</sup> /d	<b>200 000 m<sup>3</sup>/d</b>
Water quantity in dry weather	12 637 m <sup>3</sup> /h	12 071 m <sup>3</sup> /h	<b>13 000 m<sup>3</sup>/h</b>
Maximum water quantity	9 108 m <sup>3</sup> /h	8 212 m <sup>3</sup> /h	<b>9 500 m<sup>3</sup>/h</b>
Minimum water quantity (night flow)	6 902 m <sup>3</sup> /h	5 800 m <sup>3</sup> /h	<b>5 800 m<sup>3</sup>/h</b>
<b>Pollution load</b>			
Biochemical oxygen demand (BOD <sub>5</sub> )	32 468 kg/d	31 050 kg/d	<b>33 000 kg/d</b>
Chemical oxygen demand (COD)	63 093 kg/d	59 364 kg/d	<b>66 000 kg/d</b>
Total suspended solids (TSS)	33 313 kg/d	30 752 kg/d	<b>34 000 kg/d</b>
Total nitrogen (N <sub>tot</sub> )	5 232 kg/d	4 872 kg/d	<b>5 300 kg/d</b>
Total phosphorus (P <sub>tot</sub> )	884 kg/d	822 kg/d	<b>900 kg/d</b>
Population equivalent	541 137 p.e.*	517 504 p.e.*	<b>550 000 p.e.*</b>
*1 p.e. (population equivalent) is defined as the organic biodegradable load having a five-day biochemical oxygen demand (BOD <sub>5</sub> ) of 60 g of oxygen per day.			

The summarized forecast data on the quantity and pollution load of wastewater from Plovdiv shows that pollution load generated by wastewater with domestic characteristics predominates with 89.4%, while the share of industrial wastewater is 10.6% (Table № 2 and Table № 3).

**The design capacity of the existing UWWTP Plovdiv in terms of BOD<sub>5</sub> and water quantities is not exceed** with the implementation of the investment project at the end of the reference period in 2038.

**Surface water body** - Markovski collector BGMA500R117 / South outflow channel / - II category water receiver.

**The individual emission limits of the point source of pollution** (UWWTP Plovdiv after Reconstruction and upgrade) are, as per the Permit for use of water body for discharge of wastewater into surface water bodies № 33740070/11.08.2010, amended with Decision № PP – 1098/19.01.2011 for achieving the parameters Nt- 10 mg/dm<sup>3</sup> and Pt- 1,0 mg/dm<sup>3</sup>. The planned reconstruction and upgrade of the existing UWWTP Plovdiv will satisfy the requirements for the individual emission limits of the Discharge permit, and will achieve quality of treated wastewater.

**The process flowchart of UWWTP Plovdiv after reconstruction and upgrade provides the necessary treatment effect and ensures the required parameters of treated wastewater.**

**Table № 4 Parameters of wastewater treated at UWWTP Plovdiv after reconstruction and upgrade**

№	Dimensioning parameters	Unit	2038
1.	UWWTP Plovdiv effluent*		
1.1	pH		6.0 – 8.5
1.3	BOD <sub>5</sub>	mg/dm <sup>3</sup>	25
1.4	COD	mg/dm <sup>3</sup>	125
1.5	Suspended solids / SS	mg/dm <sup>3</sup>	35
1.6	Total nitrogen / Nt	mg/dm <sup>3</sup>	10
1.7	Total phosphorus / Pt	mg/dm <sup>3</sup>	1

The process flowchart guarantees increased treatment effect in terms of BOD<sub>5</sub> 70- 90 %; suspended solids – 80-90 %; COD <75%\_ Total nitrogen – Nt - 70- 80%; Total phosphorus Pt - 60-80%

The reconstruction and upgrade of the existing UWWTP includes:

- Rehabilitation of some process facilities, thereby increasing the degree of reduction of nutrients;
- Upgrade of sludge treatment aimed to achieve stabilization and mechanical dewatering of sludge, generated in the treatment process;
- Construction of a modern sludge management facility for anaerobic sludge stabilization (methane tank), biogas utilization (methane) for heating and optimization of the process, effective mechanical dewatering.
- **Rehabilitation will be carried out on the same existing site of UWWTP Plovdiv**, on land plot 56784.103.1, in the Baker area, Trakia district, in the lands of the town of Plovdiv, Plovdiv Municipality, Plovdiv district, Uniform Classifier of Administrative and Territorial Units Number 56784, with a total area of  $F = 232,534$  dka

The process flowchart of UWWTP Plovdiv includes the following facilities after its rehabilitation and upgrade.

**Table № 5 Main components of UWWTP reconstruction**

Measure
<b>INLET PUMPING STATION AND MECHANICAL TREATMENT</b>
<b>Inlet pumping station (replacement of 1 pump)</b>
Civil works for installation of 1 new spiral pump (preparation of the trough, trilling of openings etc.)
Machinery (1 new spiral pump, electrical works)
<b>New aerated grit chamber with grease trap</b>
Civil works (complete deconstruction of the existing grit chambers and backfilling, excavation for new chambers and concrete works, connection of channels, distribution channel for wastewater collector North etc.)
Machinery (2 new screens for the removal of grit, aeration system, spiral conveyor, screening press, container, gates, SCADA devices, lighting, electric works)
<b>Primary settlement tanks and pumping station</b>
Civil works (deconstruction of existing equipment, excavation and concrete works for new tanks, channel connections)
Machinery (2 new scrapers, hand rails, 2 pumps for primary sludge, pipes, gates, SCADA devices, lighting, electric works)
<b>BIOLOGICAL TREATMENT</b>
<b>Anoxic Selector and anaerobic tanks for biological phosphorus removal</b>
Civil works (channel connections, rehabilitation of crests, weirs)

<b>Measure</b>
Machinery (access bridges, agitators, gate valves, SCADA devices, lighting, electric works)
<b>Reconstruction of existing activated sludge tanks (in connection with adjustment for nutrient removal and inflow conditions)</b>
Civil works (excavation and concrete work for the new distribution channel, optimization of outlet, hand rails etc.)
Machinery (optimization of outlet)
<b>New activated sludge tanks (in connection with nutrient removal and inflow conditions)</b>
Civil works (excavation and concrete works for new tanks, walkways etc.)
Machinery (gate valves, hand rails, lighting installation)
<b>New machinery for activated sludge tanks</b>
Civil works (partial dismantling of existing aeration installations)
Machinery (rebuilding of existing aeration installation, new aeration pipes and membranes, 1 new blower, gate valves and fittings, agitators, pipes, recirculation pumps, analysis and control equipment, SCADA devices, lighting, electric works)
<b>Precipitation agent dosing installation for chemical phosphorus removal</b>
Civil works (installation surface for tank according to water protection requirements)
Machinery (tank for precipitation agent, dosing installation, SCADA devices electric works)
<b>SLUDGE TREATMENT</b>
<b>Pre-thickener (rehabilitation + replacement of mechanical equipment for 1 tank)</b>
Civil works (deconstruction of existing equipment, partial rehabilitation of crest and tank wall etc.)
Machinery (4 agitators, access bridge, sludge liquor pump, SCADA devices, electric works)
<b>Deconstruction of existing non-usable facilities</b>
Civil works (deconstruction of 4 existing digesters which are non-usable including all accompanying facilities, demolition of 2 existing gas tanks, deconstruction of 1 building with heat exchangers and pumps incl. pipes)
<b>New building for pumping station (digester) and for gas utilization</b>
Civil works (excavation and concrete works for the new building, sludge pipelines, fencing of the biogas handling area etc.)
Machinery (housing installations etc.)
<b>New gas utilization (boiler + co-generation unit)</b>
Civil works (excavation for fuel tank, supporting structures, backfilling)
Machinery (co-generation unit, boiler, pipes and fittings, emergency cooler)
<b>New sludge pumping station / heat exchanger (machinery)</b>
Machinery (new sludge pumps, heat exchangers, mixing device, pipes and fittings, compressor, electric works, SCADA devices, etc.)
<b>New anaerobic digesters</b>
Civil works (excavation and concrete works for 3 digesters, insulation, stairwell tower, handrails, walkways,
Machinery (large type screw pumps, gas hoods, pipes and fittings, measurement devices, SCADA devices, internal electrical installations)
<b>Post-thickener (rehabilitation + replacement of mechanical equipment for 1 tank)</b>
Civil works (deconstruction of existing equipment, partial rehabilitation of crest and tank wall etc.)

<b>Measure</b>
Machinery (4 new agitators, sludge liquor pump, access bridge, lighting, SCADA devices, electric installations)
<b>Sludge dewatering</b>
Civil works (dismantling of 3 existing press, partial rehabilitation works in the building, preparation of openings)
Machinery (3 new belt-type filter presses, sludge pumps, precipitation dosing station, compressor, pipes and fittings, SCADA devices, control room)
<b>New sludge collection and distribution (extruding screws, containers, roofed-over construction)</b>
Civil works (dismantling existing lime dosing installation and filter cake output, new area for containers with roof etc.)
Machinery (filter cake output and distribution, containers, 1 second-hand container lorry, SCADA devices, electric works)
<b>New gas tank and gas flare</b>
Civil works (excavation and foundation, gas tank)
Machinery (pipes and fittings, gas flare, purification of exhaust gases, pressure booster, measurement devices, electric installations and SCADA devices)
<b>Sludge drying</b>
Civil works (rehabilitation of existing building, connection to sludge dewatering, construction works for oil tank etc.)
Machinery (sludge drying machinery, housing equipment, steam generator, vapour condensation, sludge cooler, silos, conveyors, internal SCADA and electric works)
<b>MISCELLANEOUS</b>
<b>Construction site facilities</b>
<b>Extension and adjustment of operating roads for the new constructed facilities</b>
<b>SCADA (integrating the new equipment into the existing system)</b>
<b>New samplers</b>



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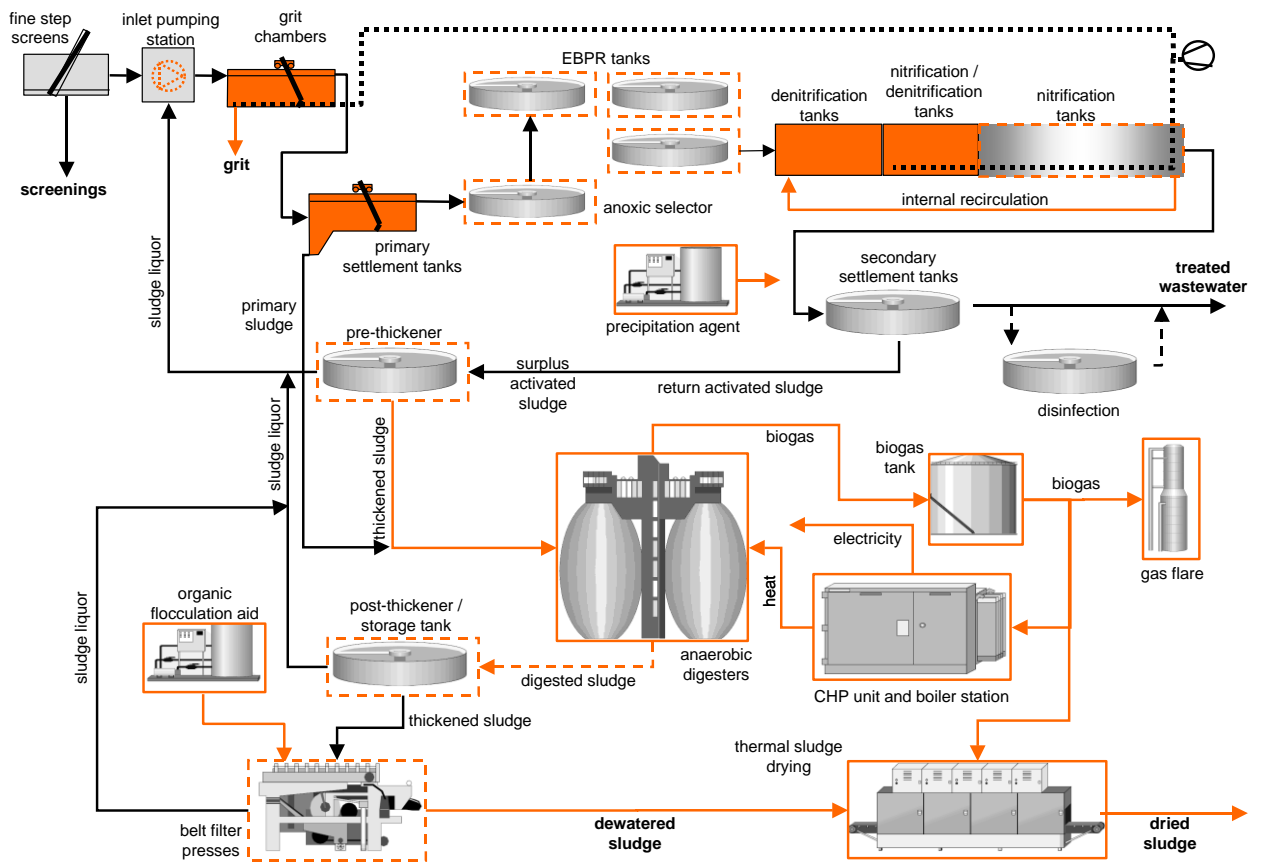
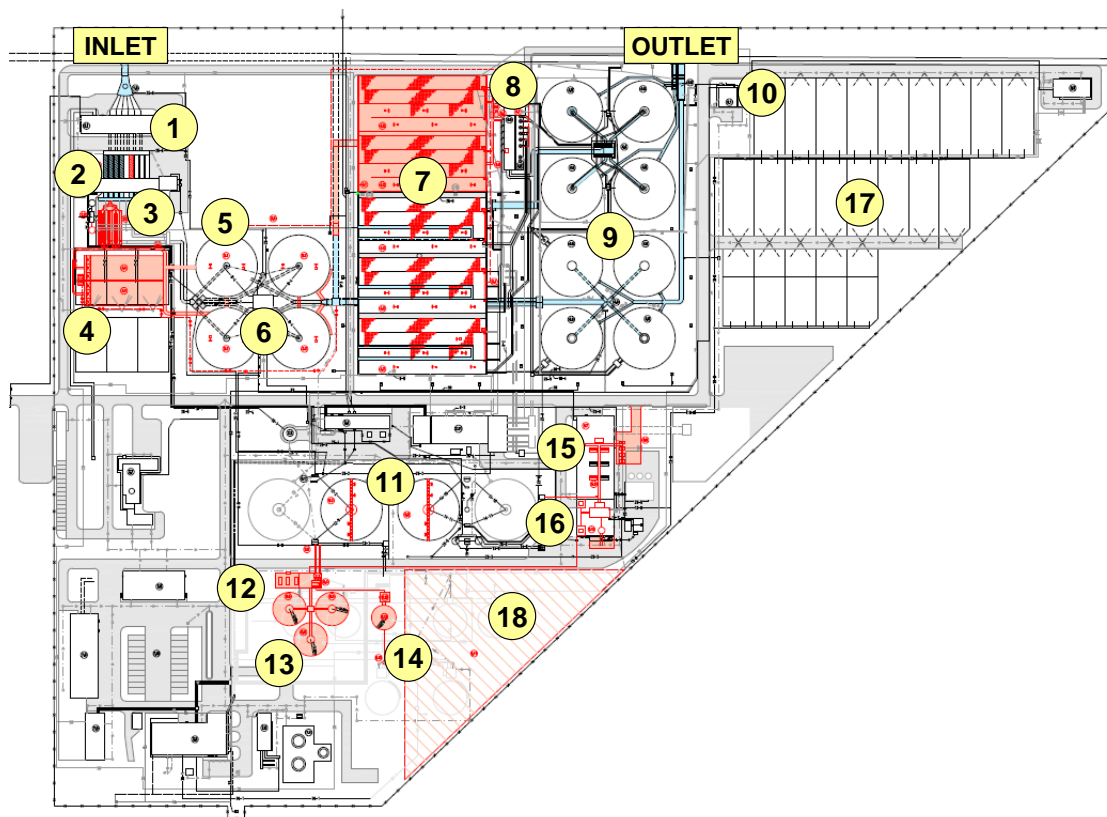


Figure № 4

UWWTP – Plovdiv after reconstruction, upgrade and extension.



1. Screens; 2. Aerated grit chambers; 3. Primary settlement tanks; 4. Anaerobic tanks (EBPR); 5. Blower building; 6. Activated sludge tanks; 7. Precipitation, 8. Secondary settlement tanks; 9. Disinfection, 10. Thickeners; 11. Building for sludge treatment; 12. Anaerobic digesters; 13. Biogas tank and gas flare; 14. Sludge dewatering; 15. Thermal sludge drying, 16. Sludge drying beds, 17. Extension area for sludge incineration

**Figure 1 UWWTP Plovdiv after Reconstruction and Extension**

The rehabilitation of UWWTP will reduce the inflow of pollutants and nutrients into the receiving water. This would achieve compliance with the European standards for waters, discharged from urban wastewater treatment plants (Directive 91/271/EEC of the Council) on economically favorable terms.

The proposed Stage 1 includes eligible investment measures for treatment of wastewaters. These measures include mainly the implementation of nutrients removal in accordance with Directive 91/271/EEC for sensitive areas with prior denitrification and chemical precipitation of phosphate. A combined heat and power unit.

The following measures will be primarily implemented at this investment stage:

- rehabilitation of the mechanical wastewater treatment step;
- installing a facility for improved biological phosphorus removal;
- implementation of a modern sludge treatment technology, including anaerobic stabilization of sludge and additional facilities for mechanical dewatering;

### **Wastes expected to be generated with the implementation of the investment project.**

A “Waste management program” will be developed and agreed with the competent authorities.

#### **Waste from construction of facilities of the investment project**

Construction is expected to generate mainly domestic and construction waste - soils, construction waste, packaging waste and others. Much of the construction waste will be used in the construction of facilities (landscaping, paving, filling damaged areas, etc.). Humus will be used at 100%. *Soils* will also be used for landscaping and excess soil will be disposed of at sites designated by the Municipality. Excavation soils will be used primarily in making backfills and landscaping of sites or for reclamation of damaged areas in the region. *Industrial waste* will be transferred to licensed disposal companies.

#### **Waste from operation of facilities of the investment project**

*Household waste*: Will be collected in containers that will be sprinkled with lime or chlorinated lime for disinfection and will be transported and disposed of in a landfill for non-hazardous waste in the locality. *Construction waste* from repairs. *Hazardous waste* - discarded lamps, waste machining oils. They will be temporarily handed over to a licensed disposal company.

#### **Non-hazardous industrial waste generated at the site of UWWTP:**

- *Waste from screens* - quantity 1000m<sup>3</sup>/year. It will be collected in containers that will be sprinkled with lime or chlorinated lime for disinfection and will be transported and disposed of together with the household waste.

- *Waste from the grit chamber* - washed sand will be transported and disposed of in a landfill for non-hazardous waste in the locality, using a soil capping 1000m<sup>3</sup>/year)
- *Sludge, generated in the wastewater treatment process, anaerobically stabilized (according to option selected with priority) and mechanically dewatered sludge (code 19 08 05) – the sludge reaches 30,000 m<sup>3</sup>/year.*

The sludge is currently not stabilized and its subsequent treatment and utilization is very difficult.

**Table № 6 Results of sludge study in 2010 for heavy metals and persistent organic pollutants (in mg/kg dry solids)**

Parameter	LAC acc. Bulgarian Regulation	Sample 31.08.2010	
		Filter press	Landfill after 12 month
pH	n/a	6.37 ± 0.02	8.03 ± 0.02
DS	n/a	20.59 ± 0.08%	21.26 ± 0.08%
Organic matter in DS	n/a	66.99 ± 0.08%	52.03 ± 0.08%
Cadmium (Cd)	30	3.38 ± 0.29	3.85 ± 0.33
Nickel (Ni)	350	49.3 ± 4.8	46.3 ± 4.5
Zinc (Zn)	3000	930 ± 32	1075 ± 36
Chrome (Cr)	500	170 ± 17	153 ± 15
Copper (Cu)	1600	270 ± 3	270 ± 3
Lead (Pb)	800	403 ± 12	670 ± 20
Mercury (Hg)	16	1.378 ± 0.276	1.808 ± 0.362
Arsenic (As)	25	3.45 ± 0.17	4.20 ± 0.21
PAHs (Polycyclic Aromatic Hydrocarbons)	6.5	0.0381 ± 0.0114	0.0482 ± 0.0145
PCBs (Polychlorinated Biphenyls)	1	0.29 ± 0.06	0.93 ± 0.19

**Table № 7 Microbiological and Parasitological Results of Sludge Studies in 2010**

Parameter	Unit	Bulgarian regulation	Sample 31.08.2010	
			Filter press	Landfill after 12 months
Salmonella	Presence in 20 g	Not allowed in 20 g	not isolated	not isolated
Escherichia coli titer	Titer in g	above 1 g	0.0000001	0.1
Clostridium perfringens titer	Titer in g	above 1 g	0.001	0.01

The content of all heavy metals lies considerably below the LAC values for use in agriculture.

Concerning the sanitary-parasitological and microbiological parameters, the sludge does not conform to the Bulgarian legislation on agricultural use. Final sludge stabilization and decontamination has not been achieved.

Permit 00-DO-314-00/28.12.2009 of the MoEW allows temporary storage, transportation and utilization of waste from WWTP Plovdiv on site 2 in Plovdiv, “Yagodovsko shosse” str. until 21.12.2014:

*Screenings* (code 19 08 01 ) – quantity around 400 m<sup>3</sup>/year (240 t/year 2010)  
*Waste from grit chamber* (code 19 08 02 ) - quantity around 1000 m<sup>3</sup>/year (680t/year 2010 )

*Sludge, generated in wastewater treatment process* - 50 000 m<sup>3</sup>/year (currently the sludge is not stabilized) currently 18% - dry solids incl. around 82% - 44 822 m<sup>3</sup>/year. The sludge reaches up to 50 000 m<sup>3</sup>/year.

Till August 2009 the dewatered sludge has been disposed in a landfill for sludge near Plovdiv. After that time, the sludge has been stored within the WWTP in the existing drying beds.

The project proposes anaerobic treatment of the sludge, generated in the treatment process, with generated biogas utilized in processes, related with drying the mechanically dewatered sludge. Additional equipment is proposed to enhance the dewatering effect achieving lower humidity, to reduce the operating costs for drying and transporting the sludge to the places of its utilization or disposal. In the future, after reconstruction and upgrade of the sludge management facility it is expected that anaerobically stabilized and effectively dewatered sludge with humidity 70% will reach 30,000 to 40,000 m<sup>3</sup>/year.

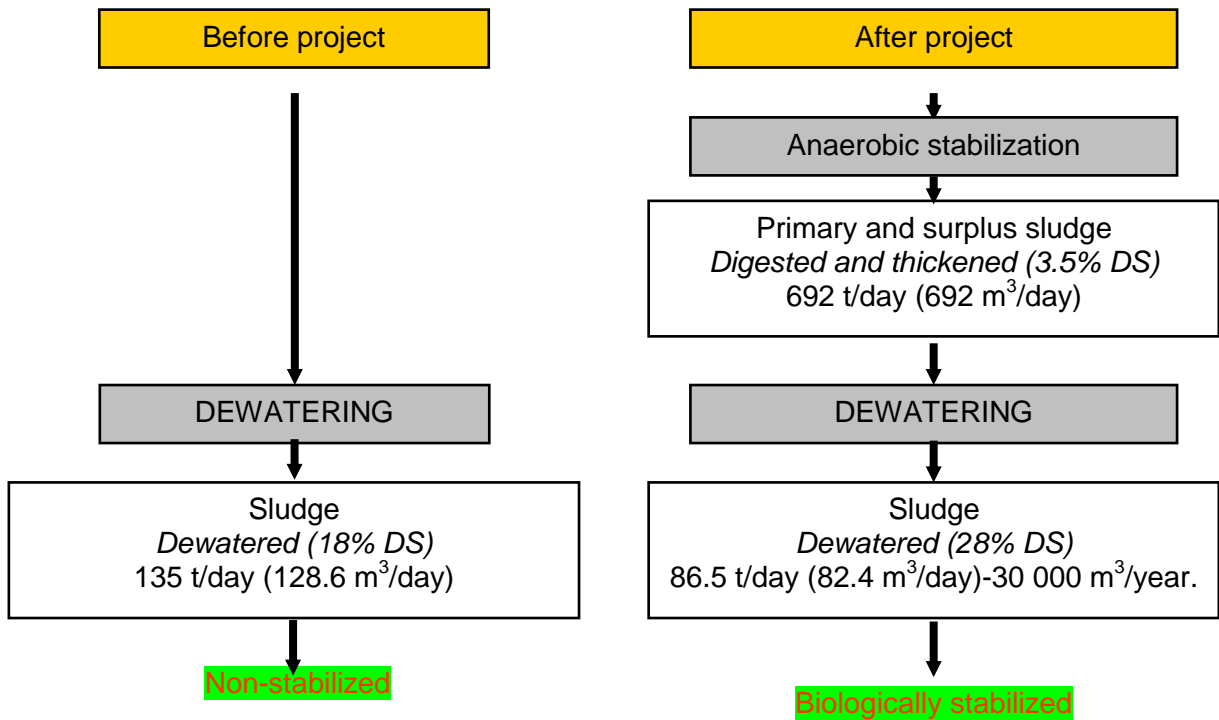
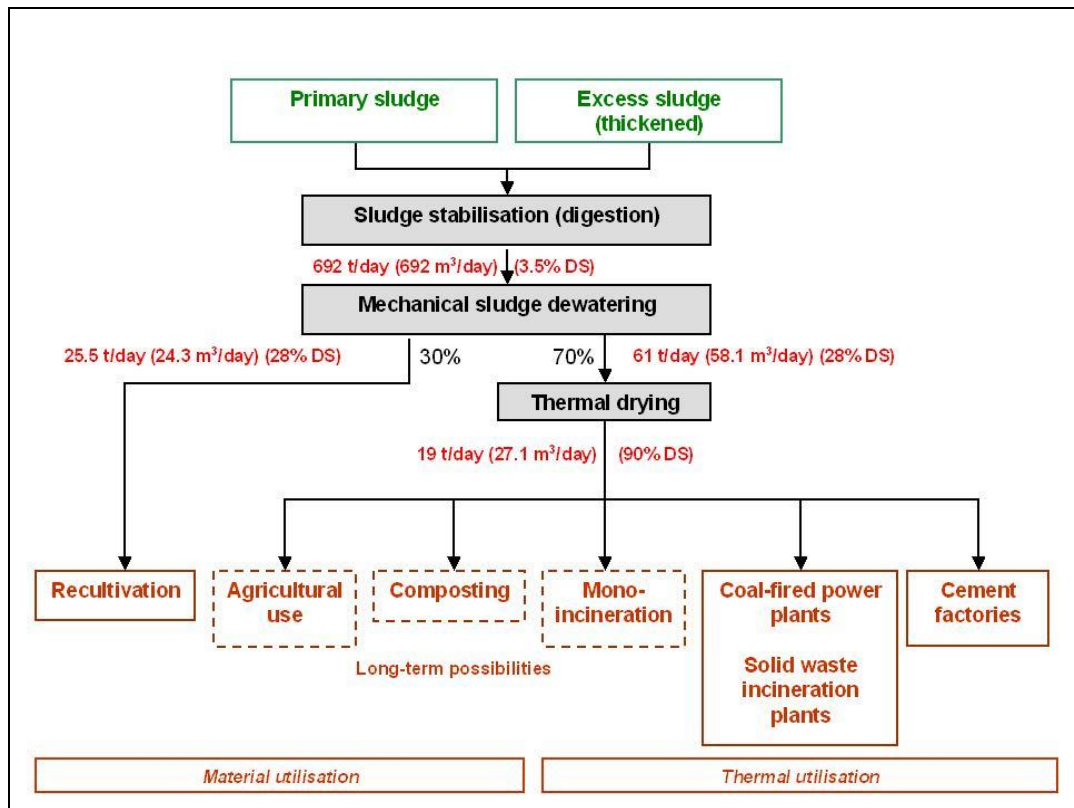


Fig .6 : Quantity of dewatered sludge before and after project



**Fig. 7. Proposed sludge disposal strategy and sludge quantities**

Measures are proposed for decentralized, subsequent utilization of sludge from UWWTP Plovdiv for soil capping of landfills, reclamation of disturbed lands, in agriculture and others.

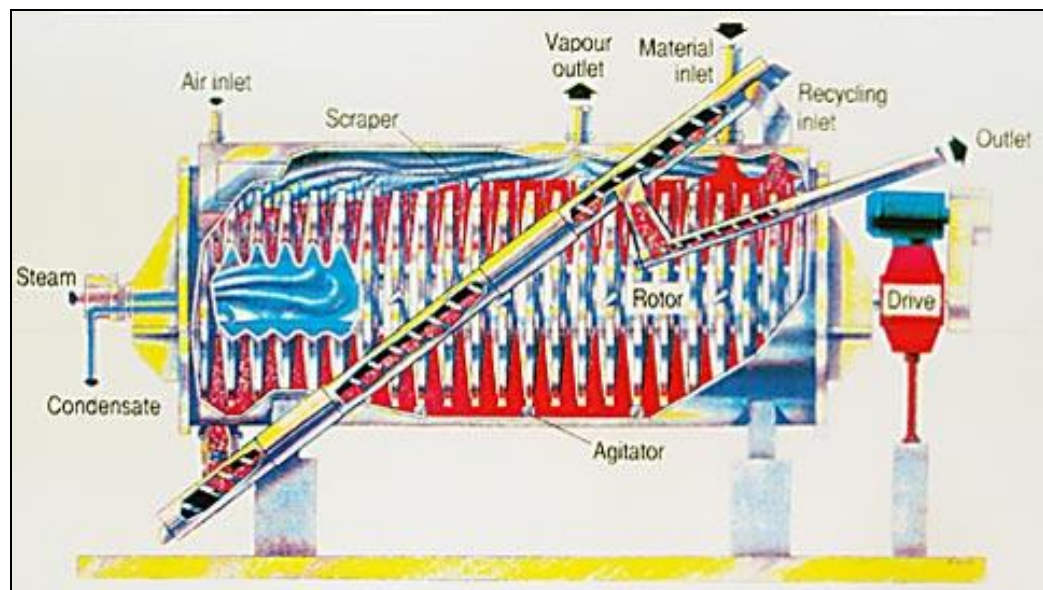
The aerobically mineralized sludge contains valuable nutrients: organic matter min. 56%, carbohydrates min. 11% (alpha cellulose min. 4% and hemicellulose min. 7%) Total nitrogen Nt - 3%, Total Phosphorus as P<sub>2</sub>O<sub>5</sub> - 2,1-2.4%, fat min. 9%, cellulose 25% and other compounds 28-30%. The sludge also contains many vitamins of the B group with predomination of vitamin B<sub>12</sub>. The dried sludge is a product which, after certain processing, can be used.

At the moment RWC Ltd has Decision № 00-TO-314/28.12.2009, issued by the MoEW for a period up to 21.12.2014, which includes also the waste and sludge from the existing UWWTP Plovdiv, currently in temporary storage on site № 2, located in Plovdiv, District Plovdiv, Plovdiv Municipality "Yagodovsko shosse" Str. Activities are under way for temporary storage, transportation and

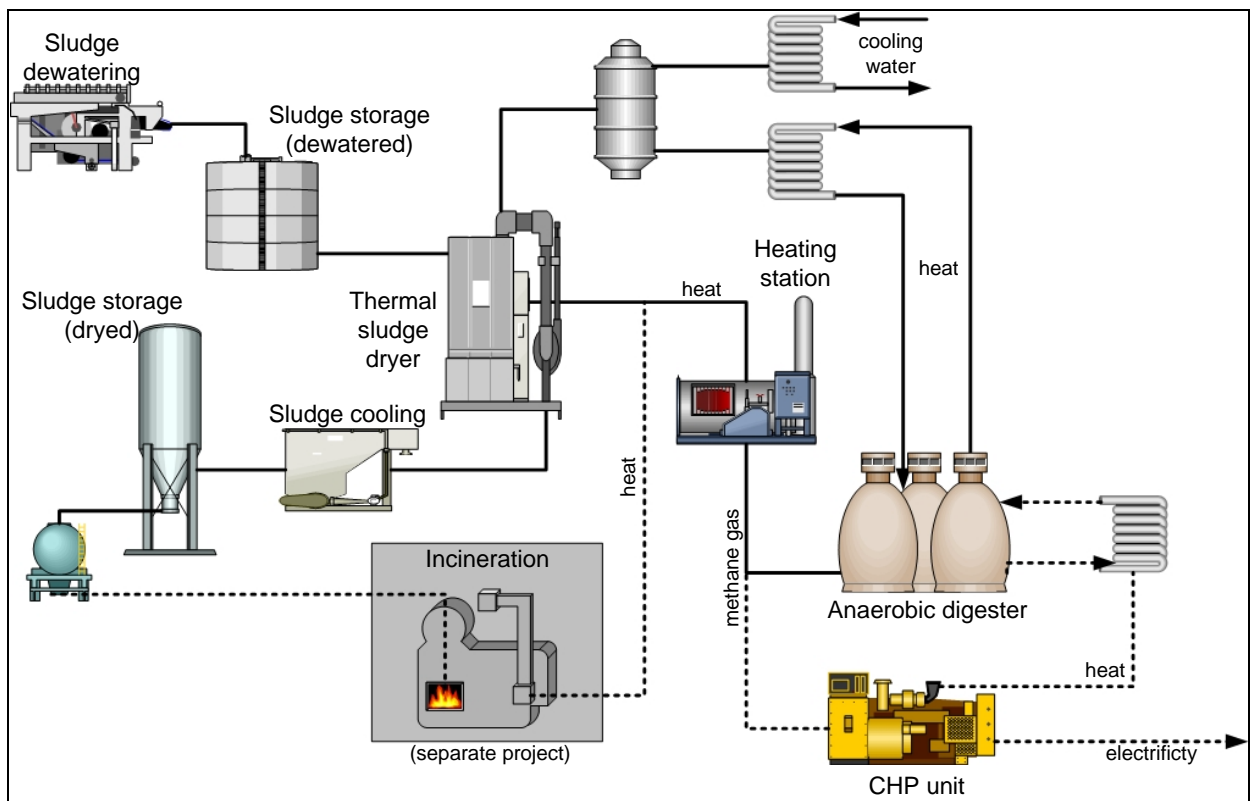
utilization. The sludge is temporarily stored also in the sludge drying beds at WWTP site.

The preliminary decisions of the consultant provide a number of proposals for the treatment of stabilized and mechanically dewatered sludge. In subsequent project stages the most rational solutions for decentralized utilization and disposal of the sludge treated at WWTP site will be chosen for implementation after precise analysis, technical and economical justification and depending on the actual conditions and possibilities of the municipality.

It is necessary to develop an updated UWWTP sludge management program. In relation with subsequent decentralized treatment of sludge from UWWTP Plovdiv it is proposed to implement Sludge drying and biogas utilization.



**Fig. 8 Schematic diagram of a disc dryer**



**Figure 9. Flowsheet of the sludge dewatering and drying system**

The facilities, included in the project for integrated water measures are environmentally sound and with highly positive impact on the environment. The negative impact from their realization on the different components of the environment and the factors that affect it, are reduced to a rational minimum.

- The project employs advanced technologies, equipment and necessary measures for ensuring minimal impact on environment.
- The use of modern rational methods, construction materials and appropriate vehicles contribute to achieve compliance with the maximum allowable limits for the substances polluting water, soil and ground-air ecosystems.
- The implementation of the investment project is expected to reduce the water consumption by limiting the leaks from the existing water supply network, which is compromised in some sections.

- The implementation of the investment project provides effective measures for achieving the hygiene standards for protection of life and health of people.
  - The extension and rehabilitation of the sewer network will eliminate the contamination of surface and ground waters, caused by leaks from septic tanks and accidental spills, direct discharge of untreated wastewaters (not collected in the existing UWWTP), wastewaters, inadequately treated in the existing UWWTP Plovdiv (the process flowchart and the equipment are morally and physically obsolete and do not meet modern requirements).
  - No construction of new road infrastructure or changing the existing one is provided.
  - No pollution with construction waste is expected to occur, because of the requirement for timely transportation of all wastes to the disposal site, designated by the Municipality at the start of construction.
  - There is a problem with the treatment of sludge, generated in the water treatment process at UWWTP Plovdiv. The investment project provides the implementation of an effective aerobic stabilization and mechanical dewatering, which will reduce its organic content. The engineering design proposes methods for sludge treatment. After preparation of a Sludge Management Program and a technological and economic justification, the most rational solution can be adopted. At present moment measures are taken to treat the sludge, generated at the UWWTP site. A number of studies have been performed on treatment of deposited and generated sludge, currently and in future. The most rational solutions are to be implemented after detailed process analysis and technical and economical justification, and taking into account decentralized treatment of anaerobically stabilized mechanically dewatered sludge in relation with its subsequent disposal or utilization.
  - The analyses of sludge from UWWTP Plovdiv show that currently its chemical parameters meet the requirements for waste, having no excessive levels of heavy metals and other harmful substances and is classified as "non-hazardous waste". The sludge, however, is not sufficiently stabilized and does not meet the requirements in terms of microbial indicators.
  - A Sludge management program has to be agreed with Plovdiv Municipality.
-

- Several alternatives for sludge treatment after reconstruction, upgrade and extension of UWWTP Plovdiv are currently being investigated.
- There is an opinion from the Cement plant in Dimitrovgrad about the use of stabilized, dewatered and dried sludge, as well as studies on use of sludge from UWWTP Plovdiv for reclamation of landfills, etc.
- No excessive negative impact on air quality is expected under the proposed measures during the period of construction and operation of the facilities, included in the investment project.
- During the implementation of the investment project and under strict control on the implementation of the measures provided, no pollution or discomfort on environment is expected.
- The sites of the investment project, related with the rehabilitation and extension of the water supply network, the sewer network and the facilities, associated with them, will be fully realized within the urbanized area of the town of Plovdiv and do not fall within Protected zones under the Biodiversity Act and shall not affect protected areas under the Protected Areas Act.
- The reconstruction, upgrade and extension of UWWTP will be done on the existing site, which is anthropogenically disturbed. The site is located within the territory of Plovdiv, Trakia residential district, Plovdiv Municipality, Plovdiv District, Uniform Classifier of Administrative and Territorial Units Number 56 784. The total area of the facility is  $F = 232534 \text{ m}^2$  (232,534 dka). The site of UWWTP Plovdiv is situated 6 km east from the center of Plovdiv, close to Trakia residential district and about 700 m from the outlying residential buildings. Treated wastewaters are discharged into the Markovski collector BGMA500R117 /South outflow channel/, 2.6 km before discharge into the Maritsa river – II category receiving water. Maritsa downstream EAS RBD. Geographical coordinates of the point of discharge N  $42^{\circ} 08, 516' 15,1''$ ; E  $24^{\circ} 49.203''$ .
- The site of UWWTP Plovdiv is located outside of “Maritsa Plovdiv” BG0002087 protected area on protection of birds (over 6 km and the channel discharges beyond the borders of the protected area) and “Maritsa Parvomay” protected area, BG 0002081 under the Birds Directive and BG 0000578 under the Habitats Directive 92/43/EEC. The upgraded UWWTP Plovdiv with improved degree of water treatment will have indirect positive contribution to sustainable development of biodiversity by enhancing the self-purification

ability of the water body and a positive impact on the aquatic ecosystems in this area.

- Taking into account the area on which the investment project will be implemented and the specifics of planned activities, it is not likely natural habitats and habitats of species to be affected, destroyed and fragmented. No forest areas or tree species will be affected and there will be no situation of isolation of species.
  - The territorial scope of impact resulting from construction is located within the allocated sites. The IP is expected to have positive cross-border impact (treated wastewaters in UWWTP Plovdiv with about 200 000 m<sup>3</sup>/day of wastewater, pollutant load over 500 000 population equivalent in BOD<sub>5</sub>, which will be reduced by about 97%, reducing also the loads of Nt (50-67%) and Pt (60 - 80%)
  - Ability for assimilation of the ecosystem in natural environment: no adverse environmental impacts are expected to occur as a result of the implementation of the investment project. The projected activities are not related with a change or disturbance of the land use.
  - No negative impact on soil functions is expected. Regulation of water supply, reduction of water losses and elimination of discharge of domestic wastewaters into the soil (in the absence of sewage) will affect positively groundwaters and soils in the area.
  - Construction works and excavation activities will temporarily increase the sound pressure in daylight hours, but within limited periods of time and locally within the activity performed (the linear facilities of UWWTP are outside the populated areas).
  - No change in noise emissions and acoustic load on the environment is expected after the completion of the sites, included in the investment project.
  - The implementation of the investment project will change significantly the sanitary and hygienic conditions of the environment, urban environment will improve, accompanied with specific favorable effects and prevention of health risk. (Appropriate measures will be taken during construction to minimize the negative impacts and exclude any adverse health effects on residents)
  - Taking into account the nature of the investment project, the impact can be defined as long-term and positive.
-

**The components of the investment project should be implemented in short term perspective to achieve higher quality of living environment for the population in the area, conforming to the European standards.**

**The implementation of the investment project will achieve:**

- Providing population with sufficient quantity of water with good quality and minimizing losses along the water supply network. Pollution of the receiving water will be prevented by the discharge of all wastewaters into a modern UWWTP, which has the required capacity and will treat wastewaters up to the requirements of applicable law.
- Improving the quality of life of people and environmental protection of the region.
- Prevention of health risk to population in the region due to discharge of untreated wastewaters into water bodies.
- Will help create better conditions for sustainable development of the aquatic ecosystem in the Maritsa river and the development of biodiversity in Maritsa - Parvomay protected area, respectively
- Rehabilitation and extension of UWWTP Plovdiv is proposed. The proposal takes into account the eligible investment measures for financing under the Cohesion Fund for wastewater treatment and optimization of sludge treatment (mechanical dewatering, sludge stabilization and biogas utilization)

**4. Current environmental conditions in the region. Impact of the investment project facilities on the environmental components and the factors, influencing it.**

The environmental condition is influenced by a complex set of factors:

- diverse natural and geographical structure of the region (topography, geological structure, surface and groundwater, soil cover, flora and fauna)
- industries
- urban network and existing technical infrastructure
- specialization and territorial organization of agriculture and the peculiarities of employed agricultural technologies
- legislation and state policy and the policy of local authorities in the use of natural resources and environmental protection
- degree of development of communal and public services to population and business
- availability of information system for monitoring, control and management of environmental protection activities and many others.

(The analysis used data from official sources of background information - the National Statistical Institute, annual reports on the state of the environment, 2006-2009, conducted studies in this area, etc.).

Geography: Plovdiv is the center of the district, located in the northern part of the South Central region. Its central geographical position is an important comparative advantage of the district.

**Natural-resource potential - the territory of the area has a varied topography.**

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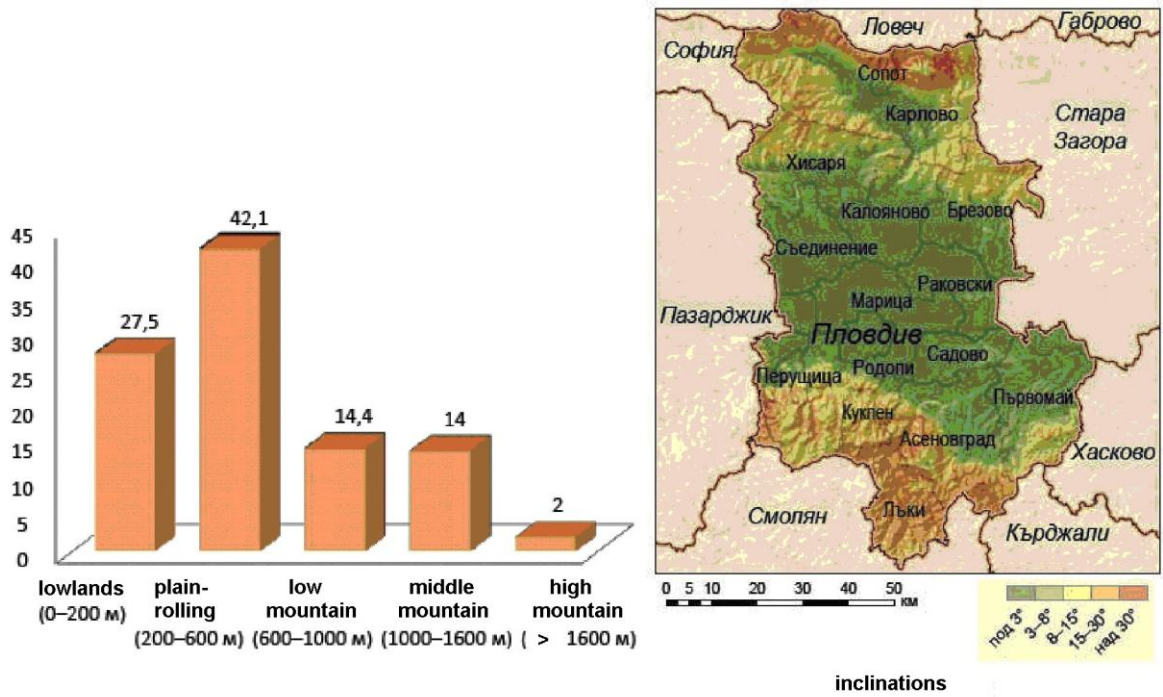


Fig. 4-1 Topography of Plovdiv district area

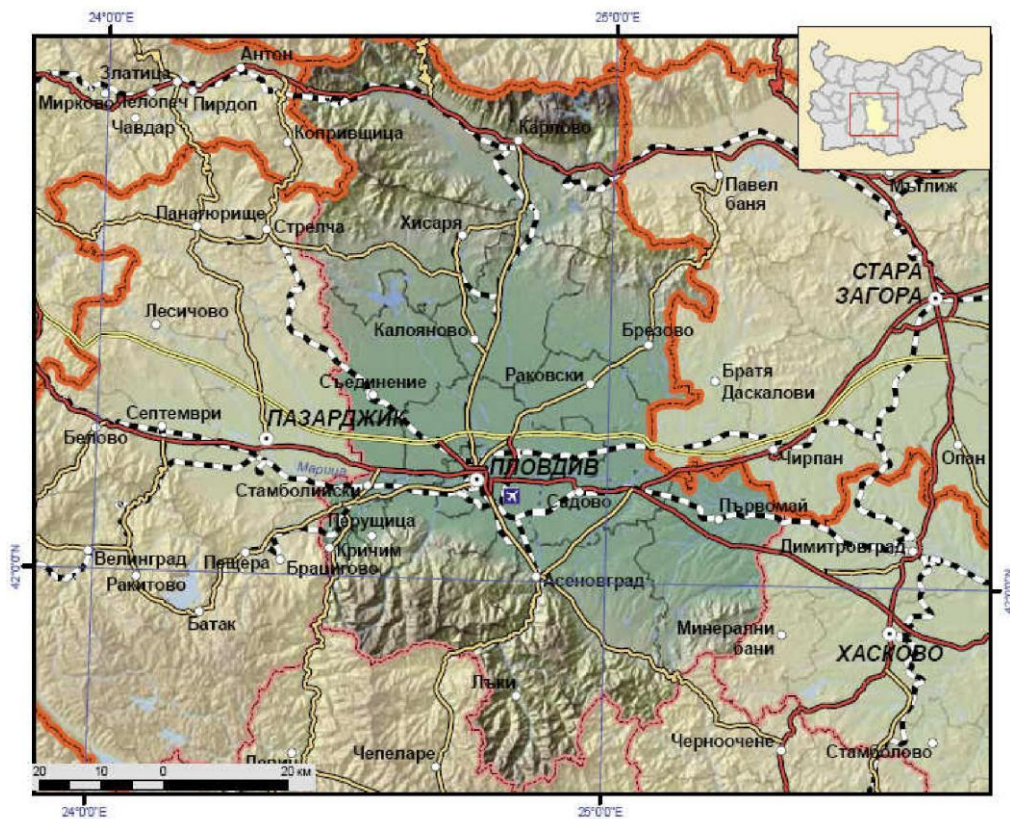


Fig. 4-2 Plovdiv district with Plovdiv in the center

**Main drainage artery is the Maritsa River** - the deepest river in Bulgaria, its catchment area includes the East Aegean drainage area of the country. The longest river within the district is Stryama (110.1 km), which is a tributary of Maritsa originating from the Balkan mountains. The Tundja River originates from the Kalofer Mountains. Larger tributaries of the Maritsa within the district originating from Sredna gora mountains are Pyasachnik and Rahmanliyska rivers, and tributaries from the Rhodopes - Vacha, Chepelarska (Asenitsa), Mechka, Kayaliyka. The Rhodope tributaries more strongly influence the characteristics of the flow of the Maritsa within the district. The high water of the rivers is from December to May and low water - in late summer and early autumn. The average annual water flow (flow module) in the basin of the Maritsa is 6-7 l/sec/km<sup>2</sup>, and for the tributaries Stryama, Vacha and Chepelare - 8-11 l/sec/km<sup>2</sup>. Many karst springs exist in Chernatitsa and Dobrostan areas. Groundwater exists in the terraces of the Maritsa and its tributaries, in the sediment cones in the Karlovo valley and the Rhodope foothills of the Plovdiv-Pazardzhik field. The mineral springs in Banya (Karlovo Municipality), Hisar and the villages of Krasново and Staro Zhelezare (Hisar Municipality) and Narechenski bani (Assenovgrad municipality) are a valuable resource for development of spa tourism. Mineral water is bottled in Hissar. Larger dams in the region are "Pyasachnik", "Domlyan", "Ezerovo", "Bryagovo" and others. Karlovo valley predominates with delluvial, alluvial-meadow and cinnamon forest soils, while the soil cover of the Plovdiv-Pazardzhik field is represented also with large portions of vertisols. These soils are suitable for growing mainly vegetables, grains, oilseeds, technical, forage crops, and vineyards. In the higher parts of the area there are cinnamon forest, rendzinas (humus-carbonate soils), brown forest and mountain-meadow soils, suitable primarily for forestry and pasture farming.

The relative portion of the territories for conservation of natural habitats and wild flora and fauna, included in Natura 2000 environmental network, amounts to 29.75% of the area of the district, ranking it 13<sup>th</sup> in the country by this parameter. Based on data for year 2007 the districts ranks 1<sup>st</sup> in the region and 4<sup>th</sup> in the country by total area of lands designated for agriculture, and by area of used agricultural lands - first in the region and third in the country. Most agricultural lands has Karlovo municipality, and least - Krichim Municipality. Agricultural areas occupy the largest portion of the territory of Rakovski municipality and the smallest portion of Laki municipality. By area of woodlands the district ranks fourth in the region and seventh in the country. By relative share of forest areas Laki is first in the district,

and Plovdiv Municipality is last. By relative share of urban territories Plovdiv municipality is first in the district, in region and in country.

#### 4.1. Ambient air

**Climate** - Karlovo and Plovdiv-Pazardzhik fields have transitional-continental climate, while the higher parts of the Balkan mountains, Sredna gora mountains and the Rhodopes have mountain climate. The average annual temperature in the non-mountainous part of the district (Plovdiv, 160 m above sea level) is 12,1°C, the average temperature in January is 0,3°C, and the average in July - 22,9°C. The annual precipitation is about 514 mm. The minimum rainfall is in October and the maximum in May. In areas with mountain climate the temperatures are lower and the rainfall is higher. The average annual temperature on mount Botev is -0,6°C, the lowest temperature is recorded in February (-8,5°C), and the highest - in August (7,2°C). The average annual rainfall there is 1094 mm.

Plovdiv field and the town of Plovdiv fall within the sub-continental transition of the European subregion. Winters are relatively mild, autumn is warm and long, summer is hot, with frequent droughts.

The area in which Plovdiv is located is characterized by specific features influenced by topography - the shape of the field and the close proximity of the Western Rhodopes. There is a continuous flow of cold air from the mountains, which penetrates the deep river valleys, enters the lowlands and affects the physical processes and phenomena of the air basin, creating specific cloudiness, extreme temperatures, inversions, local winds, fog, frost, rain, etc., solar radiation.

According to the climatic division of the country, the town of Plovdiv falls within the climatic region of Southeast Bulgaria from the sub-continental transition of the European continental zone.

Sunshine duration hours in Plovdiv: average annual 2264 hours, with a maximum in VII (321 hours) and a minimum in XII (78 hours).

A characteristic feature of Plovdiv and Plovdiv field are temperature inversions. The study on temperature inversions has found that they are more predominant in Plovdiv than in Sofia and its typical valley - 81% of the time in winter. The differences between the lower and the upper inversion limit in summer is about 1°, with an average height of 150 -170m, while in winter it reaches 19,4°, with an average height of 720 meters (maximum - 1600 m).

West winds are predominant in Plovdiv throughout the year - 33-60%, followed by winds from the east - 16-33% and winds from southwest and southeast - up to 10%. Weak winds (0-5 m / sec) are predominant, wind speeds up to 1 m/sec take 95% of time of the year, and those with speed of 2-4 m/s take 5 to 30%.

#### Climatic features of the urban area of Plovdiv Municipality

The urban area of Plovdiv has its own distinct climate, caused by the change of landscape, unlike the unbuilt parts of the city and the Plovdiv field.

The main factors affecting the city climate are the type, density, orientation and nature of the buildings, type and orientation of streets, landscaped and unplanted areas, water areas, type and reflective capacity of artificial coatings, sources of heat and gas emissions etc. The combined influence of natural and anthropogenic factors have formed local climatic conditions. For the city itself they are not very favorable. This is evident from the “Bioclimatic passport of town” A total of 58.02 days (15.89%) of the year provide uncomfortable weather conditions, in 113.2 days the climatic conditions of the environment are favorable for basic human activities, and in the other 170 days the weather is cold or cool with predominant wind.

**Table № 4.1-1 Bioclimatic passport of town**

№	Duration		Parameters			Bioclimatic assessment
	Days	% year	T <sup>0</sup> C air	humidity %	wind m/s	
1	36,30	9,93	under 0 <sup>0</sup> C	above 80	above 3,5	Discomfort cooling
2	57,03	15,62	0-5	30-70	3-3,5	Cold
3	113,20	31,01	5-15	30-70	0,5-3,0	cool
4	136,75	37,48	15-25	30-70	0,5-3,0	Comfort
5	21,72	5,96	>25	< 30	< 0,5	Discomfort heating

A complex landscape-climatic assessment of the area from the standpoint of human ecology outlines four microclimatic zones in the separate urban areas:

**A1 zone** - most favorable - includes the "Recreation and amusement" park, a land stripe 100 to 200 m along the riverbed, the green areas on the hills and the immediate surrounding. The microclimatic conditions in this area during the warm seasons are characterized by lower temperatures (and diurnal variations), higher relative humidity and better conditions of ventilation. In winter, the opposite, there are frequent episodes of "uncomfortable overcooling" (higher relative humidity - 10-18%, wind - 3-5 m/s, longer duration of mists);

**A2 zone** - favorable - zone isoline limits - the river to the north, approximately to "Bulgaria" boulevard, "Hr. Smirnenski - west" residential district to the south, "Peshtersko" shosse to "Ruski" boulevard, approximately 50 m from the eastern foot of "Bunardjika" hill, "6 September" boulevard, "Br. Veleshki" street – "Tsarigradsko Shosse". The microclimatic conditions are more favorable here than in the A1 zone. The period of "uncomfortable heating" is 18-22% longer than the "comfortable" period. In the cold months the periods "cold" and "cool" are 8-12% more than the "uncomfortable cooling" periods, compared with A1 zone.

**A3 zone** - relatively good - covers the territories north of "Bulgaria" Blvd in "Karshiaka", "Hr. Smirnenski – East" residential district, the area of the Central Railway Station, south of the territory of "Vastanicheski" district - to "Macedonia" Blvd - Freight Railway Station, "Bogomil" street – "Lauta" park – the northwest part of "Trakia" residential district along the central dividing line of "Tsar Simeon" boulevard - to "Trakia" railway station. The microclimatic conditions are relatively favorable here - the "uncomfortable heating" period is significantly larger - by 20-25% in average, shortening the "comfort" period, compared with A1 zone. The "cold" and "cool" periods are approximately the same as in the A2 zone, the "uncomfortable cooling" period is slightly extended (reduced wind speeds).

**A4 zone** - unfavorable - covers the areas south of the A3 zone isoline. Here are the southeast part of “Vastanicheski” district, the South industrial zone, the southeastern part of “Trakia” district. This zone features longer durations of the two unfavorable climatic feelings - "uncomfortable cooling" and “uncomfortable heating”. In winter, in prevailing calm weather, a "lake of cold" emerges here, there is also increased duration of mists. In winter temperatures are 3,6°C lower compared with A2 zone, and in summer - 3.8°C higher in calm weather. There is significantly lower relative humidity - 8-15%.

### **Ambient air quality (AAQ)**

#### **Monitoring of the main parameters, characterizing the quality of ground layer of air in the region of RIEW – Plovdiv**

The monitoring is performed by monitoring stations of the Ministry of Environment and Waters: Station of the Ministry of Health “HEI” - Plovdiv and The Ancient Bath, as well as the monitoring station of NIMH - Plovdiv. Control measurements are performed to determine the level of monitored pollutants: sulfur dioxide, nitrogen dioxide, total dust, particulate matter - PM<sub>10</sub> and PM<sub>2,5</sub>, lead aerosols and cadmium, ozone, carbon monoxide, ammonia, benzene, and total non-methane hydrocarbons, arsenic, nickel, surface active substances (SAS), where "level" means a particular concentration value of a pollutant. In manual stations sampling is performed 4 times a day in daylight hours every business day (this does not refer to total dust, PM10, arsenic, nickel, SAS, measured in the stations of RIEW, where sampling is performed 24 hours a day).

Various regulations have been issued on limiting the anthropogenic impact. Initially they were aimed at protecting people and later - at protecting the entire environment from the negative effects and dangers of human activity.

Air pollution is monitored by eight fixed stations, installed as a part of the national system, one of which is continuously operational and fully automatic:

- Station 01 - "NIMH" - Plovdiv – providing data on air pollution in the central part of town, characterized with heavy street traffic, local domestic and public heat power plants operating on solid and liquid fuel.
- Station 05 - "HEI" - Plovdiv - located in the western part of town in a residential area close to a park, next to a busy road, and among local domestic and public heat power plants operating on solid and liquid fuel.
- Station 07 - The Ancient Bath, the station is re-commissioned since 09.2002, and monitors the pollution from the intensive street traffic.
- Station 14 – "Gigant" apartment building - Plovdiv - located in the northern part of town at the intersection of "Karlovska shosse" and "Dunav" blvd., providing information on pollution from road transport, "Filipovo" railway station, Northern Industrial Zone and "Sever" bus station (bus station North).
- Station 15 – "Kuklen" – the village of Kuklen– provides information on the impact of industrial emissions – "KCM" AD - Plovdiv. This station was closed on 31.12.2004. It was replaced by a fixed automated station of "KCM" AD – Plovdiv.
- Station 16 - "City Hall" – the village of Dolni Voden – providing information on the impact of industrial emissions – "KCM" AD - Plovdiv.
- Station 17 – "Assenovgrad" – in the town of Assenovgrad – provides data on pollution by the emissions from "KCM" AD, as well as the formation of a background pollution by the city industry, road transport and the public utilities sector.
- Station 19 – automated measuring station "Evmolpia" – in city center, automated continuous monitoring – analyzing the general urban background pollution.

The first three stations are maintained by the departments of NIMH - Plovdiv and the Regional Inspectorate for Protection and Control of Public Health (RIPCPh) - Plovdiv and the rest - by Regional Laboratory - Plovdiv to the Executive Environment Agency (EEA). The data are received daily at RDC of RIEW.

AMS "Evmolpia" is part of the national system for monitoring the quality of ambient air in real-time and submits the results of performed measurements to RIEW over a radio frequency on hourly basis.

Since 2009 a new automatic station for control of air quality operates in Plovdiv. It is located on a busy intersection next to the Ancient Bath. It collects data on air pollution from road transport with NO, NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub>, CO, Cd, C6H6, benzo (α) pyrene. In the same year MoEW's manual sampling station at "Gigant" apartment building was closed.

### **Ambient air quality – condition and trends.**

Performed monitoring and observation of the region, under the control of RIEW, as well as the information, obtained from the monitoring stations for control on air quality, show that exceedances of the admissible values are registered occasionally in certain days in the area of the town of Assenovgrad, Gorni Voden area and Plovdiv - "HEI" station, "NIMH" and "Gigant" apartment building, primarily in the first quarter of the year. The measurements performed with the mobile automatic laboratory in the region according to the planned program show no deviations from established standards. During the winter season, by information of the municipal ecologists, there is an extensive use of solid fuel /coal and wood/ for heating in residential buildings, which, in unfavorable weather /calm weather/, results in peak excess pollution with sulfur dioxide and particulate matter /PM 10/.

Automatic measuring station (AMS) "Evmolpia" in the town of Plovdiv is of background type and measures the concentrations of **SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub>, NO, CO, NO<sub>x</sub>, H<sub>2</sub>S, PM<sub>10</sub>** and others by sending data also to the European Environment Agency under the Convention on transboundary pollution.

Taking into account the need for timely and accurate information, actions are taken to collect it. Reports, obtained from the municipal administrations and individual industries, provide summarized information on the quantity of fuels used in the respective sectors. The general environmental programs of municipalities, developed in recent years, provide additional information and analysis of pollution in the respective areas.

In relation with the implementation of the provisions of article 27 of the Clean Air Act art. 31 and art. 34 of Ordinance No 7, the Municipalities of Plovdiv, Assenovgrad and Kuklen have prepared and adopted the programs for

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emissions management and achieving the established standards for harmful substances in ambient air.

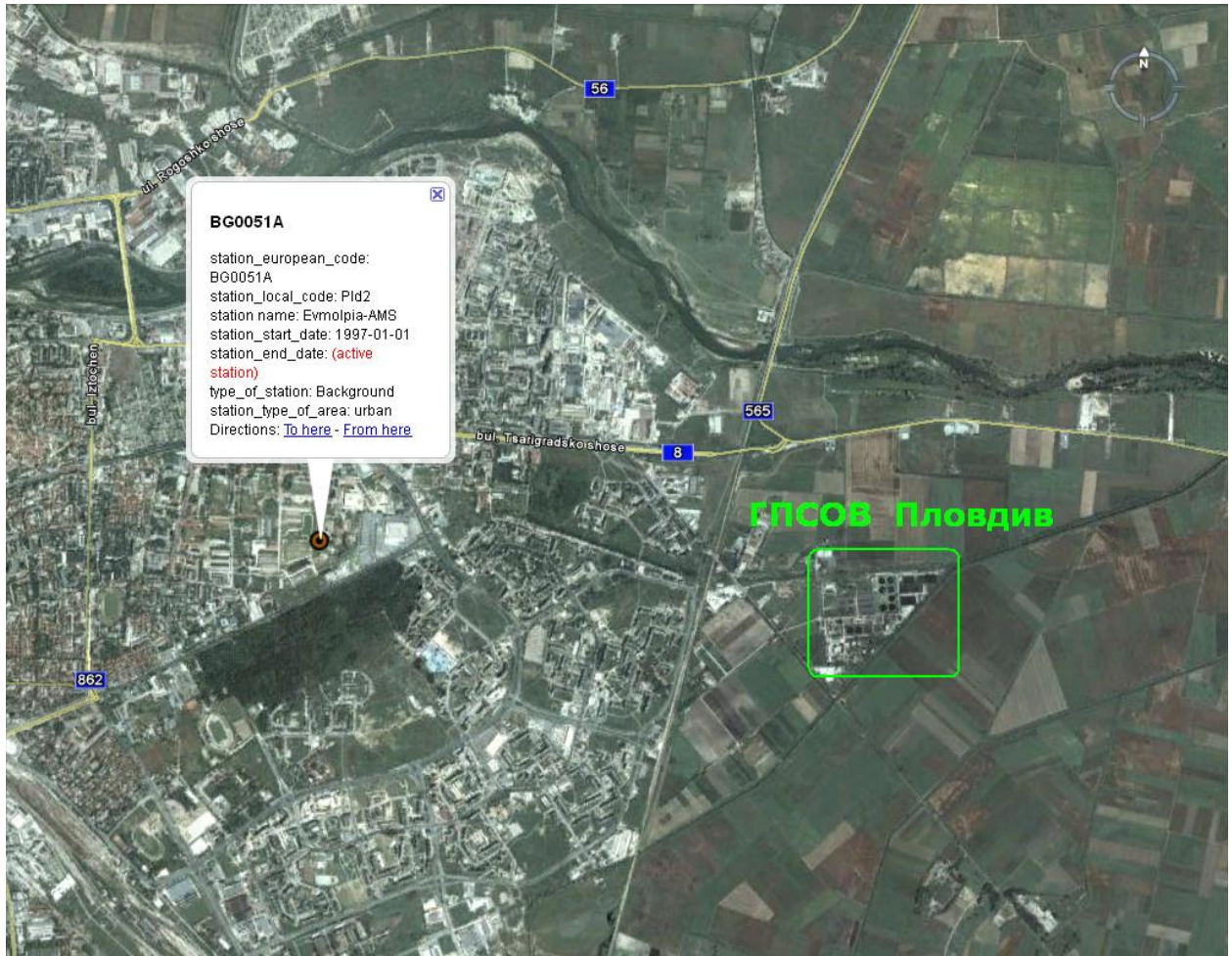
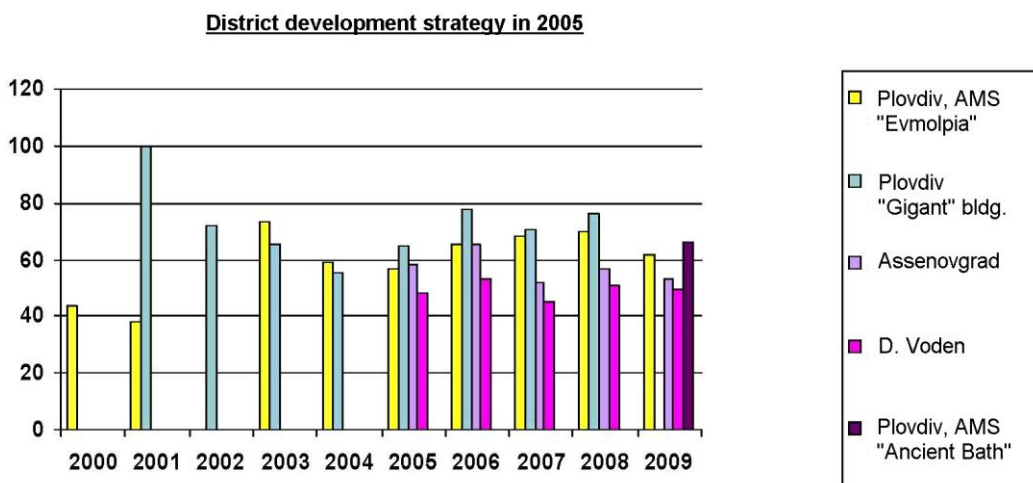


Fig. 4.1-1. Location of „Evmolpia” AMS

**Main parameters, characterizing the quality of ambient air in the region**

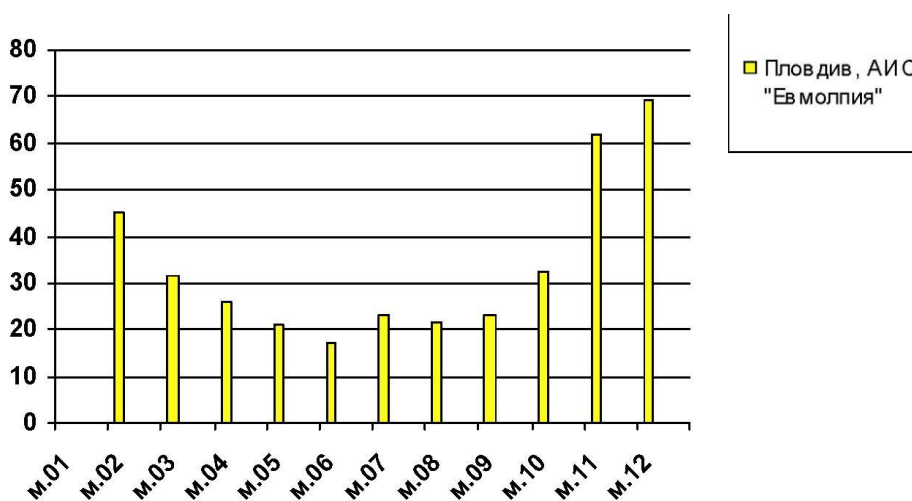
**PM10 /particulate matter/-** This atmospheric pollutant was monitored 24 hours a day at 2 stations. In 2009 both stations registered exceedances of  $LAC_{daily\ aver}$ . The highest daily average concentration in the same year was measured at the MoEW station in Assenovgrad in January -  $370.0\ mg/m^3$ . The average annual standard for  $PM_{10}$  ( $40mg/m^3$ ) was also exceeded at all four stations, the highest annual average concentration was registered at AMS

“Ancient Bath ”- 66,22 mg/m<sup>3</sup>. Data show no tendency for significant improvement of this atmospheric pollutant after the adoption of the district strategy 2005.



**Fig. 4.1-2. Air pollution with particulate matter (mg/m<sup>3</sup>) for the period 2000-2009**

PM<sub>2.5</sub> (fine dust particles under 2,5 microns) – this pollutant is controlled since the beginnig of 2004 at RIPCPH „HEI” station, and since February 2009 – also by AMS «Evmolpia». The highest measured concentration at the first station in 2009 was 208.0 mg/m<sup>3</sup> in January, and at the second station - in December - 202.7 mg/m<sup>3</sup>.



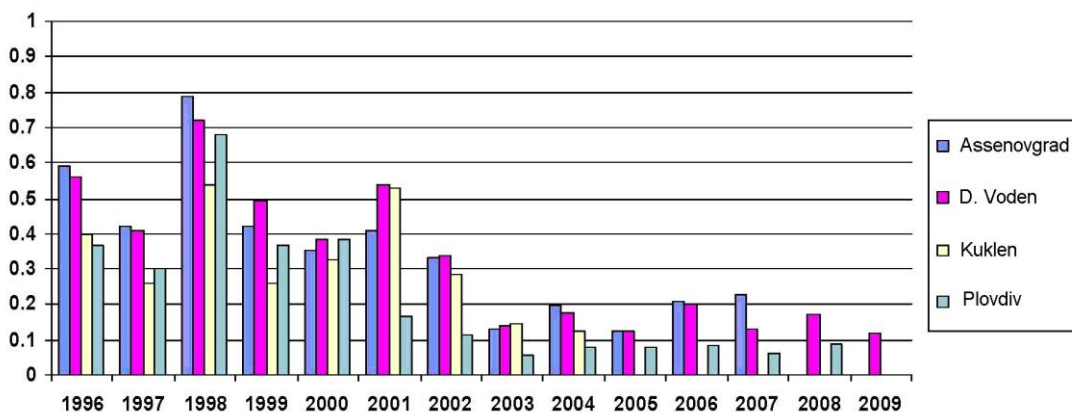
**Fig. 4.1-3**

**PM 2,5 /dust under 2,5 microns/** - This atmospheric pollutant is controlled since early 2004 at the HEI station - once a week during daylight hours /8 hours/. As many as 40% of the samples collected throughout the year registered concentrations above the daily allowable standard /48 mg/m<sup>3</sup>/ .

**Lead aerosols** – until and including 2004 this pollutant is monitored at 4 stations, until 2007 – at three stations, in 2008 – at two stations, from 01.01.2009 only at one station - Dolni Voden. After 2001 the annual concentrations of lead aerosols are below the respective average annual standard (0.5 mg/m<sup>3</sup>).

Generally, the area controlled by RIEW – Plovdiv continues the tendency for keeping the annual concentrations of lead aerosols permanently under the respective annual average standard.

**Dynamics of atmospheric pollution with lead aerosols (mg/m<sup>3</sup>) at the monitoring stations of RIEW - Plovdiv**

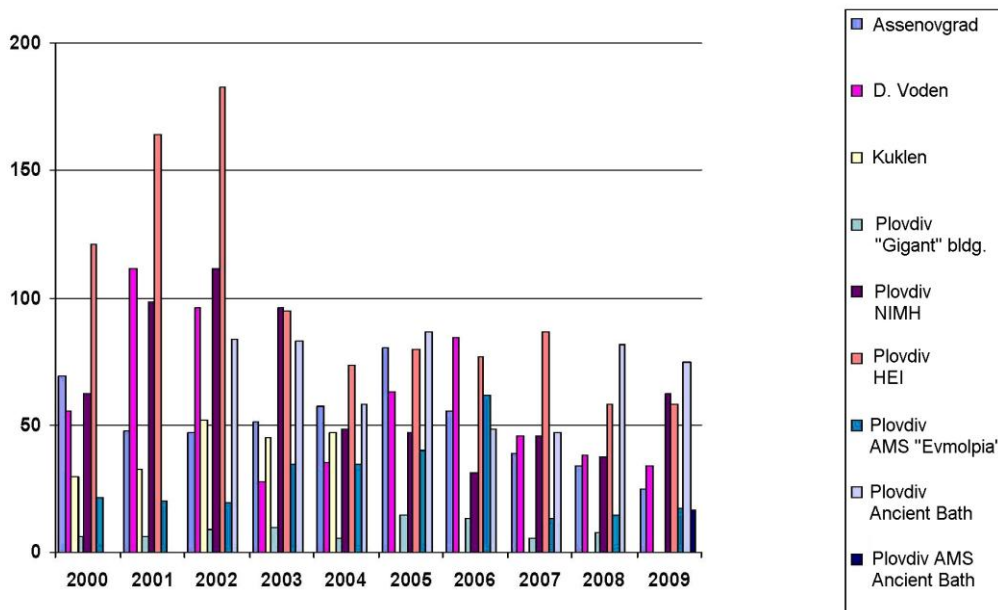


**Fig. 4.1-4. Atmospheric pollution with lead aerosols (mg/m<sup>3</sup>) in the period 1996 - 2009**

**Sulfur dioxide - SO<sub>2</sub>** Sulfur dioxide is monitored at 7 stations throughout the year. The observations show an exceedance of the LACo.t. Typically, high concentrations were obtained due to the accumulation of contaminants from combustion processes in the public utilities, domestic and industrial sectors in days after prolonged calm weather. The highest percentage of exceedances of LACo.t. were registered in Plovdiv – in the samples taken at the HEI station.

The highest concentrations were registered during the winter months in Plovdiv, which is related with the increased consumption of thermal and electric energy by population during this period. The stations, monitoring the impact of industrial activities on air quality also register seasonal tendency - the monthly change of concentration depends on production load and heating during winter months.

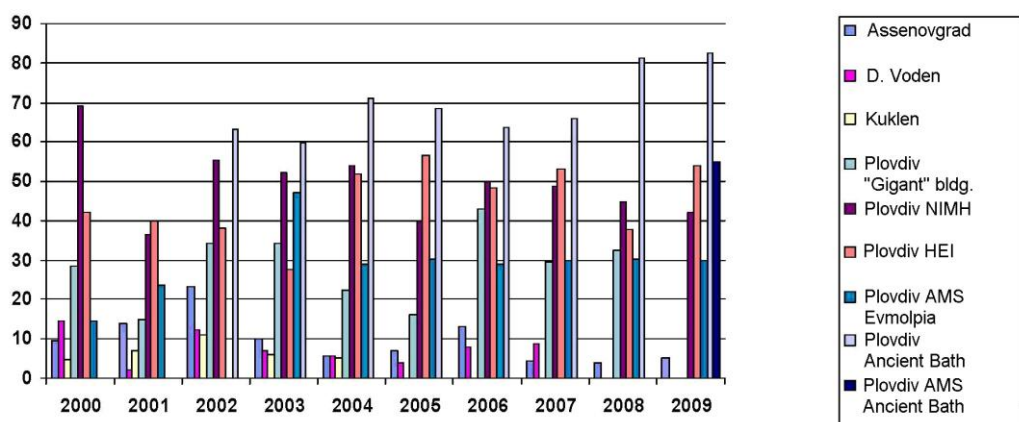
**SO<sub>2</sub>** – In 2009 this pollutant is monitored at 7 stations - 4 of MoEW, 2 of RIPCPH and 1 of NIMH. Four stations register an exceedance of LACo.t. The maximum measured value of sulfur dioxide is registered at RIPCPH station "Ancient Bath" - 1368 mg/m<sup>3</sup>, the exceedance over the standard is 3.91 times LACo.t. The highest rate of exceedances of LACo.t. is registered in Plovdiv - at RIPCPH station "Ancient Bath". The highest concentrations are typical for the winter months in Plovdiv, which is due to the increased heat consumption.



**Fig. 4.1-5. Air pollution with sulfur dioxide (mg/m<sup>3</sup>) in the period 2000-2009**

**Nitrogen dioxide** - this atmospheric pollutant is monitored at 6 stations. AMS "Evmolpia" registered exceedances of the LACo.t., with the maximum measured value of nitrogen dioxide in 2009 registered in November at AMS "Evmolpia" 323.06 mg/m<sup>3</sup>. The most frequent LACo.t. exceedances were registered by MoEW AMS "Ancient Bath". Four stations register also an

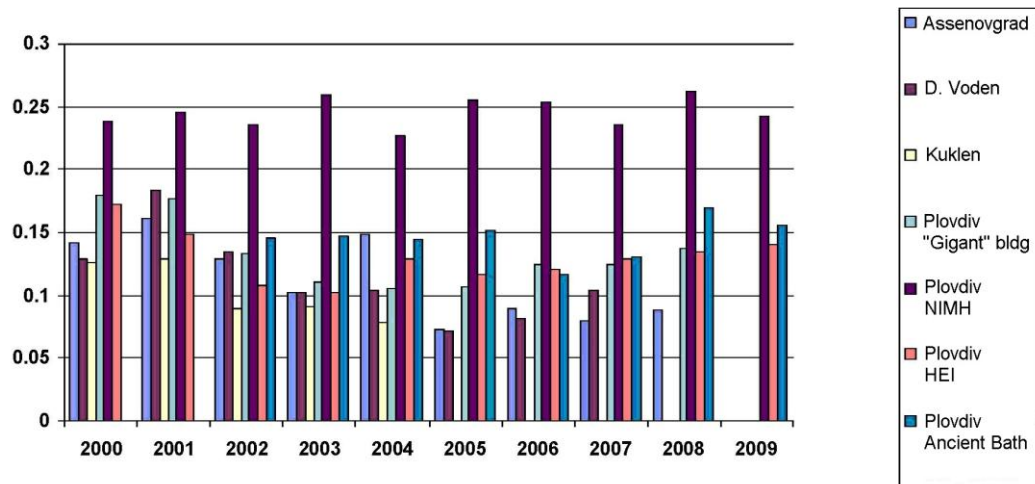
exceedance of the average annual standards (LACa.a. + AD) of  $42 \text{ mg/m}^3$  – at NIMH station – Plovdiv, RIPCPH “Ancient Bath” station, HEI station – Plovdiv and AMS “Ancient Bath”. Data show that in terms of this atmospheric pollutant no tendency for significant improvement is observed after the adoption of the district development strategy in 2005, Production of thermal energy for domestic and industrial use and road transport are the main sources of nitrogen dioxide in the atmosphere.



**Fig. 4.1-6. Air pollution with  $\text{NO}_2$  ( $\text{mg/m}^3$ )  
In the period 2000-2009**

**Total dust** - this pollutant is monitored at 6 stations. The concentrations at NIMH station are traditionally high (this station registers the highest average annual concentration in Plovdiv). There is no noticeable downtrend in the concentration of total dust in ambient air. The monthly distribution of concentrations makes clear that unlike sulfur dioxide, dust shows no significant correlation between higher concentrations values and increased consumption of fuels during the winter months. *Poorly maintained roads and green areas play an essential role for air pollution. Dust pollution remains a major problem throughout the country. Municipalities still do not pay adequate attention to washing and maintenance of this infrastructure.* Total dust – this air pollutant is controlled at RIPCPH and NIMH-Plovdiv stations, the highest concentrations are these at NIMH station. Data show that in terms of this atmospheric pollutant no tendency for significant improvement is observed after the adoption of the district development strategy in 2005. The poor

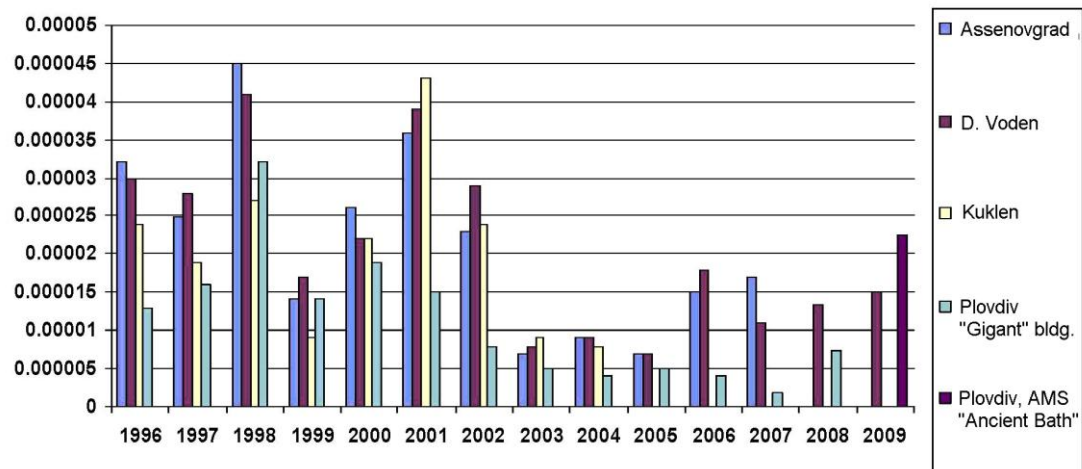
condition of roads and street infrastructure are the main sources of dust in the atmosphere.



**Fig. 4.1-7. Air pollution with dust (mg/m<sup>3</sup>) in the period 2000-2009**

**Cadmium** - monitored at the stations at "Gigant" apartment building - Plovdiv, Asenovgrad and the village of D. Voden. The concentrations measured in 2006 were exceeding the LACa.a. The reason for the exceedances were the emissions from "KCM" AD - Plovdiv at the time of sample taking, as well the cadmium deposited in soil throughout the period of operation of the industries, which, under certain weather conditions, gets in the samples, as well as the used hard fuels in households in winter.

In 2009 the pollutant is monitored at two stations - AMS "Ancient Bath" in Plovdiv and Dolni Voden near KCM. In the same year both stations recorded an exceedance of the average annual standard (LACa.a. 10 ng/m<sup>3</sup>): at the station in Dolni Voden -15.09 ng/m<sup>3</sup>, and at AMS "Ancient Bath" - 22.42 ng/m<sup>3</sup>. Data show that in terms of this atmospheric pollutant no tendency for significant improvement is observed after the adoption of the district development strategy in 2005.



**Fig. 4.1-8 Air pollution with cadmium (mg/m<sup>3</sup>)  
In the period 1996-2009**

**Nickel** – monitored at the stations at "Gigant" apartment building - Plovdiv, Asenovgrad and the village of D. Voden. No concentrations were measured exceeding the LACa.d.

**Arsenic** - monitored at the stations at "Gigant" apartment building - Plovdiv, Asenovgrad and the village of D. Voden. No concentrations were measured exceeding the LACa.d.

**Ozone** - monitored at AMS "Evmolpia". There were no registered exceedings of the threshold for informing the population (180 mg/m<sup>3</sup>) and the threshold for warning the population (360 mg/m<sup>3</sup>).

**Carbon monoxide** – monitored at AMS "Evmolpia". No exceedances of the LACo.t. /8 hours/ were registered.

**Benzole** – monitored at AMS "Evmolpia". No exceedances of the LACa.a. + AD were registered.

**Pollution from point sources** - RIEW - Plovdiv is currently monitoring more than 300 sites, potential and actual polluters of ambient air, and in future they will be subject to a complete update on the extent of emitted harmful substances from all point sources. The reason for the excessive pollutions for

some of them is the use of low grade mazut with high sulfur content as fuel in the heating and production process equipment, for which penalties were imposed. A project for the gasification of Plovdiv is under way. At this stage “Kamenitza” AD is connected. As the project progresses, other industrial sectors will be included as well and other industries located in the southern and eastern industrial zones of the city will also be connected.

### Summary, conclusions, trends in air quality at the time of implementation of the Investment project.

Fig. 4.1-9 shows the measured hourly average concentrations of nitrogen dioxide in the period from 1998 to the end of 2008. (The red line indicates the average hourly standard of 200 mg/m<sup>3</sup>).

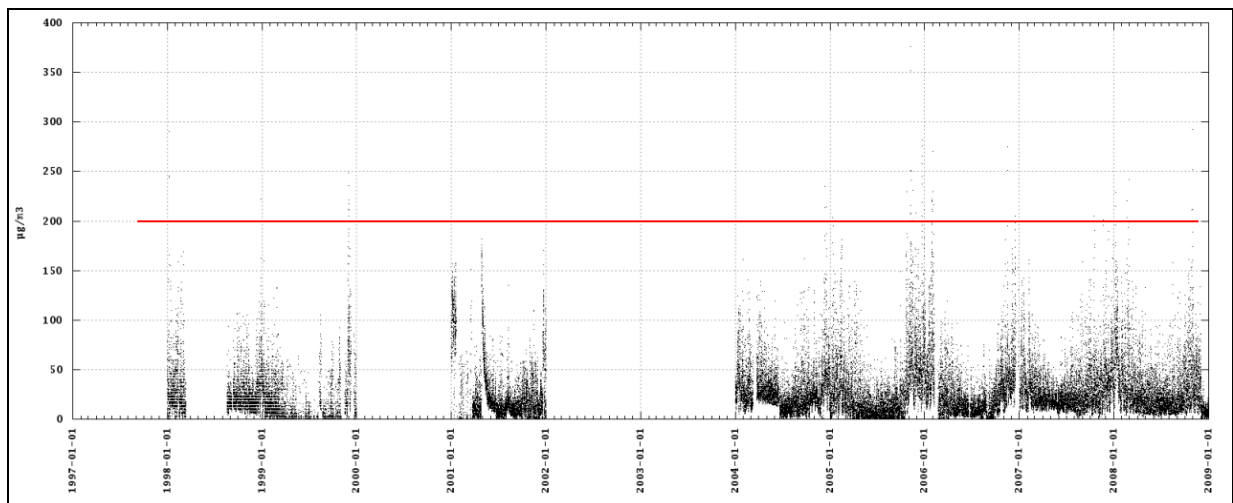
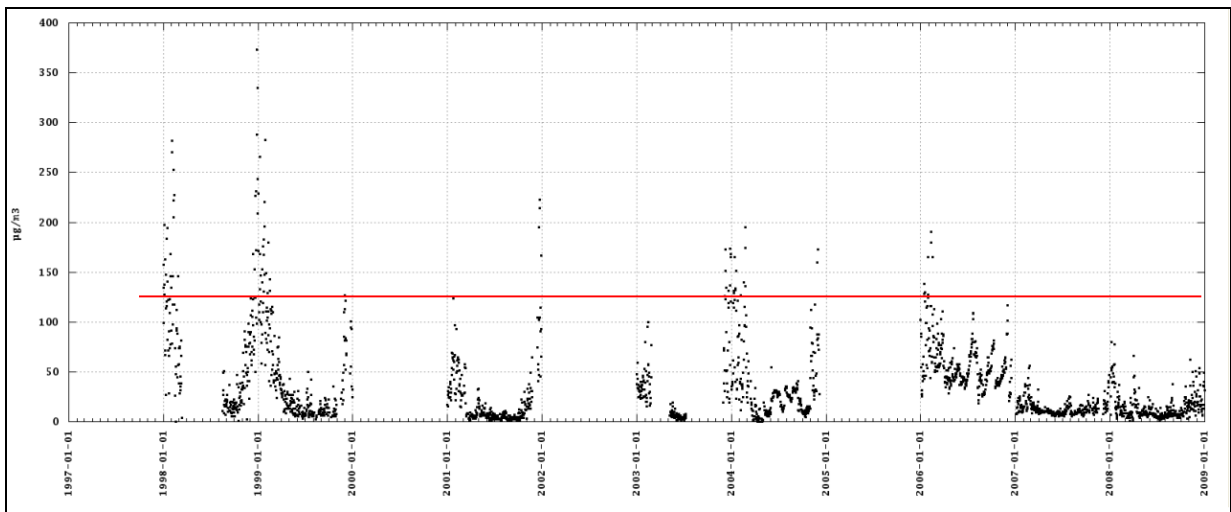


Fig. 4.1-9. Average hourly concentrations of NO<sub>2</sub>

Fig. 4.1-10 shows the averaged daily concentrations of sulfur dioxide in the period from 1998 to the end of 2008. The red line indicates the average daily standard of 125 mg/m<sup>3</sup>.

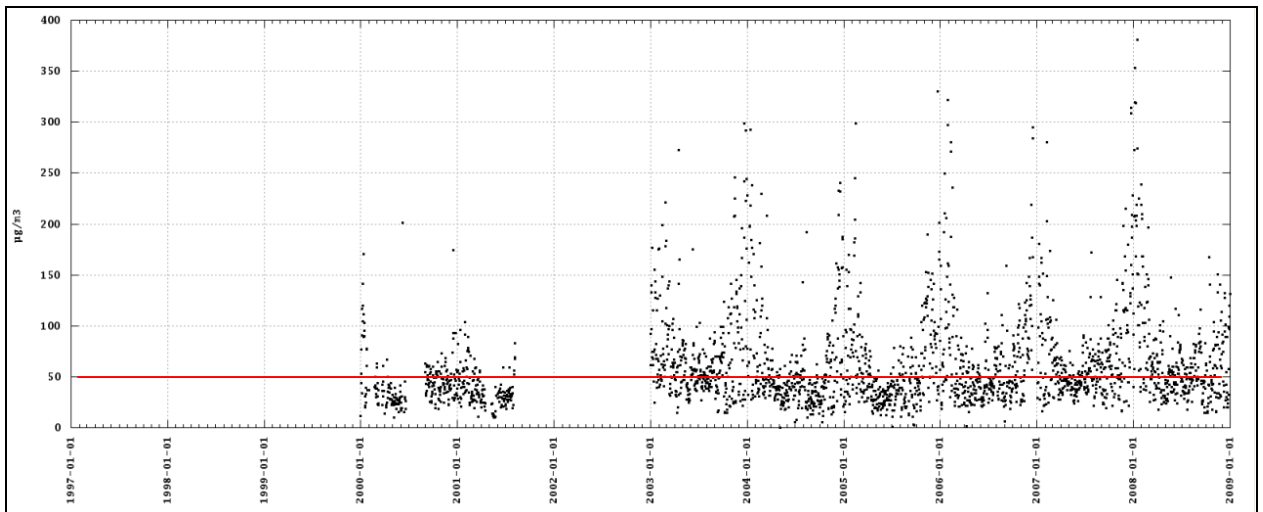
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**Fig. 4.1-10 Average daily concentrations of SO<sub>2</sub>.**

It is seen that after 2007 there are no registered exceedances of the average daily standards.

**Fig. 4.1-11** shows the averaged daily concentrations of fine dust particles in the period from 2000 to the end of 2008. (The red line indicates the average daily standard of 50 mg/m<sup>3</sup>).



**Fig. 4.1-11 Average daily concentrations of PM<sub>10</sub>.**

There is a tendency of increasing number of annual exceedances in terms of fine dust particles. The highest exceedance rates occur during the heating season, but after year 2006 and 2008 such exceedances occur also in summer.

It is clearly visible from above charts that the exceedances of the three pollutants coincide with the heating seasons, which indicates that it is not the industrial activity in the municipality that creates serious air pollution, but it is due to road transport and the use of solid fuels in the household and public utilities sectors.

The analysis of available information indicates that during the winter period, due to the intensive use of hard fuels for heating in households, and under certain weather conditions /calm weather/, pollutants accumulate in the ground layer, such as PM10, sulfur dioxide, nitrogen oxides and carbon monoxide up to the maximum allowable values. In summer months pollutions are mainly with dust and bad odors, arising from the state of the infrastructure /lack of sewers and poorly maintained roads/, landfills, breeding of various animal species in unallowed numbers within the populated areas, as well as the use of natural and artificial fertilizers in well-developed agricultural areas. This creates additional air pollution with volatile organic compounds /VOC/, methane and ammonia.

Pollution is mainly in winter period, with the use of solid fuels in households, depending on weather conditions.

The dispersion matrix of pollutions that could occur as a result of the complex impact of industrial, public utilities and transport sector under most adverse weather conditions in the populated areas, located in the outskirts of Plovdiv and Kuklen Municipalities, are within the parameters provided above. For this purpose, information on quantity of fuels used in the respective sectors up to 2004 was also taken into account, also information on the state of road infrastructure and the existence and maintenance of green areas.

The lowest relative pollution of ambient air /around 15-20% of LAC of sulfur dioxide and dust/ is in the areas of Markovo and Brestovitsa. These pollutants reach close to the maximum allowable values mainly in the areas of Krumovo, Brestnik, Belashtitsa, Brani Pole, Zlatitrap and Kadievo. The reasons are the solid fuels, used in households during the winter season, as well as some

influence of the dispersion rose of “KCM” AD, “Fabrika za Hartia” (Paper Mill) AD Stamboliyski and others.

The sections of the water supply network and sewer network of the city will be completed in sections, after a schedule (water mains will be placed in parallel and at the same time). All necessary measures will be taken to reduce to a minimum the impact on environment and the air component, respectively. The impact of UWWTP on this component at the different stages of construction and operation, and the measures taken, will be reduced to a minimum. Apart from that the site is located at a considerable distance from the residential buildings.

The impact is short, local and with no cumulative effect.

#### **4.2. Geological structure. Ground waters.**

##### **4.2.1. Geological structure, engineering-geological and hydrogeological conditions**

###### **Geological structure**

The morphological structure of the upper Thracian valley, in the western part of which is located Plovdiv, is developed on a tectonic depression, emerging as a graben, shaped under the major influence of Maritsa fault zone, which is dividing the Rhodopes from Sredna gora.

The upper Thracian graben consists of Paleogene, Neogene and Quaternary sediments, which rest on rocky substrate with block structure. In the valley of Maritsa River, which coincides in territory with Maritsa fault zone, there are block structures of different size and type – grabens, horsts, uplifts, contraction faults, etc. Among them are the Plovdiv depression and the Plovdiv horst, represented by in-valley heights, known as the Plovdiv hills, genetically related with deep tectonic faults, conductors of volcanic activity.

The following chronostratigraphic units have been established in the Plovdiv depression: pre-Cambrian, upper Cretaceous, Paleogene, Neogene and

Quaternary. The water supply and sewage networks of Plovdiv are related only with the upper cretaceous and Neogene sediments, the Quaternary formations and cultural layer.

*The upper Cretaceous includes the syenites of the Plovdiv plutonic rock and andesites ( $\alpha K_2$ ).*

The Plovdiv plutonic rocks make the Plovdiv hills, located in the city center, while the andesites are disclosed at Laut hill, east of Plovdiv.

*The Neogene is represented only by the Achmatovo Formation, which includes a variety of materials with a total thickness of 49÷67 m to 369 m: sands, gravels, clays, breccia conglomerates, sandstones, siltstones, and coalificated wood fragments of lignite type.*

*The quaternary formations in the region form one alluvial-proluvial sand-gravel formation of sands, gravels and sandy clays, where the following genetic types can be distinguished by the morphological features on the surface: alluvium, proluvium, deluvium and alluvial-proluvial formations. The thickness of the quaternary formations varies widely - from about 10 m around the Plovdiv hills to over 120 m.*

Besides the natural lithostratigraphical units on the territory of Plovdiv, there are also *anthropogenic archaeological and modern earth layers*.

The immediate geological environment of Plovdiv and the surrounding terrain is of quaternary alluvial and alluvial-proluvial formations with a thickness of 10÷60 m, from the upper cretaceous rocks, making the Plovdiv hills and anthropogenic earth layers.

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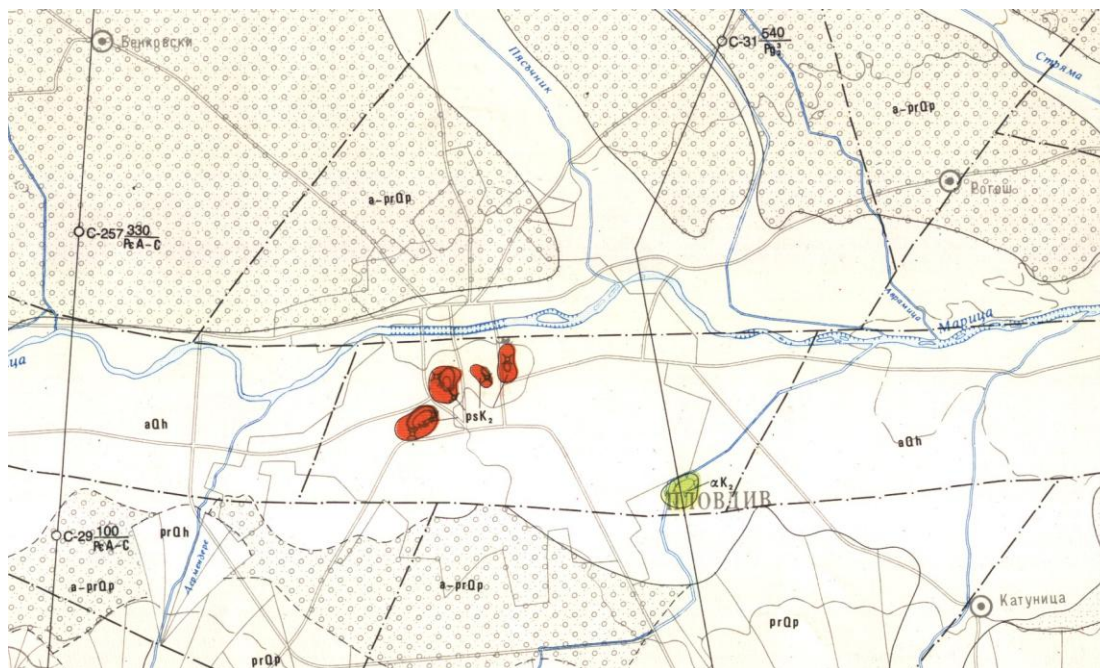
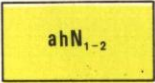
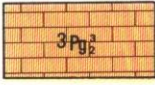
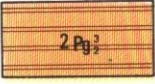
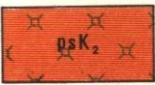
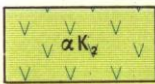



Fig. 4.2.1. Geological map of Bulgaria. Map sheet Plovdiv, 1 : 100 000 /after Kojuharov D. and others, 1990/

Legend

КВАТЕРНЕР		QUATERNARY	
	Алувиални образувания – руслови и на заливните тераси (чакъли, пясъци, глини)	холоцен	<b>Alluvial formations – riverbed and flood terraces</b> (gravels, sands, clays) Holocene
	Пролувиални образувания – наносни конуси (валуни, чакъли, пясъци)	холоцен	<b>Proluvial formations – sediment cones</b> (boulders, gravels, sands) Holocene
	Делувиални образувания (песъчливи глини, чакъли)	холоцен	<b>Deluvial formations</b> (sandy clays, gravels) Holocene
	Алувиални образувания – I и II надзаливни тераси (чакъли, гравий, пясъци)	г. плейстоцен	<b>Alluvial formations – I and II over-flood terraces</b> (rubble, gravels, sands) upper Pleistocene
	Алувиални образувания – III и IV надзаливни тераси (чакъли, гравий, пясъци)	с. плейстоцен	<b>Alluvial formations – III and IV over flood terraces</b> (rubbles, gravels, sands) middle Pleistocene
	Пролувиални образувания – наносни конуси (валуни, чакъли, пясъци)	плейстоцен	<b>Proluvial formations – sediment cones</b> (boulders, gravels, sands) Pleistocene
	Алувиално-пролувиални образувания (чакъли, пясъци, глини)	плейстоцен	<b>Alluvial-proluvial formations</b> (gravels, sands, clays) Pleistocene

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НЕОГЕН		NEOGENE	
	<b>Ахматовска свита</b> (конгломерати, пясъчници, алевролити)	меот-еоплей-стоцен?	<b>Achmatovo formation</b> meot eopleistocene? (conglomerates, sandstones, aleurolites)
ПАЛЕОГЕН		PALEOGENE	
	<b>Мергелно-варовикова задруга</b> (органогенни варовици)	г.еоцен	<b>Marly limestone formation</b> upper Eocene (organogenic limestones)
	<b>Пясъчничова въгленосна задруга</b> (пясъчници, алевролити, варовици)	г.еоцен	<b>Carboniferous sandstone formation</b> (sandstones, aleurolites, limestones) upper Eocene
ГОРНА КРЕДА		UPPER CRETACEOUS	
	<b>Сиенити (Пловдивски плутон)</b>	г.креда	Syenites (Plovdiv plutonic rocks) upper cretaceous
	<b>Андезити</b>	г.креда	Andesites    upper cretaceous
ДОКАМБРИЙ		PRE-CAMBRIAN	
	ПРАРОДОПСКА НАДГРУПА		<b>PRE-RHODOPIAN COMPLEX</b>
	<b>Неразчленена Прародопска надгрупа</b> (в геоложките профили и стратиграфските колонки)	архай ?	Unsegmented pre-rhodopian complex (in geological profiles and stratigraphic columns) archeozoic

**Engineering-geological conditions** - the engineering-geological conditions of Plovdiv are determined mainly by the lithological composition and physical-mechanical properties of the geological environment, the depth of groundwater level and its seasonal variation, the hydraulic connection with the surface waters of the Maritsa River and the outflow sections of its tributaries, the filtration properties of the water-bearing collector, etc. These factors have been considered in the design and construction of buildings, surface and ground communications in the city. The resulting requirements should be considered in the upcoming reconstruction of the water supply and sewerage network and the related construction activities, which, like those before, will be carried out mainly in quaternary sand-gravel and clay alluvial and alluvial-proluvial formations, partly in archaeological and modern earth layers and upper cretaceous rocks.

The information, contained in archival and literary sources on geological-lithological, engineering-geological and hydrogeological structure, shows that the upcoming construction of the sewage network will be performed in

quaternary sand-gravel and clay alluvial formations, partly in modern and archaeological earth layers, while the water supply network and water intake systems and equipment - in quaternary formations and Neogene sandy-clay sediments with design load of earth foundation in the range of 0,15 ÷ 0,25 MPa.

**Hydrogeological conditions** - according to the hydrogeological zoning of Bulgaria, Plovdiv falls within the Plovdiv sub-region of the South Bulgarian artesian basin in the Intermediate area. The hydrogeological conditions are characterized by interstitial groundwaters, forming groundwater bodies:

- BG3G000000Q013 - interstitial waters - Upper Thracian valley;
- BG3G000000N018 - interstitial waters in Neogene - Pazardzhik-Plovdiv region.

*Groundwater body BG3G000000Q013* is an unconfined aquifer formed in the quaternary alluvial-proluvial sandy-gravel formations. In deeper levels they are stratified by clay layers of inconsistent spatial distribution. Water chemical composition is mainly hydrocarbonate-sulphate-calcium and hydrocarbonate-sulphate-calcium-magnesium with mineralization from 400 to 800 mg/l. The upper part of the aquifer is not protected against infiltration of contaminants, which is the reason for increased concentrations of nitrates, nitrites, ammonia ions, phosphates, calcium and occasionally radium, compared to the standards.

*Groundwater body BG3G000000N018* is a confined stratified aquifer complex, formed in the deposits of Achmatovo formation, including horizontally and vertically inconsistent water-bearing layers and multi-fraction sand and gravel strata, embedded among sandstones, siltstones and clays. Water is hydrocarbonate-sulphate-calcium-magnesium with mineralization 200÷700 mg/l and slightly alkaline active reaction. It is protected against infiltration of surface contaminants.

Plovdiv is supplied with water mainly by the existing groundwater drawing systems and the river catchment on Tamrashka River, a tributary of

Parvenetska River. The table provides data on water resources and the water quantity supplied by the water drawing systems and the water catchment:

Table № 4. 2-1

Water drawing system, water catchment	Established operational capacity $Q_{oper}$ , l/s	Design capacity $Q_{des}$ , l/s	Water drawing in the period 2002÷2006	
			Water quantity $\times 10^3$ m <sup>3</sup> per annum	Average annual capacity $Q$ l/s
1	3	4	5	6
PS "South"	1221,00	1000,00	21242,10	673,58
PS "North"	717,96	540,00	11834,10	375,26
PS "East 1"	767,56	350,00	8767,44	278,01
PS "East 2"	315,89	300,00	8519,64	270,15
Total from groundwaters	3022,41	2190,00	50363,28	1597,00
Water catchment on Tamrashka river	80,00	80,00	2191,75	65,9
Total	3102,41	2270,00	52555,03	1662,90

Sanitary protection zones have been set up around the water drawing systems for drinking water to protect groundwaters from contamination (PS "South", PS "North", PS "East 1" and PS "East 2"). The protection zones have been set up in three belts I, II and III under the provision of "Ordinance № 3/16.10.200 on the terms and conditions for research, design, approval and operation of sanitary protection zones around water sources and facilities for drinking water and sources of mineral water used for therapeutic, prophylactic, drinking and hygiene needs".

Besides these water intake systems, there are also more than 170 borehole wells on the territory of Plovdiv and around, supplying water to 120 enterprises and companies, used for watering of green areas, street washing, etc. The established local operational capacity for their needs amounts to  $Q_{op}^l = 2141,72$  l/s, while the design capacity is  $Q_{des} = 392,56$  l/s.

**Environmental assessment of the situation in the area of the investment project** – the surface layer of the geological environment of Plovdiv is disturbed by excavations and backfills of foundations of numerous buildings and facilities, the implemented overground and underground sewage, water supply, transportation and other communications.

Apart from the mechanical disruption, the geological environment has suffered changes in quality as well, resulting from its pollution with solid and liquid

waste from small illegal landfills for household, agricultural and construction waste, located within the city territory, also from sewer leaks, etc.

These changes are usually long-term, because their impact extends even after elimination of the pollution sources.

The longstanding use of water drawing systems, and other water drawing facilities for household, industrial, public and other needs until present moment have had an impact on the regime and quality of groundwater, which is expressed and characterized by the following:

- extraction of significant natural, attractable and other resources from groundwater in quaternary aquifer and Neogene aquifer complex with the formation of a depression around them. The impact is direct, permanent, with a range within the operational zone of the water drawing facilities;
- changes in groundwater quality as a result of the influx of attractable resources from the Maritsa river, from the infiltration of polluted water and other activities.

The impact on soil and groundwater will also continue in the process of implementation of the proposed rehabilitation of the sewer and water supply network and the waste water treatment plant, but will be significantly lower.

#### **4.3. Surface waters**

The territory of Plovdiv municipality is crossed by our largest river - the Maritsa river. The catchment area of the Maritsa River is 53,000 km<sup>2</sup>, of which 21 034 km<sup>2</sup> are located on our territory. The river has about 100 major tributaries located symmetrically to the streambed. After the village of Raduil the Maritsa river valley enters the plain and is no longer mountainous. The valley emerges on the western and northern parts of Dolna Banya - Kostenets valley and the branches of Sredna Gora mountains. Down from the mouth of Kostenets river, the Maritsa river valley narrows and enters the famous Momino-klisurski gorge, then goes flat with low river banks on both sides. The basin of the Maritsa river in the region of Plovdiv municipality covers an area of about 3500 km<sup>2</sup>. The river inclination within the bounds of town is very small - 0.13 %, because of which the river flow is characterized by transportation and deposition of solid flow.

The approximate distribution of the water flow of Maritsa river over the seasons of the year is as follows: - spring high water - 67%; autumn high water - 24%; summer and winter period - 9%. The approximate distribution of the mean annual water flow of the Maritsa river at the town of Plovdiv and the minimum average monthly water levels with 95% probability by months are provided in Table 4.3-1 in m<sup>3</sup>/s. The high waters of the Maritsa river are determined based on the results of more than 40 years of observations. The typical high water in low probability rates are: Q<sub>0,1%</sub> = 2648 m<sup>3</sup>/s; Q<sub>1%</sub> = 1613 m<sup>3</sup>/s; Q<sub>5%</sub> = 1070 m<sup>3</sup>/s;

The length of the Maritsa river on the territory of Plovdiv municipality is about 12 719 m – from “East” ring road to the bridge on “West” ring road, from km 182+745 to km 195 +464. The width of the river section on the territory of municipality varies from 100 to 600 m. The river bed consists of alluvial deposits represented by loamy sands, sands and gravels. Most of the river is engineered and deforested at different times - 1959-1960 and 1997. Before entering Plovdiv Municipality, the Maritsa river receives untreated and treated wastewater from a number of urban settlements along its way or receives waters from tributaries carrying wastewaters. The larger cities and industries, which discharge their wastewaters into the river are Kostenets, Belovo, Pazardzhik, Stamboliyski, paper mills and other factories. The Maritsa river is extremely important for Plovdiv, as it affects the microclimate of the city and appears as a major collector for discharge of wastewater. Pursuant to Ordinance № RD-272/03.05.2001 of MoEW, the Maritsa river within the Municipality is categorized as II-nd category water receiver and after Plovdiv to Cherkezitsa river as III-rd category water receiver. There is one station for monitoring the quality of river water on the territory of Plovdiv - HMS 301, near the “Gerdjika” pedestrian bridge. The waters of the Maritsa river meet the requirements for II-nd category water receiver with the exception of nitrite nitrogen content. There are no excessive concentrations of heavy metals, which is mainly due to the decline of industrial production. “Pyasachnik” and “Parvenetska” rivers discharge into the Maritsa river on Plovdiv territory. These two rivers are categorized as II-nd category water receiver according to Ordinance № RD-272/03.05.2001 of MoEW. The waters of Parvenetska river

are contaminated with wastewater from the villages and Parvenets and Hrabrino, which discharge into it without treatment.

For the purpose to increase the conductive capacity of the Maritsa river and reduce damage from high waters, a project was developed to clean the bed of the Maritsa river from deposited materials within the bounds of town. This will create more favorable conditions for the environment, will protect the adjacent urban areas from erosion and will reduce the risk for floods, emergency and crisis situations. Cleaning the riverbed will not only improve the hydraulic conditions of the river flow, but also the aesthetic view of the riverbed, which is essential for residents and tourists.

There are no lakes and mineral springs on the territory of Plovdiv municipality. The largest water area in the municipality is the rowing channel, which is a remarkable water facility and attraction of town. The rowing channel is maintained well and hosts several national and international rowing competitions and other events.

The rowing channel opened in 1989. It covers an area of 296.4 dka. The approximate dimensions of the channel are: length - 2280 m, average width - 130 m, depth - 2,5 m. The water volume of the rowing channel is about 75 000 m<sup>3</sup>. The rowing channel is guarded very well and there is no danger of contamination by municipal and other wastes from the area.

Monitored industries on the territory of Plovdiv municipality, which generate wastewater, treat them in local treatment facilities and discharge them into the urban sewerage network to be further treated in UWWTP together with the household wastewater. Some industries have no effective local treatment facilities and do not achieve the required treatment effect. A significant number of the largest polluters in the area that are located outside the municipality, such as “Agria” and others, have no water treatment plants and their wastewaters have a significant impact on the groundwater pollution in the area.

*Conclusion:* - quality parameters of the waters of Maritsa river in Plovdiv show a trend towards improvement. This is due to our economic development at the

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moment - small industries operating at minimum capacity and working water treatment facilities because of the strict control and water basin management.

There is an irrigation channel passing through the area of UWWTP, receiving the waters treated at UWWTP Plovdiv. The irrigation channel discharges into the Maritsa river after Plovdiv. The wastewater from UWWTP Plovdiv will be treated up to the requirements for discharge into the receiving water and will not adversely affect the aquatic ecosystem in the area.

*The implementation of the facilities, included in the investment project in compliance with the foreseen measures during the periods of construction and operation will not have a negative impact on environmental components.*

*The implementation of the integrated water project is an environmentally sound project with a markedly positive impact on the aquatic ecosystem in the region.*

#### **4.4. Earth and soils**

*Plovdiv region* covers the western part of the Thracian lowland. The terrain is flat and determines largely accumulative processes, while erosion is very slight. Soil forming materials are mostly lightweight in mechanical composition, quaternary alluvial and clayey Pliocene sediments. Soil cover is varied, but most predominant are alluvial-meadow, cinnamon-colored podzolic, vertisols, highly leached cinnamon-colored forest and saline soils.

Alluvial-meadow soils occupy large areas on the terraces of the Maritsa river and its tributaries. They are characterized by a humus horizon of medium strength (30-40cm), sandy to slightly sandy-clayey mechanical structure (15-30% physical clay), lack of texture differentiation, low in humus (1.5-2.0% humus), strongly acidic to slightly alkaline reaction (pH 5.2-7.8 in water). Groundwater level in some of these soils (mainly meadow-black soil) is at a depth of 150-200cm, while in others it is more than 400cm deep and has little practical effect on the development of agricultural crops.

Some of the meadow soils on Maritsa terraces are saline. They are characterized by high concentration of salts, and depending on quantity they are low-, medium-, and highly saline. Solonchak and solonetz soils are also observed, the soil profile with them is varied, humus is low (1.0-1.5%) and the reaction is alkaline (pH 8.0-8.5).

The region falls within the western part of the climatic region of Central Bulgaria. It features relatively mild winters and hot summers. The average annual temperature is 12°C, in January it is 1.7°C, and in July it is 22.5°C. The annual precipitation here is 550-570mm and evaporation is significant. The atmospheric water balance deficit for the vegetation period is about 400mm. The total productive capacity of the lands in this region is characterized by an average (agronomic) bonus rate of 68, which classifies them in the bonus rate group of "good lands".

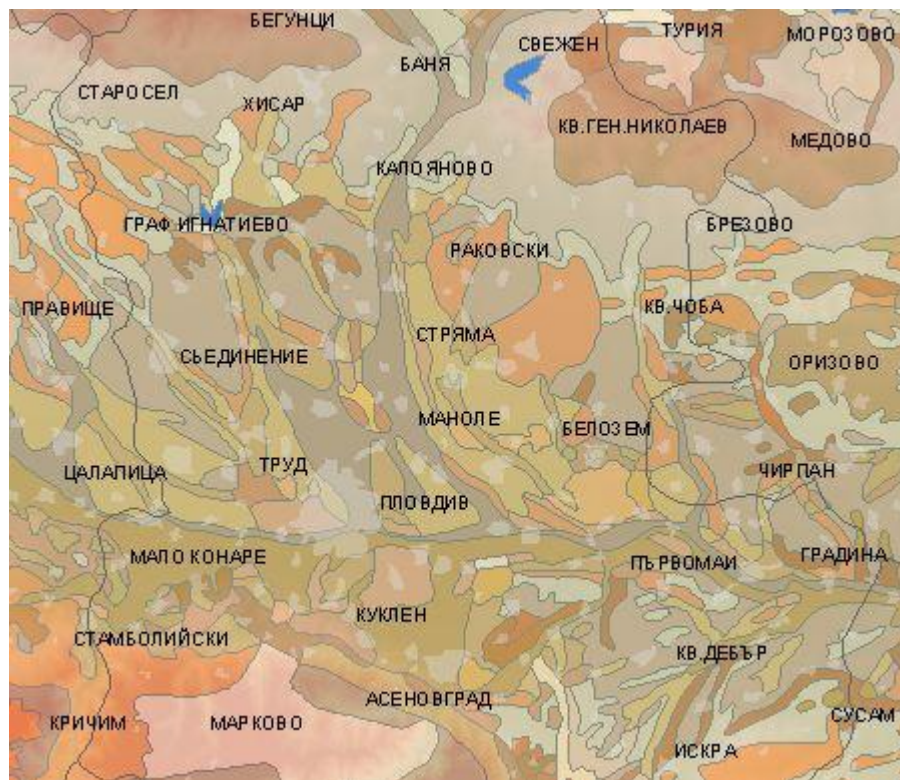


Fig. 4.4-1 Soils in Plovdiv region

### **Concise summarized assessment of soil condition on the territory of Plovdiv**

The condition of soils on the territory of Plovdiv Municipality is monitored by RIEW – Plovdiv. In recent years a tendency for reduction of soil contamination is observed. This applies mainly to agricultural lands and is due to the crisis in agriculture and the limited use of pesticides and fertilizers. The major soil polluter on monitored territory is KCM - AD. Pollutions are old. Taking into account that self-cleansing of soil is a very continued process, also the results from monitoring analyses, it appears that pollution with lead, cadmium and zinc show a tendency for stabilization. This is due to the improved air treatment facilities of KCM. Regarding soil protection, there is a significant reduction of stubble arsons; safe liquidation of warehouses storing old and unusable pesticides.

*There have been no comprehensive studies on soil condition on the territory of Plovdiv and within its regulation borders. Individual studies examine the soils of some green areas of Plovdiv.*

These and subsequent partial studies have found that the hills, the “Recreation and amusement” part, “Lauta” park and the old “Tsar Simeon” garden and the garden at “Saedinenie” square have almost undisturbed soils and their morphological structure shows almost no difference from natural soils, with the exception of the surface horizons. The surface layers show depletion and degradation of some valuable agrochemical properties. This applies to the “higher parts up the hills”, while in the “park areas the soils are mainly anthropogenic”, typical for urban environment, with clear characteristic features. They differ substantially from natural soils in terms of origin, composition and properties. They have no normal natural profile - the composition of their layers is determined by the materials dumped there at different times. They have light mechanical composition, low humus, nitrogen and phosphorus content. Absorbable moisture is very low due to high water permeability and poor water retention abilities. The typical soil microorganisms in these soils are very few and the ratio between the groups of microorganisms is different from that in natural soils. The layers that feature least microorganisms are those rich in construction waste. Where

there is household waste, bacterial forms are most abundant, followed by amino-mycetes and fungal microflora. The reduced presence of actinomycetes in the overall share of microorganisms decreases the antibiotic ability of soil to self-clean from pathogenic bacteria. In the low and relatively flattened peripheral areas of the hills the soils are heterogeneous. They usually have a profile that is disturbed by construction activities, irrigation and reinforcement activities. These soils may not be classified in a certain soil type, because their profile does not possess the characteristic morphological features of the soil, formed as a result of the natural soil formation process. Usually the terrain surface is artificially shaped in terms of leveling, slope and geographical exposure, in order to serve a specific long-term purpose. The profiles of the anthropogenic soils are usually much deeper than those of rankers and lithosols.

The Plovdiv hills are formed upon syenites, which are resistant to weathering. This determines the predomination of soil types with very shallow profiles - mainly ranker soils and lithosols. They occur higher up the hills, mainly in areas of very rugged topography and significant inclination of the terrain surface.

Main soil differences. Shallow, undeveloped soils (rankers) 1 - underdeveloped soils formed on hard siliceous rocks. The rock emerges 15 to 50 cm below the surface. These soils feature poorly developed humus horizon of not more than 25 cm, which lays directly on loose soil or solid rock. The humus content in the humus layer of 25 cm may reach 15 to 5%, if the humus horizon is less than 10 cm thick. They have no transition B or illuvial horizon. There are no hydromorphic, compaction features or signs of rubefaction.

Disturbed terrains – by data of the municipality almost all territory of Plovdiv is represented by anthropogenic soils. Exceptions are the hills, the “Recreation and amusement” and “Lauta” parks, “Tsar Simeon” garden and the garden at “Unification” square. The accumulative soil horizon is preserved and stored only in “Trakia” residential district. The remaining soils are typically urbanogenic, including anthropogenic soils of the green areas of the city. They have light mechanical composition, low content of nutrients and impaired enzymic and microbial activity. Rehabilitation of illegal landfills has

changed the soil profile and disturbed the landscape. Changes in territory levels have occurred. Similar effects are observed in the construction of massive buildings.

*The implementation of the facilities, included in the investment project in compliance with the foreseen measures during the periods of construction and operation will not have a negative impact on the soils.*

#### 4.5. **Biodiversity. Protected areas and protected zones.**

The components of the investment project (water supply and sewerage systems) are within the urban area of Plovdiv. The site of the existing UWWTP Plovdiv is located outside the city, but the area is anthropogenically affected. The reconstruction, upgrade and extension of UWWTP Plovdiv will be performed within the limits of the existing site.

##### **Affected elements of the National Ecological Network:**

The facilities of the investment project, including the site of UWWTP Plovdiv are located outside of protected areas and protected zones.

The nearest protected areas under Natura 2000 are **PA “Maritsa Plovdiv” BG0002087** for protection of birds, a special protected area under the Birds Directive (79/409/EEC), which overlaps the protected area under the Habitats Directive (type J) and **“Maritsa Parvomay” - BG 0002081** under the Birds Directive.

**PA “Maritsa Plovdiv” BG0002087** for protection of birds (over 6 km and channel discharges beyond the borders of the protected area). “Maritsa Plovdiv” BG0002087 is included in the protected areas list for conservation of wild birds with a total area of 11,175.5 dka. The area is located about 12 km northwest of the site upstream the Maritsa river. It is an important habitat for many waterfowl and waterbirds. In winter time the islands and sand strips in

the river form the “Pygmy cormorant night spending” protected area. About 5-7% of world cormorant population gathers here every winter, making it an Important Bird Area /IBA/ of international importance. The surveyed site is located far from the area, for this reason any direct impact on that colony is excluded.

The site is located far from the area, so there is no reason to believe that the implementation of the project, at the time of construction and operation of the separate subsites of the investment project can negatively affect the natural habitats and species - subject to protection during nesting, migration and wintering.

The impact of site activities on **SPA “Maritsa Plovdiv” BG 0002087** and its elements are geographically limited - outside the area, which will not cause destruction or fragmentation of natural habitats and disturbance of the variety of birds species, subject to protection.

**PA “Maritsa Parvomay” BG 0002081** under the Birds Directive – the place covers a section of the Maritsa river near Parvomay with riparian habitats and agricultural lands located around it. Riparian forests along the banks of Maritsa are mainly black alder /*Alnus glutinosa*/, willows (*Salix alba*, *S. Fragilis*) and poplars (*Populus nigra*, *P. Alba*) at places interspersed with plantations of hybrid poplars. Small oak forests are scattered among the agricultural lands.

Maritsa-Parvomay is located near a densely populated city and industrial zone – the town of Parvomay. The location is influenced by strong anthropogenic pressure due to urbanization and intensive human activities. In many places, especially along the roads, there are illegal landfills. The territory is vulnerable to human activities, mainly related to agriculture, forestry and water management. Among the most serious impacts related to agriculture is the removal of natural vegetation and the conversion of grasslands and shrub habitats in farmlands, as well as the extensive use of pesticides and fertilizers. Grazing is carried out on pastures near the villages, so that these habitats are excessively grazed. Cutting of tree and shrub vegetation on the banks of the Maritsa river and afforestation with non-native species, burning of coastal

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water vegetation, as well as the extension of the quarries for the production of sand and gravel violates habitats important for birds that use them for nesting and rest, especially the Levant Sparrowhawk and Great White Heron. The common threats to birds are fragmentation, disturbance and change of valuable habitats. In 2005 Maritsa- Parvomay was announced by BirdLife International an Important Bird Area.

The area is an important bio-corridor connecting areas across Southern Bulgaria. The interest of ornithologists here is quite strong, even throughout the year. It plays an important role as non-coastal site for wintering. Here the pygmy cormorant colony numbers 4000-6000 individual birds. Some upstream area sections protect one of the last preserved locations, where the bed of Maritsa is unchanged and riverbank vegetation is developing. The site offers conditions for development of *Nymphaea alba*.

The area includes a protected territory, declared to protect *Leucojum aestivum* - one of the few places where the number is satisfactory. Parts of the area appear as artificial wetlands, where the water level is of utmost importance for the avifauna in the area. When the lakes for fish farming are used, 170 different bird species emerge around them.

- The upgraded UWWTP Plovdiv with improved degree of water treatment will have indirect positive contribution to sustainable development of biodiversity by enhancing the self-purification ability of the water body and a positive impact on the aquatic ecosystems in this area.

No negative impact is expected to occur from the operation of WWTP, since the project provides appropriate methods for wastewater treatment, not allowing discharge of untreated water into the receiving water - the Maritsa river or environmental pollution.

- Taking into account the area on which the IP will be implemented and the specifics of planned activities, it is not likely that natural habitats and habitats of species to be affected, destroyed and fragmented. No forest areas or tree species will be affected and there will be no situation of isolation of species.

- The territorial scope of impact resulting from the construction is located within the designated sites. The investment project is expected to have positive cross-border impact (treated wastewaters in UWWTP Plovdiv with

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about 200 000 m<sup>3</sup> of wastewater per day, pollutant load over 500 000 population equivalent in BOD<sub>5</sub>, which will be reduced at about 97%, reducing also the loads of Nt (50-67%) and Pt 60 - 80%, and Pt )

- Ability for assimilation of the ecosystem in the natural environment: no adverse environmental impacts are expected to occur as a result of the implementation of the investment project. The projected activities are not related with a change or disturbance of the land use.
- No negative impact on soil functions is expected. Regulation of water supply, reduction of water losses and elimination of discharge of domestic wastewaters into the soil (in the absence of sewage) will positively affect groundwaters and soils in the area.
- Construction works and excavation activities will temporarily increase the sound pressure in daylight hours, but within limited periods of time and locally within the activity performed (the linear facilities of UWWTP are outside the populated areas).
- No change in noise emissions and acoustic load on the environment is expected after the completion of the facilities, included in the investment project.
- The implementation of the investment project will change significantly the sanitary and hygienic conditions of the environment; urban environment will improve, accompanied with specific favorable effects and prevention of health risk. (Appropriate measures will be taken during construction to minimize the negative impacts and exclude any adverse health effects on residents)
- Taking into account the nature of the IP, the impact can be defined as long-term and positive.

**Brief description of potential impact:**

- degree of impact - **minor**;
  - range-**local**;
  - impact on biodiversity in the region, on size and density of animal population - **short-term and reversible**;
  - cumulative effect - **not expected**
  - possibility for recovery – **real**
-

**4.6. Landscape**

The subject of the investment project - rehabilitation, upgrade and extension of the water supply and sewerage networks in Plovdiv and UWWTP will be performed on anthropogenically influenced areas. Landscape will not be changed, but the implementation of the planned measures will integrate the facilities into the existing landscape.

**4.7. Cultural heritage**

The subject of the investment project - rehabilitation, upgrade and extension of the water supply and sewerage networks in Plovdiv and UWWTP are not located on or near sites, included in the register of monuments. However, the subsequent stages of design and construction of individual subsites will take into account all legal requirements related to protection of environment and cultural heritage.

**4.8. Waste**

Typical of UWWTP-s operating in the country is the accumulation of waste, formed in the organic treatment of wastewater on the site of UWWTP and its subsequent disposal on the local landfill for non-hazardous waste of the settlement. The problem is now the utilization of this waste for which our country is not prepared.

For Plovdiv in particular, a rational solution for the accumulated sludge is sought.

**4.9. Harmful physical factors**

The sound pressure in the area, where construction works for rehabilitation and upgrade of the water supply and sewerage network of Plovdiv will be performed, is raised mostly in the areas around the transport network. The UWWTP is outside the residential area. Noise pressure does not exceed the legal requirements for a construction site. Construction works in the separate sections of the rehabilitation and reconstruction of the water supply and sewerage systems will be performed according to a schedule in daylight hours and under the conditions of the proposed measures. The negative local noise pressure can be significantly minimized by exercising strict control and management.

**4.10. Hazardous substances**

There is no known presence of hazardous substances at the locations, sections and areas surrounding the facilities of the investment project. No significant negative impact on the operatives and the population in the area is expected to occur with the implementation of the facilities of the investment project in compliance with all instructions for handling hazardous substances (asphalt, machining oils, paints, dyes, etc.).

**4.11. Health and hygiene aspects of the environment**

Currently in Plovdiv not 100% of the population is connected to the sewerage network, and not all wastewater is taken to the existing UWWTP Plovdiv. At places untreated wastewater is discharged into the Maritsa river water receiver, and the total outflow of wastewaters after UWWTP does not meet all requirements, under the set individual limits of the Permit for discharge of EAS RBD. The issue of management of the sludge from UWWTP has not been solved in accordance with current legislation. There are conditions creating a health risk to population in the area. The implementation of the IP will solve these problems and good conditions will be created for a high quality living environment

## 5. Features of the potential impact on the environment

The effects of the IP on the environmental components and the factors affecting the environment during the period of construction and operation are classified as positive and negative.

### Positive effects:

- Creation of new jobs - during construction and during operation;
- Achieving higher quality of living environment for the population in the area;
- The implementation of the investment project is having a strong positive effect on the environment in the region;
- At present moment part of the untreated wastewaters from the households and industries in Plovdiv is discharged directly into the receiving water (part of them within the populated area) and create a health risk to population in the area;
- The implementation of the IP will achieve and maintain the parameters required for surface waters. It is foreseen to achieve water quality meeting the requirements for a "sensitive area";
- Achieving sufficiently effective treatment of wastewaters from the city secures a certain degree of purity of the waters in the Maritsa river basin, which makes the investment project of regional importance;
- Improving the water quality of the Maritsa river will contribute to the enrichment of region's biodiversity;
- Taking into account that the Maritsa river, as receiving water, is passing through populated areas, achieving clean surface flow is important for maintaining public health and good living environment;
- In general, the IP is having a definite positive effect on the environmental parameters in the region.

### Negative impacts:

- Direct, short-term impacts (within the construction period) occurring during the construction of the facility, in terms of: ambient air, construction waste, noise and health in work environment;

- Direct, long-term and permanent impacts during WWTP operation in terms of: geological environment, soils and landscape;
- The construction of UWWTP on the site will be associated with disruption of agricultural lands, which makes necessary the preparation of a report on land recategorization. Agricultural land is municipal property, and is currently a bare land (not used for agricultural purposes);
- The execution of construction works will create local and short-term air pollution with dust. Taking the necessary measures will reduce it to the required parameters. The end of construction will also end the negative impact;
- The operation of UWWTP will be associated with waste, generated by the water treatment facilities, specified in Ordinance № 3 on waste classification /01.04.2004, SG 44/25.05.2004, issued by the Minister of MoEW and the Minister of MH;
- The exact characteristics of the wastes and the respective way of their treatment will be subject of the engineering design and the accompanying documents. An updated program will be prepared for the management of wastes, generated on site.

All unpleasant odors, exuded in the process, will be minimized by the proposed measures and their impact will be local and limited within the site.

### **5.1. Impact on people and their health**

Household wastewaters are carriers of infectious agents causing diseases such as typhoid, tetanus and others. The IP will improve the hygienic condition of the receiving water. Disinfection of treated wastewaters will limit the potential spread of epidemics. The waste, retained by the screens and the sludge pose potential contamination threat to environment. Effective waste management will be provided that will ensure their timely transportation to a disposal site. There is no health hazard to residents of nearby settlements during the construction and operation of the facility. Wastewater treatment will prevent health risk to population in the area.

**5.2. Impact on air quality**

The construction process will be associated with contamination with dust during construction and blasting and with local pollution from faulty construction equipment and vehicles with harmful gas emissions from the exhaust fumes. Possible concentrations of harmful emissions are relatively low, localized in a restricted area. During the time of operation - diffuse emission of aerosols from wastewaters and volatile organic compounds, educed along the "water way" and the "sludge way". The impact will be direct, significant, and locally limited.

**5.3. Impact on water**

The receiving water of the treated wastewaters is the Maritsa river. The quality of treated wastewaters will meet the requirements of Ordinance No 6 on emission standards for allowable level of harmful and dangerous substances in wastewaters, discharged into water bodies and conditions of the permit for discharge. Under normal operation of the treatment plant, no deterioration of river water quality is expected to occur after the point of discharge. The construction of the treatment plant will put an end to the discharge of untreated wastewater into the river and health risk to population in the area will be prevented. After the point of discharge the river flow will be increased with the quantity of treated and discharged waters. The impact will be permanent, along the entire course of the river after the point of discharge.

**5.4. Forecast for potential impact on geological environment, existing buildings, other structures and environmental components**

Construction and operation of the plant will involve direct, permanent and irreversible impact on geological environment, including mechanical disruption of the superficial layer of the site. The extent of this impact is the area that will be affected, which is calculated in the investment project.

**5.5. Impact on soil. Groundwater.**

Pollution of groundwater and soil is not possible with proper storage and timely disposal of waste and not allowing discharge of untreated wastewaters into the soil. The operation of WWTP and the emitted harmful substances -

primarily dust during construction, cannot cause pollution of soils due to the low rate of dust emissions and because of the high stability and conservatism of soils. The owner of the land is required to scoop out and utilize the humus layer, pursuing the requirements of Ordinance № 26 on the reclamation of disturbed areas, improvement of low fertility lands, protection and utilization of the humus layer.

**5.6. Impact on flora, fauna, Protected areas**

No species, protected by law, emerge on the territory of the future treatment plant and will not be affected by the implementation of the investment project.

*Impact on elements of the National Ecological Network*

No negative impact on the elements of the National Ecological Network are expected during the construction and operation.

**5.7. Impact on landscape**

The project provides appropriate afforestation and landscaping of the territory for the optimal blending of the facility into the environment.

**5.8. Impact of generated waste**

The detailed design will include a waste management program. All generated waste will be collected, stored, transported, disposed of or processed in compliance with the requirements of the existing environmental legislation, which would minimize its negative impact. All collection, transportation, disposal and treatment of waste will be performed in strict compliance with the waste management program, which, combined with most optimum performance of sludge stabilization and mechanical dewatering, will guarantee no negative impact on the environmental components. A program will be prepared for management of the sludge from UWWTP, which will plan the real possibilities for decentralized treatment (disposal, use of soil capping of landfills, rehabilitation of disturbed terrains, land reclamation, use in cement industry, in agriculture, etc.). in short- and long-term perspective.

### 5.9. Impact on noise pressure

During the period of construction, noise will be generated by the performed construction works, construction machinery and vehicles (no blasting). Construction will be performed in daylight hours, the sound pressure will be short-term, temporary, local and will not have accumulative effect. The source of noise during operation is the UWWTP, where legal regulations for the equipment require silencing structures made of special materials. The UWWTP site is far from residential buildings and the noise, accompanying the construction and reconstruction will not affect the population. During operation, the noise impact of WWTP operation will be within the regulatory limits.

**6. Description of the measures intended to prevent, reduce and where possible, to stop the significant negative environmental impacts and plan for the implementation of these measures**

**The investment project for Plovdiv Municipality includes:**

- Rehabilitation and extension of the water supply network and its facilities.
- Rehabilitation and extension of the sewerage network and its facilities..
- Reconstruction, rehabilitation and extension of UWWTP Plovdiv.
- Restoration of landscape around the building and the facilities of WWTP;
- Implementation of an afforestation belt around the WWTP.

Construction works must be carried out in strict sequence, according to a schedule, adopted in the subsequent stages of design.

The implementation of the measures aimed to reduce, limit and prevent the negative impact of the facility on the environmental components can be divided into three stages for the separate sites, within the Integrated Project on the Water Cycle in Plovdiv.

- "Design" Phase
- "Construction" Phase
- "Operation" Phase

**"Design" Phase:**

- At the start of the design the Contracting Authority will develop a "Design ToR", which will include the requirements to the project.
  - Schedule for the duration and sequence of construction works.
  - Designation of sites for temporary disposal of soils and construction waste within the UWWTP site.
  - Preparation of a plan for additional planting and landscaping of the site. Additional planting is done with tree species typical of the area.
-

### **“Construction” Phase**

During construction and assembly works (CAW), the site managers of the separate subsites have responsibilities, related to:

- Rehabilitation and extension of the water supply network of Plovdiv and its facilities.
- .
- Rehabilitation, upgrade and extension of the sewage network of Plovdiv and its facilities
- Reconstruction and Extension of UWWTP Plovdiv
- The Contracting Authority shall exercise continuous control on project implementation and quality of construction works. During the construction of the separate sites, special attention should be paid to:
  - Any stoppage or overload of WWTP facilities should be agreed in advance with the competent authority EAS RBD and RIEW Plovdiv.
  - All workers should be instructed to comply with the requirements of the Labor safety and hygiene and fire safety regulations and to perform only activities, for which they possess appropriate qualifications.
  - Construction machinery to be maintained in working order.
  - Removed humus be stored at a place, free of construction activities and after completion of construction works to be returned for reclamation.
  - Soil disposal sites have to be designated for disposal of excess soil.
  - After completion of construction works the temporary soil disposal sites have to be liquidated and disturbed soil and vegetation cover has to be restored.
  - After completion of construction works, it is necessary to restore as much as possible the disruptions made within and around the site.
  - The facilities of the water supply network, the sewerage network and UWWTP are to be made of waterproof concrete with water insulation to prevent leaks.
  - First aid kit to be maintained and available on site.

**“Operation of facility” Phase:**

- The Contracting Authority shall handle operating instructions to operational staff upon commissioning of facilities at each new section of the water supply network and the related facilities. При въвеждането в експлоатация на съоръжения на новите участъци от канализационната мрежа и съоръженията към тях Възложителят предава на експлоатационния персонал инструкции за експлоатация.
- The Contracting Authority shall handle operating instructions to operational staff upon commissioning of facilities at each new section of the sewerage network and the related facilities:
  - Upon commissioning of new facilities at UWWTP, the Contracting Authority shall handle to WWTP staff the following.
  - Detailed instructions for operation of facilities and instruction for Labour safety and hygiene and fire safety
  - Updated Self-monitoring Plan.
  - Updated Emergency Action Plan.
  - Updated Program for Waste Management.
  - Updated Program for Management of Sludge generated in the process of treatment at UWWTP.

The appointed operational staff should be trained for the activities to be performed and instructed for use of personal protective equipment.

**During the operation of WWTP it is required:**

- To perform strict control on wastewater treatment processes at WWTP and sludge stabilization, the waste is to be removed promptly.
- Electrical and mechanical equipment to be maintained in good working order.
- Waste to be collected at designated places and promptly transported to a landfill for non-hazardous waste
- An updated waste management program is to be prepared

- An updated program for management of the sludge generated at UWWTP Plovdiv is to be prepared.
- First aid kit to be maintained and available on site.

**Table № 6-1 Plan for the implementation of proposed measures.**

No	Measures	Period (phase) of execution	Result
<b>1.</b>	<b>Ambient air</b>		
1.1	Construction and transport equipment to be properly maintained. Internal combustion engines of construction equipment and trucks to be properly maintained to prevent increase of emissions of harmful substances from exhaust fumes.	CAW, O	Protection of air quality and health of workers and population in the area of construction works. Reduction of harmful gases in the atmosphere and minimizing the negative impact on ambient air in the area.
1.2	Not allowing abnormal loading of earth and rubble on dump trucks. Once scattered, crushed and smashed, these materials eventually become sources of chaotic dust emissions.	CAW – at time of loading, during loading works	Protection of air, soils and health of workers and population in the area.
1.3.	Construction and assembly works related to rehabilitation and construction of linear sections and facilities to the water supply and sewage networks to be carried out under strict supervision for the implementation of the facilities, waterproofing, subsequent backfilling and management of generated waste.	CAW and repair during O	Protection of ambient air in the area
1.4	Use of sprinkler (mobile) installation for dust control during construction works (loading - unloading, excavation, backfilling, etc.)..	CAW and repair works during O	Reduction of dust emissions in the atmosphere; Prevention of waste scattering
1.5	Storage areas for bulk materials (mainly sand) and construction waste should be watered in dry and windy weather to reduce dust emissions.	CAW-in respective weather conditions	Protection of air and health of workers and population in the area. Reduction of dust emissions in the atmosphere.
1.6	Dump trucks must be fitted with tarps when transporting excavated earth, building materials, construction waste and others.	CAW	Prevention of materials waste and pollution. Protection of air and health of workers and population in the area. Reduction of dust emissions in the atmosphere.
1.7	Immediately after completion of construction works, the sections of the water supply and sewage network and storage areas for bulk materials should be thoroughly cleaned	Immediately after completion of CAW and repair during O	Protection of air, Waste management
1.8	Optimization of the working schedule of construction and transport equipment and not allowing idle work of motors.	CAW, H	Reduction of harmful gas emissions into the atmosphere. Protection of air, health of workers and population in the area.
1.9	Strict control and effective management of technological processes in CWWTP. Timely removal of sludge.	O	Protection of air in the area of the WWTP. Prevention of bad odors. Providing healthy work environment for workers on site.
1.10	Planting vegetation for the afforestation belt of WWTP site	D, CAW	Ensuring high quality of environment and work conditions.
1.11	Using diesel fuel with low sulfur content	CAW,	Reduction of harmful gases in the atmosphere
1.12	Determining the possibility to cover the screens in the mechanical step with a building with adequate ventilation.	CAW,	Reducing the harmful gases in the atmosphere to a minimum.
<b>2.</b>	<b>Surface water and groundwater</b>		
2.1	The concrete structures of the water supply system, the sewage system and the WWTP to be designed and performed with waterproof concrete.	D, C	Not allowing leaks. Protection of soils and groundwaters from pollution
2.2	Strict control and effective management of technological processes in wastewater treatment and sludge stabilization. Keeping the equipment in good condition. Achieving WWTP outflow parameters	O	Protection of waters in the water body, sustainable development of the aquatic ecosystem, prevention of health risk to population in the area

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	meeting the requirements of the discharge permit. Ensuring efficient operation of WWTP along the route of water and sludge. Compliance with all regulatory requirements.		and workers on site.
2.3	Electric and mechanical equipment to be maintained in working order	O	Good work of WWTP, optimal process control and optimal treatment of wastewater.
2.4	A special site should be designated for used construction equipment, in a manner not allowing contamination of surface and groundwater with petroleum products.	D, CAW	Not allowing contamination of soil and water with petroleum products.
2.5	Instruction manuals for operating the equipment should be prepared. Compliance with the instruction manuals should be monitored to protect the environment components.	D, CAW, O	Minimizing the risks to human health and environmental components.
2.6	Not allowing discharge of water treated not up to the standards into the water body.	D, CAW, O	Protection of receiving water, minimizing the negative impact of the facility on the environment and prevention of health risk to workers on site and population in the area.
2.7	A schedule for maintenance of WWTP systems and facilities should be prepared.	D, CAW, O	Minimizing the negative impact of the facility on environmental components.
2.8	Meeting all requirements of the permit for discharge of wastewater of EAS RBD.	D, CAW, O	Protection of receiving water
2.9	Not allowing pollution of the water body	CAW, O	Minimizing the impact of the facility on waters and biodiversity in the region. Prevention of health risk to population in the area.
2.10	The self-monitoring plan should be updated and agreed with competent authority and be updated on regular basis.	D, CAW, O	Ensuring effective operation of WWTP. Protection of surface waters of the water body.
2.11	Strict control on the waters discharged into the urban sewage network from individual industries. Monitoring the operation of the local WWTP	O	Ensuring effective operation of the WWTP. Protection of surface waters of the water body. Generation of sludge in wastewater treatment plants that can be used in agriculture.
2.12	Not allowing water pollution during construction and operation of facilities.	CAW, O	Minimizing the impact of the facility on waters.
2.13	Chemical toilets to be provided on sites during construction	CAW	Protection of waters and soils from pollution.
2.14	A special site should be designated for used construction equipment in a manner not allowing contamination of surface and groundwater with petroleum products.	D, CAW, H	Not allowing contamination of soil and water with petroleum products.
2.15	An instruction manual should be prepared for handling used construction equipment. Its implementation should be monitored to protect the environmental components	D, CAW, O, H	Limiting the risks for human health and environmental components.
2.16	Proper performance of construction works and restoration of the areas around the newly built facilities.	CAW	Protection of groundwater from pollution
2.17	Designating a special site for temporary storage of waste;	CAW	Protection of groundwater from pollution
2.18	Maintaining buildings and facilities in good working order	O	Protection of groundwater from pollution
2.19	All emergency and bypass connections for discharge of untreated wastewater will be sealed and their use will require authorization, after notifying the controlling authority under the provisions of art. 126 of the Water Act /WA. In emergency cases the necessary measures will be taken, as per the requirements of art. 131 of the WA.	O	Protection of surface water

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<b>3.</b>	<b>Geology</b>		
3.1	Engineering-geological and hydrological studies and research where necessary	D	Obtaining data for well-grounded engineering solutions for protection of earth and groundwater.
3.2.	Seismic requirements of the region should be complied with.	D	
<b>4.</b>	<b>Earth and soils</b>		
4.1	Removed humus should be stored and returned for reclamation after completion of construction works. Humus should be stored separately from other land masses.	D, CAW	Protection of surface soil.
4.2	Using part of excavated soil for backfilling and shaping the terrain disturbed by construction and for land reclamation on sites.	D, CAW	Land reclamation of disturbed areas
4.3	Reclamation of the area, affected by construction, liquidation of temporary soil disposal sites and restoration of disturbed soil and vegetation cover.	D, CAW	Restoration of disturbed soil cover and landscape.
4.4	Soils must not be allowed in the sewer and the water body.	D, CAW	Protection of surface and groundwater from pollution.
4.5	Reinforcement of disturbed terrains and anti-erosion measures.	D, CAW	Avoidance of unwanted erosion processes and landslides, protection of vegetation typical for the area.
4.6	Planting vegetation on open areas.	D, CAW	Compliance with norms and regulations.
<b>5.</b>	<b>Biodiversity. Protected zones.</b>		
5.1	Maximum preservation of existing vegetation.	D, CAW, O	Minimizing the impact of the facility on biodiversity in the area.
5.2	The implementation of additional works on the afforestation belt should be done with trees typical of the area.	D, CAW	Positive impact on wildlife. Adverse erosion processes will be avoided as well as problems after afforestation.
5.3	Green areas should be properly maintained – grass and groups of trees and shrubs.	C, O	Protection of land and soil and the authentic landscape.
5.4	The reclamation of areas disturbed by excess soil disposal to be performed after a plan, developed by a landscape architect	C	Protection and blending of the facility into the surrounding terrain after reclamation.
5.5	Protection of existing tree species	C, O	Protection of forest plants and typical species of trees and shrubs
5.6	Initial care should be provided to vegetation to strengthen and adapt to environment.	O, H	Preservation of biodiversity in the area.
5.7	Construction works to be performed outside the breeding season of animals (spring and early summer;)	CAW, Z	Minimizing impact of facility on wildlife in the area
<b>6</b>	<b>Landscape</b>		
6.1	Appropriate architectural design of the visible part of facilities	D, CAW	Blending into the surrounding landscape.
6.2	A landscape development plan to be prepared for the site.	D, CAW	Blending into the surrounding landscape.
6.3	After completion of construction, measures should be taken for minimizing the impact – restoration of disturbed lands and landscaping where necessary – the open spaces around the facilities for the purpose of blending the site into the environment.	D, CAW	Blending into the surrounding landscape.
6.4	The work program should be strictly respected, as well as the sanitary and hygiene requirements for projects of this type.	D, CAW, O during reconstruction works	Blending into the surrounding landscape.
6.5	During and after construction it is necessary to take measures to restore the damaged areas and plant appropriate vegetation. Adequate measures should be taken against erosion processes. Rehabilitation of the upper soil layer, maximum preservation of adjacent land plots and adequate use of vegetation will minimize the change of landscape and the artificial introduction of such landscape dominant in the local	D, CAW, O during reconstruction works	Blending into the surrounding landscape.

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	industrial landscape.		
<b>7</b>	<b>Waste</b>		
7.1	Preparation of an updated program for waste management and updating it on regular basis.	D, CAW, O	Compliance with regulations and requirements. Guaranteeing the quality of treated water. Protection of the aquatic ecosystem.
7.2.	Preparation of a sludge management program for the sludge generated at WWTP Plovdiv and coordinating it with the competent authority	D, CAW, O	Compliance with regulations and requirements. Protection of soils and waters from pollution.
7.2.	Obtaining a permit for waste management activities, acc. to art. 12, par 1, item 1 of the Law on Waste Management.	D, CAW, O	Compliance with regulations and requirements.
7.3	Timely disposal of waste and sludge from CWWTTP	O	Protection of soil and water from pollution
7.4	Storage sites should be designated for temporary storage of different types of wastes until their removal by a specialized contractor.	D, CAW, O	Protecting the area of WWTP and the adjacent areas from pollution.
7.5	Immediately after completion of construction works, the separate sections of the rehabilitated or newly built networks and facilities of the water supply and sewage systems and facilities at WWTP and the storage areas for bulk materials need to be carefully cleaned.	D, CAW,	Air protection. Waste management.
7.6	After completion of construction works, the construction waste should be transported to the local landfill for construction waste.	After completion of CAW and O during reconstruction	Protection of soil. Waste management.
7.7	Stabilized sludge should be periodically tested and opportunities should be sought for its utilization.	O	Waste management. Soil protection.
7.8	Real opportunities should be provided for the utilization of compacted and stabilized sludge from WWTP Plovdiv in short and long term perspective, under the applicable environmental legislation.	O	Ensuring effective WWTP operation. Protection of soil. Waste management.
<b>8.</b>	<b>Hazardous substances</b>		
8.1	Preparing instructions for safe handling and use of personal protective equipment.	CAW, O	Prevention of health risk to workers on site
8.2	Compliance with all instructions for safe handling of hazardous substances.	CAW, O during reconstruction	Prevention of risks associated with raised concentrations of hazardous substances in the air of the working environment.
8.3	During construction on site and especially during asphalt laying, there must be strict compliance with all requirements of the Labour safety and hygiene and fire safety standards.	CAW, O during reconstruction	Prevention of risks
8.4	Compliance with the requirements for handling powdered raw materials. Proper storage of hazardous substances.	CAW, O	Minimizing possible adverse effects of hazardous substances. Prevention of health risk to workers on sites.
8.5	Ensuring compliance of storage facilities for reagents with the requirements. Minimizing possible adverse effects of hazardous substances by respecting the requirements for loading and unloading powdered materials, delivered in paper or polymer bags. Proper storage of hazardous substances.	D, CAW, O, H	Prevention of air pollution in the work environment. Healthy working conditions.
8.6	For the purpose of protection of public health and the environment, there must be strict compliance with the requirements for storage of dangerous chemicals listed in the safety data sheets /SDS, which should be required by the manufacturers and/or importers with the first delivery and must be available for inspection by the authorities under the Law on protection from harmful effects of chemicals /SG 114/2003/.	CAW, O	Prevention of health risk to workers on site.
8.7	The raw materials supplied on site must be accompanied with analysis certificates, safety data sheets, instructions for safe use, including measures for spills, dust spreading and health damage to staff.	CAW, O, H	Prevention of health risk to workers on site. Health protection.

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	Each original container must have a label, describing the health and environmental risks and safety measures. Hazardous substances and products are controlled by the authorities of the Ministry of Health.		
8.8	The traffic routes for construction of the separate sections of the water supply and sewage network and related facilities have to be agreed with Plovdiv municipality, "Roads" agency and the involved companies and individuals.		Health protection of workers and population in the area.
9.	<b>Harmful physical factors - Noise, vibrations, etc.</b>		
9.1.	Used machinery must be in good working order and should meet all modern technical requirements, specifications and standards required by EU.	CAW, O	Health protection of workers and population in the area.
9.2	Noise-generating machines should be used only in daylight hours until 17.00h. The noise impact should be limited to 50 dbA outside the area of WWTP.	CAW, O	Health protection of workers and population in the area. Minimizing the negative impact on birds in the area.
9.3	Compliance with noise emission standards must be ensured, according to the legal requirements for operation of facility.	CAW, O	Not allowing loud noise levels
9.4	Modern, short-term construction technologies should be employed. It is desirable that construction work periods with excessive noise not to coincide with the nesting periods of birds;	CAW, reconstruction activities	Birds protection in the area
9.5	During construction, workers should use personal noise protection equipment for personal protection against noise pressure.	CAW, reconstruction activities	Health protection of workers and population in the area.
9.6	The machines and equipment used in construction should be modern, reliable, in good working order and with good technical specifications, including noise characteristics. Adequate silencers are provided for ventilation and blower systems. They should be maintained in good working order.	CAW, reconstruction activities	Health protection of workers and population in the area. Not disturbing the birds in the area.
9.7	Machinery and equipment, working outdoors must meet the requirements of the Ordinance on the essential requirements and conformity assessment of machinery and equipment, working outdoors, in respect of noise emitted by them in the air (CM, SG 11 / 2004). The ordinance is synchronized with Directive 2002/88/EC.	CAW, reconstruction activities	Health protection of workers and population in the area.
9.8	The traffic routes for construction of the separate water supply and sewerage network sections and related facilities have to be agreed with Plovdiv municipality, "Roads" agency and the involved companies and individuals.		Health protection of workers and population in the area.
10	<b>Monuments and cultural heritage</b>		
10.1	The performance must comply with the requirements of art. 83 par. 1 and 2, art. 93, par. 1, art. 94, art. 97 of the Cultural Heritage Act on protection, identification and preservation of cultural artifacts, as well as art. 158, par. 1 on delivery of movable archaeological artifacts to Plovdiv regional museum.	D, CAW	Protection of cultural monuments
10.2	In accordance with art. 160 par. 1 and 2 of the Cultural Heritage Act, when structures and artifacts have been identified in the course of construction and public works, having characteristics of cultural monuments, the activity is stopped immediately and art. 148, art. 72 and 73 apply accordingly.	D, CAW	Protection of cultural monuments
10.3	If during construction works artifacts are found that have characteristics of cultural monuments, work will be temporarily suspended and the municipality on whose territory the finding was made should be immediately notified acc. art. 93, 94 and 97 of the Cultural Heritage Act.	D, CAW	Protection of cultural monuments

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10.4	There is no data for any cultural monuments existing in the area where construction works will be performed. Nevertheless, if any findings will be made during construction that resemble cultural monuments, work should be temporarily suspended pursuant to art. 18 of the Cultural Monuments and Museums act, and the Municipality should be immediately notified.	CAW	Protection of cultural monuments
11	<b>Health protection and risk management</b>		
11.1	Preparation of instructions for safe work and use of personal protective equipment.	CAW, O	Prevention of health risk to workers on site.
11.2	Compliance with all instructions for safe handling of hazardous substances. During construction on the site and especially during asphalt laying, there must be strict compliance with all requirements of the Labour safety and hygiene and fire safety standards.	CAW, O during reconstruction	Prevention of health risk to workers on site.
11.3	Construction and operation of site should comply with all requirements for safe working conditions that are provided in the design, acc. to the Law on Health and Safety at Work (1997)	D, CAW, O	Strict compliance with the requirements for safe working conditions and reduction of health risks to workers on site during construction and operation.
10.4	Compliance with all requirements of health care in terms of physiological regimes of work and rest and physiological norms for manual handling of heavy loads specified in the Regulations of the Ministry of Health	CAW, O	
11.5	Use of provided personal and collective protective equipment	CAW, O	
11.6	Compulsory instruction of workers by competent specialists	CAW, O	
11.7	An Emergency situation plan should be prepared and periodically updated.	D, CAW, O	Minimization of risk.
11.8	First aid kit to be available on site.	C, O	Rendering first aid to injured personnel in due time.
11.9	Strict control and management of the water sector. Reducing losses of drinking water. Ensuring effective decontamination.	D, CAW, O	Supplying drinking water in good quality and sufficient quantity to population.
11.10	Compliance with the requirements for storage facilities for reagents. To reduce possible adverse effects of hazardous substances it is necessary to comply with the requirements for loading and unloading of powdered materials, delivered in paper or polymer bags. Proper storage of hazardous substances.	D, CAW, O, H	Prevention of air pollution within the work environment. Health protection of workers.
11.11	The raw materials supplied on site must be accompanied by analysis certificates, safety data sheets, instructions for safe use, including measures for spills, dust spreading and health damage to staff. Each original container must have a label, describing the health and environmental risks and safety measures. Hazardous substances and products are controlled by the authorities of the Ministry of Health.	CAW, O, H	Prevention of health risk to workers on site. Health protection of workers.
11.12	All construction and reconstruction works should comply with Ordinance № 2 of 22.03.2004 on the minimum requirements for health and safety in carrying out construction works - Appendices № 1-5 to art. 2, par. 2 and Ordinance № 4 of 27.12.2006 to reduce harmful noise through sound insulation of buildings in their design and the rules and regulations in carrying out works in respect of noise emitted during construction.	D, CAW, O	Prevention of risks.
11.13	Reduction of dust emissions by watering the places, emitting dust (in dry weather and wind). Use of concretes and solutions prepared in concrete mixing plants and their machine pouring.	C, O	Risk prevention, prevention of air pollution
11.14	Now allowing spills of petroleum products. In case of spills immediate measures should be taken to locate the spill, liquidate and transport it to appropriate	C, O	Risk prevention. Protection of soils and groundwater from pollution.

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	disposal facilities.		
11.15	Construction machinery should be properly maintained and optimally operated in order to reduce the amount of exhaust fumes, noise and vibration.	C, O	Risk prevention.
	The work and rest schedule for operations, involving vibration should be made so that the total exposure per shift (exposure to vibration) should not exceed 90-120 min.	C, O	Risk prevention.
11.16	All professional activities should be performed with workwear, appropriate for the season, personal protective equipment in case of harmful factors in the working environment (dust masks, ear defenders, anti-vibration gloves) and a rational regime of work and rest should be adopted.	C, O	Risk prevention.
12	<b>Socio-economic aspects.</b>		
12.1	Activities for raising the awareness of citizens in order to enlarge their participation in decision taking process and use their competence on issues related with sustainable development and environmental protection and the safety of future generations.	D, C, O, H	
12.1	Training courses for the personnel, involved in the construction and operation of facilities.	D, C, O, H	Ensuring quality environment and working conditions.
13	<b>Others</b>		
13.1	The next stages of design should take into account all recommendations and proposed measures. Strict control and management should be performed on their implementation during operation of water and sewage networks and WWTP facilities.	D, C, O	Prevention of risks to environment and working conditions.
13.2.	The following documents should be prepared in the next stages of design and updated periodically during operation: - Operation Manuals - Program for Environmental Management - Monitoring plan - Waste Management Program - Emergencies Plan	D, C, O	Prevention of risks to environment and working conditions.
14	Performance of all measures provided for the different components and factors of the environment		

- D – design;
- C – construction; CAW – construction and assembly works
- O – operation.
- RDO – reconstruction during operation.

### **Conclusion**

The implementation of the *Reconstruction, upgrade and extension of the water supply and sewerage systems and related facilities and the Reconstruction, upgrade and extension of UWWTP Plovdiv*, subject of the investment intention will have no negative impact on the individual components of the environment under the proposed measures, control and management. The health risk to population in the region will be prevented with the discharge of untreated wastewater into water bodies. It is foreseen to install new equipment in several process areas of UWWTP Plovdiv, reconstruct and upgrade the sludge treatment plant to bring it in compliance with modern requirements.

The implementation of this package of environmental solutions will improve the quality of life and the environment across the region.

## List of Abbreviations

Ammonium nitrogen – N-NH <sub>4</sub>	Ammonium nitrogen
AAQ	Ambient air quality
AAR	Average Annual Rate
AAR	Average annual rate - the average value of the daily average concentrations recorded for one year.
ADR	Shows the permissible level of air pollution over a long period - formed as the arithmetic average of individual measurements or a continuous selection of samples.
AEI	Assessments of the environmental impact of investment proposals for construction, operations and technology
AHR	Average hourly rate, which determines the degree of the short-term effects of pollutants on human body - 30 or 60 minutes.
AIS	Automated Information System
AS	Active sludge
AT	Aeration tank
BI	Biotic Index
BOD	Biological Oxygen Demand
Cadmium Cd,	Cadmium
Carbon oxide CO	Carbon Oxide
COD	Chemical Oxygen Demand
COD	Chemical Oxygen Demand
DN	Nominal Diameter
DS	Dry substance
DWA	German Association for Water Technology
DWTP	Drinking Water Treatment Plant
EA	Ecological Assessment
EAS RBD	East Aegean Sea River Basin Directorate
EBPR	Enhanced biological phosphorus removal
EC	European Commission
EEA	Environment Executive Agency
EPA	Environmental protection act
EU	European Union
FDP	Fine Dust Particles
FIDIC	International Federation of Consulting Engineers
GIS	Geographic Information System
GL	General Layout
HDPE	High Density Polyethylene
ISPA	Instrument for Structural Policies for Accession
IWA	International Water Association
LPAL	Law on Protection of Agricultural Land
LW	Leap weir
LWM	Law on Waste Management
LWWTP	Local waste water treatment plant
LAC	Limit Admissible Concentration - permissible levels of contamination, the maximum concentration of a harmful substance, which over a given period of time has neither direct nor indirect harmful effects on man and his offspring.
LAC a.a.	Average annual concentration - acceptable level of air pollution over a long period - formed as the arithmetic average of individual measurements or a continuous selection of samples. Average annual concentration or average rate is the average value of the daily average concentrations recorded for one year.
LAC a.d.	Limit Admissible Average Daily Concentration or average daily rate - acceptable level of air pollution over a long period - formed as the arithmetic average of individual measurements or a continuous selection of samples.

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LAC o.t.	Limit Admissible One Time Concentration or average hourly rate – defines the degree of short-term effect of the pollutant on human body - 30 or 60 minutes.
MAF	Ministry of Agriculture and Forestry
MoEW	Ministry of Environment and Water
MH	Ministry of Health
MRDPW	Ministry of Regional Development and Public Works
NEMS	National Environmental Monitoring System
Nitrate nitrogen – N- NO <sub>3</sub>	Nitrate nitrogen
Nitric Oxide – NO	Nitric Oxide – NO
Nitrite nitrogen – N-NO <sub>2</sub>	Nitrite nitrogen
Nitrogen dioxide NO <sub>2</sub>	Nitrogen dioxide
NSI	National Statistical Institute
Organic nitrogen – N org.	Organic nitrogen
PE	Population Equivalent
PIP	Priority Investment Program
PIU	Project Implementation Unit
PS	Pump station
PST	Primary Settlement Tank
PVC	Polyvinyl chloride
RIEW	Regional Inspectorate of Environment and Water
RIPCPH	Regional Inspectorate for Protection and Control of Public Health
RWC	Regional Water Company
SBR	Sequence Biologic Reactor (SBR)
SCADA	Supervisory control and data acquisition
SDA	Spatial Development Act
SO <sub>2</sub>	Sulphur dioxide
Soluble phosphates like P	Soluble phosphates as phosphorus
SS	Solid substances
SST	Secondary Settlement tank
SSZ	Sanitary Security Zone
SUR	Surfactants
Total Kjeldahl nitrogen – OAK N <sub>Kjeldahl</sub> = N-NH <sub>4</sub> + N org.	Total Kjeldahl nitrogen
Total nitrogen – Nt	Total nitrogen
Total phosphorus /Pt	Total phosphorus
UWB	Underground Water Body
UWWTP	Urban Waste Water Treatment Plant
VOC	Volatile Organic Compounds
WA	Water Act
WWTP	Waste Water Treatment Plant
PM <sub>10</sub> и PM <sub>2,5</sub>	Particulate matter –