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THE MINISTRY OF AGRICULTURE AND ENVIRONMENTAL PROTECTION
The Republic Water Directorate

REPORT ON STRATEGIC ENVIRONMENTAL ASSESSMENT OF THE WATER MANAGEMENT STRATEGY IN THE REPUBLIC OF SERBIA

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C O N T E N T S

INTRODUCTORY NOTES

Strategic Environmental Assessment (SEA) is an assessment of the possible impacts that a proposed project and programme may have on the environment, and the specification of measures for prevention, minimization, mitigation, remediation or compensation of adverse effects on the environment and human health. The SEA implementation in planning gives the scope for considering the changes occurring in space, also taking into account the needs of the subject environment. Within the SEA, all activities envisaged in the plan are critically considered from environmental aspects, after which a decision is made on whether to implement the plan and under which conditions, or whether to abandon the planned activities.

Planning implies development, while a strategy for sustainable development requires environmental protection. In this context, the strategic environmental assessment is an unavoidable instrument for achieving the sustainable development objectives.

The SEA integrates socio–economic components with components of biophysical environment, links, analyses and assesses the activities in different spheres of interest, as well as directs policy, plans or programmes towards solutions which are primarily of environmental interest. It is an instrument which helps in integrating the objectives with principles of sustainable development when making decisions about spatial planning, thereby taking into account the need to avoid or limit negative environmental effects on health and socio-economic status of population. The significance of the SEA lies in the fact that it:

- Includes the aspect of sustainable development in addressing the causes of environmental problems in their source;
- Addresses the issues and impacts of wider significance, which do not deal with individual projects, for example – cumulative and synergy effects;
- Helps in checking the suitability of different alternative development concepts;
- Avoids limitations occurring in carrying out an environmental impact assessment for proposed projects;
- Ensures location compatibility of planned solutions from environmental aspects;
- Establishes a context for impact analysis of specific projects, including prior identification of problems and impacts for which more detailed analysis is needed, etc.

In domestic planning practice, the SEA is covered by the Law on Environmental Protection (“Official Gazette of the Republic of Serbia”, Nos. 135/2004, 36/09 and 72/09 – 43/11 – The Constitutional Court, Articles 34 and 35). Pursuant to Art. 35 of this Law, "*Strategic environmental assessment shall be carried out for plans, programmes and principles in the domain of spatial and urban planning or land use, energy, industry, transport, waste management,* ***water resources management*** *and other fields and shall be an integral part of the plan, programme or principle*".

The SEA must be harmonized with other strategic environmental assessments, as well as with plans and programmes for environmental protection. It has to be undertaken in accordance with the procedure prescribed by the Law on Strategic Environmental Impact Assessment (“Official Gazette of the Republic of Serbia”, Nos. 135/2004 and 88/10). For individual projects, environmental impact assessment is carried out pursuant to the Law on Environmental Impact Assessment.

The SEA is undertaken with the aim to ensure environmental protection and enhance sustainable development through integrating the basic principles of environmental protection into procedures for the implementation and adoption of plans. The SEA implies the "preparation of the report on the status of the environment, implementation of consultation procedure, taking into account the report and results of the consultations in decision making procedure and procedure of enactment or adoption of certain plans and programmes, as well as providing of information and data relating to the adopted decisions" (Law on SEA).

Pursuant to Art. 6 of the Law, criteria for identification of possible significant impacts of plans on the environment and for making decisions on undertaking the SEA are shown in Annex I. These criteria are based on: (1) Characteristics of the plan; and (2) Characteristics of environmental impact. The identification of environmental protection problems in the planning area and possible impacts of the plan on basic environmental factors are of special importance in making decision on undertaking and coverage of the SEA together with the implementation of other criteria.

The Report on Strategic Environmental Assessment has been prepared based on the Decision on undertaking a strategic environmental assessment for Water Management Strategy for the Territory of the Republic of Serbia (hereinafter referred to as the "Strategy").

Considering the need to undertake the subject SEA, in the public procurement procedure No. 04/2015, the Ministry of Agriculture and Environmental Protection of the Republic of Serbia – Republic Water Directorate, as a promoter of the SEA, has commissioned the Institute of Architecture and Urban & Spatial Planning of Serbia to undertake the SEA, with which the Ministry signed the Agreement on Undertaking the Strategic Environmental Assessment Report No.: 404-02-121/2015-07 of May 18, 2015 (Ministry) and No.: 558 of May 28, 2015 (Institute) respectively.

In accordance with the Agreement, the obligation of the strategic assessment developer is to carry out a good quality strategic environmental assessment in specified time periods, and in line with the Decision on undertaking a strategic environmental assessment, relevant legislation and Terms of Reference as specified by the Ministry.

1. STARTING POINTS FOR STRATEGIC ENVIRONMENTAL ASSESSMENT

Pursuant to Art. 13 of the Law on Strategic Environmental Impact Assessment, the starting points for the SEA include:

- Brief overview of contents and objectives of the Strategy and relationship of the Strategy to other plans and programmes;
- Overview of environmental quality and the current state of the environment in the area encompassed by the Report;
- Characteristics of the environment in the areas in which it can be exposed to significant impacts;
- Consideration of environmental protection problems in the plan and explanation of reasons why certain issues have been left out from the assessment process;
- Overview of alternative solutions relating to the environmental protection the plan and programme, including the alternative solution for non-implementation of the plan, as well as the most favourable solution from the aspect of environmental protection;
- Results of consultations with authorities and organisations concerned which are important from the aspect of SEA objectives and possible environmental impacts.

This Chapter encompasses all abovementioned points, except for the overview and evaluation of alternative solutions which are given in Chapter 3 of the SEA Report.

1.1. Overview of the subject, contents and objectives of the strategy and relationship to other documents

1.1.1. Subject of the Strategy

Analysis and research for the Water Management Strategy for the Territory of the Republic of Serbia were performed in compliance with the Water Law ("Official Gazette of the Republic of Serbia"', Nos. 30/10 and 93/12) and the relevant by-laws. The Strategy is a comprehensive planning document setting forth long-term directions for the water management in the territory of the Republic of Serbia. Adoption of the Strategy enables the continuity in the long-term planning of the water sector functioning based on the principle of sustainable development, the performance of water activities in their core areas (organisation and utilisation of waters, protection of waters against pollution, organization of watercourses and protection against dangerous effects of waters), as well as institutions and other activities essential for the functioning and development (financing, monitoring, etc.).

The Strategy is a document that will serve as a basis for pursuing reforms of the water sector in order to attain the required standards for the water management, including the organisational adjustment and systemic professional and institutional capacity building at the national, regional and local level. Strategic goals and general objectives specified in this document set the basis for the preparation of the Water Management Plan for the Danube River Basin on the territory of the Republic of Serbia, the water management plans in water areas, as well as for the draft amendments and supplements to the Water Law, including the aspect of funding. At the same time, the framework set by the Strategy must be complied with during the preparation of strategies and plans for spatial organisation, environmental protection and other areas related to waters or affecting them.

The Strategy is adopted for the period of at least ten years. Six years following the adoption, the solutions set forth in the Strategy are reviewed and, if necessary, they are amended and supplemented, and the underlying information is updated. The implementation of the Strategy is monitored by the Ministry, and if the circumstances change significantly, the Strategy is proposed to be re-examined and adjusted before the six-year period elapses. The research for the Strategy is performed in line with the general content stipulated in Art. 30 of the Water Law and it primarily includes the following:

- Assessment of the current state of play in water management,
- Objectives and guidelines for water management,
- Projection of water management development,
- Measures to achieve water management goals.

The Serbian water sector has a remarkable continuity in the strategic planning, surpassing many other sectors. In 2002, Water Management Master Plan in the Republic of Serbia was adopted by the Government Decree. This was the name for the strategic planning document according to the law that was in force at that time. The present Strategy is the continuation of the 2002 document in terms of planning and it represents its logical innovation after almost two decades since the Master Plan was developed, reflecting new organisational, economic and development environment, but also taking into consideration the two decades of hydrological research which enabled a more reliable judgement on available water resources. The present Strategy and its analyses and development projection cover a twenty-year period, more precisely, until 2034. By that time, a significant improvement of the situation in the water sector is expected. Such improvement will be achieved in line with the social and economic possibilities of the country, simultaneously observing the EU standards related to water management.

Considering the assessment of the current situation, it can be inferred that twenty years will not be enough to achieve all standards implemented in EU countries. The highest level of harmonization is expected in the area of water activities related to the utilization of water for human consumption, while in the water protection area, where the gap is the most pronounced, the reaching of standards will take more than twenty years.

The analysed twenty-year period is a very long time span from the perspective of forecasting socio-political, economic, fiscal and other business conditions, and there are no projections at the national level for this period. Macro-economic projections regarding the GDP and investments growth in the Republic of Serbia, which constitute the basis for development planning, cover only a ten-year period. That is why this document provides more details for the activities to be performed in the next ten years, while the other ten-year period contains only general level information.

The Strategy was prepared based on all relevant underlying information, planning documents and legislation, studies, strategic and other document significant for the water management on the territory of the Republic of Serbia, and when there was a lack of valid information and documents, expert assessments were conducted. The processing period is not the same for all analysed parameters and it depends on their character. The last year covered by the analyses is 2012, but the Strategy also includes information of later date, as well as facts relevant for this document.

In the Strategy, the Autonomous Province of Kosovo and Metohija[1] is covered only in the chapters dealing with natural characteristics, i.e. in the areas for which information from the previous period was available.

1.1.2. Contents of the Strategy

The Strategy is developed according to the Terms of Reference and an overall consideration of water sector of the Republic of Serbia. The Strategy comprises the following chapters:

- Natural and socio-economic drivers.
- Current state of play in the water management.
- Concept, goals and guidelines for water management.
- Projection of water management development.
- Functions (measures) for achieving the set water management goals.
- Priority activities in the water sector.

Relationship between the water management and sustainable development is one of the major factors for the strategic development of the water sector in the Republic of Serbia. It is reflected in the sustainable management of the water resources, and in the activities aimed at the protection and utilisation of water, and the protection against harmful effects of waters formulated in the following strategic objectives:

- To provide sufficient quantity of adequate quality water for various user categories, primarily for supplying the population with water, without harming the environment.
- To achieve and maintain a good status and proper environmental potential of surface and underground water bodies, in order to protect the people's health, preserve water and riparian ecosystem and satisfy the needs of water users.
- To decrease the risk of harmful effects of water.
- To improve water regime, i.e. remove the time and space gaps between the available water resources and water requirements, protection of water and protection against water, development of regional and multipurpose hydro systems.
- To finalize the legal reform of the water sector in line with the needs for adjustment with the social conditions and EU requirements, and to introduce the efficient organisation of the water sector.
- To set up a system for sustainable, long-term funding of the water sector based on the principle of self-funding, which involves stable sources of financing, continuous inflow of funds and established mechanisms for their collection.

1.1.3. Objectives for environmental protection, development and planning in the Strategy

The Strategy is a specific planning document setting forth long-term directions for the water management on the territory of the Republic of Serbia, as well as the courses of sustainable actions in the area of organisation and utilisation of waters, protection of waters against pollution, organisation of watercourses and protection against dangerous effects of waters. This implies **integrated management of water resources on the entire territory of the Republic of Serbia**, in compliance with the set basic principles and enabling the possibility of adaptive management. In view of this, and considering the natural characteristics of the

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[1] Kosovo and Metohija is the autonomous province and part of the Republic of Serbia. In accordance with the UN Security Council Resolution 1244 dated 10 June 1990, it is under the interim civil and military administration of UN.

Serbian territory, the spatial and time-related distribution of water resources of Serbia, as well as the mutual interaction between the man and the nature, **the main strategic objective** has been defined **– to achieve integral water management, i.e. a harmonised water regime on the entire territory of the state and ensure such water management that attains maximum economic and social effects in a just and sustainable manner, respecting international agreements.**

In order to attain the main strategic objective, it is necessary to:

- Establish a water management system that is adequate in legal, institutional, financial and every other sense and that would serve as a basis for achieving the strategic objective of the water sector development;
- Understand water resources as factors of the integral social development and provide sufficient quantity of adequate quality water for various user categories, primarily for supplying the population with drinking water;
- Achieve a good environmental and quality status/potential of surface water bodies and good quality and quantity status of underground water bodies;
- Ensure protection against external and internal waters, as well as protection against erosion and flash floods, in order to reduce harmful effects on the health of people, environment, cultural heritage and economic activity.

At the same time, it is necessary to:

- Harmonise different interests of water users and other users of space;
- Improve cooperation with neighbouring and other countries in order to achieve integral water management on the river basins.

Each individual area of the water sector has its own strategic goals, which must be in line with the main objective and their achievement requires numerous different activities and measures. Some of these measures can be implemented individually within the framework of the water sector, while others can only be performed through the cooperation with other national institutions, local governments and the economy sector.

Water Management Strategy spans the period until 2034, but it is clear that the main strategic objectives, as well as objectives of separate areas of water activity cannot be fully achieved until the said year due to the fact that the volume of funds required for their achievement is larger than the society's economic power. The achievement of the long-term objective will only be possible if efficient organisation of the water sector is introduced accompanied by the institutional support, and the system for sustainable, long-term funding is established including the stable sources of financing, continuous inflow of funds and adequate mechanisms for collection, striving to achieve the principle of self-funding of the water sector as one of the long-term goals. In addition, it must be taken into consideration that Serbia is one of the countries going through the process of EU accession, that it belongs to the region of UNESCE countries and that the biggest portion of its territory is on the Danube basin, where relevant countries established multilateral coordination and cooperation regarding water management, which is why the activities in this area must be conducted in compliance with the internationally acknowledged principles and through international cooperation on the watercourses of mutual significance. This is why, when starting points and individual objectives were identified, in addition to the need for organising the water sector in the Republic of Serbia, attention was paid to internationally acknowledged principles in the water area, and primarily those set forth by the European Union.

1.1.4. Relationship to other documents – strategies, plans and programmes

Strategic, planning and legislation documents that form the basis for water management in the Republic of Serbia are defined in the Water Law. Mutual harmonization of these and other strategic and planning documents that are passed at the national level and include the aspect of water is necessary and it refers to the following:

- *Spatial Plan of the Republic of Serbia from 2010 to 2020* ("Official Gazette of the Republic of Serbia" No. 88/2010) which sets forth the long-term foundations for organizing, utilization and protection of the Republic of Serbia space. The part dealing with water resources particularly highlights the importance of their sustainable and closely monitored usage, alignment of water system development with other users of space (given the fact that water systems and surface pits impose the strictest requirements for the space that is needed for their development), protection of waters as the most vital resource against pollution, implementation of optimal systems of protection against waters within the planned organization of space and basins, prevention of inadequate unplanned usage of water and space needed for the development of hydro-technical systems, well-adjusted integration of water economy infrastructure in the ecological and social environment, as well as prevention of wrong moves regarding economy and development – the biggest threat being the water privatization. Big water basins (the Danube, the Sava and the Tisza) are given multifunctional role, surface waters should have a special importance for supply of arid and waterless areas, underground waters as public property must be kept under special control, while other rivers, lakes, marshes and ponds should be protected and used in compliance with international standards applicable to such vital elements of environment.
- *National Sustainable Development Strategy* (for the period 2009–2017), which promotes the principles of integrating the environmental issues in other sector strategies and inclusion of environment related costs in pricing of products ("user pays" and "polluter pays". Sustainable development in the water sector implies optimal water management, followed by preservation and improvement of the water quality and its rational utilisation.
- *National Strategy for the Serbian Agriculture Development* ("Official Gazette of the Republic of Serbia", No. 78/05), which finds that the improvement of the situation in the water sector calls for the sustainable water management policy, recovery of economy, European integration and setting up of the water system that is compatible with the EU requirements[2].
- *The National Programme for Environmental Protection* is "a tool for rational solving of priority issues in the area of the national environmental protection" and covers the period until 2019. For the water sector, the estimated funds allocated for the implementation of this Programme in the period 2010–2019 amount to approximately EUR 860 million.
- The National Strategy for Sustainable Use of Natural Resources and Goods ("Official Gazette of the Republic of Serbia", No. 33/12) is to ensure, together Spatial Plan of the Republic of Serbia, strategic planning of sustainable usage and protection of property and resources in the Republic of Serbia.
- *Water Management Master Plan of the Republic of Serbia* ("Official Gazette of the Republic of Serbia", No. 11/2002) which was, until the Water Management Strategy

[2] Draft Strategy of Water Management and Rural Development 2014–2024 is currently on public discussion.

for the territory of the Republic of Serbia was passed, a key document for setting forth the basic strategy for usage of water, water protection and protection against waters on the entire Serbian territory for the period 2021. The underlying principle defined in the Water Management Master Plan is that administration and management must be uniform on the whole territory of the Republic of Serbia (postulate: from the functional and management perspective, Serbia is a single water management space) as well as rational utilisation and protection of all resources and potential in the framework of integrated organisation.

In addition to the listed documents, other regional and local level documents must be observed during the preparation of the planning and investment documentation in the area of water management. Such documentation might have effect on the water management or it can cover certain water-related issues.

Forms of International Cooperation

International cooperation with neighbouring countries and a wider international community, which is necessary and extremely significant for the water sector, is regulated by international contracts, conventions and agreements that are, or must become an integral part of the regulatory framework for the water management on the territory of Serbia. The most important documents underpinning the cooperation in the water sector are listed below.

Cooperation in the region of UNECE countries is based on the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), which represents a binding framework for the protection of international surface and underground waters through prevention, control and environmentally acceptable water management. It has been ratified by a special law[3].

International Cooperation on the Danube Basin is based on the Convention on Cooperation for the Protection and Sustainable Use of the River Danube (Sofia, 1994) whose adoption on the territory of the Republic of Serbia is regulated by a special law[4]. Signatory countries are obligated to strive to sustainable and equitable water management, including protection, improvement and sound utilisation of surface waters and groundwater. The implementation of the Convention is under the jurisdiction of the International Commission for the Protection of the Danube River[5] (ICPDR) with headquarters in Vienna, and Serbia is a full-fledged member since 2003. Under ICPDR, and in accordance with the Memorandum of Understanding signed in Vienna in 2004[6], international cooperation is implemented on the Tisza basin, as well.

International Cooperation for the Water Management on the Sava Basin has been established following the signing of the Framework Agreement of the Sava River Basin (Kranjska Gora, 2002) and its ratification through a separate law[7]. International commission for the Sava basin

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[3] Law on Ratification of Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the Amendment to Articles 25 and 26 of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes ("Official Gazette of RS" – International Agreements, no.1/2010)

[4] Law on Ratification of Convention on Cooperation for the Protection and Sustainable Use of the River Danube ("Official Gazette of SRY - International Agreements, No. 2/2003)

[5] International Commission for the Protection of the Danube River – ICPDR (http://www.icpdr.org/)

[6] Towards a River Basin Management Plan for the Tisza river supporting sustainable development of the region - Memorandum of Understanding (www.icpdr.org/icpdr-files/8200)

[7] Law on Ratification of the Framework Agreement of the Sava River Basin - International Agreements, No. 12/04)

was set up in 2003, while in 2006 the Secretariat was established in Zagreb. A special Protocol on Protection Against Floods to be annexed to the Framework Agreement, RS Official Gazette – international contracts 16/2014, will regulate the cooperation aimed ad prevention and/or minimization of risks of floods by undertaking certain measures and activities. The issues related to navigation on the Sava international waterway are governed by a special Protocol ratified under the law concerning the Framework Agreement on the Sava basin.

Navigation on the Danube, the river with international waterway status, is conducted in compliance with the Belgrade Convention Regarding the Regime of Navigation on the Danube[8], which also forms the framework for the navigation management between 11 EU members that are situation the basin of this river. The Convention is aimed at strengthening the economic relations in the region and underlines the need for maintaining the navigation on the entire river Danube. Implementation of this Convention is coordinated by the Danube Commission headquartered in Budapest.

The current status of *bilateral cooperation* in the water sector is not satisfactory, neither in terms of quality, nor in terms of scope. The only active bilateral commissions are the one with Romania[9] and Hungary[10] established based on agreements dating back from 1955. Cooperation with Bulgaria has been suspended since 1982. To date, the cooperation with neighbouring countries in the territory of the former SFRY (Croatia, Bosnia and Herzegovina, Montenegro and Macedonia) has not been regulated.

EU Directives Governing the Water Sector

EU water legislation is of great importance not only for member states, but for all other countries intending to cooperate with them or become a member of the Union.

The single most significant act is the *EU Water Framework Directive*[11] which represents a strategic but also an operational framework for the achievement of key objectives of the EU water policy: comprehensive protection of all waters, considering the natural interaction among them both with respect to quality and quantity, by applying the principle of integrated water resources management. The concept of integration of all relevant segments in the water sector is the key for attaining the proclaimed goals. The most important positions stated in the Directive are as follows: planning and managing water resources on the basin level, harmonisation of objectives regarding water resources management and environment, integrated management of river basins and setting up competent services for water management on the level of great hydrographical areas, imposing strict requirements for the emission of polluting materials and setting high standards for assessing the water quality in watercourses; economic policy that enables self-funding of the water sector through adequate collection of water and all water-related services; realistic, economic price of water

[8] Adopted at the International Conference in Belgrade, in August 1948, published in the "Official Gazette of FNRY", no. 4/1949

[9] The Agreement between the Government of the Federal People's Republic of Yugoslavia and the Government of People's Republic of Romania concerning the Hydrotechnical Issues on Hydrotechnical Systems and Watercourses at the Border or Crossing the State Border ("Official Gazette of FNRY" – International Agreements", no. 8/56)

[10] Agreement between Federal People's Republic of Yugoslavia and People's Republic of Hungary on Water Management Issues ("Official Gazette of FNRY"– „International Agreements", no 15/56)

[11] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

accompanied by strict observance of the principle – user pays, polluter pays, complete reimbursement of all underlying costs as well as costs related to water protection, and necessary environmental protection. All these Directive principles are significant for the Serbian water sector strategy particularly the section regarding the water sector self-funding policy on the basis of realistic prices of water and water related services (water as an economic category), and inclusion in the prices of all costs incurred for the water protection. Also important is a very precise provision on setting up management bodies on the level of great basins as well as inclusion of the public, especially the users, in the management process, in order to change the public from being a passive subject that is always poorly informed and resistant to the proposed actions in the water area, but becomes an active participant in the management process which understands the reasons behind certain measures regarding water and observes the whole structure of all costs related to research, planning, construction, maintenance and protection that must be incorporated in the pricing of water and water related services.

Following the adoption of the Water Framework Directive, water resources on the EU territory have become the focus of the entire Union, imposing the obligation for every member state to harmonise the legislative, technical and economic approach to water management and ensure a coherent water management strategy. This obligation applies to prospective EU members, as well.

WFD is an “umbrella” directive that incorporates and links other significant directives directly or indirectly dealing with water, the most important being:

- *Directive 91/271/EEC concerning urban waste water treatment,* which sets forth the obligation to treat utility waste water for all agglomerations above 2.000 EC;
- *Directive 91/676/EEC on the protection of waters against pollution caused by nitrates from agricultural sources*, which identifies vulnerable areas exposed to nitrates caused pollution and promotes rules of good water management practice;
- *Directive 75/440/ECC on the quality required of surface water intended for the abstraction of drinking water*, which deals with quality requirements for the water used or intended for abstraction of drinking water;
- *Directive 98/83/EC on the quality of water intended for human consumption*, setting standards for the quality and control of water intended for human consumption (water delivered to the public water supply systems, water used in food processing industry);
- *Directive 2006/7/EC of the European parliament and of the Council concerning the management of bathing water quality and repealing Directive 76/160/EC*, setting standards for the quality and monitoring of the water used for bathing and recreation;
- *Directive 2006/11/EC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community*, listing dangerous substances whose leakage in the natural receptions is limited or prohibited, as well as setting forth monitoring measures;
- *Directive 2006/118/EC on the protection of groundwater against pollution and deterioration,* aimed at preventing deterioration of underground waters through special measures of pollution prevention and control;
- *Directive 2008/1/EC concerning integrated pollution prevention and control*), which stipulates that industrial plants with high potential of pollution must obtain permits only if environmental protection requirements are met;
- *Directive 2008/105/EC on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC,*

83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council, whose aim is to establish environmental quality standards regarding the presence of certain polluting substances identified as priority based on the level of environmental risk;

- *Directive 2009/90/EC laying down pursuant to Directive 2009/60/EC of the European Parliament and of the Council, technical specifications for chemical analysis and monitoring of water status*, setting forth minimum requirements for their implementation during monitoring, as well as identifying rules to prove the quality of analysis results;
- *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*, aimed at establishing the framework for the assessment and management of flood risks in order to reduce their negative impact on people, environment and economy. This Directive is particularly significant for Serbia where disturbing instances of uncontrolled seizure of water land and floodplains are taking place and potential harmful effects are constantly on the rise. The starting point of the Directive is: floods cannot be prevented, but with good planning aimed at avoiding the increase of human settlements and construction of other buildings in floodplains can lead to avoidance of the constant rise of potential damage. Therefore, member states are required to provide for the establishing of flood hazard maps and flood risk maps and include them in all spatial and regulation plans. This would result in avoiding the present unsustainable situation of intensive invasion of floodplains by buildings and accelerated increase of potential adverse effects. Key requirements: preparation of flood hazard maps and flood risk maps (combination of flood probability and assessment of potential harmful consequences) and usage of this data for planning of space utilisation and organisation; preservation of inundation zones and retention areas that might alleviate the flood tides; preparation of extreme events scenarios (likely return period ≥ 100 years). Floodplains must be incorporated in the Flood Risk Management Plans as well as spatial planning documents at all levels, as a restriction for construction of buildings jeopardised or damaged by floods.

Obligations stemming from EU Directives and international cooperation

In the framework of the EU integration process, and in order to fulfil its obligations specified in the accepted international conventions and agreements, Serbia has started the transposition of the EU directives that are significant for the water and environmental protection sectors. The Water Law from 2010 and the related secondary legislation now include or will be amended to include provisions from the FWD and Floods Directive, as well as provisions from other directives affecting waters, to the extent possible, given the socio-economic situation in the Republic of Serbia. EU legislation is planned to be fully transposed in the Serbian law by 2018.

Serbia participated in international activities on the river basins of the Danube, the Sava and the Tisza. The yearlong implementation of the FWD by ICPDR resulted in the adoption of the Danube River Basin Management Plan in 2009[12], followed by the adoption of the Tisza Basin Management Plan in 2011. Implementation of the Floods Directive is underway which should lead to the adoption of the Flood Risk Management Plan for the Danube River Basin by 2015. The Sava Basin Management Plan is completed and it was adopted on the Fifth Meeting of the Parties to the Sava Basin Framework Agreement (December 2014). Each of the said plans

[12] Danube River Basin Management Plan (http://www.icpdr.org/icpdr-pages/danube_rbm_plan_ready.htm)

includes the common programme of measures to be implemented with the aim to improve the basin environment conditions.

Bilateral cooperation is particularly important for Serbia due to the fact that large part of major watercourse basins (except the Great Morava) is outside of its territory. For that reason, draft agreements with neighbouring countries have been prepared, initiatives and negotiations have been launched for establishing bilateral cooperation that will, inter alia, be based on the common implementation of the FWD and Floods Directive on cross-border waters.

1.2 Overview of environmental quality and the current state of the environment [13]

In the course of preparation of the Strategic Environmental Impact Assessment it is necessary to make an overview of the current state and quality of the environment in the area covered by the Assessment since the characteristics of the current state of the environment are a basis for investigating and evaluating environmental problems in an area. Environmental quality is considered one of the basic criteria for a balanced and sustainable development in the Republic of Serbia. For the needs of this investigation, basic characteristics of the current status are defined based upon the existing strategic documents, environment reports, environmental studies, as well as other available professional and scientific literature.

1.2.1. Natural characteristics

1.2.1.1. Climate and meteorological characteristics

Climate and meteorological characteristics in Serbia are defined by the geographical position and relief. Serbia is located in the south of a moderate geographical area and is affected by air currents coming from different directions causing a diverse climate which is often shaped by the local physical and geographical factors. Based on the research conducted so far, there are three major climate categories in Serbia. Each climate area has separate sub-areas. The first climate area covers Vojvodina and the peri-Panonnian land, Pomoravlje and Eastern Serbia up to Nišava. The biggest part of this climate area is characterised as the **continental** climate. The southern border is linked to the course of the Nišava river and West Morava up to Drina (north-west from Užice). In other parts of the climate area, marked as **A**, the border coincides with the administrative border between Serbia and Bosnia, Croatia, Hungary, Romania and Bulgaria. As part of this area, there are two distinct lowland sub-areas (Vojvodina, peri-Pannonian land, Pomoravlje A-1 and Negotinska Krajina A-1-b) and three mountain sub-areas (Valjevo hinterland and southern Šumadija A-2-a, mountains from the Danube to Niš A-2-b and at the far east Stara Planina and Svrljig mountains A-2-v).

The second climate area, marked as **B,** is located south from the previously described area, stretching provisionally to the border with Metohija. Owing to the inability to precisely define the climate types in valleys and ravines (B-1) it was not possible to perform a detailed regionalisation of this area. Separation of sections with lower altitude would result in scattering of parts with poor network of observation posts. The number of separate sub-areas would exceed the other two areas and insisting on the individuality of each sub-area would require the application of indicators that could hardly be applied to other areas. Since it is not

[13] For the analysis and presentation of the environmental quality data, the following data have been used: data received from the Agency for Environmental Protection; documentary basis of the Spatial Plan of the Republic of Serbia; Environment Situation Analysis in the Strategy for the Water Management and other available documentation from the spatial plans and studies concerning areas with the most important water object.

possible to precisely define the separate altitude zones, this area has the biggest challenges when it comes to determining the climate types. The examination of correlation between high mountain stations and the stations located in the foot of the mountains showed that the temperature regimes on different mountain belts mostly have independent patterns. The most practical solution would be to determine altitude belts that would be given certain temperature ranges according to the sloping and exposed mountain sides. It can be noted that among the defined climate areas, the largest portion of land under woods is in this B Area. There are sections under woods spanning tens and hundreds of square kilometres and as such they are a significant factor for the establishment of climate features. The largest part of the B Area would be categorised as **moderately continental** climate. Separate sub-areas belonging to this area are Pešter Plateau (B-3-a) and Kosovo (B-3-b).

The third climate area, **C** Area approximately coincides with the regional-geographical border between Kosovo and Metohija. In the north-east direction, the lower hilly area of Drenice enables the dominant **maritime** air movements in the part of north Kosovo as well. In the south-east direction, down the Prizrenska Bistrica valley continental influence is stronger. Separate section in this area is the Metohija ravine (C-1-a), while mountains Šara (C-2-a) and Prokletije (C-2-b), as sub-areas, are marked as separate territorial units.

Air Temperature

In the north of Serbia mean annual air temperatures range from 10.8°C to 11.5°C, while in the lower parts of central and south Serbia they range from 10°C to 12.1°C. Hills and mountain regions have lower temperatures. Mean annual air temperatures drop as the altitudes rise, with the vertical gradient of –0.6°C/100 m. The following lowest air temperatures have been recorded in meteorological stations across Serbia: Sjenica –38.0°C, Negotin –33.2°C, Smederevska Palanka i Vršac –32.6°C, Kraljevo –31.7°C, Vlasina –31.2°C, Jaša Tomić –31.0°C, Žagubica –30.8°C, Požega and Rimski Šančevi –30.7°C, Leskovac –30.5°C, Babušnica, Kruševac and Šabac –30.0°C etc. Absolute maximum air temperatures have been registered in the following meteorological stations: Jagodina 43.0°C, Ćuprija, Prokuplje and Zaječar 42.7°C, Niš and Vlasotince 42.5°C, Kruševac 42.4°C, Smederevska Palanka 42.1°C, Dimitrovgrad, Knjaževac, Leskovac and Negotin 42°C etc.

Precipitation

Precipitation regime is very heterogeneous depending on the area. Annual precipitation volume ranges from 500 mm in the north to over 1.000 mm in mountain regions, while the average precipitation volume in Serbia equals approximately 730 mm/y. The precipitation below 800 mm is recorded in all lower areas, while annual precipitation values rise with the rise of the altitude, with the vertical gradient of 25 mm/100 m to 40 mm/100 m. There is a general downward volume trend from west to east. The lowest annual values are registered in sub-basins of the rivers South and Great Morava, as well as in Vojvodina. On almost the entire territory of the Danube basin in Serbia, the highest precipitation is seen in the period May–July, and the lowest during January–March.

It can generally be observed that the month with the greatest volume of precipitation is June, and the lowest values are seen in February and March. In addition to average monthly and annual precipitation values, also significant are the extreme daily or annual quantities of precipitation, which have been registered on the following stations:

- Absolute maximum daily quantities: Rakov Dol 220 mm, Negotin 211.1 mm, Vršac 189.7 mm, Lazarevac 173.6 mm, Vajska 162.4 mm, Jabukovac 162.3 mm;
- maximum annual quantities: Krnjača 1,884.7 mm, Pleš 1,641.5 mm, Brežđe 1,585.1 mm, Lukovo 1,569.5 mm, Poćuta 1,506.5 mm;
- minimum annual quantities: Kikinda 642.2 mm, Sremska Mitrovica 761.1 mm, Sombor 780.8 mm, Zrenjanin 799.5 mm.

1.2.1.2. Hydrographical network and hydro geological characteristics

Serbia possesses significant aggregate water resources. It is a result of its natural conditions dominated by mainly hilly and mountain relief, a predominantly waterproof geological base and sizeable quantities of precipitation. Resources include underground and surface water. However, these resources are characterised by space and time inequality and their quality is increasingly under threat.

Territory of the Republic of Serbia is a single water management space comprising parts of the Black Sea basin (rivers of the Danube basin), Aegean Sea (the Lepenac, the Pčinja i the Dragovištica) and Adriatic Sea (the Drim and the Plavska River), as well as parts of basins and sub-basins belonging to them.

The largest part of the Serbian territory belongs to the *Black Sea basin* (app 92.5%). Basin's average altitude is 470m; the highest point in the Black Sea basin is the top of the mountain Hajla 2,400m, at the wellspring of the river Ibar, while the lowest point is at the confluence of the river Timok – only 30m, which is also the lowest point in Serbia. Black Sea basin encompasses the longest rivers in Serbia: the Dunav, the Tisza, the Sava, the Great Morava, the Mlava, the Pek, the Porečka River and the Timok, with their numerous tributaries. Approximately 176 billion m^3 of water flows toward the Black Sea per year. The river Danube, with the basin surface of around 801,463km^2 and median flow at the mouth at the Black Sea of approximately 6,500m^3/s, is 24th biggest river in the world, and second biggest in Europe. It arrives to Serbia from Hungary, and exits after the confluence of the Timok, at the junction of three borders with Romania and Bulgaria. On the Serbian territory, several significant tributaries flow into the Danube: the Tisza, the Sava and the Great Morava, as well as many other smaller rivers.

- The largest left tributary of the Danube is the Tisza (basin surface around 157,186km^2, u in Serbia approximately 10,856km^2), which is at the same time the biggest Danube tributary considering the total basin surface. It enters Serbia from Hungary, at Banat village Đale, entering the Danube at Slankamen. Another large left tributaries of the Danube are the Tamiš, the DTD channel and the Nera. The largest Tisza tributary in Vojvodina is the Begej.
- The Sava is the longest right tributary of the Danube (considering the length and water-richness), entering the Danube at Belgrade. The surface of its basin area is approximately 97,713km^2 (in Serbia around 15,147km^2). Through Serbia, the Sava has many important tributaries: the Drina, the Bosut and the Kolubara.
- The largest Sava tributary is the Drina river, with total basin surface of approximately 20,320km^2, whose 220km – long section forms the border between Bosnia and Herzegovina and Serbia. It enters the Sava at the village Crna Bara in Serbia.
- The Lim is the largest right tributary of the river Drina. It enters Serbia from Montenegro at the town Bijelo Polje, and exits at Priboj, flowing to Bosnia and Herzegovina and entering the river Driva from its territory.

- An important furthest downstream tributary of the Sava river is the Kolubara, which is formed by the Obnica and the Jablanica rivers upstream from Valjevo, and enters the Sava near Obrenovac.
- The second-largest right tributary of the Danube river in Serbia is the Great Morava (app. 38,207km^2), whose biggest part of the basin is located in Serbia, while some parts are in Montenegro and Bulgaria. Downstream from the point where the South Morava (basin surface around 15,696km^2) joins the West Morava (basin surface around 15.754km^2) near Stalać, the Great Morava receives tributaries: the Lugomir, the Lepenica, the Jasenica, the Resava and the Jezava.
- The South Morava is formed by the Binačka Morava and the Moravica, near the town of Bujanovac. The most important tributary of the South Morava is the Nišava, which enters from the neighbouring Bulgaria. Upstream from the Nišava, the South Morava receives the following tributaries: the Veternica, the Jablanica, the Pusta River and the Toplica.
- The West Morava is formed by the Moravica and the Đetinja. The most important tributaries of the West Morava are the Ibar, the Rasina and the Čemernica.
- The Greater Danube tributaries downstream from the Great Morava are: the Mlava, the Pek, the Porečka River and,the most important, the Timok. The Timok is formed by the White Timok and the Black Timok near Zejačar and flows from the village of Bregovo until its confluence into the Danube (approximate length of 15.5km), it is a border river between Serbia and Bulgaria.

South border of the Black Sea basin is composed of the dividing ridge towards the Aegean Sea and the Adriatic Sea basins. The section of Aegean Sea basin located in the territory of Serbia is a part of the Vardar basin (the Pčinja, the Lepenac) and Struma (the Dragovištica), while the part of Adriatic Sea basin situated in Serbia is the Drim basin (the Beli Drim, the Plavska River).

Adriatic Sea basin stretches across 5.3% of the Serbian area. It encompasses Metohijska ravine with its mounting rim, where the hydrographical system of the White Drim developed. All its tributaries, except the Plavska River, flow entirely through Serbia. From the Serbian territory, the rivers White Drim (basin area in the territory of Serbia 4,283km^2) and the Plavska River (basin area in the territory of Serbia 399km^2) flow towards Aegean Sea. Plavska River flows down the western slopes of the Šara mountain and arrives to Albania. The most significant right tributaries of the White Drim are: the Pećka Bistrica, the Dečanska Bistrica and the Erenik, while the left tributaries are the Klina and the Prizrenska Bistrica. Average altitude of this basin is 820m. Approximately 2 billion m^3 of water flows toward Adriatic Sea basin a year.

Aegean Sea basin covers 2.2% of the Serbian territory (1,926km^2). It includes the rivers Lepenac and Pčinja, left tributaries of the river Vardar, and the Dragovištica, the right tributary of the river Struma. Three rivers belong to the Aegean Sea basin and their total basin area in the territory of Serbia is less than 2,000km^2: the Lepenac (app. 681km^2), left tributary of the Vardar, the Pčinja (app. 516km^2), which also flows to Macedonia and the Dragovištica (basin area in Serbia 691km^2), which flows into the river Struma in Bulgaria. Average altitude of this basin is 825m. Aegean Sea basin receives approximately 0.5m^3 of water a year.

Table 2.1. Minimum annual flows, average multi-annual and maximum annual flows

No.	River	Hydrological station	F (km^2)	$Q_{95\%}$ (m^3/s)	$Q_{sr\ god}$ (m^3/s)	$Q_{1\%}$ (m^3/s)
1.	Drina	Bajina Bašta	14,797	53.50	331.00	6,594
2.	Lim	Brodarevo	2,762	10.70	71.90	1,047
3.	Lim	Prijepolje	3,160	12.00	77.50	1,167
4.	Danube	Bezdan	210,250	952.00	2,268.0	8,356
5.	Danube	Bogojevo	251,593	1,257.00	2,777.0	9,275
6.	Danube	Smederevo	525,820	1,976.00	5,264.0	15,323
7.	Tisza	Senta	141,715	135.00	802.00	4,222
8.	Sava	S. Mitrovica	87,966	273.00	1,535.0	6,706
9.	Ibar	Raška	6,268	5.41	40.73	1,171
10.	Ibar	Ušće	6,883	7.72	46.58	1,260
11.	Ibar	Lopatnica Lakat	7,818	10.50	56.72	1,368
12.	Studenica	Ušće	540	1.74	7.11	229
13.	Lopatnica	Bogutovac	155	0.16	1.94	128
14.	South Morava	Mojsinje	15,390	11.30	93.52	2,131
15.	South Morava	Korvingrad	9,396	4.72	56.11	1,903
16.	South Morava	Grdelica	3,782	1.78	24.68	687
17.	South Morava	Vladičin Han	3,242	1.14	18.82	657
18.	Lužnica	Svođe	318	0.34	2.75	298
19.	Vlasina	Svođe	350	0.78	3.75	331
20.	Vlasina	Vlasotince	879	1.40	7.84	680
21.	South Morava	Vranjski Priboj	2,775	0.60	12.89	709
22.	Gradac	Degurić	159	0.35	2.77	189
23.	Jablanica	Sedlare	140	0.06	1.52	220
24.	Obnica	Belo Polje	185	0.04	1.75	210
25.	Kolubara	Valjevo	340	0.18	3.57	295
26.	Ribnica	Paštrić /Mionica	104	0.05	1.23	473
27.	Ljig	Bogovađa	679	0.12	4.43	270
28.	Kolubara	Beli Brod	1,896	1.28	15.78	621
29.	Visočica	Visočka Ržana	139	0.36	5.44	244
30.	Nišava	Niš	3,870	3.98	28.89	946
31.	Kutinska	Radikina Bara	205	0.09	1.29	150
32.	Visočica	Brajićevci	227	0.00	1.62	169
33.	Trgoviški Timok	G. Kamenica/ /Štrbac/ D. Kamenica	331	0.21	3.23	218
34.	White Timok	Knjaževac	1,242	0.51	7.93	383
35.	White Timok	Vratarnica	1,771	0.58	9.74	406
36.	Black Timok	Zaječar/Gamzigrad	1,199	0.56	10.75	402
37.	Toplica	Pepeljevac	986	0.55	7.10	478
38.	Toplica	Doljevac	2,083	0.81	10.34	721
39.	Kosanica	Visoka	370	0.06	2.14	302
40.	Toplica	Prokuplje	1,774	0.67	9.65	663
41.	Great Morava	Varvarin	31,548	29.20	206.50	3,040
42.	Great Morava	Bagrdan	33,446	31.50	217.90	3,079
43.	Great Morava	Ljubičevski Most	37,320	34.80	233.90	2,738
44.	Lugomir	Jagodina /Majur	427	0.05	1.78	440
45.	Resava	Manastir Manasija	388	0.36	3.66	356
46.	Jasenica	Donja Šatornja	83,60	0.04	0.62	181
47.	West Morava	Gugaljski most/ Kratovska Stena	2,688	3.70	31.77	820
48.	West Morava	Kraljevo/ Miločaj	4,658	4.58	43.00	1,234
49.	West Morava	Jasika	14,721	16.40	105.30	1,844

No.	River	Hydrological station	F (km^2)	$Q_{95\%}$ (m^3/s)	$Q_{sr\ god}$ (m^3/s)	$Q_{1\%}$ (m^3/s)
50.	Đetinja	Stapari		0.44	3.48	320
51.	Moravica	Ivanjica	475	0.66	6.65	311
52.	Moravica	Arilje	831	1.38	10.52	436
53.	Rzav	Arilje		0.92	7.91	306
54.	Skrapež	Požega	630	0.40	4.97	556
55.	Rasina	Brus	213	0.23	2.40	169
56.	Rasina	Bivolje	958	0.71	7.62	430
57.	West Morava	Trstenik	13,902	15.40	103.50	1,784
58.	Dičina	Brđani	208	0.10	1.55	238

South, south-west and western parts of Serbia are richer in water than its central and eastern parts. Given that the mountain areas receive larger quantities of precipitation, these terrains produce specific flows above 15 $L/s\cdot km^2$. In plain and hilly areas, in the northern and central parts of Serbia specific outflow is mostly below 6 $L/s\cdot km^2$. The lowest quantity is registered in Vojvodina and in the basins of left tributaries of the Great Morava and the Kolubara (from 2 to 5 $L/s\cdot km^2$). The richest basins in the Serbian territory are the basins of the Bistrica, the Gradac, the Lopatnica and the Studenica, where the values range from 15 to 17 $L/s\cdot km^2$.

Table 2.2. Total water quantities in the territory of Serbia, broken down by basins (Aegean, Adriatic and Black Sea)

Watercourse / basin	From other areas			From the territory of Serbia			Total	
	Average (m^3/s)	Annual flow (10^6 m^3/y)	Inflows from	Average (m^3/s)	Annual flow (10^6 m^3/y)	Outflows to	m^3/s	10^6 m^3/y
Aegean basin								
Lepenac				8.92	281	Mac	8.92	281
Pčinja				3.29	104	Mac	3.29	104
Dragovištica				4.89	154	Bulg	4.89	154
Total Aegean basin							17.1	539
Adriatic basin								
White Drim and Plavska reka				62.79	1,978	Alb	62.8	1,978
Total Adriatic basin							62.8	1,978
Black Sea basin								
Danube with Drava	2,77	87,575	Hung and Cro				2,7	87,575
Tisza with Begej*	825	26,001	Hung and Rum	17.92	564		842	26.565
Chanel Baja-Bezdan* and Plazović stream*	2.00	63	Hungary				2.0	63
Tamiš	39	1,224	Romania	3.40	107		41.8	1,331
Brzavica, Moravica, Karaš, Nera	35	1,104	Romania	5.16	163		40.1	1,267
Sava before Drina	1.13	35,762	Croatia				1.13	35.762
Lim in Serbia				36.34	1,145		36.3	1,145
Drina in Serbia				26.24	826		26.2	826
Drina with Lim	302	9,523	MNG and BiH	62.58	1,971		364	11,494
Kolubara				21.40	674		21.4	674

Watercourse / basin	From other areas			From the territory of Serbia			Total	
	Average m^3/s	Annual flow 10^6 m^3/y	Inflows from	Average m^3/s	Annual flow 10^6 m^3/y	Outflows to	m^3/s	10^6 m^3/y
Sava basin				14.81	467		14,8	467
Sava before confluence	1.43			98.79	3,112		1,535	3,112
Nišava	5.02		Bulgaria	22.83	719		27.8	719
South Morava basin				66.81	2,105		71.8	2,105
Ibar				51.94	1,636		51.9	1,636
West Morava				57.18	1,801		57.1	1,801
Great Morava basin				22.55	710		27.5	872
Danube basin				43.29	1,364		43.2	1,364
Timok				27.90	879		27.9	879
Danube after Timok	5.11			417.76	13,159		5.53	174.57
Total Black Sea basin							5.53	174.57
TOTAL	**5.11**	**16,.415**		**497.65**	**15,676**		**5,617**	**177.09**

* Approximately – Taken from the Water Management Master Plan of Serbia, in the Strategy such analysis is not specified.

There is a vast space-related diversity in the river outflow from the territory of Serbia. On average, specific richness of all basins in Serbia equals 5.63 $L/s \cdot km^2$. the lowest values are seen in Vojvodina (1.48$L/s \cdot km^2$), the highest in Kosovo and Metohija (9.21$L/s \cdot km^2$), while in central Serbia it stands at 6.53$L/s \cdot km^2$.

Underground waters are extremely important Serbian natural resources as they greatly affect the water supply of settlements and the industry. In addition, they are utilised in agriculture, while thermo-mineral waters are also used in medicine and tourism. Territory of Serbia is characterised by a complex combination of tectonic structures and a diverse lithological composition. There are several geo-tectonic sections with distinct geological, geo-morphological and hydrological features. Therefore, they are also different in the hydro-geological sense as well. Geological composition of the territory of Serbia is characterised by extreme complexity, both in terms of litho-facial and tectonic features.

The terrain composition includes igneous, sedimentary and metamorphic rocks created since Precambrian to the Holocene epoch. Complexity of the geological structure and composition is reflected to the diversity of hydro geological characteristics of the Serbian territory. In such a complex area, several different segments can be identified with specific geological composition and hydro geological features. Therefore, the following hydro-geological units are identified: Bačka and Banat area; Srem, Mačva and Posavo-Tamnava area; south-west Serbia; western Serbia; central Serbia; and eastern Serbia.

Underground water bodies represent basic units for groundwater resource management, status monitoring and implementation of measures aimed at ensuring good status of underground waters.

There are total of 153 underground water bodies in the Republic of Serbia, of which 152 belong to the Danube (Black Sea) basin, and one belongs to the Aegean basin. The size of individual water bodies ranges from 35km^2 to 2,643km^2. Out of the total number of these water bodies, 131 are national, while 22 are identified as cross-border.

1.2.1.3. Pedological properties

Soil properties depend on a large number of natural factors, such as physical-chemical properties, geological subsoil, hydrogeological and hydrographical conditions, orography, climate, vegetation, presence of macro and microorganisms. Soil formation, including its regeneration, is an extremely slow process, so the soil may be regarded as a partly renewable resource. The general classification of the soil in Serbia is based on the character of its natural soil moisture, i.e. on hydro-physical soil properties, which is not only an appropriate, but a goal-oriented approach in regulating water regime from the aspect of implementation of hydro and agro-ameliorative measures, as well as with respect to the assessment of the soil's irrigation capacity. Soil in the territory of the Republic of Serbia can be classified into three large categories (the said areas do not encompass the territory of the autonomous province of Kosovo and Metohija):

- Automorphic soil – 6,222,350 ha (80%). Precipitation is the exclusive source of automorphic soil moisture, with water percolating freely through the soil, without long periods of retention of excessive water. However, there are several subunits within this category (particularly in the region of the Morava rivers, the Sava region, and partly Bačka and Banat), which, due to degradation, started displaying certain negative properties that should be mitigated and/or removed through hydro and agro-ameliorative measures.
- Hydromorphic soil – 1,445,555ha (19%). Hydromorphic soil is characterised by occasional or permanent waterlogging caused by surface and ground water acting individually and/or jointly, whereas flood waters provide the additional moisture. This soil is located on lower ground levels, in the depressions of loess, lake and river terraces, particularly in the valleys of large rivers (the Danube, the Tisza, the Sava, the Morava and their tributaries).
- Halomorphic soil – 79,360ha (1%). Halomorphic soil includes defective soil (salt marshes), formed under the dominant impact of easily dissoluble salts. Apart from salt marshes, which are a typical representative of this type of soil, some other types of soil, primarily heavy soil of hydromorphic and automorphic character, are also exposed to adverse effects of salinization and alkalisation to some extent. This type of soil occupies a relatively small surface, but is quite important for the water regions of Bačka and Banat, Lower Danube and Srem, for both drainage and irrigation.

Table 2.3. Division and surface area of the type of soil in Serbia

Water region	Soil (ha)			
	Automorphic	Hydromorphic	Halomorphic	Total
Banat and Bačka	1,228,016	468,150	77,383	1,773,549
Belgrade	203,656	121,028	0	324,684
Lower Danube	964,049	106,546	0	1,070,595
Morava	2,853,942	327,660	0	3,181,602
Sava	686,827	332,952	0	1,019,779
Srem	285,860	89,219	1,977	377,056
Total in Serbia	6,222,350	1,445,555	79,360	7,747,265

Apart from natural conditions and processes, soil properties and its degradation is significantly shaped by constant pressures of human activities, including: community development, infrastructure development, agriculture, forestry, chemical usage and worryingly increasing usage of the agricultural land of highest quality (envisaged for agricultural usage by law in the majority of countries), for the so-called green field investments, although there is land of lower quality or facilities in the immediate vicinity, which can no longer be used due to deterioration, etc. Numerous soil functions are related to water, namely: irrigation, hydroelectric power plants, urban development, etc. On the other hand, the manner of soil usage may create an impact on the quality of water and water courses, so this impact ought to be taken into consideration when planning to change soil function. The 2006 Corine Land Cover programme, addressing the basic land cover structure, showed the following land cover structure in Serbia: agricultural land accounts for 57%, forest land 38%, urban area 4% and water and wet lands for 1% of the country's territory.

1.2.1.4. Biodiversity, geodiversity, area-specific diversity and nature protection

In biogeographical sense, the territory of Serbia is located at the crossroads of several regions, namely central-European region, Pontic-South Siberian and Mediterranean–sub-Mediterranean, and with respect to mountain-high mountain relief, i.e. height zoning of flora and fauna, it also falls within Central and South-European and Boreal region. The main feature of the biodiversity of the Republic of Serbia is immense ecosystem, species and genetic diversity, as well as relatively limited quantities of biological resources, both potential and the ones already used.

A total of 1,200 plant communities and 500 sub-associations, divided into 59 vegetation classes, have been registered in Serbia. A large number of these communities is relict endemic, particularly the ones found in gorges, canyons, mires and high mountain areas. Although Serbia occupies as much as 1.9% of the European continent, it still boasts the majority of the European ecosystems: 39% of vascular flora, 51% of ichthyofauna, 49% of reptile and amphibian fauna; 74% of avifauna and 67% of mammal fauna of Europe.

Approximately 44,200 taxa (species and subspecies) are officially registered in the Republic of Serbia. With the recorded 3,662 vascular plant taxa at the level of species and subspecies (39% of the European flora), Serbia is ranked among the countries with the highest floristic diversity in Europe. As many as 625 species of fungi (*Macromiceta*) and 586 species of lichen are registered and described in the territory of the Republic of Serbia, but it is estimated that the number of fungi species is much higher. Out of 178 species on the European Red List, 42 species (23.6%) are in Serbia. Between 98 and 110 fish species and cyclostomata have so far been registered in Serbia. Thirteen species were proposed for the Red List of Vertebrates of Serbia, and 19 taxa of international importance were also registered. Serbian territory is home to 21 species of amphibians and 25 species of reptiles with approximately 20 subspecies. The number of bird species of all categories in Serbia (nesting birds, bird species in Serbia during winter, those registered during migration and potentially present birds) is approximately 360, and 343 are internationally important. As many as 94 species of mammals or 50.51% of the total teriofauna of Europe have so far been registered in Serbia, of which 68 are on the Preliminary Red List of Vertebrates of Serbia and 16 on the European Red List.

Serbia is home to 460 areas of natural values that are placed under protection, including 5 national parks, 17 nature parks, 20 landscapes of exceptional features, 68 nature reserves – strict and special, 309 natural monuments (botanical-dendrological, geomorphological, geological and hydrological) and 3 protected habitats, with the aim of preserving, enhancing and sustainably using the features and values of flora and fauna, geological heritage and landscape of these regions, as well as 38 areas with integrated cultural-historical and natural values, i.e. areas with immovable cultural heritage. Strictly protected wild types of plants, animals and fungi include 1,759 species, namely: 1,032 types of animals, 75 types of fungi, 627 types of plants and 25 types of algae, while the category of protected wild species of plants, animals and fungi include 854 species, namely 258 types of animals, 37 types of fungi and 559 types of plants.

The total surface of the protected areas measures 583,183 ha, accounting for 6.6% of the Serbian territory. Thus Serbia is placed among European countries whose share of areas protected as natural heritage within the state territory is rather small. With respect to the protected areas, Category I of the protection regime was established over the surface of 19,456 ha, accounting for 0.0023% of the Serbian territory (3.89% of protected areas), Category II over 88,537 ha, or 0.010% of the Serbian territory (15.16% of protected areas), while over 80% of protected areas fall into Category III of the protection regime. Owing to protection regimes, protected areas now do not require complete restriction of economic development on national and regional level.

International status of protection was granted to 10 areas placed on the List of wetlands of international importance based on Convention on wetlands of international importance especially as aquatic birds habitats (Ramsar Convention), which occupy a total of 63,319ha and one area placed on the List of biosphere reserves based on the UNESCO *Man and* Biosphere-Mab programme, which occupies a total of 53,800ha. Based on relevant international programmes, the Republic of Serbia is home to 42 internationally Important Bird Areas (IBA), 61 Important Plant Areas (IPA) and 40 Prime Butterfly Areas in Europe (PBA).
Based on the Convention on the conservation of wild flora and fauna and natural habitats (Bern Convention), Emerald Network in Serbia encompasses 61 areas, spanning a total of 1,019,270ha, or around 11.5% of the territory of the Republic of Serbia.

The Decree on Ecological Network (RS Official Gazette, No 102/2010 of 30 December 2010) establishes the Ecological Network in the Republic of Serbia, with the aim of preserving biological and landscape diversity and habitats of particular importance, and in order to preserve, restore and/or improve disturbed habitats and preserve certain species. The Ecological Network consists of: ecologically significant areas, ecological corridors, buffer zones that reduce the negative environmental impacts on ecologically significant areas and ecological corridors. The total of 101 significant ecological areas spread across the surface of 1,849,201.77ha.

1.2.2. Quality of basic environmental factors

The characteristics of the current state of the environment are a basis for investigating and evaluating environmental problems in a given area. Environmental quality is considered one of the basic criteria for a balanced and sustainable development of the Republic of Serbia.

Different factors determine the state of the environment in Serbia, out of which the most important include: urban, mining and industrial areas with high concentrations of population, industry and traffic, which exert pressure on the environment and landscape, posing a threat to environmental quality on the one hand, and to the survival of rural and protected areas with a depopulation trend, with environment preserved to a greater or smaller extent, on the other.

1.2.2.1. Ambient Air Quality

Ambient air quality is certain areas and cities is dependent on emissions of SO_2, NOx, SO, soot, fine particulate matter and other pollutants generated by different facilities and processes. Major causes of ambient air pollution include: obsolete technologies, lack of flue gas purification devices or poor efficiency of filtration devices, irrational use of raw materials and energy resources, poor maintenance, etc. Considerable air pollution comes from inappropriate storage and disposal of by-products, such as fly ash from thermal power plants and mine waste rock from open-pit mines. Levels of traffic-generated pollution are raising, including high emissions of benzene, lead and soot, particularly in large cities. Major sources of air pollution include thermal power plants in Kolubara and Kostolac lignite basin and the RTB Bor Mining and Smelting Complex. Lignite has a low caloric value and high moisture content, while large quantities of fly ash, sulphur and nitrogen oxides are emitted from lignite combustion. The most important industrial ambient air polluters include: oil refinery in Novi Sad; cement plants in Beočin, Kosjerić and Popovac, chemical plants in Pančevo, Šabac and Kruševac and Smederevo steel mine. The highest levels of pollution come from combustion processes of low quality lignite (thermal power plants in Obrenovac, Lazarevac and Kostolac) and liquid fuels (Belgrade, Niš, Užice, Čačak, Valjevo, etc.).

The ambient air pollution also comes from the use of solid fuels (wood and coal) in households, boiler rooms in buildings and solid fuel burners. The emission of **acidifying gasses** increases their concentration in the air, in turn changing the chemical balance in the environment. The following pollutants serve as indicators of acidifying gasses emission: NO_x, SO_2 and NH_3.

- The greatest contribution to the entire emission of acidifying gasses comes from "energy production and distribution" (NO_x on average by 57% and SO_2 on average by 80%) and "agriculture" (on average by 90% in respect of NH_3).
- NO_x and SO_2 emission trends have kept constant, falling during the 1998-1999 period, only to record a mild growth thereafter, except for NO_x emission, which fell during the 2011–2012 period.
- From 1990 to 2012, HN_3 emission kept constant, save for a mild rise since 2005 onwards.

Ozone precursors are substances which contribute to the creation of ground-level, i.e. tropospheric ozone. The indicator shows the total emission and trend of ground-level ozone precursors (NO_x, CO, CH_4 and NMVOC).

- The trend of NMVOC emissions was constant in the entire period, while NO_x emissions fluctuated, mildly growing from 1993 to 2000 and falling from 2008.
- In the period from 1990 to 2012, the trend of CO emissions recorded consistently greater fluctuations, both in terms of rising and falling.
- CH_4 emissions are not shown because there are still no adequate data available.
- The greatest contribution to total emissions of ozone precursors is provided by "Road traffic" (on average 32% of NMVOC and 55% of CO), "Heating plants with power under 50 MW and individual heating" (on average 31% of CO and 12% of NMVOC). A considerable part of NMVOC emissions is contributed by "Agriculture" with 27%, "Use of solvents and industrial products" with 21%, and "Industrial processes" with 7%, while minor CO emissions are also found in categories "Production and distribution of electricity" with 9% and "Waste" with 8%.

Emissions of **primary suspended particles** and secondary precursors and suspended particles (PM10, NO_x, NH_3 and SO_2). The indicator shows the total emissions and the trend of primary suspended particles smaller than 10µm (PM10) and secondary particle precursors NO_x, NH_3 and SO_2.

- The trend of emissions of PM10 and NH_3 is constant, except for NH_3 emissions for the period from 2006, when it began to rise mildly.
- The trends of emissions of NO_x and SO_2 were almost identical from 1990; from then, both were on the rise, only to fall sharply in 1998 and 1999, when the emissions became constant, with the exception of 2011 and 2012, when the emissions of SO_2 declined.
- The contribution of PM10 emissions is the highest by "Heating plants with power under 50MW and individual heating", averaging at 37%, "Agriculture" with 29%, "Production and distribution of electricity" with 17%, while emissions of other categories are minor.

The total emissions of **heavy metals** of anthropogenic origin controlled by the LRTAP convention (Cd, Hg, Pb, As, Cr, Cu, Ni, Se and Zn).

- The trend of emissions of heavy metals shows a plunge from 1990 to 1993, followed by growth from 1994 to 1998, after which emissions remained stable up to 2012.
- The trend of total anthropogenic emissions of heavy metals (Cd, Hg, As, Cr, Cu, Ni, Se and Zn) declined from 1990 to 1996, after which emissions rose.
- Emissions of lead dropped from 1992 to 1993, which was followed by growth and a subsequent contraction from 1998 to 1999. From 2000 to 2008, emissions were constant, after which they fell because fuels containing lead stopped being produced.

In 2013, the Agency for Environmental Protection continued implementing operational monitoring of air quality in the national air quality monitoring network at the level of the Republic of Serbia.

In 2011, the Agency carried out operational automatic monitoring of air quality on 35 AMSKV (automatic station for air quality monitoring).

Of those stations, 82% achieved data availability above 90% of all planned parameters.

This percentage fell significantly in the years that followed. Air Quality Report for 2013 was based on the available data prescribed by the Regulation, and included the data from automatic monitoring of air quality in the local network of the City of Pančevo and the Autonomous Province of Vojvodina.

- In agglomerations Bor, Belgrade, Užice and Smederevo, quality of air was category III – excessively polluted air (with exceeded tolerances for one or more pollutants).
- In the Bor agglomeration, daily concentrations of sulphur dioxide in 2013 exceeded limit values in 48% of the cases, of which 9% were polluted air and 39% very polluted air.
- Concentrations of suspended particles and nitrogen dioxide are dominant contaminants which determine air quality in the Republic of Serbia.

Table 1.4. Air quality assessment for 2013 based on average annual concentration of pollutants and the number of days when limit values were exceeded

	АМСКВ СТАНИЦА	Оцена квалитета ваздуха; Категорија квалитета ваздуха у 2013.	ГОДИШЊЕ ВРЕДНОСТИ КОНЦЕНТРАЦИЈА ЗАГАЂУЈУЋИХ МАТЕРИЈА									
			SO2		NO2		PM10		CO		O3	
			µg/m3	бр дана > 125 µg/m3	µg/m3	бр дана > 85 µg/m3	µg/m3	бр дана > 50 µg/m3	mg/m3	бр дана > 5 mg/m3	µg/m3	бр дана > 120 µg/m3
1	Кикинда	1	10.1	0	11.9	0			0.3	0	70.7	3
2	Сомбор (АПВ)								0.7	0	49.6	0
3	Зрењанин (АПВ)		13.3	0	—	—			0.5	0	—	—
4	Нови Сад_Спенс	1	—	—	—	—	32.6	47	0.6	0		
5	Нови Сад_Лиман	1	9.7	0	18.8	0			0.3	0	77.0	25
6	Нови Сад Шангај (АПВ)		13.0	1								
7	С. Митровица	1	12.0	0	25.2	0			0.6	0		
8	Беочин Центар	1	7.0	0	24.4	0	38.1	79				
9	Панчево_Содара	1	11.3	0	17.9	0			0.5	0		
10	Панчево_Војловица	1	11.3	0			29.4	27				
11	Панчево Ватрогасни дом		11.7	0	21.5	1	—	—				
12	Панчево_Старчево		3.3	0	—	—	—	—	—	—	—	—
13	Београд_Стари град	1	—	—	31.5	1	29.5	44	0.6	0	72.9	46
14	Београд_Н.Београд	1	—	—	29.2	1	24.9	33	0.5	0	74.9	29
15	Београд_Мостар	2	14.9	0	45.8	3	40.4	79	0.5	0	33.6	0
16	Београд_Врачар	1	—	—	31.1	0	39.0	67	0.6	0	53.0	0
17	Београд Зелено брдо	2	22.2	0	18.8	0	40.8	87	0.4	0	90.5	59
18	Београд_Д.Стефана_ГЗЗЈЗ	3	13.3	0	56.6	46	54.8	146	0.6	1		
19	Београд_Славија_ГЗЗЈЗ	2	25.0	0	54.9	24	—	—	0.7	0		
20	Београд_НБг_О.Бригада_ГЗЗЈЗ	3	10.8	0	34.1	1	50.2	112			71.2	27
21	Београд_Овча ГЗЗЈЗ	3	14.0	0	12.1	0	48.5	123	0.4	0		
22	Београд_Земун ГЗЗЈЗ	1	38.6	4	18.5	1	33.9	65	—	—		
23	Београд_Лазаревац ГЗЗЈЗ		—	—	9.8	0			—	—	39.9	0
24	Београд_Грабовац ГЗЗЈЗ	1	15.6	0	—	—	38.3	75	—	—		
25	Шабац	1	—	—	22.1	0			0.8	2		
26	Обедска бара (АПВ)	1	7.3	0							31.6	0
27	Костолац		—	—	—	—			0.4	0		
28	Обреновац_Центар	2	13.9	0	—	—	41.3	86	—	—	37.8	3
29	Обреновац ГЗЗЈЗ	2	10.4	1	8.7	0	41.8	79				
30	Смедерево_Царина	1	19.8	0	13.8	0			0.5	0		
31	Смедерево Центар	3	32.6	0	—	—	54.2	119	—	—		
32	Лозница	1	21.6	0	—	—			0.5	0		
33	Зајача	1					34.0	41				
34	Ваљево	3	—	—	34.2	7	63.1	118	0.8	1		
35	Бор_Градски парк	3	225.1	137			—	—				
36	Бор_Институт РИМ	3	85.2	73	24.6	2			0.5	0		
37	Бор Кривељ	3	55.8	36								
38	Крагујевац	1	—	—	26.9	0			0.6	0		
39	Косјерић	2	11.5	0	12.9	0	40.2	83	0.9	0		
40	Зајечар		—	—	15.7	0			0.7	5		
41	Поповац Холцим	1	9.0	0	7.5	0	37.3	76	0.6	0	79.7	9
42	Чачак_Инс. за воћарство	1	13.5	0	15.8	0			0.5	0		
43	Ужице	3	—	—	48.7	16	61.0	110	1.1	6		
44	Краљево		—	—	—	—			—	—		
45	Крушевац	1	12.8	0	15.1	0			0.8	5		
46	Каменички Вис - ЕМЕП	1	—	—	4.1	0	17.3	1	0.2	0	93.5	41
47	Параћин	1	13.0	0	—	—			0.6	0		
48	Ниш_О.ш. Св. Сава	1	9.4	0	16.2	0			0.7	0	64.0	6
49	Ниш_ИЗЈЗ Ниш	1	—	—	35.7	0	30.8	52	0.6	0		
50	Копаоник	1	9.0	0	2.9	0			0.3	0	97.6	33
51	Врање	1	—	—	37.0	0			0.8	1		

The table shows the overview of the **air quality assessment for 2013** based on average annual concentration of pollutants (SO_2, NO_2, PM10, CO and O_3) and the number of days when daily limit values were exceeded. The results were obtained using automatic air quality monitoring in the national network.

Categorisation carried out in this way represents the official assessment of air quality for 2013, and can be summed up in the following manner:

- **Category I**, *clean air or slightly polluted air* (where limit values were not exceeded with respect to any pollutant) in 2013 was recorded at the following AMSKV measuring points: Kikinda, Novi Sad_Spens, Novi Sad_Liman, S. Mitrovica, Beočin Centar, Pančevo_Sodara, Pančevo_Vojlovica, Beograd_Stari grad, Beograd_N.Beograd, Beograd_Vračar, Beograd_Zemun GZZJZ, Beograd_Grabovac GZZJZ, Šabac, Obedska bara (APV), Smederevo_Carina, Loznica, Zajača, Kragujevac, Popovac Holcim, Čačak_Institut za voćarstvo, Kruševac, Kamenički Vis – EMEP, Paraćin, Niš_Sveti Sava, Niš_IZJZ, Vranje and Kopaonik.
- **Category II**, *moderately polluted air* (where limit values were exceeded with respect to one or more pollutants, but no tolerance values were exceeded) in 2013 was recorded at the following AMSKV measuring points: Beograd_Mostar (nitrogen dioxide), Beograd_Zeleno brdo (suspended particles PM10), Beograd_Slavija_GZZJZ (nitrogen dioxide), Obrenovac_Centar (suspended particles PM10), Obrenovac_GZZJZ (suspended particles PM10) and Kosjerić (suspended particles PM10).
- **Category III**, *excessively polluted air* (where tolerance values were exceeded with respect to one or more pollutants) in 2013 was recorded at the following measuring points: Beograd_D. Stefana_GZZJZ (nitrogen dioxide and suspended particles PM10), Beograd_Novi Beograd, Omladinskih brigada (suspended particles PM10), Beograd_Ovča (suspended particles PM10), Smederevo Centar (suspended particles PM10), Valjevo (suspended particles PM10), Bor_Gradski park (sulphur dioxide), Bor_Institut RIM (sulphur dioxide), Bor Krivelj (sulphur dioxide) i Užice (suspended particles PM10).

1.2.2.2. Water quality

Surface water quality is generally determined by the operation of industrial plants, agricultural production, and long-lasting periods of drought both in the territory of the Republic of Serbia and in the neighbouring countries and basins of transboundary watercourses. Main sources of pollution of surface water in Serbia are untreated industrial and communal wastewater, drainage water from agriculture, drainage and seepage water from landfills, and pollution associated with river navigation, floods and operation of thermoelectric power plants.

Characteristics (in terms of quantity and quality) of surface and groundwater are determined by monitoring relevant parameters. The results of monitoring are also used to define the water level in watercourses from the aspect of watercourse regulation and protection against damaging effects of water, including forecasts in order to protect against floods. For decades, the Republic Hydrometeorological Service of Serbia monitored the parameters of surface water and groundwater of principal aquifers, according to the annual programme whose content is prescribed by law. Starting from 2011, this programme has been implemented by both the Institute and the Agency for Environmental Protection.

The quality of surface water in Serbia is monitored on river watercourses, some canals and reservoirs, and lately monitoring has been expanded to include groundwater – but only principal aquifers. The position of measuring points, as well as the number and frequency of measuring of parameters are not appropriate on all watercourses, and observations on small and medium watercourses are too infrequent, which also reflects on the reliability of assessment of the quality of surface and groundwater and the status of bodies of surface and groundwater. Furthermore, groundwater of deep aquifers is not monitored, which needs to change in the coming period.

The level of development of the system for collection and removal (primary and secondary sewage network and main sewage collectors) and treatment of wastewater from settlements (water treatment plants) is low relative to European standards. This particularly refers to the level of development of water treatment plants, which is why most communal wastewater is released to the recipients without undergoing necessary treatment. In the past several decades, a little over 50 public water treatment plants were built in settlements with over 2,000 people in Serbia. Of these constructed plants, 32 are now operational, of which only a few work per their designed criteria, while the efficiency of others is far below the designed levels. Effects of public wastewater treatment (for selected parameters) are given in the following table, at the level of basins.

Table 2.5. Effects of communal wastewater treatment at the level of basins

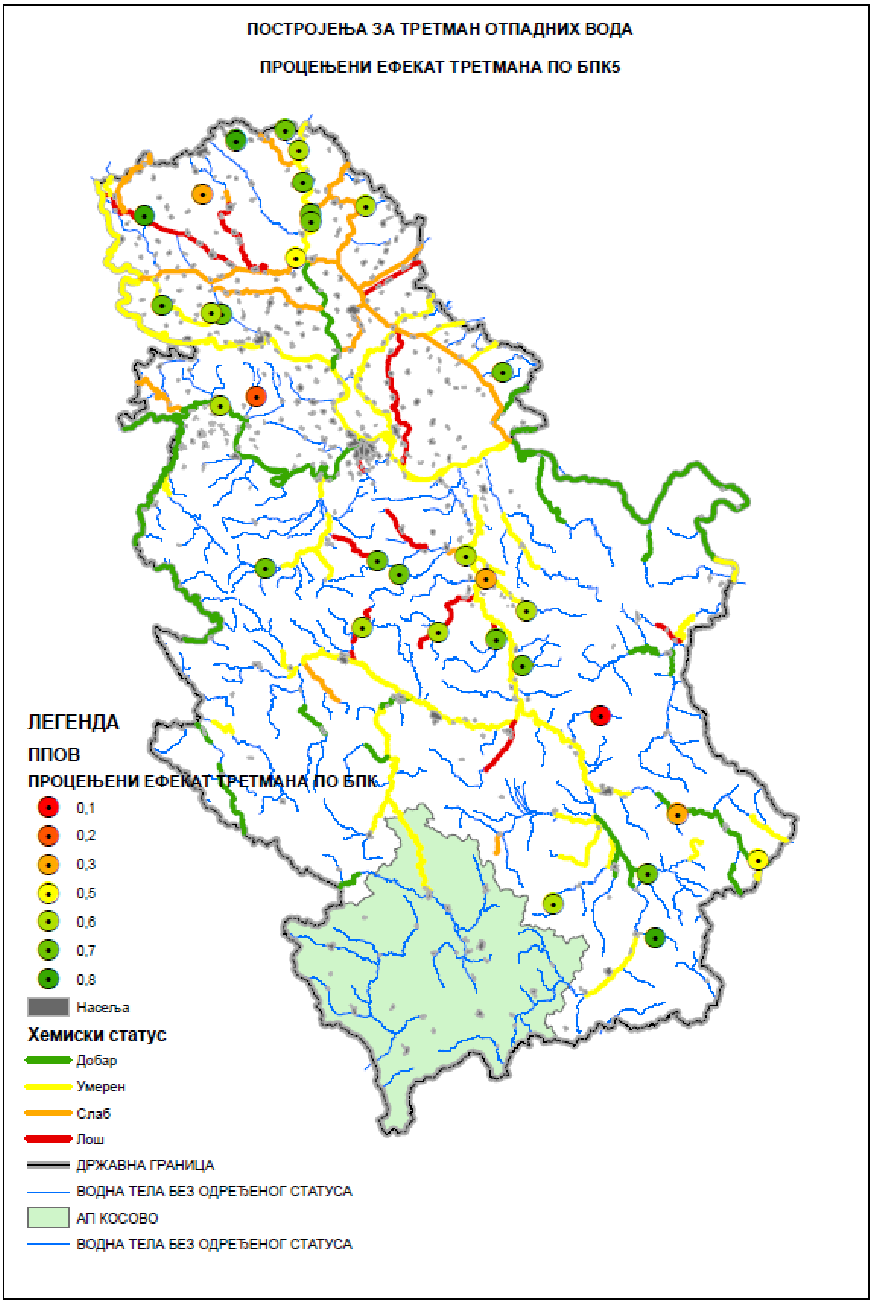
Basin	Number of residents connected	Effective treatment			Number of plants
		BOD, PE	total N, PE	total P, PE	
S. Morava	40,766	23,903	10,054	9,325	5
W. Morava	22,988	13,793	4,598	4,598	1
G. Morava	242,178	151,114	73,379	39,684	8
Tisza	124,547	90,130	59,422	61,577	6
Sava	82,967	44,886	32,582	16,479	3
Danube	90,814	61,236	26,547	17,922	9
TOTAL	**604,260**	**385,061**	**206,582**	**149,584**	**32**

Source: Statistical Office of the Republic of Serbia

The plants currently in operation service around 600,000 people, though their total effective treatment comes at around 385,000 PE (population equivalent). The conclusion that follows is that less than 10% of the population is covered by some degree of wastewater treatment. The overall effect of treatment in terms of removal of organic loading is below 65%, of nitrogen components – below 35%, and of phosphorus components – below 25%. Furthermore, the spatial distribution of the plants constructed in Serbia is uneven. Concentrated sources of pollution from settlements with over 2,000 inhabitants make up around 80% of total pressure in relation to the phosphorus parameter and around 70% in relation to the nitrogen produced by the population.

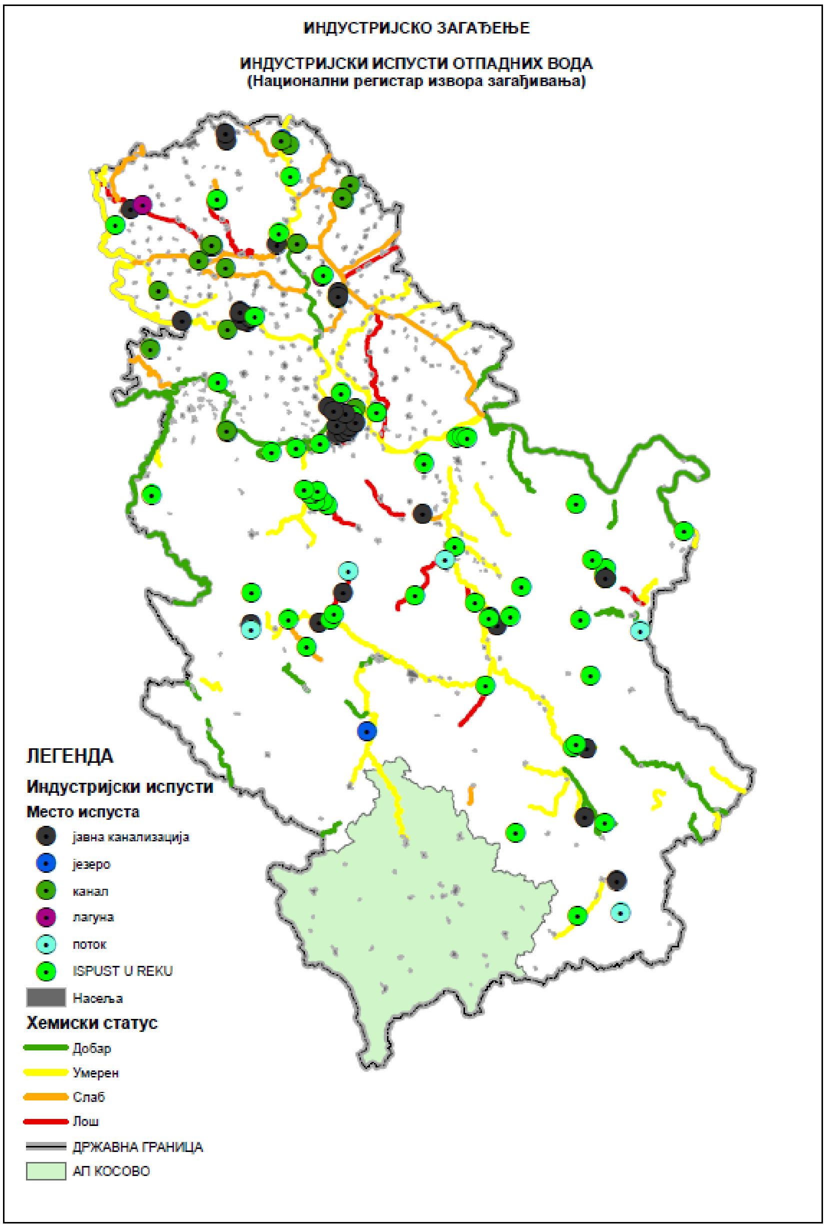
Current industrial capacities within settlements are most frequently connected to the public sewage system. There are not enough reliable data on the type and quantity of industrial wastewater from these industrial plants to draw appropriate conclusions. Given the fall in production in Serbia, the share of industrial wastewater in settlements dropped significantly and is estimated to be under 20% (down from around 45% in the 1980s).

Figure 2.1. Wastewater treatment plants in Serbia and the assessment of effects of treatment on BOD



As regards industry, it is clear that there are most often no constructed plants for the pre-treatment of industrial wastewater before its release into city sewage systems, i.e. recipients, or their operation is inefficient, which can also jeopardise the functioning of existing communal wastewater treatment plants, and the well-being of life in aquatic and riparian ecosystems. Records on industrial water pollution for large polluters are kept within the National Register of Pollution Sources (Agency for Environmental Protection), while for smaller polluters, within local registers at the level of local self-governments. Practice has shown that the majority of polluters do not submit reports in a regular and timely manner, and those who do submit them provide incomplete data, which makes reliable quantification of pressures from industry impossible. Since there are no relevant data, the below figure shows the locations where wastewater is released by large industrial capacities.

Figure 2.2. Industrial pollution – industrial wastewater discharge



A part of dispersed sources of pollution is made up by the population connected not to public, but rather to individual sewage systems (or other types of sanitation with negligible effect from the aspect of water protection). Quantification of the impact of dispersed pollution due to seepage from the terrain, primarily from agricultural surfaces, is conducted on the basis of targeted monitoring. As this type of monitoring is still not used in our country, the assessment was conducted based on a database on land cover (CORINE 2006) and the expert assessment of pressures (in kg/ha·year) in terms of the manner of usage of space. According to the level of development of the sewage infrastructure, the Republic of Serbia is a medium-developed country, while in terms of wastewater treatment, it is among the worst. Namely, the sewage network covers around 55% of the population, while less than 10% is covered by any degree of wastewater treatment.

Only a few industrial plants use pre-treatment of technological wastewater before releasing it into sewage networks or other recipients.

Quality of water – Serbian Water Quality Index

The Agency for Environmental Protection devised an environmental indicator – Serbian Water Quality Index – based on the method which aggregates ten parameters of physical, chemical and microbiological quality (dissolved oxygen, BOD_5, ammonium ion, pH, total nitrogen oxides, orthophosphates, suspended matter, temperature, electrical conductivity and coliform bacteria) into a composite indicator of the quality of surface water.

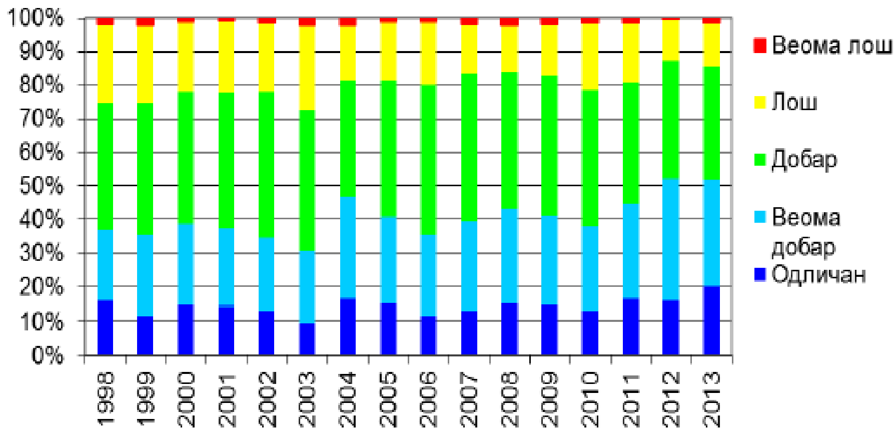
Water quality analysis using the SWQI was carried out for river basins in the Republic of Serbia and included:

- Water in Vojvodina, watercourses and canals of the Danube–Tisza–Danube hydro system on the left bank of the Danube;
- The Danube, from the Bezdan station to Radujevac;
- The Sava River basin, including the Drina and the Kolubara basins;
- Tributaries of the Đerdap Lake, right tributaries of the Danube downstream from the mouth of the Great Morava River;
- Basin of the Great Morava River, including the South Morava and the West Morava basins.

The SWQI analysis covers the period from 1998 to 2013 with a total of 21,819 samples of physical and chemical indicators sampled once a month on average. **The monitoring programme for 2013** covered 91 measuring points for surface water quality control; a total of 1,056 samples were taken at these locations for laboratory analysis.

The chart below shows the quality of all samples of water by year (1998-2013) expressed as a percentage, determined using the SWQI method.

Chart 2.1. Quality of all water samples by year (1998-2013) expressed as a percentage, determined using the SWQI method



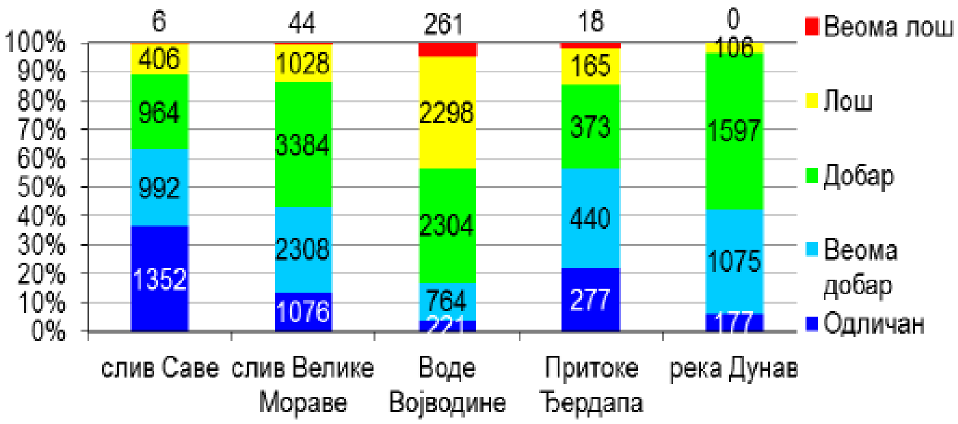
source: Agency for Environmental Protection, Environmental Report for 2013 (pp. 52-56). http://www.sepa.gov.rs/download/Izvestaj2013.pdf

Analysis of the quality of all water samples determined using the SWQI method for 2013 shows that the percentage of samples in the *very poor* category increased in relation to 2012, which could indicate the impact of pollutants. However, by reviewing the results from measuring points in the Monitoring Programme for 2012, it can be seen that the Monitoring Programme for 2013 included new stations – Slatina (Borska River) and Slatina (Kriveljska

River). A total of 22 samples were taken at these stations, 15 of which ranked *very poor* and 7 *poor*, which gave a different impression of water quality by basin in the multi-year average and diminished the average quality of tributaries of the Đerdap Lake.

Quality of all water samples by basin (for the appropriate number of samples) for the period 1998-2013, expressed as a percentage and determined using the SWQI method follows.

Chart 2.2. Quality of all water samples by basin (for the appropriate number of samples) for the period 1998-2013, expressed as a percentage and determined using the SWQI method



source: Agency for Environmental Protection, Environmental Report for 2013 (pp. 52-56). http://www.sepa.gov.rs/download/Izvestaj2013.pdf

According to the analysis of all samples from all basins, as much as 79% of samples in the *very poor* water quality category were taken from the territory of Vojvodina. The poor quality of water in canals and rivers in Vojvodina is compounded by the fact that as much as 59% of samples in this region fall in the *very poor* and *poor* categories. It is particularly troubling that the watercourses and canals incorporated in the Danube–Tisza–Danube hydro system are in very poor condition. This was caused by the misuse of the hydro system for the discharge of wastewater of large settlements and industries, although the characteristics of the system (rate of flow) are not fitting for this purpose.

The consequences are severe and are rarely talked about: the quality of water in this hydro system, which was conceived as a typical melioration system (for drainage, irrigation, protection against floods), is currently so poor that the water at many sections of the hydro system should not be used for irrigation, since it could pollute both crops and soil. The system was very poorly maintained, or more precisely, barely maintained at all, resulting in a considerable reduction in the dimensions and discharge of canals and regulated watercourses, due to the accumulation of sediment.

However, the real problem is that that this accumulated sediment also contains numerous pollutants (e.g. heavy metals) from wastewater which was released and is still being released into the canal network, further complicating the issue of cleaning the canal system, as permanent degradation of soil quality must be prevented in the areas with these deposits.

An overview of the table “ten worst watercourses” for 2013 shows that the average annual SWQI value of two measuring points was very poor – Slatina (Borska River) with SWQI = 29 and Slatina (Kriveljska River) with SWQI = 38 index points.

Surface water quality

Assessment of the quality of surface water represents the foundation for all planning documents which define the measures for the achievement and preservation of sound condition of water and enables the monitoring of the impact of human activity on its quality. For decades, the only authority in the Republic of Serbia responsible for systematic examination and measurement of parameters of surface water quality was the Republic Hydrometeorological Service of Serbia (RHMSS). Since 2011, the list of competent institutions to monitor water quality was expanded to include the Agency for Environmental Protection, an administrative authority within the Ministry and the RHMSS.

The quality of surface water is systematically monitored at around 140 stations which cover 103 of around 500 bodies of water defined by law. In the period between 2004 and 2012, which was adopted as the benchmark period for this area, the list of monitored parameters of surface water quality was changed (due to changes in legal regulations), as was the list of some monitoring stations. The assessment of the quality of surface water was performed by identifying their average quality and identified long-term trends, above all according to parameters which indicate the pollution of surface water caused by various groups of pollutants. Based on the available data, a classification was performed for 103 bodies of water which are covered by the network of surface water quality monitoring stations.

Figure 2.3. Bodies of water according to the Regulation on Limit Values of Pollutants

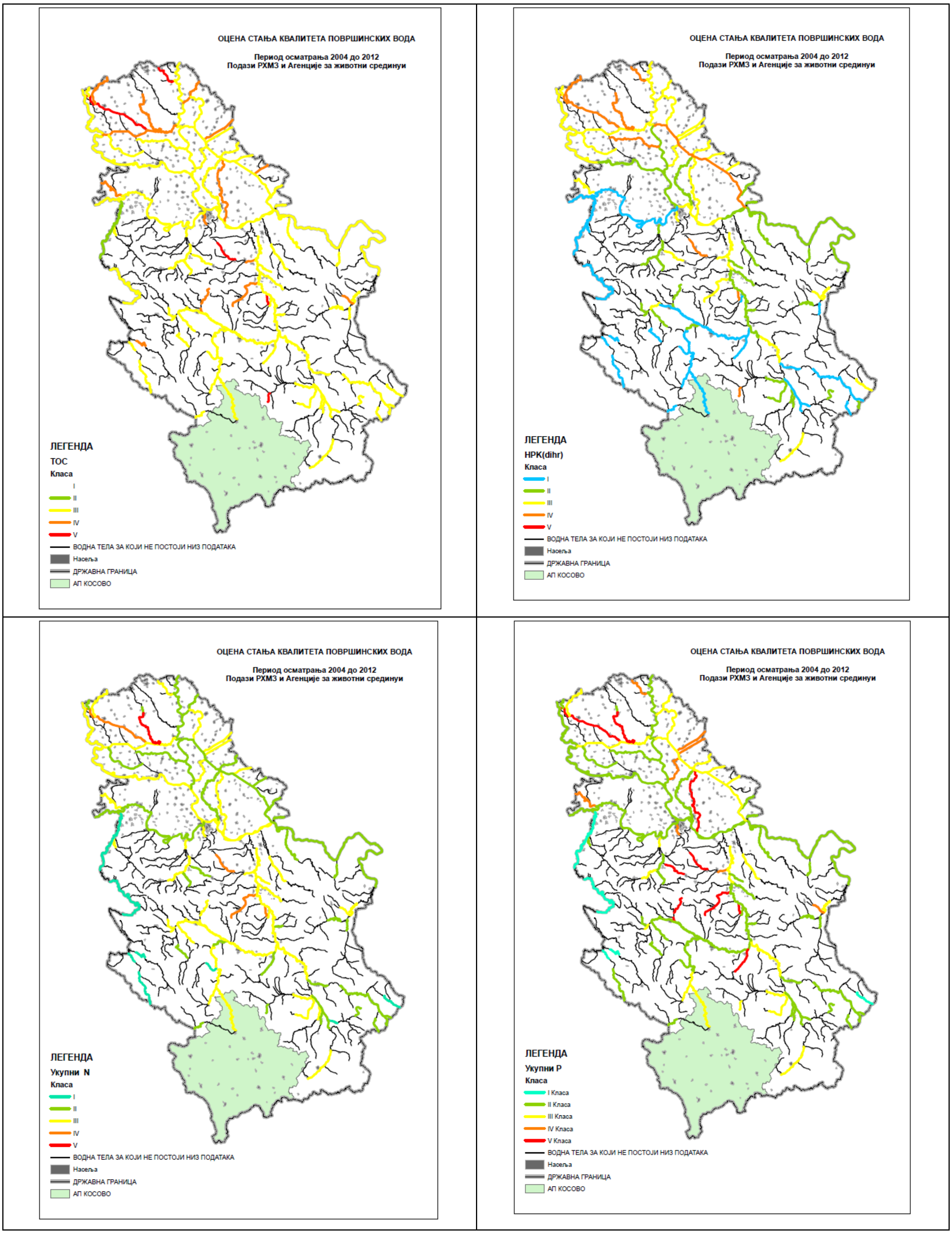
	BPK5	HPK(dihr)	TOC	NH4	NO3	Uk. N	Uk. P	Orto P
V Класа	1	1	1	4	0	2	10	8
IV Класа	4	26	4	10	0	7	9	9
III Класа	6	49	37	45	72	45	79	76
II Класа и боље	92	27	61	44	31	49	5	10

The majority of bodies of water fall into II and III quality class (over 80% of monitored bodies of water), while fewer than 20% of bodies of water belong to quality classes IV and V. It should be underlined that bodies of water in large watercourses, primarily the Danube, the Tisza, the Sava and the Drina rivers, as a rule, satisfy the criteria for class II, with the exception of the orthophosphate content at the exit section of the Danube, which belongs to class III. Higher orthophosphate content in this section of the Danube probably stems from the used methodology of sampling[14]. The deterioration in the quality of some bodies of water was recorded mostly in smaller watercourses and canals in Vojvodina, as well as near larger settlements. In general, the conclusion is that the quality of surface water is relatively good, given the fact that less than 10% of wastewater undergoes adequate treatment. It is particularly significant to note that water quality of the Danube at its exit from Serbia is

[14] Samples on the benchmark station for this body of water are taken along the right shore (state boundary is located at the centre of the Danube), rather than in the middle, as is usual for all other observed profiles.

considerably better than the quality at its entrance, indicating improvement of the water throughout the country. This precise and easily provable fact is underused in Serbia's appearances before international bodies, although it could be used to show the important role that Serbia plays in the protection of the Black Sea, which is an important objective of all measures for the protection of the Danube.

Figure 2.4. Assessment of surface water quality in the Republic of Serbia



In line with the new approach, quality assessment is made for bodies of water, as special and significant elements of surface water. The assessment is made according to the worse of the environmental and chemical status, for rivers and lakes, and according to the environmental potential and chemical status for man-made and considerably altered bodies of water.

Environmental standards define the values of biological (aquatic invertebrates, algae, macrophytes, microorganisms) and the selected physical and chemical quality parameters (oxygen parameters, acidity, nutrients) compared to the undisturbed, natural state (benchmark condition) for each type of aquatic ecosystem, while the quality status[15] was defined by standards of environmental quality with regard to priority, priority hazardous and other specific substances.

Based on the parameters of environmental and chemical status[16], surface water in the territory of Serbia, excluding Kosovo and Metohija, was classified according to type:

- large lowland rivers dominated by fine sediments (the Danube, the Sava, the Great Morava, the Tisza, the Tamiš, the Begej and the Stari Begej) – type 1;
- large rivers dominated by medium sediments, excluding rivers in the Pannonian Plain – type 2;
- small and medium watercourses up to 500 m.a.s.l. dominated by coarse sediments – type 3;
- small and medium watercourses above 500 m.a.s.l. dominated by coarse sediments – type 4;
- watercourses in the Pannonian Plain (excluding type 1 watercourses) – type 5;
- small watercourses outside of the Pannonian Plain not included in other types and watercourses not included in the rulebook which regulates this area – type 6.

According to type of body of water, large rivers and man-made bodies of water were subject to most extensive and thorough monitoring, while the data is scarcest for small and medium watercourses (up to and above 500 m.a.s.l) and small watercourses outside of the Pannonian Plain, whose condition could not be assessed due to insufficient relevant data.

The quality of watercourses in terms of biological parameters was poor in around 25% of bodies of water, which include parts of the rivers the South Morava, the Rasina, the Kubršnica, the Nišava, the Begej, the Zlatica, the Turija, the Ljig, reservoirs Potpeć, Sjenica, Bovan, Gruža, etc.

The most threatened bodies of water, with poor quality in terms of environmental and chemical parameters, include: canal Vrbas – Bezdan in the DTD hydro system and the rivers Krivaja (from the confluence with the DTD canal to the Zobnatica dam) and the Pek (Gorge of the Kaona, from the confluence of the Ljesnica to the confluence of the Kučajska River.

It should be underscored that the different approach to water quality assessment (within a water area, relative to the environmental and quality status of bodies of water) requires the alignment of the monitoring system with the new requirements in the coming period, including alignment of the relevant regulations and an adequate selection of monitoring stations.

[15] Legal documents which fully define the chemical status of water are still not complete.
[16] Measurements in the period 2007/12, at 140 profiles located at 66 watercourses, 26 reservoirs and 5 lakes, as well as results of other examinations, especially of biological parameters.

The current monitoring system does not cover the majority of the bodies of water determined by regulations, while numerous quality parameters (indicators) for the assessment of the environmental status according to biological parameters have never been systematically monitored. For this reason, environmental status was assessed based on partial data and a pressure analysis, as well as on expert assessments.

Quality of groundwater

Assessment of the quality of groundwater resources in the Republic of Serbia was made based on the available data by competent ministries, monitoring results, technical documents and the results of individual papers and surveys.

Adequate assessment of water status, identification of changing trends and the assessment of effects of undertaken protection measures rely on systematic monitoring and updating of data on the quality of groundwater. Representativeness in terms of space and time, as well as the scope of tested parameters, directly affect the quality of data used to determine the quality of water.

The natural quality of groundwater in Serbia is quite uneven, which is caused by the different mineralogical and petrographic composition of water-bearing areas, genesis of groundwater and aquifers, age of water, different rate of exchange of water, etc., and varies from exceptional quality (which requires no treatment) to water which requires highly complex conditioning procedures prior to usage in public water supply.

The chemical composition of groundwater of first water released in the area of *west and south Bačka* is characterised by mineralisation from 250–500 mg/l in the riparian area of the Sava and Danube rivers, up to 400–800mg/l in the area of the "Varoška" terrace, while in some parts of Bačka this parameter measures over 2,000mg/l. Iron and manganese content is elevated. In northeast Bačka, the principal aquifer is characterised by mineralisation of 240–480mg/l, while the south part of the area features values of 350–635mg/l.

From the aspect of quality of basic water released, the area of *Banat* can be divided into 3 areas: area north of the Begej and Plovni Begej, middle Banat (Zrenjanin – Žitište) and south Banat.

The quality of water-bearing horizons I, II and III in the area of *Srem* is similar to that in Banat, considering the connectedness of waters of these horizons. Mineralisation ranges from 600–850mg/l, hardness is over 20ºdH, consumption of $KMnO_4$ is low (3–7mg/l), while iron is regularly elevated (0.5–3.5mg/l).

High arsenic concentration is an important characteristic of groundwater of basic water released in the area of *Vojvodina*. High concentrations can be found in the area of central and north Banat (10–50µg/l and over 50µg/l), central and north Bačka (10–50µg/l, and even over 50µg/l) and west Srem (10–50µg/l).

The quality of water from deep aquifers in Bačka and Banat areas is not satisfactory (elevated mineralisation, iron, organic matter, turbidity), while it is considerably higher in the area of Srem.

Table 2.6. Characteristic parameters of taken raw groundwater, with parameters exceeding MPC (maximum permitted concentration) in the area of Vojvodina

District	Total samples	% defective	Parameters exceeding MPC
South Bačka	790	77	colour, consumption of $KMnO_4$, electrical conductivity, ammonium, arsenic, chloroform, nitrites, iron, manganese, turbidity, odour, magnesium, pH, chlorides, trihalomethanes, sodium, phosphates, nickel, fluorine, suspended solids
West Bačka	132	92	colour, turbidity, iron, consumption of $KMnO_4$, manganese, ammonium, chlorides, residue on evaporation
North Bačka	493	94	colour, odour, turbidity, ammonium, iron, arsenic, manganese, nitrites, potassium, mineral oils, aluminium
North Banat	412	98	colour, turbidity, consumption of $KMnO_4$, ammonium, iron, odour, electrical conductivity, chlorides
Central Banat	624	100	colour, turbidity, consumption of $KMnO_4$, ammonium, iron, phosphates, nitrites, chlorides, arsenic, electrical conductivity
South Banat	43	88	colour, turbidity, ammonium, iron, consumption of $KMnO_4$, electrical conductivity, chlorides, odour
Srem	360	25	manganese, ammonium, colour, nitrites, iron, turbidity

Particularly evident negative impacts were registered in damaged industrial plants of the petroleum industry (Novi Sad, Pančevo), in the area of some watercourses (Great Bačka Canal, etc.), in zones of numerous settlements without sewage systems, in zones around farms and industrial and processing plants. In the rest of the territory of the Republic of Serbia (*area south of the Sava and the Danube*), chemical content of groundwater is diverse, so a general overview will be given by type of water-bearing area. Aquifers in alluvions of large rivers in Central Serbia are generally characterised by relatively low mineralisation, with a highly variable iron content and low manganese content. High water conductivity levels above 1,000µS/cm can be considered to indicate anthropogenic effects and generally occur in combination with high nitrate, chloride and, often, sulphate content.

The alluvion of the Great Morava River frequently features increased nitrate concentration, with nitrite concentrations sporadically exceeding maximum permitted concentration. All of this reflects on the poor quality of water used in public water supply systems (in line with PHIVP) in the majority of settlements which use individual shallow wells, and in the sources used at Garevina, Žabari, Livade, Meminac and Ključ settlements.

1.2.2.3. Soil quality

In Serbia, soil quality, i.e. degree of soil degradation, is affected by numerous natural processes (erosion, landslides, surface runoff). However, soil quality is considerably impacted by anthropogenic phenomena and processes, the most significant of which include: soil pollution by chemical substances (mineral fertilizers, pesticides) and organic fertilizers (solid and liquid manure) used in agricultural production; industrial processes; mining works; inappropriate waste disposal, existence of septic tanks that receive non-sanitary wastes (farm households, livestock farms), pollution of soil along roads due to water drainage issues, changes in land use (illegal construction), etc.

Soil is also polluted by inappropriate agricultural practices, including uncontrolled and inadequate use of artificial fertilizers and pesticides, as well as the absence of quality control of water used for irrigation. Sporadic presence of heavy metals in soil is a result of untreated drainage waters from landfills, as well as from mining facilities and power plants. Soil is polluted in areas of intensive industrial activity, inappropriate waste disposal sites, mining areas, and in locations of various accidents.

In 2013, the degree of soil vulnerability to chemical pollution was carried out in **urban zones** at 140 locations. A total of 219 samples were analysed in eight cities. Tests were conducted in Belgrade, Požarevac, Smederevo, Kragujevac, Kruševac, Novi Sad, Subotica and Novi Pazar. The results of analysed samples were interpreted according to the Regulation on the programme for the systematic monitoring of soil quality, soil degradation risk assessment indicators and methodology for the development of remediation programmes (RS Official Gazette, No 88/10). The results indicate that the soil contains excessive content of certain heavy metals (Cd, Cu, Ni, Pb, Zn, Cr, Co).

From 2009 to 2013, soil testing was carried out in Belgrade, Kragujevac, Novi Sad, Subotica, Kruševac, Požarevac, Smederevo, Užice, Niš, Novi Pazar and Čajetina. Local soil testing programmes were not continuous, which is demonstrated by the different number of locations and samples in the observed period.

Soil quality testing programme in the territory of the City of *Belgrade* in 2013 included sampling and laboratory tests of soil at 29 locations at depths of up to 10cm and 50cm. Tests were carried out in zones next to busy roads, around public drinking fountains, around children's playgrounds, on green areas, in gardens and on arable fields. Results indicate that the soil on tested locations is categorised as potentially polluted according to certain parameters, while a small percentage (3%) of soil is alarmingly polluted according to total nickel content.

Figure 2.5. Exceeded limit and remediation values of tested parameters relative to the total number of samples, at the depth of up to 10cm, expressed as a percentage

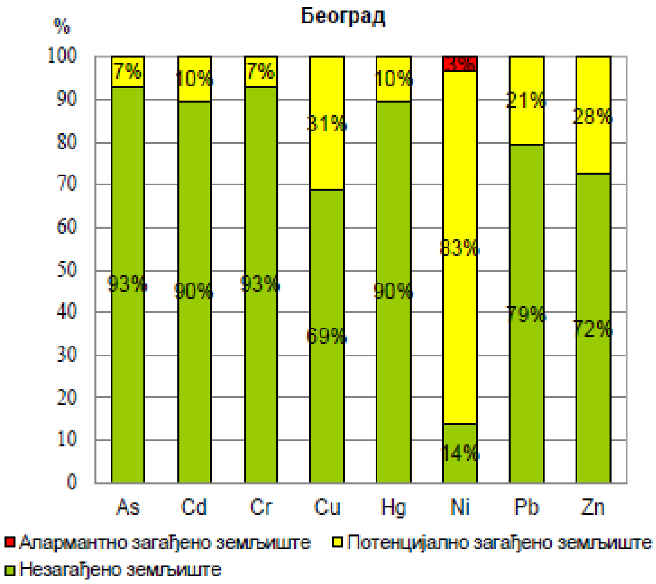


Figure 2.5 shows the exceeded limit and remediation values of the tested parameters relative to the total number of samples, at the depth of up to 10cm, expressed as a percentage.

Soil quality testing programme in the territory of the City of *Požarevac* included sampling and laboratory testing of soil at 30 locations at the depths of up to 10cm and 50cm from agricultural areas, busy roads, parks and areas surrounding water intake facilities. Results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters.

Soil quality testing programme in the territory of the City of *Kragujevac* included sampling and laboratory testing of soil at 14 locations, at the depths of up to 10cm and 50cm, in the area around water sources for the city's water supply, the urban environment, the industrial zone, area around busy roads, the agricultural zone and the city landfill. The results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters.

Soil quality testing programme in the territory of the City of *Kruševac* included sampling and laboratory testing of soil at 33 locations in the territory of the city of Kruševac. The results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters, while 12% of samples is alarmingly polluted according to total nickel content.

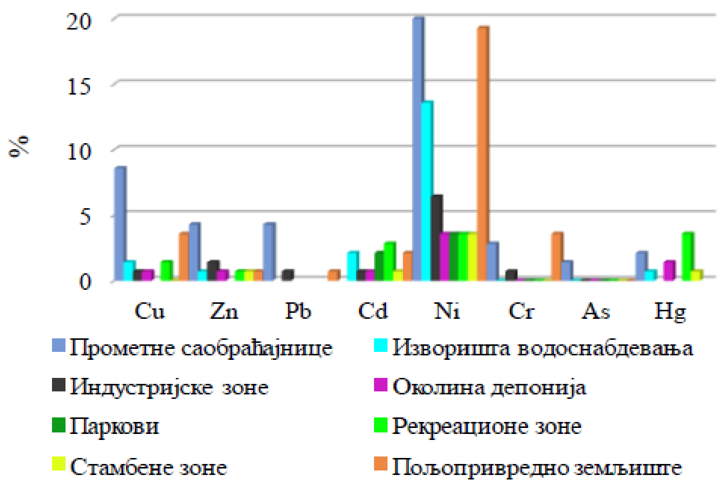
Soil quality testing programme in the territory of the City of *Subotica* included sampling and laboratory testing of soil at 10 locations, in parks, areas surrounding industrial facilities and water intake facilities. The results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters, while 10% of samples is alarmingly polluted according to chromium and zinc content.

Soil quality testing programme in the territory of the City of *Novi Sad* included soil analyses at 5 locations on agricultural and non-agricultural land. The results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters.

Soil quality testing programme in the territory of the City of *Smederevo* included soil analyses at 12 locations in the areas surrounding the industrial zone, city landfill, water intake facility, pre-school institutions and the health centre. The results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters, while nickel content exceeded the limit value in 100% of the samples. Soil quality testing programme in the territory of the City of *Novi Pazar* included soil analyses at 7 locations in the area surrounding the water intake facility, near a nursery, in the city park and on a recreation area. The results indicate that the soil at tested locations is categorised as potentially polluted according to certain parameters.

Based on data from the soil quality testing programme, in 2013 a total of 140 samples from the soil surface layer in **urban environments and on agricultural land** were analysed in and around the following cities: Belgrade, Požarevac, Kragujevac, Kruševac, Smederevo, Novi Sad, Subotica and Novi Pazar. Of the total analysed samples, 66% were taken from urban environments (busy roads, industrial zones, parks, residential areas, water supply sources, areas around landfills, recreation areas), while 34% were taken from agricultural land. Some samples taken from urban environments contained concentrations of Cu, Zn, Pb, Cd, Ni, Cr, As and Hg which exceeded limit values. Zn and Cr exceeded remediation values in 1% of samples, and nickel in 2.15% of samples. Samples taken from agricultural land contained elevated levels of Ni, which is probably of geochemical origin, while increased concentrations of copper most often result from the use of plant protection chemical agents.

Figure 2.6. Exceeded (%) limit values of heavy metals in urban environments and agricultural land in around cities in 2013



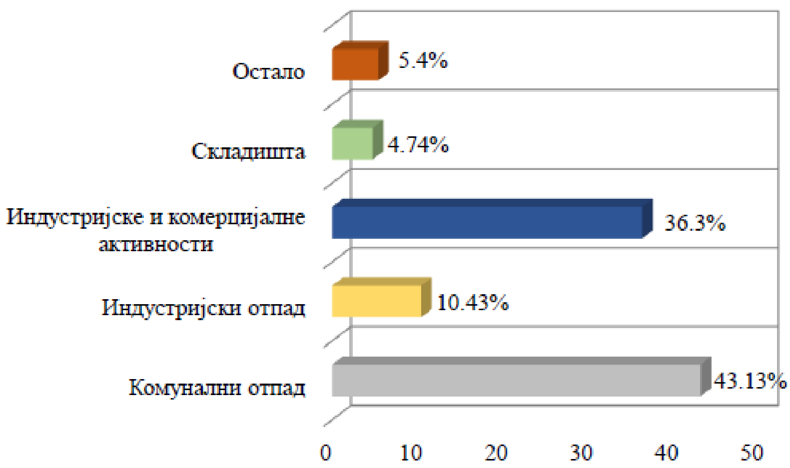
The above chart shows exceeded (%) limit values of heavy metals in urban environments and agricultural land in and around cities 2013. There are 422 identified sites in the territory of the Republic of Serbia which are potentially contaminated or contaminated. By analysing data which relate to management of contaminated sites, it may be concluded that the majority of sites is potentially contaminated. Of the total number of potentially contaminated and contaminated sites, 15.88% were subject to preliminary research, 4.03% were subject to main research, while 80.09% of sites were identified without research.

In 2006, the Agency for Environmental Protection began preparing the national Inventory of contaminated sites. The data are collected via local self-government units and industries.

The data from the Inventory of contaminated sites indicate that in 2013, public municipal landfills made up the largest part of the total sites (43.13%), followed by industrial and commercial sites (36.30%) and industrial waste landfills (10.43%).

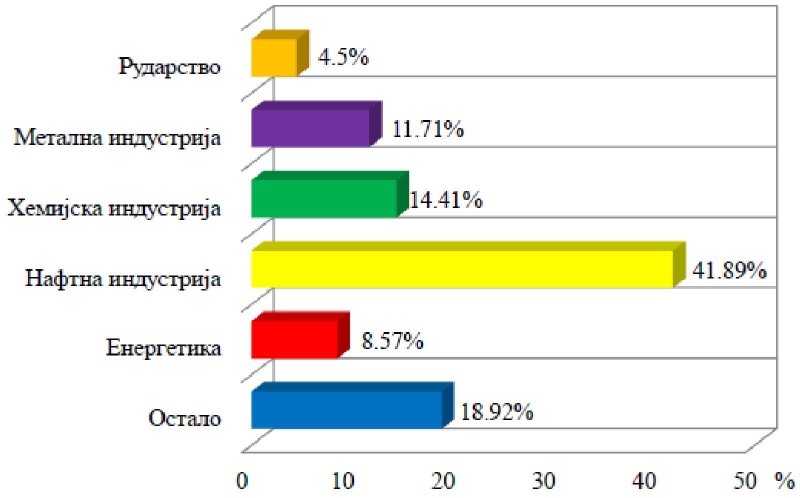
The below chart shows the share of main types of localised sources of soil pollution in the total number of identified sites (%).

Figure 2.7. Share of main types of localised sources of soil pollution in the total number of identified sites (%)



The database of potentially contaminated and contaminated industrial sites includes 222 locations. The highest contribution to localised soil pollution is given by the petroleum industry (41.89%), followed by chemical industry (14.41%) and metal industry (11.71%), while power plants (8.57%) and mining facilities (4.50%) make up a somewhat smaller share.

Figure 2.8. Share of sectors of industry which cause localised soil pollution (%)



The above chart shows the share of sectors of industry which cause localised soil pollution (%). Tests were conducted on agricultural land surrounding the three most significant mining and energy complexes: the Kostolac Basin, Thermal Power Plants Nikola Tesla in Obrenovac and the Kolubara Basin, where exploitation and combustion of lignite are performed. The total number of samples taken from all three sites comes at 344. The results of soil analyses in the surroundings of the above mining and power plants indicate that certain parameters exceeded limit values, in particular Cd, Co, Cu and Ni.

1.2.2.4. Transboundary impacts

As regards transboundary impacts, the most severe water pollution comes from Romania, where the water of the Begej, Tamiš, Zlatica, Karaš and Nera rivers are below the required class. Accidents such as the cyanide spill in the Tisza River from the gold mine in northern Romania, and spills of tailings, left an environmental disaster in their wake, with long-term consequences to the ecosystem in the Republic of Serbia. The Republic of Serbia cooperates with other countries in the region as regards the control and impacts of transboundary pollution. International cooperation primarily refers to the quality of water in the Danube, the Sava, the Tisza, the Tamiš and the Drina rivers. The water in the Danube is particularly important for the Republic of Serbia, chiefly for its water supply and protection of South Bačka and South Banat groundwater against pollution. The pollution of the Danube reflects on the quality of the water in Lake Đerdap. Developing regional cooperation in the field of water resource management is hugely important. To this end, by ratifying the international Convention on Co-operation for the Protection and Sustainable Use of the River Danube and signing the Framework Agreement on the Sava River Basin, the following is implemented: sustainable water management, regulation of use, protection of water and the aquatic ecosystem, as well as protection of water against adverse effects. Potential transboundary pollution of water in the countries down the Danube (Romania and Bulgaria) can come from Majdanpek and Mining and Smelting Combine Bor (mines, mills, smelting plant and refinery) via the rivers the Borska, the Pek, the Timok, the Kriveljska and the Danube. Transboundary pollution of the countries down the Danube is possible via the Sava River (towns Šabac, Barič), and transboundary pollution of Bosnia and Herzegovina via the Drina River (towns Ljubovija, Zajača, Krupanj).

1.2.3. Elements of the environment exposed to impacts of hydroelectric power plants

Hydroelectric power plants (HPPs) cause environmental impacts which can be both negative and positive. Negative impacts are reflected in the changes to the aquatic ecosystem of reservoirs and the riparian ecosystem, which are permanent and require continuous monitoring and protection measures. Unless protection measures are undertaken, different processes take place in reservoirs of HPPs which cause significant degradation in water quality due to the introduction of organic matter and waste to the reservoirs. However, protection measures, primarily in terms of introduction of nutrients, can help slow down or even prevent the problem of reservoir eutrophication. There are numerous extremely affirmative examples across the world which show that measures for treating wastewater released into reservoirs and preventing the discharge of nutrients have reversed and improved the processes in lakes, even returning some reservoirs from eutrophic to oligotrophic state – which is the highest quality of water. Earlier problems concerning fish migration can now be solved with a great degree of success by setting up structures which facilitate fish movement (fishways, fish locks, etc.), or by producing spawn in hatcheries and systematically stocking new areas of water.

Positive impacts of reservoirs, especially those which balance flow throughout the year, generally concern the improvement of conditions during low flows. In critical low-water conditions, when all aquatic and riparian ecosystems are threatened (these conditions most frequently coincide with periods of extremely high temperatures, with extreme negative synergetic impacts), water can be released from reservoirs in order to increase the flow downstream from dams, thus considerably improving the environmental conditions in the entire downstream section of the river. The positive impact is further enhanced by setting up so-called selective water intake facilities with the option of releasing environmental flows from the most favourable temperature layer of the reservoir. This enables the management of both the quantity and temperature of water, enabling the achievement of optimum conditions for all aquatic ecosystems in rivers even in critical water level and temperature conditions. Furthermore, with adequate targeted management, reservoirs enable the achievement of drastic improvements of environmental conditions for fish in spawning seasons: during spawning season, water level in the reservoir is stabilised, particularly in shoals where fish deposit their spawn, preventing the spawn and roe from dying out, which otherwise happens in natural conditions because of changing levels during spawning season and the development of fish roe (because spawn ends up on dry land due to lower water level).

Impacts of notable power plants

Hydroelectric power plants (HPPs) in the HPPs Đerdap system include: HPP Đerdap 1, HPP Đerdap 2, HPP Pirot and Vlasinske HPP.

Hydroelectric power plant Đerdap 1

Location: The plant is located 10km upstream from Kladovo, 943km from the mouth of the Danube at the Black Sea. The hydropower and navigation system Đerdap 1 is a complex multipurpose facility. It is still the largest hydro-technical facility on the Danube. It is completely symmetrical, designed in the way that each country (Serbia and Romania) has equal parts of the main facility at its disposal, which they maintain and use according to the agreement and conventions on construction and exploitation. It is a run-of-the river hydroelectric power plant.

Relief: Relief of the terrain is complex and very diverse, composed of tectonic forms (mountains and valleys) and terrain formed by exogenic processes – paleo-abrasion relief, fluvial-denudation plateaus, karsts both on and beneath the surface, aeolian forms. There are two zones in the reservoir: the downstream, mountainous zone (Miroč, Severni Kučaj) and the upstream zone, upstream from Golubac, characterised by plains, on the edges of the ancient Pannonian Sea. The backwater formed by the HPP Đerdap 1 extends roughly to the confluence of the Tisza River, to the lower water level at the dam on the Tisza near Titel. Riparian areas in this lowland zone are protected by embankments and drainage systems.

Geological features: Almost all types of rocks can be found, formed during all geologic periods: Paleozoic crystalline schist, Permian red sandstones, Mesozoic sandstones and dolomites, Paleogene-Neogene sediments, Quaternary deposits of marl and quicksand and plutonic and volcanic rocks.

Morphological aspects: Main morphological elements include the Đerdap Gorge and lower and medium-high mountains with valleys between them. The gorge is 100km long and connects the Pannonian basin with the Pontic basin, cutting through the Carpathian mountains.

Climate: It is located at a climate boundary zone between steppe climate of the Pannonian plain, moderate-continental climate of the south edge of the Pannonian basin (Šumadija) and true continental climate of the lowland of Vlaška.

Hydrological characteristics: The Danube River, identified as the Pan-European transport corridor 7 is a vital connection between Western Europe and countries of Central and Eastern Europe. The Đerdap Lake was formed by the construction of a 54m high and 760m wide dam. The lake is 140km long and 130m deep. It extends between Sip and Ram. The discharge of the Danube can be highly uneven, so at the profile Veliko Gradište (average discharge of around 5,470m^3/s), it ranges from as little as 1,300m^3/s, or even less in extreme low flows, to over 16,100m^3/s, which is the level of the 1% probability flood. The discharge ratio exceeds 1:12, demonstrating the complexity of both the system for protection against floods and the system for protection of the aquatic ecosystem, which is particularly threatened during low flow periods, which are becoming increasingly long and unfavourable.

Soil and groundwater: The creation of the Danube backwater resulted in changes in the groundwater regime in the riparian area. Groundwater level is higher, but its oscillations have been mitigated. Complex drainage systems have been built to preserve the groundwater level in the riparian area within the predefined limits set out in the project. Given its importance for impact analysis, the criterion is as follows: • protection of agricultural areas: groundwater dip level in the duration of 1% must not be smaller (shallower) than 0.8–1m from the surface of the terrain; • protection of settlements: groundwater dip level in the duration of 1% at the depth no smaller than 3m from the surface for large settlements, and 2m for villages. The issue of maintenance of protection systems is now heightened because drainage systems are the weakest in this respect, as their effectiveness can deteriorate drastically if they are not properly maintained. There have been reports in some riparian areas that these criteria are not met, precisely because of inadequate system maintenance.

Water quality: According to basic physical, chemical and biological quality indicators, the water in the reservoir meets the prescribed quality requirements for class II waters. As regards hazardous materials, high concentrations of phenol matter and mineral oil are occasionally registered in the water, which can be linked to the fact that the Danube is one of the largest navigation routes. The content of other hazardous substances and materials in the water is within the permitted limits for class II waters (heavy metals, polychlorinated biphenyls, polynuclear aromatic hydrocarbons, radionuclides).

Floating debris: The current level of urbanisation, industry and utility infrastructure has resulted in the occurrence of a large number of different concentrated and dispersed pollutants upstream from the hydroelectric power plant. Solid wastes from many illegal landfills located at the banks of the reservoir, along with untreated wastewater and used water, generate a large amount of floating solid waste which accumulates upstream from the hydroelectric power plant, leading to problems in the operation of the plant and its ancillary facilities.

Noise: So far, noise levels have not been measured in the area surrounding the facilities of HPPs Đerdap (Power Plants Đerdap Limited Liability Company) because hydroelectric power plants are dislocated from settlements and, as such, are not factors of this type of environmental risk.

Waste: Municipal and floating waste collected from the surface of the water and in the grilles in front of hydro-generators at the entrance facility of the hydroelectric power plant is transported to the landfill built near Davidovac on regular basis. The landfill is arranged and secured in accordance with the relevant regulations. However, huge quantities of floating waste have become one of the HPP’s greatest problems, as they have piled up and consolidated in the area of the dam where water does not flow, and the conditions are becoming increasingly difficult for the removal, transport and disposal of such consolidated material.

Wastewater: Approximately 100 million m^3 of technical water and 20,000m^3 of sanitary wastewater is discharged from HPP Đerdap 1 per year. Technical water is mostly cooling water used for turbine cooling and it is discharged into the Danube as such. Cooling water contains small amounts of oil.

Hazardous materials: In HPP Đerdap 1, there are 12 transformers filled with transformer oil which contains PCBs. Other hazardous materials include turbine and hydraulic oils which are stored in the central storage facility. The oil service unit contains 16 reservoirs with 30m^3 of oil each. HPP Đerdap 1 uses a relatively small amount of chemicals which may be considered dangerous. For this reason, both power plants are not a source of danger in this regard.

Other impacts: geological stability – there are no relevant negative impacts; impact on flora and fauna due to changes in water level – there is a minor, but relevant impact of preventing migration of beluga and sturgeon, considering that a fishway was not constructed[17]; impact on

[17] During the design and construction stages of HPP Đerdap 1, a partial solution of this problem was envisaged in the form of the construction of a hatchery for the production of spawn in Vrbica, downstream from Kladovo. However, during transition times, the HPP lost ownership of the hatchery, which was privatised, so the good environmental intention is no longer viable. The pressure of environmentalists from Europe is increasingly

locally higher relative humidity – this impact is minor, as the lake surface is mostly kept within the limits of the channel for high flows; impact on water quality in the lake – the trophic state of the lake is maintained at the acceptable mesotrophic level; erosion downstream along river banks due to fluctuations in river water level – there are no relevant adverse impacts.

Hydroelectric power plant Đerdap 2

Location: The plant was constructed 80km downstream from HPP Đerdap 1. HPP Đerdap 2 is the second hydroelectric power plant on the Danube built by Serbia and Romania together. It was built 863km from the mouth of the Danube at the Black Sea, at the Kusjak-Ostrovul Mare profile. This system represents a complex and multipurpose hydro-technical facility. It consists of the main power plant, two additional power plants, two spillway dams, two water locks, and two switchgears. One of each two mentioned facilities belongs to Serbia and Romania respectively. Considering that Serbian-Romanian border is between these facilities, each side maintains and exploits its part of the system without interruption. Đerdap 2 is a run-of-the river hydroelectric power plant.

Relief: The relief is complex and very diverse, represented by tectonic forms (mountains and valleys) and the terrain formed through exogenic processes – paleo-abrasion relief, fluvial-denudation plateaus, karsts found both on the surface and beneath it, aeolian forms. The majority of the reservoir is located in the valley parts of Ključ and the Negotin lowland, which necessitated complex systems of riparian area protection.

Geological features: Almost all types of rocks can be found, formed during all geologic periods: Paleozoic crystalline schist, Permian red sandstones, Mesozoic sandstones and dolomites, Paleogene-Neogene sediments, Quaternary deposits of marl and quicksand and plutonic and volcanic rocks.

Morphological relief forms: The main morphological elements of the relief in the Danube hinterland are the karstified foothills of the Miroč, Veliki Greben and Deli Jovan mountains, while the flow of the Danube included in the Đerdap 2 backwater extends to a region of plains, the valley of Ključ and a part of the Negotin lowland.

Climate: It is located in a climate boundary zone between steppe climate of the Pannonian plain, moderate continental climate of the south edge of the Pannonian basin (Šumadija) and true continental climate of the lowland of Vlaška.

Hydrological characteristics: The Danube River, identified as the Pan-European transport corridor 7 is a vital connection between Western Europe and countries of Central and Eastern Europe. The Đerdap Lake was formed by the construction of a dam 54m high and 760m wide. The lake is 140km long and 130m deep. It extends between Sip and Ram. The remark about the extremely uneven discharge of the Danube which applied to HPP Đerdap 1 is also relevant here. During low flows (when discharge drops below 1,300m^3/s), there are sometimes restrictions for navigation in the river channel downstream from the dam. It should be taken into account that, due to increasingly intensive abstraction of water from the Danube and its

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higher to construct fishways on the system. However, the technical implementation of that would be extremely expensive and complicated, not to mention a very important electrical and economic fact: the loss in electric power caused by the water consumed by potential fishways on both sides of the Đerdap system would greatly outweigh the sum of all energy output which is planned on all small HPPs in Serbia.

larger tributaries in the countries upstream, discharge in the Serbian part of the river is declining – which is apparent in these critical low-water conditions.

Suspended debris: At all measured profiles in the reservoir of HPP Đerdap 2, content of suspended matter was under 10mg/l. A decrease in the concentration of suspended matter was recorded along the watercourse during April, while values measured in June and September were very low and uniform along the entire watercourse.

Floating debris: The problem of floating debris is particularly pronounced in the period of high water levels when a great amount of wood waste, plastic package waste, and other floating waste originating from different sources of pollution upstream from the plant accumulate on the grilles in front of generators. This waste is collected by special lifting equipment – so-called "sweepers", and transported to the industrial landfill of HPP Đerdap 2.

Water quality: According to all basic physical, chemical and biological indicators, the water in the reservoirs meets the prescribed quality requirements for class II waters. Water quality in the reservoir is a direct result of the quality of water which flows into the reservoir.

Wastewater: Sources of wastewater from the main and additional power plant of HPP Đerdap 2 include water from sanitary blocks and cooling systems of generators and block-transformers. The quality of wastewater from HPP Đerdap 2 is monitored on quarterly basis. All prescribed water quality indicators are monitored according to the Regulation of Water Classification (RS Official Gazette, No 5/68), as well as according to the Regulation on limit values of pollutants in surface and ground waters and sediments, and the deadlines for their achievement (RS Official Gazette, No 50/2012). Considering that all technical and sanitary water is discharged into the Danube in the same place, the cumulative impact of wastewater and technical water is monitored.

Hazardous materials: In HPP Đerdap 2, these include hydraulic oil and turbine oil in auxiliary systems of generators, while spare amounts of these oils, as well as transformer oil, are stored in the central storage facility. Oils used in HPP Đerdap 2 are PCB-free. Transformers are constructed above impermeable reservoirs in order to prevent oil spillage into the river even in case of transformer damage.

Waste: Waste is collected in locations where it is generated and is then transported to the plateau in front of the central storage facility in Kursjak, which is located within the HPP Đerdap 2 complex. Hazardous waste is stored in the storage facility for hazardous materials in Kusjak. The storage facility and its surrounding area are arranged in accordance with the relevant regulations. In HPPs Đerdap, there is an ongoing process of introducing a waste management system (sorting, classification in locations where it is generated and processing for further treatment). Oil purification is carried out in the purification facility within the main hydroelectric power plant. The purified oil is reused so long as its properties remain satisfactory, while waste sludge from oil is collected and disposed of in the storage facility for hazardous waste, from where it is delivered to institutions authorised for further waste treatment.

Noise: So far, noise levels have not been measured in the area surrounding the facilities of HPPs Đerdap because hydroelectric power plants are dislocated from settlements and, as such, are not factors of this type of environmental risk.

Other impacts:

- Microclimate change in the reservoir of HPP Đerdap 2 – there is no negative impact of the reservoir relative to its natural state, as the surface of the water stays in the main channel of the Danube, only its level is now higher;
- The recreational use of reservoir banks is not significantly hampered by water-level fluctuations, since the run-of-the-river operation of the power plant keeps the water level generally stable, even more so than in the natural state (which was defined by the plant limitations), which can best be seen from the popular Kladovo beaches, which are famous tourist destinations;
- Disturbance of the natural surface water regime is not unfavourable for tourism of the water area, as the levels are quite stable and conducive to all water-based activities, so this is in fact a positive impact, as the water level is now managed in an effective way, also in respect to the improvement of the water level compared to its natural state;
- Level of groundwater along the reservoir is controlled using drainage systems, while an accompanying positive impact of those systems is the lake – retention basin in the very city of Kladovo, in accordance with the obligation that groundwater levels should be below 3 m from the surface of the ground. In this lake – retention basin, the constant level of high quality water is maintained by a pumping station. This small lake fits extremely well in the urban hub of the city, hence a beautiful recreation centre was constructed here, along with a rest stop for birds (swans) during their migration;
- Since the reservoir is located in a flat alluvial area ("Ključ"), there is no relevant risk of potential landslides;
- Great daily water-level oscillations of the Danube are kept in the prescribed boundaries under normal circumstances, which is conditioned not only by social and environmental, but also navigation reasons, making this impact irrelevant;
- Adverse impact of protective embankments along the "Ključ" valley on the inflow of small watercourses (the Velja Mare, the Velika River, the Grabovica, the Slatinska River, etc.) into the Danube was offset by pumping stations. However, the issue of drainage of the riparian area and settlements in conditions of extremely high water level was not resolved, which led to severe problems in May 2014;
- There are no fish migration structures and their implementation would also be very complex, expensive and problematic in terms of electrical energy output; thus, hatcheries for the production of spawn for fish stocking should be restored.

Hydroelectric power plant Pirot

Location: It is located in the territory of southeast Serbia, between the town of Pirot and the Serbian-Bulgarian border. The hydroelectric power plant uses water from the Visočka River at the profile of the Zavoj dam. It is an hydroelectric power plant with an impoundment reservoir which balances flow throughout the year, making it particularly valuable for the water management system, as well as for the environmental system in the entire length of the Nišava River downstream from Pirot to the mouth.

Relief: The mountains were formed during the Alpine orogeny. They constitute the western part of the Balkanides confronting the Meridian Carpathians and creating an arch-shape mountain belt. The mountains include Stara Planina and Suva Planina, Svrljiške Planine, Ozren and Devica, Tupižnica, Tresibaba, and Belava. The Pirot valley is a part of the composite valley of the Nišava River.

Geological features: Mesozoic rocks. The types of rocks include different colours of sandstones and conglomerates. Limestone and dolomitic limestone cover a very large area, while alevrolites and sandstone shale are imbedded in carbonate rocks. The belt close to the river is composed of eluvial-diluvial deposits. Concerning the geological rock formation, the terrain is almost always composed of mixed rocks, which therefore often form a flysch.

Climate: Valley and sub-alpine climate, more continental than moderate-continental climate. Lower amounts of precipitation (around 800 mm) than expected for high mountains.

Hydrological characteristics: Due to scarce precipitation, mountains are mostly dry, without water sources and streams of greater importance. The Nišava, the Timok, the Moravica, and the Visočica rivers are the major watercourses in the region. There is also the Zavoj artificial lake. Water sources and strong springs (Čitlučko – strong spring of the Moravica river) are found at foothills (a water source just below the Vražja Glava peak of the Stara Planina mountain). Considering the high irregularity of water regimes, which is particularly unfavourable in this part of Serbia, the existence of a reservoir with seasonal flow balancing indicates the significance of that system in the environmental sense, because it enables the improvement of water regimes during low flows. A fine example of high irregularity of water regimes is the Visočica River (water station Visočka Ržana), where the ratio between average flow ($5.44m^3/s$) and low flow $Q_{95\%}$ ($0.3m^3/s$) is 1:18, while the ratio between $Q_{95\%}$ and the high flow $Q_{1\%}$ is close to 1:1000!

Vegetation: Considering that it is a mountain area, the existing forest cover is insufficient to protect soil against erosion. A great part of the land area is covered by degraded forests and underbrush which do not offer sufficient soil protection against erosion.

Waste: In HPP Pirot, according to amount of waste, only some types of waste are separated in an organised way, while other, non-hazardous, types of waste are disposed of in municipal landfills. Depending on the type, waste is collected at three locations. Waste oils and liquids are collected and stored in the storage facility for oils and lubricants before being delivered to companies which are authorised for waste treatment.

Wastewater: HPP Pirot discharges approximately $200m^3$ of sanitary wastewater per year into the Pirot sewage system. Depending on the duration of hydro-generator operation, an average of approximately $330{,}000m^3$ of technical water is discharged per year. Technical water is mostly cooling water which is used to cool generators and hydro-generator bearings and, as such, it is discharged into the drainage canal. Due to higher pressure in the cooling water system than the oil pressure, it is unlikely that significant amounts of oil will get into the water. A smaller amount of technical water, approximately $10{,}000m^3$, is actually drainage water which is collected at the hydroelectric power plant and pumped into the drainage canal.

Hazardous materials: There are 2 large transformers (45 MVA) and 6 small ones (100 – 1,000kVA) in the hydropower plant. Transformer oil is PCB-free. Other hazardous materials include hydraulic oil and turbine oil which is stored in the storage facility. The oil is tested on a regular basis, while the turbine oil is dried and filtered every year during the overhaul of the hydropower plant. The transformers are constructed in the manner which prevents oil from getting lost in the drainage canal, even in case of damage.

Other impacts:

- The change (reduction) in the flow regime of the rivers Visočica and Temštica on the section downstream from the dam to the confluence with the Nišava River is not only compensated, but the flow is enhanced by ensuring the release of the guaranteed environmental flow, in the volume of two minimum natural flows, and the option exists to increase the flow even more during extreme low flows ("enriching" low water levels);
- The change (increase) in the flow regime of the Nišava River in the section downstream from the inflow of the drainage canal of the HPP is not a negative, but rather a positive impact, especially during low flows, because the aligned work of the HPP for environmental needs during low flows, with the higher release of clean water from the Zavoj Lake, can significantly improve the ichthyological conditions in the Nišava in critical periods, when small flows coincide with high water temperatures, creating a highly unfavourable synergetic effect of oxygen deficiency in the water;
- The change in the micro-climate in the narrow strip around the Zavoj reservoir (band of around 300–500m, by analogy with highly detailed research conducted in reservoirs with similar properties) is not a negative, but rather a positive impact, since the large mass of water with a high thermal capacity actually stabilises extreme temperature oscillations (increases low and reduces high temperatures), which is attested by the tendency of people to construct their vacation houses exactly in this strip around reservoirs;
- The retention capacity of the reservoir is a very positive environmental impact, as it considerably alleviates flood waves, one of the most dangerous forms of natural disasters to the environment;
- Recreational use of reservoir banks is difficult due to water-level fluctuations.

Hydroelectric power plant Vlasina

Location: A series of four impoundment hydroelectric power plants are positioned in steps from the Vlasina River to the town of Vladičin Han. The system includes HPP Vrla 1, Vrla 2, Vrla 3, Vrla 4 and PAP Lisina (Pumping Station). The main element of this system is the Vlasina Lake, created by the construction of an earthfill dam on the Vlasina River, which also receives water from the Bitvrđa village watershed and the Romanovska and Masurčka rivers. The highest elevation is 1,213m.a.s.l, volume of the reservoir is $168\times10^6m^3$ and its surface area $16.5km^2$. Water is taken from the reservoir and directed through tunnels to the cascade of four HPPs. Within the Vlasina HPPs system, on rivers Božica and Lisina, a large pumped storage plant, PAP Lisina was built, with the aim of pumping, when necessary, the water from the Lisina Lake into the Vlasina Lake (the main reservoir of the Vlasina HPPs system). This HPP is an impoundment hydroelectric power plant, and is currently the most valuable reservoir in Serbia, one of the few with the ability of partial multi-year balancing of flow.

Relief: The relief is composed of deep narrow valleys and old rocks with erosion surfaces in mountains Vardenik, Čemernik and Gramada.

Geological features: Old rocks (gneiss, granite), extrusive igneous rocks (andesite) are also frequently found, while limestone is rarely found in the area.

Climate: Climate is sub-alpine with cool summers and cold winters. Despite the high elevation of the area, annual precipitation is low at around 800mm.

Hydrological characteristics: The Vlasina Lake and the rivers Vlasina, Vrla and Lužnica are in the north, while the Pčinja and Božićka rivers are in the south.

Waste: Temporary, partially arranged landfill is located near the central workshop on HPP Vrla 3. Hazardous waste and transformer and turbine oils are stored in the storage unit which meets legal requirements.

Wastewater: An average amount of 6.5x106m^3 of wastewater originating from cooling systems, as well as approximately 60x10^{3}m^3 of sanitary wastewater is discharged from Vlasina HPPs per year. This water is discharged from the hydroelectric power plants without prior treatment.

Waste materials: In Vlasina HPPs, there are 18 transformers containing 7–25t of transformer oil each and 15 smaller transformers containing 0.4–0.8t of transformer oil each. In HPP Vrla 3, there is a central storage facility for storing all types of oil used in the system. All HPPs have auxiliary storage units for storing certain amounts of technical oil. Technical oil regeneration is carried out occasionally, while a certain amount of waste oil is later sold to authorised companies. The transformers are constructed above impermeable chambers, preventing oil from flowing into the watercourse even in the case of a hazard.

Groundwater: Six reservoirs are conceived so as to prevent adverse environmental impact of groundwater created under the influence of reservoirs, except in case of landslides which occur on reservoirs of Lisina and HPP Vrla 2.

Other impacts: The very concept of the Vlasina system, implying the use of water from natural watercourses, redistribution of water between river basins and finally the construction of 6 reservoirs, 4 hydroelectric power plants and 1 pumping plant with all accompanying infrastructure in the area of 520km^2, implies significant impacts of the system on the environment. In numerous ways, these impacts are positive: the Vlasina Lake is an environmental rarity in Serbia, a haven of biodiversity; the lake and its surroundings are a tourist gem in Serbia; water regimes can be improved in periods of low flow in the section the Vrla – the South Morava rivers; regimes during high water periods are improved owing to high retention capacity of the reservoir; the lake and basin area are one of the most regionally important sources of water, etc.

Hydroelectric power plants on the Drina River

Location of HPP Bajina Bašta: The run-of-the-river hydroelectric power plant Bajina Bašta in Perućac is the largest hydropower facility built on the Drina River. A concrete dam 90m high and 460m long was built across the Drina River. The reservoir extends to a length of 52 kilometres towards the town of Višegrad. Normal water level is 291 m.a.s.l, and the volume 340×10^6m^3.

Location of RHPP Bajina Bašta: The reversible hydroelectric power plant RHPP Bajina Bašta is of a derivative type, with an impoundment. The upper reservoir – Lazići – Zaovine Lake (normal water level = 880 m.a.s.l, volume 340×10^6m^3) is located in the valley of the Beli Rzav River, while the lower reservoir is a lake of the existing HPP Bajina Bašta. It is a reversible hydropower plant. With installed capacity of around 620MW and the ability of flow balancing, the RHPP is one of the most valuable European facilities of the kind, for it provides a highly valuable operating reserve of the electric power system.

Location of HPP Zvornik: It was built 93 kilometres from the confluence of the rivers Drina and Sava. It is a run-of-the-river hydroelectric power plant.

Relief: The relief is composed of narrow valleys with and old mountain rocks with erosion surfaces, as well as numerous medium-high and high mountains. Almost all genetic relief types (except for aeolian) can be found: tectonic, fluvial-denudation, paleo-abrasive, paleo-volcanic, karsts, and rarely even glacial. Mountainous relief dominates. In the hinterland of the HPP Bajina Bašta rests the Tara mountain, the location of the Zaovine Lake for the RHPP, which has become an aquatic ecosystem of great value in a high quality oligotrophic state.

Geological features: slate, serpentinites, limestone, igneous rocks (more extrusive than intrusive rocks), lake sediments. Impermeable rocks dominate, though limestone can also be found.

Climate: Moderate-continental climate, with higher relative humidity after the creation of artificial lakes in Perućac and Zaovine, with positive impacts in terms of moderating temperature extremes.

Hydrological characteristics: The Drina River with tributaries – small rivers the Pilica, the Rača, and the Rogačič. An artificial reservoir, the Perućac Lake, was built on the Drina River. The Drina flow is highly irregular: at the Bajina Bašta profile Qsr=331m^3/s, low flow $Q_{95\%}$=53.5m^3/s, while the high flow is $Q_{1\%}$=6,600m^3/s. Floods last for short periods of time, around one day, characterising the Drina as a torrential river.

Other impacts: geological stability was locally threatened only when the Bajina Bašta lake was completely emptied during the construction of the RHPP; impacts on flora and fauna due to changes in water level; impacts on local increase in relative humidity, but a positive impact on the moderation of temperature extremes; impacts on water quality is irrelevant because water quality in the lake and downstream from it is maintained at a high quality level; downstream changes in bank erosion rates due to water-level fluctuations – at the level of local disturbances which can be meliorated with regulating structures – revetments. A highly significant positive impact is provided by the option to improve the regime of low flows through targeted management of the reservoir. The Lazići reservoir, with the highest quality (oligotrophic) state, enables the improvement of critical water quality conditions through targeted water management.

Hydroelectric power plants on the Lim River

Location of HPP Bistrica: Located on the Lim River between the towns of Prijepolje and Priboj. It is an impoundment hydroelectric power plant, as it uses two upstream reservoirs (Uvac and Kokin Brod) with annual flow balancing, while the Radoinja Lake is only used as a balancing reservoir which enables the smooth operation of HPP Bistrica at peak power in line with HPP Kokin Brod.

Location of HPP Potpeć: It is located on the Lim River near the Pribojska Banja spa. It is a run-of-the-river hydroelectric power plant.

Location of HPP Kokin Brod: The dam and hydroelectric power plant Kokin Brod were built on the Uvac River. The construction of the dam led to the creation of the Zlatar Lake, 28km in length, with a reservoir with partial multi-year flow balancing (normal water level =

888 m.a.s.l, volume $273\times10^6m^3$). It is a highly valuable impoundment hydroelectric power plant, as it is utilised for electricity production at all downstream steps – HPP Kokin Brod, HPP Bistrica, HPP Višegrad, HPP Bajina Bašta and HPP Zvornik.

Location of HPP Uvac: The Uvac River was dammed for the needs of the hydroelectric power plant, thus creating the Uvac (Sjenica) Lake. It is an impoundment hydroelectric power plant with partial multi-year flow balancing (normal water level = 880 m.a.s.l, volume $213\times10^6m^3$), and its value is seen in the electricity produced along the entire Uvac, Lim and Drina cascade of HPPs. It is particularly valuable because of the high water quality, and it represents one of the most significant sources of water of national importance.

Relief: The relief is divided by narrow valleys and gorges. There are medium-high and high mountains with valleys. All genetic relief types, except for aeolian, are found in the region:

- tectonic relief – mountains (Tara, Zlatibor, Golija and Rogozna), valleys (Novopazar and Sjenica valleys and secondary valleys: Ivanjica, Arilje, Tutin, Priboj and Prijepolje valleys);
- fluvial-denudation – composite valleys of the Lim and the Golijska Moravica rivers, as well as narrow valleys of the Mileševica and the Uvac rivers;
- karsts – Pešter Field, Koštam Field, Ušac glacial system, the Tubić, Potpećka and Stopić caves;
- glacial relief – on the Golija mountain.

Geological features: The terrain features diverse composition, from Paleozoic shale to lake and Quaternary river sediments. Slate, limestone, serpentinites, igneous rocks and sediments can be found.

Climate: More sub-alpine than moderate-continental (in the north).

Hydrological characteristics: The Lim River is the most water-rich tributary of the Drina River. The Lim forms a composite valley. Upstream from Priboj, the Lim is dammed to form an artificial lake (Potpeć Lake). The valley of the Uvac River, the Lim's tributary, features two reservoirs with partial multi-year flow balancing – the Uvac and Zlatar Lakes, as well as the Radoinja reservoir, as a balancing reservoir from which water is directed to HPP Bistrica via a tunnel. The Uvac River is the greatest tributary of the Lim flowing from the eastern part of the Drina river basin. Many mountain streams flow down the northeast slopes of the Ozren mountain and join to form the source of the Uvac River. The total surface area of the Uvac basin is $1{,}344km^2$, while median elevation is 1,300m above sea level. The river is 115km long with the height variation of 657m. The Uvac River has high hydropower potential. The most significant hydrographic elements in the region also include the rivers Raška (60km), Golijska Moravica and Rzav. This is the largest potential source of high quality water in Serbia, with the ability to direct water from the Zlatar Lake towards the Great Rzav, and via the course the Great Rzav – the Moravica – the West Morava – towards central parts of Serbia, which are lacking in high quality water.

Impacts of waste: The power plants do not produce any waste matter which can impact the environment. However, a very troubling issue is the impact of the waste from the surroundings on reservoirs and power plants. The Sjenica landfill practically rests on the shore of the Uvac, thereby endangering this precious reservoir, which is a water source of national importance. The reservoir is also threatened by wastewater from Sjenica and the Štavalj mine. The notion of issuing a concession to construct the thermoelectric power plant

Štavalj is very dangerous, as it would lead to radical worsening of the conditions in that part of the basin, with highly unfavourable impact on all reservoirs on the Uvac. The condition in the Lim valley is already alarming. There is a large landfill in the riparian area of the reservoir of HPP Potpeć, which threatens the lake. However, there are numerous landfills along the entire length of the Lim in Serbia and in particular in Montenegro. These landfills are located directly along the channel of the Lim and its tributaries, and are frequently situated in the zone of the high flow channel (this appears to be entirely intentional, because high flows transfer the waste to the neighbours downstream!). The results are devastating: huge quantities of floating waste reach the Potpeć Lake and wash upon the dam. This is a very serious problem that Serbia cannot fix on its own, by managing its own section of the Lim – it can only be solved through bilateral contacts with Montenegro, because the waste that arrives from that country upstream is significantly higher.

Other impacts: In general, reservoirs on the Uvac have a very positive impact on water regimes in the course Uvac – Lim – Drina, as they reduce flooding (due to high retention capacity of the Uvac and Zlatar lakes), so water regimes can be managed in the manner which is the most favourable from the aspect of the social and natural environment. There is no relevant danger of potential landslides and geological stability is not threatened. The impact on the flora and fauna is present, due to the changes in the natural regime of flow, but, principally, these new conditions enrich biological diversity. While there are local impacts on the increase in relative humidity, there is a positive impact on the moderation of temperature extremes. Water quality in the lakes is high, between oligotrophic and mesotrophic states. Even though fish are unable to migrate, the reservoirs are self-contained, rich and diverse aquatic ecosystems. There is danger from pollution from a series of concentrated polluters (Sjenica, Štavelj, the Sjenica landfill on the very bank, numerous vacation houses).

Hydroelectric power plant "Međuvršje i Ovčar Banja"

Location of HPP Ovčar: It is located on the West Morava River at the entrance to the Ovčar-Kablar Gorge near the settlement Ovčar Banja. It is a run-of-the-river hydroelectric power plant.

Location of HPP Međuvršje: It is located at the exit from the Ovčar-Kablar Gorge. It is a run-of-the-river hydroelectric power plant. The process of clogging of the reservoir of Ovčar Banja with sediment is finished, which formed a new alluvial channel in the deposited sediment, with stabilised morphological forms and riparian vegetation which led to the creation of a rich riparian ecosystem with stable biodiversity. The clogging of the Međuvršje reservoir is still ongoing, but the process is gradually slowing down. Morphological forms can be expected to stabilise there as well, as will the ecosystem and biodiversity.

Relief: Striking massifs of Ovčar and Kablar mountains. The West Morava River that flows between these two mountains has cut a huge gorge.

Geological features: The Kablar mountain is composed of serpentinites, limestone, diabase and hornstone, while Neogene sediments are found in valleys.

Hydrological characteristics: The river Morava, together with the West Morava is the largest Serbian river. The Great Morava is 185km long, but together with the West Morava its length is 493km. The Great Morava flows through the most fertile and most densely populated region of Central Serbia called Pomoravlje (the Morava River Valley). The West

Morava flows from the west to the east, separating the Šumadija region from southern parts of the country. At the time of their construction, Međuvršje and Ovčar Banja were the first large HPPs in Serbia. They were built in one of the most beautiful parts of Central Serbia where the river has cut a huge gorge between Ovčar and Kablar mountains. The West Morava is a torrential river. The average flow recorded by the water station Gugaljski Most is around $32m^3/s$. However, in low water periods, the flow falls to as little as below $3m^3/s$, while the so-called 100-year water level is around $730m^3/s$. There are indications that during the May 2014 floods, the flow at the profile of the Ovčar Banja dam exceeded $1{,}250m^3/s$.

Climate: Moderate-continental climate. There are great differences in microclimate between towns and the surrounding mountains, while the climate becomes colder toward the west.

Other impacts: The new morphology of the course of the river was formed in the area of both reservoirs. Potential landslides are irrelevant or inactive, except in isolated locations; geological stability was not jeopardised either, except locally, which was not caused by the reservoir. Flora and fauna are impacted, but biodiversity has not been endangered, as it is now stabilised in accordance with the changed morphological, hydrological and trophic conditions. Relative humidity was increased in a quite narrow strip around the water; water quality in the lake is impacted, but the reservoirs have a slight positive impact on the quality of water downstream; there are no conditions which enable fish migration.

1.2.4. The impact of other multipurpose reservoirs

There are a total of 29 large reservoirs constructed in Serbia, including the reservoir Stuborovni on the Jablanica and Selova on the Toplica, which are completed, but are not operational due to organisational reasons. In addition to the reservoirs which are used for the production of electricity, whose impacts on the environment were presented above, in section 1.2.3, we should also consider the environmental impact of reservoirs with numerous important water management functions. Impacts considered here will pertain to environmental impact, because this experience is valuable for all other planned reservoirs.

Brestovac reservoir (Bor Lake). This is a multipurpose reservoir located on the Brestovac River, a tributary of the Timok. Its primary task is to provide water for technological processes at RTB Bor, but its function of improving water regimes (mitigating floods and increasing low water levels), and its importance as a tourist attraction have also risen. The rockfill dam 54m high, with a 350m long crest, and the normal water level of 639 m.a.s.l, provides the volume of $12\times10^6m^3$. The environmental impact of the reservoir is exemplary, and it is a prime example of how such facilities can be used to enrich the environment while being in harmony with nature. The reservoir turned a watercourse which was doomed to devastation into an exemplary lake which has superbly fit in with its surroundings and now represents an important tourist location. Further, biodiversity has been enriched, while the impact on the social environment was very positive. Since the continued existence of RTB Bor hinges on this reservoir, its economic significance is immeasurable.

Gazivoda Lake on the Ibar. The reservoir, whose dam is situated in the territory of Kosovo and Metohija, was formed by a rockfill dam 108m high, with a 520m long crest. Normal water level is 693 m.a.s.l, and its volume is $370\times10^6m^3$. The reservoir was planned to provide water to settlements and industrial facilities in north Kosovo and mitigate high flows, but the Spatial Plan of Serbia envisaged that in later stages, the water from this large reservoir with annual flow balancing (with elements of multi-year flow balancing as well) should be directed by its natural course, the Ibar, towards areas in Central Serbia poor in water. The reservoir yields many positive environmental impacts: it significantly mitigates floods; it has the option of improving (increasing) low flows of the Ibar, contributing to the preservation and enrichment of biodiversity; as the head reservoir, it would have a positive impact on the function of the entire cascade of Ibar HPPs. Negative impacts include: considerable oscillations of the water level make approach to the water area and its recreational use difficult; the reservoir is subject to clogging by both sediment and waste which is transported via the Ibar, as well as from Montenegro. If the upstream impoundment HPP Ribarić is constructed (at the end of the backwater), the regime of waters in the Gazivoda reservoir will improve, creating better conditions for its protection. Water quality in the lake is still mesotrophic.

Reservoir on the Tisza near Titel. The construction of the 25m high dam with floodgates led to the creation of the backwater zone near the town of Titel, with the dynamic volume (taking account of the level of the backwater) around $160\times10^6 m^3$. The dam and reservoir on the Tisza are one of the most important facilities in the DTD hydro system, as they enable water from the Tisza to be taken and directed to the main channel of the hydro system. The reservoir is in harmony with its surroundings, considering that it is located in the Tisza high flow channel. Upon opening, the high capacity floodgates enable the conditions of normal flow regime during high flows, meaning there are no adverse impacts. There are no adverse impacts on biodiversity either; and it can even be said that the stabilised water area of the Tisza in this zone provides for their enrichment. The backwater of the Đerdap reservoir stretches to the lower water level of the Tisza dam, which enhances conditions for navigation on both rivers.

Reservoir Ćelije on the Rasina. This is one of the most important multipurpose reservoirs in Serbia, and the source of the Rasina–Morava system of public water supply. Its rockfill dam is 52m high, with a 220m long crest, its normal water level is 284 m.a.s.l, and the volume is around $60\times10^6 m^3$. The reservoir is used for the regional public water supply system supplying Kruševac, Aleksandrovac, settlements along the West Morava and the upper course of the Great Morava (Stalać, Ćićevac, Varvarin), even reaching as far as Paraćin. Its role in mitigating flood waves is also very important – its location was selected with this purpose in mind; it also enables the improvement of water during low flows, by releasing clean water in critical periods of low water and poor quality of the Rasina and the West Morava. The reservoir is in harmony with its surroundings. It causes no environmental problems. However, the reservoir, which is used to supply water to people, is faced with severe problems stemming from the upstream sections: landfills of the town of Brus and numerous illegal landfills are located on the very shores of the Rasina; sewage systems of Brus and Blace operate with no water treatment facilities so their wastewater flows directly into the lake; many illegally built vacation houses are situated in the very zone of direct protection and their wastewater is released into the lake as well; there are even some village structures located in the protection zone. While the lake is still in a sound state of mesotrophy, it is threatened by the same danger as the Vrutci reservoir, unless planned sanitary protection measures are undertaken.

Reservoir Bovan on the Moravica. This is a very significant multipurpose reservoir, one of the most important sources of the Lower South Morava regional water supply system. Its rockfill dam is 52m high, with a 151m long crest, its normal water level is 262 m.a.s.l, and the volume is around $59\times10^6 m^3$. As a source of the regional system, its water is used to supply the town of Aleksinac and numerous villages towards the town of Ražanj. It is also very important for the moderation of flood waves, as it has an area designated for this purpose; it also enables the improvement of water during low flows, by releasing clean water in critical periods of low water and poor quality of the Moravica. The reservoir is in harmony with the environment, causing no adverse effects to the climate, which is witnessed by the numerous vacation houses surrounding it. It causes no environmental or social problems, but the problems it faces because of upstream factors are quite serious. Despite the clearly set out provisions of the Rulebook on the protection of water sources and the project of sanitary protection, the entire edge of the reservoir is surrounded by hundreds of vacation houses, quite often located in the very band of direct protection, some even with terraces over the surface of the lake, which release its wastewater into the lake. To make things worse, the water treatment facility of Soko Banja works at very low capacity, making it a source of concentrated pollution. Another source of hazard to the lake is the old sunken asphalt road which descends into the lake, resulting in the lake being used for cleaning cars. The lake enhances biodiversity, it is still in a sound state of mesotrophy, but is threatened by the same danger as the Vrutci reservoir, unless planned sanitary protection measures are undertaken.

Reservoir Vrutci on the Đetinja. This is a very important reservoir, without which the City of Užice and settlements down the Đetinja valley all the way to Sevojno would not have access to a reliable source of water. However, it serves as a warning of what can happen if planned protection measures are not taken in the reservoir's basin, if a small HPP is constructed on the dam in a questionable manner, which abstracts more water than the environmental flow, bringing down the water level of the lake, which reflects on the processes in the lake itself. The reservoir's arch dam, which is 77m high, with a 241m long crest, normal water level of 628 m.a.s.l, and the volume of $54\times10^6 m^3$, is used for annual flow regulation. In addition to providing reliable water supply to Užice and the parts of the valley towards the town of Sevojno, the reservoir is also used for flood protection, as it has an area designated for wave mitigation (it saved Užice from the May 2014 floods), and it also enables the improvement of waters during low flows. The problem of the reservoir lies in the fact that planned protection measures were not implemented at all. Nothing was done in the basin in terms of protection, and as a consequence, wastewater from many facilities, including slaughterhouses and food industry companies, is released into the lake unchecked. The reservoir's processes of self-purification helped it "resist" the processes of eutrophication for a long time, sending out many warning signs, even visual signals (algae on its surface), that its state was reaching critical levels. Since no action was taken even then, the condition drastically deteriorated, causing the reservoir to stop being a safe water source. It is fortunate that protection measures can help bring the lake back into its old functionality, but lessons should be learned and applied with regard to all other reservoirs in Serbia. Without adhering to even the most basic sanitary measures in protection zones, this unacceptable mode of behaviour will invariably lead to negative consequences.

Reservoir Gruža on the Gruža. This is one of the most important reservoirs in Serbia in terms of water management and social benefits. Because of this reservoir, the City of Kragujevac and a part of its surrounding area can survive in the water-deficient area of Šumadija. Its arch dam is 52m high, with a 288m long crest, its normal water level is 270 m.a.s.l, and the volume is $65\times10^6 m^3$. This is a multipurpose reservoir: its main purpose is to supply Kragujevac and its wider surroundings with water; it is also used to moderate flood waves in an efficient manner because the reservoir envisages a special area for this purpose; it can also improve low flows and help in critical situations, by releasing clean water from the reservoir. The reservoir is in line with its environment, and produces no relevant negative impacts. Its construction created an aquatic ecosystem which is more biologically diverse than it used to be in natural conditions. The reservoir causes no environmental or social problems.

However, it does face grave problems caused by its surroundings. Despite the clearly set out provisions of the Rulebook on the protection of water sources and the project of sanitary protection, the edge of the reservoir is lined with numerous vacation houses, quite frequently within the very strip of direct protection. These houses release their wastewater into the lake. Numerous illegal landfills are situated around the lake, often on the very coast. No sanitary protection measures have been taken in the villages upstream, thus wastewater from houses and structures for livestock (barns, pens) flow into the lake. The lake is still in a mesotrophic state, but is in danger of slowly degrading in quality. The problem lies in the fact that, should this occur, the consequences will not be manageable by temporary solutions like in the case of Užice, so Kragujevac could end up experiencing a social, sanitary and political collapse.

Reservoir Grlište on the Grliška River. Eastern Serbia is deficient in water, its waters have highly irregular flow and are characterised by long periods of low flows, which reflect highly negatively on the capacities of alluvial aquifers. For this reason, this reservoir is of tremendous importance, because Zaječar and its greater area would not be supplied by water without it. Its rockfill dam is 32m high, with a 101m long crest. Its normal water level is 193 m.a.s.l, and the volume is $12\times10^6 m^3$. This is a multipurpose reservoir, with the primary function of supplying Zaječar and settlements in its lowland surroundings with water. The reservoir is a very important source of the Timok regional public water supply system. The reservoir has absolutely no relevant adverse impacts on the environment; however, like the abovementioned reservoirs, it is threatened because no sanitary protection measures have been taken. It is particularly endangered because no sanitation measures were implemented in settlements Leskovac, Gornja Bela Reka and Lenovac. These settlements are dispersed, but are still relevant polluters. The quality of water in the lake is still good (mesotrophic state), and the biological diversity of both the lake and the riparian area is undisturbed, even better than in natural conditions.

Reservoir Barje on the Veternica. This extremely important reservoir is the source of the Lower South Morava regional system, which facilitates reliable water supply of the city of Leskovac and its greater area. It has a rockfill dam 75m high, with a crest 326m long. Its normal water level is 382 m.a.s.l, and its volume is $41\times10^6 m^3/s$. This is a multipurpose reservoir – its priority function is to supply settlements with water, but another very important objective is to protect Leskovac from floods, since Leskovac would be unable to defend itself with linear systems of protection. The reservoir can be used to improve regimes of low flows. It is in harmony with its surroundings and the water is successfully preserved in a sound mesotrophic state. It produces no relevant adverse impacts, but sanitary protection measures must be strictly adhered to, although this important task is performed better at this reservoir than at those previously mentioned.

Reservoir Prvonek on the Banjska River. Reservoir Prvonek is an excellent example of the fact that reservoirs are necessary for the reliable provision of water supply to large settlements in water-deficient areas in Serbia. The City of Vranje used to have a very unreliable water source, namely it used around 40 wells in alluvial zones in the riparian area of the South Morava. The South Morava is a river with highly irregular water regimes. Average flow at water station Vransjki Priboj is around $12.9 m^3/s$, monthly low flow $Q_{95\%}=0.60$, $Q_{1\%}=710 m^3/s$, making the ratio of $Q_{95\%} : Q_{1\%} \approx 1:1200$!! For this reason, low flows used to be times of great crises, because the wells shared the fate of the river from which they obtained their water, resulting in their supply either diminishing greatly or drying out altogether in prolonged periods of low water. The sole reliable source of water was the Prvonek system. Its rockfill dam is 88 m high, with a 250m long crest. Normal water level is 618 m.a.s.l. and it provides a volume of $20\times10^6 m^3$. While this is a multipurpose reservoir, its predominant purpose is the supply of water to Vranje and lowland settlements around it. The reservoir is among the most important sources of the Upper South Morava regional water supply system, but it also has the function of moderating flood waves and improving low flow regimes. The reservoir fits very well in its surroundings, and produces absolutely no relevant adverse impacts on the environment. In fact, it produces positive impacts: highly reliable water supply of Vranje and other settlements; flood protection; option of preserving ecosystems in critical low water conditions which coincide with periods of high temperatures, when all ecosystems are jeopardised because of the synergetic effect of low flows, high temperatures and low oxygen content in the water.

Reservoir Stuborovni on the Jablanica. This reservoir has many important functions: it is an indispensable source in the Kolubara regional system, which needs to ensure reliable water supply to municipalities of Valjevo, Mionica, Ub, Lajkovac and Lazarevac; further, it needs to provide water to TPP-heating plant Kolubara B; it is also tremendously important for flood protection; it enables the improvement of low flows in the entire downstream section of the Jablanica and the Kolubara. The reservoir has a rockfill dam which is 74m high, with a 430m long crest. Its normal water level is 360 m.a.s.l, and its volume is $52\times10^6 m^3$. Although the dam and the reservoir have extremely positive environmental impacts, they are not operational because of obstructions by interest groups and the manipulation of the public. However, it should be noted that in May 2014, although its foundation outlet was not sealed, it saved Valjevo from a very dangerous flood, because, for the most part, it held back the flood wave from the Jablanica. Had the foundation outlet been sealed as well, there would have been no damage done in Valjevo, because the reservoir would have accepted and kept the entire flood water away from the part of the Jablanica basin which is the most important in terms of flood genesis.

Reservoir Selova on the Toplica. Reservoir Selova has been completed, but it cannot be put into operation because the section of the road to the Lukovska Banja spa, which will be flooded, has not been relocated. This reservoir is very strategically important for Serbia, because it is the head multipurpose reservoir which needs to control water regimes in the entire course of the Toplica River and to provide for maximum reliability of public water supply in the Toplica River valley, all the way to Niš. It has a rockfill dam 73m high, with a 210m long crest. Its normal water level is 525 m.a.s.l, and its volume is $70\times10^6 m^3$. It contains a special area for moderating flood waves, so after becoming operational, the Toplica valley will not be threatened by floods up to probabilities below 1%, which will have a very positive contribution to environmental protection. The reservoir will ensure a reliable water supply in all settlements in the Toplica valley – Kuršumlija, Prokuplje, Žitorađa, Doljevac, and will provide additional quantities of reliable water supply of Niš, which is currently affected by severe shortages during low flows, when capacities of karst springs and sources at Medijana are drastically reduced. There are fully achievable plans for the reservoir's alignment with the environment, and it can rightly be expected that it will significantly increase the economic potential of tourism on the slopes of the Kopaonik mountain.

1.2.5. Considered issues and problems of the nature and environmental protection in the Plan and reasons for omitting certain issues from the SEA

Criteria for the identification of possible significant impacts of plans and programmes on the environment can be found in Annex I of the Law on Strategic Environmental Impact

Assessment. These criteria are based on: characteristics of the plan/programme and characteristics of impacts.

In this specific case, in addition to the above criteria, it is especially important to identify problems in environmental protection in the area under the direct influence of facilities and activities in the water sector, and to analyse possible effects of the above activities on the quality of the environment, and in particular on:

- Quality of basic environmental factors: air, water, soil;
- Natural resources (in particular protected natural resources);
- Cultural and historic heritage;
- Waste generation and treatment;
- Human health;
- Social development;
- Economic development;

This SEA thoroughly analysed the relevant environmental impact of all significant existing water facilities, in the areas of water use, protection against water and water protection. Thorough deliberations were carried out about very important facilities surrounded by prejudice and controversy regarding their alleged adverse environmental impacts: hydroelectric power plants and multipurpose reservoirs, because making deductions about their impacts is very important in order to understand how such facilities will fit in the natural, social and other environments in the future. Namely, Serbia cannot endure and develop smoothly without the creation of many new reservoirs with annual flow balancing. This was correctly established in the Water Management Strategy, which is under consideration here. Also under consideration is the aspect of use of small hydroelectric power plants (SHPPs) and their harmonisation with the environment and other aspects of development in the water sector. The goal of these deliberations is to identify the strategic approach in planning water systems even in conditions of possible deterioration of water regimes, with increasingly severe consequences to the environment.

The Strategic Environmental Assessment Report can explain why certain issues related to environmental protection have not been appropriate for consideration. In this specific case, this refers to a lack of a detailed impact assessment of individual facilities and activities in the water sector in the form of a technical and technological analysis, considering that the Strategy was not prepared in such detail. This level of detail will be achievable in the elaboration of the Strategy, and during the preparation of planning and design-related technical documents for each planned water and electrical facility. In this context, strategic assessment will predominantly be based on the assessment of environmental trends occurring as a consequence of planned activities in the water sector.

1.2.6. Prior consultations with authorities and organisations concerned

In the preparatory stage of the Decision on Carrying out SEA for the Strategy, consultations were carried out with relevant ministries and institutions. Cooperation with these institutions resulted in the draft of the Decision on Carrying out SEA based on which the SEA in question was undertaken.

2. GENERAL AND SPECIAL OBJECTIVES OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT AND SELECTION OF INDICATORS

Pursuant to Article 14 of the Law on Strategic Environmental Impact Assessment, general and specific objectives of the strategic environmental impact assessment have been set forth based on requirements and objectives related to environmental protection in other plans and programmes, environmental protection objectives set out at national and international levels, data collected on the state of the environment and significant issues, problems and proposals in respect of environmental protection in the plan or programme. The appropriate indicators that will be used when undertaking the strategic assessment will be selected based on the defined objectives.

2.1. General objectives of SEA

General objectives of SEA (Table 2.1) have been defined based on requirements and objectives in respect to environmental protection in other plans and programmes, environmental protection objectives set at the national level and objectives of relevant sectoral documents related to environmental protection. Based on requirements and objectives in respect to environmental protection set in plans and strategies, the general SEA objectives have been defined, and they predominantly relate to the following fields of the environment: protection of basic environmental factors, primarily water, and sustainable use of natural resources, as well as improvement in waste management and rational use of hydropower resources aimed at reducing the pressure caused by human activities in environmentally threatened areas; conservation of biodiversity; landscape enhancement; protection of cultural and historic heritage, as well as socio-economic development and strengthening of institutional capacities for environmental protection.

2.2. Specific objectives of SEA

Specific objectives of SEA have been set forth in certain fields of environmental protection in order to achieve general objectives. Specific SEA objectives (Table 2.1) are concrete, partly quantified elaborations of general objectives in the form of guidelines for change and actions (measures, works, activities) for the implementation of these changes. Specific SEA objectives are primarily a methodological measure by which the effects of a plan/programme on the environment are handled and checked. They have to provide a clear picture of key environmental impacts of the plan/programme to decision-making authorities, based on which it is possible to make decisions aimed at environmental protection and achievement of general objectives of sustainable development.

2.3. Selection of indicators

Strategic planning is a key link in the system for managing changes in an environment, while the first and most important stage in the planning process is the creation of a database (information base) for the identification of that environment. The identified state of the environment can be used as a basis for defining adequate measures in the planning process for the purpose of achieving efficient environmental protection. Indicators are an integral part of an information system. Environmental management indicators are a very important segment in the planning process, as well as a level within the complex spatial information system. The purpose of their use is to direct the strategic solutions toward the achievement of set objectives.

Indicators are quite suitable for measuring and evaluating planning solutions from the aspect of potential damage to the environment, as well as for identifying adverse impacts which are to be mitigated or eliminated. They are also an instrument for systematic identification, assessment and tracking of the state, development and conditions of the environment as well as for considering future consequences. Furthermore, they are tools used for monitoring certain variables both in the past and in the present, and are also required as input data for each planning (strategic, spatial, urban planning, etc.).

In Serbia, there is a permanent shortage of environmental data, which makes it very difficult to perform a high-quality analysis of the state of the environment. An information system should enable efficient provision of information and data which are processed and analysed in accordance with international and European methodologies. The environmental information system maintained by The Agency for Environmental Protection is still not equipped with all necessary data. The Agency for Environmental Protection collects data on air emissions, emissions to water and waste management. In addition, environmental indicator systems suitable for the needs of planning, and the methodology for preparing and implementing the planning documents, have not been elaborated in detail.

In the field of strategic planning in Serbia, there is no specific environmental indicator system, but some spatial and environmental indicators can be found in systems of indicators for other purposes. Such a situation to a great extent results in inefficient environmental management and inefficient strategic planning in general. There is also no standardised environmental indicator system in the current legislation which would be applicable (measurable) in strategic planning.

Sustainable development indicators are needed to identify trends that calibrate progress towards sustainability objectives, and set goals for improving general welfare. However, it is not possible to discuss sustainability indicators and criteria without previously defining sustainable development and the basic principles it rests on. In 2008, the Republic of Serbia adopted the National Sustainable Development Strategy (RS Official Gazette, No. 57/08) which defines principles and priorities of sustainable development, as well as 76 indicators for tracking the progress of Serbia towards sustainable development. These indicators have been selected from the set of UN indicators, but not all of them are used in Serbia. The indicators are specified in the Law on Spatial Plan of the Republic of Serbia (RS Official Gazette, No. 88/10). The Regulation on the National List of Environmental Indicators (RS Official Gazette, No. 37/2011) prescribes the list of environmental indicators, which have been used herein.

The SEA indicators (Table 2.1) have been selected in accordance with the abovementioned SEA objectives, based on the indicators of the Spatial Plan of the Republic of Serbia and the National Sustainable Development Strategy of the Republic of Serbia, which build on the "CSD Indicators for Sustainable Development of the United Nations". This set of indicators is based on the concept of *cause-effect-response.* Indicators of *cause* denote human activities, processes and relationships affecting the environment, the indicators of *effect* denote the state of the environment, while indicators of *response* define strategic options and other responses aimed at changing "consequences" for the environment.

Table 2.1. Selection of general and specific SEA objectives and selection of relevant indicators as defined within SEA

Area of SEA	General SEA objectives	Special objectives of SEA	Indicators
WATER	**Protection and preservation of surface and ground waters quality and protection against water**	- To reduce polution of surface and ground waters - To lessen the impact of water-power facilities on hydrological regime	- The change in water quality due to the antropogenic activities in the water management sector - The change in the hydrological regime
SOIL	**Protection and sustainable use of forest and agricultural land**	- To protect forest and agricultural land - To reduce land degradation and erosion	- The change in forest land area (%) - The change in agricultural land area (%) - The share of surfaces degraded due to the activities in the water management sector (%) - The area of land threatened by erosion (ha)
AIR AND CLIMATIC CHANGES	**Reducing air pollution levels**	- To reduce the emmission of air polutants to prescibed levels	- The increase in share of renewable energy resources in hydropower balance (%)
NATURAL VALUES	**Landscape, natural values and biodiversity and geodiversity protection, preservation and enhancements**	- To protect the area - To protect natural values and landscapes - To preserve biodiversity and geodiversity	- The number of water-power facilities that affect the area - The area of protected natural areas that can be affected by the activities in the water management sector - The number of endangered animal and plant species that can be affected by the activities in the water management sector
CULTURAL AND HISTORIC HERITAGE	**Preservation of protected cultural heritage**	- To protect cultural heritage, to preserve historic monuments and archeological sites	- The number and significance of immovable cultural monuments that can be affected by the activities in the water management sector
WASTE	**Sustainable waste management**	- To advance the wastewater treatment	- The increase in the number of sewage water treatment facilities and the increase of the efficiency of wastewater treatment to the required level

Area of SEA	General SEA objectives	Special objectives of SEA	Indicators
SOCIAL DEVELOPMENT	**Population health improvement and social cohesion**	- To lessen the negative impact of the water management activities on the health of the population - To improve the quality of life in the area - To preserve the population in rural areas - To protect the communities from negative effects of water	- The incidence of diseases that can be attributed to the polluted drinking water - The increase in number of households attached to the public water supply system (%) - The increase in number of households attached to the public sewage system (%) - The number of displaced households due to the activities in the water management sector - The number of people potentially threatened by torrents and floods
INSTITUTIONAL DEVELOPMENT	**Strengthening institutional capacity for environmental protection**	- To improve the environmental protection service, monitoring and control	- Development of water management information system - Strengthening of institutions in the water management sector - The number of measuring locations in the monitoring system
ECONOMIC DEVELOPMENT	**Encouraging economic development**	- To support economic development - To promote local employment To reduce the transboundary impact of water-power facilities on the environment	- The number of tourist activities based on using water resources - The percentage of water management sector employees with the income above the average income in the country - The decrease in the number of the unemployed due to their employment in the water management sector (%) - The number of developmental programmes for environmental protection in the water management sector - The number of water-power facilities with transboundary impact

Table 2.2. Designation of SEA special objectives

No.	SEA Objective
1.	Reducing surface and groundwater pollution
2.	Mitigating the impact of water facilities on hydrological regime, improving water regimes through targeted management of water facilities, primarily reservoirs.
3.	Protecting forest and agricultural land
4.	Reducing soil degradation and erosion
5.	Reducing emissions of air pollutants to prescribed values
6.	Protecting landscape
7.	Protecting natural resources and areas
8.	Preserving biodiversity and geodiversity
9.	Protecting cultural heritage, preserving historical monuments and archaeological sites
10.	Improving wastewater treatment
11.	Reducing the negative impact of the water sector on public health
12.	Improving the citizens' quality of life
13.	Preserving population density in rural areas
14.	Protection against water – increasing the degree of protection of defended areas to the levels set forth by the Spatial Plan of the Republic of Serbia
15.	Enhancing environmental protection service, monitoring and control function
16.	Encouraging economic development
17.	Promoting local employment
18.	Reducing transboundary impacts of water facilities on the environment

The evaluation will be carried out for each individual sector of the Strategy (in evaluating alternative solutions), i.e. for each strategic commitment (priority goal) in each sector of the Strategy. The evaluation is based on multi-criteria qualitative assessment and identification of strategically significant impacts in relation to specific SEA objectives shown in Table

3. ENVIRONMENTAL IMPACT ASSESSMENT

The aspect of environmental protection is one of the prime social tasks nowadays. Negative effects that are present today are mainly the result of wrong planning of settlements and transport systems construction, uncontrolled and inadequate use of water, other natural resources and energy as well as the lack of rudimentary knowledge in the field of environmental protection. From the abovementioned point of view, changes stemming from the adaptation of the nature to the needs of the man can turn out to be as expected, but can also, quite often, prove unfavourable for the mankind. The set of such changes triggers rather complex consequences which generally have a feedback effect on the initiators of changes, thus creating new environmental conditions and resulting in new consequences.

The purpose of strategic environmental assessment for the Strategy is to consider possible negative trends/adverse effects on the environment and provide guidelines for their mitigation, i.e. to reduce them to acceptable levels without causing conflicts in the area, while taking into account environmental carrying capacity of the subject area.

The Strategy will be a framework for water system development in the Republic of Serbia with all possible (positive and negative) implications for environmental quality. Bearing this in mind, the focus in the strategic environmental assessment has been placed not only on an analysis of strategic commitments which may imply negative impacts and trends, but also on strategic commitments which contribute to environmental protection and better quality of life of the population. In this context, the SEA will provide an analysis of possible effects of planned activities on the environment which will be evaluated against defined objectives and indicators.

Pursuant to Article 15 of the Law on Strategic Environmental Impact Assessment, the assessment of possible effects of plans/programmes on the environment contains the following elements:

- overview of the assessed impacts of alternative solutions of plans and programmes that are favourable from the aspect of environmental protection, with the description of measures aimed at preventing and limiting the adverse effects or increasing the positive effects on the environment;
- the comparison of alternative solutions and an overview of reasons for selection of the most favourable alternative solution;
- the overview of the assessed effects of plans and programmes on the environment with the description of measures aimed at preventing and limiting adverse effects and increasing positive effects on the environment;
- the manner in which the environmental factors have been taken into consideration in the environmental impact assessment, including the data on: air, water, soil, climate, ionizing and non-ionizing radiation, noise and vibrations, flora and fauna, habitats and biodiversity, protected natural values, population, human health, cities and other settlements, cultural and historic heritage, infrastructure, industrial and other structures or other man-made values;
- the manner in which the following impact characteristics have been taken into account: probability, intensity, complexity/reversibility, time dimension (duration, frequency, reversibility), spatial dimension (location, geographical area, size of the exposed

population, transboundary nature of impact), as well as cumulative and synergistic nature of impact.

3.1. Assessment of alternative solutions

The Law on Strategic Environmental Impact Assessment does not prescribe alternative solutions of the plan/programme that are subject to strategic environmental assessment. However, in practice, the following two alternatives are considered:

1) the alternative according to which the plan/programme should not be implemented and
2) the alternative including the adoption and implementation of the plan/programme.

Alternative solutions of the subject Strategy represent different rational manners, instruments and measures for the achievement of Strategy objectives, by considering the possibility of using a given natural resource for special purposes and activities.

The overall effects of the plan, and its environmental impacts, may be identified only by comparing the current status with objectives and solutions of the Strategy.

Although certain alternative solution have been presented within the Strategy itself, it would not be productive to analyse them without spatial/micro location determination, which would be the case here. In this context, the strategic environmental assessment will deal only with the following alternatives:

- alternative A – scenario based on current trends, and
- alternative B – scenario with the implementation of the Strategy and strategic solutions defined therein.

It should be noted that non-adoption or non-implementation (Alternative A) would mean further pursuit of current trends in the water sector of the Republic of Serbia,, based on earlier data, trends and predictions.

The matrix method is used in exploring the fields for the needs of the SEA, or more precisely, for the assessment of effects of alternative solutions on the environment. The same method is applied in assessing the environmental impact of strategic guidelines with respect to the areas covered by the Strategy.

As the SEA is conducted for a long-term Strategy, which in turn entails uncertainties with regard to its implementation, the used method for constructing development scenarios allows for the assessment of positive and negative impacts of selected alternatives. In matrices, the development scenarios per sector of the Strategy are intersected with objectives of the SEA and related indicators.

Environmental protection implies resolving of potential conflicts in space in the context of national interest for the water sector development on the one hand, and interests of local communities, on the other.

In this context, the most important task of strategic assessment is to recognise signs of potential conflicts and prevent or minimise their importance and intensity through adequate guidelines.

Table 3.1. Assessment of impacts of the Strategy in relation to the SEA objective by alternative solution

SEA objectives

1. Reducing surface and groundwater pollution
2. Mitigating the impact of water facilities on hydrological regime, improving water regimes
3. Protecting forest and agricultural land
4. Reducing soil degradation and erosion
5. Reducing emissions of air pollutants to prescribed values
6. Protecting landscape
7. Protecting natural resources and areas
8. Preserving existing biodiversity and geodiversity
9. Protecting cultural heritage, preserving historical monuments and archaeological sites
10. Improving wastewater treatment
11. Reducing the negative impact of the water sector on public health
12. Improving the citizens' quality of life
13. Preserving population density in rural areas
14. Protection against water – increasing the degree of protection of defended areas to required levels
15. Improving the environmental protection service and monitoring and control
16. Encouraging economic development
17. Promoting local employment
18. Reducing transboundary impacts of water facilities on the environment

Field of the Strategy	Alternative solutions	Scenarios of development	SEA objectives																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Use of water	A	Predictions about the necessary amounts and manner of use of water are not fully in compliance with the current trends and predictions currently being made based on new data.	-	-	-	-	0	-	-	-	-	-	-	0	-	-	0	0	0	-
	B	Providing sufficient quantities of water (with the appropriate degree of reliability) of appropriate quantity for the current needs and development, namely for water supply of the population and other potable water consumers within the public water supply system, for irrigation, production of hydroelectricity, industry, navigation, hatcheries, bathing, sports, recreation, etc.	+	0	0	0	0	-	+	+	0	+	+	+	+	+	+	+	+	-
Water protection	A	Applying rational technical and technological measures in respect to wastewater and other waste matter, technical measures in watercourses, control of water pollution, control of transport and use of dangerous substances; and other non-investment measures, etc., usually staying in the sphere of theoretical assumptions.	+	-	0	0	0	-	-	-	0	+	0	-	0	0	0	+	+	-
	B	Preserving human health and the environment through the achievement and conservation of the good status of surface and groundwater (environmental status/potential and qualitative status), reducing hydromorphological pressures on natural bodies of water, preventing and controlling water pollution and the rational use of available resources. Water protection is planned and implemented within integral water management, based on harmonised strategic and planning documents of the water sector and other sectors.	+	+	+	+	+	+	+	+	+	+	+	+	+	0	+	0	0	+

Field of the Strategy	Alternative solutions	Scenarios of development	SEA objectives																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Regulating watercourses and protection against adverse impacts of water	**A**	Non optimal system of watercourse regulation and protection against the adverse impacts of water which was proven such in the 2014 floods with all negative socio-economic and environmental implications.	-	-	-	-	-	0	0	-	-	0	-	-	0	-	0	-	0	0
	B	Maintaining the stability and preventing deformations of the river channel, ensuring the required rate of flow of the channel, the necessary dimensions of the waterway, and the conditions for rational use of water for various purposes (water supply, irrigation, hydroelectricity, recreation, etc.). An integral approach of flood risk management is established by defining the strategy at the level of the basin/sub-basin, within the corresponding Flood Risk Management Plan, which provides an adequate combination of investment works, preventive and operative measures, based on cost assessment, technical viability, environmental impact assessment and social acceptability of these measures and works.	+	+	+	+	+	+	+	+	+	0	+	+	+	+	0	+	+	0
Regional and multipurpose hydrosystems	**A**	Integral, joint, complex and rational use and protection of complex regional water supply systems and watercourses is not implemented.	-	-	-	0	0	0	0	-	0	0	0	0	0	0	0	-	0	0
	B	Construction of complex water systems, regional and/or multipurpose, including reservoirs with multiple purposes in the area of water use, water protection and protection against water.	+	+	+	0	0	+	0	0	0	0	0	+	+	+	0	+	+	+
Other factors and measures important for water management	**A**	Rational resolution of the interaction between the water sector and other natural resources in the context of protecting both waters and other national resources (integral protection of natural resources and the environment) is not implemented in the manner prescribed by the Water Management Basis of the Republic of Serbia.	0	0	0	0	0	0	0	-	-	0	0	0	0	0	0	-	0	0
	B	Adequate current and investment maintenance of existing regional and multipurpose hydro systems, and development of institutional and legal framework for sustainable water management.	+	+	0	+	+	0	+	0	+	+	+	+	0	+	+	+	+	+

Meaning of the symbols: + overall positive impact; - overall negative impact; **0** no direct impact or impact is unclear;
A – scenario based on the current trends; **B** – scenario according to the Strategy.

Summarising the assessment of the impact that alternative solutions may have with respect to the SEA objectives, we may conclude as follows:

- Alternative A – the existing scenario essentially builds on the previously followed trends of worryingly low investment into the water sector development and failure to achieve the development objectives that were clearly defined in the 2002 Water Management Strategy of the Republic of Serbia. During the validity period of the Water Management Strategy (2002–2015), investment into the water sector was so low that it failed to ensure even the everyday production – coverage of exploitation costs and proper maintenance of the system following the well-known norms, including even the systems of vital importance for the entire region (e.g. Danube-Tisza-Danube hydro system, drainage and flood protection systems, maintenance of dams and the existing wastewater treatment facilities, emergency interventions on flood-prone watercourses etc.). Moreover, in order to maintain social peace, the prices of water management services (price of water, water management services etc.) were kept at a level that failed to provide for the coverage of everyday production costs and even for the adequate system maintenance. Even the special-purpose funds allocated for the water management purposes (Water Fund) were misapplied under the decision of the then incumbent government in 2011. The consequences are grave: the water sector development has grinded to a halt, the functionality of the systems that were not adequately managed has deteriorated and a number of important facilities has reached a worrying state in terms of both the function and reliability. In other words, the life of the Water Management Strategy was not marked only by the failure to achieve the highest priority development objectives set under this planning document, but also by a serious backsliding with respect to the maintenance of the existing systems so they couldn't operate in accordance with the planned characteristics. It is why this alternative – alternative that entails investment into the water sector at the currently low level that cannot be tolerated – fails to provide adequate water resources management in the Republic of Serbia and implies negative effects on the Strategic assessment objectives.

- Alternative B – scenario entailing the implementation of the new Water Management Strategy envisages the necessary water sector development which, in the technical sense, builds on the 2002 Water Management Strategy solutions, yet it is innovated in several respects and encompasses the revision of water demand which takes into account current demographic and other development trends, revised hydrology, new priorities taken into account, trends recorded over the last two decades since the drawing up of the 2002 Water Management Strategy. It is also quite important that the new solutions build on the EU guidelines in this area, which should ensure sustainable management of water resources of the Republic of Serbia, being mindful of the implementation of the EU directives which pertain to the water sector, primarily the Water Framework Directive and the Directive on Assessment and Management of Flood Risks. The new Strategy rests on the updated data on the current situation in the water sector which serve as the basis for all the presented forecasts and shaping of the optimal objectives in the water management area.

Based on the above, it can be easily concluded that from the aspect of sustainability and adequacy with respect to the needs of the water sector, alternative B, entailing the implementation of the Strategy, is much more favourable than the alternative A.

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3.2. Evaluation of characteristics and significance of effects of strategic commitments

Evaluation of significance, spatial extent and probability of impact of planning solutions on the environment has been presented in the text to follow. The impact significance is assessed in relation to impact magnitude (intensity) and spatial extent of potential impact. Impacts, i.e. effects of planning solutions, are evaluated according to the magnitude of change by assigning scores from –3 to +3, where the minus sign is used to denote a negative change, while the plus sign denotes a positive change. This evaluation system is used both for individual impact indicators and for related categories through summary indicators.

Table 3.2. Criteria for evaluating the impact magnitude

Impact magnitude	Designation	Description
Critical	**–3**	Significant environmental overload
Greater	**–2**	Environmental disturbance of great extent
Smaller	**–1**	Environmental disturbance of smaller extent
No impact	**0**	No direct and/or unclear environmental impact
Positive	**+1**	Smaller positive environmental changes
Favourable	**+2**	Favourable environmental changes
Very favourable	**+3**	Changes that significantly improve the quality of life

Criteria for evaluating the spatial extent of impacts are shown in Table 3.3.

Table 3.3. Criteria for evaluating the spatial extent of impacts

Impact significance	Designation	Description
International	**I**	Possible transboundary impact
National	**N**	Possible impact at the national level
Regional	**R**	Possible impact at the regional level
Local	**L**	Possible impact of local character

Criteria for assessing the probability of impact occurrence are shown in Table 3.4.

Table 3.4. Scale for assessing the impact probability

Probability	Designation	Description
100%	**S**	Impact will definitely occur
More than 50%	**L**	Likely impact
Less than 50%	**P**	Possible impact
Less than 1%	**N**	Impact is not likely to occur

Additional criteria can be derived according to the impact duration, i.e. duration of consequences. In this context, temporary/occasional (PO) and long-term (LT) impacts can also be defined. Based on all the above mentioned criteria, the importance of identified impacts for the achievement of SEA objectives has been evaluated.

<u>It is adopted that</u>: Impacts of strategic importance for the subject Strategy are the ones with strong or greater (positive or negative) effects on the entire territory of the Republic of Serbia or at the regional level, or which imply transboundary impacts, according to criteria shown in Table 3.5.

Table 3.5. Criteria for evaluating strategically important impacts

Level	Impact magnitude		Designation of significant impacts
International level: I	Strong positive impact	+3	I+3
	Greater positive impact	+2	I+2
	Strong negative impact	–3	I–3
	Greater negative impact	–2	I–2
National level: N	Strong positive impact	+3	N+3
	Greater positive impact	+2	N+2
	Strong negative impact	–3	N–3
	Greater negative impact	–2	N–2
Regional level: R	Strong positive impact	+3	R+3
	Greater positive impact	+2	R+2
	Strong negative impact	–3	R–3
	Greater negative impact	–2	R–2

Table 3.6. Strategic solutions envisaged by the Strategy included in the impact assessment

Strategy Sector	Strategy Solutions
Water usage	**Improvement of the public water supply system**
	Improvement of water supply in the industrial sector
	Provision of the sufficient amount of and the rational usage of irrigation water
	Sustainable usage of hydropower potential
	Preservation of hydromorphological characteristics of both aquatic and litoral ecosystems in watercourses
	Preservation of water quality and the aquatic ecosystems in pisciculture development
	Supply of drinking water to tourist, sport and recreational centers and preservation of water quality in multipurpose accumulations
Water protection	**Prevention of water pollution and water protection management**
	Decreasing pollutionfrom concentrated and scattered pollutors
	Designation and usage of protected areas
	Protection of ground watersquality and quantity
	Limiting hydromorphological pressure on natural water bodies and improving the ecologic potential of the affected water bodies
Watercourse regulation and protection from adverse effects of water	**Regulation, maintenance and preservation of watercourses**
	Protection from floods caused by transboundary watercourses
	Protection from erosion and torrential waters
	Protection from floods caused by inlandwatercourses (drainage)
	Sustainable management of water resources in drought and water shortage periods
Regional and multipurpose hydrosystems	**Optimal usage of multipurpose accumulations, meeting watermanagement objectives and harmonious fitting into ecological and other surroundings**
	Development of regional drinking water supply systems
The rest of the factors and measures significant in water management	**Development of institutional framework in water management sector**
	Planning and implementing the planned activities in the water management sector
	Strengthening professional capacities necessary for effective and sustainable water management
	Monitoring the status of surface and ground waters
	Development of water management information system

Table 3.6 illustrates the choice of strategic solutions/activities per sector of the Strategy to be included in the multi-criteria evaluation process. The Strategy defines operational objectives (one or several) for each of the presented strategic solutions that ought to be achieved in order to have strategic solutions put into practice. The said operational objectives were also taken into account during the evaluation of strategic solutions. The multi-criteria evaluation of strategic solutions against the objectives of the strategic assessment is presented in Tables 3.7 and 3.8.

Table 3.7. Assessment of the size of the impact of strategic priorities on environment and sustainable development elements

SEA objectives

1. Reducing surface and groundwater pollution
2. Mitigating the impact of water facilities on hydrological regime, improving water regimes
3. Protecting forest and agricultural land
4. Reducing soil degradation and erosion
5. Reducing emissions of air pollutants to prescribed values
6. Protecting landscape
7. Protecting natural resources and areas
8. Preserving biodiversity and geodiversity
9. Protecting cultural heritage, preserving historical monuments and archaeological sites
10. Improving wastewater treatment
11. Reducing the negative impact of the water sector on public health
12. Improving the citizens' quality of life
13. Preserving population density in rural areas
14. Protection against water – increasing the degree of protection of defended areas to the levels required
15. Enhancing environmental protection service, monitoring and control function
16. Encouraging economic development
17. Promoting local employment
18. Reducing transboundary impacts of water facilities on the environment

Strategy solutions	SEA objectives																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Improvement of public water supply system	+2	0	+1	+2	+1	+1	+2	+1	0	0	+1	+1	+1	0	+1	0	0	0
Improvement of water supply in the industrial sector	0	0	+1	+1	0	0	0	0	0	0	0	0	0	0	+1	+1	0	0
Provision of the sufficient amount of and the rational usage of irrigation water	0	0	+1	0	0	0	+1	0	0	0	0	+1	0	0	0	+1	0	0
Sustainable usage of hydropower potentials	-1	-2	-2	-2	+1	-2	-1	-1	-1	0	0	0	0	0	0	+1	+1	-1
Preservation of hydromorphological characteristics of both aquatic and littoral ecosystems on navigable rivers	0	0	0	0	0	+1	+2	+2	0	0	0	0	0	0	0	0	0	+1
Preservation of water quality and the aquatic ecosystems amid pisciculture development	0	0	0	0	0	0	+2	+2	0	0	0	0	0	0	0	0	0	+1
Water supply to tourist, sport and recreational centres and preservation of water quality in multi-purpose use of reservoirs	-1	0	0	0	0	0	+1	+1	0	+2	0	+1	+1	0	+1	+2	+2	0
Prevention of water pollution and water protection management	+3	0	+1	+1	+1	+1	+2	+1	0	+2	+1	0	0	0	+1	0	0	+1
Decreasing pollution from concentrated and scattered polluters	+3	0	+1	+1	+1	+1	+2	+1	0	+3	+1	+1	0	0	+1	0	0	+1
Designation and usage of protected areas	+3	0	+2	+2	+1	+1	+2	+2	0	+1	+1	+1	+1	0	+2	0	0	+1
Groundwater – quality and quantity protection	+3	0	0	0	0	0	+2	0	0	0	+1	0	0	0	+2	0	0	0

Strategy solutions	SEA objectives																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Limiting hydromorphological pressure on natural water bodies and improving the ecologic potential of the affected water bodies	+1	+1	0	0	0	0	+1	+1	0	+1	0	0	0	0	0	0	0	0
Regulation, maintenance and preservation of watercourses	-1	-1	0	+1	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0
Protection against floods caused by transboundary watercourses	+1	0	+2	+2	0	+2	+2	+2	+1	0	+2	0	0	+3	+3	+1	0	0
Protection against erosion and flood water	0	0	+3	+3	0	+1	+1	0	+1	0	+1	0	0	+2	0	0	0	0
Protection against floods caused by inland watercourses (drainage)	0	0	+2	+2	0	+1	+1	+1	+1	0	+1	0	0	+3	+3	0	0	0
Sustainable management of water resources in drought and water shortage periods	0	+1	0	0	0	0	+1	+1	0	0	0	+1	0	0	+1	0	0	+1
Optimal usage of multipurpose reservoirs, with the aim of meeting water management objectives and harmonious fitting into ecological and other surroundings	+2	+2	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+2	+1	0	0	0
Development of regional drinking water supply systems	0	0	0	0	0	0	0	0	0	0	0	+2	+2	0	0	0	0	0
Development of institutional framework in the water management sector	+1	+1	+1	+1	+1	+1	+1	+1	0	+3	+1	0	0	+1	+3	+1	+1	+1
Planning and implementing the planned activities in the water management sector	+1	+2	+2	+2	+1	+2	+1	+1	+1	+1	+1	+1	+1	+2	0	0	0	0
Strengthening professional capacities necessary for effective and sustainable water management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+2	0
Monitoring the status of surface and ground waters	1+	+1	+1	+1	+1	0	0	+1	0	+1	+1	0	0	+2	+3	0	0	+1
Development of water management information system	1+	+1	+1	+1	+1	0	0	+1	0	+1	+1	0	0	+2	+3	0	0	+1

* - criteria according to Table 3.2.

Table 3.8. Assessment of the spatial scale of the impact of strategic priorities on environment and sustainable development elements

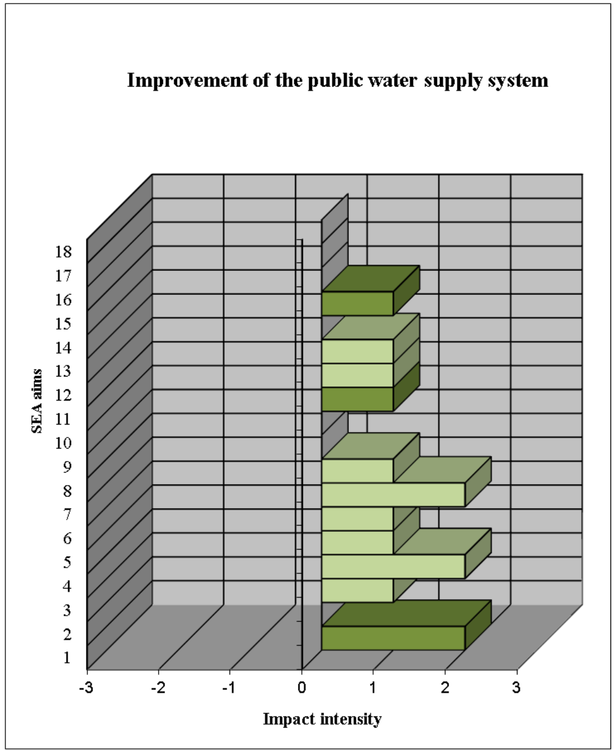
SEA objectives

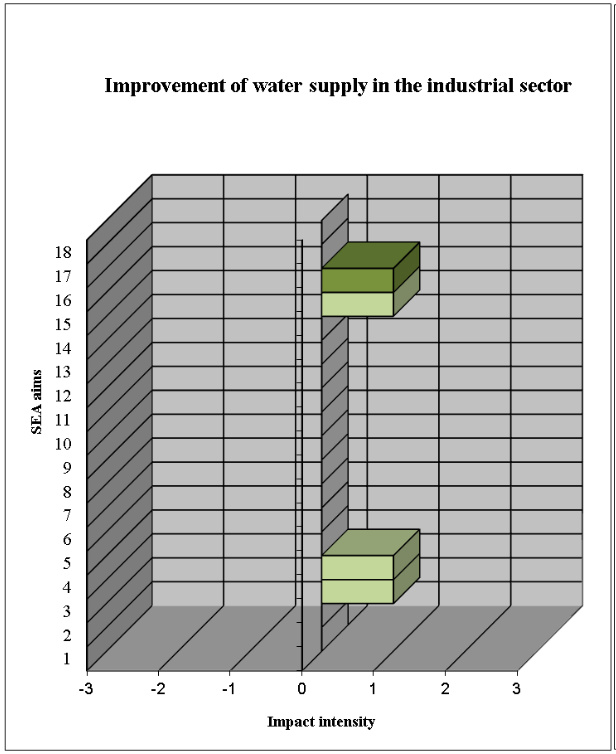
1. Reducing surface and groundwater pollution
2. Mitigating the impact of water facilities on hydrological regime, improving water regimes
3. Protecting forest and agricultural land
4. Reducing soil degradation and erosion
5. Reducing emissions of air pollutants to prescribed values
6. Protecting landscape
7. Protecting natural resources and areas
8. Preserving biodiversity and geodiversity
9. Protecting cultural heritage, preserving historical monuments and archaeological sites
10. Improving wastewater treatment
11. Reducing the negative impact of the water sector on public health
12. Improving the citizens' quality of life
13. Preserving population density in rural areas
14. Protection against water – increasing the degree of protection of defended areas to the levels required
15. Enhancing environmental protection service, monitoring and control function
16. Encouraging economic development
17. Promoting local employment
18. Reducing transboundary impacts of water facilities on the environment

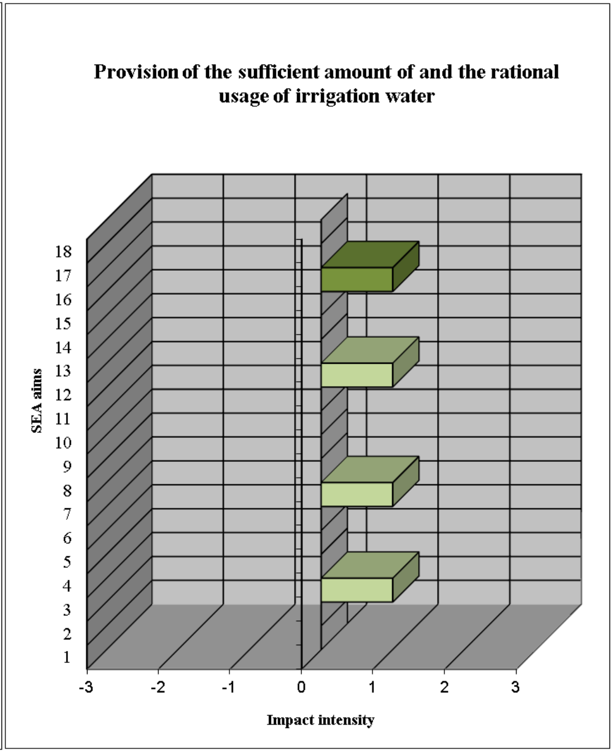
Strategy solutions	SEA objectives																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Improvement of public water supply system	N		L	L	L	L	L	L			N	L	L		N			
Improvement of water supply in the industrial sector			L	L											L	N		
Provision of the sufficient amount of and the rational usage of irrigation water			L				L					L				R		
Sustainable usage of hydropower potentials	I	L	L	L	L	L	L	L	N							L	L	I
Preservation of hydromorphological characteristics of both aquatic and littoral ecosystems on navigable rivers						L	R	N										I
Preservation of water quality and the aquatic ecosystems amid pisciculture development							R	N										I
Water supply to tourist, sport and recreational centres and preservation of water quality in multi-purpose use of reservoirs	R						L	L		R		L	L		L	R	L	
Prevention of water pollution and water protection management	I		L	N	L	L	N	N		N	N				N			I
Decreasing pollution from concentrated and scattered polluters	I		L	N	L	L	N	N		N	N	L			N			I
Designation and usage of protected areas	R		R	R	L	L	N	N		L	R	L	L		L			I
Groundwater – quality and quantity protection	R						R				L				L			

Strategy solutions	SEA objectives																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Limiting hydromorphological pressure on natural water bodies and improving the ecologic potential of the affected water bodies	L	L					R	N		L								
Regulation, maintenance and preservation of	L	L		L			N	N										
watercourses	N		N	N		L	L	L	N		L			R	R	R		
Protection against floods caused by transboundary watercourses			N	R		L	L		N		L			R				
Protection against erosion and flood water			R	R		L	L	L	N		L			R	L			
Protection against floods caused by inland watercourses (drainage)		L					L	L				L			N			I
Sustainable management of water resources in drought and water shortage periods	R	R	R	R	R	R	R	R		R	R	R	R	R	R			
Optimal usage of multipurpose reservoirs,												R	R					
with the aim of meeting water management objectives and harmonious fitting into ecological and other surroundings	N	N	N	N	N	N	N	N		N	N			N	N	N	N	N
Development of regional drinking water supply systems	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
Development of institutional framework in the water management sector															N	N	N	
Planning and implementing the planned activities in the water management sector	N	N	N	N	N			N		N	N			N	N			N
Strengthening professional capacities necessary for effective and sustainable water management	N	N	N	N	N			N		N	N			N	N			N

* - criteria according to Table 3.3.



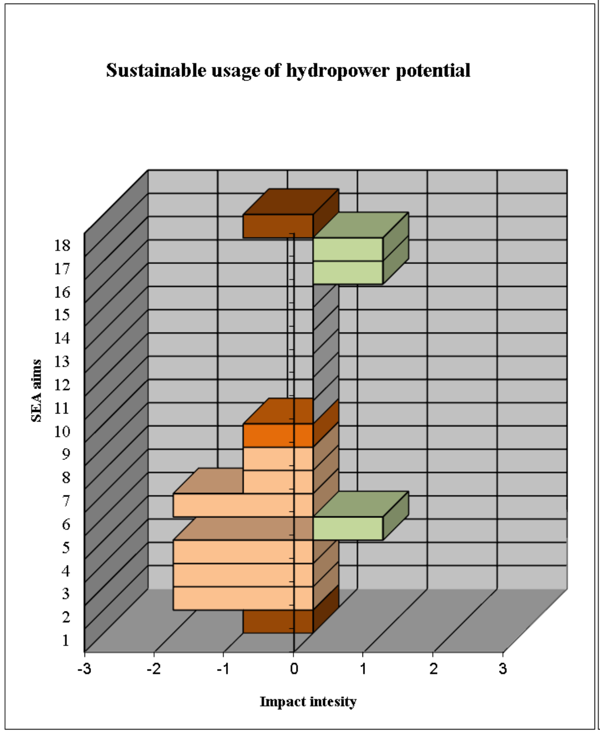


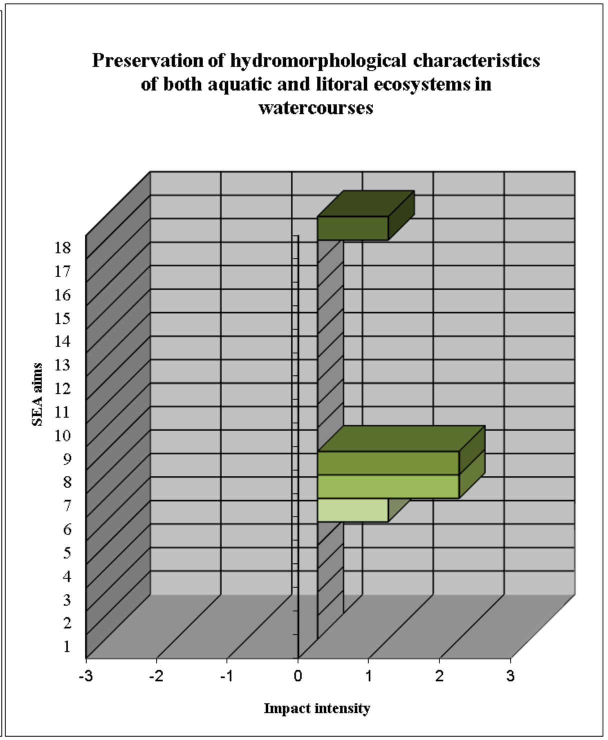


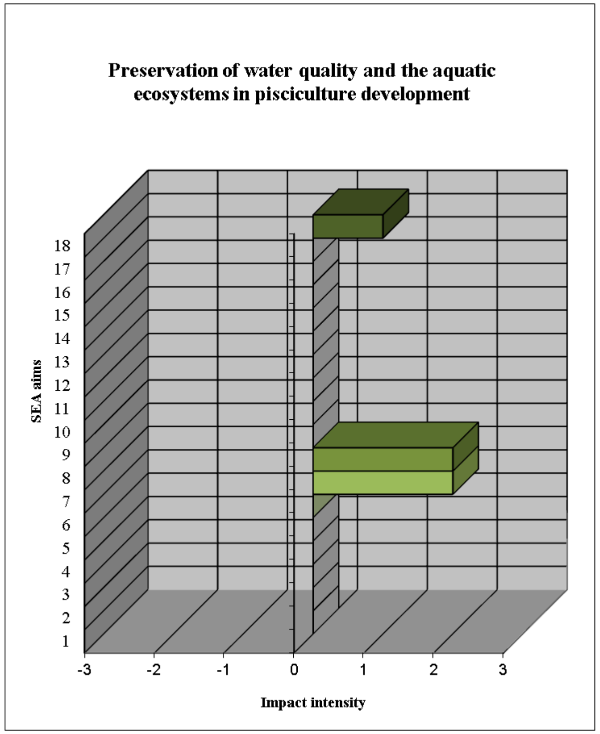
Designation (negative)	Impact significance	Designation (positive)
I	International	**I**
N	National	**N**
R	Regional	**R**
L	Local	**L**

SEA objectives

1. Reducing surface and groundwater pollution
2. Mitigating the impact of water facilities on hydrological regime, improving water regimes
3. Protecting forest and agricultural land
4. Reducing soil degradation and erosion
5. Reducing emissions of air pollutants to prescribed values
6. Protecting landscape
7. Protecting natural resources and areas
8. Preserving biodiversity and geodiversity
9. Protecting cultural heritage, preserving historical monuments and archaeological sites
10. Improving wastewater treatment
11. Reducing the negative impact of the water sector on public health
12. Improving the citizens' quality of life
13. Preserving population density in rural areas
14. Protection against water – increasing the degree of protection of defended areas to the levels required
15. Enhancing environmental protection service, monitoring and control function
16. Encouraging economic development
17. Promoting local employment
18. Reducing transboundary impacts of water facilities on the environment







Designation (negative)	Impact significance	Designation (positive)
I	International	**I**
N	National	**N**
R	Regional	**R**
L	Local	**L**

SEA objectives

1. Reducing surface and groundwater pollution
2. Mitigating the impact of water facilities on hydrological regime, improving water regimes
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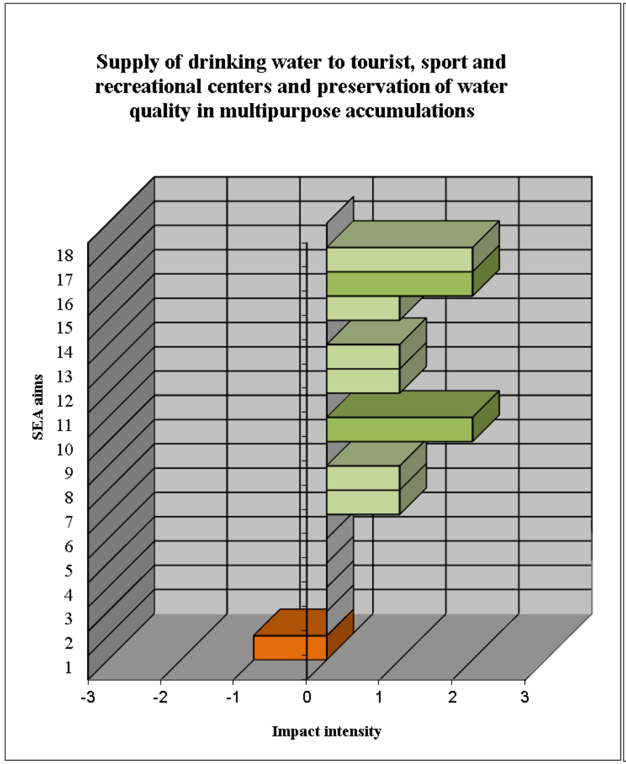
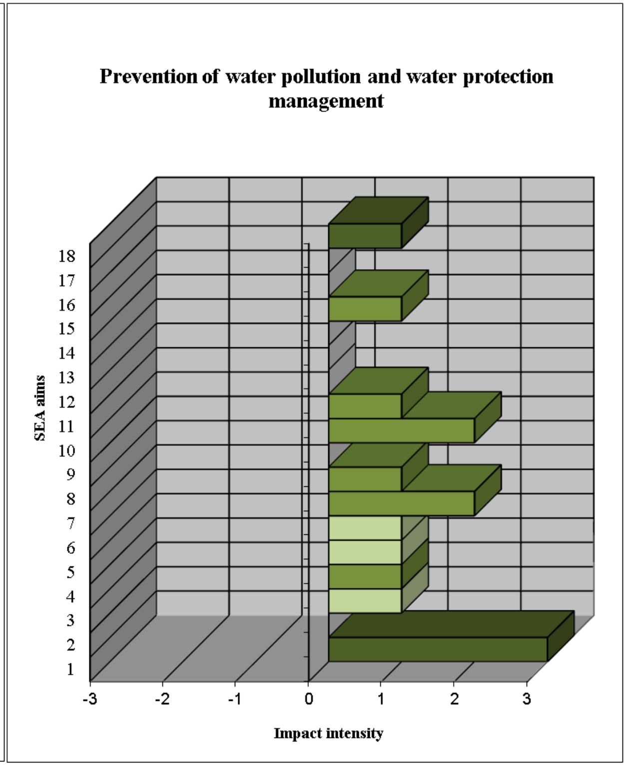
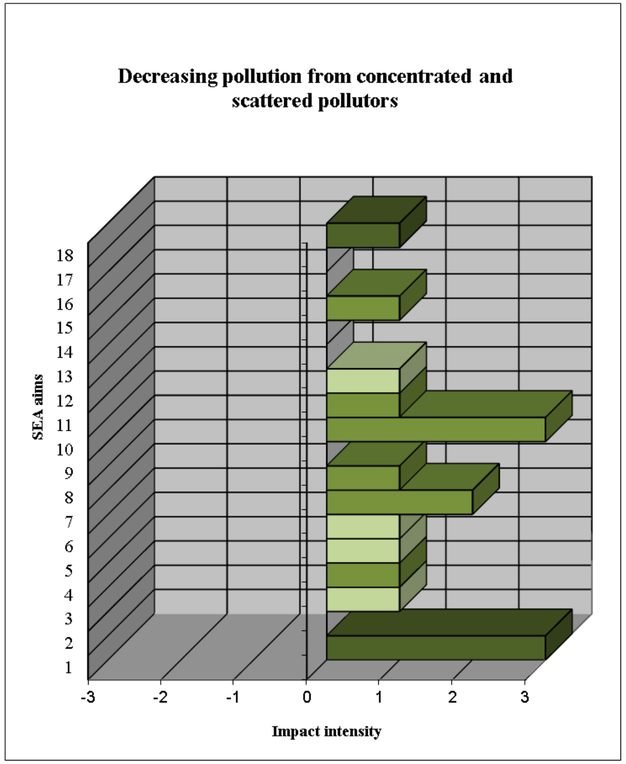
9. Protecting cultural heritage, preserving historical monuments and archaeological sites
10. Improving wastewater treatment
11. Reducing the negative impact of the water sector on public health
12. Improving the citizens' quality of life
13. Preserving population density in rural areas
14. Protection against water – increasing the degree of protection of defended areas to the levels required
15. Enhancing environmental protection service, monitoring and control function
16. Encouraging economic development
17. Promoting local employment
18. Reducing transboundary impacts of water facilities on the environment







Designation (negative)	Impact significance	Designation (positive)
I	International	**I**
N	National	**N**
R	Regional	**R**
L	Local	**L**

SEA objectives

1. Reducing surface and groundwater pollution
2. Mitigating the impact of water facilities on hydrological regime, improving water regimes
3. Protecting forest and agricultural land
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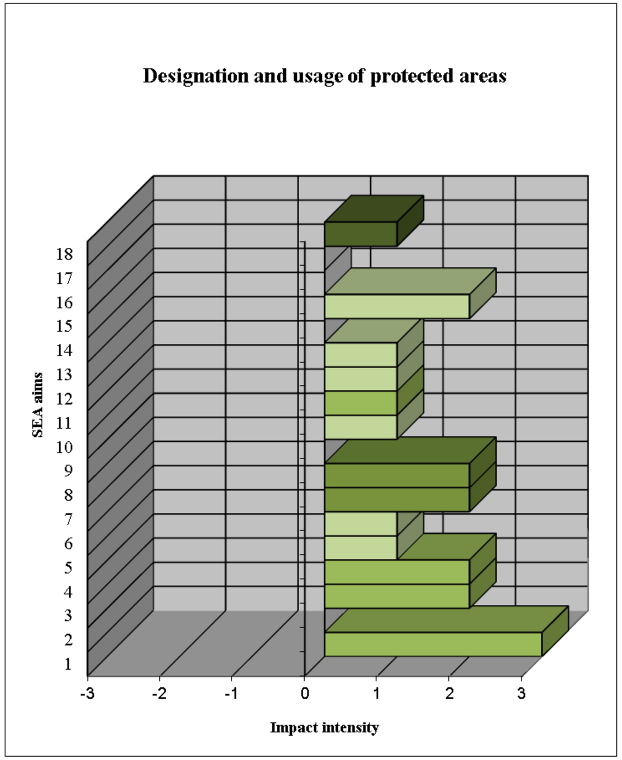

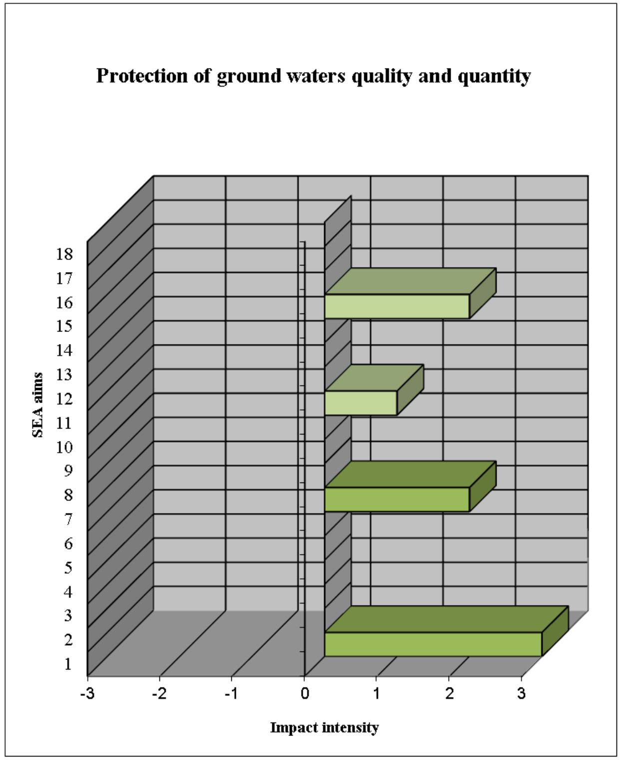

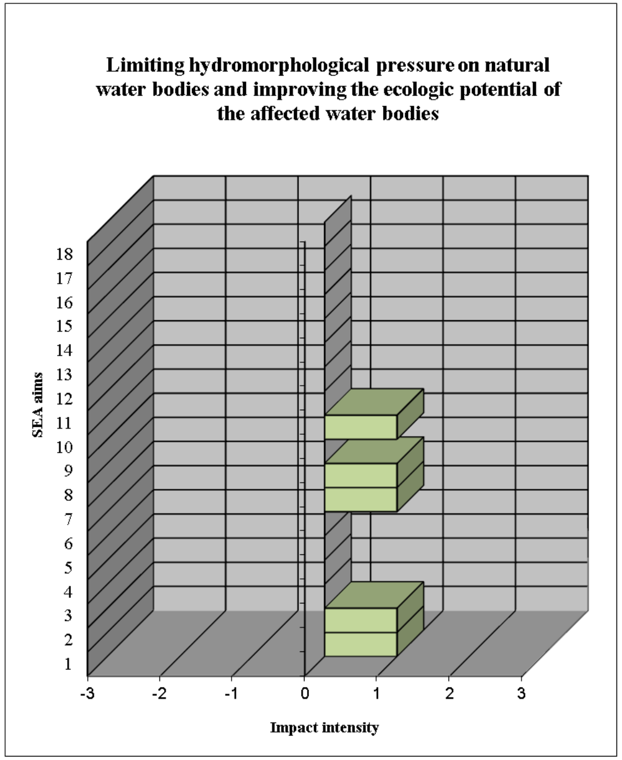

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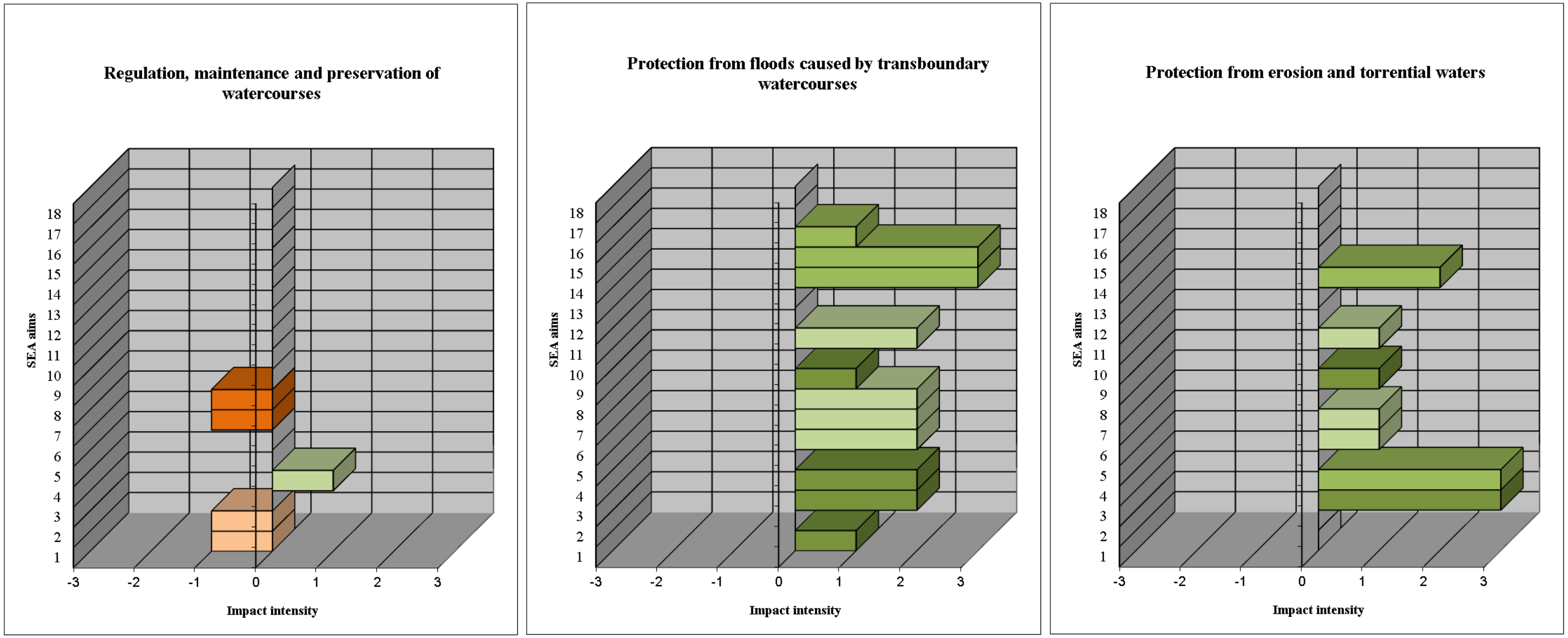

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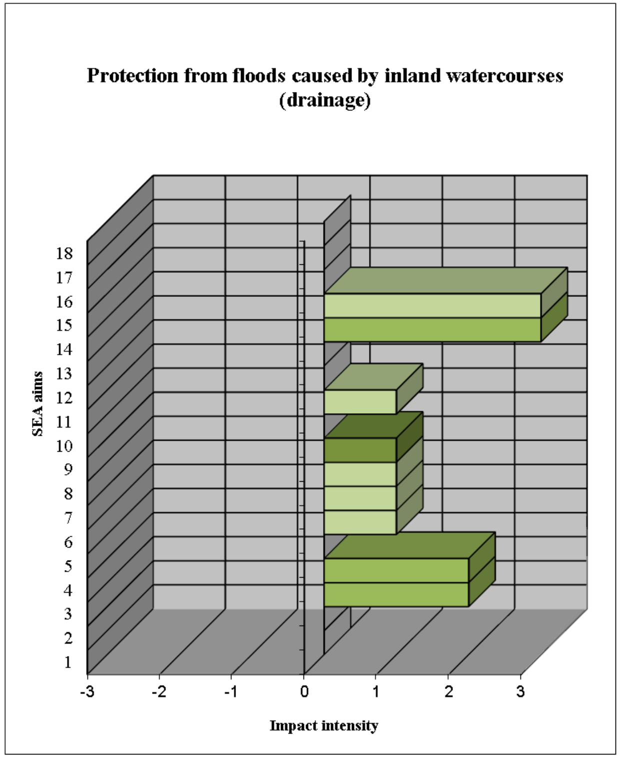

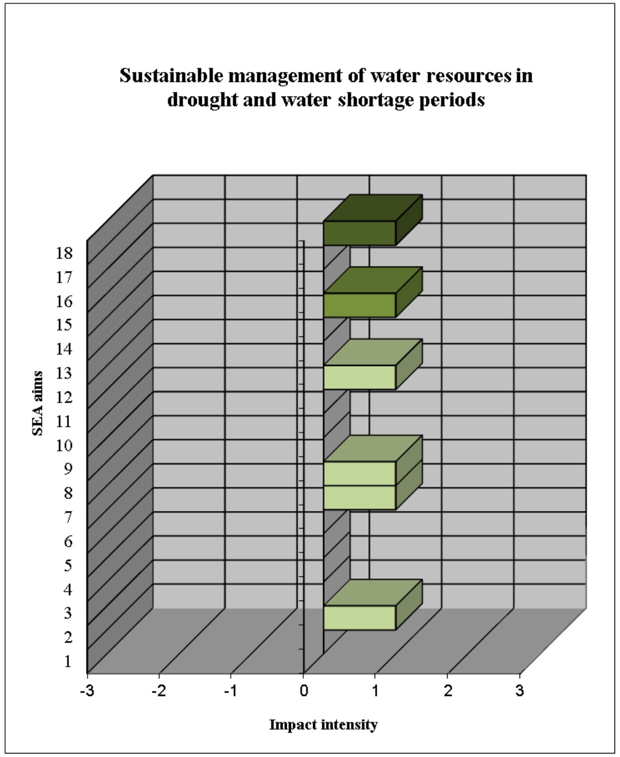

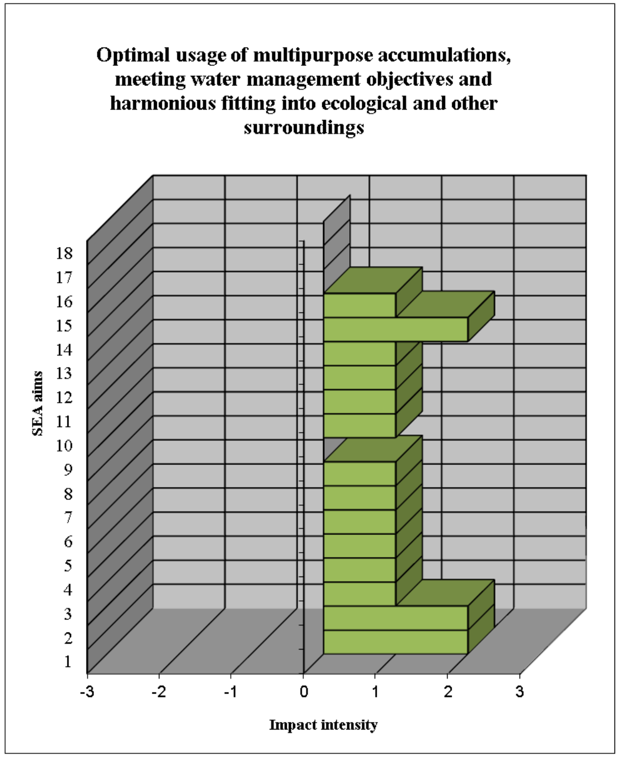

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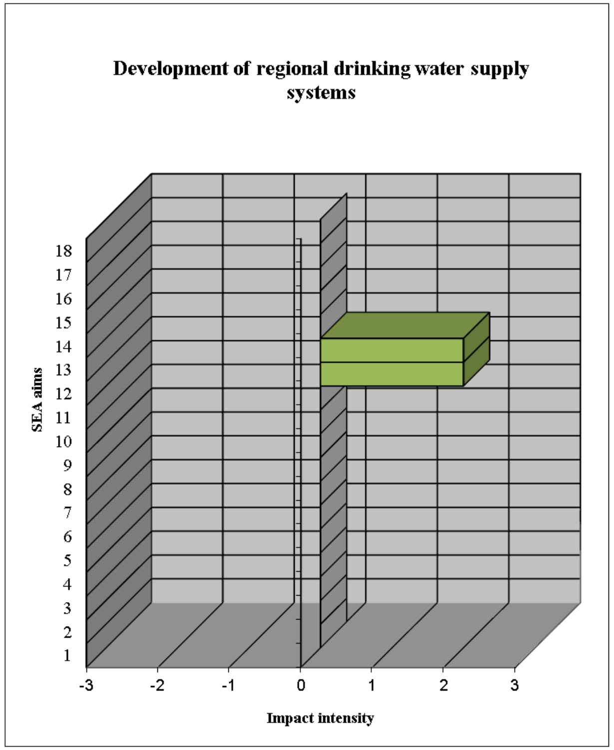

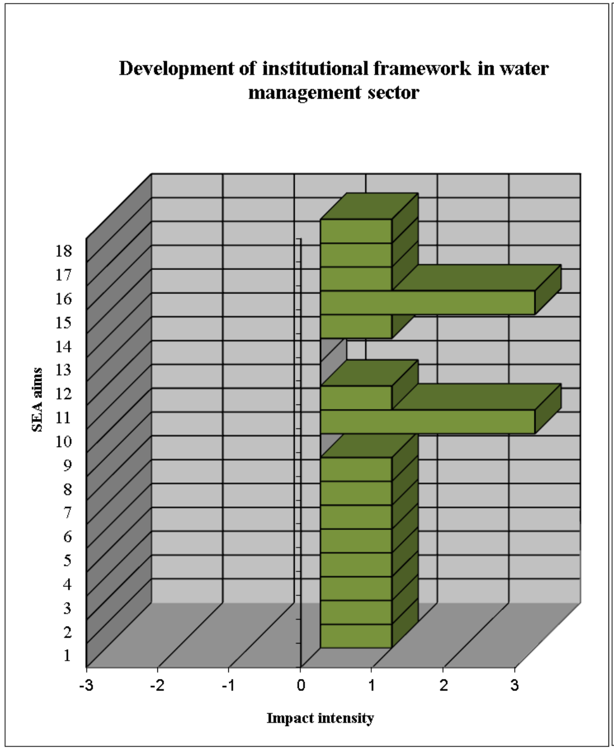

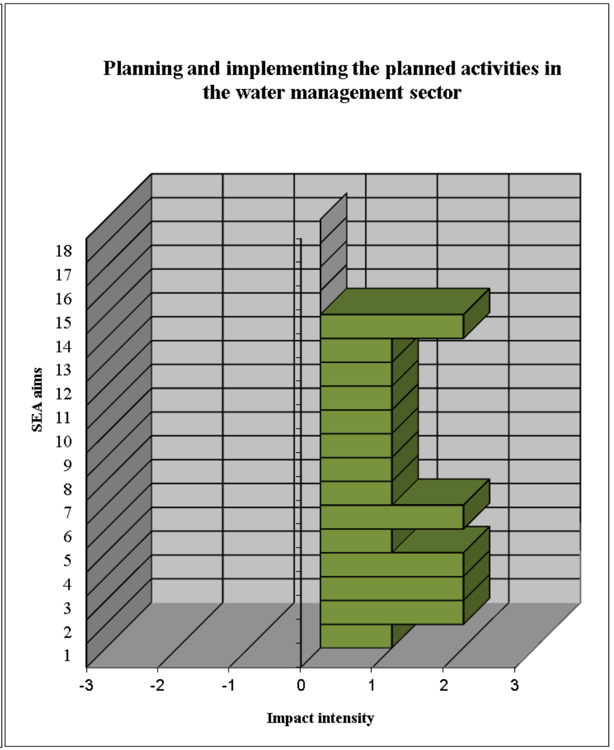

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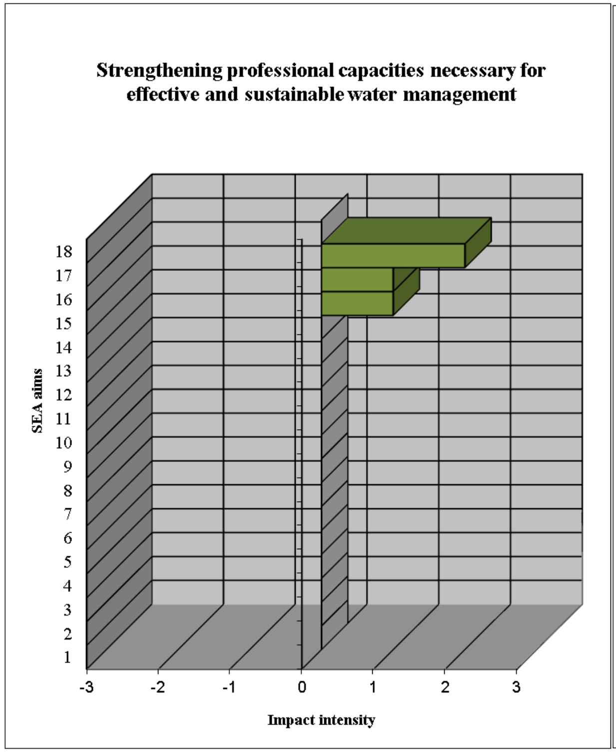

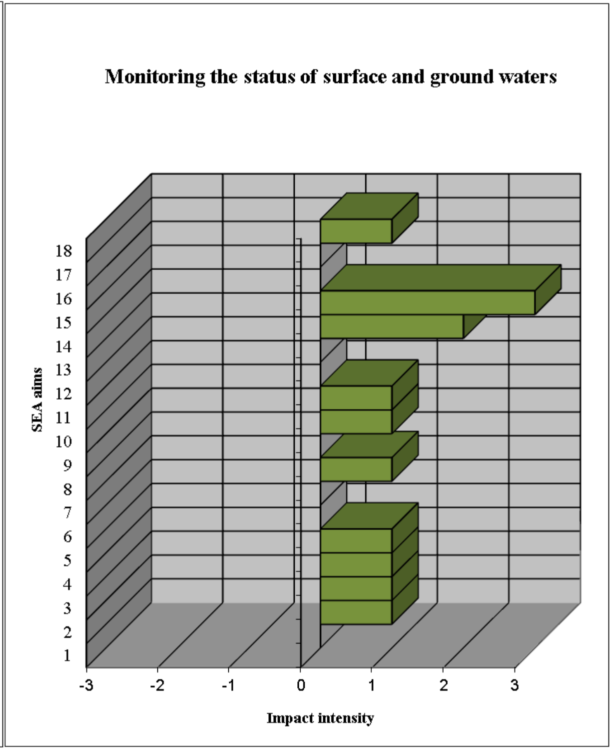

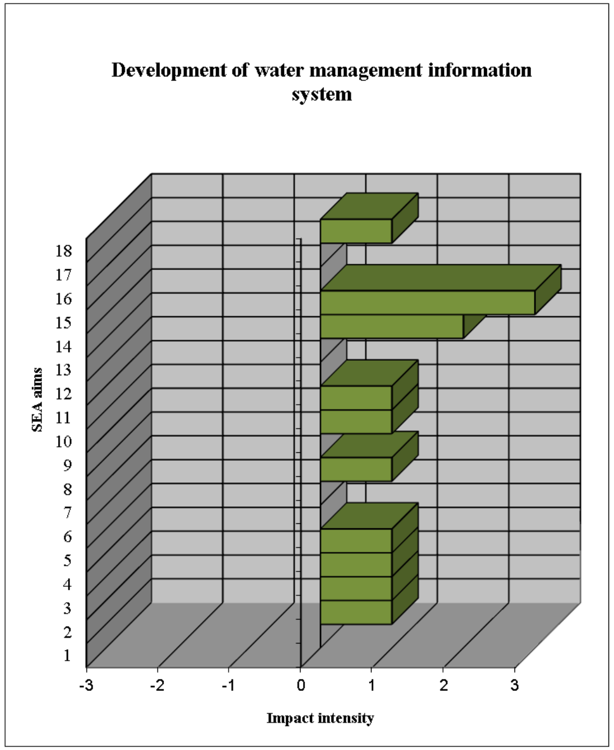

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Table 3.9. Identification and assessment of strategically significant impacts of priority activities

Strategy solution	Identification and assessment of significant impacts		Explanation
	SEA objective	Rank	
WATER USAGE			
Improvement of public water supply system	**1**	**N+2 / P**	Through achievement of some of operational objectives (Operational objective 5), it is possible to significantly improve water quality via: protection of the headwaters, research, protection and preservation of water resources, used or intended for human consumption.
Preservation of hydromorphological characteristics of both aquatic and littoral ecosystems on navigable rivers	**7**	**R+2 / P**	There may be positive impacts in the context of preservation of natural values and positive impacts on the preservation of biodiversity as a result of undertaking measures to protect aquatic and littoral ecosystems on navigable rivers.
	8	**N+2 / L**	
Preservation of water quality and the aquatic ecosystems amid pisciculture development	**7**	**R+2 / L**	There are likely to be positive impacts in the context of protection of natural values and biodiversity as a result of water protection amid pisciculture development.
	8	**N+2 / L**	
Water supply to tourist, sport and recreational centres and preservation of water quality in multi-purpose reservoirs	**10**	**R+2 / P**	The aspect of water protection in development of tourist areas entails previous establishment of the entire communal infrastructure. This directly contributes to water protection through enhancement of the wastewater treatment in tourist areas, and preserves the attractiveness of tourist areas, which in turn contributes to economic development of the area, as a second positive contribution.
	16	**R+2 / P**	
WATER PROTECTION			
Prevention of water pollution and water protection management	**1**	**I+3 / L**	It is expected to have strong positive impacts on the quality of surface and groundwater and consequently on the protection of natural values, which will be partly manifested through the improvement of the wastewater treatment.
	7	**N+2 / L**	
	10	**N+2 / S**	
Decreasing pollution from concentrated and scattered polluters	**1**	**I+3 / S**	It is expected to have strong positive impacts on the quality of surface and groundwater and consequently on the protection of natural values, which will be partly manifested through the improvement of the wastewater treatment.
	7	**N+2 / L**	
	10	**N+3 / S**	
Designation and usage of protected areas	**1**	**R+3 / L**	Strong positive impacts on the water quality are almost certain and they are to be achieved through: protection of headwaters used for drinking water supply, protection of areas intended for abstraction of drinking water, bodies of water for recreational purposes, sensitive ecological areas. Consequently, it is likely to have positive impacts on the protection of forest and agricultural land and reduction of erosion and degradation, as well as on the preservation of natural values of protection of biodiversity.
	3	**R+2 / P**	
	4	**R+2 / P**	
	7	**N+2 / P**	
	8	**N+2 / P**	
Groundwater – quality and quantity protection	**1**	**R+3 / L**	The implementation of this strategic solution is expected to have positive impacts on the quality of groundwater and on the preservation of natural values of an area.
	7	**R+2 / P**	

Strategy solution	Identification and assessment of significant impacts		Explanation
	SEA objective	Rank	
WATER COURSE REGULATION AND PROTECTION AGAINST ADVERSE EFFECTS OF WATER			
Protection against floods caused by transboundary watercourses	3	N+2 / P	It is expected to have significant positive impacts at a national or regional level in the prevention of the adverse effects of water on the population and natural and manmade values of an area, forest and agricultural land, as well as on the reduction in degradation and devastation of an area and soil erosion. In addition to technical, organisational and institutional measures, improvement of the overall flood protection system is an important positive aspect of this strategic solution.
	4	N+2 / P	
	14	R+3 / L	
	15	R+3 / L	
Protection against erosion and flood water	3	R+3 / P	It is expected to have significant positive impacts at a regional level in the prevention of the adverse effects of water on the population and natural and manmade values of an area, forest and agricultural land, as well as on the reduction in degradation and devastation of an area and soil erosion. Other positive aspect of this strategic solution are: establishment of a legal framework for improvement of protection against erosion and flood water and for monitoring and maintaining facilities. This solution therefore primarily incudes undertaking of all the necessary measures for preventive action in the protection against erosion and flood water.
	4	R+3 / P	
	15	R+2 / L	
Protection against floods caused by inland watercourses (drainage)	3	R+2 / P	It is expected to have significant positive impacts at a regional level in the prevention of the adverse effects of water on the population and natural and manmade values of an area, forest and agricultural land, as well as on the reduction in degradation and devastation of an area and soil erosion. Other positive aspect of this strategic solution are: improvement of the system for protection against floods caused by inland watercourses, efficient and coordinated protection against inland watercourses and regular maintenance and control of the functionality of water facilities.
	4	R+2 / P	
	15	R+3 / L	
REGIONAL AND MULTIPURPOSE HYDROSYSTEMS			
Optimal usage of multipurpose reservoirs, with the aim of meeting water management objectives and harmonious fitting into ecological and other surroundings	1	R+2 / L	It is expected to have significant positive impacts at a regional level on the water quality, cushioning of the impact of water facilities on the hydrological regime (indirectly), and on the protection against water when the need arises. These positive results will be achieved through improvement in the usage of the existing reservoirs, control of the functionality and maintenance of the existing reservoirs, increase in the reservoir capacities, adequate usage and control of the catchment area.
	2	R+2 / P	
	14	R+2 / P	
Development of regional drinking water supply systems	12	R+2 / P	Positive impacts of this strategic solution are most clearly seen in respect to the improvement of the quality of life of citizens and contribution these systems will give to the preservation of population of rural areas by ensuring continuous supply of high-quality water. The expected impacts are of a regional character.
	13	R+2 / P	

Strategy solution	Identification and assessment of significant impacts		Explanation
	SEA objective	Rank	
REST OF THE FACTORS AND MEASURES SIGNIFICANT IN WATER MANAGEMENT			
Development of institutional framework in the water management sector	**10**	**N+3 / P**	It is expected to have strong positive impacts at a national level, primarily in respect to the improvement of environmental protection service, monitoring and controlling. These impacts will be achieved through: institutional strengthening of the water sector and closer cooperation with other sectors not related to the water sector, introduction of a regulatory function in the water sector, transparency of the water sector operation and strengthening of scientific and competent capacities as a support to the water sector.
	15	**N+3 / L**	
Planning and implementing the planned activities in the water management sector	**2**	**N+2 / P**	As a key element in the water management system and environmental protection in general, planning is expected to create significant positive nation-wide impacts particularly in respect to: cushioning of the effect of water facilities on the hydrological regime, protection of forest and agricultural land, reduction in soil degradation and erosion, protection of areas, and protection against water.
	3	**N+2 / P**	
	4	**N+2 / P**	
	6	**N+2 / P**	
	14	**N+2 / P**	
Strengthening professional capacities necessary for effective and sustainable water management	**17**	**N+2 / L**	It is likely to have significant positive national impacts in respect to the promotion of local employment in the water sector through the optimisation of competent staff in the water sector.
Monitoring the status of surface and ground waters	**14**	**N+2 / P**	It is expected to create significant impacts on all aspects of water management, particularly in respect to protection against water and improvement of environmental protection service, monitoring and controlling. Continuous monitoring of the quality of surface and groundwater should allow timely and adequate reaction in case the quality of surface or groundwater is impaired.
	15	**N+3 / L**	
Development of water management information system	**14**	**N+2 / P**	Given the scope of information and data, water management information system plays an important role in monitoring and development of water regime, planning of water infrastructure development and operational management of water and water systems. An important part of this information system are water cadastres (water resources, water facilities, usage of water and pollutants), and their compiling and regular updating are of significance for the efficiency and quality of water management. Establishment of water management information system will create strong positive nation-wide impacts, particularly in respect to: water preservation, protection against water and improvement of environmental protection service, monitoring and controlling.
	15	**N+3 / L**	

* - criteria according to Table 3.5.

3.3. Summary of significant impacts of the Strategy

Based on the assessment of significance of the impacts shown in Table 3.9, it may be concluded that the implementation of the solutions envisaged by the Strategy can lead to strategically significant improvements with respect to spatial planning and environmental development. These positive impacts also stem from the commitment to have the Strategy underpin environmental protection and its significant aspect – water resources. In order to consider possibilities of a harmonious integration of planned solutions into the environment, the document will go on to briefly summarise positive and negative impacts, as well as measures that can be undertaken in order to harmonise hydro-technical solutions and environment.

3.3.1. Systematisation of positive impacts of the solutions envisaged by the Strategy

A series of strategically significant positive impacts of the Strategy have been identified, whose rank and impact significance have been presented and elaborated on in Table 3.9, and which address all the aspects of sustainable development. These positive impacts may be divided into two groups of development impacts:

- **Socio-economic development** – creating all the necessary prerequisites in the water sector required for the implementation of all components of more rapid economic and social development of the country. This requires securing conditions for: • necessary reindustrialisation of the country, • development of the entire rural sector from primary production to the last stages of final production of food products that are attractive for exports, • re-establishing construction sector as one of the pillars of the Serbian economy and exports (premise: usage of mainly domestic resources for the construction purposes, with engagement of domestic project and scientific/research sector), • improving communal hydro-technical systems and raising them to the level that meets the high standards of urban renewal and community development, • developing tourism – particularly the aspects of vital economic and social importance – at the level of family-run business which is of utter importance for demographics and developmental-economic stabilisation of rural areas, mountain areas in particular, • creating employment opportunities in the water sector through its development and optimisation of competent staff necessary for high-quality and efficient functioning of the water management system of the Republic of Serbia, • improving the quality of life of the population by increasing the availability of high-quality drinking water and connection to the faecal and atmospheric sewage systems, • protection of population and property against the adverse effects of water, • development of water management information system which would provide citizens with information important for the quality of life and local economic development: general hydrological data, state/pollution level of watercourses, water traffic, danger from floods and flood water, fishing etc.

- **Environmental quality –** the reduction in water pollution on the account of a whole set of strategic solutions (technical, planning, organisational, institutional, legal – which inter alia imply transposition of EU directives in the water management sector) dominantly based on prevention, maintenance and construction of facilities intended for water usage, water protection and the protection against water. Improvement of water regimes with the aim of observing the fundamental postulate of the ecosystem protection that environment is best protected amid increasingly unfavourable anthropogenic pressures by taking active management measures, of which the most significant is the measure on the water regime improvement – targeted management of reservoirs with annual adjustment (increase low flows and reduce high flows which are a particularly unfavourable type of environmental destruction). Protection of land, anti-erosion and biological arrangement of catchment areas as the key prerequisite for integrated arrangement, usage and protection of areas. Protection of all natural and cultural heritage and biodiversity – as a result of the implementation of strategic solutions envisaged by the Strategy (Table 3.9).

Observing the Water Management Strategy from the perspective of the most significant improvements in ecological, social and development terms, it may be summarised that the envisaged solutions would allow the following rather significant goals in environmental protection development to be achieved:

- Ensuring healthy drinking water supply, thus preventing waterborne epidemics, which is a significant ecological impact.
- Producing hydropower, which is the purest source of energy in ecological terms, and thus reducing pollution from solid, liquid, gas, thermal and radioactive waste from alternative thermal power plants, which would have to be used for an extensive period of time to replace hydroelectric power plants, if hydroelectric power plants were not constructed.
- Enabling intensive food production, using irrigation, which is one of the most noble ecological endeavours. This would also reduce the ecological pressure on the soil of lower capability, which could then be afforested and used for other purposes.
- Reducing high flows and the danger of floods, thus relieving communities from fear of water disasters, and protecting environment from floods which are the greatest form of ecological destruction.
- Increasing low flows during dry and warm parts of the year (low flow enrichment effect), precisely at the time when survival of the majority of biocenoses in rivers is threatened by the synergy of lower flows, high temperature and low oxygen levels in the water. This is an example of support to the environmental protection postulate that proactive management should help ecosystems survive and develop amid higher anthropogenic pressures.
- Water regimes becoming managed: reducing high flows and increasing low flows, which can significantly help improve ecological state downstream from the reservoir. Improvement of water regimes through flow balancing in the reservoirs and accompanying adjustments and arrangement of river banks enable communities, previously stricken by floods or water shortages, to get down to rivers and integrate the cultivated river banks into their urban structures in the most suitable way, after constructing a reservoir. Within the area of a settlement, flow balancing is carried out according to the principles of the so-called urban regulation, which is one of the most important measures of urban development around the river areas, either downstream from the reservoirs or in their backwater areas.
- Emergency discharge of water from the reservoir improves the quality of water downstream from the reservoirs and prevents ecological disasters in case of water pollution induced by incidents.
- Construction of reservoirs is accompanied by anti-erosion works in the catchment area, particularly sanitation of the erosion-prone areas of I and II type (excessive

and strong erosion). Anti-erosion works underpin biotechnical and biological protective measures (afforestation, renewal of degraded forests, amelioration of meadows etc.), which is an ecologically significant contribution to spatial planning.
- Reservoirs construction necessarily entails implementation of a series of measures regarding sanitation of communities, drainage works and construction of wastewater treatment facilities, in order to protect reservoirs and rivers from eutrophication. These measures of water quality protection, significant for improvement of the state of aquatic ecosystems, are initiated and financed precisely from the funds allocated to projects regarding dams and reservoirs.

Lastly, of increasing importance: construction of large water areas, as a rule, creates favourable environment for tourism, sports and recreational valorisation of space.

3.3.2.Systematisation of some negative impacts of the solutions envisaged by the Strategy

Certain negative effect identified within the Strategy are not great in their intensity or spatial proportion, therefore they are deemed strategically insignificant, by criteria presented in Table 3.5 The identified small-scale negative effects are the inevitable consequence of development and usage of hydropower potential in the Republic of Serbia. A beneficial circumstance is that, with adequate planning, large number of such effects can be either considerably reduced or compensated with other, positive effects.

Sustainable usage of hydropower potential. Although the word "sustainable" is used in the formulation of this strategic solution, denoting that in the usage of water-power potential a special attention is given to the aspect of environmental protection, it is undeniable that such anthropogenic activities on bodies of water could have negative effects on hydrological regime, benthic organisms, biodiversity and the ecological status of aquatic ecosystems, etc. Bearing in mind the formulation of this strategic solution, its operative objectives and measures for reaching them as defined in the Plan, these negative effects are not considered significant in either their intensity or spatial proportion. This is certainly contributed by the commitment that in the process of carrying out the hydropower projects, the water management sector be included in all the activities connected to the usage of hydropower potential of watercourses, starting from strategic acts and plans in the energy sector, to the realisation of projects and management of water-power facilities so as to secure harmonisation of various aspects of water usage, water and environmental protection, and protection from riparian waters. However, such impacts should not be disregarded, especially not because of their transboundary potential in case of border watercourses, i. e. they should be prevented by implementing measures envisaged in the Plan as well as by following guidelines defined in the said strategic environmental assessment impact. These negative impacts are, in ecological terms, partly compensated through the following management possibilities of reservoir facilities: ▪ raising the flow above its natural level through controlled discharge of clean water from reservoirs during the dry periods and ecological emergencies (synergy of extreme low flows, high temperatures, low oxygen levels in the water, incidental water pollution), which preserves water ecosystems in the better part of the river, ▪ controlled stabilisation of the water level in reservoirs and the parts of the watercourse downstream from the dam during the spawning period and development of whitebait, so as to prevent oscillations – lower water levels, typical of natural hydrological conditions – from causing death of the fish egg and whitebait, ▪ construction of facilities for fish transit (fish ladders), which have become standard when constructing hydro-technical facilities (envisaged as a part of all systems planned to be built on large rivers – the Drina, the Morava, the Ibar etc.), ▪ cultivation of river banks in the backwater areas and downstream from the facilities in order to create conditions for smooth usage of water areas for recreational and tourism purposes.

- **Supply of drinking water to tourist, sport and recreational centres and preservation of water quality in multipurpose accumulations.** An increase in anthropogenic activity in certain area leads to the possible increase in pressure on all natural resources in the said area. Bearing that in mind, the development of tourism represents a threat to water resources. In case of mountain tourism, construction of accommodation facilities for a large number of tourists in the high areas of mountains (Kopaonik, Stara planina etc.) where small streams and springs are main body waters, there are two large forms of danger: • abstraction of all water bodies (springs, small streams) for the purpose of supplying water to these centres, in such a way that threatens small watercourses and ecosystems relying on these watercourses and particularly wild animals which are then deprived of drinking water sources, • pollution of water courses, as wastewater treatment facilities are rather demanding when constructed, in mountain-based tourist facilities whose accommodation capacities are depleted on a seasonal basis[18]. The second danger may occur in the case when the tourist offer relies predominantly on the usage of water resources, such as the increasing number of "ethno villages" and large centres situated at the very river bank. In such case, large amounts of wastewater, containing numerous organic matter – and the used household chemicals – are discharged directly into rivers, so they become contracted sources of pollution of rivers of highest quality. There are a number of such facilities on the banks of the Drina river and on a number of ecologically valuable rivers. It is necessary to regulate the operation of such facilities with technical solutions which would prevent these types of pollution (watertight tanks which would be regularly discharged by public utilities, without any request from the owner of the facility, etc.).

- **Regulation, maintenance and preservation of watercourses.** Negative effects that may result from this strategic solution are perceived solely during works on regulation, maintenance and preservation of a watercourse, and therefore the identified minor negative effects of this strategic solution are considered insignificant in their effect and character.

[18] Remark that the problem would be easily solved by a construction of waste water treatment facilities is an oversimplification of the problem when such facilities are built in mountain areas and in case of seasonal work of mountain tourist centres (winter and summer, with long breaks in the between). In order to have the wastewater management facility operate properly, secondary treatment should be in place, and it should include bacteria that should spawn at an appropriate temperature and reach the number required to dissolve organic matter. If a waste water management facility faces disruptions in operation due to the seasonal nature of mountain centre operation, this stable system would be drastically deteriorated, and it would take weeks to have it stabilised again. This is the reason why there is practically no waste water management facility operating in mountain centres. This leads to a drastic devastation of entire hydrographic systems in the areas of large mountain centres, due to discharge into environment of non-purified or partly purified water, which has only undergone the primary treatment, usually including only the usage of stilling basin.

- **Construction of small hydroelectric power plants.** By undertaking to increase the share of energy from renewable energy sources in the gross final consumption, incentives have been introduced for the privileged power producers from renewable energy sources, and even small hydroelectric power plants. Defined incentives led to higher investor's interest in this area. In case of large and medium hydroelectric power plants, protection measures and harmonious integration into environment may be implemented quite successfully, while this is quite a challenge in case of small hydroelectric power plants. Namely, as a rule, small hydroelectric power plants are based on quite long penstocks, which enable achievement of a higher value of the head (the only way to attain small power, often measuring only several hundreds of kW), which leads to a permanent devastation of entire stretches of watercourses. Requirements on the discharge of mandatory minimum sustainable flow s are often ignored, as they cannot be controlled, and this ought to be taken into consideration when defining appropriate guidelines for the construction of small hydroelectric power plants. As small watercourses are the finest "capillaries" of all ecosystems, their devastation leads to a "domino" effect of devastation of all larger ecosystems that are connected with them. Assessment of some already constructed small hydroelectric power plants shows ecological destruction of very valuable small watercourse for the sake of low energy results. In addition, there is no unique list of possible locations and planning documents addressing mini hydroelectric power plants are not harmonised. Having all the above in mind, as well as the possibility of cumulative effect of several small hydroelectric power plants on the same watercourse, it is necessary to pay special attention to the aspect of responsible planning of the number and spatial order of small hydroelectric power plants.

- **Negative impacts on the shoreline,** due to the changes in the regime of groundwater. This impact is particularly pronounced in the case of reservoirs constructed on alluvial rivers, with low shoreline. It can be neutralised quite successfully through construction of adequate drainage systems. These systems are an inseparable part of spatial planning and allow for the management of groundwater – by keeping the groundwater within the defined boundaries and at levels which are not detrimental to urban systems and agricultural production. These systems may serve a two-fold function – drainage and irrigation, thus moving from the domain of negative impacts into the one of positive impacts of the system. Such a scenario was achieved in the case of hydroelectric power plant Đerdap, and these will be the driving principles of the maintenance of water regimes in the basin of the Velika Morava and the Mačva, once the integral systems on the Morava and the Drina have been constructed.

- **Clogging of the reservoir** due to disrupted regime of the transport of deposit. Negative impacts that cannot be removed, but rather only mitigated through anti-erosion works and selection of appropriate position of evacuation parts on the dam.

- **Lake eutrophication processes** are one of the most grave phenomena indicating deterioration of a reservoir and degradation of quality of the water they contain, if proper protection measures are not taken. These detrimental processes may be successfully prevented and controlled if appropriate water quality control measures are applied at the entrance of the reservoir. What is encouraging is that there are numerous examples of reservoirs in late stages of eutrophication and quality degradation which have been preserved and returned to the oligotrophy stages, by applying appropriate measures of the control of nutrient intake, primarily phosphor. These examples indicate that such processes may be put under control and that lakes may be preserved in ecologically favourable state with the use of adequate measures.

- **Change in microclimate** within the narrowest radius of the reservoir. This is a phenomenon that is quite unnecessarily overdramatised. Recent analyses across various countries have shown that the change in microclimate is a far less significant problem than previously anticipated, their impacts of a much more restricted radius that previously believed. Worldwide thorough analyses and in-depth mathematical models indicate that all changes in respect of changes in temperature and humidity (relative to the original state) in case of reservoirs planned to be constructed in Serbia, become insignificant and immeasurable at a distance of around 600 to 800 metres from the reservoirs. However, even this strictly local impact on the temperature changes is positive, as it reduces extreme temperature oscillations (decreasing high and increasing low temperature), owing to huge thermal capacity of the water mass in the reservoir.

3.3.3. Transboundary impacts

Possible transboundary impacts are of particular strategic significance considering that they extend beyond the special scope of the Strategy. As a signatory to the Espoo Convention and Kiev Protocol, the Republic of Serbia has undertaken to inform other countries about proposed projects which may have transboundary impacts. The Espoo Convention on Environmental Impact Assessment in a Transboundary Context defines the transboundary impact as *"any impact not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another party".* If the proposed activity is found to cause significant adverse transboundary impact, for the purposes of ensuring adequate and effective intervention, the Espoo Convention requires the party, i.e. the government of the country undertaking the activity, to notify any other party (other country's government) which it considers to be affected by the activity at earliest convenience and no later than the moment of informing its own public about the proposed activity. With respect to possible transboundary impacts, no impacts have been identified that are of strategically important character (neither positive nor negative), as it was estimated that they do not burden capacities of the space.

Slightly negative impacts that could ensure from the usage of hydro-energetic potential on transboundary watercourses have been identified. No adverse effects have been identified in respect of hydrological regimes, benthonic organisms and ichthyofauna of Serbian systems on boundaries with Hungary, Romania and Bulgaria. Negative impacts on boundary with Montenegro, ensuing from planned facilities on the Lim river in the Brodarevo zone, with the backwater not transferred into Montenegro, will be neutralised with fish ladder on both stairs.

Effects on the Drina on the boundary with Bosnia and Herzegovina (Republika Srpska) are mutual, as the system is built on the transboundary belt, so these effects will be addressed jointly. On boundary with Macedonia, significant impacts would occur only if the Prohor reservoir were to be built on the Pčinja river, which remains rather uncertain at the time.

Other identified transboundary impacts that were also not assessed as strategically important, are positive, and come as a result of the implementation of strategic solutions that relate to: preservation of geomorphological characteristics and aquatic and shoreline ecosystems on navigable rivers; preservation of water quality and the aquatic ecosystems amid pisciculture development; prevention of water pollution and water protection management; decreasing pollution from concentrated and scattered polluters; designation and usage of protected areas; sustainable management of water resources during drought and water shortage periods; development of an institutional framework in the water management sector; monitoring the status of surface and groundwater, development of water management information system.

Although positive effects of the said strategic solutions have not been assessed as strategically significant, their sublimation will certainly lead to significant improvements in the water sector in the transboundary areas.

3.4. Cumulative and synergistic environmental effects assessment

In compliance with the Law on Strategic Environmental Impact Assessment (Article 15), the strategic assessment should also include an assessment of cumulative and synergistic effects on the environment. Significant effects can results from interactions of numerous smaller effects of the existing facilities and activities, as well as planned activities for the area covered by Plan. An example of "numerous smaller effects" would be massive construction of small hydroelectric power plants, which, given the large number of such facilities (several hundreds), could have quite adverse ecological effects on the wide mountain-hilly region of Serbia which is the most valuable and best preserved ecosystem.

Cumulative effects arise when sectoral solutions each have insignificant effects, but together create a significant effect.

Synergistic effects interact to produce a total effect greater than the sum of the individual effects, so that the nature of the final impact is different to the nature of the individual impacts.

Table 3.10. Identification of possible cumulative and synergistic effects of strategic priority activities (according to Table 3.6)

Interaction of strategic solutions	Area of strategic assessment
WATER	
3, 7, 13	Construction of RHE and small hydroelectric power plants (particularly if a large number of small hydroelectric power plants were constructed on the same water course – cumulative impact) would lead to a disruption in the hydrological regime on watercourses. Coupled with tourism development and regulation, maintenance and preservation of watercourses could exert certain pressures on water bodies.
1, 5, 6, 8, 9, 10, 11, 12, 18, 21, 22, 23, 24	Implementation of the said strategic solutions and their joint effect should enable sustainable water management along with efficient water protection at all levels.
SOIL	
3, 21	Construction of hydroelectric power plants with a powerhouse at the toe of the dam and/or small hydroelectric power plants necessarily leads to flooding and changes in the soil function, which also happens during the planning of new reservoirs. Interaction of these strategic solutions exerts certain pressures on the soil.
5, 10, 11, 12, 14, 15, 16, 20, 21	Interaction of the said strategic solutions will ensure protection of soil (forest and agriculture), particularly the soil located close to water bodies, and exposed to pressures, flooding etc.

Interaction of strategic solutions	Area of strategic assessment
AIR AND CLIMATE CHANGES	
/	/
4, 17	Positive cumulative effects on the reduction of exposure of the population to polluted air are created using the renewable energy sources and ensuring sufficient amounts of water during drought, when incidence of wildfire and consequent pollution of air are likely. Interaction of the said solutions contributes to air protection and reduction in greenhouse gas.
NATURAL VALUES	
4, 7	Usage of hydropower potentials, coupled with expansion of tourist offer, could create certain pressures on natural values.
5, 6, 8, 9, 10, 12, 13, 17, 18, 21, 23, 24	Interaction of a whole series of strategic solutions will create multiple positive impacts in respect to protection of natural values and biodiversity, particularly in case of aquatic ecosystems.
CULTURAL HERITAGE	
/	/
14, 15, 16, 21	Preventive protection of cultural and historical heritage will be ensured through interaction of strategic solutions which refer to the aspect of water protection and responsible planning and implementation of plans in the water management area.
WASTE	
/	/
7, 8, 9, 12, 17, 19, 20, 21, 22	Implementation of measures in the water protection sector which refer to implementation of projects and application of cutting-edge technologies in the wastewater treatment, along with planning and other institutional measures and water monitoring, will ensure significant improvement in the wastewater management and directly contribute to improvement of the water quality.
SOCIAL DEVELOPMENT	
/	/
1, 2, 12, 14, 16, 17	The presented planning solutions envisaging a higher number of connections to city water supply network, fecal and atmospheric sewage systems, will create a cumulative long-term positive impact on public health. Solutions envisaging the development of nautical tourism and intensification of water traffic give a positive cumulative contribution to the improvement of the quality of life of the population through encouragement of local economic development and employment. The implementation of measures for protection against floods and the environmental effect of water facilities on environment have a positive cumulative effect on the quality of life of citizens.
INSTITUTIONAL DEVELOPMENT	
/	/
20, 22, 23, 24	The presented solutions will give positive cumulative contribution to institutional development in the water sector, having a multiple positive effects on efficient and sustainable management of water resources in the Republic of Serbia.
ECONOMIC DEVELOPMENT	
/	/
2, 3, 4, 7, 14, 15, 16, 18, 19, 20, 21, 22,	While contributing to the water management system improvement, the interaction of the presented strategic solutions in the water sector will also secure significant prerequisite for economic development.

positive impact negative impact

3.5. Description of guidelines for preventing and mitigating negative impacts and maximizing positive impacts on the environment

Environmental protection implies taking into account all general measures for environmental and nature protection and related laws and regulations. In this context, the guidelines for environmental protection have been established based on the analysis and assessment of current state of the environment, as well as on identified potential environmental impacts.

Guidelines for environmental protection are aimed at bringing the identified adverse environmental impacts within limits of acceptability for the purpose of preventing the threat to the environment and human life. They help maintain the trend of positive environmental impacts. Guidelines for environmental protection enable the development and prevent conflicts in the subject area, aiming at achieving the sustainable development objectives.

Based on the results of multi-criteria analysis of priority activities envisaged in the Strategy, the following guidelines are determined hereafter and they are to be followed during the implementation of the Strategy, i.e. its execution though documents of lower ranks.

3.5.1. General guidelines:

- it is mandatory to fully implement regulations pertaining to environmental protection and undertaken international obligations in the water sector and environmental protection sector;
- it is mandatory to implement measures for achieving objectives of environmental protection pursuant to provision of the Water Law (RS Official Gazette, Nos 30/10 and 93/12), which include prevention of deterioration, protection and improvement of all water bodies of surface and groundwater, with the aim of achieving good status of surface and groundwater and protected areas;
- it is mandatory to implement guidelines for environmental protection defined in this SEA and their in-depth elaboration in the implementation of the Strategy, i.e. through drawing up of the Programme for implementation of Strategy, producing of planning documentation and project-technical documentation for specific projects;
- it is mandatory to monitor environmental quality in accordance with applicable regulations and the Environmental Monitoring Programme as defined in this SEA;
- ensure education and public participation in all stages of the implementation of projects in the water sector;
- in respect to the activities established to cause significant negative transboundary impact, “the party” i.e. the state is obliged to undertake activities, for the purpose of ensuring adequate and efficient intervention, to inform all other parties (states) which it considers that will be affected by the activities, at earliest convenience, and no later than the moment it informs its own public on such activities;
- ensure data availability, education and public participation in all stages of the implementation of projects in the water sector – by establishing a comprehensive water management information system, available online, regarding all significant aspects related to water quality and local socio-economic development (hydrology, state (quality) of waters/watercourses, information on water traffic, information on dangers of floods and flood water, information regarding hunting and fish hunting, nautical tourism etc.), through public opinion surveys, forming of special focus groups, and through transparency and discussions on the projects in the water sector;

3.5.2. Guidelines for significant priority activities of the Strategy

<u>Measures for harmonious integration of hydro-technical systems into the environment</u>

- Reservoir parameters, primarily backwater level, should be chosen in accordance with the ecological criteria, being mindful of characteristics of the reservoir as a biotope in the exploitation period. Solutions proposing shallow reservoirs should be avoided, as such reservoirs are prone to the eutrophication process.
- All ancillary facilities of the reservoir (dams, evacuation parts, head gates, machinery storage houses of hydroelectric power plants, etc.) should be placed in such a way so as to integrate them into the environment in the best possible way. The majority of these facilities, save for the dam, may be placed below the ground in case of rivers with special spatial values.
- Borrow pits should be located in the areas which will later become backwater, or if this is not possible, these areas should be modelled and completely “healed” with biological measures, and even used for the enrichment of ambient values.
- Each project must be accompanied with a thorough ichthyologic analysis, which will indicate whether there is a need to construct facilities for fish migration (fish ladders, pool-and-weirs, fish elevators) within the hydro engineering complex. Reservoirs are new water biotopes, and they allow human action to control the desired development path of the ichthyofauna. This fact should be borne in mind when planning any activity regarding fish stocking and construction of fish protection facilities (fish ladders, hatcheries).
- The dynamics of the initial filling of the reservoir should be planned and carried out in accordance with ecological requirements. The reservoir area should be thoroughly cleaned immediately prior to filling, in order to prevent any unfavourable effects on the eutrophication process.
- Characteristic of the outlet tower (capacity, number of gates and its height, the choice of the type of the valves) should be harmonised with ecological requirements. In order to secure that the guaranteed minimum sustainable flow discharged from the reservoir is of highest quality – facilities for discharge of the flow ought to be constructed as selective water intakes, allowing to manage the amount and the quality of the water discharged. The water discharge should be adjusted to the requirements of the downstream biocenoses (discharge from an adequate temperature layer, most suitable for the development stage of the downstream biocenoses. In order to manage the flows discharge, water stops need to be adjustable. It is necessary to ensure aeration of the flow (cone valves are most adequate in this respect), so as to manage the oxygen regimes of the guaranteed minimum sustainable flows. It follows that outlet towers should be constructed in such a way that allows efficient management of temperature and oxygen regimes downstream from the dam.
- Floodgates need to be strong enough in order to provide for pre-discharge of the reservoir in accordance with the forecasts of formation of waves of high flows, thus improving the effects the reservoir will have in respect to protection against floods.
- Hydro-technical facilities need to be constructed in such a way so as to ensure the prescribed minimum sustainable flow pursuant to Article 81 of the Water Law (RS Official Gazette, No. 30/10), which does not question the survival, growth and migration of fish and other water organisms.
- Groundwater regimes in the area of low shorelines need to be controlled through systems of protection which secure full protection against overwatering. These systems should be established as manageable systems which enable improvement of water regimes compared to their natural state. These systems should also be adjusted

to other hydropower engineering and ecological objectives (irrigation, tourism valorisation of area). A prime example of such area-enriching system is the Srebrno jezero on the Danube River, as a part of the shoreline protection of hydroelectric power plant Đerdap, which, owing to managed water regimes, grew to become a remarkable tourist–recreational centre. Shoreline protection systems should be implemented in a multipurpose manner, so that they could facilitate control of salt regimes, irrigation etc., in addition to drainage.

- Anti-erosion protection of reservoirs should be regarded as a wider measure of development and cultivation of the catchment area. Special attention should be paid to biological measures of catchment area protection (afforestation, amelioration of meadows), treating them in the long run not merely as an ecological factor, but also as a factor of stabilising economy for the survival of the communities located in the parts of the catchment area where soil if of lower quality.
- Managing reservoir levels should be adjusted to both ecological and tourism standards. For instance, it should secure stable water levels during the period of fish spawning, in order to prevent loss of roe in the shallow water, and stabilise the water level during the summer period of those reservoirs that play a tourism-related role.
- All biological interventions in the system (fish stocking, afforestation, etc.) should be carried out only after minutely completed ecological studies, so that interventions would not disrupt desired and already struck ecological balance.
- Guaranteed minimum sustainable flows should be selected with respect to ecological requirements, treating them as a dynamical category and adjusting them to biocenoses development downstream from the reservoirs (discharge of higher flows during the warmer parts of the year, which is the time of reproduction of all species in the ecosystem).
- To keep reservoirs in the most favourable trophic states it is necessary to take adequate measures of quality protection of the water entering the reservoir. Through adequate monitoring of the reservoir water quality, and by applying mathematical methods of quality development, it is necessary to timely detect the ageing of the reservoir, so as to take adequate protection measures.
- Regular waste extraction activities and dredging as a regular measure of maintenance of reservoir areas with the aim of ensuring longer operation of the hydro-technical systems.
- Envisage appropriate forest protection corridors in new water areas, for the sake of animal protection during their migration and safer crossing of water obstacles (rivers, derivation channels).
- Water areas and hydro-technical facilities within the settlements should be planned from the viewpoint of harmonious functional and aesthetic integration into the urban tissue. Construction of reservoirs in the urban areas should be used to connect settlements with water areas in the most harmonious manner. For instance, some parts of Belgrade that got down to the Sava in accordance with urban planning principles, and central parts of Kladovo, Golubac and Bečej, which got down to the Danube in the part where it is in the area of the Đerdap backwater.

Hydroelectric power plants and small hydropower plants

Construction of hydroelectric power plants of all types and sizes have certain specificities with respect to harmonious integration into environment. In addition to the already said measures for all hydro-technical systems, the following specific requirements should also be borne in mind:

- The construction of these systems may not block the watercourse nor may the usage hydraulic structures do so;
- Derivational facilities mean significant spatial interventions and in planning such facilities, the measures referred to in the latter part of the list should be taken into account.
- Canyons and river valleys that are of important ambient value must not be visually "polluted", nor devastated with water pipelines which, in case of small hydro power plants, are often fixed of rock formation of canyons, or placed on the surface, directly next to the watercourse. If it is impossible to use tunnel derivation facilities or underground water pipelines, such solutions should be altogether abandoned.
- When planning the course of the canals for water transfer, it should be taken into account how wild animals would overcome such obstacles on their migration paths. Slope of these canals (inclination, surface of the slope on the points of wild animals' crossing) ought to be solved in such a manner so that wild animals can overcome such obstacles. Also, forest protective corridors should also be taken in consideration and envisaged on the appropriate location within the zone of new water area, as well as on the canals for water transfer, with the aim of protecting animals at the time of migration, when getting down to watering places and with the aim of animals' safer crossing of water obstacles.
- As hydroelectric power plants are often constructed in areas known for typical architectonic heritage – all facilities ought to be located in such a manner as to integrate well with the urban and architectonic setting. Facilities that do not visually integrate well into the environment, such as warehouses, should be avoided. As small hydroelectric power plants require facilities of smaller dimensions, it would be very suitable if these facilities were designed as forms of traditional folk architecture, especially in the case of mills and rolling mills, which are often constructed on small rivers.
- Layout and construction of overhead transmission lines are of particular interest. Paths leading over or immediately next to protected areas should be avoided whenever possible. Felling trees and shrubs for their construction should be carried out so as to avoid affecting environmental values and intensifying erosion.
- Fish ladder should be designed in relation to water intake so that the amount of water will ensure an average minimum monthly flow rate to enable undisturbed passage of ichthyofauna and other aquatic organisms;
- If the fish ladder is comprised of a greater number of smaller basins, the height difference between them should not exceed 0.2m;
- Turbulence of water through fish ladder should be at a speed low enough (depending on the dominant species of the ichthyofauna) to enable the passage of migrating juvenile aquatic organisms. Longer fish ladder should also contain resting points, in the form of a pool, whose bottom is covered with the material from the river bed.
- The bottom of fish ladder should be covered by natural substrates. The best solution is to use substrates from waterways, i.e. the part of substrates settling downstream form the dam;
- Undisturbed functioning of fish ladder must have a priority over the electricity generation, which means that in case of minimum flow rate the turbines must be stopped to ensure enough water for fish ladders;
- The above mentioned water intake system and fish ladders must be appropriately ensured, including entrance and exit, to prevent unauthorised persons from accessing them, as well as to prevent any type of ichthyofauna catching devices to be placed in them;

- Fish ladder should be regularly cleaned by removing debris which can disturb movement of aquatic organisms;
- In case fish ladders are obstructed or in case of other accidents causing their dysfunction, the operation of hydroelectric power plant/small hydropower plant must be stopped until the causes are eliminated;
- In areas which are prone to flooding and, consequently, to landslides, a policy applicable in cases of collapses/landslide occurrence may be adopted to mitigate the probability of occurrence of such accidents after filling the reservoirs;
- It is necessary to separately plan cumulative impacts of a greater number of small hydropower plants if their construction is planned on the same watercourse;
- Using the topographic features of the terrain and vegetation as visual barriers to prevent visual impacts.

4. GUIDELINES FOR UNDERTAKING THE SEA AT LOWER HIERARCHICAL LEVELS

Pursuant to Article 16 of the Law on Strategic Environmental Impact Assessment, the Strategic Environmental Assessment Report contains guidelines for plans or programmes at lower hierarchical levels which suggest the need for carrying out the strategic assessment and environmental impact assessment, aspects of environmental protection and other issues of importance for environmental impact assessment for plans and programmes at lower hierarchical levels.

The water-related problems will be solved through the following strategic/planning documents:

- Danube River Basin Management Plan (6-year period) – its preparation is entrusted to the Republic Office for Water Affairs – draft produced by the Jaroslav Černi Institute (adoption in 2015).
- Plan for Protection of Water from Pollution – its preparation is entrusted to the Republic Office for Water Affairs – draft produced by the Jaroslav Černi Institute (adoption in 2015).
- Plans for water management in water areas (6-year period) – preparation is entrusted to public hydropower utilities.
- Plans for managing risk of floods (6-year period), preparation of the Plan for the Territory of the Republic of Serbia is entrusted to the Republic Office for Water Affairs and preparation of plans for water areas falls within the competence of public hydropower utilities.
- As regards all planned reservoirs to be constructed in the future, it is necessary to prepare appropriate planning documents set forth by the law regulating planning, development and usage of landscape, so that all further activities in these areas would be directed in such a manner as to avoid interference with the area envisaged for reservoir construction (location securing).
- Large frontal reservoirs with multi-annual regulation will be of significant importance for Serbia in the future, as they will allow sorting of "strategic water reserves" for hydrological, ecological and water crisis situation, that are bound to increase. The Strategy rightly states the possibility of directing the water from the Uvac, from the Kokin Brod or the Bistrica reservoirs, into the Veliki Rzav basin, via a base tunnel, 12-14 km long, depending on the alternative. This would allow bringing of water from the Uvac spring, to the central Serbia region with largely depleted water sources. In order for these effects to reach their fullest extent, it would be necessary to construct the „Velika Orlovača" reservoir with multi-annual regulation on the Veliki Rzav river. This is the sole profile in Serbia where strategic water reserve of $700 \div 800 \times 10^6 m^3$ can be constructed. Such a reservoir would be strategically significant for Serbia, as it would allow to direct clean water from the Veliki Rzav via the Moravica via the West Morava to the Great Morava, in the event of hydrological and ecological crisis situations. To enable the construction of such a facility in the future, it is necessary to preserve this currently inhabited and ecologically preserved space form devastation, which could be managed through a preparation of an appropriate planning document on the Veliki Rzav (this reservoir, as well as two smaller reservoirs planned to be constructed downstream – Roge and Svračkovo, currently under construction).

Mandatory nature of the SEA preparation. It is necessary to carry out the strategic effect assessment for all planned major water facilities referred to in the Strategy: reversible hydroelectric power plants, hydroelectric power plants, a large number of hydroelectric power plants or small hydroelectric power plants planned to be constructed on a single water course, open pits, reservoirs, etc. – whose spatial dispersion of impacts surpasses the local boundaries. In order to assess possible impacts on the quality of environment, and the cumulative effect and the synergy of impacts and define appropriate protection measures that would mitigate possible negative impacts, it is necessary to prepare the strategic effect assessment for these facilities.

Pursuant to propositions and provisions of the Law on Environmental Impact Assessment (RS Official Gazette, Nos 135/04 and 36/09), it is possible to require carrying out of Environmental Impact Assessment Study at the level of project-technical documentation for specific water facilities.

In respect to planned activities defined under the Strategy, and as regards the Decree on establishing the list of projects which require environmental impact assessment and list of projects which may require environmental impact assessment (RS Official Gazette, No. 114/08), the following projects require the previous Environmental Impact Assessment Study[19]:

1. Inland waterways where international or interstate sailing regime is in place, and ports and piers for inland waterway traffic where international or interstate sailing regime is in place, regulation works on inland waterways which permit the passage of vessels of over 1,350 tonnes.
2. Groundwater abstraction or artificial groundwater recharge schemes where the annual volume of water abstracted or recharged is equivalent to or exceeds 10 million cubic metres.
3. Facilities:
    - Hydro-technical facilities for the transfer of water resources between river basins aiming at preventing possible shortages of water and where the amount of water transferred exceeds 100 million cubic metres/year;
    - In all other cases, facilities for the transfer of water resources between river basins where the multi-annual average flow of the basin of abstraction exceeds 2,000 million cubic metres/year and where the amount of water transferred exceeds 5% of that flow, excluding transfers of piped drinking water.
4. Wastewater treatment plants with a capacity exceeding 100,000 population equivalent.
5. Dams and other installations designed for holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million cubic metres.
6. Abstraction of mineral and thermo-mineral waters exceeding 10 l/s.
7. Activities and installations for which an integrated licence is issued pursuant to Decree on types of Activities and installations for which an integrated licence is issued (RS Official Gazette, No. 84/05).

For other energy facilities of smaller capacities, the Project Promoter is, pursuant to Article 8 of the Law on Environmental Impact Assessment, obliged to submit to the authority

[19] All the stated projects require preparation of an appropriate planning document with the Report on strategic environmental impact assessment in accordance with the postulates stated in the fourth paragraph of Chapter 4 of the subject Strategic Effect Assessment.

responsible for issues related to environmental protection the Request for Determining the need for Making the Environmental Impact Assessment Study, pursuant to the Law on Environmental Protection (RS Official Gazette, No. 135/04, 36/09 and 72/09 – 43/11 – Constitutional Court), Law on Environment Impact Assessment (RS Official Gazette, No. 135/04 and 36/09), Rules on the Contents of the Environmental Impact Assessment Study (RS Official Gazette, No. 69/2005), and Ordinance on Determining the List of Projects for which an Impact Assessment is Mandatory and the List of Projects for which an Impact Assessment May be Required (RS Official Gazette, No. 114/08).

5. PROGRAMME FOR ENVIRONMENTAL MONITORING DURING THE IMPLEMENTATION OF THE STRATEGY

The precondition for achieving environmental protection objectives, i.e. the SEA objectives, is to establish an efficient monitoring programme as one of the main priorities in the Strategy implementation. Under the Law on Environmental Protection, the government adopts a monitoring programme pursuant to special laws for the period of two years for the entire territory of the Republic of Serbia, while local self-government units adopt environmental monitoring programmes for their territories, which must be harmonised with the mentioned programme of the government.

The Law on Strategic Environmental Impact Assessment sets forth an obligation of defining the environmental monitoring programme during the implementation of plans or programmes for which the SEA is undertaken. The Law also specifies the contents of the monitoring programme which shall include the following in particular:

1) description of objectives of plans and programmes;
2) environmental monitoring indicators;
3) rights and obligations of competent authorities, etc.

Therefore, this programme can also be an integral part of the existing monitoring programme provided by the competent environmental protection authority. Furthermore, monitoring should provide information on the quality of the existing report, which could be useful in making the future report on the state of the environment.

5.1. Description of Strategy objectives

The description of general and specific objectives of the Strategy is given in more detail in the Chapter 1 of the SEA Report. Therefore, a greater attention will be dedicated to the objectives of the Environmental Monitoring Programme.

The main objective in creating a monitoring system is to provide, amongst other things, a timely response to and warning of possible negative processes and accident situations, as well as a complete insight into the status of elements of the environment and an identification of the need to undertake protection measures depending on threats from pollution and its forms. It is necessary to provide a continuous monitoring of the state of environment and activities, in this specific case for the entire territory of the Republic of Serbia (especially on sites of the existing or planned water facilities), thus opening the possibility for rational environmental management.

Pursuant to the Law on Environmental Protection, the Republic, autonomous province and local self-government units, within their competencies specified by the Law, provide a continuous environmental control and monitoring pursuant to this Law and other related laws. Pursuant to Article 69 of the mentioned Law, objectives of the Environmental Monitoring Programme would be:

- providing the monitoring;
- defining the contents of and methods for carrying out the monitoring;
- specifying the organisations which are authorised for carrying out the monitoring;

- defining the pollution monitoring;
- establishing the information system and defining a data delivery method for the purpose of maintaining an integrated cadastre of polluters, and
- introducing reporting obligations on the state of the environment according to prescribed contents of environmental reports.

The key planning objective in this case is to protect water resources in the catchment areas of reservoirs, as well as other natural and environmental factors, along with creating the conditions for sustainable socio-economic development of the area. In correlation with the above mentioned objectives, the key fields of monitoring are: water, air, soil, air pollutant emissions, noise and natural values (through biodiversity, geological heritage, landscape, forests).

5.2. Indicators for environmental monitoring

The environmental monitoring is carried out through the systematic measurement, identification and evaluation of environmental and pollution indicators, including the monitoring of natural factors, i.e. environmental changes and characteristics.

Considering the spatial coverage of the Strategy and possible pollution, the monitoring system primarily relates to the following indicators:

- The system for measuring the level and flow within the network of measuring stations under the competence of Hydrometeorological Service of Serbia. The network can be expanded with additional measuring stations in the event of planning facilities and systems, and these stations would be included into the regular network of measuring stations, for the purpose of later monitoring of water management system functioning.
- In case a measuring station is to be submerged upon the construction a reservoir, additional measuring station need to be set timely both upstream from the backwater and downstream from the dam, so that parallel monitoring provided by all three stations (station to be submerged and new stations that will remain functional) could provide insight into correlation, so that hydrological analyses of time series could be carried out normally.
- Water quality control and monitoring in the territory of the Republic of Serbia. In addition to regular stations for monitoring of water quality in the state system (Hydrometeorological Service of Serbia and Serbian Environmental Protection Agency), some water management systems (e.g. HS DTD, large springs of surface and groundwater of alluvial origin) require establishing of additional stations, as these systems need to have quite reliable data on water quality used for irrigation or abstracted for purification for water supply.
- Control of implementation of sanitary protection in the zones around water sources.
- Monitoring soil quality through control of the soil pollution levels.

All abovementioned parameters should be monitored in relation to indicators given according to environmental receptors which are shown in Table 1, as well as pursuant to laws and by-laws for certain environmental aspects mentioned in points 5.2.1–5.2.6. In addition to the above, monitoring of the implementation of planning protection measures defined within the SEA is also of particular importance.

5.2.1. Water Quality Monitoring System

The Annual Water Quality Monitoring Programme is the main document for water quality management. Pursuant to Articles 108 and 109 of the Law on Waters (RS Official Gazette, No. 30/10), the Programme is established by the decree of the government at the beginning of each calendar year for the current year. The Programme is implemented by the Republic Hydrometeorological Service of Serbia and the Serbian Environmental Protection Agency. The monitoring includes: for surface water – volume, water levels and flow rates up to the level of importance for ecological and chemical status and ecological potential, as well as parameters of ecological and chemical status and ecological potential; for groundwater – levels and control of chemical and quantitative status. Through the implementation of the Plan, it is necessary to establish the obligation of extending the network of observation points and determine competencies for implementing additional obligations of water quality monitoring.

The monitoring of water facilities providing water supply is carried out by institutions for health protection having territorial competence (at the level of local self-management unit, where there is one), while the extent and type of the monitoring are adapted to the schedule of the implementation of planning solutions related to water supply.

Continuous measurements of water volume and testing of water quality are carried out for water bodies from which more than 100 cubic metres of water can be taken per day and which are earmarked by the Water Management Plan for drinking water supply and sanitary and hygiene needs.

Measurements and testing are carried out by the republic organisation responsible for hydrometeorological activities, and according to annual plans adopted by the Ministry of Agriculture, Forestry and Water Management (based on Article 78 of the Law on Waters).

Based on Article 74 of the Law on Waters, the public company or other legal entity involved in water supply services is obliged to install devices for permanent and systematic water measuring and quality control at water intakes and undertake measures for ensuring safety of drinking water and maintenance of hygiene in facilities, as well as to undertake adequate technical measures to keep devices in good working order.

5.2.2. Soil Quality Monitoring System

The soil-quality monitoring intended for agricultural production is specified by the Law on Agricultural Land (RS Official Gazette, No. 62/06 and 65/08). It includes soil quality testing to determine the concentration of harmful and hazardous matter in soil for agricultural uses and irrigation water. It is carried out according to the programme which is adopted by the Minister responsible for agricultural affairs. The soil quality testing can be carried out by qualified legal entities (enterprises, companies, etc.) authorised by the competent ministry.

The Minister also prescribes allowable concentration of hazardous and harmful matters, as well as testing methods.

Fertility control of agricultural land and amount of applied mineral fertilizers and pesticides is carried out if necessary, but at least once in five years.

The control can be carried out by a registered, authorised and qualified legal entities, while costs are borne by users or owners of agricultural land. The soil test report contains mandatory recommendations for the type of fertilizers to use and best methods for improving chemical and biological soil properties.

The protection of agricultural land, as well as agricultural land quality monitoring, is a mandatory element of the agricultural base, whose content, method and adoption is governed by Articles 5–14 of the Law on Agricultural Land. The same Law also envisages the strategic environmental assessment of the agricultural base.

Monitoring of soil erosion, particularly washouts and accumulation of materials by action of water, is an important instrument for a successful protection both of agricultural land and of forestland and other types of land, which was included in the Law on Agricultural Land and Law on Forests as an implicit obligation, while in the Law on Environmental Protection as a general obligation. The provisions of Articles 61 and 62 of the Law on Waters also envisage the protection against harmful effects of erosion and flash floods.

5.2.3. Emission monitoring

Methodological postulates of the majority of the discussed environmental monitoring systems rest on the measuring and monitoring of the *quality of ambient air and water*, i.e. pollutants in the ambient air and water, without reflecting directly on the source of the pollution nor the causes. However, it is very important, even more important than determining the pollution level – to monitor the emission from the concentrated sources of pollution.

The Law on Integrated Environmental Pollution and Control (RS Official Gazette, Nos 135/04 and 36/09) sets forth an obligation of monitoring the emissions/effects in their source as an integral part of documentation for obtaining an integrated permit for the plants and activities which have negative effects on the environment and human health, regulated by enactments of the government (Decree on Types of Activities and Installations for which Integrated Permit is to be Issued – RS Official Gazette, No. 84/05), Decree on Content of the Programme of Measures for Adapting the Existing Installation and Activities to the Prescribed Conditions (“Official Gazette of the Republic of Serbia”, No. 84/05), Decree on the Criteria for Determining the Best Available Techniques for Implementation of Quality Standards and for Determining Emission Limit Values in an Integrated Permit (RS Official Gazette, No. 84/05), or the act of Minister responsible for environmental protection (Regulation on the Content and Methods for Keeping the Register of Issued Integrated Permits – RS Official Gazette, No. 69/05).

The integrated permit, which is issued by the authority responsible for environmental protection (at the national, provincial or municipal level – depending on which authority grants a building permit) also contains a monitoring plan to be implemented by the *operator* (legal or physical entity which operates or controls the plant, etc.).

5.2.4. Natural resource monitoring

The main objective is to establish a biodiversity monitoring system, i.e. to monitor natural habitats and the population of wild flora and fauna, primarily vulnerable habitats and rare, endangered species, but also the condition of landscape features and the state of geological heritage objects and their changes. The mentioned monitoring is a direct responsibility of the

Institute for Nature Conservation of Serbia and the Provincial Institute for Nature Protection in Novi Sad respectively, which is carried in accordance with medium-term and annual programmes for natural resources protection.

The general monitoring of natural values must be carried out at least once a year, while individual biodiversity monitoring activities are organised if necessary, i.e. in cases of unexpected changes which can have significant negative effects. Monitoring is carried pursuant to the Law on Nature Protection (RS Official Gazette, Nos 36/09 and 88/10 and correction 91/10) and related bylaws.

5.3. Rights and Obligations of Competent Authorities

The rights and obligations of competent authorities related to environmental monitoring stem from the Law on Environmental Protection, i.e. Articles 69–78 of the Law. Pursuant to the mentioned articles of the Law, the rights and obligations of competent authorities are the following:

1. The government adopts monitoring programmes for the period of two years;
2. Local self-government units adopt monitoring programmes for their territories which must be in accordance with the programme of the government;
3. The government and local self-government units respectively provide financial resources for monitoring;
4. The government establishes criteria for determining the number and distribution of measurements points, network of measuring points, scope and frequency of measurements, classification of monitored phenomena, methods of work and indicators of environmental pollution and monitoring, data delivery time frame and methods;
5. Monitoring can be carried out only by authorised organisations. The Ministry sets detailed requirements which authorised organisations must meet, and designates authorised organisations upon prior consent of the Minister responsible for the specific field.
6. The government specifies the types of air emissions and other phenomena which are subject to pollution monitoring, as well as methods of measurement, sampling and recording, and data delivery time frame and methods;
7. State bodies, organisations and local self-government units, authorised organisations and the polluters, are obliged to submit data arising from monitoring to the Serbian Environmental Protection Agency in a prescribed way;
8. The government sets contents and method of maintaining the information system, methods, structure, common databases, categories and levels of data collection, as well as contents of information which are regularly and mandatory provided to the public;
9. Information system are maintained by the Serbian Environmental Protection Agency;
10. Minister sets methodology for integrated cadastre of polluters, as well as the type, methods, classification and time frame of data delivery;
11. The government submits annual environmental reports to the National Assembly;
12. Competent local self-government authorities submit environment reports for their territories to the assembly once in two years;
13. Environmental reports are published in official journals of the Republic of Serbia and local self-government units respectively.

Pursuant to the Law on Environmental Protection and other regulations, state bodies, local self-government units, authorised and other organisations are obliged to timely, completely and objectively inform the public about the current state of the environment, i.e. phenomena which are subject to ambient air quality monitoring, as well as about warning measures or pollution which may pose threat to the life and health of people. Furthermore, pursuant to the same Law, the public has the right to access to prescribed registries or records containing associated information and data.

6. OVERVIEW OF THE USED METHODOLOGY

6.1. Methodology for carrying out the SEA

The purpose of the SEA is to facilitate a timely and systematic review of possible environmental impacts at the level of strategic decision-making with regard to plans and programmes, taking into account the principles of sustainable development.

The SEA has grown in importance after the adoption of EU Directive 2001/42/EC on the impacts of certain plans and programmes on the environment (in effect since 2004), and in Serbia after the adoption of the Law on Strategic Environmental Impact Assessment (in effect since 2005).

Given that current experience is insufficient for the implementation of the SEA, numerous problems will have to be solved. In the strategic environmental assessment of plans so far, the following two approaches have been in use:

(1) **technical approach**: represents an extension of the methodology for environmental impact assessment to the plans and programmes which cover small areas and there is no complex interaction between planning solutions and concepts, so EIA principles can easily be used; and

(2) **planning approach**: requires a considerably different methodology for the following reasons:

- Plans are much more complex than projects. They address strategic issues and have less detailed information on the environment and the processes and projects which will be implemented in the planning area. Consequently, it is difficult to identify impacts that will occur during the elaboration of the planning document at lower hierarchical level of planning;
- Plans are based on the concept of sustainable development and, in addition to environmental issues, they also address social and economic issues to a greater extent;
- Sophisticated mathematical methods of simulation are not applicable due to the complexity of structures and processes, and cumulative and synergistic impacts in the planning area;
- Parties concerned, the public in particular, have a greater degree of influence over decision making, thus the used methods and assessment results must be understandable to participants in the assessment process, and presented in a clear and simple way.

For the above reasons, strategic assessment most frequently relies on expert methods such as: control lists and questionnaires, matrices, multi-criteria analysis, spatial analysis, SWOT analysis, the Delphi method, evaluation of environmental carrying capacity, cause-and-effect analysis, environmental vulnerability assessment, risk assessment, etc.

Charts and/or matrices are created to show results of each method used. They are used to examine changes which could be caused by the implementation of plans/programmes and the selected alternatives. Charts and/or matrices are created by establishing a relationship between objectives of the plan, planning solutions and SEA objectives, to which appropriate indicators are assigned.

Specificities of conditions related to the subject assessment are reflected in the fact that the aim of the SEA was to assess the objectives of the Water Management Strategy of the Republic of Serbia and identify the characteristics of possible negative impacts, as well as set guidelines for reducing negative environmental impacts to acceptable levels.

The content of the strategic environmental assessment and, to some extent, the basic methodological approach, are prescribed by the Law on Strategic Environmental Impact Assessment and the Law on Environmental Protection.

The methodology used in the subject SEA has been developed and supplemented in Serbia over the last 15 years. It is aligned with recent approaches to and instructions for carrying out the SEA used in the European Union[20, 21, 22]. The evaluation methodology and the method developed within the scientific project entitled "Methods for strategic environmental assessment in planning spatial development of lignite basins" were used. The project was carried out by the Institute of Architecture and Urban & Spatial Planning of Serbia from Belgrade and financed by the Ministry of Science and Environmental Protection of the Republic of Serbia between 2005 and 2007.

Methods whose merit has been confirmed in EU countries were taken as a basis for developing the abovementioned method. The used methodology is based on a multi-criteria expert qualitative evaluation of environmental, social and economic aspects of development in the Strategy area, its immediate and wider surroundings, as a basis for the valuation of the area for further sustainable development.

In the context of general principles of the methodology, the SEA was carried out by firstly defining: initial elements of the programme (content and objectives of the Strategy), baselines, and the current state of the environment. A significant part of the analysis was dedicated to:

- Assessment of the current state of the environment, which can be used to give environmental planning guidelines;
- Qualitative identification of possible impacts of planned activities on the basic environmental factors which also served as basic indicators in the research;
- Analysis of strategic determinants based on which environmental guidelines for the implementation of the Strategy, i.e. for determining the scope of the environmental valuation of the area for further development, are defined.

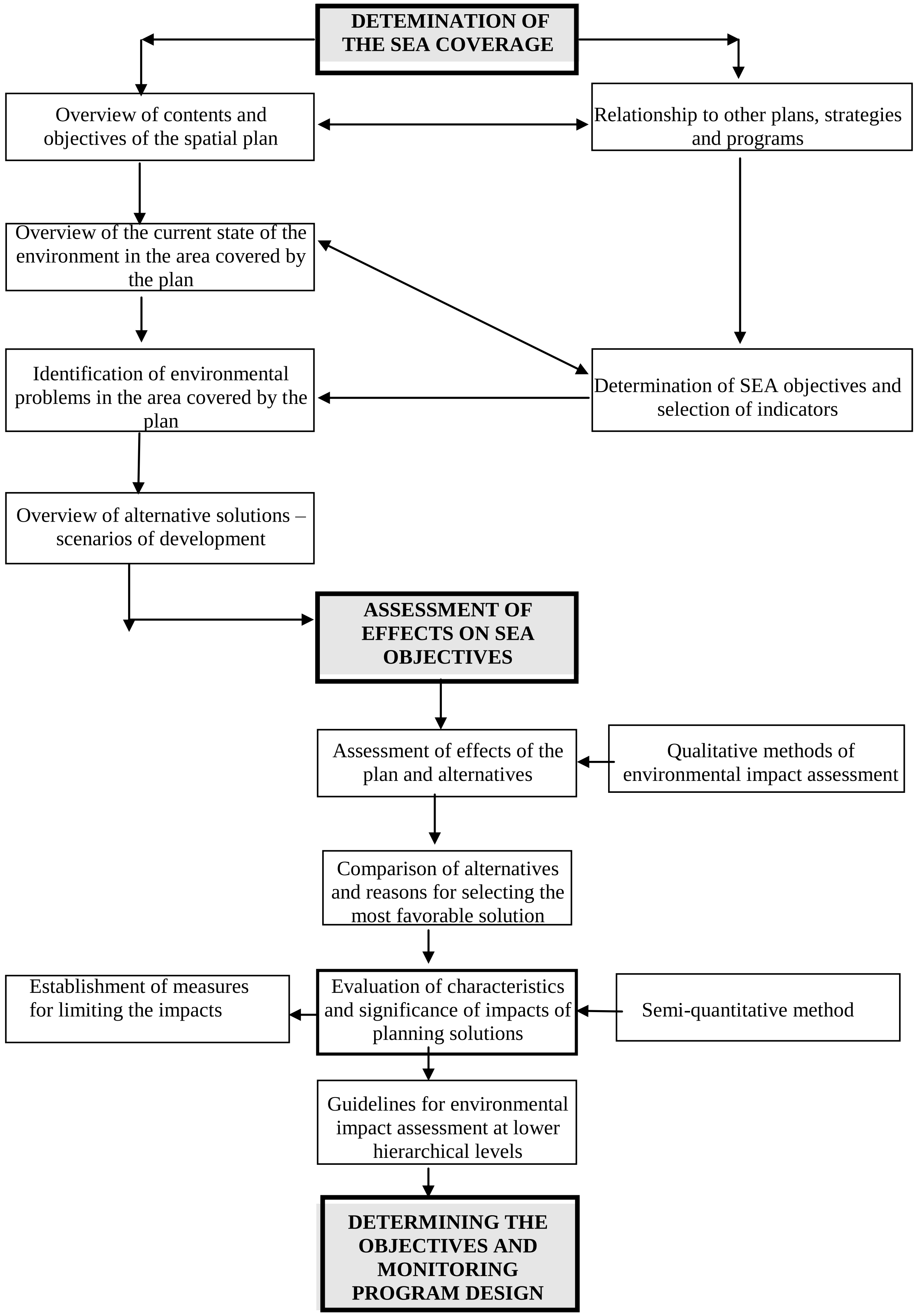
The viability of the used approach has been proven in over forty SEA that have been carried out in the country and abroad at different hierarchical levels of planning. Some of the results were published in top international scientific journals (Renewable Energy Journal, Environmental Engineering and Management Journal, etc.).

[20] A Source Book on Strategic Environmental Assessment of Transport Infrastructure Plans and Programs, European Commision DG TREN, Brussels, October 2005

[21] A Practical Guide to the Strategic Environmental Assessment Directive, Office of the Deputy Prime Minister, London, UK, September 2005

[22] James E., O. Venn, P. Tomilson, Review of Predictive Techniques for the Aggregates Planning Sector, TRL Limited, Berkshire, UK, March 2004

Figure 6.1. Procedural and methodological framework for carrying out the SEA



6.2. Difficulties in carrying out the SEA

The lack of a uniform methodology for carrying out this type of assessment has necessitated special efforts in order to carry out the analysis, assessment and valuation of strategic commitments in the context of environmental protection and to use an appropriate model for preparing a strategic document for environmental protection.

Another serious problem lies in the fact that there is no spatial information system, let alone an environmental information system in Serbia, nor is there a system of indicators for environmental assessment appropriate for the strategic planning process.

The situation is similar regarding the criteria for the valuation of selected indicators. For this reason, it was decided to select indicators from “CSD Indicators for Sustainable Development” in accordance with the Instructions issued by the Ministry of Science and Environmental Protection in February 2007. This set of indicators is founded on the concept of cause-effect-response. Indicators of cause denote human activities, processes and relationships affecting the environment; indicators of effect denote the condition of the environment; and indicators of response define political options and other responses aimed at changing the “consequences” for the environment.

A problem regarding the Strategy for which the SEA is undertaken lies in the fact that strategic guidelines contained in the Strategy are not based on actual investments which are certain, but rather on plans and assumptions. This implies that the exact locations for individual water facilities which will be built in accordance with the Strategy are unknown. Therefore, it was not possible to carry out the environmental impact assessment in relation to specific capacities, technological processes and the quality of the environment using determinants of micro-locations. Rather, guidelines for environmental protection were given based on possible impacts. Though generalised, they are still a good basis for implementing a policy of sustainable development in the implementation stage of the Strategy. A detailed evaluation and assessment of potential impacts will only be possible once the Strategy is elaborated through plans of water management and other documents relating to the water sector.

The Draft Strategy and collected and updated available environmental data for the territory of the Republic of Serbia were the basis for undertaking the SEA.

7. OVERVIEW OF DECISION-MAKING METHODS

The importance of potential negative and positive impacts of the proposed Strategy on the environment, human health, and social and economic status of the local communities necessitates that adequate and transparent inclusion of parties concerned (investors, competent authorities, local administration, non-governmental organizations, and population) in the decision-making process in respect of environmental protection issues be raised to a higher level than the current practice of holding formal public debates on the Draft Strategy.

Article 18 of the Law on Strategic Environmental Impact Assessment stipulates that the authorities and organisations concerned should participate and have the option of submitting their opinion within 30 days.

The authority competent for the preparation of plans/programmes shall ensure public participation in the consideration of the Strategic Assessment Report prior to the submission of the request for granting the approval of the Strategic Assessment Report (Article 19). The authority competent for the preparation of plans/programmes shall inform the public about the manner and deadlines for inspecting the content of the Report and submitting opinions, as well as about the time and venue of the public debate organised in accordance with the law regulating the procedure for the adoption of the plan/programme.

The participation of competent authorities and organizations shall be ensured in written form and through presentations in all stages of carrying out and considering the strategic assessment. The participation of the public concerned and non-governmental organizations shall be provided through public media and public presentations.

The authority competent for the preparation of the plan/programme shall prepare the Report on participation of authorities and organisations and the public concerned which shall contain all opinions on the SEA, as well as opinions submitted during the public inspection and public debate. The Strategic Assessment Report shall be submitted together with the report on professional opinions and public debate to the authority competent for environmental protection for evaluation. The evaluation shall be carried out according to criteria specified in Annex II of the Law. Based on the evaluation, the authority competent for environmental protection shall approve the strategic environmental assessment report within 30 days from the receipt of the request for evaluation.

After collecting and processing all opinions, the authority competent for the preparation of the plan/programme shall submit the Draft Strategy and the Strategic Assessment Report to the authority competent for decision-making.

8. OVERVIEW OF CONCLUSIONS OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT REPORT

Strategic environmental assessment is a process that should ensure that objectives and principles of sustainable development are integrated into the Strategy, while taking into account the need: (a) to avoid or limit negative effects on the environment and socio-economic development of the Republic of Serbia, (b) to increase positive effects that water management systems, when adequately managed, by applying the criteria of best environmental impact, can have on all environmental components and all other systems, (c) to enhance, to the extent required, the degree of protection against floods, given that floods may lead to the most severe economic, social and ecological destruction.

Strategic environmental assessment carried out under the Water Management Strategy of the Republic of Serbia included an analysis of the current state of the environment with a special view of areas affected by activities in the water sector and the domain of hydropower, importance and characteristics of the Strategy, characteristics of the effects of planned priority activities, and other environmental protection issues and problems, according to the criteria for identifying possible significant environmental impacts. The process largely rests on the planning approach, which considers trends that may be brought about by the activities in the water sector, as well as the scenarios of the water sector development.

The used methodological approach to carrying out the SEA rested on the defining of the objectives and indicators of sustainable development, as well as on a multi-criteria evaluation of planned priority activities of the Strategy in relation to defined SEA objectives and related indicators. In this context, it is especially important to underline that SEA is the most important instrument in the implementation of principles and objectives of sustainable development in a strategic planning process and planning *per se*. This means that SEA has not addressed only environmental protection, but also the socio-economic aspect of development, and SEA objectives have consequently been defined in this context.

Within SEA, 18 sustainable development objectives and 25 indicators for assessing sustainability of the Strategy were defined.

The indicators shown here have been selected from the basic set of the UN sustainable development indicators, and adapted to the particular needs of the said document. This set of indicators is based on the principle of identifying “cause” and “consequence” and defining “response” which would minimize the problems caused in the environment. The process of multi-criteria evaluation yielded 24 strategic solutions envisaged by the Plan (Table B), assessed by the following sets of criteria:

- the scale of impact,
- the spatial proportion of possible impact, and
- the probability of impact.

For each and every strategic solution, matrices were formed, in which a multi-criteria evaluation of the defined planning solutions (21 of them) was carried out against the defined objectives/indicators (18 out of 25) and criteria for the impact assessment (15 of them), resulting in a number of graphs. In that way the results were presented in simple and clear way. That was followed by the assessment of potential cumulative and synergetic effects of preferential activities in every area of the strategic assessment.

The results of the multi-criteria evaluation show that the implementation of the Strategy produces a considerable number of strategically significant clearly positive implications in space and the environment. That was contributed by the determination that the stress in the Strategy be on the environmental protection and its important factor – water resources.

Positive impacts of the implementation of solutions stipulated by the Strategy are numerous, highly significant and are succinctly systematised and briefly presented in Section 3.1.1.

Negative impacts are systematically presented in Section 3.3.2 and have been roughly estimated in accordance with the size of the impact, but also relative to the chance of a possible mitigation or compensation by according positive impacts. Such negative impacts have been identified as a necessary result of the water sector development, as the "price" to be paid in order to adequately supply communities with water, protect highly threatened valley areas, and ensure the necessary electricity supply from the highly valuable regulatory hydropower plants, ensure water for technological processes and agriculture, regulate the regime of surface and ground waters. In terms of the spatial dispersion of the impact, the largest number of specified negative impacts is local in nature. Only some impacts have been assessed as strategically significant as they manifest on a regional and/or national level.

The largest negative impacts could be expected if HPP Đerdap 3 was to be constructed, particularly if the solution was to include higher volume of upper reservoir, which would require submersion of vast space in Severni Kučaj, in highly developed karst formations and with rather drastic oscillation in the level of these two joint lakes. Such a solution is sensitive both from the environmental and social aspect and should be considered in more detail in the sense of its impact and sustainability. Certain negative impacts could also come from HPP Bistrica, primarily as water of quite lower quality from the Lim river would be directed towards the Klak reservoir that would replace the Radoinja lake which falls into the highest quality class (trout waters), all which would in turn significantly devastate biodiversity in the ecosystem of this lake.

Planned cascades on the Great Morava, the Srednja Drina, the Donja Drina and the Ibar rivers – may also pose negative impacts (impacts of reservoirs have already been discussed in Section 3.3.2), but project protection measures may largely help cushion negative impacts in the shorelines of these rivers as well, owing also to changes in water regimes. All plans regarding these systems include creation of fish ladders and the implementation of all ecosystem protection measures.

As elaborated in great detail in Section 3.3.2, the real environmental impact of the construction of a large number of small hydroelectric power plants is rather unfavourable, as they are constructed in the most sensitive areas of Serbia, in mountain-hilly regions, and very often in the protected areas (Golija and Stara Planina mountains), or in the areas supposed to be protected in accordance with the international obligations that Serbia has taken up when signing NATURA 2000 document, which stipulates that the percentage of areas placed under some kind of environmental protection is to be increased to 12.5%. The largest number of small hydroelectric power plants is planned to be constructed precisely in such ecologically valuable areas, which are still not placed under formal protection, but it is quite certain that Serbia has to bear them in mind when fulfilling its obligations (mountain streamlets with high waterfalls and slopes, geomorphologically significant canyons). Having this in mind, and with regard to the possibility of accumulative effects of several small hydroelectric power plants on a single watercourse, it is necessary to pay special attention to responsible planning of the number and position of small hydroelectric power plants. Unlike small hydroelectric power plants, medium and large hydroelectric power plants can be successfully integrated into the environment, by implementing adequate planning and management measures, as shown in Section 3.5.2.

All other water facilities - dams, regulatory facilities, drainage and irrigation systems, anti-erosion construction works, water protection facilities – do not have unfavourable impacts, but make highly positive contribution to landscape management. The problem is caused by wastewater treatment facilities as they are not regarded as „friendly neighbours“ in the urban matrix. If purification is not conducted in accordance with technical process requirements and project capacities, problem may be caused by the unpleasant smell emanating from the water waste treatment facilities. It is therefore important that all spatial and urban planning documents timely set adequate locations of water waste treatment facilities somewhere downstream from the settlements, with a protection area around them into which no urban elements would be introduced, and to designate such locations solely for the said purposes.

In the context of possible transboundary impacts, the Republic of Serbia, as a signee of the Espoo Convention and the Kiev Protocol, is obliged to inform other countries of its projects with potential transboundary impacts. Under the Espoo Convention provisions on the impact assessment, transboundary impact is defined as “any impact, not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another Party”. As the Convention envisages, if an activity is likely to cause a significant adverse transboundary impact, the Party (country) of origin shall, for the purpose of ensuring adequate and effective consultations, notify any Party (country) which it considers may be an affected Party as early as possible, and no later than when informing its own public about that proposed activity. The solutions envisaged by the Plan do not include any facilities that could have any significant impact on the neighbouring countries, with the exceptions of the systems planned in the areas of middle and lower Drina. Those systems belong both to the Republic of Serbia and Bosnia and Herzegovina (Republika Srpska) and therefore both countries are obliged to cooperatively and jointly take measures for smooth incorporaton of those systems in the surrounding. A beneficial circumstance is that the realisation of those systems coincide with the goals of flood protection, river basin regulation, stabilisation of the currently unstable river banks and riverbed of the lower Drina and with the management of the water regimes in the riverine flood plains. Other identified possible negative transboundary impacts are considered strategically insignificant since they do not considerably infringe on the capacity of space.

In order to keep the positive impacts of the planned solutions within the estimated values that will not jeopardise the capacity of the space, as well as to minimise and/or prevent the possible negative impacts of the solutions planned, certain environmental protection guidelines are determined, which are necessary to follow. Separate monitoring systems for different environmental factors are developed as well, as an instrument for following the implementation of the planned activities and monitoring the current condition of the environment.

8.1. General conclusion

In accordance with the global practice of giving special status to such documents, Water Management Strategy in the territory of the Republic of Serbia is a strategic plan of the highest significance, not only with regard to the water sector, but in terms of strategic government planning, given the strong impact of the water sector on all other components of country development and security. Solutions envisaged by the Strategy treat the Serbian territory as a unique waterpower area. These solutions rest on modern achievements of such strategic planning in the water sector. The suggested solutions for development of water management infrastructure and the planned activities which should follow its development have the following features:

- The solution envisages a harmonious development in phases of integral water management system which meets all the country's needs for water usage, management and protection. The term "integral" refers to the multipurpose system smoothly incorporated in the environment, in line with all the other developmental components of the country, in terms of its economic, social, urban, infrastructural and ecological development. Bearing in mind such an approach to planning, that document is, after the Spatial Plan of the Republic of Serbia, the most important state document on regulation and protection of the country's territory (its water supply, regulation and sanitation of its settlements, the water supply for industrial and other systems, flood prevention and control, protection and regulation of land for the purpose of intensive agriculture, regulation and management of water regimes of surface and underground waters, creating conditions for urban development of settlements, protection and improvement of biodiversity, etc). The significance of this document is that, in addition to pointing to the development of the water management sector, it points to the conditions of development of all the other systems in space, which when planned should take into the account the availability of water, the development of areas to be used by the water management sector (water springs and their protected zones, the areas of potential accumulations and protection facilities), as well as the exposure of land to flooding.
- In the course of evaluation of the Plan's significance, the suggested solutions and the dinamics of the water management systems development, some important facts should be taken into consideration.
  - The development or the stagnation of the water management sector directly affects the state and development of all the other systems. Because of that it is justly globally believed that the development of water management infrastructure is the driving force for the development of all the other systems. Many countries, therefore, have seeked the solutions for their great crises and have tried to create conditions for starting new economic and social development cycles through large-scale projects in the water management sector.
  - In line with the basic principles of sustainable development, there is the tightest connection and positive corelation between country's development and its environmental protection. The utterance of some insufficiently informed conservative ecological circles which oppose the development of key water facilities (accumulations, water power plants), that the best strategy for the environment is "do nothing", is completely wrong. Such strategy leads the country to backsliding and poverty, and poverty is the single greatest enemy of the environment. Such conservative approach is now abandoned, coming from the period when anthropogenic influences were small, with insignificant impacts to

ecosystems. The only reasonable approach today is to help ecosystems by active management and improvement of conditions for their survival and growth. The only facilities helpful to ecosystems are water accumulations, as the only means of redistribution of water in space and time and improvement of water regimes, especially in hydrological and ecological crises which could lead to the destruction of water ecosystems.

- Parts of the Strategy dealing with measures neccessary for the realisation of envisaged planned solutions (institutional and legal framework, necessary funds, development phases, priorities, monitoring, etc.) are acceptable. The evaluation of priorities and neccessary investment is realistic.
- This SEA evaluates, compares and contrasts the development scenario in case the Strategy is implemented (variant B) to the scenario in case the current development trends are continued (variant A), and their impacts to the environment, based on current stagnation trends in the water management sector due to small investment in it. Based on the impact importance evaluation (the synthesis of which is shown in Table 3.9), it can be concluded that the implementation of solutions envisaged by the Strategy would lead to strategically important positive shift in space development and environment promotion. The commitment of the Strategy creators to accentuation of the environment protection and its highly important factor – water resources, contributes to it. Possible negative impacts of the planned activities and systems could be eliminated, significantly reduced or compensated by considerably greater positive impacts on other components of the environment.

Bearing in mind all the aforesaid, it can be concluded that the Danube River Basin Management Plan for the territory of the Republic of Serbia offers solutions with highly positive impacts on the environment, both on the territory of the Republic of Serbia and the territories of the surrounding countries. By means of adequate planning, certain negative impacts can be considerably reduced or compensated by other beneficial impacts. In terms of its impact on the environment, this document can be considered fully acceptable.

SUMMARY

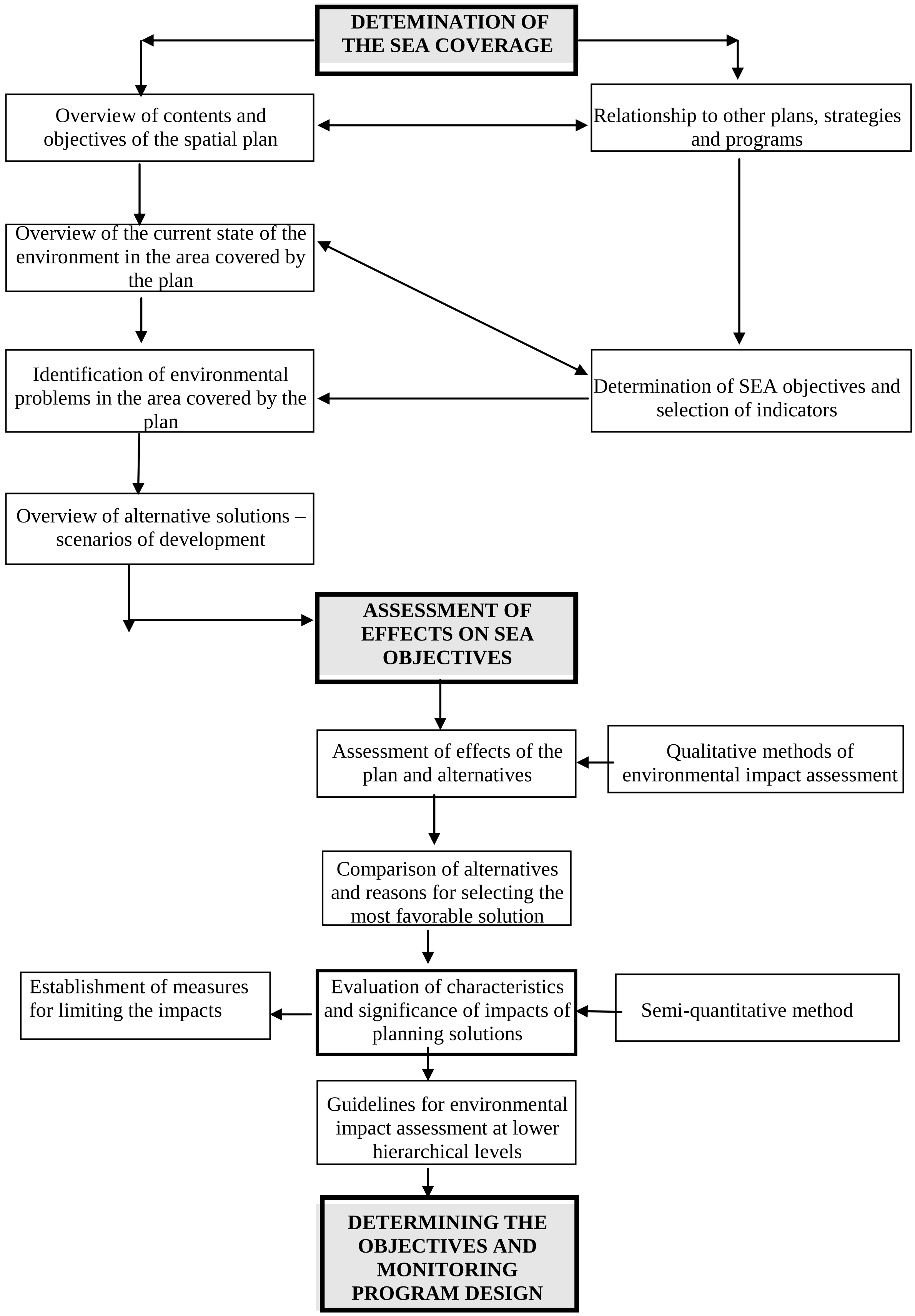
Strategic Environmental Assessment (SEA) is an evaluation of impacts that plans and programmes may have on the environment, and proposal of measures that would prevent, minimise, mitigate, remediate or compensate harmful effects on the environment and the health of population. By implementing SEA in planning it is possibly to envisage newly arisen changes in space and take into account the needs of the environment in question. Through SEA, the impact of all the planned activities on the environment are critically assessed, followed by a decision whether to implement the planned activities and under what conditions, or to abandon them.

Planning implies development, while a strategy for sustainable development calls for environmental protection. In such context SEA represents an unavoidable instrument for achieving the sustainable development objectives. SEA integrates socio-economic and bio-physical components of the environment; it links, analyses and assesses the activities in different spheres of interest, as well as directs the policies, plans or programmes towards solutions which are primarily proposed in the interest of the environment. It is an instrument which helps in integrating the objectives and principles of sustainable development when making decisions in spatial planning, while at the same time taking into account the necessity to avoid or limit possible negative effects on the environment and on the health or socio-economic status of population.

In the domestic planning practice, SEA is covered by the Law on Environmental Protection (“The Official Gazette of the Republic of Serbia”, Nos. 135/2004, 36/09 and 72/09 – 43/11 – The Constitutional Court, Articles 34 and 35). Pursuant to Article 35 of this Law: "Strategic environmental assessment shall be carried out in plans, programmes and principles in the domain of spatial and urban planning or land use, energy, industry, transport, waste management, **water management** and other fields, and shall be an integral part of the plan, programme or principle".

Strategic assessment of the Strategy on Water Management in the Republic of Serbia has been used as an examination tool of the current state of the environment, with a particular consideration of the areas threatened by the activities in the water management and water-power supply sectors, of the importance and characteristics of the Strategy, of the characteristics of the planned preferential activities and other environmental issues in line with the criteria for determination of possible considerable impacts on the environment. A methodological approach (Figure A) used in SEA is based on defining objectives and indicators of sustainable development and on the multi-criteria quality evaluation of the preferential activities envisaged by the Strategy as compared to the defined SEA objectives and their indicators. It is especially important to point out that SEA is the single most important instrument in realisation of principles and objectives of sustainable development in the process of strategic planning and planning in general. It means that in addition to assessing the aspects of the environmental protection, SEA deals with all the other aspects of sustainable development, i.e. socio-economic ones, therefore the objectives of SEA has been determined in such context.

Figure A. Procedural and methodological framework for carrying out the SEA



Within SEA, 18 sustainable development objectives and 25 indicators for assessing sustainability of the Strategy were defined (Table A).

Table A. Selected environmental objectives and relevant environmental indicators as defined within SEA

Area of SEA	Special objectives of SEA	Indicators
WATER	- To reduce polution of surface and ground waters - To lessen the impact of water-power facilities on hydrological regime	- The change in water quality due to the antropogenic activities in the water management sector - The change in the hydrological regime
SOIL	- To protect forest and agricultural land - To reduce land degradation and erosion	- The change in forest land area (%) - The change in agricultural land area (%) - The share of surfaces degraded due to the activities in the water management sector (%) - The area of land threatened by erosion (ha)
AIR AND CLIMATIC CHANGES	- To reduce the emmission of air polutants to prescibed levels	- The increase in share of renewable energy resources in hydropower balance (%)
NATURAL VALUES	- To protect the area - To protect natural values and landscapes - To preserve biodiversity	- The number of water-power facilities that affect the area - The area of protected natural areas that can be affected by the activities in the water management sector - The number of endangered animal and plant species that can be affected by the activities in the water management sector
CULTURAL AND HISTORIC HERITAGE	- To protect cultural heritage, to preserve historic monuments and archeological sites	- The number and significance of immovable cultural monuments that can be affected by the activities in the water management sector
WASTE	- To advance the wastewater treatment	- The increase in the number of sewage water treatment facilities and the increase of the efficiency of wastewater treatment to the required level
SOCIAL DEVELOPMENT	- To lessen the negative impact of the water management activities on the health of the population - To improve the quality of life in the area - To preserve the population in rural areas - To protect the communities from negative effects of water	- The incidence of diseases that can be attributed to the polluted drinking water - The increase in number of households attached to the public water supply system (%) - The increase in number of households attached to the public sewage system (%) - The number of displaced households due to the activities in the water management sector - The number of people potentially threatened by torrents and floods
INSTITUTIONAL DEVELOPMENT	- To improve the environmental protection service, monitoring and control	- Development of water management information system - Strengthening of institutions in the water management sector - The number of measuring locations in the monitoring system
ECONOMIC DEVELOPMENT	- To support economic development - To promote local employment - To reduce the transboundary impact of water-power facilities on the environment	- The number of tourist activities based on using water resources - The percentage of water management sector employees with the income above the average income in the country - The decrease in the number of the unemployed due to their employment in the water management sector (%) - The number of developmental programmes for environmental protection in the water management sector - The number of water-power facilities with transboundary impact

The indicators shown here have been selected from the basic set of the UN sustainable development indicators, and adapted to the particular needs of the said document. This set of indicators is based on the principle of identifying "cause" and "consequence" and defining "response" which would minimize the problems caused in the environment. The process of multi-criteria evaluation yielded 24 strategic solutions envisaged by the Strategy (Table B), assessed by the following sets of criteria:

- the scale of impact,
- the spatial proportion of possible impact, and
- the probability of impact.

Table B. Strategic solutions/activities envisaged by the Strategy included in the impact assessment

Strategy Sector	Strategy Solutions
Water usage	**Improvement of the public water supply system**
	Improvement of water supply in the industrial sector
	Provision of the sufficient amount of and the rational usage of irrigation water
	Sustainable usage of hydropower potential
	Preservation of hydromorphological characteristics of both aquatic and litoral ecosystems in watercourses
	Preservation of water quality and the aquatic ecosystems in pisciculture development
	Supply of drinking water to tourist, sport and recreational centers and preservation of water quality in multipurpose accumulations
Water protection	**Prevention of water pollution and water protection management**
	Decreasing pollution from concentrated and scattered pollutors
	Designation and usage of protected areas
	Protection of ground waters quality and quantity
	Limiting hydromorphological pressure on natural water bodies and improving the ecologic potential of the affected water bodies
Watercourse regulation and protection from adverse effects of water	**Regulation, maintenance and preservation of watercourses**
	Protection from floods caused by transboundary watercourses
	Protection from erosion and torrential waters
	Protection from floods caused by inland watercourses (drainage)
	Sustainable management of water resources in drought and water shortage periods
Regional and multipurpose hydrosystems	**Optimal usage of multipurpose accumulations, meeting water management objectives and harmonious fitting into ecological and other surroundings**
	Development of regional drinking water supply systems
The rest of the factors and measures significant in water management	**Development of institutional framework in water management sector**
	Planning and implementing the planned activities in the water management sector
	Strengthening professional capacities necessary for effective and sustainable water management
	Monitoring the status of surface and ground waters
	Development of water management information system

For each and every strategic solution, matrices were formed, in which a multi-criteria evaluation of the defined strategic solutions (24 of them) was carried out against the defined objectives/indicators (18 out of 25) and criteria for the impact assessment (15 of them), resulting in a number of graphs. In that way the results were presented in simple and clear way. That was followed by the assessment of potential cumulative and synergetic effects of preferential activities in every area of the strategic assessment.

The results of the multi-criteria evaluation show that the implementation of the Strategy produces a considerable number of strategically significant clearly positive implications in space and the environment. That was contributed by the determination that the stress in the Strategy be on the environmental protection and its important factor – water resources.

Certain negative effect identified within the Strategy are not great in their intensity or spatial proportion, therefore they are deemed strategically insignificant. The identified small-scale negative effects are the inevitable consequence of development and usage of hydropower potential in the Republic of Serbia.

As compared to the objectives of strategic assessment, the negative effects were perceived as a consequence of implementation of the following strategic solutions:

- Sustainable usage of hydropower potential. Although the word "sustainable" is used in the formulation of this strategic solution, denoting that in the usage of water-power potential a special attention is given to the aspect of environmental protection, it is undeniable that such anthropogenic activities on bodies of water could have negative effects on hydrological regime, benthic organisms, biodiversity and the ecological status of aquatic ecosystems, etc. Bearing in mind the formulation of this strategic solution, its operative objectives and measures for reaching them as defined in the Strategy, these negative effects are not considered significant in either their intensity or spatial proportion. This is certainly contributed by the commitment that in the process of carrying out the hydropower projects, the water management sector be included in all the activities connected to the usage of hydropower potential of watercourses, starting from strategic acts and plans in the energy sector, to the realisation of projects and management of water-power facilities so as to secure harmonisation of various aspects of water usage, water and environmental protection, and protection from riparian waters. However, such impacts should not be disregarded, especially not because of their transboundary potential in case of border watercourses, i. e. they should be prevented by implementing measures envisaged in the Strategy as well as by following guidelines defined in the said strategic environmental assessment impact;
- Supply of drinking water to tourist, sport and recreational centres and preservation of water quality in multipurpose accumulations. An increase in anthropogenic activity in certain area leads to the possible increase in pressure on all natural resources in the said area. Bearing that in mind, the development of tourism represents a threat to water resources, especially when the touristic potential of an area is predominantly based on the usage of water resources. As proposed in the previous strategic solution, it is necessary here as well to determine guidelines to be followed in order to prevent or minimise the negative effects;
- Regulation, maintenance and preservation of watercourses. Negative effects that may result from this strategic solution are perceived solely during works on regulation, maintenance and preservation of a watercourse, and therefore the identified minor negative effects of this strategic solution are considered insignificant in their effect and character.

On the other hand, the whole array of strategically significant positive impacts of the Strategy is perceived in all the aspects of sustainable development:

- As for the environmental quality, positive impacts are: the reduction in water pollution due to the whole set of strategic solutions (technical, planning, organisational, institutional, legal – which among others imply transposition of EU directives in the water management sector) dominantly based on prevention, maintenance and development of facilities intended for water usage, water protection and the protection from water; the protection of land, natural and cultural heritage, and biodiversity, as a result of implementation of most solutions proposed by the Strategy.
- As for the socio-economic development, positive impacts are: creating preconditions for developing tourist potential in order to promote economic growth and create possibilities for employing more people in the water management sector due to its development and the optimisation of professional capacities necessary for good and effective functioning of the Republic of Serbia's water management system; improving quality of life of the population by increasing the availability of high-quality drinking water; the protection of lives, property etc. from detrimental effect of water.

A special attention is drawn to possible transboundary impacts, since they surpass the territory covered by the Strategy.

As a signee of the Espoo Convention and the Kyiv Protocol, the Republic of Serbia is bound to notify other countries of all the project that may have transboundary impact on the environment. In the Espoo Convention on Environmental Impact Assessment, a transboundary impact is defined as "any impact, not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another Party".

The Convention guarantees that if a proposed activity is likely to cause a significant adverse transboundary impact, the Party of origin, i.e. country, shall, for the purposes of ensuring adequate and effective consultations, notify any Party (country) which it considers may be an affected Party as early as possible and no later than when informing its own public about that proposed activity.

In the context of possible transboundary impacts, no strategically significant impacts (either positive or negative) are determined here, since it is estimated that any impacts arising from the planned activities do not jeopardise the territories of the neighbouring countries.

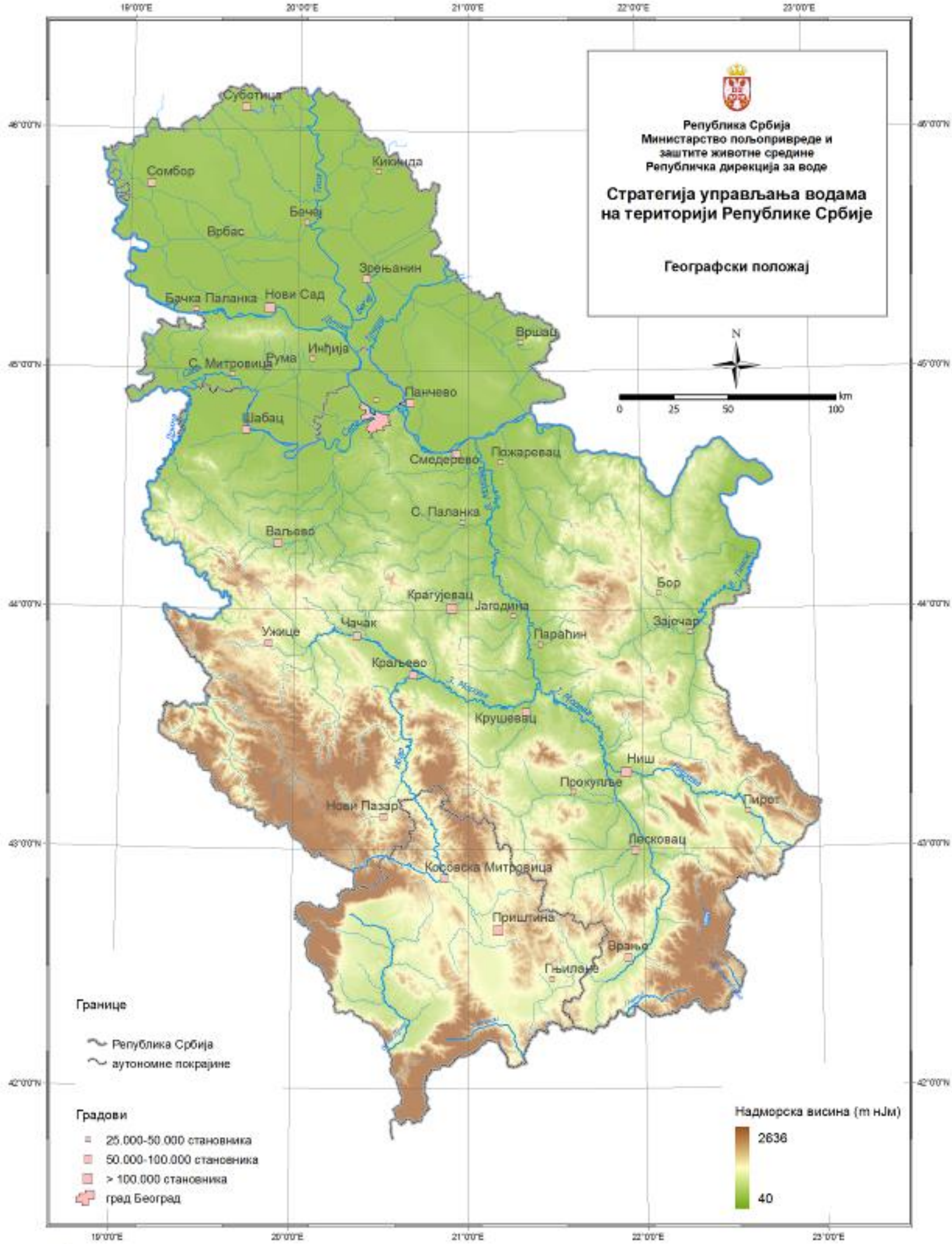
Minor negative impacts on hydrological regime, benthic organisms and ichtiofauna of the watercourses on the Serbian border with Montenegro, Bosnia and Herzegovina, and Romania, are possible as a consequence of using hydropower potential of transboundary watercourses.

The rest of the identified transboundary impacts, also deemed strategically insignificant, are positive, resulting from the implementation of strategic solutions in the areas of: preservation of hydromorphological characteristics of both aquatic and riparian ecosystems of watercourses; preservation of water quality and aquatic ecosystems in pisciculture development; prevention of water pollution and implementation of water protection management; reduction of pollution from concentrated and scattered pollutors; designation and usage of protected areas; sustainable management of water resources in drought and water shortage periods; development of institutional framework in water management sector; monitoring the status of surface and ground waters; and development of water management information system. Although the positive impacts of the said strategic solutions are considered strategically insignificant, their sublimation will certainly lead to significant improvements in the development of transboundary water management sector.

In order to keep the positive impacts of the planned solutions within the estimated values that will not jeopardise the capacity of the space, as well as to minimise and/or prevent the possible negative impacts of the solutions planned, certain environmental protection guidelines are determined, which are necessary to follow. Separate monitoring systems for different environmental factors are developed as well, as an instrument for following the implementation of the planned activities and monitoring the current condition of the environment.

To summarise all the aforesaid, as well as the results of the assessment of the Strategy's impact to the environment and the elements of sustainable development, the conclusion drawn in the Report on Strategic Environmental Impact Assessment is that all the possible impacts of the Strategy’s implementation are analised and identified within SEA. Although it is concluded that the Strategy itself is trully dedicated to the protection of water and the environment in general, the SEA has envisaged specific guidelines to ensure that the activities planned in the water management sector have the least possible impact on the environment, which is definitely in line with meeting sustainable development objectives both in the Republic of Serbia and in the neighbouring countries.

GRAPHIC APPENDICES



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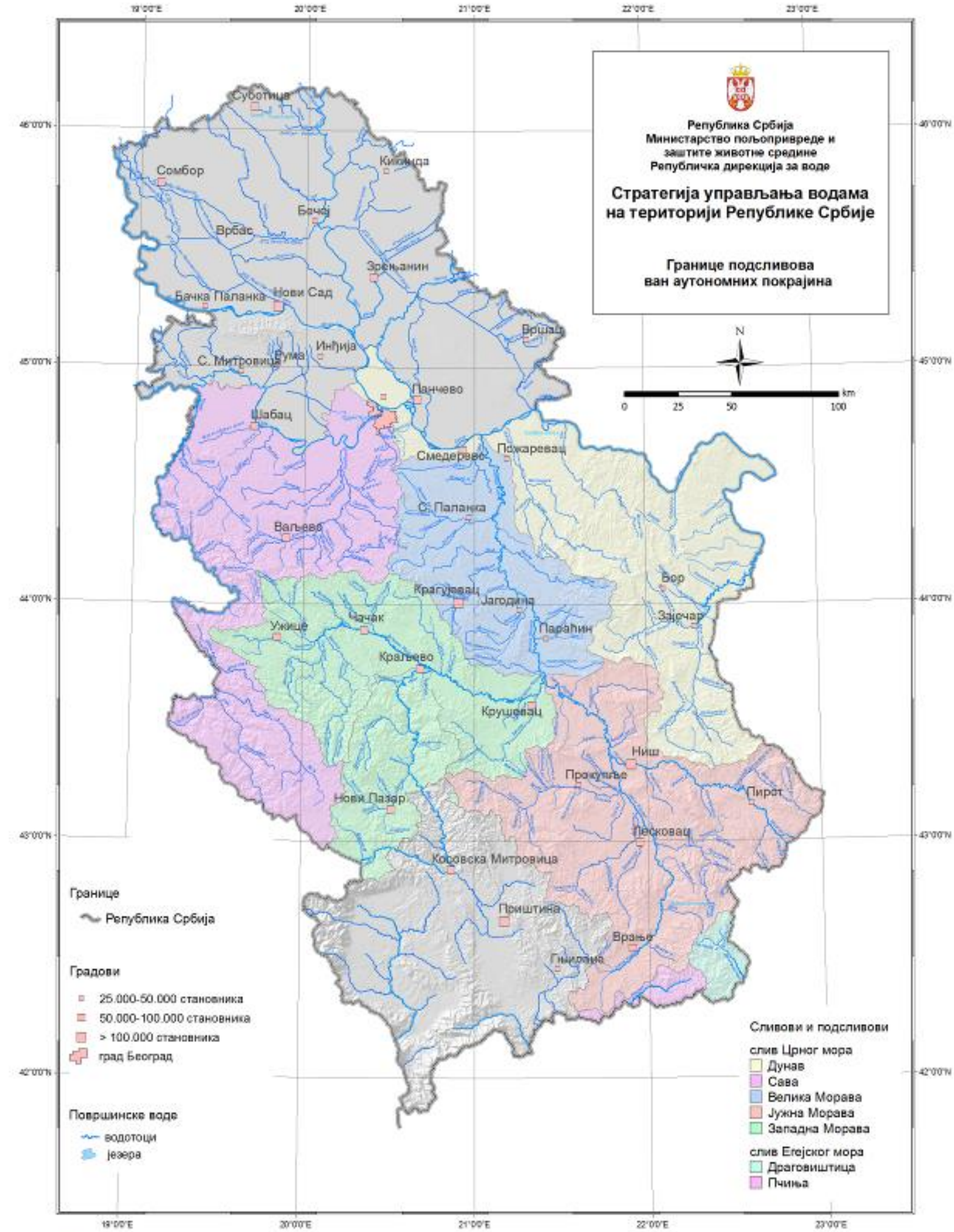

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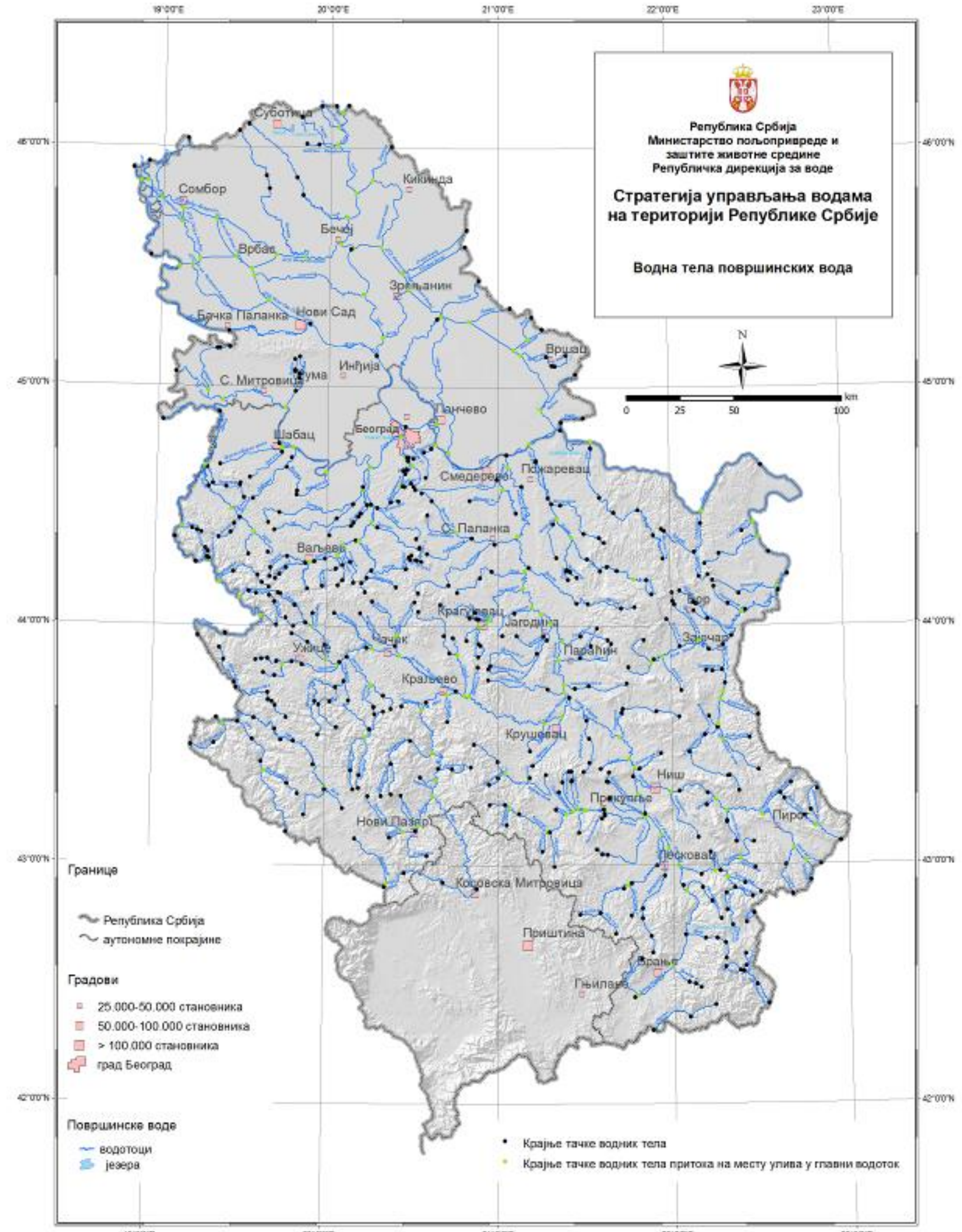

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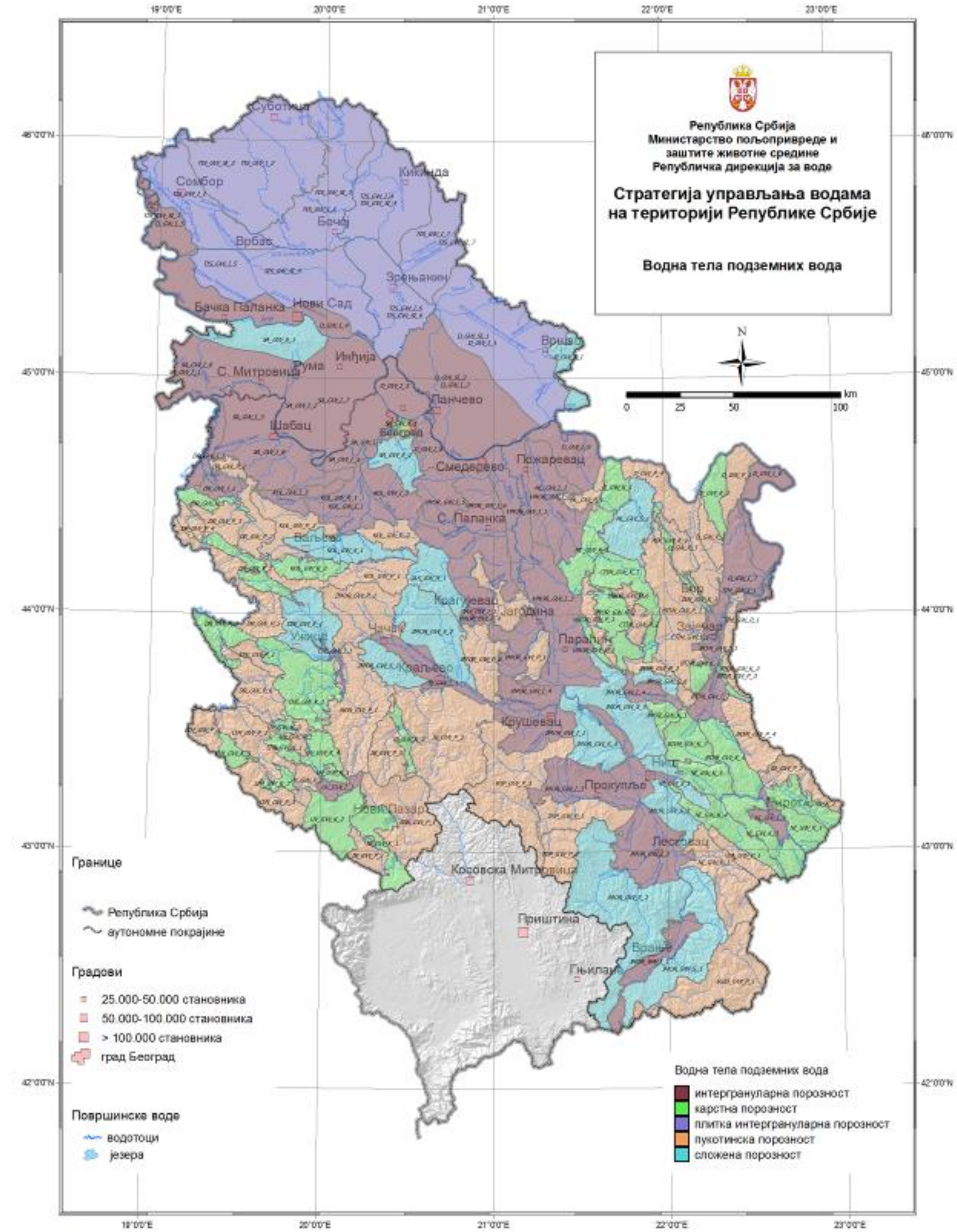

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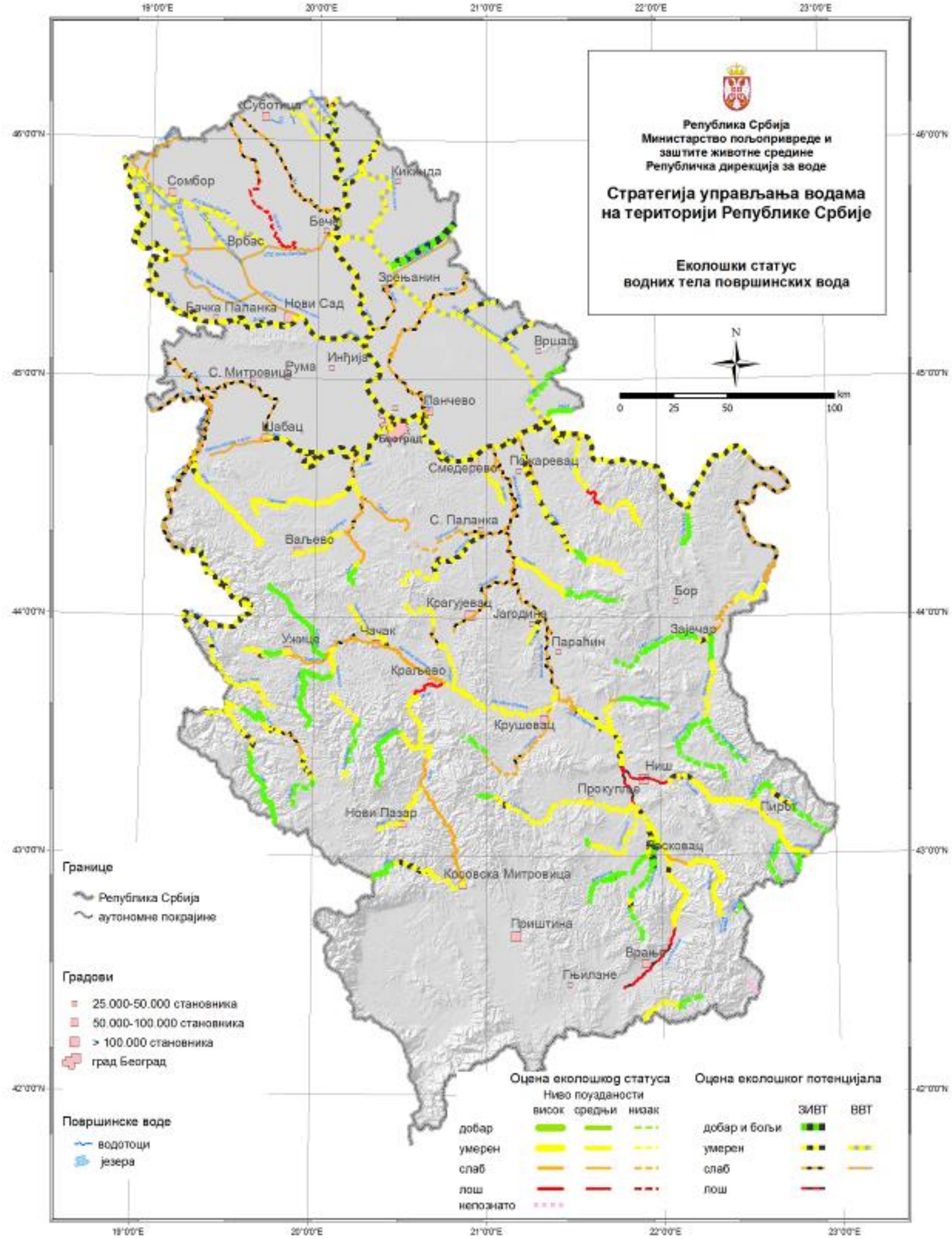

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