Financira Europska unija

IPA PROGRAM PREKOGRANIČNE SARADNJE BOSNA I HERCEGOVINA - CRNA GORA

WILD LANDFILLS AND IMPACT ON WATERCOURSES

BOKA KOTORSKA (MONTENEGRO)

Project developer:

Association for Development, Environment and Culture EKO ZH

NGO Our Action

Youth DRIVE

EKO

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IPA – Cross - border cooperation program BiH - Montenegro
Project **YOUth Drive** – Program for raising awareness on proper waste management and empowering legislators for taking action

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Project developer: **Association for Development, Environment and Culture EKO ZH**
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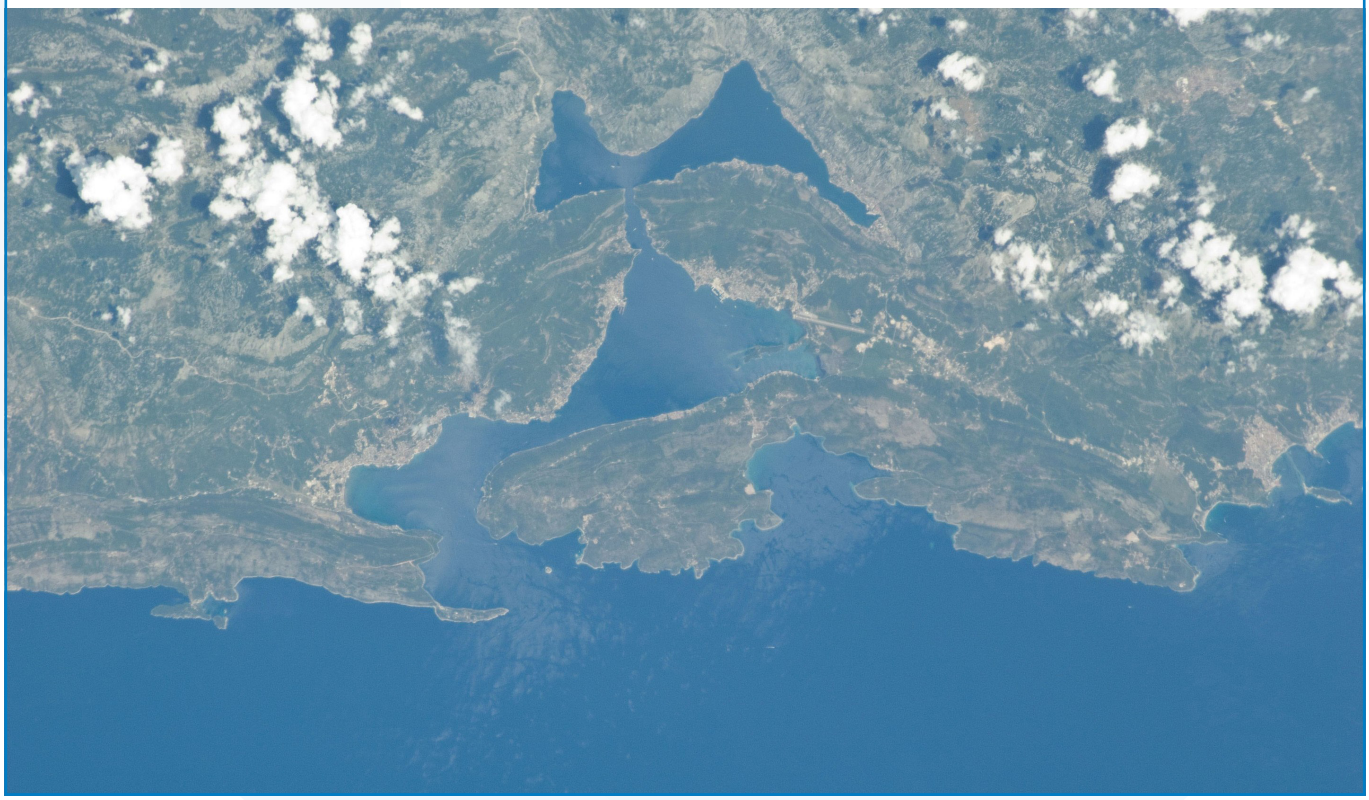
September, 2020.

"This publication was made with the help of the European Union. The content of this publication is the exclusive responsibility of the Association for the Development, Environment and Culture of EKO ZH and NGO Our Action, and does not necessarily represent the views of the European Union.



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B.

BOKA KOTORSKA (MONTENEGRO)

1. REVIEW OF THE CURRENT SITUATION
MUNICIPALITIES OF KOTOR, TIVAT AND HERCEG NOVI

1.1. Introduction – Boka Kotorska

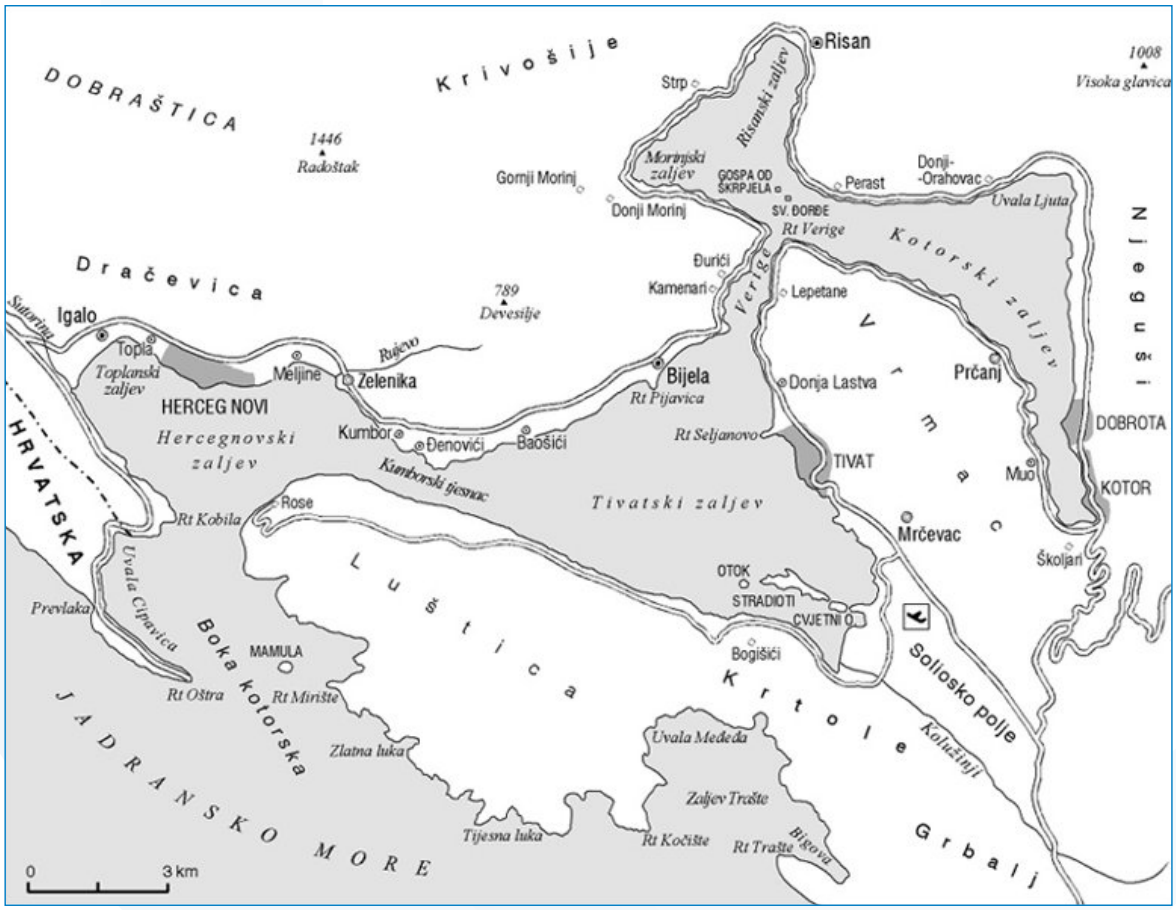
Boka Kotorska, a vast and branched bay in the southern part of the eastern coast of the Adriatic Sea, is an integral part of the Montenegro's coast, and the extreme southwestern part around the peninsula Oštra belongs to Croatia; covers 87.3 km². North and northeast of the Cape Mirište - Cape Oštra the bay is about 24 km deep into the mainland. Boka Kotorska consists of several interconnected bays: the outer Herceg Novi or Toplan Bay, the central Tivat and the inner Risan, Morinj and Kotor Bays. In the hinterland of the Boka Kotorska, the limestone mountains Lovćen (1749 m) and Orjen (1894 m) rise, whose slopes descend steeply towards the coast. During the Pleistocene[1], the river flowed through the Bay of Kotor, digging valleys (bays) in the softer flysch layers, and in the hard limestones of the gorge (the sea straits of the Verige and the Bay of Kotor). More resistant limestone parts (humes) remained in the valleys, which could not be completely leveled by river erosion. As sea levels rose after the ice age, river valleys and gorges were submerged; a branched bay was created, in which the peaks of the hummocks protrude above the sea level like islets. The Bay is connected to the open sea by the Boka Kotorska Gate or the Oštra Strait, and to the Bay of Tivat by the Kumbor Strait. At the very entrance to the Bay of Kotor is the island of Mamula.The northern shore of the Bay is steep and rocky; the greatest depth is 45 m. The Bay of Tivat is the central part of the Bay of Kotor, which is about 300 m wide and 2.5 km long by the Strait of Veriga connected with the Gulf of Risan, Morinj and Kotor in the north; the greatest depth is 41 m (along the coast 10 m). In its southeastern part are the islands of St. Mark (Stradioti), Flower Island (Prevlaka) and the Island of Our Lady of Mercy. Of the three inland bays, the largest and deepest (36 m) is the Bay of Kotor. At the place where the bays meet, there are the islands of Sveti Đorđe and Gospa od Škrpjela (Our Lady of the Rocks). Larger cities and ports are: Herceg Novi, Kotor, Zelenika and Tivat; other settlements are Igalo, Bijela, Dobrota Risan, etc., Perast. Larger ships dock in Kotor; ear Tivat is the international airport. The Adriatic Highway runs along the western and northern coasts of the Bay of Kotor.The Boka Kotorska area has been inhabited since prehistoric timesRemains (money, fortifications, etc.) were discovered from the Illyrian period, and inscriptions (Kotor, Perast, etc.), architectural remains, graves, mosaics (Risan), traces of the road leading from Aquileia to Shkodra have been preserved.

[1] **The Pleistocene** is a geological epoch in the history of the Earth, within the Neogene period. he name comes from the Greek words pleistos (most) and ceno (new). The Pleistocene follows the Pliocene epoch and precedes the Holocene epoch. It is the third epoch of the Neogene period or the sixth epoch of the Cenozoic era. It lasted from 2.588 million years ago to 11,550 years ago.

Kotor is a municipality on the Montenegrin coast, in the extreme northeastern part of the Bay of Kotor. The name of the town comes from the medieval Latin name Catarum, which also appears in the forms Decadaron, Dekatera, Cathera, Cathara,etc. Archaeological finds in the area of today's Kotor indicate a relatively long life in that place. The city is surrounded by old, four-kilometer-long walls through which it is entered through three gates Since 1979, it is on the UNESCO list of protected world cultural heritage. The city has a maritime museum, a maritime faculty, an institute of marine biology, a theater, a historical archive and the food, chemical and metal industries. It is connected by road with Cetinje, Podgorica, the coast and the hinterland.

Tivat is a municipality and a city in Montenegro. Tivat belongs to Boka and is located in the Bay of Kotor. There are three different opinions about the origin of the name Tivat.. According to the first, the name Tivat is derived from the name of the Illyrian queen Teuta, who once had her capital in Risan, and possibly summer houses near today's Tivat. According to another opinion, the name could be derived from the names of Christian saints such as sanctus Theodorus, Theodosius, Theodotus, Theodulus or the medieval (12th century) Theudo, Theodo. The third opinion was expressed very briefly and without major explanations. According to this opinion, the name comes from the Celtic word "touto" which means city.

Herceg Novi is a town and municipality on the Montenegrin coast - Boka Kotorska, Montenegro. It is located in an extremely important and attractive geographical area between the highest mountain of the Dinaric massif, Orjen (1,895 m) and the entrance to one of the most beautiful bays in the world, the Bay of Kotor. It is the administrative, cultural and economic center of the Municipality, which stretches from the border crossing Debeli Brijeg to the narrowest part of the Bay of Kotor (Strait of the Verige-300 m wide), with a very rich and picturesque rural hinterland, covering a total area of 235 km2 and has 33,034 inhabitants,while the city itself has about 12,739 inhabitants (according to the 2003 census).



BOKA KOTORSKA, location map

1.2. Natural characteristic of Boka Kotorska

The area of Montenegro is not a unique natural-geographical area, but thanks to the geological composition, geotectonic and altitude structure, as well as the erosive action of external forces, there was the formation of individual relief units that are quite different from each other. These are: the Montenegrin coast, the plateau of deep karst (Krivošije, Grahovski, Rudine and Banjani), the central valley of Montenegro, the area of high mountains and and the area of northeastern Montenegro

1.2.1. Hydrogeological features

Boka Kotorska belongs to the Montenegrin coast and covers a narrow coastal belt, which is sharply separated from the rest of the country by Orjen, Lovćen, Sutorman and Rumija. Their steep sides and vertical sections are furrowed with deep grindstones and toothed reefs.

From the hydrogeological aspect, it is necessary to notice the complexity of the lithological basis in certain parts of Montenegro. Even at short distances, the compressive masses are very different in terms of permeability and resistance to denudation, fluvial erosion and corrosion.

From the point of view of similarity of the problems of arrangement and protection of natural values of the state, the territory of Montenegro can be divided into three, in a sense, clearly separated regional units: coastal, central and northern region. Boka Kotorska belongs to the coastal belt.

Municipality of Kotor

Karst features of the area have greatly influenced hydrology. On rainy days, Kotor is all on the water. It is strictly limited by two strong springs of Lovćen sinkholes. From the north Škudra, which derives its name from ancient Illyrian times from the south Gurdić, an ancient name of Latin or Greek origin. Škurda and Gurdić belong to the salty (brackish) springs. The maximum yield of Škurda was recorded in November 42 m^3/s, and Gurdića 30 m^3/s. Up to 180 m^3/s of water flows out of the surrounding spring Ljuta, at the time of maximum yield. Gurdić is in connection with the abyss on Njeguši, into which the eponymous stream Njeguši sinks. It has no trough of its own. It erupts from an underwater cave, from a gaping hatch, over which it swirls, hence its name from the Latin word “gurges”, which means whirlpool. During the dry summer, Gurdić dries up, then his hatch swallows the sea water, which he expels from the other side, into the Škurda riverbed, a few meters above the sea surface, through a secret underground corridor. In underground channels, abysses and caves in several places, in depressions on compact or clastic rocks, water sometimes lags behind during summer droughts. Most often, these are giant pots, larger oysters and ponds, which in speleology are usually called underground lakes.

Municipality of Herceg Novi

Based on the hydro-geological characteristics of porosity-type rocks, the following types of rocks have been singled out in the narrower area of aquifer:

- The compacted type of aquifer is represented within the crumb and moraine deposits. The collector formed within this aquifer is relatively low, which largely depends on the presence of the clay component This aquifer is fed only at the expense of precipitation, or at the expense of contact from the karst aquifer (Kutsko polje)
- karst type aquafers forming within brecoid high karst limestones (J2 + J3), which is the main groundwater collector in this area. They can be classified as well permeable rocks.

In this area, during atmospheric precipitation, karst aquifers are fed almost directly. Drainage is most likely done through Morinjske vrele or by deep circulation below sea level. The lateral barrier to the karst type of aquifers, i.e. the circulation of groundwater, is represented by flysch sediments (E1). There is no underground aquifer at the site or it is at a very great depth. It is assumed that the site is located within the catchment area of Morinj spring, and further research is needed to prove a possible hydrogeological connection between the site and the source.

Municipality of Tivat

The front part of the Bay of Kotor (Tivat) is open, wide vistas, bordered by gentle slopes under lush, evergreen vegetation, with a vast Tivat field and two “green” (semi) islands (Island of Flowers-Miholjska prevlaka and Sveti Marko). The location is part of the Tivat field, mostly with a slight slope (up to 5 °), with a hill of 20 ° -30 ° in the hinterland. >The height difference of the terrain at the location is about 60 m, from 1.5 to 60 m above sea level. The exposure of the terrain is very favorable because the location is exposed to the southeast side. Floods that cause floods are very common in this area. They are characterized by a sharp rise and fall of water levels and the transfer of a large amount of crushed material - sediment. They cause the greatest damage in the lower course, at the mouth of the sea. The main surface flow is the occasional stream Vodice, which occurs at an elevation of 320 m. It passes through the middle of the military complex and flows into the sea next to the ferry. The stream is regulated through the barracks and paved with stone. Flow regulation is characterized by clear geometry. The stone style that paved the stream bed is well preserved.

1.2.2. Climatic characteristics

The climate of an area is defined on the basis of mean values, extremes and other statistical parameters of meteorological conditions over a longer time interval, and not on the basis of daily observations. The content of climatography is prescribed by the Technical Regulations of the World Meteorological Organization (WMO).

Montenegro is a very complex climatic area characterized by pronounced variations in time and space due to its geographical position, proximity to the sea, morphological forms - mountain ranges that prevent deeper penetration into the mainland of maritime influences, as well as air currents.

The first is the so-called Genoa cyclone, which causes high rainfall, and the second is the so-called Siberian anticyclone, which causes extreme values of air pressure and very low temperatures. There are two dominant influences on the climate picture of Montenegro.

The coast (Bay of Kotor) and the Zeta-Bjelopavlićka plain are areas with a Mediterranean climate, characterized by long, hot and dry summers and relatively mild and rainy winters.

Places in the valleys, such as Podgorica, Danilovgrad and others, have lower temperatures in January than coastal places at approximately the same latitude, while during the summer they have a slightly higher temperature. In warm summers, the Zeta valley stands out in particular, and the absolute maximum air temperature in Montenegro and the highest average number of tropical days have been registered in this area.

Climatic conditions (Boka Kotorska) are characterized by a Mediterranean climate with dry and warm summers and mild winters, with rainy periods. Snowfall is very rare, as shown by the average air temperature of 17.6 C°. The general precipitation regime in the Bay of Kotor is characterized by a maximum during the winter and a minimum during the summer period of the year. Precipitation is exclusively in the form of rain, while other forms of precipitation are very rare here. The average annual rainfall is 1755mm, while the values of the average annual relative humidity for Tivat, for example, are 70.5%. The average sea temperature during the summer months ranges from 22C° to 26C°. The predominant winds in this area are: southeast (Jugo), north / northeast (Bura) and north-west (Maestral, characteristic in the summer months).

1.3. Disposal of solid and liquid waste and problems with landfills

1.3.1. Solid waste

Based on the data of the National Environmental Approximation Strategy with the Action Plan for the period 2016-2020 (NEAS) in the waste management system of Montenegro, the basic principles of waste management on which waste management in the EU is based have not yet been applied, especially when word on the principle of hierarchy, which ensures compliance with the order of priorities in waste management (waste prevention, preparation for reuse, recycling and other methods of processing (energy use) and waste disposal). It is stated that this also applies to the management of special waste streams in Montenegro. Systems for separate collection of municipal waste have not been established at a satisfactory level, and for certain types of special waste streams, export is currently the only possible solution. The built waste management infrastructure includes regional landfills for non-hazardous waste in Podgorica and Bar, recycling centers, waste vehicle treatment plant, transfer station and recycling yards. The decision on the construction of the landfill in Herceg Novi will be made after the end of the lawsuit of LC Morinj against the Decision on issuing the construction permit of MORT for the construction of this landfill.

There are 10 recycling yards; Regional Recycling Center in Podgorica, Recycling Center Zabjelo, Podgorica, Recycling Center Golubovci, Podgorica, Recycling Center Tolosi, Podgorica, Recycling Center Zlatica, Podgorica, Recycling Center Donja Gorica, Podgorica, Recycling yard Konik, Podgorica, transfer station / Recycling Center "Lovanja", Kotor, transfer station / Recycling Center

"Meljine, Herceg Novi,and Recycling Center for metal, Podgorica. Secondary selection of waste is carried out in four material recovery plants in Podgorica, Herceg Novi, Kotor and Žabljak. They work within recycling centers where all separately collected fractions of municipal waste are collected and temporarily stored, but they also serve for temporary storage and treatment of mixed municipal waste that needs to be sorted or otherwise processed. Infrastructure for secondary waste selection in other municipalities has not been built nor is it currently started at any other location. Official data show that these four recycling centers are still not operating at their full capacity, i.e., that the entire amount of waste collected is not sorted. The first regional composting plant for the municipalities of Tivat, Kotor, Herceg Novi and Budva was opened in Kotor in 2016. A facility for processing medical waste collected from the territory of several municipalities has been installed in the municipality of Berane, and such a facility has also been installed in Podgorica. The construction of a leachate treatment plant is underway at the landfill in Podgorica, where a waste vehicle treatment plant has been installed, although it is not operating at full capacity.

Therefore, the Waste Management Infrastructure in Montenegro is still not developed. Its development is part of the new National Solid Waste Management Plan. There are currently 6 recycling yards (4 in Podgorica, 1 in Herceg Novi and 1 in Kotor), 4 material sorting plants (in Podgorica, Zabljak, Kotor and Herceg Novi) and 2 sanitary landfills (in Podgorica (Livade) and Ulcinj). (Mozura).

1.3.1.1. Problems with waste and landfills in the municipality of Kotor

As in all municipalities in Montenegro and in the Municipality of Kotor, waste collection is entrusted to a utility company owned by the municipality. The Assembly of the Municipality of Kotor at a session held on 27.12.2013. passed the Decision on the establishment of the Limited Liability Company “Komunalno Kotor”- Kotor. The Decision entrusts the Company with the performance of communal activities envisaged in area 38, branch 38.1, group 38.11 - Collection of non-hazardous waste, as the predominant activity.

The number of households and legal entities covered by this service in the period 2013-2016 is shown in the following table:

Table: Number of households and legal entities covered by the waste collection service from 2013 - 2016

Year	2013	2014	2015	2016
Households	8182	8237	8678	8337
Legal entities	840	833	833	840

Collection of municipal waste in the Municipality of Kotor, depending on the type, is done by placing adequate bins and containers for collecting waste from households and the commercial sector and collecting waste from bins and containers by directly transferring it from bins and containers to specialized trucks.

Removal of waste from public areas means disposal in containers and transport of waste collected from waste bins and baskets as well as discarded waste from public areas (sidewalks, pedestrian paths, green areas). These tasks are performed daily throughout the calendar year.

Table: Number of containers and number of vehicles for collection and transport of mixed, municipal waste

CONTAINERS		
TYPE	NUMBER	
1,1 m^3	712	kom.
5 m^3	22	kom.
7 m^3	5	kom.
10 m^3	15	kom.
Press conteiner	3	kom.
Rolo conteiner	2	kom.
from 120 L	120	kom.
from 240 L	10	kom.

VEHICLES	
TYPE	NUMBER
Special vehicles	8
Self-elevator	2
Tipper	5
Bulldozer	1
JCB	1
Forklift	2
Electric Vehicles	2
Cleaner	2
Cistern	2

Table: Quantitative composition of generated municipal waste in the Municipality of Kotor

Organic	4011
Paper and plastic	1628
Glass	1065
Metals (aluminum and other)	344
Wood	320
Composite packaging	459
PET	696
Plastic	1489
Textile	353
Inert waste	288
Hazardous waste	79
Green waste	638
Other	1130
Total	12500

Recycling and reuse of waste the goal of the material recovery and secondary selection plant, ie the MRF (Material Recovery Facility), is to separate useful materials from the waste for further use. The process is performed before disposal, incineration or mechanical-biological treatment. There are different technological concepts of MRF plants. In principle, they are designed to accept complete unselected household waste, mixed recyclable materials, etc. Within the MRF plant, the basic facility is a hall for sorting useful materials in which all equipment is located, which usually consists of two technological lines:

- ”dirty line”, where recyclable components are separated from mixed municipal waste and inserted into the boxes provided for that purpose;
- “Clean” line for baling secondary raw materials that are separated on the “dirty” line.

Transshipment station LLC “Komunalno Kotor” is positioned in the municipality of Kotor at the old location of the landfill “Lovanja” (N 42 ° 24,133’ E 18 ° 44,272’). It covers an area of 5,500 m2 and is designed for the treatment of mixed waste from the territory of Kotor, with a total population of 22,515.

It was funded in part through a MEIP project grant and a World Bank project loan for MESTAP. The funds were provided by the Government of Montenegro in the desire to build a regional hunting landfill for the municipalities of Kotor, Tivat and Budva. The landfill was put into operation in July 2004 and operated until January 2008. At the beginning of November 2005, the procurement of equipment for recycling secondary raw materials was completed. While it was operational, the Lovanja landfill was managed by the company "Lovanja" llc (46% owned by the Municipality of Kotor, 29% owned by the Municipality of Budva and 25% owned by the Regional Water supply system). After the closure of the Lovanja landfill, in January 2008, the company "Lovanja"; llc rented equipment for recycling and accompanying land LLC "Komunalno Kotor" for a monthly fee. The recycling center was repaired in 2009, and since then this plant has been fully operational and under the management of LLC "Komunalno Kotor". Mixed waste from the municipality of Tivat is treated in this plant and transported to the sanitary landfill in accordance with the agreement. In 2013, a recycling yard (MRF) was built on the same location. The recycling yard in Kotor is a typical plant for material recovery and sorting, for mixed and pre-selected waste, with a transshipment station. In the recycling yard, there are containers for collecting 10 types of waste, of which 3 are intended for special types of waste (medical waste, batteries, accumulators and oils). The transfer station consists of a rotary perforated sieving drum, a conveyor belt for waste transport and a box for sorted raw materials. There are three containers for sorted raw materials, one for separate cardboard, the other for separated PET, and the third for aluminum. The transshipment station consists of three (3) containers for pressing waste fractions with a volume of 30 m^3. The projected capacity is 40 t/ day, however, this plant also processes over 100 t/day in the peak of the summer season.

The following table shows the data from the Kotor Recycling Center, which were obtained from LLC "Komunalno Kotor" in which it is stated that received 8093 t of mixed municipal waste from Tivat, and from the territory of the Municipality of Kotor 11435.8 t with the note that 2714.2 t of rubble, i.e. construction material for which there is an obligation to collect separately, so such a quantity cannot be treated as municipal waste.

Table: Estimated amount of collected waste by morphological composition by fractions (t / year) for the period 2017 - 2020

Type of recyclable fractions (%)	t/2016 year. (67%)	t/2017 year. (72%)	t/2018 year. (77%)	t/2019 year. (82%)	t/2020 year. (87%)
Organic waste (32%)	2860	3117	3400	3695	3997
Paper and cardboard (13%)	1162	1266	1382	1502	1624
Glass (8,5%)	759	828	903	981	1062
Metal and cans (3%)	268	292	319	346	375
PET and plastics (18%)	1608	1753	1913	2078	2249
Wood (2,6%)	232	253	276	300	325
Inert waste (2,4%)	213	234	255	277	299
Green waste (5,1%)	456	498	542	587	637
Composite packaging (3,7%)	331	360	393	427	462
Textile (2,8%)	234	273	298	323	350
Hazardous waste (0,6%)	53	58	63	69	75
Other (8,3%)	759	809	882	958	1037
TOTAL	**8935**	**9741**	**10626**	**11543**	**12493**

Composting plants

Composting is a process designed to utilize the biodegradable component of waste. Composting of organic or biodegradable waste can be performed locally in households or in a central composting plant, within the regional landfill complex. Composting can help local communities meet legally set recycling targets and significantly reduce the amount of municipal waste that will be disposed of.

Composting is the controlled decomposition of organic matter by microorganisms (mainly bacteria and fungi) into a stable humus material, dark brown or black in color, which has the smell of earth. In addition to compost, the decomposition process also produces water and carbon dioxide, with the development of heat. The process is controlled for the purpose of accelerating decomposition, optimizing efficiency and minimizing possible negative environmental impacts and inconveniences that may occur. It is considered that primary separate collection at the start could be provided for organic waste generated during the arrangement of public areas and accordingly define the space for composting. LLC "Komunalno Kotor" built the first composting plant in Montenegro on its land in Kavča as part of a donation from EU funds, which was put into operation on March 28, 2016 for the municipalities of Kotor, Tivat, Budva and Herceg Novi. The plant was built on an area of 600m2 with a steel canopy and two boxes that serve to dispose of the collected green waste. In the composting plant, the green waste that is characteristic for this area is processed into compost. The obtained product will be used by the mentioned municipalities for the maintenance of public green areas. In the production process, a shredder is used to grind green waste and a turner / composter is used to turn over and irrigate compost heaps. In order for the Waste Management Plan for the area of the Municipality of Kotor to be implemented by 2020, it is necessary to provide financial resources for the procurement of equipment, funds and devices as well as for the provision of space and staff.

Funds for the implementation of the Waste Management Plan for the Municipality of Kotor will be provided from:

- loans from international financial institutions
- the budget of the Municipality of Kotor and the funds of utility companies (established by the municipality)
- budget of Montenegro,
- and other sources in accordance with the law.

Construction waste

Contractors using their own machinery remove this type of waste, not separating the useful fractions, but transporting the mixed waste to the disposal site. Until July 2012. The utility company disposed of construction waste at a construction waste landfill in the Municipality of Kotor, however, with the closure of this landfill, the Municipality of Kotor and the local utility company found themselves in serious trouble. One part of the problem was overcome, with additional efforts, by bringing all collected construction waste within the company, classified into municipal and inert waste (brick, concrete, tile,...) where the inert waste was taken further to the former landfill Grabovac, in order to of its rehabilitation, and the remaining municipal waste deposited in Nikšić, and from the end of 2012. In Bar. The second part of the problem, much more serious, concerns more frequent uncontrolled disposal, along roads. For this negative trend, the existing capacities of the Utility Company, to dispose of improperly disposed waste in the prescribed manner, are insufficient.

Hazardous waste

Hazardous waste is waste that contains elements or compounds that have one or more of the following hazardous properties: explosiveness, reactivity, flammability, irritability, harmfulness, toxicity, infectivity, carcinogenicity, corrosivity, mutagenicity, teratogenicity, ecotoxicity, corrosivity and release properties toxic gases by chemical or biological reaction and sensitivity / irritability, as well as waste from which, after disposal, another substance may have some of the hazardous properties.

In the last few years, the Local Utility Company has not recorded a single case of an individual addressing any type of hazardous waste precisely defined by the Ordinance on Waste Classification and Waste Catalog (OJMNE no. 35/12 from 06.07.2012.) hand over for further proper treatment, and hazardous waste, together with other components of municipal waste, is collected and disposed of at the municipal waste landfill.

Bulky waste collection

Pursuant to paragraph 36 of the Decision on maintaining cleanliness, bulky waste from households and business premises may only exceptionally be left in public areas at places and at the time determined by the cleaning company with the consent of the local government body responsible for communal police. If during the tour of the terrain you notice the deposited bulky waste next to the container, it is immediately collected and taken away.

Summary

Based on all the data presented so far, but also defined demographic, economic and social directions of development of Montenegro, it is possible to make a relative estimate of the amount of waste that will be generated by 2020. The amount of waste and its morphological composition depends on a number of different factors, the most important of which are the number of inhabitants, the level of development of the country, the volume of industrial and agricultural production, the level of tourism development, the level of primary selection, ie the use and recycling.

The National Waste Management Plan provides an overview of the estimated quantities of waste in the coming period for all municipalities in Montenegro. Based on the estimated number of inhabitants in the following period, a waste growth coefficient of 2% was used for the coastal region.

The volume that the collected waste will occupy was calculated on the basis of the calculation of the average density of municipal waste in Montenegro of p = 0.32 t / m3. When it comes to further management of municipal waste in Montenegro and estimating the amount of waste that would appear in certain phases as quantities that should be treated in a certain way, the processor of the National Plan was guided in its calculations by the following facts and assumptions:

- In accordance with the Law on Waste Management, Montenegro has a plan to establish a waste management system that will ensure the collection of the entire amount of generated waste (100%). Due to the fact that the level of waste collection is currently 89%, the Processor considers that the collection of waste in the percentage of 95% of the total generated waste is the most optimal for the time period for which this plan is made.
- whereas in recent years the number of containers and vehicles in the service of collecting primarily selective waste (paper, cardboard, metal, plastic, glass) has significantly increased, with a serious approach to the organization of waste collection, education of the population and employees in public utilities companies, as well as a more agile approach to the work of communal inspection, the processors estimate that, during the period of validity of this Management Plan, the percentage of waste components selected by primary selection will reach 25%.
- Separation of construction and demolition waste from mixed municipal waste and its disposal at specially designated locations in each of the municipalities does not require excessive investments and higher costs than the current ones, so the Processor considers it realistic to expect that the percentage of separately disposed construction waste from municipal waste significantly increased. Of course, it is expected that by 2020, certain locations for the disposal of construction and demolition waste on the territory of all municipalities of Montenegro will be defined;
- t is calculated that within the recycling yards, transfer stations and MRF plants, it will be planned to bring and temporarily store other types of waste that belong to special waste streams, such as: car tires, waste from electrical and electronic products, bulky waste,

- packaging of household chemicals and paints and varnishes, etc., which is why it is necessary in the further elaboration of the solution through the project-technical documentation to envisage the manner and capacities for their temporary storage;
- waste remaining after secondary separation is taken to landfill. It is expected to reduce the amount of waste that needs to be disposed of in line with the increase in the efficiency of primary and secondary selection.

As for glass, it is a big problem as it is not recycled in any municipality in the Bay of Kotor.

When we talk about the existing plant for the process of dirty and clean separation on Lovanja, it is also not the most modern, there are many shortcomings and the question is how long it will last, since Lovanja is uncovered and is in mud and water. Thus, the plant in question has not undergone any overhaul of any kind, while the plant in Herceg Novi is new, covered and on a concrete base, which helps its efficiency, or durability.

1.3.1.2. Problems with waste and landfills in the municipality of Tivat

The origin of waste in Tivat municipality are: households, hotels and restaurants, shops, schools, administration, health centers, private practices, beauty salons, warehouses, airport, shops, craft and service facilities, construction sites - construction waste and rubble, "green" waste from public green areas and from households, etc. Note, LLC "Komunalno" Tivat provides the service of collecting municipal waste from vessels.

Waste collection and treatment

Since 2005. precise records are kept of the quantities of collected waste, ie the quantities of waste that were sent to landfills and handed over to registered collectors of special types of waste. Not so far back in 2005. at the landfill Lovanja (Kotor) Public Undertaking "Komunalno" Tivat disposed of 4,972.29 tons of mixed municipal waste, while the collected amount of primarily selective cardboard was about 77 tons. In addition to cardboard, metal waste was also selectively collected, and in 2005 it was collected around 220 tons. The implementation of most of the measures to prevent the generation and reduction of municipal waste, listed in the previous Local Plan of the WM 2009-2013 recorded an increase in the amount of waste collected separately - primary selection (paperboard, PET, biodegradable waste, used tires) compared to the amount of municipal waste collected.

Municipal waste

On the territory of the Municipality, municipal waste is collected from waste disposal containers with a capacity of 80 liters to 1.1 m^3. Waste is rarely disposed of in containers of 5 and 7 m^3. For the needs of collecting municipal waste, the Utility Company has 8 special vehicles. The following is the number and type of waste disposal containers available to Komunalno LLC Tivat:

- containers of 1.1 m^3: 430 pcs +70 (at 10 locations there are a total of 40 containers in underground containers)
- 1.1 m^3 separate waste disposal containers: 221 pcs (used for the purpose of mixed municipal waste disposal
- waste bins of 5 m^3: 5 pcs
- 7 m^3 waste bins: 22 pcs

Waste bins or containers of 1.1 m^3 are located at over 160 locations in the territory of the Municipality. Waste bins of larger capacities (5 and 7 m^3) are placed as needed in various locations (for

cleaning public areas or for the purpose of disposing of various types of waste at the request of citizens or legal entities). 9 vehicles are included in the collection of municipal waste with the following capacities: 5x16 m^3 (pressure plate); 2x9 m^3 (pressure plate), forklift (5 and 7 m^3 waste bins) as well as a mini dump of 3 m^3.

In accordance with the Agreement signed in May 2013 with JKP "Kotor", the collected municipal waste from the territory of the municipality of Tivat is transported to the recycling center of JKP "Kotor" (now as the legal successor of "Komunalno Kotor" LLC). With this Agreement, "Komunalno Kotor" LLC is obliged to after the secondary selection of municipal waste (separation: plastic, metal, nylon, glass, cardboard, PET packaging, etc.) to transport the remaining mixed municipal waste with its special dimensional vehicles (30 m^3) to the landfill "Možura" in the municipality of Bar.

The morphological composition of municipal waste is the mass fraction of individual components in the characteristic waste sample. It directly depends on many factors and is basically dictated by the standard of the population that creates it in a particular area, its habits, the type of settlement in which it lives, the quality of existing communal infrastructure, types of economic activity represented in a given area, season, climate, etc.

In August 2013, a (for the first time) qualitative and quantitative analysis of municipal waste was conducted in accordance with the modified EU methodology and technical support provided through the project "Preparation and implementation of national and local waste management plans". The samples were analyzed from 9 locations, the overview of which is given in the following Table:

Table: Morphological composition of municipal waste

Municipal waste fraction	%
Organic waste	33
Paper and cardboard	13
Glass (bottles and other)	8,5
Iron	1,2
Aluminum and other	1,8
Green waste	5
Composite waste	4
PET	6,7
Plastics (LDPE, HDPE, Polystyrene, etc.)	11,3
Textile	3
Inert material	2,2
hazardous material (2,5 kg/person year urban, 1,5 kg/person year rural)	0,6
Other	9,6
Total	**100**

Biodegradable waste, as part of municipal waste, in addition to paper and cardboard, is bio-waste, which includes waste from gardens, parks, food and other waste generated in households, restaurants and retail facilities, wood residues, etc. and are of organic origin This waste can be decomposed by aerobic or anaerobic processes and its disposal in landfills generates gases and leachate that endanger the environment. The simplest way to treat this type of waste is composting. Most of the biodegradable waste is collected from public green areas (large city park, small parks, squares, green belts along the streets, etc.). Although the utility company has taken various measures to reduce the amount of uncontrolled disposal of this type of waste, citizens still dispose of it in containers for municipal and other types of waste, and quite often next to the container boxes. At several locations

in the city, containers for the disposal green waste have been set up, in which large quantities of various waste are often found. Thus, mixed waste, the employees of the Utility Company are forced to subsequently sort and separate green waste before its further transport and disposal. Numerous notifications to citizens that they can dispose of their green waste in the fleet in special containers for large-capacity waste did not yield results.

In addition to the urban area, the presence of this type of waste is pronounced in suburban areas, while removal from such areas is difficult due to the lack of technical capacity of the Utility Company.

Hazardous municipal waste

Hazardous municipal waste can be generated in: households, schools, business facilities with a wide range of economic and non-economic activities, which include:

- cleaning agents (alkaline and acidic),
- paints and varnishes (various organic solvents, paint thinners and sprays),
- solvent and fixator, films
- aerosol cans, contaminated and packaging material,
- fungicides, herbicides, insecticides, pesticides,
- fluorescent packaging tubes, low voltage bulbs, thermometers
- treated wood and wood preservatives,
- pharmaceutical products,
- natural and synthetic oils and articles related thereto (filters, etc.)
- car batteries, mercury batteries, lithium batteries, ZnC alkaline batteries, discarded electrical and electronic equipment,
- cartridges, toners, contaminated debris, etc.

So far, this waste has not been separated from mixed municipal waste, so data on individual types of this waste group do not exist. Hazardous municipal waste from households and institutions on the territory of the municipality of Tivat is disposed of with other municipal waste in containers.

Construction waste

Construction waste is waste generated during the construction, maintenance and removal of buildings. Until the adoption of the Law on Amendments to the Law on Waste Management (2016), this group of waste was not the competence of local self-government units. According to paragraph 78a, these amendments prescribe the obligations of local self-government units to determine the location where non-hazardous construction waste collected from the area of the local self-government unit and the entity managing the temporary storage will be temporarily stored, to ensure record keeping, and to decide on temporary storage of non-hazardous construction and environmental protection conditions. The decision on the removal of the facility is made by the administrative body, ie the local administration body ex officio or at the request of the owner, accompanied by proof of ownership and a study on the removal. The removal study states the management of construction materials and waste.

In the study on removal, it is stated that the complete external and internal carpentry is previously dismantled, all installation elements that can be dismantled and as such are taken to recycling centers. If there are no recycling centers, this waste is disposed of in a designated landfill in accordance with applicable municipal decisions.

Construction rubble will be treated by separating steel from concrete and treated as a secondary raw material so that it can be delivered to registered purchase stations.

In the municipality of Tivat, construction waste with land is specially collected and temporarily deposited in order to rehabilitate the unregulated landfill "Grabovac". At the request of citizens or legal entities, the utility company delivers waste containers of larger capacities (5 or 7 m3) for the disposal of this type of waste. Unfortunately, these examples of conscientious waste disposal are few. Citizens generally choose to dispose of their construction waste next to container boxes or in other public areas in sparsely populated or uninhabited parts of the Municipality. In this case, the Utility Company uses mechanization: a combined construction machine and a dump truck. It is clear that significant funds are being spent in this way in order to properly collect and transport waste.

Other types of waste

In addition to these, the following types of waste are collected in the area:

- waste tires that citizens rarely dispose of next to container boxes (collected using special vehicles to collect primarily selective packaging);
- bulky waste is largely reused (reise). he utility company is trying to return the furniture and various machines (white goods, etc.) that are in relatively good condition to use in a way that it will first offer the same to its workers and then to citizens with poor material condition. Ultimately, this waste is broken down into its constituent parts, most of which is used to heat workers. The amount of bulky waste collected during the year is around 500 m^3 (rough estimate)
- The primary selection of textiles for the purpose of its reuse is the result of the project realized by the Red Cross - Tivat in the way that two special containers for storing used clothes were placed at two locations. It is estimated that approximately 180 m3 of this type of waste is collected annually at these locations;
- metals are rarely disposed of next to containers or in the improvised recycling yard of the Utility Company, and in the last 10 years the amount collected by the Utility Company has drastically decreased.

Table: Estimated amount of COLLECTED waste according to MORPHOLOGICAL COMPOSITION by fractions (t / year) for the period 2017-2020, for the municipality of TIVAT

Type of recyclable fractions (%)	t/2017. (95% amt)	t/2018. (97% amt)	t/2019. (97% amt)	t/2020. (97% amt)
Organic waste (33%)	2672	2783	2839	2896
Paper and cardboard (13%)	1085	1130	1152	1175
Glass (8,5%)	710	739	754	769
Metal and cans (3%)	228	237	243	247
PET and plastic (18%)	1456	1516	1547	1577
Inert waste (2,3%)	191	199	203	207
Green waste (5%)	426	444	452	462
Composite packaging (4%)	301	314	320	327
Textile (3%)	235	244	249	254
Hazardous waste (0,6%)	53	55	56	57
Other (9,6%)	972	1013	1033	1054
TOTAL	**8329**	**8674**	**8848**	**9025**

SUMMARY - OBJECTIVES

The percentage increase in the amount of collected municipal waste from 95% to 97% in relation to the generated municipal waste for the planning period implies that this type of waste is collected in poorly accessible or peripheral parts of settlements where organized waste collection was not performed until this planning document. In order to realize the above, it is necessary to procure special types of vehicles for waste collection, the so-called mini dumpsters whose cargo space capacities range from 3 to 5 m3 all with the aim of their safe and easier access.

In this sense, the local government should, in accordance with its competencies and powers, influence the obligation of both legal entities and individuals, to provide waste disposal facilities for the needs of their residential or business facilities (two-bin system for households or other types of dishes when it comes to larger facilities). Locations should be provided within urban or cadastral parcels available for waste collection and disposal.

Paragraph 14 of the Law on Waste Management stipulates the obligation to achieve the goals for reuse and recycling, as follows:

- at least 50% of the total mass of collected waste material, such as paper, metal, plastic and glass, from households and other sources where waste streams are similar to household waste streams, preparation for reuse and recycling;
- at least 70% of non-hazardous construction waste is prepared for reuse and recycling and other processing methods, such as use to replace other materials in the backfilling process excluding materials from nature.

For biodegradable municipal waste, it is prescribed that 50% of the total mass of biodegradable waste produced in 2010 must be reached by 2020 at the latest. The stated objectives regarding the separation of recyclable fractions will be ensured by:

PRIMARY SELECTION

a) Collect paper, cardboard and PET separately in institutions, schools, companies, households, container places-boxes..
b) Door-to-door waste collection system
c) By collecting certain types of waste on certain days.

SECONDARY SELECTION

a) Introduction of the “two bins” system which would be realized through the recycling center in the municipality of Kotor until the realization.
b) Recycling yard in the area defined by DUP Gradiošnica in the municipality of Tivat.

Achieving the goals of biodegradable waste disposal will be achieved by implementing the following activities:

1. Separate collection of paper and cardboard, green waste, textiles.
2. Door-to-door collection system.
3. By collecting certain types of waste on certain days, with a focus on green waste.
4. By collecting and measuring textiles, which will be given for humanitarian purposes.
5. By introducing composting in households
6. Education of the population in order to reduce biodegradable waste.

The above is equally a problem for Kotor and Herceg Novi. Also, Tivat only partially uses the Lovanja transshipment station / sorting station as it currently does not have any plant or space for it. As financial municipalities do not have the funds for individual plants or overhaul of the old one, and it makes no sense to do it at a distance of several kilometers, it is recommended to build one plant for these two cities, ie to be a joint investment.

1.3.1.3. Problems with waste and landfills in the municipality of Herceg Novi

The municipality of Herceg Novi has twenty-seven settlements organized into twenty-one local communities. ost of the population lives in the city. According to the 2011 census in the urban zone live 19617 inhabitants (about 63%), in the rest (suburban part of the municipality) live 11375 inhabitants - 37%. The presented data of MONSTAT, according to the methodology of determining urban and other settlements, is not acceptable for determining urban and rural settlements in terms of servicing organized municipal waste collection services. Assessing that all settlements below the Adriatic Highway, as well as parts of the settlements just above the Adriatic Highway, and the regional road Petijevići - Meljine have equal treatment, the organization of the service of collection and disposal of municipal waste, and appreciating that they are covered by planning documentation, in the urban part - 24548, (79.21%), or in the rural part of the municipality 6444 inhabitants, ie (20.79%). The applied methodology for determining the coverage by the service is the maximum distance to the waste disposal container - 500m. The settlements mentioned in the table are organized into 21 local communities. The table of settlements is taken from the official report of the 2011 Census, in which many settlements are not listed individually, but are an integral part of other settlements, while some settlements include several local communities.

The coverage of the municipality with the service of organized collection of municipal waste in the urban part is 100%, and in the rural area 30%. The total coverage of the service is 86.34%.

Quantity and types of waste

LLC ČISTOĆA Herceg Novi, keeps accurate records of the amount of waste collected from the territory of the municipality of Herceg Novi, or the amount of municipal waste, since 2012, which were disposed of at the landfill or handed over to registered collectors of special types of waste. According to the Law on Waste Management, the company submits annual reports on waste management to the competent state bodies, MONSTAT and local government bodies.

Municipal waste

Municipal waste is waste generated in households or waste generated during the performance of activities that is similar in properties to waste generated in households. The main sources of municipal waste are:

- Households;
- Commercial, industrial and institutional activities that produce waste that is similar in composition to household waste. In addition to these two main sources of waste, there are other sources of municipal waste production, such as: waste from gardens and parks, waste from markets, residues from street cleaning, sludge from septic tanks, waste generated during sewage cleaning, bulky waste.

Given the way of organizing the collection of municipal waste in Herceg Novi, the lack of precise data on the amount of waste generated by businesses, as well as insufficiently precise data on the number of tourist nights, complicate the possibility of calculating generated waste in the municipality. However, using the SWIS1 model, developed within NALAS2, it is found that the total amount of waste generated for Herceg Novi is 19,662 tons per year, estimating the way of organizing and providing services and the degree of coverage of services in urban areas 100%, ie 34, 30% in the rural part. By the decision to maintain cleanliness („OJMNE- municipal regulations “, br. 18/06, 37/11, 17/15) Cleaning activities on public areas belonging to the Municipality are entrusted to LLC Čistoća Herceg Novi. According to the same Decision, the activities of maintaining cleanliness on the areas managed by the Public Company for Management of Marine Assets of Montenegro in the municipality of Herceg Novi are performed by the company with which this public company enters into a maintenance contract, as well as legal and natural persons using those areas.

Data from LLC Čistoća for 2015 show that in that year a total of 18238,20 Mg4 of waste was collected, of which 15841,40 Mg of mixed municipal waste. Waste management records for 2015, tabular presentation of received and shipped types and quantities of waste shown in Annex 2. The data was obtained on the basis of regular measurements, because each truck is weighed on an electronic scale in the Recycling Center in Meljine.

The construction and commissioning of the Municipal Solid Waste Recycling Plant in June 2012 continues the project implemented at the level of the Municipality of Herceg Novi since 2006, which is defined through the project of reducing waste at source, ie the project of separate waste disposal. The modification of the area of the former reloading ramp Meljine, into a space where there will be three units (transfer station, recycling yard and recycling center) combines a very significant activity of waste recycling for the business of LLC Čistoća as a carrier of municipal waste management and disposal. In accordance with the legal regulations, separately collected waste: plastic, paper, cardboard and aluminum packaging are delivered by truck to the location where it is performed: baling, pressing, etc., which provides secondary raw materials ready for further transport to those who buy such products. Also, at the same location, citizens can, 24 hours a day, bring their own waste. Also, general municipal waste (not selected) collected on the territory of the municipality of Herceg Novi is delivered to the Recycling Center "Meljine", where its weighing is performed, separation of fractions for recycling and part of the waste which, through the transfer station, is transported by trucks to the temporary storage of municipal waste "Tisove grede".

Table: Estimated quantities and composition of municipal waste in the Municipality of Herceg Novi

Herceg Novi		
Type of waste	**Average**	**Amount (tone)**
Garden waste	7.77%	1,417.87
other biodegradable waste	35.50%	6,474.32
Paper	6.13%	1,117.10
Cardboard	8.07%	1,471.23
Cardboard (tetrapack)	1.37%	249.49
Glass	8.00%	1,459.43
Metal packaging and others	1.03%	187.51
Metal aluminum cans	1.21%	220.77
PET	3.89%	709.22
Plastic packaging waste	2.50%	455.24
Plastic bags	6.41%	1,169.85
Hard plastic	1.44%	263.19
Tekstile	2.85%	520.31
Diapers	5.65%	1,031.00
Construction waste	4.54%	828.24
Electronic and electrical waste	0.11%	19.88
Medical waste	0.04%	7,89
Leather	0.09%	16.28
Wood	1.49%	271.39
Other	0.26%	47.92
fine fraction < 10mm	1.65%	300.07
Total	**-**	**18,238.20**

Pursuant to paragraph 78 of the Law on Waste Management, the Municipal Assembly of Herceg Novi, with the prior consent of the Ministry of Sustainable Development and Tourism, passed a "Decision on the temporary storage of municipal waste and environmental protection and human health" at the location "Tisove grede" , until the construction of the sanitary landfill "Duboki do". With the construction of the sanitary landfill, the Municipality of Herceg Novi would fully fulfill all the obligations provided by the Law on Waste Management.

Hazardous municipal waste

Hazardous waste is waste that by its origin, composition or concentration of hazardous substances can cause danger to the environment and human health and has at least one of the hazardous characteristics determined by special regulations, including packaging in which hazardous waste was or is packaged. Hazardous municipal waste can be generated in: households, schools, business facilities with a wide range of economic and non-economic activities, which include:

- cleaning agents (alkaline and acidic),
- paints and varnishes (various organic solvents, paint thinners and sprays),
- solvent and fixator, films
- aerosol cans, contaminated and packaging material,
- fungicides, herbicides, insecticides, pesticides,
- fluorescent packaging tubes, low voltage bulbs, thermometers
- treated wood and wood preservatives,
- pharmaceutical products,
- natural and synthetic oils and articles related thereto (filters, etc.)
- car batteries, mercury batteries, lithium batteries, ZnC alkaline batteries,
- discarded electrical and electronic equipment,
- cartridges, toners,
- contaminated debris, etc

So far, this waste has not been separated from mixed municipal waste, so data on individual types of this waste group do not exist. Hazardous municipal waste from households and institutions on the territory of the municipality of Herceg Novi is disposed of with other municipal waste in containers. In the municipality of Herceg Novi, at the location of the Adriatic Shipyard Bijela, there are certain quantities of hazardous industrial waste, which includes waste grit from ship sanding, but it is not within the competence of local self-government and will not be considered in this plan.

Construction waste

There is no record of the amount of construction waste. There is currently no official landfill for construction waste. Construction waste is stored on private plots in accordance with the contracts of private plot owners and investors who build facilities. Years ago, construction waste and rubble were disposed of at the landfill on Kameno, which was managed by LLC "Komunalno stambeno" The only data available to the Secretariat for Communal Housing and Ecology is the data for 2012 from the "Annual Report on Waste Generated in the Construction and Service Sectors for 2012. (Pilot project) ", submitted by PU" Komunalno stambeno ", where it is stated that in the area of the private plot" Kameno "- landfill above Herceg Novi, construction waste from the demolition of the hotel" Tamaris "in the amount of 8,280 tons was stored. There is a possibility to build a construction waste treatment plant on the site of Rupe, which is 100% owned by the municipality of Herceg Novi, in accordance with the law. In the document - Analysis of the selection of the location of the sanitary landfill for municipal waste in Herceg Novi, February 2003, processed by the Faculty of Civil Engineering

in Podgorica, in addition to other sites, the site of Rupe was processed in detail. If the methodology defined is taken into account National Waste Management Plan for estimating the quantities of construction and demolition waste for Montenegro with the following production rates:

150 kg/PE/per year for construction and demolition waste, of which

50 kg/PE/per year for mineral waste,

100 kg/PE/per year for mixed construction waste and demolition waste (including hazardous waste) then the estimated amount of construction waste for the Municipality of Herceg Novi in 2015:

Estimated quantities of construction waste

Herceg Novi	quantity (tonnes)
Mineral construction waste	1610 t
Mixed construction waste	3221 t
Total	**4831 t**

Packaging waste

Packaging waste - is packaging remaining after unpacking the product, and includes all products that serve to protect and handle the placement and sale of another product (households, companies, institutions, scientific and professional organizations, catering, shops). It should be noted that there are no reliable data on the quantities of this waste and that there are large variations in the daily produced quantities and composition of this waste.

Biodegradable waste

Biodegradable waste is defined in accordance with the Landfill Directive “waste that has the potential to decompose anaerobically or aerobically, such as food, garden waste paper and cardboard”. This means that the term “biodegradable waste” includes some other types of waste also such as: wood, paper, cardboard, waste sludge, natural textiles. Currently, in Montenegro as well as in the municipality of Herceg Novi, it is common to collect mixed municipal waste (from households, by commercial buildings and institutions and the business sector) in the same containers and disposal at the landfill landfill whether legal or not. In this sense, it is very difficult to assess the relationship between waste generated by different activities (from households, industry or the business sector).

Furthermore, waste from street cleaning and maintenance of privately owned greenery ends up in the same container or next to the container. There are activities for the collection of green waste from the maintenance of park and other green areas in the city, and under the jurisdiction of “Komunalno – stambeno” LLC, which after shredding would be transported to the composting plant in the municipality of Kotor.

Brief description of the disposal system

Disposal of municipal waste in the municipality of Herceg Novi is defined by the Decision on the manner of temporary storage of municipal waste and the conditions for the protection of the environment and human health of the Municipality of Herceg Novi. The location of “Tisova greda” with an area of 720,000 m2, on cadastral parcel 2000, real estate certificate no. 119 KO Ubli.

By the decision of the Municipal Assembly of Herceg Novi, number:01-3/72-12, od 14.09.2012.

After the separation of the recycling fractions in the Meljine Recycling Center, all remaining municipal waste is loaded into the company’s trucks at the Meljine transshipment station, weighed at the exit from the Recycling Center and transported to the temporary storage of Tisova greda. Only the temporary warehouse “Tisove grede” is organized in two zones. Zone 1 is a reception and dispatch zone consisting of a porter’s lodge, a ramp with parking, a concrete plateau for waste unload-

ing. Zone 2 is a zone for temporary storage of municipal waste with a part where there is an inert material that serves to cover the waste. The temporary warehouse has an organized security service, a service for receiving municipal waste and a service for maintenance of temporary storage. The temporary storage is fenced on each side from which there is no natural barrier to access the temporary storage, in order to prevent the presence of unauthorized persons and animals and uncontrolled disposal of municipal waste.

Summary

Considering the current state of waste management in the municipality of Herceg Novi, the following can be concluded: The integrated waste management system in the municipality of Herceg Novi has not been completed

The Municipality of Herceg Novi owns a part of the facilities that it built in the period 2009-2016. which partially meet the needs for the establishment of an integrated waste management system. These are: the applied system of selective waste collection, waste treatment plant, recycling yard, transfer station and temporary storage of municipal waste Tisova greda.

The Municipality of Herceg Novi has not completed activities on the construction of the sanitary landfill "Duboki do" as the basic facility for municipal waste management and despite the established primary selection system in 2006, the system does not meet the total needs of citizens, and the percentage of utilization of collected secondary raw materials did not exceed 10%.

The total staff training in local government and companies does not meet the needs for managing a sustainable municipal waste management system.

In the municipality of Herceg Novi, despite legal restrictions, a large number of natural persons, representatives of the informal sector, are involved in the collection of secondary raw materials, which is reflected in the amount of total collected and processed secondary raw materials by the registered company.

The Lustica peninsula, which is divided into all three municipalities (but Tivat and Herceg Novi have the largest part), is not mentioned in particular. The general problem of the geographical separation of this peninsula and the division of the territory has created a unique problem in the disposal and removal of waste, especially with the increase in population, various tourist resorts on this peninsula. Most of the landfills shown are located at this location.

1.3.2. Waste waters

The Kotor - Trašte sewerage system is used to drain wastewater from Kotor, the industrial zone of Kotor and Tivat into the open sea. The capacity of the "Kotor" part of the system is about 160 l/s from Kotor and about 70 l/s from the industrial zone. The length of the mainland is over 11 km, and the submarine outlet of Trašte is 3600 m.

The main city system is located on the coast and collects wastewater from settlements along the bay and transports it to PS Peluzica. The sewerage system of the Old Town is a special unit. The collector, together with other installations, is located in an underground passage under the streets of a part of the Old Town built after the earthquake, popularly called the gallery. Since part of the Old Town system is below sea level, there is a pumping station that pumps wastewater into the main system.

Secondary systems drain wastewater from individual facilities to the main system. There are also local systems located in settlements where there is no main city system on the coast. They continue to discharge wastewater into the bay. Wastewater treatment plants have been built for Kotor and Tivat. The most important object of the sewage system is the Peluzica pumping station. The sewerage system was built from Peluzica to Kavalin in Dobrota and on the other side of the bay to the Splendid Hotel (Prčanj). The sewerage system of Kotor was built as a separate system, ie atmospheric and fecal waters are drained by special systems. Functionally speaking, the fecal sewage system consists

of the sewerage system Kotor - Trašte (partly a common system for Kotor and Tivat), the main city system on the coast and local sewerage systems of individual settlements.

The problem in the functioning of the existing sewage system is the inflow of large amounts of foreign water into the sewer system during heavy rainfall.

Table - Proposed scope of renovation / rehabilitation of wastewater collection system per local self-government unit

No.	Municipality	Total length of sewer network (km)	Sewer blockages (#/km/ year)	Average age of sewer network (y)	Network Rehabilitation Index *	Proposed network rehabilitation (%)	Proposed network rehabilitation L (m)
21	Kotor	45,0	9,0	19,9	0,73	7,5%	3,4
22	Tivat	50,0	8,8	10,0	0,36	3,7%	1,8
Ukupno		190,9	36,6	18,8		29,7%	23,0

Table - Pumping plants and discharge pipelines for wastewater (main characteristics)

No.	Municipality	Push pipe (km)	Small pumping plants (#)	Medium pumping plants (#)	Large pumping plants (#)	Comments / Rating
20	Herceg Novi	1.3	3	1	4	The four main sewage pumping stations built in 2017 are practically new and in very good operational condition, and the one in Igalo is planned for major reconstruction.
21	Kotor	2.9	0	8	1	The main pumping stations Pelužica, Plagenti, Stari grad and Solila are in satisfactory to good operational condition. Other medium-sized stations built around 2008 are in good operating condition.
22	Tivat	5.1	3	8	3	As noted, practically all pumping stations are fairly new, built or completely reconstructed in 2016 and therefore in good operating condition.

Table - The most important sea outflow in the coastal region

No.	Municipality	The main outflows into the sea (#)	The main outflows into the sea (km)	The main outflows into the sea – raspon DN(mm)	Comments / Rating
20	Herceg Novi	1	1,3	1,000	The new outflow in Meljine is in very good operational condition, but there are still about 25 uncontrolled local outflows.
21	Kotor	8	nema podataka	200-250	There are eight local short outflows all designed for closing / leaving. Wastewater is directed to the main outflow in Tivat (Trašte)
22	Tivat	1	3,6	600	The main sea outflow for Tivat-Kotor (Trašte) is estimated to be damaged and in poor operational condition. There are four local uncontrolled outflows that need to be closed and abandoned.

Wastewater treatment plants (WWTP)

Table - List of existing WWTPs and those under construction (Boka Kotorska)

Municipiality	PPOV name/ location	Recipient / basin	Projected (existing) capacity (ES)	Future capacity - Phase I (ES)	Additional capacity Phase II (long term) (ES)	Total final capacity (ES)	Note
Herceg Novi	PPOV H.Novi	Jadranski	69.100		-	69.100	Tretman mulja nije dovršen
Tivat&Kotor	PPOV Tivat/Kotor	Jadranski	72.000	-	18.000	90.000	

Table - Main characteristics of existing WWTPs (Boka Kotorska)

WWTP Name/ location	Quantity of treated WW - estimation (m3/a)	Pollution load (ES) - treated (high season)	Purification process	Primary purification	Secondary (biological) purification	Tertiary purification - N	Tertiary purification - P	Disinfection of effluent	Sludge treatment	Amount of sludge produced (t / a)
WWTP H.Novi	1.923.109	49.673	SBR	NO	YES	YES	YES	YES	-	0
WWTP Tivat/ Kotor	1.055.317	29.619	SBR	NO	YES	NO	NO	NO	aerobic stabilization + drainage + lime	1.872
	2.978.426	79.292								1.872

The WWTP in Tivat is designed for peak season loads within the Tivat and Kotor agglomerations. The existing WWTP capacity is 72,500 ES. Like Budva, except in the summer season, the WWTP operates with lower pollution loads (around 30,000 ES). However, due to the high infiltration in the winter, the inflow flows are equal to or even higher than the flows in the highest summer season in dry weather. The treatment process includes a preliminary purification followed by an activated sludge process that takes place in SBR tanks. The treated effluent is transported to the discharge tower and discharged over a 3,600 m long sea outlet at the salting boundary of Trašte Bay. Since at the time of construction of the facility the recipient water body was not considered a sensitive area, this facility is designed to meet the requirements for non-sensitive areas. Sludge treatment includes aerobic stabilization, dehydration and lime stabilization.

The WWTP in Herceg Novi is designed for a load of 69,100 ES. Similar to the WWTP in Tivat, biological treatment is based on SBR technology. However, given the micro-location of the respective outlet in the sea located in the Bay of Kotor, which has been declared a sensitive area, this plant is designed to remove nutrients. Currently, the wastewater line is in trial operation, while the construction of the sludge treatment plant is not yet complete.

Picture - WWTP Kotor-Tivat (SBR units)

WWTP Herceg Novi, disposition

Sewage sludge management

Upravljanje kanalizacionim muljem predstavlja jedan od ključnih elemenata u sveukupnom ciklu-su upSewage sludge management is one of the key elements in the overall municipal wastewater management cycle. In Montenegro, the management of processed sewage sludge is regulated by the following regulations:

Law on Waste Management (OJMNE, no. 64/11 i 39/16),

- Regulation on detailed conditions to be met by municipal sewage sludge; quantities, scope, frequency and methods of analysis of municipal sewage sludge for permitted purposes and conditions to be met by land planned for its application („OJMNE, no“, br.89/09), Regulation on detailed characteristics of the location, construction conditions, sanitary-technical conditions, method of operation and closure of landfills („OJMNE, no“. 031/13 i 025/16).

  Management of treated sewage sludge has been developed in all studies on wastewater treatment, but the following documents have specifically addressed this issue in Montenegro:
- Study on sludge disposal in the coastal region of Montenegro, 2010, amended in 2014
- Study on the management and application of sewage sludge in the central and northern region of Montenegro, 2013
- Solar sludge drying plants for WWTP Herceg Novi and Tivat / Kotor, 2016

As the number of functional wastewater treatment plants increases, adequate management of treated sludge will become an increasingly important and complex issue. Based on the information received from MORT, VODACOM and directly from the relevant water and sewage companies, the current situation regarding the treated sewage sludge generated in the wastewater treatment plants can be summarized as follows:

- Budva and Tivat / Kotor - dehydrated sludge is exported to Albania after stabilization with lime,
- Herceg Novi - sludge treatment has yet to be completed,
- Although the feasibility study for the construction of a solar sludge drying plant in Tivat and Herceg Novi (DAHLEM, 2016) identified solar sludge drying as a viable option for reducing the amount of sludge, there were no further activities on project preparation / implementation,
- The potential use of sludge in agriculture has been considered as an option in the Regulation on sewage sludge, but has not been accepted and introduced into the legislation applicable to agriculture.

Septic tanks

As already mentioned, it is estimated that up to about 300,000 inhabitants are connected to the public wastewater collection system throughout the country. The rest of the population relies on some kind of on-site solution, the most common of which is the use of septic tanks.

Means for the solution of sewage in a given place, such as septic tanks, are considered a widespread way of drainage and treatment of wastewater in Montenegro. Septic tanks are widely used in rural areas as well as in parts of cities. The following table lists the number of inhabitants using sewage collection systems and the remaining population with some kind of septic tanks by municipalities.

Table - Population covered by collector systems and with septic tanks (Boka Kotorska)

Municipiality	Total population 2016 (#)	Population covered by collector systems (#)	Population with septic tanks (#)
Herceg Novi	30.690	19.259	11.431
Kotor	22.651	8.399	14.252
Tivat	14.774	5.843	8.931
Ukupno	68.115	33.501	34.614

Table – Pregled opcija za upravljanje muljem i količine mulja

Agl. no.	Agglomeration	Solar drying (tds/a)	Land remediation / reclamation (t/a)	Comments
28	H.Novi 1	1.200	3.540	WWTP in commissioning phase Construction of solar sludge drying plant H. Novi
29	H.Novi 2	49	-	Drying of dehydrated sludge in the solar sludge drying plant Tivat
30	H.Novi 3	49	-	Drying of dehydrated sludge in CSSDP Tivat
31	Kotor 1	0	-	Connected to the existing WWTP Kotor - Tivat
32	Kotor 2	33	-	
33	Kotor 3	36	-	
34	Kotor 4	48	-	
35	Tivat 1	1.200	3.723	Existing WWTP Kotor-Tivat, construction of a solar sludge drying plant
36	Tivat 2	48	-	It should be connected to the WWTP Kotor-Tivat

Minimum required measures

A good coordination between the main stakeholders in the field of wastewater and waste management is a prerequisite for dealing with the growing amounts of sewage sludge generated in the WWTP. The sludge management plan that is an integral part of the Waste Management Plan will be updated in accordance with the Master Plan of Municipal Wastewater Measures.

Additional treatment of dehydrated sludge that will lead to further reduction of sludge should be developed through regional schemes, based on available land, geotechnical location conditions, ecological and climatic conditions, national and municipal spatial planning documents, feasible connec-

tion with neighboring production centers (WWTP)on the basis of transport costs and fees for waste disposal (gate free), final disposal or use of the final product.

The remaining residue from the regional sludge treatment centers could be disposed of in ash dumps (mono-fill) which can be foreseen within the regional centers or within the nearest regional waste management center.

According to the Municipal Wastewater Management Act, all towns and villages (agglomerations) with more than 2,000 ES should have wastewater collection (sewerage) systems (according to Paragraph 3 of the UWWTD Directive) in accordance with the following deadlines:

- For agglomerations > 15.000 ES – until 31st December 2025.
- For agglomerations from 2.000 to 15.000 ES – until 31st December 2027.

With regard to ensuring adequate treatment of municipal wastewater in terms of the UWWTD Directive (Paragraphs 4 and 5), the Law on Urban Wastewater Management sets the following deadlines:

- To ensure stricter treatment within the meaning of Paragraph 5 of the Directive - until 2025,
- To ensure adequate wastewater treatment (Paragraph 4 of the Directive) - agglomerations > 15.000 ES by 31 December 2027,
- To ensure adequate wastewater treatment (Paragraph 4 of the Directive) - agglomerations of 10,000 to 15,000 ES and agglomerations of 2,000 to 10,000 ES (discharge of effluent into freshwater and estuaries), until 31 December 2029,
- To ensure adequate wastewater treatment (Article 4 of the Directive) - agglomerations< 10.000 ES (for effluent discharge into coastal waters) and agglomerations < 2.000 ES (effluent discharge into freshwater and estuaries), by 31st December 2029.

To conclude, based on the above, the complete collection and treatment of municipal wastewater related to areas categorized as sensitive should be established by 2025, while for the entire territory the collection and treatment of wastewater should be completed by the end of 2029.

2. IDENTIFICATION OF WILD LANDFILLS

2.1. Identification of illegal and existing sanitary landfills

Based on the terms of reference and methodology of this study, as well as on the basis of the described existing state of waste, landfills and the impact on water resources, an analysis of possible pollutants in the environment and surface and groundwater was made. Thus, these are landfills (wild and neglected), which still exist and have a negative effect on the area of the Bay of Kotor (the area we are analyzing in this study). The analysis was done for three cities / municipalities of Boka Kotorska: Kotor, Tiva and Heceg Novi. Below is a list of locations of illegal landfills and an illustrative presentation (picture) of some of the illegal landfills, which are the most expressive from the aspect of environmental endangerment.

2.2. Municipality of Kotor - locations of illegal dumps

On the land, mostly next to local and uncategorized roads owned by the municipalities of Kotor and the state of Montenegro, waste is often deposited and illegal landfills are created, the removal of which requires additional financial commitment for the municipality and the utility company.

2.2.1. Spreadsheet presentation of identified landfills

No.	Landfill code	Landfill name	Coordinates	Quadrature	Waste type
1	001010	Mirac, KO	42.389867, 18.768221	15 m^3	Household
2	002010	Bigova, KO	42.356913, 18.705107	20 m^3	Plastic bottles
3	003010	Troica, KO	42.4044968, 18.763152	18 m^3	Mixed
4	004010	Troica, KO	42.401374, 18.762658	150 m^3	Mixed
5	005010	Donjogrbaljski put, KO	42.372238, 18.711352	5 m^3	Mixed
6	006010	Donjogrbaljski put, KO	42.371493, 18.711910	20 m^3	Mixed
7	007010	Donjogrbaljski put, KO	42.369975, 18.711095	20 m^3	Construction
8	008010	Donjogrbaljski put, KO	42.369238, 18.711631	40 m^3	Construction
9	009010	Donjogrbaljski put, KO	42.368540, 18.712575	20 m^3	Construction
10	010010	Donjogrbaljski put, KO	42.367184, 18.714388	10 m^3	Construction
11	011010	Donjogrbaljski put, KO	42.366693, 18.714742	5 m^3	Mixed
12	012010	Stari put prema Troici, KO	42.416475, 18.760319	5 m^3	Construction
13	013010	Put Troica - Jugodrva, KO	42.398263, 18.756350	20 m^3	Construction
14	014010	Put Troica - Jugodrva, KO	42.393366, 18.755341	10 m^3	Construction
15	015010	Put Troica - Jugodrva, KO	42.381562, 18.755658	20 m^3	Construction
16	016010	Industrijska zona, KO	42.388163, 18.751924	30 m^3	Construction
17	017010	Ft. Skaljari, Vrmac, KO	42.388163, 18.751924	30 m^3	Tires
18	018010	Ft. Skaljari, Vrmac, KO	42.410175, 18.757664	5 m^3	Construction
19	019010	Ft. Skaljari, Vrmac, KO	42.408543, 18.759863	30 m^3	Construction
20	020010	Ft. Skaljari, Vrmac, KO	42.408543, 18.759863	30 m^3	Diseased palms
21	021010	Ft. Troica, KO	42.403112, 18.762127	15 m^3	Mixed
22	022010	Road to Vrmac, KO	42.415470, 18.750626	60 m^3	Mixed
23	023010	Desna obala Ljute, KO	42.486353, 18.766480	20 m^3	Mixed
24	024010	Ind. Zona, KO	42.391214, 18.748335	200 m^3	Mixed
25	025010	Stari put Risan, KO	42.526566, 18.705404	250 m^3	Mixed
26	026010	Skaljari, KO	42.417304, 18.767054	5 m^3	Mixed
27	027010	Lastva Grbaljska, KO	42.322135, 18.783812	130 m^3	Mixed
28	028010	Lastva Grbaljska, KO	42.322135, 18.783812	10 m^3	Construction
29	029010	Lastva Grbaljska, KO	42.319410, 18.785314	50 m^3	Construction
30	030010	Lastva Grbaljska, KO	42.324011, 18.780894	90 m^3	Mixed
31	031010	Lastva Grbaljska, KO	42.352636, 18.765374	25 m^3	Mixed
32	032010	Lastva Grbaljska, KO	42.322135, 18.783812	5 m^3	Mixed
33	033010	Donje Skaljari, KO	42.421283, 18.764563	10 m^3	Mixed
34	034010	Skaljari, Vidikovac, KO	42.408721, 18.769112	5 m^3	Plastic
35	035010	Troica, KO	42.402421, 18.762717	7 m^3	Mixed
36	036010	Mirac, KO	42.397229, 18.760388	5 m^3	Plastic
37	037010	Mirac, KO	42.394060, 18.762770	10 m^3	Mixed
38	038010	Gorazde, KO	42.396661, 18.763802	15 m^3	Mixed
39	039010	Gorazde, KO	42.395104, 18.763577	5 m^3	Mixed
40	040010	Gorazde, KO	42.395853, 18.764087	15 m^3	Mixed

2.3. Municipality of Tivat - locations of illegal dumps

2.3.1. Spreadsheet presentation of identified landfills

No.	Landfill code	Landfill name	Coordinates	Quadrature	Waste type
1	001020	Plavi Horizonti, TV	42.376584, 18.691046	5 m^3	Plastic bottles
2	002020	Put ka Gornjoj Lastvi, TV	42.452225, 18.699529	15 m^3	Construction
3	003020	Petrovici, Krasici, TV	42.420948, 18.618252	8 m^3	Mixed
4	004020	Petrovici, Krasici, TV	42.420442, 18.619542	10 m^3	Mixed
5	005020	Djurasevici, TV	42.388255, 18.704041	1 m^3	Plastic deck chairs
6	006020	Donjogrbaljski put, TV	42.389587, 18.703569	15 m^3	Construction
7	007020	Donjogrbaljski put, TV	42.387852, 18.703435	20 m^3	Construction
8	008020	Donjogrbaljski put, TV	42.384571, 18.705087	20 m^3	Construction
9	009020	Donjogrbaljski put, TV	42.382946, 18.704197	5 m^3	Construction, tires
10	010020	Donjogrbaljski put, TV	42.381860, 18.704336	25 m^3	Mixed
11	011020	Donjogrbaljski put, TV	42.380402, 18.704679	10 m^3	Construction
12	012020	Lustica bay plaza, TV	42.385497, 18.660727	40 m^3	Plastic
13	013020	Djurasevici, TV	42.390443, 18.703381	10 m^3	Construction
14	014020	Radovici, TV	42.390301, 18.678450	45 m^3	Construction

2.4. Municipality of Herceg Novi - locations of illegal dumps

2.4.1. Spreadsheet presentation of identified landfills

No.	Landfill code	Landfill name	Coordinates	Quadrature	Waste type
1	001030	Baosici, HN	42.448843, 18.623316	60 m^3	Mixed
2	002030	Bitoljska ulica, HN	42.450920, 18.545956	10 m^3	Household
3	003030	Selo Ubli, HN	42.568890, 18.519618	150 m^3	Tires
4	004030	Krusevice, HN	42.322808, 18.300436	10 m^3	Household
5	005030	Put do Krusevice, NH	42.5305641, 18.4919291	45 m^3	Mixed
6	006030	Put do Bunovica, HN	42.4959637, 18.5958366	20 m^3	Household
7	007030	Znak Sv. Ilija, HN	42.4984792, 18.5991196	40 m^3	Construction
8	008030	Blizu Sv. Ilije, HN	42.4962771, 18.6018588	5 m^3	Plastic bottles
9	009030	Bunovici, HN	42.4905906,18.5874620	45 m^3	Mixed
10	010030	Bunovici, HN	42.4884968, 18.5839772	40 m^3	Mixed
11	011030	Kuti, HN	42.4887636, 18.5695412	60 m^3	Construction
12	012030	Pestorici, HN	42.460031, 18.603820	40 m^3	Household
13	013030	Izletiste Vrbanj, HN	42.560412, 18.506196	110 m^3	Mixed
14	014030	Tici, Lustica, HN	42.413451, 18.573508	100 m^3	Construction
15	015030	Izmedju Tici - Mrkovi, HN	42.414061, 18.572896	100 m^3	Construction
16	016030	Mrkovi, Lustica, HN	42.414513, 18.572209	100 m^3	Construction
17	017030	Beach Nautilus, HN	42.458920, 18.516176	5 m^3	Construction
18	018030	Bakoci, HN	42.477059, 18.607508	20 m^3	Mixed
19	019030	Vrbanje, HN	42.566554, 18.539341	10 m^3	Mixed
20	020030	Djurici, HN	42.464135, 18.659050	15 m^3	Mixed
21	021030	Ponte Veslo, HN	42.373671, 18.607980	250 m^3	Mixed

2.5. Ilustrative photo presentation of individual landfills in the area of Boka Kotorska with basic data

Picture 1

Landfill name: **Skaljari, Vidikovac**. Landfill code: **034010**. Coordinates: **42.408721, 18.769112**.
Quadrature: **5 m³**. Waste type: **Plastic.**

Picture 2

Landfill name: **Troica**. Landfill code: **035010**. Coordinates: **2.402421, 18.762717**.
Quadrature: **7 m³**. Waste type: **Mixed.**

Picture 3

Landfill name: **Mirac**. Landfill code: **036010**. Coordinates: **42.397229, 18.760388**.
Quadrature: **5 m³**. Waste type: **Plastic.**

Picture 4

Landfill name: **Mirac**. Landfill code: **037010**. Coordinates: **42.394060, 18.762770**.
Quadrature: **10 m³**. Waste type: **Mixed.**

Picture 5

Landfill name: **Gorazde**. Landfill code: **038010.** Coordinates: **42.396661, 18.763802.**
Quadrature: **15 m³**. Waste type: **Mixed.**

Picture 6

Landfill name: **Gorazde.** Landfill code: **039010**. Coordinates: **42.395104, 18.763577.**
Quadrature**: 5 m³**. Waste type: **Mixed.**

Picture 7

Landfill name: **Gorazde**. Landfill code: **040010 b**. Coordinates: **42.395853, 18.764087.**
Quadrature: **15 m³**. Waste type: **Mixed.**

Picture 8

Landfill name: **Lustica bay plaza, TV.** Landfill code: **012020**. Coordinates: **42.385497, 18.660727.**
Quadrature: **40 m³**. Waste type: **Plastic.**

Picture 9

Landfill name: **Djurasevici, TV**. Landfill code: **013020**. Coordinates: **42.390443, 18.703381.**
Quadrature: **10 m³**. Waste type: **Construction.**

Picture 10

Landfill name: **Mrkovi, Lustica, HN**. Landfill code: **013020**. Coordinates: **42.414513, 18.572209.** Quadrature: **100 m³**. Waste type: **Construction.**

2.6. Annex - maps with the location of illegal landfills

3. SAMPLING AND ANALYSIS OF WATER

3.1. Water resources in the area of Boka Kotorska

Water is a unique and irreplaceable natural resource of limited quantities and uneven spatial and temporal distribution. The fact that all forms of life and all human activities are more or less related to water clearly shows the importance of the relationship with water and the meaning of the documents that regulate this relationship. Economic development and urbanization lead, on the one hand, to a large increase in water needs, and on the other hand, to the endangerment of water resources. Water can thus become a limiting factor in the development and threat to human health and the sustainability of natural ecosystems. Therefore, it is especially important for every society to balance these relations and devise a policy and strategy for the regulation, exploitation and protection of water resources. Water potential is one of the basic development potentials of Montenegro. In terms of water resources in relation to its surface, it is one of the most water-rich areas in the world.

There is a large amount of precipitation in Montenegro. A large part of the territory where the largest amounts of sediment fall (Orijen, Lovćen, Rumija and Katunska nahija) suffers from water shortages, because they are irretrievably lost in the karst underground. The total runoff is 604 m3/s, and average 44 l/s/ km2 (the world average runoff is 6,9). Groundwater potentials have been estimated at around14.000 l/s.

However, hydrological analyzes of flow distribution, which reveal a very large unevenness of water in terms of space and time, strongly relativize the stated optimistic data and give a completely different, much more unfavorable picture when concluding about the water wealth of Montenegro.

Due to all the above, there is a need for optimal management of water resources. For all strategic planning in the field of water, special attention should be paid to the following facts:

- water resources and water balances must be considered by larger catchment areas;
- due to the large uneven flow over space and time, analyzes of water regimes, especially large and small water regimes, are of great importance for all strategic planning;
- due to the great importance for planning decisions, two concepts must be clearly distinguished: water present in the basin and water that has resource attributes;
- **water protection and preservation of good surface and groundwater quality.**

Surface waters

The flows of the continental karst flow through the abyss into the underground and spring in the basins of the Adriatic and Black Sea rivers, or below the sea surface. Part of these waters flows underground to neighboring territories (Trebišnjica, Konavle).

The largest number of surface flows in Montenegro is of a torrential nature. They are grouped into torrent systems according to characteristic geographical determinants: coastal, Skadar, Boka Kotorska, Našice, Cetinje, Podgorica, Pivljan, Limljan and others.

Of the coastal torrent systems, the torrent subsystems of the Bay of Kotor, Budva torrents, bar torrents, Sutomore and Ulcinj torrents are more significant.

Of the torrents in Boka Kotorska, we should mention the Zverinjak stream, of the Budva torrents Kučac, of the bar torrents Željeznica and Rikavac, which flow towards the sea. The Ulcinj torrents are characterized by: the Medjurečka, Vladimirska and Rastiška rivers, which flow towards Šasko Lake and the Bojana River. The following subsystems are characteristic of the Skadar torrents: Crmnica, Orahovo and Skadar, of which the torrents of the Crmnica field Bistrica and Sutorman are significant. There are three watercourses near KotorThe river Škurda flows along the northern walls of Kotor

and assumes that it feeds on the waters from the Njeguški plateau. Škurda is a hydrogeological phenomenon because it works as a spring (karst spring), a brackish spring (saline i.) and a sinkhole. It is a diffuse karst aquifer (whose waters are used for the Kotor water supply system), which is emptied at the point of contact of flysch and limestones of the Dobrota-Škaljari zone. The yield of this source varies between 0,1 m3 /s in the hydrological minimum, up to over 30 m3/s at the hydrological maximum. On Škurda, outside the city gates of Porta Fiumera (Gate to the River), mills operated which, due to the abundance of water, functioned all year round, until the beginning of the 20th century. In front of the Gate on the river, there was a chain bridge over the river Škurda from 1540.

The Gurdić stream, whose waters are brackish, is located south of the city walls. Stream Zveronjak, also called Velji stream or. priest's water springs at the foot of Troljeza, flowed in the indented bay of the Bay of Kotor, where it created a floodplain on which the Kotor settlement of Škaljari developed. Nearby is another smaller stream Fontana, which flows into the Bay of Kotor, on older topographic maps recorded as Lokva. In the dry season, when Gurdić acts like a sinkhole, Škurda's stream becomes salty.

The entire Boka Kotorska area and its hinterland is a typical karst area characterized by special morphology and hydrology. Although parts of this hinterland receive extremely large amounts of precipitation, due to the karst relief, almost all water sinks underground, and creates groundwater flows that erupt on the surface in contact with flysch terrain, in the form of karst springs at sea level (Škurda and Gurdić near Kotora, Ljuta near Dobrota), as secrets above sea level (Sopot near Risna under Orjen), or springs on the seabed, ie below sea level.

Škurda and Gurdić belong to the salty (barrel) springs. Most of the water flows into the Bay salted or as an underwater spring, which is a consequence of the subdivision of the water-resistant layer of soil below sea level. Vrelo Gurdić belongs to a spring of the estavela type, which means that it works as a spring in winter and as an abyss in summer.

In accordance with Paragraph 75 of the Law on Waters („OJMNE, no", no. 27/07 i „OJMNE, no", no 32/11, 48/15 i 52/16) water quality standard and water status is determined on the basis of:

1) criteria for determining the objectives of protection of surface and groundwater and protected areas;
2) chemical and ecological parameters for surface waters, chemical and quantitative parameters for groundwater and assessment of the state and characteristics of permanent changes in the state of surface and groundwater;
3) criteria for determining artificial and heavily modified water bodies and their ecological, chemical and quantitative parameters;
4) criteria for determining cases when temporary deterioration of water status is not considered a violation of the objectives of protection of surface and groundwater and protected areas;
5) list of priority substances, priority hazardous substances and other pollutants;
6) restrictions on the discharge of pollutants into water;
7) restrictions on the disposal of pollutants in places where there is a possibility of water pollution.

In order to determine whether surface and groundwater and coastal sea water are in a certain class, monitoring of qualitative and quantitative water parameters is performed by the state administration body responsible for hydrometeorological affairs (Institute of Hydrometeorology and Seismology of Montenegro). , and according to the annual Program of systematic examination of the quantity and quality of surface and groundwater, and submits the data to the Environmental Protection Agency, which has the obligation to inform the public about the state of all segments of the environment, including water. According to the current Regulation, waters are divided according to their purpose into:

▶ Waters that can be used for drinking and food industry on the basis of limit values of 50 parameters and are classified into four classes, namely:

- Class A - water that in its natural state, with possible disinfection, can be used for drinking;
- Class A1 - waters that can be used for drinking after a simple physical process of processing and disinfection;
- Class A2 - water that can be used for drinking after proper conditioning (coagulation, filtration and disinfection)
- Class A3 - water that can be used for drinking after treatment that requires intensive physical, chemical and biological treatment with prolonged disinfection and chlorination, or coagulation, flocculation, decantation, filtration, absorption on activated carbon and disinfection with ozone or chlorine.

▶ Waters that can be used for fishing and shellfish farming, and are classified based on 10 parameters into classes, as follows:

- Class S - waters that can be used for breeding noble species of fish (salmonids);
- Class Š - waters that can be used for shellfish farming
- Class C - waters that can be used for breeding less noble fish species (cyprinids).Waters that can be used for bathing, and are classified into two classes:
- Class K1 - excellent,
- Class K2 - satisfactory.

Underground water

The territory of Montenegro belongs to the southeastern Dinarides, which are characterized by a complex lithofacial composition (sedimentary, metamorphic and volcanic rocks) and tectonic structure, which is a consequence of the turbulent geological evolution of the terrain.

Carbonate rocks represented by limestones, dolomitic limestones and dolomites of Paleozoic and Mesozoic age, which make up over 60% of its territory, have a dominant share in the structure of the terrain of Montenegro. The process of karstification has come to full expression in these rocks, which is manifested through numerous surface and underground karst forms, complex and specific hydrogeological relations and phenomena, especially in karst fields and coastal karst.

Subordinate participation in the structure of the terrain that are important for the subject matter have:

- clastic (mechanical) sediments of Paleozoic, Triassic, Paleogene and Neogene age, represented by clays, sandstones and marls, which have the function of complete, lateral or suspended barriers for groundwater;
- metamorphic rocks of Paleozoic age represented by poorly permeable to impermeable shales of higher and lower crystallinity, which are present in the northeastern part of Montenegro;
- volcanic rocks discovered at several locations along the Montenegrin coast, central and northern parts of Montenegro, which most often represent lateral barriers to groundwater;
- Quaternary sediments (clays, sands, gravels) deposited in karst fields and major depressions within which groundwater is represented in the form of compacted type.

Groundwater in Montenegro provides about 92% of the total amount of water for water supply of settlements. In general, the quality of groundwater in Montenegro in natural conditions for most of the year (excluding coastal releases that are under the influence of the sea) corresponds to the first class.

In the coastal part, the main natural negative factor of groundwater quality is the impact of salty seawater on low karst releases in the coastal area. Numerous occurrences of groundwater in this zone are either saline, or during exploitation they are exposed to the influence of sea water to the point of unusability for drinking. In the continental part, the natural water quality at almost all groundwater sources is worsened by predominantly anthropogenic influences and is the result of inadequate sanitary protection and inadequate sanitation of the catchment area.

Protected areas of drinking water - sanitary protection zones of springs

The implementation of measures for the sanitary protection of springs used to supply water to the population in accordance with legal obligations is far below the required level, although some progress has been evident in recent years. A large number of springs do not have an established sanitary protection zone or even legally prescribed water acts.

Sanitary protection zones of origin, in respect of the protection regime, laid down in the Ordinance on the definition and designation of zones for sanitary protection of sources and restrictions in those zones („OJMNE, no“, no. 66/09), are:

- strict protection zone - I protection zone (immediate protection zone);
- restricted protection zone - II protection zone (narrower protection zone);
- surveillance zone - III protection zone (wider protection zone).

Table - Sanitary protection zones of springs[2]

Herceg Novi	The Opačica spring has defined narrower and wider sanitary protection zones determined by the Decision on the determination of sanitary protection zones for the Opačica spring in Zelenica
Kotor	Kotor has 6 springs for water supply through the public spring system, namely: Grbaljski spring, Simiš, Spila, Orahovac, Tunnel Vrmac and Škurda-Tabačina. For 3 springs – “Spila” Risan, ”Orahovac” and ”Tabačina”, studies (main projects) on protection zones with established boundaries have been made, for which consent has not yet been given. For the other 3 sources, a procedure for preparing a study has been initiated. At all 6 springs, regular quality control and chlorination of water is performed. The Directorate for Development and Construction of Kotor has also started the procedure for the preparation of the Study for Morinj Water Springs.
Tivat	Zone sanitarne zaštite utvrđene su za: - Izvorište Plavda – Elaborat od 20.03.2000. godine - Izvorište Češljar – Elaborat od 27.11.2000. godine - Izvorište Brštin – Elaborat od 18.01.2001. godine - Izvorište Topliš – Elaborat iz marta 1999. godine

Summary

Water protection as well as protection of aquatic ecosystems and terrestrial ecosystems dependent on water is a concern and obligation of the state and local self-government and all economic entities and individuals and will be implemented on the basis of national legislation, harmonized with the acquis Communautaire.

Strategic objective: achieving and maintaining good status and good ecological potential of surface and groundwater bodies, in order to protect human health, preserve aquatic flora and fauna and meet the needs of water users.

[2] Source: Report on the implementation of measures from the Action Plan for reducing the negative impact on the environment, for the period January-June 2015.

Having in mind the importance and complexity of water protection issues, the achievement of the strategic goal can be achieved by respecting the following principles:

- combined approach to water protection (emission and immission)
- standards;
- reduction of pollution at the place of origin;
- precautions (preventive action);
- The polluter pays principle
- inclusion of water protection in all sectors
- and public participation.

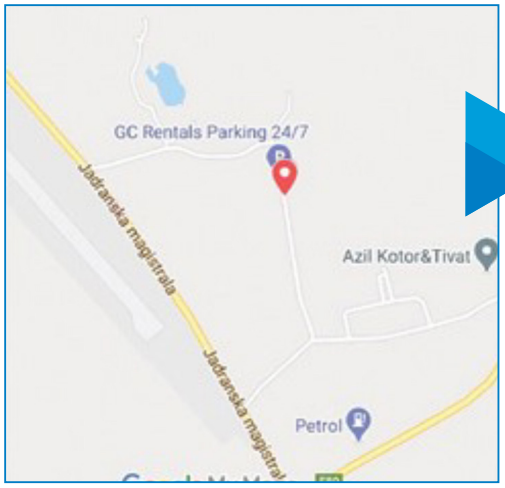
3.2. Locations of water samples taken for analysis

Locations for water sampling were determined based on the selection of one location from all three areas: the Municipality of Kotor, the Municipality of Tivat and the Municipality of Herceg Novi. Water analysis was performed for LABORATORY testing of physicochemical parameters, laboratory testing of heavy metals, laboratory testing of polycyclic aromatic hydrocarbons (pahs) and laboratory testing of pesticides.

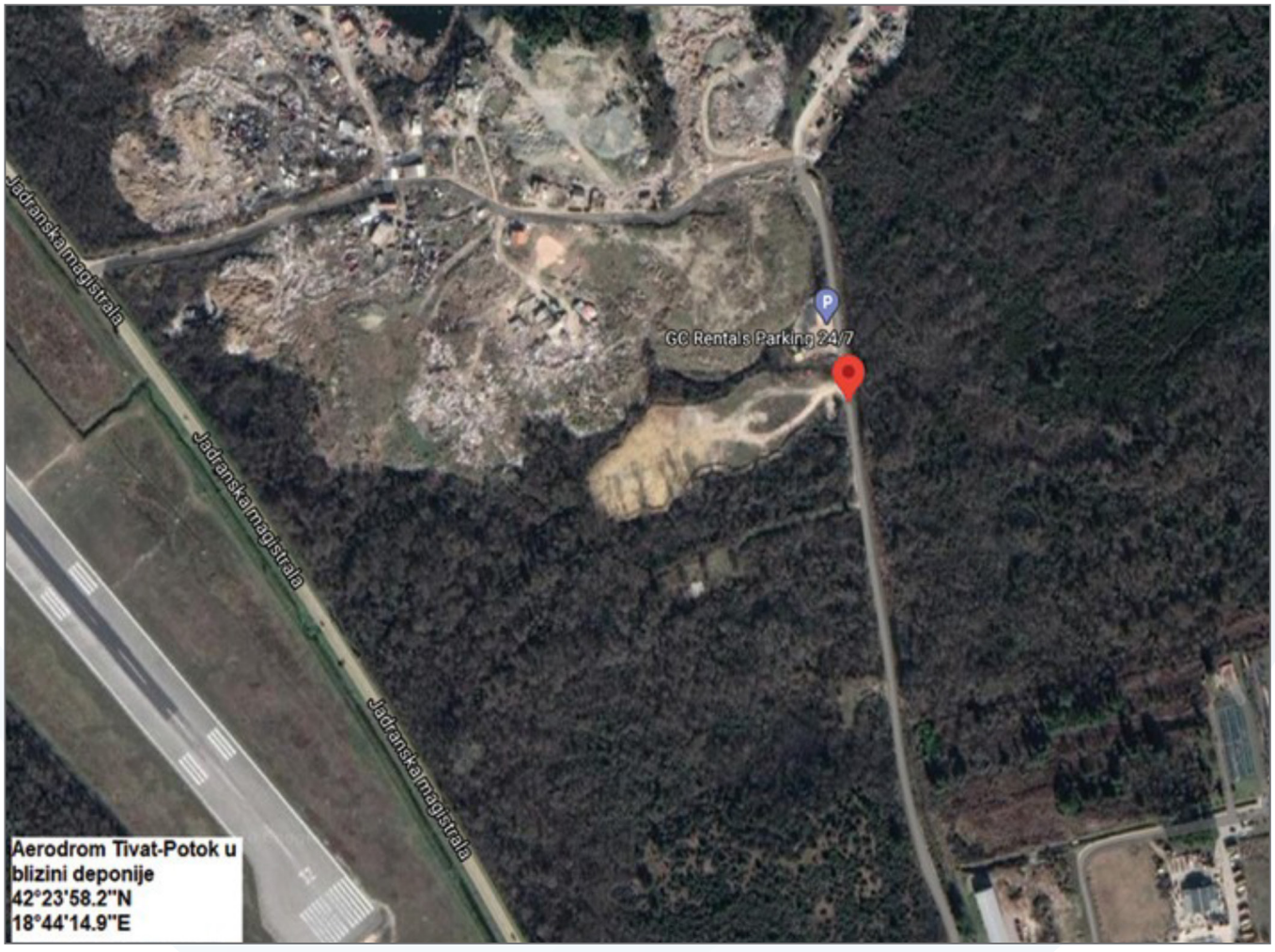
3.2.1. Municipality of Kotor

Kotor - next to the walls of the old city Rijeka Škurda
Coordinates: 42°25’ 37,4’’ N; 18° 46’ 28,5’’ E

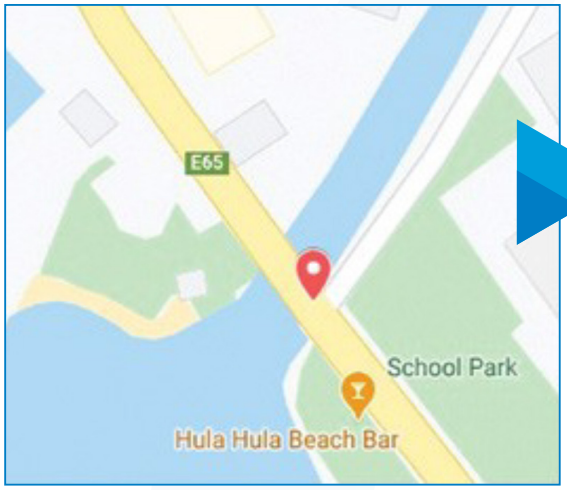
3.2.2. Municipality of Tivat



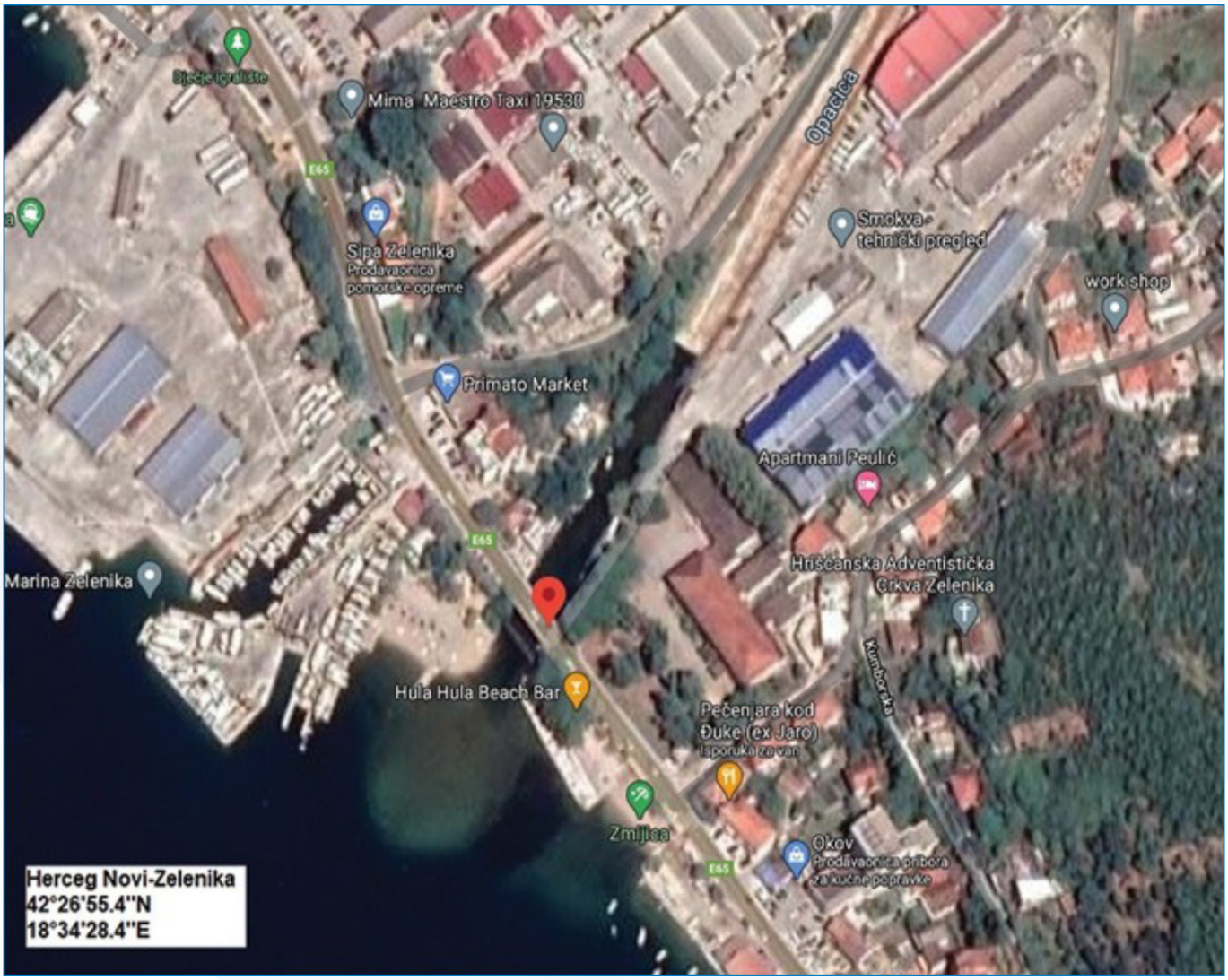
Tivat – a stream near the landfill flows into the sea near the airport
Coordinates: 42°23’58,0’’ N; 18°44’’14.9’’ E



3.2.3. Municipality of Herceg Novi



Herceg Novi – Zelenika, river Sutorina
Coordinates: 42°26’55,4’’ N; 18°34’’28.4’’ E



4. ANALYSIS OF THE OBTAINED RESULTS

4.1. Legislation

Legislation related to water and water bodies is quite complex and demanding. The area of water protection and quality is particularly sensitive. Therefore, water analysis in the context of existing legislation requires quality planning, management and constant monitoring - monitoring of surface and groundwater systems, both the quantity and quality of water.

Legislative and strategic framework for waste management in Montenegro

Sustainable waste management is one of the foundations of sustainable environmental management. Environmental sustainability, from the aspect of waste management, can be defined as a waste management system, which reduces the overall (negative) impact of waste management on the environment, including energy consumption, soil, air and water pollution, where the total costs of the system waste management acceptable to all members of the community, including households, the economy, institutions and the government (White and dr. 1995; Warmer bilten, 49/1996Bearing in mind that the right to a healthy environment, the right to be informed about the state of the environment, as well as the right to participate in the decision-making process related to the environment, are recognized by the Constitution of Montenegro as basic human rights. Declared as ecological in 1991, it has an obligation to provide all citizens with a quality environment.

One of the preconditions for good quality of all segments of the environment is sustainable waste management. Montenegro started its waste management policy in 2004, with the adoption of the National Waste Management Policy. Then the Strategic Master Plan for Waste Management (2005) was prepared and the Law on Waste Management was adopted in the same year. As it was estimated that no preconditions were created for its implementation, its implementation was first postponed to 2008, and then to 2010. The problem with the implementation of this Law was present even after that date, and the obligation to further harmonize it with European legislation was generated by the dynamics of its development, and for these reasons there was a need to draft a new Law, which was adopted in 2011. In addition to the new law, a number of bylaws have been adopted. In the mentioned period, the National Waste Management Plan for the period 2008-2012 was adopted, as a strategic document which regulates the area of waste management in Montenegro.

The above-mentioned strategic documents and legal provisions have only partially, and it can be stated, with little political will on the part of those who need to implement them, solve many of the problems that Montenegro faced in those years, as evidenced by numerous European Commission reports. (EC) and other relevant institutions and organizations.

Since the period for which the previous set of strategic documents was prepared has expired, and it was necessary to draft and adopt a new set of documents, there was a need to review previously planned and achieved goals in the field of waste management, as well as to consider all existing problems, needs and possibilities of Montenegro when it comes to this area. For this reason, at the end of 2013, the State started amending the existing and drafting new documents in this area. The Law on Amendments to the Law on Waste Management was recently adopted (June, 2016).

In order to establish an integrated waste management system, Montenegro has adopted the basic Law on Waste Management in recent years („OJMNE, no. 64/2011), Law on Amendments to the Law on Waste Management ("OJMNE, no. 39/2016") and a set of relevant bylaws, establishing a solid legal framework.

It is expected that this set of regulations will be supplemented by regulations that are currently missing, but also that in time it will be harmonized with all changes that will take place at the EU

level. It should be noted here that the situation in this area will be improved only by full, non-selective implementation of all legal provisions and application of penal policy, when necessary.

The current strategic directions of improvement and development in the field of waste management on the territory of Montenegro are determined by strategic and planning documents adopted at the state and local level.

National Waste Management Policy from 2004, Strategic Master Plan for Waste Management from 2005, National Waste Management Plan for the period 2008-2012, Waste Management Strategy of Montenegro until 2030, as well as the National Waste Management Plan for the period 2015-2020. year, the most important are the strategic documents which regulated / regulates the field of waste management in Montenegro.

Strategic principles in the field of waste management of Montenegro must be harmonized with the basic principles of the EU in it, which are:

1. The concept of sustainable development
2. The precautionary principle
3. The polluter pays principle
4. The proximity principle
5. Waste management hierarchy:
   a) prevention of waste generation and reduction, ie reduction of resource use and reduction of quantities or hazardous characteristics of generated waste;
   b) preparation for re-use of the product for the same or another purpose; recycling, ie treatment of waste in order to obtain raw materials for the production of the same or another product;
   c) recovery of waste values (composting, incineration with energy recovery, etc.);
   d) Disposal of waste in regulated landfills.

Water management and legislation

Given that water is one of the most important environmental factors, it is clear that Montenegro through its Constitution has defined the competence over the management, use and protection of water in an integrated manner and in the general interest of all its citizens. The constitutional basis for the enactment of the Law on Waters is contained in the provision of Paragraph 16, item 5 of the Constitution of Montenegro, which stipulates that the law, in accordance with the Constitution, regulates issues of interest to Montenegro.

Back in 2007, Montenegro adopted the Law on Waters, which was largely in line with international law. Reports on the analytical review of the harmonization of the legislation of Montenegro assessed that it amounted to 67 %. Due to the need for further harmonization of national legislation, especially the Law on Water, as the basic sectoral law in the field of water, with the legislation of the European Union, in August 2015 Amendments to the Law on Water were adopted, which is fully harmonized with EU directives. relating to water.

This Law regulates the legal status and manner of integrated management of waters, water and coastal land and water facilities, conditions and manner of performing water activities and other issues of importance for water and water resources management, such as:

- territorial water management (waters of local and state importance, water areas, strategy, water management plans, etc.);
- water use (for water supply, irrigation, bottling, fish farming, electricity generation, navigation, sports and recreation, etc.);
- protection of waters from pollution, with the definition of areas of special protection of waters, sensitive and vulnerable areas as well as plans for protection against pollution, monitoring;
- regulation of watercourses and protection against harmful effects of water (definition of endangered areas from floods, risk assessment and flood risk management, protection against erosion and torrents, protection measures and plans, monitoring, etc.)

Paragraph 23 of this Law defines the framework for the development of the Water Management Strategy (hereinafter: the Strategy), as a planning document which determines the long-term directions of water management. The strategy contains an assessment of the current situation in the field of water management, goals and guidelines for water management, measures for achieving the set goals and a projection of the development of water management.

The strategy is adopted by the Government for a period of at least ten years, and is reviewed after six years from the date of adoption. If the Ministry, while monitoring the implementation of the Strategy, determines that there have been significant changes in the circumstances on the basis of which it was made, the review may be conducted before the expiration of the six-year period. The Ministry monitors the implementation of the Strategy and prepares an annual report on the implementation of the Strategy, which is submitted to the Government no later than April 15 of the current year.

Within this document, the analysis and projection of development covers the period of twenty years, ie the period until 2035. In this period, a significant improvement of the situation in the water sector is expected compared to the existing ones. This improvement will take place in accordance with the social and economic capabilities of the country, while respecting EU standards in the field of water. Starting from the assessment of the current situation, it can be concluded that a period of twenty years is not enough to reach all the standards that apply to EU member states. The highest degree of harmonization is expected in the part of water activity related to the use of water for human consumption, while it will take more than twenty years to reach the prescribed standards in the part related to water protection. Strategy, spatial plans, development and management plans for natural resources and other strategic documents must be mutually harmonized.

Basic goals of the Strategy

The goal of the Water Management Strategy is to achieve a unique and fully harmonized water regime in Montenegro, in each of its two river basins - Adriatic and Danube (in accordance with Paragraph 21 of the Law on Waters), which can be defined as follows:

- creating a legal framework for the efficient functioning of the water sector;
- ensuring economic stability, which enables sustainable development of the water sector;
- ensuring sufficient quantities of water of appropriate quality for water supply of the population and all the needs of the economy;
- protection of the population and material goods from floods and other forms of harmful effects of water
- regulation of watersheds in order to protect water management and other systems, as well as environmental protection
- water protection and achieving good water status, in order to protect and improve the environment and improve the state of biodiversity;

- establishing metering, management and IT support for the realization of all water management goals;
- defining the connection and interdependence of all plans in the field of water with the requirements of regulation space and preservation and protection of the environment and vice versa, ensuring more reliable planning when locating other facilities and systems, respecting the criteria, limitations and opportunities arising from water infrastructure;
- organizing the water sector in such a way as to be able to successfully implement the concept of integrated water resources management, in the context of managing all resources that depend on water and the water sector;
- Involvement of the public in the process of adopting strategic guidelines for the development of integrated water management systems;
- providing a clear platform for all forms of international cooperation in the field of water with neighboring countries, as well as with all other countries in the process of joining the EU;
- Water and water land management is based on the following principles;
- irreplaceability of water as a resource and conditions of existence - water as a natural public good can be used only in a way that does not endanger its substance and does not exclude its natural role;
- integrity - processes in nature, a significant component of which is water, as well as the connection and interdependence of aquatic ecosystems and coastal ecosystems, must not be disturbed;
- unity of the water system, based on integrated water management, within a single water area, in accordance with the development of Montenegro, with the establishment of a single water information system and respect for international agreements, especially regarding sustainable water management of river basin countries;
- sustainable development, which, in order to meet the needs of the present, does not jeopardize the ability of future generations to meet their needs;
- long-term quality protection and purposeful use of available water sources;
- the right to protection from the harmful effects of water (protection of the population and its property), taking into account natural processes, protection of natural values and economic justification of protection;
- economic evaluation of water, which includes covering the costs of water insurance and preparation for different users and the costs of water protection and management, on the principle of “user pays - polluter pays”;
- continuous management at all levels of planning and stages of regulation, use and protection;
- public participation, which enables appropriate participation of the population and other stakeholders in the adoption of water management plans;
- Respect for the best available technologies and new scientific achievements on natural laws.

4.2. Municipiality of Kotor

4.2.1. WATER TEST REPORTS No. 10-848/20

TEST LABORATORY **template code OB.107**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	Rver Škudra, Kotor, Republic of Montenegro
Municipality and county	Kotor, Republic of Montenegro
Water area	Water area of the Adriatic Sea
Sampling performed by	Rajko Udovičić
Sampling performed according to methods / instructions	/
Preservation of samples performed according to the method / instructions	/
Place and date of sampling	The Škudra river next to the walls of the old town (42025'27.4"N ; 18046'28.5"E)
Date of receipt of the sample in the laboratory	12.10.2020.
Date of examination	12.10.2020. – 27.10.2020.
Sampling report no.	/
Test order No.	100/20
Sample code / seal number	1
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The sample is non-original packaging, clear, without visible impurities.

DECLARATION OF COMPLIANCE:

ATTACHMENT TO THE QUALITY CONTROL REPORT IS THE TEST REPORT NO.10-848-1/20.

The report shall refer to the sample submitted. The quality control report shall not be duplicated without the prior written consent of the person responsible for the management system.

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PHYSICO-CHEMICAL ANALYSIS	TEMPERATURE	BAS DIN 38404-4:2010*	^{0}C	13,40
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m^3	35,30
	pH VALUE	BAS ISO 10523:2013*	/	7,53
	QUANTITY OF SULFATE	Standard methods 23th edition-4500 E:2017*	mg/l	33,4
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (part 4)*	mgP/l	0,388
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (part 8)*	mgP/l	0,412
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	50,77
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO_2/l	7,33
	AMOUNT OF AMMONIA (NH_3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0047
	NITRATE AMOUNT (NO_3-N)	BAS ISO 7890-3:2002*	mgN/l	0,4778
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen according to Kjaldahl *	mg/L	1,64
	CHEMICAL CONSUMPTION O_2	BAS ISO 6060:2000*	mgO_2/l	< 30,0
	BIOCHEMICAL CONSUMPTION O_2	BAS EN 1899-1:2002*	mgO_2/l	5,67

LABORATORY TESTING OF HEAVY METALS

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B) izd. APHA-AWWA-WEF, 2017 god	g/m^3	< 0,03
	QUANTITY OF ARSENE	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	0,583
	QUANTITY OF COPPER	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	11,74
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	< 0,50
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	0,019
	QUANTITY OF CADMIUM	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	< 0,05
	QUANTITY OF LEAD	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	< 0,10
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	< 0,50

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 27.10.2020.

ODGOVORNA OSOBA ZA SISTEM UPRAVLJANJA:

CONTROL-H d.o.o. MOSTAR

4.2.2. Conclusion

Based on Article 75 paragraph 6 and 76 paragraph 2 of the Law on Waters („Official Journal MNE“, no. 27/07), At its session of 11 October 2007, the Government of the Republic of Montenegro adopted the **Regulation on the Classification and Categorization of Surface and Groundwater** („Official Journal MNE”, no. 2/07 od 29. October 2007).

Based on this decree and water analysis at the selected location **River Škudra, Kotor, Republic of Montenegro**, the following can be concluded:

Physico-chemical tests of the parameters of these surface waters are within the expected values, which indicate a good state of surface water quality. This also applies to the limit values of **PAHs, heavy metals and pesticides**, which are also below the detection limit of the accredited method, which means that they are present in such small quantities that they can only be detected to exist in the sample. accredited methods can be quantified, but the result in this case is expressed as (<of the value of the detection limit), because the laboratory in these cases cannot and must not express the result as a finite number. If drinking water is to be analyzed, a micro-biological analysis of the water must also be performed.

Therefore, according to these analyzes, and in accordance with the legislation of Montenegro In the regulation of classification and categorization of surface and groundwater (Official Journal of Montenegro No. 2/07 of October 29, 2007), this water can be classified as Waters that can be used for drinking and food industry - Class A1 - waters that can be used for drinking after a simple physical process of processing and disinfection and A2 - waters that can be used for drinking after proper conditioning (coagulation, filtration and disinfection).

For example: Total organic carbon (C): 0,035 mg/l (allowed A1: 1 mg/l), Biokem. Oxygen consumption (BPK5): 5,67 mg/l (allowed A1: 3 mg/l, A2: 4 mg/l, A3: 7,0 mg/l), Chemical oxygen demand (HPK): < 30 mg/l O2 (allowed A1: 2 mg/l, A2: 4 mg/l, A3: 8 mg7l), nitrates: 0,478 mg/l (allowedA1: 10 mg/l).

Water related to fishing and shellfish farming, class S or Š 1, class S - waters that can be used for breeding noble species of fish (salmonids); class Š - waters that can be used for shellfish farming, (it can be determined exactly after microbiological analysis of water). Bathing water, class K1 and K2 - 1) class K1 - excellent, class K2 - satisfactory.

In general, it can be concluded that this is water of class (A1, A2, S, K1) - which classifies it as “category I” or “category II”; - it can be accurately determined only after microbiological analysis of water.

4.3. Municipiality of Tivat

4.3.1. QUALITY CONTROL REPORT no.10-849/20

TEST LABORATORY **template code OB.104**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	Tivat, Republic of Montenegro
Municipality and county	Tivat, Republic of Montenegro
Water area	Water area of the Adriatic Sea
Sampling performed by	Rajko Udovičić
Sampling performed according to methods / instructions	/
Preservation of samples performed according to the method / instructions	/
Place and date of sampling	Tivat, a stream near the landfill flows into the sea, next to the airport (42024'49.8"N ; 18042'59.5"E)
Date of receipt of the sample in the laboratory	12.10.2020.
Date of examination	12.10.2020. – 27.10.2020.
Sampling report no.	/
Test order No.	100/20
Sample code / seal number	2
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The sample is non-original packaging, clear, with visible impurities and sediment.

DECLARATION OF COMPLIANCE:

The pattern is non-original packaging, clear, colorless without visible impurities.10-849-1/20.

The report shall refer to the sample submitted. The quality control report shall not be duplicated without the prior written consent of the person responsible for the management system.

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PHYSICO-CHEMICAL ANALYSIS	TEMPERATURE	BAS DIN 38404-4:2010*	^{0}C	13,49
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m^3	61,10
	pH VALUE	BAS ISO 10523:2013*	/	6,90
	QUANTITY OF SULFATE	Standard methods 23th edition-4500 E:2017*	mg/l	32,11
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (dio 4)*	mgP/l	0,456
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (dio 8)*	mgP/l	0,490
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	123,69
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO_2/l	6,65
	AMOUNT OF AMMONIA (NH_3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0128
	NITRATE AMOUNT (NO_3-N)	BAS ISO 7890-3:2002*	mgN/l	0,4993
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen	mg/L	1,88
	CHEMICAL CONSUMPTION O_2	BAS ISO 6060:2000*	mgO_2/l	< 30,0
	BIOCHEMICAL CONSUMPTION O_2	BAS EN 1899-1:2002*	mgO_2/l	12,35

LABORATORY TESTING OF HEAVY METALS

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B) izd. APHA-AWWA-WEF, 2017 god	g/m^3	0,070
	QUANTITY OF ARSENE	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	1,71
	QUANTITY OF COPPER	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	12,99
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	3,06
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	0,016
	QUANTITY OF CADMIUM	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	< 0,05
	QUANTITY OF LEAD	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	< 0,10
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	6,33

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 27.10.2020.

ODGOVORNA OSOBA ZA SISTEM UPRAVLJANJA:

CONTROL-H d.o.o. MOSTAR

4.3.2. Conclusion

Based on Article 75 paragraph 6 and 76 paragraph 2 of the Law on Waters („Official Journal MNE“, no. 27/07), At its session of 11 October 2007, the Government of the Republic of Montenegro adopted **the Regulation on the Classification and Categorization of Surface and Groundwater** („Official Journal MNE”, no. 2/07 od 29. October 2007).

Based on this decree and water analysis at the selected location **River Škudra, Kotor, Republic of Montenegro**, the following can be concluded:

Physico-chemical tests of the parameters of these surface waters are within the expected values, which indicate a good state of surface water quality. This also applies to the limit values of **PAHs, heavy metals and pesticides**, which are also below the detection limit of the accredited method, which means that they are present in such small quantities that they can only be detected to exist in the sample. accredited methods can be quantified, but the result in this case is expressed as (<of the value of the detection limit), because the laboratory in these cases cannot and must not express the result as a finite number. If drinking water is to be analyzed, a micro-biological analysis of the water must also be performed.

Therefore, according to these analyzes, **and in accordance with the legislation of Montenegro In the regulation of classification and categorization of surface and groundwater** (Official Journal of Montenegro No. 2/07 of October 29, 2007), this water can be classified as Waters that can be used for drinking and food industry - Class A1 - waters that can be used for drinking after a simple physical process of processing and disinfection and A2 - waters that can be used for drinking after proper conditioning (coagulation, filtration and disinfection).

For example: Total organic carbon (C): 0,061 mg/l (allowed A1: 1,0 mg/l), Biokem. Oxygen consumption (BPK5): 12,35 mg/l (allowed A1: 3 mg/l, A2: 4 mg/l, A3: 7,0 mg/l), Chemical oxygen demand (HPK): < 30 mg/l O2 (allowed A1: 2 mg/l, A2: 4 mg/l, A3: 8 mg7l), nitrates: 0,499 mg/l (allowedA1: 10 mg/l) itd.

Water related to fishing and shellfish farming, class S or Š 1, class S - waters that can be used for breeding noble species of fish (salmonids); class Š - waters that can be used for shellfish farming, (it can be determined exactly after microbiological analysis of water). Bathing water, class K1 and K2 - 1) class K1 - excellent, class K2 - satisfactory.

In general, it can be concluded that this is water of class (A1, A2, S, K1) - which classifies it as “category I” or “category II”; - it can be accurately determined only after microbiological analysis of water.

4.4. Municipiality of Herceg Novi

4.4.1. QUALITY CONTROL REPORT no.10-850/20

TEST LABORATORY **template code OB.104**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	River Sutorina, Zelenika, Herceg-Novi,, Republic of Montenegro
Municipality and county	Herceg-Novi, Zelenika, Republic of Montenegro
Water area	Water area of the Adriatic Sea
Sampling performed by	Rajko Udovičić
Sampling performed according to methods / instructions	/
Preservation of samples performed according to the method / instructions	/
Place and date of sampling	River Sutorina, Zelenika-Herceg Novi (42026'55.4"N ; 18034'28.4"E)
Date of receipt of the sample in the laboratory	12.10.2020.
Date of examination	12.10.2020. – 27.10.2020.
Sampling report no.	/
Test order No.	100/20
Sample code / seal number	3
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The pattern is non-original packaging, clear, colorless without visible impurities.

DECLARATION OF COMPLIANCE:

ATTACHMENT TO THE QUALITY CONTROL REPORT IS THE TEST REPORT NO.. 10-850-1/20.

The report shall refer to the sample submitted. The quality control report shall not be duplicated without the prior written consent of the person responsible for the management system.

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PHYSICO-CHEMICAL ANALYSIS	TEMPERATURE	BAS DIN 38404-4:2010*	^{0}C	13,55
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m^3	45,20
	pH VALUE	BAS ISO 10523:2013*	/	7,47
	QUANTITY OF SULFATE	Standard methods 23th edition- 4500 E:2017*	mg/l	37,41
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (dio 4)*	mgP/l	0,538
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (dio 8)*	mgP/l	0,382
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	113,45
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO_2/l	6,70
	AMOUNT OF AMMONIA (NH_3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0054
	NITRATE AMOUNT (NO_3-N)	BAS ISO 7890-3:2002*	mgN/l	0,4432
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen according to Kjaldahl *	mg/L	1,15
	CHEMICAL CONSUMPTION O_2	BAS ISO 6060:2000*	mgO_2/l	< 30,0
	BIOCHEMICAL CONSUMPTION O_2	BAS EN 1899-1:2002*	mgO_2/l	10,74

LABORATORY TESTING OF HEAVY METALS

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B) izd. APHA-AWWA-WEF, 2017 god	g/m^3	< 0,03
	QUANTITY OF ARSENE	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	86,44
	QUANTITY OF COPPER	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	13,24
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	3,95
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	0,010
	QUANTITY OF CADMIUM	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	0,171
	QUANTITY OF LEAD	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	15,24
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B) izd. APHA-AWWA-WEF, 2017 god	mg/m^3	12,93

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 27.10.2020.

ODGOVORNA OSOBA ZA SISTEM UPRAVLJANJA:

CONTROL-H d.o.o. MOSTAR

4.4.2. Conclusion

Based on Article 75 paragraph 6 and 76 paragraph 2 of the Law on Waters („Official Journal MNE“, no. 27/07), At its session of 11 October 2007, the Government of the Republic of Montenegro adopted the **Regulation on the Classification and Categorization of Surface and Groundwater** („Official Journal MNE”, no. 2/07 od 29. October 2007).

Based on this decree and water analysis at the selected location **River Škudra, Kotor, Republic of Montenegro**, the following can be concluded:

Physico-chemical tests of the parameters of these surface waters are within the expected values.

Regarding the limit values of **PAHs, heavy metals and pesticides**, it is evident from the analysis that there is an increased level of arsenic in the water, which is worrying.

According to this analysis, ie the sample, due to the read level of arsenic, water is currently not recommended for drinking. This accredited method can be used to quantify samples, and the result is expressed as (<of the detection limit value), because in these cases the laboratory cannot and must not express the result as a final number.

If you want to further analyze drinking water, it is necessary to make a micro-biological analysis of water, although it is evident that due to the increased level of arsenic is not recommended for consumption

5. CONCLUSION - Guidelines and recommendations

5.1. Summary of results obtained

Based on the Decree on Classification and Categorization of Surface and Groundwater and Water Analysis at Selected Locations, the following can be concluded: Physico-chemical tests of the parameters of these surface waters are within the expected values, which indicate good surface water quality.

Regarding the limit values of PAHs, heavy metals and pesticides, they are below the detection limit of the accredited method, except in Herceg Novi where a high level of arsenic was detected in the sample, so a recommendation is given for further research of this water resource.

Therefore, according to these analyzes, and in accordance with the legislation of Montenegro Decree on classification and categorization of surface and groundwater ("Official Journal of Montenegro", No. 2/07 of October 29, 2007) water in Tivat and Kotor can be classified into waters that can be used for beverage and food industry, which means that most of the parameters (which are analyzed) are within the maximum value. Due to the increased amount of arsenic, water in Herceg Novi is not recommended for consumption, however, it is necessary to do further analyzes and research on this issue.

In general, it can be concluded that it is a class of water (A1, A2, S, K1) - which classifies it as "category I" or "category II"; - can be accurately determined only after microbiological analysis of water. The following was also observed:

- Parameters that are slightly above the limit is Biokem. Oxygen consumption (BOD5) of 5,67 mg/l, 10,64 mg/l i 12,35 mg/l, and it can be concluded that the increased parameter indicates an increased organic load, and the impact of wastewater discharge should be examined in more detail, as well as the impact of landfills, as the main pollutants with organic load.
- PAHs, heavy metals and pesticides are within the permitted values of class A1, except in Herceg Novi where high levels of arsenic were read.

Therefore, maintaining good water quality and preventing additional pollution of water resources can be controlled through:

- Point pollution from the discharge of municipal waste (fecal water)
- Diffuse (diffuse) pollution of watercourses and groundwater: 0 Agriculture (pesticides and other protective equipment)
    - Forestry
    - Mining
    - Construction
- Leachate pollution from public and illegal landfills
- Pollution from industrial wastewater.

5.2. Wastewater drainage - status and recommendations

In addition to illegal landfills and solid waste disposal, a major problem for environmental protection, ie water resources, is wastewater drainage. Insufficient construction of sewerage system and appropriate infrastructure, damage and deterioration of existing infrastructure in the sector of drainage and wastewater treatment, as well as insufficient maintenance of infrastructure, lead to the possibility of increasing pollution of surface and groundwater, and thus deteriorating drinking water quality. All Boka Kotorska municipalities (meaning the analysis of Kotor, Tivat and Herceg Novi) have a Wastewater Treatment Plant.

Wastewater collection and sewerage infrastructure

Based on the described current situation regarding wastewater disposal, measures have been proposed for upgrading the elements of wastewater collection systems (main sewer pipes, collection networks and other elements) as well as elements designed especially for effluent discharge, ie discharges into the deep sea. .

The proposed extension of the wastewater collection system is directly correlated with the planned increase in the previously shown coverage of wastewater collection services, which should allow for gradual compliance with the Urban Wastewater Treatment Directive (Paragraph 3) and relevant national regulations; primarily the Law on Municipal Wastewater Management.

Given the large volume of work (and investment) required to ensure the target level of wastewater coverage, as well as the associated organizational, financial and affordability constraints, the projected service coverage should be achieved gradually. Therefore, it is proposed to plan almost full coverage of services in relation to the proposed deadline from the national Negotiating Position on Chapter 27, ie the end of 2035.

The measures are defined at the level of agglomerations and then merged by municipalities and regions. Proposed measures including the following elements of wastewater infrastructure:

- Wastewater collection and disposal (collection network and main sewer pipes),
- Pumping devices and discharge pipelines,
- Discharge of treated wastewater in the depths of the open sea.

The analysis / elaboration of technical measures included the following:

- Engineering assessment project specifically for areas of the agglomeration where no studies of technical projects of the appropriate standard were available;
- Relevant, updated feasibility studies and / or technical projects dealing with the assessment and development of municipal wastewater infrastructure in the project area;
- Relevant information on the planned wastewater infrastructure from urban and spatial plans of a certain local self-government unit and special purpose spatial plans;
- CORINE 2012 analysis of information on land cover, especially continuous and discontinuous urban tissue in order to accurately define the desired geographical coverage of service coverage;
- If necessary, technical proposal defined in the appropriate feasibility study / project supplemented by other elements, based on engineering assessment;

To summarize, these are the basic technical characteristics of the proposed components for wastewater collection / collection and wastewater discharge (taking into account the measures whose implementation is in progress):

- Total length of sewerage network (km):190 km (Kotor, Tivat I Herceg Novi) The total length of the proposed remediation approx.30%
- The new outlet in Meljine is in very good operational condition, but there are still about 25 uncontrolled local outlets.
- There are eight local short outlets all designed for closing / leaving. Wastewater is directed to the main outlet in Tivat (Trašte)
- The main sea outlet for Tivat-Kotor (Trašte) is estimated to be damaged and in poor operational condition. There are four local uncontrolled outlets that need to be closed and abandoned.
- In addition to rehabilitation, it is necessary to build a new sewerage network for certain parts of municipalities / cities, as well as a connection with agglomerations.

When it comes to the proposed wastewater collection systems, it should be noted (as originally envisaged) that the areas to which these systems need to be extended are less favorable than the areas with existing systems. Network density would be much lower, 237 users / km of network (compared to current 321) or 4,2 m network/user (compared to current 3,1). It implies higher unit costs (per capita served) than for existing systems. It is important to note that the starting point is the assumption that all new wastewater collection networks will be built as completely separate systems (for wastewater only). Typical characteristics (size) of networks are estimated in relation to the size of the relevant area in which the services are provided.

5.2.1. Waste water treatment

The need for new wastewater treatment facilities is based solely on the need to comply with agglomeration delimitation requirements.

In the assessment of wastewater treatment needs (global situation for Montenegro):

- The need to treat wastewater from all defined agglomerations at least at the secondary level of treatment has been fully taken into account.,
- Existing wastewater treatment capacities have been taken into account in accordance with their assessed status, functionality and compliance with (for effluent quality) requirements under the UWWTD. Except for the WWTP in Podgorica (which is about 30 years old, obsolete and overloaded), all other larger plants in Montenegro were built recently, after 2014 (Budva, Herceg Novi, Kotor-Tivat, Niksic). Also, it is expected that the facilities under construction (Pljevlja and Berane) will be completed long before the planned start of the implementation of the measures given in this study. Therefore, these facilities are considered fully functional and apart from some upgrade process (when it is necessary to enable requirements for sensitive areas) no other investments are planned at this stage. When an existing treatment plant needs to be rehabilitated and / or upgraded to a significant extent in order to meet the requirements of the Directive and national regulations, it is considered a “new” treatment plant in this report (eg Podgorica),
- The need to apply the provisions concerning the elimination of nutrients in accordance with the proposed Decision and the Ordinance on sensitive areas and the application of stricter treatment has been fully taken into account. According to the above documents, the entire project area including the respective wastewater discharge points, except the municipality of Ulcinj and its planned discharge points is considered a sensitive area within the meaning of the UWWTD Directive. Therefore, all new wastewater treatment plants with a capacity of more than 10,000 population equivalent should be equipped with appropriate nutrient elimination units.

- An attempt was made to optimize the efficiency of treatment by minimizing the number of treatment plants by transferring (through tansy collectors) wastewater from several agglomerations to treatment plants - this was done using natural slopes (gravity) and based on the proximity of areas covered by services, when possible,
- Regarding the basic design criteria for wastewater treatment, they are in full compliance with the UWWTD Directive and the transposed national regulations.,
- Sludge generated during wastewater treatment, ie proper management, is considered to be a very important component of overall wastewater management. Requirements related to the characteristics of treated sludge OV are defined by the Ordinance on detailed conditions to be met by municipal sewage sludge (Official Journal MNE, no. 89/09). The requirements provided in the ordinance refer to a number of potential applications of treated sludge (for agricultural purposes, as a material for covering landfills, land reclamation, in parks and other green areas, etc.) Therefore, it was considered essential to create adequate conditions (technical, financial) for additional sludge treatment in the proposed wastewater treatment plants to ensure that the finally treated sludge has a quality that allows further compliance with the ordinance. The costs of additional sludge treatment are included in the estimate of the total investment costs of wastewater treatment.

It should be noted that this many-to-one approach for treatment plants in agglomerations:

- It is in full compliance with the Directive and the accompanying guidelines;
- Increases capital costs of sewerage transmission infrastructure (transit collectors and pumping stations);
- It slightly reduces the capital costs of WWTP construction through economies of scale
- Significantly reduces the operating costs of OV purification.

According to the Decision on Designation of Sensitive Areas in Montenegro (Official Journal MNE, no. 046/17 i 048/17), recipients within the Danube and Adriatic basins should be considered as sensitive areas within the meaning of the UWWTD. The Adriatic Sea (marine water body) at the points of discharge of treated effluent from the existing WWTP Tivat-Kotor and the planned WWTP in Bar and Ulcinj could be considered insensitive, due to good water exchange and therefore low probability of eutrophication (should be further examined). The existing discharge into the sea in Ulcinj is outside the boundaries of the identified sensitive area, and the treated effluent from the Kotor-Tivat WWTP is discharged at the outer boundary of the Trašte Bay, through a 3.6 km long deep-sea discharge. In addition to the analysis of tidal currents and seabed geology considered in the design of deep-sea discharges, a study and assessment of the impact on the marine environment should be performed for each of the mentioned deep-sea discharges. Additional testing will include physicochemical, microbiological and biological analyzes of the seawater at the point of discharge. Depending on the size of the WWTP, the requirements related to the quality of the effluent are:

- For WWTPs with more than 10,000 ES (except WWTP Tivat-Kotor, Bar and Ulcinj) in accordance with the UWWTD Directive for sensitive areas
- For WWTP Tivat-Kotor, Bar and Ulcinj in accordance with the UWWTD Directive for insensitive areas
- For WWTPs with less than 10,000 ES in accordance with the UWWTD Directive for non-sensitive areas
- For WWTPs with a capacity of more than 10,000 ES and discharge of treated effluent into the soil or reuse for irrigation in accordance with the UWWTD Directive for insensitive areas, BWD and WHO recommendations

Table - Required quality of wastewater discharged in sensitive areas (10.000-100.000 ES)

Parameter	Unit	Value
BPK_5	mg/l	25
HPK	mg/l	125
Total suspended matter	mg/l	35
Total nitrogen *	mg/l	15
Total phosphorus	mg/l	2

*Total nitrogen: organic N + NH_4-N + NO_3-N + NO_2-N

Table - Required quality of wastewater discharged in sensitive areas for WWTP > 100.000 ES

Parameter	Unit	Value
BPK_5	mg/l	25
HPK	mg/l	125
Total suspended matter	mg/l	35
Total nitrogen *	mg/l	10
Total phosphorus	mg/l	1

* Total nitrogen: organic N + NH_4-N + NO_3-N + NO_2-N

Table - Required quality of wastewater discharged in insensitive areas

Parameter	Unit	Value
BPK_5	mg/l	25
HPK	mg/l	125
Total suspended matter	mg/l	35
Total nitrogen *	mg/l	-
Total phosphorus	mg/l	-

Sewage sludge is identified by the Law on Waste Management as residual waste generated in the WWTP during wastewater treatment. The sewage sludge management plan is an integral part of the current National Waste Management Plan until 2020 (which was drafted and adopted in 2015). In accordance with the Law on Waste Management (OJMNE, no. 064/11 and 039/16), sewage sludge should be subjected to biological, chemical and thermal treatment, long-term storage and other appropriate processes designed to reduce its fertility and health hazards arising from its use before use in agriculture. In general, treated sewage sludge can be used in agriculture, green areas and parks, for land reclamation including afforestation, landfill cover, landfill closure and reclamation, or energy recovery.

Sewage sludge directive 86/278/EEC regulates the use of sewage sludge in agriculture in order to prevent harmful effects on land, plants, animals and people. The directive deals with the reduction of pathogens and the potential for the accumulation of long-term pollutants in soil, but does not set limits for organic pollutants. However, most EU Member States have introduced stricter standards for sludge quality including stricter restrictions for most potentially toxic elements in the soil, while in some countries the use of sewage sludge in agriculture is prohibited. Regarding the legal and institutional framework, the Ministry of Sustainable Development and Tourism in accordance with Article 22 of the Law on Waste Management (OJMNE, no.064/11, 039/1), prepare Sewage Sludge Management Plan.

The current situation regarding treated sewage sludge generated in wastewater treatment plants can be summarized as follows:

- Tivat / Kotor - dehydrated sludge is exported to Albania after lime stabilization,
- Herceg Novi - sludge treatment has yet to be completed.

To conclude, based on the above, the complete collection and treatment of municipal wastewater related to areas categorized as sensitive should be established by 2025, while for the entire territory the collection and treatment of wastewater should be completed by the end of 2029.

We must also point out the problem with sludge, namely it is planned to go to Albania, it is currently exported to Albania mostly due to the price of transportation. After visiting the same plant in Mojkovac where the Slovenian company installed the system for drying and treatment in reed fields, the construction of which will pay off after 3 years, and the process is according to EU standards, so we can recommend this practice for both locations.

5.2.2. Objectives, measures and recommendations for reducing surface and groundwater pollution

The predominant surface water pollutants are wastewater from the population (settlements) and industry, which occur as concentrated sources of pollution. In addition to the permanent population, significant amounts of wastewater, especially in the coastal region, come from the occasional population - tourists. Bulk, difficult to control springs are related to atmospheric waters from urban, agricultural and other areas, which, in addition to surface waters, also pollute groundwater.

A big problem is unregulated and illegal landfills, of which there are many registered and recorded in the area of the Bay of Kotor, which is the subject of this study.

The quality of water on the rivers of Montenegro depends on the quantity and quality of effluents, which has changed significantly compared to the effluent discharged into watercourses at the end of the last century. This is due to the following factors: on the one hand in conditions when due to the transition process, war events and economic crisis economic activities are significantly reduced and thus the amount of wastewater from industry, significantly reduced and effluent load of watercourses, and on the other development of tourism as one of the basic economic branches, there has been an increase in the amount of municipal wastewater.

Protection of water from pollution, in terms of the Water Act, is a set of measures and procedures that maintain water quality, ie improve it to the level prescribed for use for certain purposes. Measures to protect water from pollution are implemented through the following:

- organization of water quality control and sources of pollution, prohibition and restriction of introduction of dangerous and harmful substances into waters, prohibition of placing on the market of substances dangerous for waters for which there is substitution of more environmentally friendly products, etc .;
- economic measures by paying a fee for water pollution, which is not lower than the cost of its purification;

- wastewater treatment at the place of origin, application of technical-technological measures and introduction of modern technologies in production;
- water measures, which improve the regime and quality of small waters by purposefully discharging clean water from reservoirs, and especially in order to eliminate the consequences of emergency pollution.

5.3. Wild landfills - measures and recommendations

Wild dumps are a constant - everyday occurrence. As a rule, they occur along local less frequent roads. One of the main goals of this project is to define a proposal for a plan to solve the problem of registered landfills whose existence causes pollution of water resources in the analyzed area. In the next step, it is necessary to make an analysis of groundwater, and to consider and analyze the state of groundwater quality in the context of environmental pollution (landfills and others). Wild landfills contain mostly unsorted municipal and construction waste.

In order to achieve strategic goals in environmental protection, it is necessary:

- Preserve biodiversity
- Improve the quality of life
- Protect water
- Reduce all forms of air pollution
- Preserve natural and historical landscapes

It is necessary to rationally manage waste, which means the following:

1. URGENTLY stop the creation of new landfills (tighten the existing legislation, introduce communal wardens - inspectors)
2. Place signs prohibiting waste disposal at all locations,
3. In all municipalities / cities to form landfills of inert and hazardous (asbestos - salonite) construction waste,
4. Rehabilitate existing landfills in one of the acceptable ways:

   4.1. Relocation of unregulated landfills

   Disposal of unregulated landfills is a procedure recommended in situations when they are located near larger landfills that have a large enough capacity to receive the amount of waste of a particular unregulated landfill and when there are opportunities to safely transport waste from one location to another. Of course, this step should be decided only in situations when a certain unregulated landfill has a relatively small amount of waste, ie when it is not rational to perform its complete remediation. A larger regulated landfill can be considered a local or regional landfill, but for several reasons it is recommended that it be a local sanitary landfill.

   4.2. Partial remediation of unregulated landfills

   If the relocation of a particular unregulated landfill is still not possible in the manner described above, it is recommended to consider the possibility of partial remediation. The basic condition for the application of this solution, in addition to certain financial resources that are necessary, is a sufficient distance of groundwater from the landfill body so that the problem of further pollution of the surrounding water does not remain unresolved. If a detailed analysis of the terrain shows that the groundwater is far enough away, partial remediation of the landfill can be approached, which means its closure or arrangement in a way that minimizes its negative and potentially negative impact on the environment.

4.3. Complete remediation of unregulated landfills

In order to complete the remediation of the landfill, it is necessary to perform detailed research works: topographic measurements, testing of contact with groundwater and the necessary geotechnical research. After the research, it is necessary to develop a remediation project that would include the study of all data obtained, present a specific remediation solution derived from the characteristics and features of the terrain and all norms and standards for solving this type of problem and provide detailed environmental measures. **As practice has shown, that soon after cleaning, waste reappears, in order to protect the regulated site, we suggest installing video surveillance on rehabilitated landfills.**

Start educating the population with an emphasis on the harmfulness of inadequate waste disposal in water supplies and the need for selective waste collection - special emphasis on primary selection during waste collection.

In all municipalities - cities, form recycling yards and organize the purchase of secondary raw materials with an emphasis on packaging hazardous waste. Involve existing operators, public companies, eco-organizations and associations in all activities and organize waste management in one of the acceptable ways that has been proven in implementation. Transport the unusable part of the waste to the regional landfill.

5.3.1. Possible protection measures and proposal for guidance on reducing pollution of water resources from wild landfills

Within this project "Wild landfills and the impact on natural watercourses" for the areas of the Bay of Kotor (Montenegro) or for municipalities / cities belonging to this area, after the analysis of illegal landfills and water analysis of watercourses, the following can be concluded :

Local unregulated and illegal dumpsites were identified and positioned, ie recorded, including all data on them that were recorded directly on the site. The analysis of the results obtained during the implementation of this project revealed the existence of a large number of illegal landfills in local communities, which can be attributed to low public awareness of the negative impact of waste disposal on illegal landfills. in accordance with European guidelines and recommendations.

Pursuant to the Law on Environmental Protection and Water Protection, and on the basis of the adopted Environmental Protection Strategy and the Waste Management Strategy in Montenegro, which stipulates that an integrated waste management system follows the regional concept, ie is created in several municipalities. are grouped into regions, for which local waste management plans are then developed. According to the Law on Waste Management, as one of the measures to reduce the risk to the environment and human health and the establishment of a priority infrastructure for integrated waste management, the rehabilitation and closure of municipal landfills is envisaged. Therefore, the following measures can be singled out as basic measures for local unregulated and illegal landfills:

- Rehabilitation and closure of local unregulated landfills with the creation of conditions for the transition to an integrated waste management system that follows the regional concept,
- Removal of illegal landfills and waste material from areas that have a negative impact on surface and groundwater in accordance with defined priorities,
- Waste removal from the site
- Waste removal to the disposal site,
- Landscaping, the so-called "Tightening the terrain" (leveling and filling a layer of humus 20 cm thick),

- Pest control and disinsection of the site, placing a sign prohibiting waste disposal,
- Development of regional sanitary landfills for the area of Boka Kotorska (Montenegro).
- Some of the landfills are located in private facilities, often of unknown owner, and their cleaning cannot be performed without the consent of the owner. Therefore, the removal must be carried out on the order of the appropriate municipal inspection.
- Inspections also need to be stepped up. Increase penalties for illegal waste disposal.

5.4. Summary

Based on previously conducted analyzes, it is necessary to propose an action plan to address water and environmental pollution. The analysis of identified and recorded landfills in the field showed that there are landfills near rivers, near springs, and even in water protection zones - protected areas. Therefore, it is important to define these parameters for determining priorities for landfill remediation, according to the criteria where the priority for remediation will be those landfills that most endanger the waters on which human health depends. It is proposed to group all landfills into 4 groups: high priority, priority, medium priority and other, based on the sanitary protection zone, proximity to watercourses, hydrogeological base, etc. by phases - priorities and current needs.

Another problem is wastewater from households and industry, rainwater that also needs to be disposed of and treated before being discharged into the recipient. Guidelines have been proposed to address the problem of wastewater concerns.

Based on the previous analyzes, the main general problems in the field of waste management and disposal at the level of the state of Montenegro can be drawn:

- Lack of reliable and complete data when it comes to the amount and morphological composition of waste generated in Montenegrin households, which is one of the most important prerequisites for the selection of waste treatment technology and construction of appropriate plants for these purposes;
- A special problem is the low percentage of primary waste selection, in the amount of 2.66% for 2013, which indicates a real possibility that the obligation that Montenegro has imposed on itself on the path of European integration, that by 2020 the percentage recycling of recyclable waste will be 50%, will not meet within that period.
- As the system of selective disposal has not yet come to life, nor have waste disposal facilities been built to treat / dispose of municipal waste in most cities of Montenegro, it is still disposed of in municipal landfills.
- A big problem in Montenegro is represented by rural areas from which, for the most part, no municipal waste is collected, which is a big problem. Faced with this fact, citizens are often forced to dispose of waste in inappropriate places.
- Therefore, in addition to city landfills, there is a large number of unregulated and illegal landfills in Montenegro. The mentioned unregulated and illegal landfills represent large sources of environmental pollution, especially due to the fact that contaminated leachate from landfills, passing through the land, pollutes surface and groundwater.

Proposed measures and recommendations:

- It can be stated that in Montenegro, legal, strategic and planning documents in the field of waste management have been adopted (or are in the process of adoption) and that progress

has been made towards the introduction of a waste management system in accordance with EU regulations.

- The state should make efforts to move from a linear to a circular economy model, in order to conserve natural resources and prevent further degradation of all components of the environment.
- It is important to make additional efforts in order to establish a system of primary waste selection, with the expansion of the scope of households provided with communal services.
- It is necessary to create precise databases that will be continuously updated, and which will contain information on the quantities and morphological composition of municipal waste. Based on such data, it will be possible to precisely dimension capacities and strategically plan waste management at the local and regional level.
- It is necessary to ensure sustainable mechanisms for monitoring and control of the implementation of State and local plans, ie appropriate inspection supervision that will ensure the implementation of activities from local plans, especially when it comes to unsanitary landfills and thus, environmental awareness of citizens.
- The state should solve the issue of certain black environmental points and permanently solve the issue of hazardous industrial waste management.
- The issue of operating costs of the waste management system will be a particular problem. Therefore, it is recommended to define clear and efficient economic instruments for fully systemic achievement of goals in the field of waste management. It is also necessary to consider the possibility of finding sustainable mechanisms for their long-term financing
- The existing capacities of the public administration for the adoption and implementation of waste management plans are one of the significant limiting factors. It is necessary to carefully review the existing and really needed capacities at the local level, in order to clearly define actions and activities in the development and implementation of local waste management plans.
- Strengthening the role and capacity of civil society organizations is one of the prerequisites for achieving goals in the field of waste management and implementation of local plans, as well as the National Plan. In this sense, it is necessary to undertake certain activities in terms of strengthening the capacity of civil society organizations and vocational education of their members. Competent involvement of civil society organizations in activities in the field of waste management (and the environment in general) would significantly contribute to the improvement of waste management, as well as the implementation of waste management plans. In order to strengthen the environmental awareness of citizens, it is proposed to intensify the campaigns of the civil sector in this direction
- It is proposed to reform the existing education system with the aim of introducing disciplines into the education programs within which the contents in the field of environment are studied as compulsory (and not only elective) subjects.

If this is how waste management is organized, we will have small amounts of unusable waste, we will preserve a healthy environment and ensure cheap, economical and rational disposal of solid waste.

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LIST OF ABBREVIATIONS

a.) Boka Kotorska

UNESCO - UNESCO (eng.: United Nations Educational, Scientific and Cultural Organization)

WMO - World Meteorological Organization

NEAS - National Environmental Strategy - Action Plan

MORT - Ministry of Sustainable Development and Tourism

MRF - Material Recovery Facility – a plant for the separation of useful materials from waste for the purpose of further use.

MEIP - Environmental Infrastructure Project in Montenegro

MESTAP - Project for ecologically sensitive tourist areas of Montenegro

PET - PET is a label for polyethylene terephthalate used to produce plastic packaging for a variety of beverages

UO - Waste Management DUP - Detailed urban plan

MONSTAT - Directorate for Statistics Crne Gore

MNE - Republic of Montenegro

PS - Pump station

WWTP - Wastewater treatment plant

SBR - Sequencing Batch Reactor

UWWTD - Urban Waste Water Treatment Directive EC - European Commission

CORINE - Coordination of Information on the Environment WW - Wastewater

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