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ASSESSMENT OF THE STATUS OF TRANSBOUNDARY RIVERS, LAKES AND GROUNDWATERS

ASSESSMENT OF TRANSBOUNDARY RIVERS, LAKES AND GROUNDWATERS IN SOUTH-EASTERN EUROPE DISCHARGING IN THE AEGEAN SEA

Note by the secretariat

Summary

This document was prepared pursuant to decisions taken by the Working Group on Monitoring and Assessment at its tenth meeting (Bratislava, 10–11 June 2009, ECE/MP.WAT/WG.2/2009/2, paras. 8–44) and by the Working Group on Integrated Water Resource Management at its fourth meeting (Geneva, 8–9 July 2009; ECE/MP.WAT/WG.1/2009/2, paras. 44–48). This document contains the draft assessment of the different transboundary rivers, lakes and groundwaters in South-Eastern Europe (SEE) that are located within the Agean Sea drainage basin by transboundary basin and aquifer.

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CONTENTS

I. INTRODUCTION

1. The present document contains the assessments of the different transboundary rivers, lakes and groundwaters in South-Eastern Europe (SEE) which are located within the Black Sea drainage basin. The river basins which assessments are presented in this document are sub-basins of the Danube. The document has been prepared by the secretariat with the assistance of Global Water Partnership Mediterranean (GWP-Med) on the basis of information provided by SEE countries.

2. The present document contains several references to figures, which are not presented here but will be included in the final assessment publication as edited or redrawn, as needed. It should be noted that maps of the basins and maps showing locations of the transboundary aquifers are not referred to here but will be developed for the final assessment, consulting the riparian countries when necessary. For ease of reference, in most cases the numbers in front of the names of the aquifers and groundwater bodies in the tables containing related information refer to the numbering used in the list of transboundary groundwaters in South-Eastern Europe in the First Assessment of Transboundary Rivers, Lakes and Groundwaters. For descriptions of the transboundary aquifer types and related illustrations, Annex V of document ECE/MP.WAT/2009/8 should be referred to.

II. VARDAR/AXIOS RIVER BASIN[1]

Table 1. Basin of the Vardar/Axios River

Area	**Country**	**Country's share**	**Number of inhabitants**		**Population density (persons/km^2)**
23,750 km^2	The former Yugoslav Republic of Macedonia	19,737 km^2	88.7%	1,800,000	91
	Greece	2,513 km^2	11.3%	1,600,000	637

3. The former Yugoslav Republic of Macedonia and Greece share the basin of the Vardar/Axios River[2]. The transboundary Lake Dojran/Doirani[3] is located in this basin.

A. VARDAR/AXIOS RIVER

Hydrology and hydrogeology

4. The river has its source in the Shara massif (a mountainous area between Albania and the former Yugoslav Republic of Macedonia) and empties into the Aegean Sea at Thermaikos Gulf (Greece). The total length of the river is 389 km, with the 87 km being in Greece. The river has a pronounced mountainous character with an average elevation of about 790 m a.s.l.

[1] Based on information mainly from the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Ministry of Environment, Physical Planning and Public Works/Central Water Agency, Greece and the Ministry of Urban Planning, Construction and Environment, the former Yugoslav Republic of Macedonia; some additional information was provided by the former Yugoslav Republic of Macedonia.
[2] The river is known as Vardar in the former Yugoslav Republic of Macedonia and Axios in Greece.
[3] The lake is known as Dojran in the former Yugoslav Republic of Macedonia and Doirani in Greece.

5. Major tributaries in the Greek side include the rivers Gorgopis (sub-basin 70 km^2), Sakoulevas (sub-basin 901 km^2) and Vardarovasi (sub-basin 102 km^2). Major tributaries in the former Yugoslav Republic of Macedonia are the Treska (sub-basin 2068 km^2), Lepenec (sub-basin 770 km^2), Pcinja (sub-basin 2840.7 km^2), Bregalnica (sub-basin 4306.8 km^2) and Crna (sub-basin 5890 km^2) Rivers.

Table 2. Water resources (× 10^6 m^3/year) and water resources per capita (m^3/year)[4]

		Sub-basins		Vardar/Axios
		Vardar/Axios	**Dojran/Doirani Lake**	
The former Yugoslav Republic of Macedonia	Surface water resources	N/A	N/A	4,185 x 10^6 *
	Groundwater resources	N/A	N/A	N/A
Greece	Surface water resources			
	Groundwater resources			

*average for the years 1961 to 1990

Table 3. Discharge characteristics of the Vardar/Axios and its tributaries in the former Yugoslav Republic of Macedonia

Gauging station: Gevgelija - Vardar River		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	7.99 m^3/s	1961-2005
Q_{max}	195.8 m^3/s	N/A
Q_{min}	0.206 m^3/s	N/A
Mean monthly values		
October: 3.78 m^3/s	November: 6.28 m^3/s	December: 8.04 m^3/s
January: 8.70 m^3/s	February: 9.68 m^3/s	March: 12.11 m^3/s
April: 15.42 m^3/s	May: 15.81 m^3/s	June: 8.49 m^3/s
July: 3.10 m^3/s	August: 1.79 m^3/s	September: 2.66 m^3/s
Gauging station: Lepenec (Vliv) - Lepenec River		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	132.9 m^3/s	1961-2005
Q_{max}	2,010.0 m^3/s	N/A
Q_{min}	7.3 m^3/s	N/A
Mean monthly values		
October: 73.59 m^3/s	November: 111.32 m^3/s	December: 144.30 m^3/s
January: 158.08 m^3/s	February: 183.78 m^3/s	March: 205.62 m^3/s
April: 231.69 m^3/s	May: 203.92 m^3/s	June: 119.81 m^3/s
July: 59.30 m^3/s	August: 44.23 m^3/s	September: 58.54 m^3/s

[4] - Surface water resources: Defined as run-off internally generated from precipitation within the part of the basin that is the country's territory plus incoming water flow from adjacent basin country/countries. Groundwater resources: Defined as estimated annual groundwater recharge derived from precipitation falling on the country's territory within the river basin concerned, plus entering external groundwater flow. It should be noted that external groundwater flow may also originate from outside the basin.

Gauging station: Sv. Bogorodica – Treska River		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	23.16 m^3/s	1961-2005
Q_{max}	750.0 m^3/s	N/A
Q_{min}	0.31 m^3/s	N/A
Mean monthly values		
October: 10.30 m^3/s	November: 17.24 m^3/s	December: 23.10 m^3/s
January: 26.05 m^3/s	February: 27.64 m^3/s	March: 37.06 m^3/s
April: 46.53 m^3/s	May: 40.90 m^3/s	June: 21.70 m^3/s
July: 11.31 m^3/s	August: 7.74 m^3/s	September: 8.36 m^3/s

Gauging station: Katlanovska Banja – Pcinja River		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	11.43 m^3/s	1961-2005
Q_{max}	348.0 m^3/s	N/A
Q_{min}	0.10 m^3/s	N/A
Mean monthly values		
October: 5.33 m^3/s	November: 8.05 m^3/s	December: 11.19 m^3/s
January: 12.48 m^3/s	February: 16.20 m^3/s	March: 21.14 m^3/s
April: 23.07 m^3/s	May: 18.18 m^3/s	June: 10.71 m^3/s
July: 4.98 m^3/s	August: 2.54 m^3/s	September: 3.33 m^3/s

Gauging station: Stip – Bregalnica River		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	10.84 m^3/s	1961-2005
Q_{max}	344.0 m^3/s	N/A
Q_{min}	0.032 m^3/s	N/A
Mean monthly values		
October: 5.64 m^3/s	November: 7.95 m^3/s	11.18
January: 12.83 m^3/s	February: 18.80 m^3/s	March: 18.91 m^3/s
April: 18.62 m^3/s	May: 13.35 m^3/s	June: 8.81 m^3/s
July: 4.80 m^3/s	August: 4.06 m^3/s	September: 5.20 m^3/s

Gauging station: Rasimbegov Most – Crna River		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	22.14 m^3/s	1961-2005
Q_{max}	1,152.0 m^3/s	N/A
Q_{min}	0.65 m^3/s	N/A
Mean monthly values		
October: 7.48 m^3/s	November: 16.33 m^3/s	December: 25.29 m^3/s
January: 29.06 m^3/s	February: 39.45 m^3/s	March: 45.07 m^3/s
April: 41.15 m^3/s	May: 32.96 m^3/s	June: 14.25 m^3/s
July: 6.16 m^3/s	August: 3.72 m^3/s	September: 4.82 m^3/s

Table 4. Discharge characteristics of the Vardar/Axios in Greece (measuring station Kafkasos Railway Bridge/Tributary Sakoulevas)

Discharge characteristics	Discharge	Period of time or date
Q_{av}	3.5 m^3/s	1950-1990
Q_{min}	0.3 m^3/s	N/A
Q_{max}	8.5 m^3/s	N/A
Mean monthly values		
October: 1.2 m^3/s	November: 2.2 m^3/s	December: 5.1 m^3/s
January: 3.8 m^3/s	February: 8.5 m^3/s	March: 8.1 m^3/s
April: 5.8 m^3/s	May: 6.5 m^3/s	June: 2.3 m^3/s
July: 0.7 m^3/s	August: 0.3 m^3/s	September: 0.4 m^3/s

6. There are 120 large and small dams in the former Yugoslav Republic of Macedonia. Floods in the downstream area were considerably reduced due to these dams.

7. Gevgelija/Vardar aquifer (no. 41), described in the table below, is transboundary between the former Yugoslav Republic of Macedonia and Greece.

Table 5. Gevgelija/Axios-Vardar aquifer[5]

No. 41 Gevgelija/Axios-Vardar		**Shared by: the former Yugoslav Republic of Macedonia and Greece**
Type 3 or none of the illustrated transboundary aquifer types, Quaternary alluvial sediments, sands with gravel, partly clayey and silty with cobbles of bedrock - diabases, biotite gneisses and schists. Average thickness of 10-30 m and maximum 60-100 m. Very shallow water table. Medium to strong link with surface water systems, groundwater flow from the former Yugoslav Republic of Macedonia to Greece and from west to east in the Greek part.		**Mediterranean Sea Basin** Border length (km):
	The former Yugoslav Republic of Macedonia	**Greece**
Area (km^2)	N/A	8
Water uses and functions	Maintaining baseflow and springs and support of ecosystems; abstractions for agriculture	>75% of abstraction is for irrigation, <25% each for drinking water supply and livestock, also support of ecosystems

[5] Based on information from the First Assessment of Transboundary Rivers, Lakes and Groundwaters - for which information had been provided by the Ministry of Environment and Physical Planning, The former Yugoslav Republic of Macedonia, and the Institute of Geology and Mineral Exploration and the Central Water Agency, Greece.

Status, pressures and transboundary impact

8. The main forms of land use are cropland (68.7%), grassland (7.4%) and forests (7.9%). In Greece, a large part of the basin is a protected NATURA 2000 site.

9. Water is abstracted for irrigation (63%), fishponds (11%) and drinking water (12%) as well as for municipal and industrial uses (15%). There is an overuse of water in many parts of the river basin, mainly for agricultural purposes. In the former Yugoslav Republic of Macedonia extensive and severe increases in pumping lifts from the Gevgelija/Vardar aquifer have resulted in decline of groundwater levels, reduction in borehole yields, severe reduction of baseflow and springflow locally and degradation of ecosystems; according to the former Yugoslav Republic of Macedonia the observed impacts are also due to pressures at transboundary level.

10. The main pressure on water resources in terms of quality stems from agriculture. In the former Yugoslav Republic of Macedonia, crop and animal production takes place in river valleys, especially the Pelagonija, Polog and Kumanovo valleys, as well as in the whole Bregalnica catchment area.

11. A few industrial installations also affect the aquatic ecosystem. In the former Yugoslav Republic of Macedonia, mining and quarrying activities are particularly located in the catchments area of the eastern tributaries (rivers Bregalnica and Pcinja). Metal industry at Tetovo and heavy metal industry at Veles, as well as chemical industry, petroleum refineries and pharmaceutical industry at Skopje, are additional pressure factors.

12. The treatment and disposal of solid waste and wastewater and their management at communal level is a problem and has to be improved. This is especially true for the former Yugoslav Republic of Macedonia: while there are controlled landfills for solid wastes from bigger cities there are also a number of illegal dumpsites for solid waste from the villages. For the time being, the only properly working wastewater treatment plant is located at Makedonski Brod in the Treska River catchment. Organic matter from waste-water discharges results in a transboundary impact.

13. When last reported (in the First Assessment of Transboundary Rivers, Lakes and Groundwaters), the surface water quality was classified as “good/moderate”, considered to be appropriate for irrigation purposes and to be used for water supply after treatment. While the quality of groundwater had been reported as, in general, very good and often used for water supply without or very little treatment in the former Yugoslav Republic of Macedonia, the existence of nitrogen, pesticides, heavy metals, pathogens, industrial organics and hydrocarbons in the Gevgelija/Vardar aquifer had been reported as well. The salinization observed is of natural origin.

Responses

14. The implementation of the EU Water Framework Directive (WFD)- in progress in both countries, but Greece being an EU Member State is much ahead in this respect - is expected to improve the status of the system in the long term.

15. Implementation of good agricultural practices and public awareness are necessary measures in Greece and abstraction controls and monitoring need to be improved. More efficient groundwater and lake water use, monitoring of the lake's and the aquifers' water quantity and quality, raising public awareness, defining protection zones, carrying out vulnerability mapping as well as wastewater treatment is necessary be improved in the former Yugoslav Republic of Macedonia; other measures need to be applied or are planned.

16. Data exchange is deemed necessary by both countries.

Trends

17. Greece and the former Yugoslav Republic of Macedonia are considering drawing up a bilateral agreement to replace the existing 1959 agreement, which dealt primarily with the establishment of a joint body for the joint management of water resources management. The new agreement will be based on the most recent developments in international law and European Union legislation.

B. LAKE DOJRAN/DOIRANI[6]

Hydrology and hydrogeology

18. Lake Dojran/Doirani is a small (total area 43.10 km^2) tectonic lake with a basin of 271.8 km^2. The lake is shared by the former Yugoslav Republic of Macedonia (27.4 km^2) and Greece (15.7 km^2). The lake is rich with fish – 16 species. The "Aquatic Forest of Mouria" has been listed as a "Natural Monument" and also proposed, together with a small part (2 km^2) of Lake Dojran/Doirani, for inclusion in the NATURA 2000 network.

19. Dojran/Doirani Lake aquifer (no. 42) described in the table below, is transboundary between the former Yugoslav Republic of Macedonia and Greece.

[6] Based on information mainly from the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Ministry of Environment, Physical Planning and Public Works, Greece; some additional information was provided by the former Yugoslav Republic of Macedonia.

Table 6. Dojran Lake aquifer7

<table>
<tr><td colspan="2">No. 42 Dojran Lake</td><td>Shared by: Greece and the former Yugoslav Republic of Macedonia</td></tr>
<tr><td colspan="2" rowspan="2">Type 3, Quaternary and Upper Eocene alluvial aquifer, lake deposits and terraces of silts, clays, sands and gravels, average thickness 150 m and up to 250 m, overlying metamorphic rocks, sedimentary sequences and carbonate formations - Precambrian, older Paleozoic and Green Metamorphic Complex. Unconfined, with strong links with surface water systems, groundwater flow is from north to south in the Nikolic area of the former Yugoslav Republic of Macedonia, north east to south west on the Greek side and generally towards the lake. Groundwater is 90% of total water use in the Greek part</td><td>Mediterranean Sea basin</td></tr>
<tr><td>Border length (km):</td></tr>
<tr><td></td><td>Greece</td><td>The former Yugoslav Republic of Macedonia</td></tr>
<tr><td>Area (km^2)</td><td>120</td><td>92</td></tr>
<tr><td>Water uses and functions</td><td>>75% for irrigation, <25% for drinking water supply and livestock, maintaining baseflow and springs and support of ecosystems</td><td>Irrigation and water supply</td></tr>
<tr><td>Notes</td><td>Groundwater abstraction exceeds mean annual recharge</td><td></td></tr>
</table>

Status, pressures and transboundary impacts

20. Lake Dojran/Doirani has been affected by quantity decrease and quality reduction since the early 1990s due to activities in both countries, such as water abstraction and municipal wastewater disposal; water abstraction has been a pressure factor also for the underlying aquifer resulting in the decline of groundwater levels.

21. The situation was aggravated by the low precipitation in the period 1989-1993 and high evaporation rates in the lake basin. Over the last 20 years, the lake's level has dropped continuously also due to increasing Greek abstraction, mainly for irrigation purposes. The most extreme water level and water volume decrease have occurred since 1988; from 262 million m^3 in 1988, the volume decreased to 80 million m^3 in 2000.

22. Pollution is caused by municipal wastewater, municipal solid wastes, sewage from tourist facilities, and agricultural point source and non–point source pollution; since the lake is an entity the impacts are felt in both countries.

23. Water quality is characterized by high alkalinity and elevated carbonate and magnesium hardness. Additionally, concentrations of certain toxic substances are near or even beyond toxic

[7] Based on information from the First Assessment of Transboundary Rivers, Lakes and Groundwaters - for which information had been provided by the Ministry of Environment and Physical Planning, the former Yugoslav Republic of Macedonia, and the Institute of Geology and Mineral Exploration and the Central Water Agency, Greece.

levels. In Greece, there are high values of phosphates; low concentrations of heavy metals have been observed in the aquifer.

24. In recent years, the lake has been struggling for survival. Since 1988, because of the decrease in water level and volume, according to biologists over 140 species of flora and fauna have disappeared. The water level has dropped 1.5 m below its permitted hydro-biological minimum.

Responses[8]

25. The lake, in the former Yugoslav Republic of Macedonia, is being recharged by water coming from the Gjavato wells through a pumping and transfer system that has a capacity of 1,000 l/s; the project "Feasibility study on Dojran lake salvation" was financed by the Ministry of Environment and Physical Planning and the Ministry of Agriculture, Forestry and Water Economy in 2001.

III. STRUMA/STRYMONAS RIVER BASIN[9]

26. The basin of the Struma/Strymonas[10] River is typically considered to be shared by Bulgaria and Greece; the shares of Serbia and the former Yugoslav Republic of Macedonia in the total basin area are small. The river has its source in western Bulgaria (Vitosha Mountain, south of Sofia) and ends up in Aegean Sea (Strymonikos Gulf – Greece).

Table 7. Basin of the Struma/Strymonas River

Area	Country	Country's share		Number of inhabitants	Population density (persons/km^2)
18,340	Bulgaria	8,545 km^2	46.6	487,206*	57.01*
	Greece	7,282 km^2	39.7		
	Serbia	865 km^2	4.7	N/A	~ 10
	The former Yugoslav Republic of Macedonia	1,648 km^2	9.0	120,869**	73,3**

*2006 **2002

27. The total length of the river is 400 km, with its last 110 km flowing through Greece. Major tributaries include the rivers Butkovas, Exavis, Krousovitis, Xiropotamos and Aggitis, shared by Bulgaria and Greece; Dragovishtitsa, shared by Serbia and Bulgaria; Lebnitsa and Strumica/Strumeshnitsa shared by the former Yugoslav Republic of Macedonia and Bulgaria.

[8] See also "Responses" under Vardar/Axios.
[9] Based on information from Bulgaria, the former Yugoslav Republic of Macedonia and Serbia. Information about Strumica river catchment area (the former Yugoslav Republic of Macedonia) was based on the Second Communication on Climate Change. Section: Vulnerability Assessment and Adaptation for Water Resources Sector; December 2006, the former Yugoslav Republic of Macedonia. References related to Greece are based on information from the First Assessment of Transboundary Rivers, Lakes and Groundwaters - for which information had been provided by the Ministry of Environment and Water, Bulgaria, and the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.
[10] The River is called Struma in Bulgaria and Strymonas in Greece.

28. The basin has a pronounced mountainous character with an average elevation of about 900 m a.s.l.

29. Parts of the basin in Bulgaria and Greece are under protection status designated as NATURA 2000 sites.

Hydrology and hydrogeology

30. There are about 60 artificial lakes in the Bulgarian part of the river basin, used for water supply, power generation and irrigation purposes. The Kerkini Reservoir in Greece was created with the construction of a levee in 1933 for regulating the river discharges, for irrigation purposes and flood protection (a new levee was constructed in 1982). The Kerkini Reservoir was finally developed into an important wetland protected under the Ramsar Convention on Wetlands. In Greece, irrigation dams exist also at Lefkogeia and Katafyto. The Lisina Reservoir on Dragovishtitsa River in Serbia is a part of the Vlasina hydropower production system.

31. There is high risk of flooding in Bulgaria due to the basin's geomorphologic and hydrological characteristics. Bulgaria reported that global climate change over the last 20 years has resulted in approximately 30% decrease in precipitation and a subsequent decrease in water resources in the basin[11]; provisions regarding the decrease of water resources will be included in the programme of measures of the river basin management plan.

Table 8. Discharge characteristics of the Struma River at the gauging station Marino Pole (Bulgaria)

Discharge characteristics	Discharge	Period of time or date	Discharge	Period of time or date
Q_{av}	75.57 m^3/s	1961 – 1998	77.49 m^3/s	1961 – 2002
Q_{max}	149.00 m^3/s	1961 – 1998	833.23 m^3/s	1961 – 2002
Q_{min}	24.13 m^3/s	1961 – 1998	9.418 m^3/s	1961 – 2002

Mean monthly values		
October: 54.79 m^3/s	November: 62.58 m^3/s	December: 70.04 m^3/s
January: 74.99 m^3/s	February: 85.86 m^3/s	March: 92.22 m^3/s
April: 101.30 m^3/s	May: 119.10 m^3/s	June: 88.89 m^3/s
July: 57.02 m^3/s	August: 51.06 m^3/s	September: 49.18 m^3/s

Source: Ministry of Environment and Water, Bulgaria.

[11] No detailed information has been provided by Bulgaria on the spatial or temporal extent of the underlying observations.

Table 9. Discharge characteristics of the Strumica River at the gauging station Novo Selo (the former Yugoslav Republic of Macedonia)

Discharge characteristics	Discharge	Period of time or date
Q_{av}	3.89 m^3/s	1961 - 2005
Q_{max}	280.0 m^3/s	1961 - 2005
Q_{min}	0.00 m^3/s	1961 - 2005
Mean monthly values		
October: 1.48 m^3/s	November: 3.19 m^3/s	December: 5.04 m^3/s
January: 4.86 m^3/s	February: 7.92 m^3/s	March: 7.86 m^3/s
April: 6.26 m^3/s	May: 4.56 m^3/s	June: 3.29 m^3/s
July: 1.07 m^3/s	August: 0.53 m^3/s	September: 0.67 m^3/s

Source: Hydro-meteorological institute, the former Yugoslav Republic of Macedonia

Table 10. Water resources (× 10^6 m^3/year) and water resources per capita (m^3/year)

Bulgaria	Surface water resources	1,961.000 *
	Groundwater resources	199.623**
	Total water resources	2,160.326 **
	Total water resources per capita	4,435 **
Greece	Surface water resources	
	Groundwater resources	
	Total water resources	
	Total water resources per capita	

*Average for the years 1961 to 2004 **Average for the years 1980 to 2004

32. Two transboundary aquifers were identified as hydraulically linked to the surface water system and included in the first assessment: (i) the Sandansky - Petrich aquifer (shared by Bulgaria, Greece and the former Yugoslav Republic of Macedonia) and (ii) Orvilos-Agistros/Gotze Delchev karst aquifer (shared by Bulgaria and Greece - as reported by Bulgaria, it extends also to and is hydraulically linked with the surface water systems of Mesta/Nestos River basin).

33. Bulgaria reported that new data available suggests that the Sandansky – Petrich aquifer is divided in two distinguished aquifers thus, should be substituted by them here[12]: (i) the Sandansky valley aquifer (shared by Bulgaria and Greece) and (ii) the Petrich valley aquifer (shared by the former Yugoslav Republic of Macedonia and Bulgaria).

34. According to Greece[13] the Orvilos-Agistros/Gotze Delchev karstic aquifer is not hydraulically linked with the surface waters of either Struma/Strymonas or Mesta/Nestos basins. In addition, Bulgaria expresses uncertainty whether the aquifer should be considered as transboundary. The reason, reported by Bulgaria, is that the state border between Bulgaria and Greece is located in a highland area where the aquifer is inferred to extend along the local watershed divide[14]. Therefore groundwater is suspected not to flow across the state border, but flow towards Bulgaria in the northern part, and towards Greece in the South.

[12] The position of Greece and the former Yugoslav Republic of Macedonia is not available in this regard.
[13] Based on information provided by Greece.
[14] It should be noted, though, that karstic aquifer flow systems are difficult to characterize and the groundwater divide does not necessarily coincide with the topographic divide.

35. Information about all the aforementioned aquifers is given in the tables below:

Table 11. Sandansky-Petrich aquifer

No. 43 Sandansky – Petrich			**Shared by: Bulgaria, Greece and the former Yugoslav Republic of Macedonia**
Pliocene and Quaternary alluvial sands, gravels, clays and sandy clays of the Sandansky (up to 1,000 m thick) and Petrich (up to 400 m) valleys, with aquifer with free level of groundwater from 10 to 100 m, thermal water is characterized from 100 to 300 m in Paleozoic rocky masses with schists and Paleozoic limestones with karst aquifers with different quantity of groundwater. Flow occurs from the former Yugoslav Republic of Macedonia to Bulgaria and Greece			**Mediterranean Sea Basin** Border length (km): BG/GR - 18, BG/MK - 5
	Bulgaria	**Greece**	**The former Yugoslav Republic of Macedonia**
Area (km^2)	-		
Water uses and functions	-		Drinking water, irrigation and industry, thermal springs, agriculture

Table 12. Sandansky valley aquifer

No. 43.1 Sandansky valley		**Shared by: Bulgaria and Greece**
Pliocene, predominantly, and Quaternary lake sediments and alluvial sands, gravels, clays and sandy clays of Sandansky (up to 1000 m thick) valley, free groundwater table at a depth varying from 10 to 100 m; flow occurs from Bulgaria to Greece		**Mediterranean Sea Basin** Border length (km): 18
	Bulgaria	**Greece**
Area (km^2)	630.5	
Water uses and functions	Maintaining baseflow and springs. Supports ecosystems.	

Table 13. Petrich valley aquifer

No. 43.2 Petrich valley		**Shared by: the former Yugoslav Republic of Macedonia and Bulgaria (?)**
Pliocene, predominantly, and Quaternary lake sediments and alluvial sands, gravels, clays and sandy clays of Petrich (up to 400 m) valley, free groundwater table up to 10 m; flow occurs from the former Yugoslav Republic of Macedonia to Bulgaria		**Mediterranean Sea Basin** Border length (km): 5
	The former Yugoslav Republic of Macedonia	**Bulgaria**
Area (km^2)		124
Water uses and functions		Drinking water, irrigation and industry. Maintaining baseflow and springs. Supports ecosystems.

Table 14. Orvilos-Agistros/Gotze Delchev aquifer

No. 44 Orvilos-Agistros/Gotze Delchev		**Shared by: Bulgaria and Greece**
Type 1, Karstic marble aquifer formed in the Proterozoic crystalline schist of the Rhodopi with thick marbles overlying gneiss, some Pleistocene alluvial sediments at the edges. Dominant groundwater flow from east to west (in Greece). Strong links with the surface water systems		**Mediterranean Sea Basin** Border length (km): 22
	Greece	**Bulgaria**
Area (km^2)	95	325
Water uses and functions	<25% for irrigation, drinking water supply, industry, mining, thermal spa, livestock, fish production, hydropower, also maintaining baseflow and support of ecosystems	Irrigated agriculture and drinking water supply; it supports ecosystems.

Table 15. Mean annual water withdrawal by sector

		Total withdrawal	**Agriculture**	**Domestic**	**Industry**	**Energy**	**Other**
Bulgaria*	2006	54.739 × 10^6 m^3/year	7 %	30 %	52 %		11 %
Greece							

* 754.578 × 10^6 m^3/year are used for hydropower production and not included in the table above

Table 16. Water demands (× 10^3 m^3/year) in the Strumica catchment area in the former Yugoslav Republic of Macedonia

		Population and tourists	**Industry**	**Irrigation**	**Minimum accepted flow**	**Total water demands**
Strumica	2006	11,510.9	32,897.6	117,941.0	13,000.0	175,349.5
	2020	18,233.4	34,441.7	169,343.0	13,000.0	235,018.1
Total in the country	2006	218,269.1	274,147.0	899,335.0	635,000.0	2,227,891.1
	2020	348,261.3	287,014.0	1,806,711.0	635,000.0	3,491,286.3

Source: Second Communication on Climate Change. Section: Vulnerability Assessment and Adaptation for Water Resources Sector. Prepared by Katerina Donevska. December 2006, the former Yugoslav Republic of Macedonia

36. Although a major part of the basin area in Bulgaria is cropland, only a relatively small share of total water withdrawals is used for agriculture; more than half is used to supply industry. In the part of the Strumica sub-basin that extends to the territory of the former Yugoslav Republic of Macedonia water is mainly used for irrigated agriculture; the respective water demand is expected to increase significantly (more than 40%) until 2020.

Table 17. Land cover/use (% of the part of the basin extending in each county)

	Lakes / reservoirs	Forests	Cropland	Grassland	Urban / industrial areas	Protected areas	Other forms of land use
Bulgaria*	…	20.6	42.1	8.7	…	...	24.6 *
Greece							

* Shrubs; Mining sites and dumpsites occupy some 40 km^2

Status, pressures, and transboundary impacts

37. Erosion and subsequent accumulation of sediments was reported by Serbia to take place in Dragovishtitsa River basin due to torrents and deforestation. Bulgaria reported that there are morphological alterations in the part of the river extending in the territory of the country due to water abstractions and possible diversions in the Serbian part.

38. Hydro-technical constructions in the Bulgarian part such as dams (serving hydropower generation, irrigation and drinking water supply purposes) are pressure factors. Small hydropower stations may exert pressure to the environment; Bulgaria reports that the issue is under investigation.

39. Diversion of watercourses towards artificial reservoirs used for drinking water supply was reported by Bulgaria. There is intensive groundwater abstraction from some aquifers in the region. While degraded water conveyance and distribution infrastructure result to water losses, drinking water quality is of concern in some areas; measures are being taken by regional water companies to improve water distribution infrastructure to reduce water losses.

40. Untreated wastewater is an important pressure factor. In Bulgaria organic matter from wastewater discharges is of concern; the initiated construction of wastewater treatment plants (to be finished until 2014 - for settlements with more than 2,000 inhabitants) will address the issue of lack of collection and treatment facilities in many of the settlements. Strumica town (the major town in the part of Strumica sub-basin extending in the former Yugoslav Republic of Macedonia) lacks a waste water treatment plant.[15]

41. Agricultural runoff is a source of pollution in Bulgaria and so are the many small illegal dumpsites; livestock breeding units’ effluents and fish-farming are additional significant sources. Gravel extraction was reported as a very important issue; research on the effects of this pressure is being conducted. According to Bulgaria gravel extraction in the Greek part of the watercourse influences the water table on the Bulgarian side and alters the morphology of the Struma/ Strymonas River.

42. The water quality is generally “good”. The water is suitable for use, especially for irrigated agriculture. Decreasing industrial activity after 1990 in Bulgaria resulted in water-quality improvements.

[15] Second Communication on Climate Change. Section: Vulnerability Assessment and Adaptation for Water Resources Sector. December 2006, the former Yugoslav Republic of Macedonia.

Table 18. Water-quality characteristics of the Struma River upstream from the Bulgarian-Greek border (Monitoring station 30065124)

Date	Value	BOD_5 (mg/l)	Ammonia (mg/l)	Nitrites (mg/l)	Nitrates (mg/l)	Phosphates (mg/l)
	Minimum and maximum values for the period 2000-2005					
	Maximum	6.5	1.7	0.07	3.5	1.7
	Minimum	1	0.1	0.01	1	0.5
	Water quality in 2008					
31.1.2008		2.28	0.1197	0.0115	1.543	0.2103
03.4.2008		1.79	0.0711	0.0264	1.2257	0.42
16.7.2008		1.95	<0,006	0.0391	0.3253	0.314
15.10.2008		<1,5	0.0752	0.0373	0.9235	0.405

Source: Ministry of Environment and Water, Bulgaria.

43. As can be observed from the table above, the concentrations of phosphates measured in 2008 are lower than the minimum for 2000-2005. The same applies to ammonia (for the three out of four values provided here). According to Bulgaria, a decrease of industrial and agriculture activities may be reasons contributing to this.

Responses

44. The part of the the Struma/Strymonas basin that is within Bulgaria’s territory has been assigned to the West Aegean Basin District while the part that is within Greece’s territory has been assigned to the Central Macedonia District as well as to the Eastern Macedonia and Thrace Basin District. There is a management authority that has the primary responsibility for water resources management and a basin council (a consultative body) at the level of the river basin district. The Integrated Management Plan for the West Aegean Basin District covers the part of the basin falling within the Bulgarian territory and is expected to be finalized until the end of 2009 (the draft plan has been prepared).

45. There is a monitoring station[16] in Bulgaria near the Bulgarian – Greek borders. Monitoring programmes are being established in both countries in accordance to the EU WFD. Bulgaria reports that joint monitoring regarding the aquifers should be established.

Transboundary cooperation

46. An Agreement between Bulgaria and Greece was signed in 1964. According to it both countries are bound, inter alia, not to cause significant damage to each other, arising from the construction and operation of projects and installations along the valleys of the rivers

[16] Water quality in this station has been monitored since 2003; 20 basic physico-chemical parameters are being monitored (such as water temperature, BOD, pH, dissolved oxygen, suspended substances, turbidity, conductivity, ammonia, nitrites, nitrates, total phosphorous, phosphates and specific substances as heavy metals, organic pollutions, oils, phenols etc.).

Struma/Strymonas, Mesta/Nestos, Arda/Ardas and Maritsa/Evros. The agreement provides for exchange of information and data between parties for preventing floods as well as exchange of information concerning the installations subject to the agreement. According to an Agreement signed between the two countries in 1971 a Bulgarian-Greek Commission on cooperation in the field of electro-energy and the water use of the rivers flowing through their territories was set up. Bulgaria reports that the agreement is not active for the time being (2009) and that discussions regarding its renewal and possible updating are on-going. Finally, an Agreement was signed between the Ministry of Environment and Water of the Republic of Bulgaria and the Ministry for the Environment, Physical Planning and Public Works of the Hellenic Republic (1 November 2002) on Cooperation in the field of Environmental Protection.

Trends

47. The increase of tourism in the Bulgarian part is expected to result in increased water consumption needs.

IV. MESTA/NESTOS RIVER BASIN[17]

48. The basin of the river Mesta/Nestos[18] is shared by Bulgaria and Greece.

Table 19. Basin of the Mesta/Nestos River

Area	Country	Country's share		Number of inhabitants	Population density (persons/km^2)
5,613 km^2	Bulgaria	2,785 km^2	49.9%	128,206*	51.59*
	Greece	2,834 km^2	51.1%		

*2006 statistics

49. The river has its source in the Rila Mountains in the vicinity of Sofia (Bulgaria) and flowing through Greece ends up in the North Aegean-Sea. The basin has a pronounced mountainous character in its upper part and a lowland character further downstream. Dospat/Despatis[19] is a major transboundary tributary; the river has its source in the Rodopy Mountains in the vicinity of Sarnitsa (Bulgaria) and flows in Mesta/Nestos River in the territory of Greece.

[17] Based on information from Bulgaria; references related to Greece are based on information from the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Ministry of Environment and Water, Bulgaria, and the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.
[18] The river is called Mesta in Bulgaria and Nestos in Greece.
[19] The river is called Dospat as well as Dospatska in Bulgaria and Despatis in Greece.

50. Large parts of the basin in Bulgaria and Greece have been designated as NATURA 2000 sites[20]. The Nestos delta, in Greece, is of great ecological importance and has been designated as a Ramsar site.

Hydrology and hydrogeology

Table 20. Water resources (× 10^6 m^3/year) and water resources per capita (m^3/year)

Bulgaria	Surface water resources	958 *
	Groundwater resources	91.770 **
	Total water resources	1,049.770 **
	Total water resources per capita	8,188 **
Greece	Surface water resources	
	Groundwater resources	
	Total water resources	
	Total water resources per capita	

*Average for the years 1961 to 2002 **Average for the years 1980 to 2002

51. Bulgaria reported that global climate change over the last 20 years has resulted in approximately 30% decrease in precipitation and a subsequent decrease in water resources in the basin[21]; provisions regarding the decrease of water resources will be included in the programme of measures of the river basin management plan.

Table 21. Discharge characteristics of the Mesta/Nestos River at the gauging station 52 850 (Hadjidimovo, Bulgaria)

Discharge characteristics	Discharge	Period of time	Discharge	Period of time
Q_{av}	23.36 m^3/s	1961 - 1998	30.756 m^3/s	1961 - 2002
Q_{max}	66.30 m^3/s	1961 - 1998	537.190 m^3/s	1961 - 2002
Q_{min}	12.39 m^3/s	1961 - 1998	4.842 m^3/s	1961 - 2002

Mean monthly values		
October: 14.26 m^3/s	November: 18.77 m^3/s	December: 25.14 m^3/s
January: 22.76 m^3/s	February: 26.99 m^3/s	March: 28.70 m^3/s
April: 41.52 m^3/s	May: 48.03 m^3/s	June: 29.22 m^3/s
July: 10.20 m^3/s	August: 6.88 m^3/s	September: 8.33 m^3/s

52. Major dams for hydropower generation and irrigation include these of Thisavros (built in 1997) and Platanovrisi (built in 1999) on Nestos River in Greece and the Dospat Dam (on Dospat River – built in 1967) in Bulgaria.

[20] In Bulgaria, these are (reference code in brackets): West Rodopi (BG0001030), Dolna Mesta (BG0000220), Mesta River (BG0001021), Pirin National Park (BG0000209), Alibotush (BG0001028), Rila National Park (BG0000495).
[21] No detailed information has been provided by Bulgaria on the spatial or temporal extent of the underlying observations.

53. Orvilos-Agistros/Gotze Delchev karstic aquifer shared by Bulgaria and Greece (presented in the assessment of the status of the Struma/Strymonas River), extends to and is hydraulically linked with the surface water system of both Mesta/Nestos and Struma/Strymonas Rivers basins (as reported by Bulgaria[22]). According to Greece, the shared aquifer is not hydraulically linked to the surface waters of either basin.

Status, pressures and transboundary impacts

54. When last reported (first assessment) the water quality was “suitable for irrigation and water supply for other users”. In the few years preceding the first assessment, the quality of the Mesta had improved as a result of reduced economic activities (including industrial) and the construction of small local wastewater treatment plants in Bulgaria. Values for a few water-quality determinands in the Mesta River downstream from the city of Hadzhidimovo are shown in Figure 1.

[Figure 1. Annual median concentrations (mg/l) of selected water quality determinands in Mesta River at monitoring station 30064117[23] in Bulgaria. In 2000 and 2005, data were available for twelve months, in 2008 for six. Source: Ministry of Environment and Water, Bulgaria.]

55. Hydro-technical constructions such as dams (serving hydropower generation, irrigation and drinking water supply purposes) and small hydropower stations in the Bulgarian part have caused hydro-morphological alterations and exert pressure to the environment. Diversion of watercourses towards artificial reservoirs used for drinking water supply was reported by Bulgaria. There are water losses due to degraded water conveyance and distribution infrastructure. While drinking water quality is of concern in some areas, action to address related issues has been taken.

Table 22. Mean annual water withdrawal by sector

		Total withdrawal	**Agriculture**	**Domestic**	**Industry**	**Energy**	**Other**
Bulgaria*	2006	9.473×10^6 m^3/year	*21%*	*49%*	*14%*		*17%*
Greece							

*133.909×10^6 m^3/year are used for hydropower production and not included in the above table

[22] Bulgaria expresses uncertainty whether Orvilos-Agistros/Gotze Delchev karstic aquifer should be considered as transboundary. See the section in Struma/Strymonas River basin where the aquifer is described.

[23] 20 basic physico-chemical parameters are being monitored (such as water temperature, BOD, pH, dissolved oxygen, suspended substances, turbidity, conductivity, ammonia, nitrites, nitrates, total phosphorous, phosphates and specific substances as heavy metals, organic pollutions, oils, phenols etc.) The monthly data values for 2000 and 2005 are shown in the first Assessment.

Table 23. Land cover/use (% of the part of the basin extending in each county)

	Lakes / reservoirs	Forests	Cropland	Grassland	Urban / industrial areas	Protected areas	Other forms of land use
Bulgaria	…	39	23.5	…	…	…	25.5*
Greece							

* Shrubs

56. Uncontrolled solid waste disposal in the Bulgarian part had resulted in water pollution hence, potential environmental problems especially in times of heavy precipitation. Measures to address this issue in Bulgaria[24] are being taken.

57. Sand extraction is an issue of concern.

Responses

58. With what concerns institutional arrangements for the management of the water resources at the level of the Mesta/Nestos River basin, the part extending in Bulgaria has been assigned to the West Aegean Basin District while the part extending in Greece has been assigned to the Eastern Macedonia and Thrace Basin District. The Integrated Management Plan for the West Aegean Basin District, in Bulgaria, covers the part of the basin falling within the country's territory.

59. With regard to monitoring in Bulgaria, apart from that described above, new monitoring programmes are established in accordance to the EU WFD. An automatic station on the Mesta/Nestos River, will be established in Bulgaria[25] near the Bulgarian - Greek border by the end of 2009, and measure both water quality and quantity parameters.

Transboundary cooperation

60. Agreements between Bulgaria and Greece touching upon the Mesta/Nestos River basin are those of 1964 and 1971, mentioned in the assessment of the status of the Struma/Strymonas River basin. Besides these, reference should be made to the Agreement that was concluded between Bulgaria and Greece on 22 December 1995 and refers specifically to Mesta/Nestos (additional information about these legal documents can be found in Annex III of document ECE/MP.WAT/2009/8).

61. The existing cooperation framework between the two riparian countries for Mesta/Nestos is linked to the implementation of the EU WFD; integrated water resources management plans are being prepared (the draft plan for the Bulgarian side has already been prepared).

Trends

62. The increase of tourism in the area is followed by increased water consumption needs.

[24] Wastes from all eight municipalities in the river basin are now being collected; about 25 uncontrolled disposal sites were closed and most of them have already been rehabilitated.

[25] In the framework of the PHARE financed "Strengthening of monitoring network of the surface water" project.

V. MARITSA / EVROS / MERIC RIVER BASIN [26]

63. Bulgaria, Greece and Turkey share the basin of the Maritsa/Evros/Meriç River[27].

Table 24. Basin of the Maritsa / Evros / Meriç River

Area[28]	Country	Country's share		Number of inhabitants	Population density (persons/km^2)
52,600 km² ** or 54,206 km² ***	Bulgaria	**35,230 km^2**	62 %*	2,363,273	-
		21,928 (Maritsa sub-basin)		1,613,241****	77
		8,029 (Tundzha sub-basin)		488,296****	62
		5,273 (Arda sub-basin)		261,736****	50
	Greece	**3,685 km²** **	7%**		
		- (Evros sub-basin)			
		- (Ardas sub-basin)			
	Turkey	**14,560 km^2**	27%***	1,033,211*****	71*****
		- (Maritsa sub-basin)		N/A	N/A
		- (Tundja sub-basin)		N/A	N/A
		- (Arda sub-basin)		N/A	N/A

*Based on information provided by Bulgaria **According to the First Assessment ***Based on information provided by Turkey ****2003, ***** 2007

Hydrology and hydrogeology

64. The Maritsa/Evros/Meriç River is about 500 km long, has its source in the Rila Mountain (Bulgaria) and flows in the Aegean Sea. Major transboundary tributaries include the rivers Arda/Ardas[29] (Bulgaria, Greece and Turkey), Tundzha/Tundja[30] (Bulgaria, Turkey) and Biala/Erithropotamos (Bulgaria, Greece). The river Ergene is an important tributary, located in Turkey.

Table 25. Discharge characteristics of the Maritsa/Evros/Meriç River (Monitoring site: Maritsa River, Bulgaria - close to the border with Greece)

Discharge characteristics	Discharge	Period of time or date
Q_{av}	107.92 m^3/s	1961-1998
Q_{max}	204.81 m^3/s	1961-1998

[26] Based on information from Bulgaria, Turkey. References to Greece are based on the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Ministry of Environment, Physical Planning and Public Works/Central Water Agency, Greece and the Ministry of the Foreign Affairs of Turkey.
[27] The river is called Maritsa in Bulgaria, Evros in Greece and Meriç in Turkey.
[28] 53,475km^2 is the total area of the Basin if calculated as the sum of the figures provided by Bulgaria and Turkey corresponding to the areal extent of the basin in the respective territories and the figure corresponding to the areal extent of the basin in Greece according to the First Assessment.
[29] The river is called Arda in Bulgaria and Turkey and Ardas in Greece.
[30] The river is called Tundzha in Bulgaria and Tundja in Turkey.

Q_{min}	43.05 m^3/s	1961-1998
Mean monthly values		
October: 54.84 m3/s	November: 69.01 m3/s	December: 96.61 m3/s
January: 99.76 m3/s	February: 140.66 m3/s	March: 163.11 m3/s
April: 186.99 m3/s	May: 184.89 m3/s	June: 127.38 m3/s
July: 74.17 m3/s	August: 54.73 m3/s	September: 46.72 m3/s

Table 26. Discharge characteristics of the Maritsa/Evros/Meriç River (Monitoring site: Evros-Pythio, Greece)

Discharge characteristics	Discharge	Period of time or date
Q_{av}	383 m3/s	1951-1956
Q_{max}	921 m3/s	1951-1956
Q_{min}	234 m3/s	…

65. The basin has a mountainous character at its upper part; low mountains and mostly plains cover the major part of the basin. The average elevation is 100 m a.s.l.

66. The climatic and geomorphologic characteristics of the basin lead to specific run-off conditions characterized among others by high inter-annual flow variability. Floods in all three sub-basins may cause severe damage in all three countries; among the most disastrous were the floods in 2005 (recurrence interval, 1,000 years), in 2006 and in November 2007.

67. Bulgaria reported that global climate change has affected the basin over the last 20 years, resulting in approximately 30% decrease in precipitation and a subsequent decrease in water resources[31] .

Table 27. Water resources (× 10^6 m^3/year) and water resources per capita (m^3/year)

		Sub-basins			Maritsa/Evros/ Meriç River basin
		Maritsa/Evros/ Meriç	**Arda/Ardas**	**Tundzha / Tundja**	
Bulgaria	Surface water resources	3,403.360*	2,290.302	1,256.778*	6,950.44
	Groundwater resources	1,388.091	157.756	390.778	1,936.625
	Total water resources	4,791.451	2,448.058	1,647.556	8,887.065
	Total water resources per capita	3,000	9,353	3,373	5,242
Greece	Surface water resources				
	Groundwater resources				
	Total water resources				
	Total water resources per capita				

[31] - Measures to improve hydrologic conditions (e.g. forestation), reduce water loses and increase water use efficiency are included in the program of measures of the River Basin Management Plan in Bulgaria; the programme specifically refers to studies to investigate the impact of the climate changes as necessary. No detailed information has been provided by Bulgaria on the spatial or temporal extent of the underlying observations.

		Sub-basins			Maritsa/Evros/ Meriç River basin
		Maritsa/Evros/ Meriç	Arda/Ardas	Tundzha / Tundja	
Turkey	Surface water resources	N/A	N/A	N/A	1,330**
	Groundwater resources	N/A	N/A	N/A	364***
	Total water resources	N/A	N/A	N/A	1,694**
	Total water resources per capita	N/A	N/A	N/A	1,627**
Total	Surface water resources	-	-	-	8,330**
	Groundwater resources	-	-	-	
	Total water resources	-	-	-	
	Total water resources per capita	-	-	-	5,000****

*(1961-1998), **(1986-2005) - Based on information provided by Turkey, ***(1994-2000), **** Based on information provided by Turkey

68. Orestiada/Svilengrad-Stambolo/Edirne (aquifer no. 45) is an aquifer that is strongly linked to the surface waters of Maritsa/Evros/Meriç River basin.

Table 28. Orestiada/Svilengrad-Stambolo/Edirne aquifer

No. 45 Orestiada/Svilengrad-Stambolo/Edirne			**Shared by: Greece, Bulgaria and Turkey**
Type 3, Neogene lake and river alluvial sands, clayey sands, gravels, sandy clays and clays of mean thickness 120 m and maximum 170 m. Dominant groundwater flow is from Bulgaria towards Turkey and Greece. Strong links with surface water systems, with recharge from and discharge towards the rivers Arda/Ardas and Maritsa/Evros/Meriç. Groundwater is 25% of total use.			**Mediterranean Sea Basin** Border length (km):
	Greece	**Bulgaria**[32]	**Turkey**
Area (km^2)	450	712	N/A
Water uses and functions	>75% for irrigation and <25% for drinking water supply, also support ecosystems	Drinking water supply, irrigation, industry, support ecosystems	N/A

69. As reported by Turkey, Evros/Meriç (aquifer no. 52) is an alluvial aquifer shared by Turkey and Greece.

[32] For Bulgaria, the tabled information only refers to the groundwater body identified according to the EU WFD in the porous Neogene formation of Svilengrad-Stambolo (national identification number: BG3G 000000 N 011). Bulgaria reports that in the River Basin Management Plan, the following additional groundwater bodies, connected with Greece and Turkey, are specified: Fissure groundwaters in Ivailovgrad massif (national code BG3G00PtPg2024, surface area 191 km^2); 2) Fissure groundwaters in Svilengrad massif (national code BG3G0000Pg025, surface area 48 km^2); the position of Greece and Turkey is not available in this regard.

Table 29. Evros/Meriç aquifer

No. 52[33] Evros / Meriç		**Shared by: Turkey and Greece ? [34]**
Type 3, Cenozoic, sand, clay, sandstone and siltstone with a mean thickness of 50 m and maximum 400 m with weak links to surface waters (Evros/Meriç and Ergene), groundwater flow from Turkey to Greece.		**Mediterranean Sea Basin** Border length (km):
	Turkey	**Greece**
Area (km^2)	1,538	
Water uses and functions	Agriculture, industry and drinking water	

70. Topolovgrad Massif, shared by Bulgaria and Turkey is a karstic aquifer with medium connections to surface waters of Tundzha/Tundja River sub-basin (see aquifer table no. 46 under Tundzha/Tundja River later in the document).

71. Cooperation among the three countries for the delineation of the boundaries of the transboundary aquifers in the basin and the enhancement of relevant knowledge is necessary. Moreover, Bulgaria suggests that countries should cooperate for the clarification of the stratigraphy of the Orestiada/Svilengrad-Stambolo/Edirne and Evros/Meriç aquifers; as reported, due to the Paleogene aquifer in Svilengrad and Ivailovgrad, it is possible that Evros/Meriç extends also in the territory of Bulgaria.

Status, pressures and transboundary impact

72. The delta of the Maritsa/Evros/Meriç River shared by Greece and Turkey (150 out of the 188 km^2 of the delta lies in the Greek territory) is of major ecological significance. It is one of the most important bird wintering areas in the Mediterranean. A major part of the delta in Greece (100 km^2) has been designated as Ramsar site; it enjoys also the status of Special Protected Area and NATURA 2000 site. Extensive areas in the Bulgarian part of the basin (33%) have been also designated as NATURA 2000 sites. Areas of ecological importance in Turkey are under national protection status. Areas near the delta are used as agricultural land.

[33] This is a new aquifer number as this aquifer did not appear in the First Assessment of Transboundary Rivers, Lakes and Groundwaters.
[34] Based on information from Turkey; the position of Greece is not available in this regard. It is possible that Bulgaria is a riparian country (see the body text).

Table 30. Land cover/use

	Maritsa/Evros/ Meriç River basin			Maritsa / Evros / Meriç River sub-basin			Arda River sub-basin			Tundzha/Tundja River sub-basin	
	Bulgaria	Greece	Turkey	Bulgaria	Greece	Turkey	Bulgaria	Greece	Turkey	Bulgaria	Turkey
Lakes/ reservoirs	183.9 km^2		75 km^2	N/A		N/A	-		N/A	-	N/A
Forests	12,338 km^2		3,203 km^2	N/A		N/A	59 %		N/A	30 %****	N/A
Cropland	10,320 km^2 **		10,074 km^2	N/A		N/A	16.8 %		N/A	36 %****	N/A
Grassland	3,640 km^2 **		873 km^2	N/A		N/A	10 %		N/A	5 %****	N/A
Urban/ industrial areas	1,071 km^2 *		307 km^2	N/A		N/A	2 %		N/A	4 %	N/A
Protected areas	33 % **		285 km^2	N/A		N/A	45 %		N/A	32 %	N/A
Other forms of land use	-		28 km^2	N/A		N/A	-		N/A	-	N/A

2005, 2006 statistics
* 2000, **2005, ***2008, ****2000

Table 31. Mean annual water withdrawal by sector

			Total withdrawal (x 10^6 m^3/year)	Agriculture	Domestic	Industry	Energy	Other
Maritsa / Evros / Meriç River basin	Bulgaria*		2,721.583	-	-	-	-	-
	Greece							
	Turkey	2009	1,352.000	82 %	4 %	13%	0 %	1%
		Projection for 2015	2,000.000	78 %	6%	15%	0 %	1 %
Maritsa / Evros / Meriç River sub-basin	Bulgaria*		2,343.85	51 %	1%	3%	44 %	1 %
	Greece							
	Turkey		N/A	N/A	N/A	N/A	N/A	N/A
Arda/Ardas River sub-basin	Bulgaria	2007	40.114	31 %	20%	37%	- %	12 %
	Greece							
	Turkey		N/A	N/A	N/A	N/A	N/A	N/A

			Total withdrawal (x 10^6 m^3/year)	Agriculture	Domestic	Industry	Energy	Other
Tundzha/ Tundja River sub-basin	Bulgaria*	-	337.619	86%	1%	1%	9%	3 %
	Turkey		N/A	N/A	N/A	N/A	N/A	N/A

* Information for Bulgaria refers to water abstraction from surface waters; the percentages given under energy refer to consumptive uses.

73. The total number of reservoirs in the Bulgarian part is as high as 722. Hydropower production is common in the upper part of the basin, and cascades of dams form big reservoirs.[35] Many small dams are used for irrigation purposes and fish-breeding. In Turkey seven dams and one regulator are under operation on the Ergene River and its tributaries serving irrigation, flood control and some drinking water supply purposes (15 % of drinking water of Edirne and Kırklareli cities is supplied from two reservoirs - Suloglu and Armagan). There are also 53 small dams located on several tributaries used for irrigation. In Greece a number of dams are used for irrigation purposes.[36]

74. Depending on the climatic conditions and the needs, the operation of the dams upstream has a share in the variability of flow. Reduced flows, when they occur, may lead among others to saltwater intrusion.

75. In Bulgaria the operation of small hydropower stations and gravel extraction have led to hydro-morphological changes in the Maritsa, Arda and Tundzha Rivers. Abstraction of groundwater for irrigation and partly for industrial use (textile, food, paper, cement production) in Turkey has led to a decline of piezometric levels of 10-12 m since the 1990's; as a response measure, groundwater abstraction in the Ergene sub-basin has been forbidden.

76. In Bulgaria untreated urban wastewater, is a source of pollution; wastewater collection facilities serve 67% of the population while 30% of wastewaters in the Maritsa sub-basin are treated. Construction of collection and treatment systems is on-going. By magnitude, diffuse sources are the second biggest pressure; 74% of diffuse pollution comes from agriculture. Nitrate pollution in groundwater is one of the effects. Industrial activities in the Bulgarian part (include food production and production of non-ferrous metals and chemicals) may be a potential source of heavy metals as well as organic and nitrogen pollution of local importance. Mining activities at mountainous areas are sources of surface and groundwater as well as sediment pollution; impacts on ecosystems are also possible. There are 12 waste disposal sites in the Bulgarian part; after the construction of 10 new regional disposal sites the operation of the old ones will be terminated.

[35] Big water cascades on Maritsa include: Cascade Vacha (2 dams with 5 hydropower stations), Cascade Batak (5 dams with 3 hydropower stations), Cascade Belmeken-Sestrimo (1 dam reservoir with 4 hydropower stations).
[36] These include those on the rivers Ardas, Lyra, Provatonas, Ardanio and Komara (when last reported –First Assessment- the last was under construction)

77. Untreated domestic wastewater is one of the main pollution sources in Turkey, particularly in the Ergene sub-basin; the river is of Class IV (very polluted water), threatening human health and biodiversity. Both urban wastewater and solid waste volumes have been increased due to population growth. The construction of wastewater treatment plants for municipalities in the basin is expected to improve the situation; these are planned to be completed by 2012. Illegal waste disposal is also a pressure factor; pollution of water from controlled disposal areas was also reported. Industrial development since 1980 has led to the increase of the concentration of related pollutants e.g. in Ergene river; this is linked with illegal wastewater discharges. Unsustainable agricultural practices is an additional pressure factor; these are related to (i) the use of fertilizers and pesticides (resulting in nitrogen, phosphorous, and pesticides pollution) and (ii) inefficient irrigation techniques. Groundwater pollution is the outcome of the aforementioned pressures. Turkey reports that there is loss of biodiversity in some parts of the basin.

78. According to Turkish assessments, the water quality status of the Meriç River is of Class III (polluted water) both at the point where it enters the territories of Turkey[37] (and Greece since it is the beginning point of the boundaries of the two countries) and at its mouth at the Aegean Sea. Tundja is reported as of Class IV with regard to heavy metals, at the point entering Turkey.

Response measures

79. In Bulgaria the monitoring network include 27 stations for surveillance monitoring and 48 for operative monitoring (quality monitoring is performed). Hydrological parameters are planned to be monitored in 25 stations. In Turkey, monitoring of water quality is carried out periodically at five monitoring stations on the Meriç, one on the Arda, and one on the Tundja Rivers since 1979. Cooperation between the competent authorities of Bulgaria and Turkey has led to the establishment of four telemetry hydrometric stations in the Bulgarian part (one on each of the Arda and Tundzha/Tundja Rivers and two on the Maritsa/Meriç River) that supply real time data.

80. Bulgaria works for the update of hydrological data, mapping of the sensitive areas and creating of a hazard map. As the downstream countries, Turkey and Greece are highly vulnerable to floods, it is evident that measures for flood prevention can only be improved and their effects be mitigated through cooperation and use of common information sources. Joint development and establishment of integrated information systems such as flood forecasting/early warning systems is essential. The cooperation between Bulgaria and Turkey[38] in this regard, provides a basis for further action. The broadening of the scope of related activities in the future to include also Greece is deemed necessary. The use of better dam operation techniques and rules can considerably mitigate floods.

[37] According to water quality monitoring results at Ipsala water station (Turkey) – quality monitoring has been carried out since 1979 in this station.
[38] PHARE project Technical Assistance for Flood Forecasting and Early Warning System - "Capacity Improvement for Flood Forecasting in the BG-TR CBC Region" project.

81. The operation of the dams should be carried out in a coordinated manner among the riparian countries in accordance to the upstream-downstream needs and considerations; the need to preserve the natural values of the delta area should also be taken into account.

82. The implementation of good agricultural practices and the establishment of buffer zones are response measures taken in Bulgaria to address diffuse pollution from agriculture. There is a need for restoration of the existing irrigation infrastructure.

83. In Turkey, the development plans for the Meriç-Ergene basin integrates up to a point the development strategies in water related sectors. There is no conjunctive management of surface water and groundwater. The Protection Action Plan for Meriç-Ergene basin (2008) assesses the effects of development projects and economic activities on the environment and provides for a short, medium and long term action plan in terms of water resources management. There is also a land use plan for the Meriç-Ergene basin.

84. The respective parts of the Maritsa/Evros basin are within the East Aegean Basin District in Bulgaria and the Eastern Macedonia and Thrace District in Greece; there is a management authority and a basin council in each of these Basin Districts.

85. An Integrated Management Plan for the East Aegean Basin District (Bulgaria) is expected to be finalized until the end of 2009. As reported, stakeholder involvement activities have been implemented in this regard. Water demand management measures in Bulgaria include water abstraction control.

Transboundary cooperation

86. Existing bilateral agreements and cooperation in the basin cover issues of flood protection (in the river Tundzha/Tundja) and joint infrastructure projects as well as general environmental cooperation including conservation of protected areas. A reference should be made to the 1975 and 1993 agreements between Bulgaria and Turkey; the 1964 and 1971 agreements between Bulgaria and Greece; and the 1934 agreement between Greece and Turkey (more information can be found in Annex III of document ECE/MP.WAT/2009/8). There is communication between Bulgaria and Turkey regarding the possible construction of the Suakacagi dam on the Tundzha/Tundja River at the border between the two countries, aiming to address flood issues. The major part of the construction would extend to the Bulgarian territory.

87. Building on the existing bilateral cooperation arrangements, the establishment of a cooperation mechanism in the whole basin, involving all three riparian countries, should be considered. Transboundary initiatives that touch upon issues of transboundary concern e.g. ecosystems and biodiversity may provide the enabling environment for the initiation of an inter-basin dialogue in this regard. The on-going cooperation process between Bulgaria and Turkey to limit and prevent floods and their damaging effects provide an additional “entry point” for the enhancement of cooperation; Greece, should be included as appropriate. A coordination structure including the experts of three riparian countries may be considered as an initial step.

VI. ARDA/ARDAS RIVER[39]

88. Bulgaria, Greece and Turkey share the sub-basin of the river Arda/Ardas. The Arda/Ardas has its source in the Rodopi Mountains (Bulgaria) and discharges into the Meriç River. The Aterinska River is a tributary shared by Bulgaria and Greece.

Table 32. Discharge characteristics of the Arda/Ardas River at the boundary gauging station in Bulgaria

Discharge characteristics	Discharge	Period of time or date
Q_{av}	72.63 m^3/s	1961-1998
Q_{max}	148.63 m^3/s	1961-1998
Q_{min}	27.61 m^3/s	1961-1998
Mean monthly values		
October: 23.03 m^3/s	November: 60.34 m^3/s	December: 129.21 m^3/s
January: 114.72 m^3/s	February: 154.94 m^3/s	March: 126.03 m^3/s
April: 100.41 m^3/s	May: 71.91 m^3/s	June: 47.37 m^3/s
July: 22.51 m^3/s	August: 11.50 m^3/s	September: 10.95 m^3/s

89. The sub-basin has a pronounced mountainous character with an average elevation of 635 m a.s.l.

Status, pressures and transboundary impact

90. Dams are common for the Arda/Ardas sub-basin; 100 are located in Bulgarian territory. The largest serve multiple purposes: energy production, irrigation, industrial and drinking water supply. Flow regulation is a pressure factor resulting in hydromorphological changes; the change in the water temperature due to the construction of the big dams has had an impact on the macrozoobenthos in the downstream section of Arda in Bulgaria. In Greece a dam was build close to the border with Bulgaria to regulate discharge from the Ivailovgrad Dam (Bulgaria); water from the reservoir also covers irrigation needs.

91. Non-treated urban wastewater, waste disposal and animal breeding are pressure factors in the Bulgarian part of the basin resulting in pollution, having impacts on the ecosystem; the impacts are reported by Bulgaria to be of local importance. Eutrophication has been observed at the reservoirs of the (big) dams Kardgali, Studen kladenez and Ivailovgrad. Nitrogen and organic pollution is expected to be reduced since the sewerage system is being extended, now connecting

[39] Based on information from Bulgaria and Turkey. References to Greece are based on the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Ministry of Environment, Physical Planning and Public Works/Central Water Agency, Greece and the Ministry of the Foreign Affairs of Turkey.

67% of the population. There are 3 new municipal wastewater plants and a new one is under construction.

92. Mining activities have a local but important impact due to heavy metals contained in the discharges from mines. Five tailing ponds containing mining waste are potential sources of pollution. Industrial activities in the area are possible sources of heavy metals and organic (impact of local importance) pollution.

93. There are nine waste disposal sites in the Bulgarian part; a regional disposal site is under construction.

VII. TUNDZHA/TUNDJA RIVER[40]

94. Bulgaria and Turkey share the sub-basin of Tundzha/Tundja which has its source in the Stara Planina Mountain (Bulgaria) and flows into the Meriç River. Fishera River is a tributary shared by Bulgaria and Turkey. Topolovgrad Massif is an aquifer that is shared by the two countries.

Table 33. Discharge characteristics of the Tundzha River at the boundary gauging station (Bulgaria)

Discharge characteristics	Discharge	Period of time or date
Q_{av}	32.09 m^3/s	1961-1998
Q_{max}	69.36 m^3/s	1961-1998
Q_{min}	18.81 m^3/s	1961-1998
Mean monthly values		
October: 12.93 m^3/s	November: 21.89 m^3/s	December: 32.82 m^3/s
January: 38.40 m^3/s	February: 57.87 m^3/s	March: 61.70 m^3/s
April: 53.23 m^3/s	May: 46.85 m^3/s	June: 28.09 m^3/s
July: 12.94 m^3/s	August: 10.29 m^3/s	September: 9.94 m^3/s

Source: Ministry of Environment and Water, Bulgaria.

[40] Based on information from Bulgaria, Turkey and the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Ministry of Foreign Affairs of Turkey.

Table 34. Topolovgrad Massif aquifer

No. 46 Topolovgrad Massif [41]		**Shared by: Bulgaria and Turkey**
Type 2 according to Turkey, Type 1 according to Bulgaria, Triassic and Jurassic karstic limestones, dolomites, marbles, schists, in a narrow synclinal structure with complicated, faulted block structure, medium links with surface water systems. Dominant groundwater flow direction: from W-SW to E-NE towards Turkey. Proportion of groundwater in total water use is not known.		**Mediterranean Sea Basin** Border length (km):
	Bulgaria	**Turkey**
Area (km^2)	315	N/A
Water uses and functions	25 - 50% Drinking water supply, < 25% each for irrigation and livestock, maintaining baseflow and springs and support of ecosystems	N/A
Note	Bulgaria expresses uncertainty whether the aquifer should be considered as transboundary as the state border between Bulgaria and Turkey is located in an area where the aquifer extends along the local watershed divide, therefore the groundwater flow is suspected not to cross the state border, but divided to the North in Bulgaria, and to the South in Turkey. It should be noted, though, that karstic aquifer flow systems are difficult to characterize and the groundwater divide does not necessarily coincide with the topographic divide	

Status, pressures and transboundary impact

95. There are 264 dams located in the Bulgarian part. The larger dams/reservoirs serve multiple purposes: energy production, irrigation, industrial and drinking water supply. There are four hydropower stations and three thermal power plants.

96. Eutrophication in the reservoirs of the big dams in Bulgaria as well as nitrate pollution of groundwater, in the middle part of the basin, has been observed. Among pollution sources, wastewater discharge from municipalities and industry ranks in the first place, followed by diffuse pollution (78% of diffuse pollution comes from agriculture). It is reported that measures for the improvement of the situation are taken e.g. wastewater treatment plants are being constructed. The sewerage system currently serves 31% of the population in the Bulgarian part while wastewater treatment plants treat 11% of the urban wastewaters. There are 6 waste disposal sites in the Bulgarian part.

[Figure 2. Map of main dams in the Arda/Ardas and Tundja/Tundzha rivers]

[41] Based on information from the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Basin Directorate for the Black Sea Region, Bulgaria.

VIII. TRANSBOUNDARY AQUIFERS WHICH ARE NOT CONNECTED TO SURFACE WATERS ASSESSED IN THE SEE ASSESSMENT (OR INFORMATION CONFIRMING A CONNECTION HAS NOT BEEN BY PROVIDED BY THE COUNTRIES CONCERNED

A. PELAGONIA- FLORINA/BITOLSKO AQUIFER

Table 35. Pelagonia- Florina/Bitolsko Aquifer

No. 40 Pelagonia- Florina/Bitolsko 42		**Shared by: Greece and the former Yugoslav Republic of Macedonia**
According to the riparian countries represents none of the illustrated transboundary aquifer types;, Quaternary and Neogene unconfined shallow alluvial sands and gravels with some clay and silt and cobbles, with confined Pliocene gravel and sand aquifer, total thickness average 60 m and up to 100 - 300 m overlying Palaeozoic and Mesozoic schists, medium links to surface waters, groundwater flow from Greece to the former Yugoslav Republic of Macedonia. Groundwater is more than 50% of total use		**Mediterranean Sea Basin** Border length (km): 45 ?
	Greece	**The former Yugoslav Republic of Macedonia**
Area (km^2)	180	N/A
Water uses and functions	25-50% irrigation, <25% each for drinking water supply, industry and livestock, also support of ecosystems	Drinking water supply, support of ecosystems and agriculture and maintaining baseflow and springs

97. Agriculture is a pressure factor in Greece; there is local and moderate reduction of borehole yields observed. In the former Yugoslav Republic of Macedonia widespread and severe increase of pumping lifts has resulted in reduction of borehole yields, local but severe reduction in baseflow and spring flow and degradation of ecosystems.

98. Nitrate and heavy metals are present in the Greek side of the aquifer while nitrogen, pesticides, heavy metals, pathogens, industrial organic compounds and hydrocarbons are present in the part that extends to the former Yugoslav Republic of Macedonia. Polluted water is drawn into the aquifer in both countries.

99. According to both countries, there are no transboundary impacts.

100. In Greece, the implementation of appropriate management measures are planned or already implemented in accordance to the EU WFD; monitoring, vulnerability mapping for land use planning and wastewater treatment are needed.

101. Necessary measures in the former Yugoslav Republic of Macedonia include increased efficiency of groundwater use, monitoring of quantity and quality, protection zones, vulnerability

[42] Based on information from the First Assessment of Transboundary Rivers, Lakes and Groundwaters – for which information had been provided by the Institute of Geology and Mineral Exploration and the Central Water Agency, Greece, and the Ministry of Environment and Physical Planning, the former Yugoslav Republic of Macedonia.

mapping, good agricultural practices and public awareness; treatment of industrial effluents need to be improved while other measures are planned.

102. According to the former Yugoslav Republic of Macedonia exchange of data between the two countries need to be improved.
