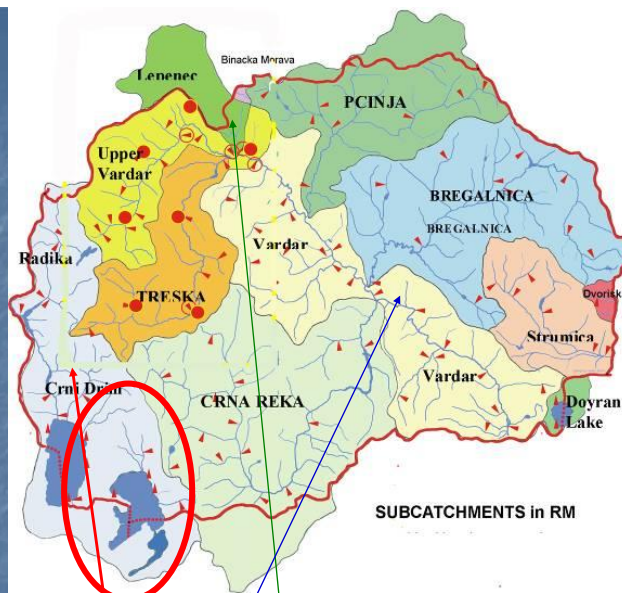


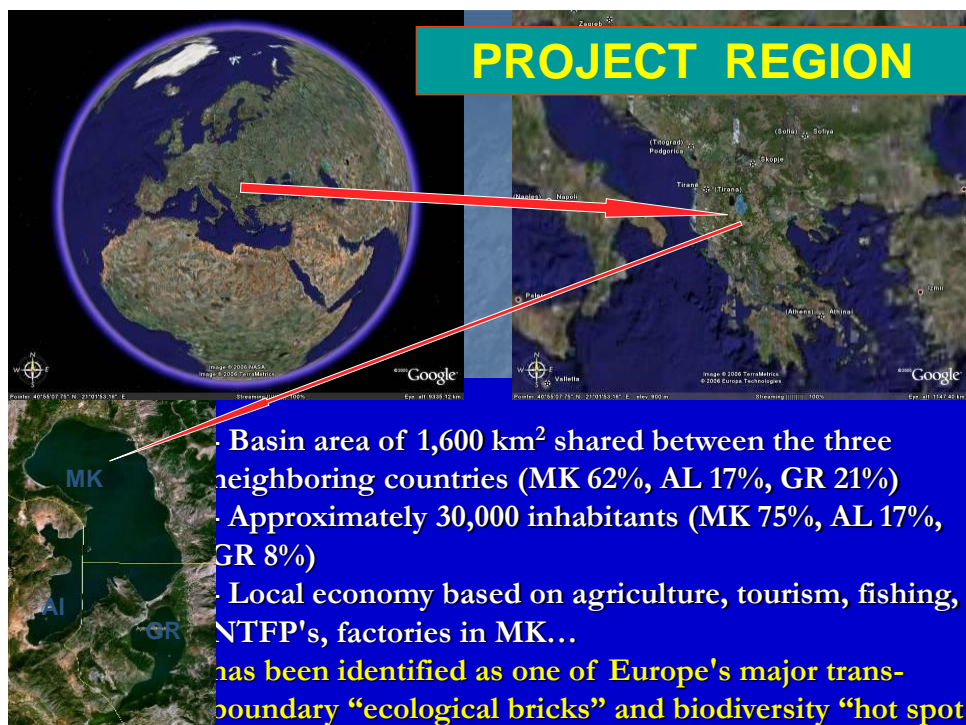
The total water resources
 $6,37 \cdot 10^9 \text{ m}^3$ (normal year)
 $4,80 \cdot 10^9 \text{ m}^3$ dry year),
 out of which 80% are
 carried in the Vardar basin.

$3100 \text{ m}^3/\text{capita}$

Uneven spatial and timely
 distribution over the
 country, more favorable
 conditions in the WM
 but being characterized
 over all the national
 territory by a timely
 distribution which presents
 long drought spells and
 high intensity rainfalls
 which constitute at the
 same time a threat for
 crops and which prone
 erosion phenomena.



-Black Sea basin - (44 km^2 or 0.17%) ;
 - Adriatic Sea basin (3359 km^2 or 13.07%)
 - Aegean Sea basin (22310 km^2 or 86.76%)



THE FINAL STATUS OF DELINEATED WATER BODIES

WATER BODY NAME	WB TYPE	STATUS					ACTION NEEDED UNDER	
		High	Good	Moderate	Poor	Bad	UWWTD or ND	WFD
SURFACE Water Bodies - RIVERS								
Istočka Reka 1	1		Good				no	no
Istočka Reka 2	1					Bad	yes	yes
Istočka Reka 3	1				Poor		yes	yes
Golema Reka 1	1		Good				no	no
Golema Reka 2	1			Moderate			yes	yes
Golema Reka 3	1			Moderate			yes	yes
Golema Reka 4	1			Moderate			yes	yes
Golema Reka 5	1			Moderate			yes	yes
Kurbinska Reka 1	1			Moderate			yes	yes
Kranska Reka 1	1	High					no	no
Kranska Reka 2	1			Moderate			yes	yes
Brajčinska Reka 1	1	High					no	no
Brajčinska Reka 2	1				Poor		yes	yes
SURFACE WATER BODIES – HEAVILY MODIFIED WB								
Golema Reka 6	1h					Bad	yes	yes
SURFACE WATER BODIES – ARTIFICIAL WB								
Golema Reka 7	1a					Bad	yes	yes
Golema Reka 8	1a				Poor		yes	yes
SURFACE WATER BODIES – LAKE								
PRESPA LAKE	1L			Moderate			yes	yes

ECONOMIC ANALYSIS

Table17. Municipal and industrial water supply, consumption and revenue

	Covered Area	Number	Water Consumption m3	Price MKD/ha	Cost MKD
Population connected to public WS system	Resen	13.600	720.000	22,3	16.056.000
Population with self-supply	16 villages	4.000	200.000	22,3	4.460.000
WS – industry & companies	Resen	300	180.000	37,73	6.791.400

Table 19. Revenues from water delivered to users

Description	Monthly Quantities In m3	Current Price	Monthly Revenues	In %
Citizens	43.765 m ³	16.25 MKD/m ³	711.181 MKD/мес	69.56%
Companies	11.317 m ³	27.50 MKD/m ³	311.217 MKD/мес	30.44%
Total:	55.082 m³		1.022.398 MKD/мес	100.00%



PROGRAMME OF MEASURES

analysis, prioritization & implementation plan



ENVIRONMENTAL OBJECTIVES

- The objective is that all water bodies should achieve "Good status".
- In addition, any deterioration in the existing status of both surface waters and groundwater is to be prevented.
- TDA, 2010
- For protected areas – other EOs

ENVIRONMENTAL OBJECTIVES

For the surface water bodies:

- **EO 1: Improvement of environmental conditions ensuring good water and soil quality for human health and for the ecosystem by 2025 (long-term)**
- **EO 2: To control water levels (prevent losses) and promote sustainable use (short-term & continuous)**
- EO 3: To ensure sustainable fisheries (mid-term)
- EO 4: Reducing pesticide/fertilizer loadings, waste from packaging and pressure from agriculture (short-term & continuous)
- EO 5: Reduction of physical pressures (short-term & continuous)

For the groundwater bodies: (These include the abovementioned Environmental Objectives 1, 2, 4 and 5, as well as the following objectives):

- EO 6: The drinking water supply is to be based on pure groundwater without the need for more than simple treatment (long-term); To ensure that the water supplied to the population only contains nitrate in natural concentrations (short-term & continuous).
- EO 7: The groundwater resource must be safeguarded against overexploitation (mid-term).
- EO 8: The groundwater must be protected against contamination (short-term & continuous); there must be no pesticides or other hazardous substances in groundwater used for the supply of drinking water (short-term & continuous).

For protected areas (PA):

.....

Environmental objectives 1 and 2, being the most important, have been adopted as guidance for further elaboration of the Prespa WMP and as a basis for the development of the Program of Measures and the 6-year implementation plan.

ENVIRONMENTAL OBJECTIVES – WATER BODIES

Name	Current status	Action needed?	Objectives	
			Rivers	HMWB & AWB
Istocka 1	Good			
Istocka 2	Bad	Y	Good	
Istocka 3	Poor	Y	Good	
Golema 1	Good			
Golema 2	Moderate	Y	Good	
Golema 3	Moderate	Y	Good	
Golema 4	Moderate	Y	Good	
Golema 5	Moderate	Y	Good	
Golema 6	Bad	Y		Good potential
Golema 7	Bad	Y		Good potential
Golema 8	Poor	Y		Good potential
Kurbinska	Moderate	Y	Good	
Kranska 1	High			
Kranska 2	Moderate	Y	Good	
Brajcinska 1	High			
Brajcinska 2	Poor	Y	Good	

■ ENVIRONMENTAL OBJECTIVES - INDICATORS

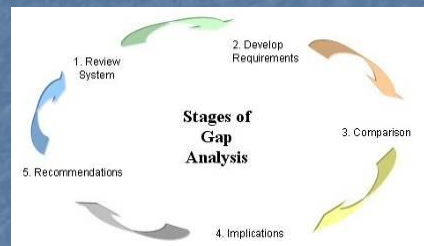
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Programme of measures

- in-depth expert investigation and study
- All identified measures have been scrutinized and checked for environmental effectiveness, extent, contribution to specific objectives, cost (economic and financial) and social effects

Problem and GAP Analysis

- **Problem Analysis** ← causes



- **Gap analysis (current VS desired)**

- In addition:
 - Legal framework & policies
 - Organizational setup & capacity
 - Management systems & procedures

Programme of measures

The measures are grouped as follows:

- **water used for abstraction of drinking water** (to improve the reliability and quality of drinking water)
- Measures for **controlling the abstraction and impoundment of water**
- for **point source discharges** and other activities which have an impact on the status of water
- to prevent or reduce the impact **of accidental pollution incidents**
- to **reduce the priority substances** (to eliminate the discharge of priority substances)
- for **bodies of water unlikely to achieve good quality status** (to improve HMWBs)
- to minimize irrigation water use and **minimize pollution by**
- **For reducing adverse impact of water**
- Details of the **supplementary measures** identified as necessary in order to meet water quality environmental objectives (Eutrophication of Prespa Lake)
- **Register of further detailed plans and programs** for the Prespa Lake basin dealing with particular water issues

Programme of measures

45 measures identified...

Analyzed in detail for:

- Priority
- Responsible institution
- Schedule/duration of implementation
- Indicators
- Cost (CBA, NPV, cost-effectiveness...)
- Impact to waterbodies / ecosystems (Rivers, Lake, HMWB, Artificial , Wetlands, Groundwater, Terrestrial/natural Habitats)
- Expected effects (Nitrogen, Phosphorus, Physical Pressure, Natural Habitats, Priority substances, Water supply security, Harmful impacts of water, Other)

Programme of measures – prioritization - MCA

The 45 measures have been ranked and prioritized in accordance with the following:

- Environmental effectiveness
- Legal requirement, and
- Multi-criteria analysis (MCA) score (highest score) according to the following criteria:
 - Legal requirement 0-20 points
 - Environmental extent 0-10 points
 - Environmental effect 0-10 points
 - Security & resources preservation 0-20 points
 - Prevention of harmful impacts 0-5 points
 - Economic benefits 0-10 points
 - Financial costs 0-10 points
 - Social benefits 0-15 points
- **Total 0-100 points**

Technical ranking of measures

Rank	Score	ID	Programme of Measures	Legal requirements	Cost		Implementation Period /Duration [y]
					Total [10³ €]	Annual [10³ €]	
1	68,3	23	Regulate irrigation wells	Yes	200		3
2	66,2	22	Regulate irrigation intake from rivers	Yes	0		3
3	65,3	426	Develop green cover in orchards	-	300		6
4	63,3	34	Erosion control	-	7,500		18
5	63,0	421	Upgrade irrigation schemes	-	300		5
6	62,3	422	Closure of illegal dumping sites and establishment of a controlled sanitary landfill	-	250		2
7	62,2	413	Upgrade industrial wastewater treatment	Yes			12

10

Possible Implementation Strategies

Три (3) алтернативи...

- A '*Business as Usual*' Strategy ,
- A **Water Framework Directive Implementation Strategy** in which all the 45 measures are implemented in full accordance with the WFD, ensuring the achievement of the environmental objectives.
- A *Realistic Implementation Strategy* in which some of the above 45 measures are implemented based on the availability of economic resources, manpower and skills. → **Prioritization**

Programme of measures - prioritization

Ранг	Бодови	ID	Мерка	Трошоци		Период-изпълн. (год.)	Приблиз. алтернатив			Почети
				Високи (млн €)	Год. (млн €)		0	1	2	
1	66.3	23	Регулации на бунари за наводнения	200	3					
2	66.2	22	Регулации на зефети на реки за наводнения	0	3					
3	65.3	425	Съхраняване на селскостопански	300	6					
4	63.3	34	Противопожарни мерки	7,000	18					
5	63	421	Надгледване на системи за наводнения	300	6					
6	62.3	422	Запасване на двете дикони и изградба на контролирана санитарна диконна	250	6					
7	62.2	413	Надгледване на системи за пречистване на индустриални води	0	12					
8	62	414a	Надгледване на колектор за отпадни води в Сирен	600	2					
9	61.7	62	Реконструкция на рибарите и конструкции на затварящи на Голяма река	250	3					
10	61.5	33	Противопожарни планове базирани на процени на рисковете от изсушаване и тресавици	500	6					
11	61.5	61	Имплементация на планове за управление на изпитателните подизградни Пилеи, Гилеи и Сирен	0	30000					
12	61.3	421	Имплементация на РДВ мониторинг на Пилеи и Сирен	0	20	30000				
13	60.3	419	Имплементация на РДВ	0	30000					
14	59.8	24	Изграждане на фермата за добри земледелие и висококачествени изпитателни изпитателни на отпадъци от селскостопанските	400	2					
15	59.7	30	Подготовка на планове за защита от поглъщане и наводнения	250	3					
16	59.8	423	Изпитателни на изпитателни системи за наводнения на фермата и изпитателни	400	2					
17	57.7	24	Изпитателни на системи за защита от поглъщане на 4,000 ha	4,000	6 + 6					
18	56.4	22b	Изграждане на бариери на Чисков река	30,000	6					
19	56.2	420b	Изграждане на подизградни за мониторинг и реконструкция	40	20000					
20	53.8	416	Изграждане на управление на мониторинг на процени на рисковете и изпитателни	100	20000					
21	53.7	25	Изграждане на бариери за защита от наводнения	100	2					
22	53	32	Имплементация на контролни мерки против поглъщане	5,000	12					
23	53	414a	Изграждане на пречиствателни станции за отпадни води за по-висока икономия	2,000	12					
24	52.5	63	Изпитателни на мониторинг на приватните бунари	200	20000					
25	52.2	427	Надгледване на изпитателни на фермата за мониторинг на изпитателни на изпитателни на изпитателни	50	2					
26	41.4	60	Изпитателни на изпитателни на изпитателни на изпитателни	0	4					

Necessary preparatory measures

Based on the assessments described above and taking into account the following factors:

- the as yet insufficiently developed and inconsistent legal and regulatory framework;
- the lack of fully clarified roles and responsibilities in the organisational structure; and
- the need to improve institutional capacity,

Prespa Lake Watershed Management Plan will be implemented on the basis of a two-tier strategy:

The first priority will be to implement measures that address the enabling environment—the institutional roles and management instruments – i.e. the preparatory measures.

1. While the legal and regulatory framework is being put into place and as the organisational structures and institutional capacities are developed, more technical measures will be implemented in a structured “learning-by-doing” process.

Necessary preparatory measures

The preparatory measures to be addressed in relation to the Macedonian context:

- **The Enabling Environment**
 - Policies
 - Legislative Framework
 - Financing and Incentive Structure
- **Institutional Roles**
 - Creating and Organisational Structure
 - Building Institutional Capacity
- **Management Instruments**
 - Social Change Instruments
 - Regulatory Instruments
 - Economic Instruments

Possible Implementation Strategies

3 alternatives (3 альтернативи)

- A '**Business as Usual**' Strategy
- A **Water Framework Directive Implementation Strategy** in which all the 45 measures are implemented in full accordance with the WFD, ensuring the achievement of the environmental objectives.
Analysis of Alternative Implementation Strategies
= 52 million €
-
- A **Realistic Implementation Strategy** in which some of the above 45 measures are implemented based on the availability of economic resources, manpower and skills.
= 14.5 million €

■ Analysis of Alternative Implementation Strategies

Effects – Environmental objectives

Objectives	Sub-objective	Indicators	Alternatives		
			"0" No action	1 Realistic	2 Full WFD
Overall Objective 1: Improvement of environmental conditions ensuring good water and soil quality for human health and ecosystem by 2025 Indicator: Measurable decline in levels of the main pollutant groups and pressures on water, sediment and biota	1a: Good surface water quality:	Reduce/prevent further eutrophication/organic pollution			
		Reduce/prevent further hydromorphological changes			
		Reduce/prevent further habitat fragmentation			
		Maintain biological water quality (phytoplankton, macrophytes, invertebrates and fish)			
		Reduce/prevent hazardous substances pollution			
	1b: Good groundwater quality:	Control water abstraction			
		Reduce/prevent water pollution from point and non-point sources			
		Maintain good physical and chemical characteristics			
	1c: Good ecological	Reduce/prevent further eutrophication/organic pollution			
		Reduce/prevent further hydromorphological changes			
		Reduce/prevent further habitat			

Environmental effects

Name	Current status	Action ?	Objectives		Alternatives		
			Rivers	HMWB & AWB	"0" No action	1 Realistic	2 Full WFD
Istocka 1	Good				Good	Good	Good
Istocka 2	Bad	Y	Good		Bad	Moderate	Good
Istocka 3	Poor	Y	Good		Poor	Moderate	Good
Golema 1	Good				Good	Good	Good
Golema 2	Moderate	Y	Good		Moderate	Good	Good
Golema 3	Moderate	Y	Good		Moderate	Good	Good
Golema 4	Moderate	Y	Good		Moderate	Good	Good
Golema 5	Moderate	Y	Good		Moderate	Good	Good
Golema 6	Bad	Y		Good potential	Bad	Moderate	Good
Golema 7	Bad	Y		Good potential	Bad	Moderate	Good
Golema 8	Poor	Y		Good potential	Poor	Moderate	Good
Kurbinska	Moderate	Y	Good		Moderate	Good	Good
Kranska 1	High				High	High	High
Kranska 2	Moderate	Y	Good		Moderate	Good	Good
Brajcinska 1	High				High	High	High
Brajcinska 2	Poor	Y	Good		Poor	Moderate	Good
Lake Prespa	Moderate		Good		Poor	Good	Good

■ ECONOMIC ANALYSIS

■ **Cost-based valuation method –**

based on the assumption that the cost of maintaining an environmental benefit is a reasonable estimate of its value.

■ **Necessity of Assessing Disproportionate Costs**

an approach for determining whether the total costs of the programme of measures are disproportionately costly is relevant for justifying derogation.

- In a **cost-effectiveness analysis**, the costs of a particular environmental measure are expressed in monetary units, while the environmental effect
- of the measure is expressed in physical units such as the reduction in the number of tonnes of nitrogen or phosphorus loaded in the aquatic environment.
- **The following assumptions were taken into account:**
- *A. The suggested measures are expected to be realized in the next 24 years, even though the period according to the ToR is 6 years. The period of realization is longer than the period in the ToR because there are a number of preconditions that need to be achieved in order for the measures to be realized.*
- B. The expense of each measure has been estimated/calculated by the expert team. Each expense is increased for running costs. **Direct costs** (made up of mainly financial and administrative costs) are included in all components of the economic assessment. **Financial costs** are the costs of providing and administering water services. **Operating costs** are all the costs incurred to keep an environmental facility running (e.g. material
- and staffing costs). The operating costs should take into account additional costs to ensure new capital investments. **Maintenance costs** are the costs of maintaining existing (or new) assets in good functioning order until the end of their useful life. **Capital costs** include new investments, the cost
- of new investment expenditures and associated costs (e.g. site preparation costs, start-up costs, legal fees). **Associated costs** are also substantial.
- For projections, the costs of new capital investments are spread over a number of years.

- C. The **discount rate** used for the calculation of expenses is 6%. The factors taken into consideration in determining the discount rate include the following: the reference rate of the Central Bank of the Republic of Macedonia (4% at the moment of the determination of the discount rate); the annual rate of EURIBOR (2.14% at the moment of determining the discount rate); and the macroeconomic policy of the Republic of Macedonia, according to which the rate of inflation is expected to be between 3% and 5%
- D. The measures are divided into **two groups**.
 - The first group of measures refers to water used for irrigation. The first group of users consists of farmers who will use the water for irrigation. In this group, one hectare of agriculture area is considered as the cost unit. The total irrigation area is 4,000 hectares.
 - The second group of measures refers to the treatment of wastewater.
 - The reason for this classification is to enable the distribution of the costs for the measures per unit. The second group of users consists of the legal
 - entities that will be included in the treatment of wastewater, in which group households and legal entities are considered as cost units. There are 4,000 households and legal entities (companies and institutions) in the area.

- E. Two periods have been taken into consideration in determining the payback period: 40 years and 20 years.
 - In the first case, the expenses for the implementation of the measures are expected to be recovered over a longer period, i.e. 40 years, which represents the average useful life of the dam.
 - In the second case, if the measures are implemented by issuing concessions for operation of the dam or the establishment of PPP, the private investor is interested in recovering the investment in a shorter period and therefore the payback period is calculated as 20 years.
- F. The Annual Equivalent Cost (AEC) method allows for converting the Net Present Value (NPV) of a new capital expenditure into an annuity (or rental) which has the same value. This is done as follows:
 - 1. By listing all capital expenditures as they are incurred;
 - 2. By calculating the net present value of expenditures, using the chosen discount rate;
 - 3. By converting this net present value into an annual equivalent cost (AEC)

Net present value (NPV) calculated for the two groups of measures for 2 alternatives

Table 29. NPV - group of measures on water supply & irrigation

Measures for treatment of water for irrigation	NPV ('000 €)	Repayment period 40 years		Repayment period 20 years	
		Annual equivalent cost ('000 €)	Annual cost per ha (4.000 ha) in €	Annual equivalent cost ('000 €)	Annual cost per ha (4.000 ha) in €
Alternative 1 - Full WFD Implementation	42.838	1.071	268	2.142	535
Alternative 2 -Realistic Implementation Strategy	11.035	276	69	552	138

Table 30. NPV – group of measures for treatment of wastewater

Measures for treatment of wastewater	NPV ('000 €)	Repayment period 40 years		Repayment period 20 years	
		Annual equivalent cost ('000 €)	Monthly cost per entity (4.000) in €	Annual equivalent cost ('000 €)	Monthly cost per entity (4.000) in €
Alternative 1 - Full WFD Implementation	8.843	221	4,5	442	9
Alternative 2 -Realistic Implementation Strategy	472	12	0,2	24	0,5

PoM – implementation schedule

Rank	Score	ID	Measures	Cost		Impl.Period (years)	Proposed Alternatives			Initial 6-year WMP implementation period	Second 6-year WMP implementation period	Third 6-year WMP implementation period
				Total (NP €)	Ann. NP €		0	1	2			
							BW	R	WFD	Year 1-6	Year 7-12	Years 13-18
1	88.2	23	Regulate irrigation wells	200	3	3						
2	88.2	23	Regulate river intake from	16	3	3						
3	85.5	428	Green cover in orchards	300	8	8						
4	82.5	34	Erosion structures	7.000	18	18						
5	83	421	Upgrade irrigation schemes	300	5	5						
6	82.5	422	Closure of illegal dumps	250	6	6						
7	82.5	410	Upgrade industrial WWTP	300	12	12						
8	82	414a	Upgrade Erosion WWTP	300	2	2						
9	81.7	42	Inhabitable fish ponds	350	5	5						
10	81.5	33	Erosion control plans	300	6	6						
11	81.5	61	Management plans Pila	6	30cent	30cent						
12	81.2	411	WWTP monitoring for Lake Prespa	6	30cent	30cent						
13	80.2	411	Reforestation of pine	6	30cent	30cent						
14	59.8	424	Educating farmers in good agricultural and environmental practice including composting of orchard waste	100	2	2						
15	59.7	21	Preparation of flood risk and mitigation plans	250	2	2						
16	57.8	421	Pilot project for environmental safe use of fertilizers and pesticides	100	2	2						
17	57.7	34	Introduce drip irrigation systems on 4.000 ha	4.000	4 + 4	4 + 4						
18	55.4	23b	Construction of a dam on Chiosnika River	30.000	6	6						
19	55.2	410	Designate and monitor recreational areas	40	30cent	30cent						
20	53.6	410	Upgrade fisheries management based on source and catch assessment	150	30cent	30cent						
21	53.7	25	Develop a database on irrigation	100	2	2						
22	53	32	Implement flood control measures	5.000	12	12						
23	53	414a	Construction of WWTP for smaller agglomerations (<2000 PE)	2.000	13	13						
24	52.6	43	Establish inventory of private wells	200	20cent	20cent						
25	52.2	427	Upgrade farmer's capacity for proper hazardous waste disposal and use of pesticides	50	2	2						
26	51.8	56	Train farmers in proper irrigation management	30	1	1						
27	50.8	54	Improve management of priority substances	60	2	2						
28	50.5	415a	Improve sewage network in Resen and Zankovc	1.000	6	6						
29	50	410	Introduce regular monitoring of algae blooms	40	30cent	30cent						
30	49	434	Improve fertilizer management including capacity for laboratory analysis	60	30cent	30cent						
31	48.8	420	Introduce effective eutrophication strategies	1.000	4	4						
32	48	414b	Establish tertiary wastewater treatment in former fish ponds	300	2	2						
33	47.8	64	Establish trans-boundary monitoring programme	300	150cent	150cent						
34	46.5	65	Ensure harmonization of environmental data management	25	1	1						
35	46	410b	Improve existing and construct new sewage network in smaller agglomerations in the region	2.500	14	14						
36	45.5	65	Pilot project for use of biomass as energy resource	700	2	2						
37	45.2	52	Conduct detailed local hydro-geological investigations	100	1	1						
38	44.2	51	Conduct regional hydro-geological investigations	800	4	4						
39	44	410a	Conduct a feasibility study on alternative eutrophication mitigation strategies	600	1	1						
40	38.3	55	Conduct source investigations of priority substances in ground water	30	1	1						
41	37.8	418	Conduct modeling of the effect of different discharge reduction strategies	300	2	2						
42	37.2	417	Implement project for separation of storm water and construction of proper outfalls	250	6	6						
43	37.2	22a	Conduct a comprehensive feasibility study for improvement of management of water for irrigation purposes, soil infiltration, irrigation, fish, wildlife, catchment, water	300	2	2						

