

CHAPTER 8

THE MASTER PLAN



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8.1 Rationale and Objectives

Stable and safe water supply is essential for improving the living conditions of the people in Macedonia, where droughts have happened and caused various negative impacts almost everywhere and in each of the past 10 years. In addition, this country has been in a transition period to cope with the democratic system and market-oriented economy since its independence in 1991 with the final goal of joining the European Union; "water" is one of the precious resources for reestablishment of the economic potentials in the agricultural and industrial sectors. Substantial investments were made in the development of water resources, however, a more integrated approach is required for the optimum utilization of the limited water resources in Macedonia.

In order to meet the requirement, the Master Plan has been formulated, of which process is explained in Chapter 7, on the purpose of giving the comprehensive scope of effective and sustainable water resources development in Macedonia.

8.2 Components

The Master Plan consists of the two components: (1) a water resources development plan and (2) a water resources management plan.

The water resources development plan proposes the development strategy for the facility construction and rehabilitation as well as development projects allocated into the three phases with dividing the national area into the five regions including 1) the Vardar River upper reach, 2) the Vardar River middle reach, 3) the Vardar River lower reach, 4) the Crn Drim River, and 5) the Strumica River.

The water resources management plan proposes reinforcement and establishment of an efficient and effective management system for the development projects as well as the commissioned projects to bring out the best of the projects effects, consisting of 1) the water quality conservation plan, 2) the watershed conservation plan, 3) the surface water and groundwater monitoring system improvement plan, 4) the water-related facilities operation and maintenance improvement plan, 5) the institutions and legal system strengthening plan, and 6) the human resources development plan.

8.3 Water Resources Development Plan by River Basin

8.3.1 Water Resources Development Plan in Vardar River Upper Reach

(1) Strategy for Development

The region of the Vardar River upper reach consists of river basins of the Vardar

main stream, a tributary on the right bank side - the Treska river, a tributary on the left bank side - the Pchinja river and its sub-tributary on left bank side-the Kriva River. The catchment area occupies 33% of the whole land and 56% of the population live in the region. In the Skopje metropolitan and its surrounding area, there are factories of light industry like food & beverage, pharmacy, textile, leather, tobacco, chemistry, and heavy industry of metallurgy and metal, which use approximately 60% of the industrial water in the country. On the other hand, water is demanded for production of self-efficiency crops such as wheat, maize, vegetable, etc. in the Polog irrigation system (15,000 ha) situated on the left bank side of the Vardar River upper reach and Lipkovo irrigation system (20,000 ha) situated in the basin of the Pchinja River. Livestock water is also demanded in the Lipkovo irrigation area.

The Vardar River upper reach is located in the west/central-north of the country with relatively high rainfall, while the basin of the Pchinja River located in the east/northeast of the country has small rainfall.

The region has experienced droughts almost every year from the end of 1980s to the present, suffering from seasonal water shortage due to limited rainfall in the dry season in summer as well as freezing in the winter season. In addition, wastewater discharged from households, factories and livestock farms pollutes water in the rivers and wells, which causes social concerns for safe drinking water and environment impact. Recently, people in the rural area migrate into the urban area, resulting in overpopulation in Skopje metropolitan and depopulation in villages in the rural area. To cope with this trend, the rural area must improve the level of satisfying Basic Human Needs (BHN) and living conditions, make rural communities active, and promote return to home villages. Further, it is needed to secure water for municipal, industrial and agricultural use as well as the Vakuf irrigation system (22,000 ha) planned to be newly developed for the production increase around 2015. It is also necessary to utilize the facility of multipurpose projects, which are likely to be realized in future, for a hydroelectric power generation with installation of small hydro system, and so on.

Considering these backgrounds and needs in the region, the following development direction was established:

- 1) Firstly, to develop water resources with installation of water supply network to deal with water shortage for municipal and industrial use in the Skopje metropolitan and its surrounding area
- 2) Secondly, to develop rural water supply facilities for a purpose of contribution to BHN satisfaction, improvement of living conditions, activation of rural communities and promotion of returning to home villages
- 3) Thirdly, in parallel with 2), to improve the existing irrigation system to deal

with seasonal shortage of agricultural water through increase of irrigation efficiency

- 4) Fourthly, to develop water resources with irrigation system for a purpose of securing water to the Vakuf irrigation system planned to be developed newly for the production increase around 2015
- 5) Fifthly, though it is rather an accompaniment, to construct a small-size and environmental-friendly hydroelectric power station in the facility of multipurpose projects to be developed for a purpose of well utilization of the facility as well as reduction of fossil fuel consumption for thermal power plants

Further,

- 6) In parallel with 1), to protect rivers and wells from water pollution due to wastewater from households and factories

To meet the development directions above, development projects were identified and selected for the project evaluation. As a result, the strategy of development in the region was formulated as follows by water use purpose and phasing.

- 1) To secure municipal water, development of projects which are expected to have good results after implementation, relatively small size and mostly ready to be implemented in PHASE I. Projects that need further investigation and study, or high investment cost will be developed by the end of PHASE II.
- 2) To secure agricultural water, improvement of the existing small size irrigation system for a purpose of increase of irrigation efficiency in PHASE I. The existing rather large size irrigation system and projects, which are expected to have high contribution to the local society after implementation, will be developed in PHASE II. Other projects than above will be developed in PHASE III.
- 3) To secure industrial water, same strategy as municipal water is applied.
- 4) Some projects included in the development plan are small hydroelectric plan. They are rather accompaniment with low priority in the energy sector, and hence will be developed in PHASE III.

(2) Development of Projects

From the above, the following 15 projects are proposed to be developed as the development plan in the region (See Figure 8.1).

Proposed Projects in Vardar River Upper Reach

PHASE	Project Name (No.)	Purpose/ Supply of
I	1) Water Supply Project for Tetovo – River Pena Intake (1)	1) M&I
	2) Kichevsko Pole Area Irrigation System Rehabilitation Project (2)	2) RI
	3) Patishka Reka Water Supply Project (3)	3) M
	4) Slupchanka Dam Project (4)	4) M
	5) Treska Upper Reach Rural Water Supply Project (34)	5) RS
	6) Skopje Circle Rural Water Supply Project (35)	6) RS
	7) Kriva Palanka/Kumanovo Circle Rural Water Supply Project (36)	7) RS
II	1) Studena Voda Groundwater Development Project (9)	1) M
	2) Paligrad Multipurpose Dam Development Project (10)	2) M&I,A,P
	3) Lipkovo – Glaznja Area Irrigation Rehabilitation Project (11)	3) RI
	4) Kiselichka Dam Project (12)	4) M&I,A
	5) Vakuf Multipurpose Dam Development Project (13)	5) M&I,A,P
	6) Vardar Upper Reach Rural Water Supply Project (38)	6) RS
III	1) Construction of By-pass Channel Raven – Rechica (23)	1) A
	2) Pelince Dam Project (24)	2) A

(M : Municipal Water, I : Industrial Water, A : Agricultural Water, RI : Improvement/Rehabilitation of Existing Irrigation System, P : Hydroelectric Power Generation Water, RS : Rural Water Supply)

Prevention from water pollution is included in the water quality conservation plan in the water resources management plan (See Subsection 8.4.1).

Seven projects proposed in PHASE I are featured as follows:

- 1) **The Water Supply Project for Tetovo – River Pena Intake (1)** is sited at the west of Tetovo, which is located in the western part of the country, suffering from water shortage in summer as well as due to freezing in winter. The Pena River, originated from the western mountainous area, flows through the town of Tetovo collecting clean water from such high summit as Popova Shapka and finally joins to the Vardar River. This project targets to supply municipal and a part of industrial water to Tetovo with a capacity of 200 l/sec of intake. The intake is to be constructed on the river at around an altitude of 500 m a.s.l and through a supply pipeline with diameter and length of approximately 400 mm and 10km, respectively. After the implementation of the project, the water shortage problem in/around Tetovo will be solved with such expectation as improvement of health conditions of people, enjoying of civilized living, activating the activities in the local industries like manufacturing, commercial and service sectors, and so on. An increase of water demand is forecasted for municipal and industrial water in Tetovo area. A feasibility study is required to be combined with the Studena Voda Groundwater Development Project (Project No. 9 in the Water Resources Development Plan) so as to meet the future demand as recommended in Chapter 9.

- 2) **The Kichevsko Pole Area Irrigation Rehabilitation Project (2)** is sited at the upper reach of the Treska river-a right bank tributary of the Vardar River. This project targets to rehabilitate the existing irrigation system with an area of 1,500 ha. It is reported that irrigation area supplied with water covers approximately 40% of the existing irrigation area in the whole country, which is presumed to be applied to the project area through site inspection, etc. After the rehabilitation, the irrigation area supplied with water will increase, resulting in increase of cash crop such as fruits, vegetable, etc., which will bring about growth of income, improvement of living conditions of people, settlement in the area, activation of the activities in the region, and so on.
- 3) **The Patishka Reka Water Supply Project (3)** is sited on the east-south suburb of the Skopje metropolitan. The area is blessed with natural environment and people living there can work in Skopje daily. The area has little water sources because of underflow of surface water through karst, that accelerates migration from the area to Skopje. As a result, Skopje has overpopulation exerting such influence as seasonal water shortage as well as increase of an unemployment rate, while the area was devastated due to depopulation in the mountainous area. After the project for water supply with the planning of 80 l/sec (equivalent to water supply volume for inhabitants of 27,000) to the Skopje metropolitan, the present seasonal water shortage in the east/east-south parts of Skopje will be dealt with. In future a large scale multipurpose dam project like Paligrad will be realized, the surplus water taken from Patishka Reka can be supplied to the rural area including 13 villages with inhabitants of approximately 11,000 sited between the intake and Skopje. Then, it will be expected settlement in the rural area, promotion of returning to their home villages, protection of the area from the devastation as well as watershed conservation, promotion of agricultural production, activation of the activities in the region, keeping up of a scene, green tourism for people living in the urban area to refresh at a weekend, and so on.
- 4) **The Slupchanka Dam Project (4)** targets drinking water supply to Kumanovo area, which is suffering from seasonal water shortage because of increase of population in recent years. Kumanovo is located in the northeast of Skopje and the second largest city after Skopje. Water-related problems in Kumanovo include water pollution. After the project for water supply with the planning of 260 l/sec in summer season (equivalent to water volume for 90,000 persons per day), drinking water will be supplied to inhabitant approximately 100,000 in summer season and water shortage problem will be mostly settled.

Accordingly, it is expected improvement of health conditions of people, enjoying of civilized living, activation of the activities in the region, and so on.

- 5) **The Treska River Upper Reach Rural Water Supply Project (34)** targets to supply drinking water to rural areas scattered in the upper reaches of the Treska - a right bank tributary of the Vardar River. The beneficiary there is estimated approximately at 15,300 living in 72 villages in 1997. After the project, it is expected keeping of access to safe water, reduction of waterborne diseases, improvement of health condition of inhabitants, protection of the area from the devastation as well as watershed conservation in the mountainous area, activation of the activities in the region, green tourism for people living in the urban area to refresh at a weekend, and so on.
- 6) **The Skopje Circle Rural Water Supply Project (35)** targets to supply drinking water to rural areas scattered in the hilly/mountainous suburbs of the Skopje metropolitan including the Petrovec area. The beneficiary is estimated approximately at 37,300 living in 62 villages in 1997. After the project, it is expected keeping of access to safe water, reduction of waterborne diseases, improvement of health condition of inhabitants, protection of the area from the devastation as well as watershed conservation in the mountainous area, activation of the activities in the region, green tourism for people living in the urban area to refresh at a weekend, and so on.
- 7) **The Kriva Palanka/Kumanovo Circle Rural Water Supply Project (36)** targets to supply drinking water to the rural areas scattered in the upper reaches of the Kriva River, which originates in the eastern mountainous area and joins the Pchinja River - a left bank tributary of the Vardar River. The beneficiary is estimated approximately at 34,800 living in 97 villages in 1997. After the project, it is expected keeping of access to safe water, reduction of waterborne diseases, improvement of health condition of inhabitants, protection of the area from the devastation as well as watershed conservation in the mountainous area, activation of the activities in the region, green tourism for people living in the urban area to refresh at a weekend, and so on.

8.3.2 Water Resources Development Plan in Vardar River Middle Reach

(1) Strategy for Development

The region of the Vardar River middle reach consists of river basins of the Vardar main stream and a tributary on the left bank side-the Bregalnica River. The catchment area occupies 23% of the whole land and 13% of the population live in the Vardar River middle reach. In/around Veles along the Vardar main stream,

there exist factories of light industry like food and beverage, textile and chemistry, and heavy industry of metallurgy, which use approximately 20% of the industrial water in the country. On the other hand in the basin of the Bregalnica River, more water is demanded than that for light industry like textile, leather, etc. and mining, for production of self-efficiency crops such as wheat, maize, vegetable, etc. as well as paddy, grape, plum in the Bregalnica irrigation system (32,000 ha). Livestock water is also demanded in the Bregalnica irrigation system.

The Vardar River middle reach is located in the central/south/east of the country with little rainfall.

The Vardar River middle reach has experienced droughts of which intensity exceeded more or less those in the past almost every year from the end of 1980s to the present, suffering from seasonal/all the year water shortage due to limited rainfall in the dry season in summer. Such water shortage, in addition to wastewater discharged from households, factories and livestock farm, pollutes water in the rivers and wells, which causes social concerns to the safe drinking water and environmental impact. Recently, depopulation in villages in the rural area progresses and it is required for the rural area to improve the level of satisfying BHN and living conditions, to make rural communities active, and to promote returning to home villages. Further, it is also necessary to utilize the facility of multipurpose projects to be developed effectively, say, for a hydroelectric power generation with construction of small hydro system in the facility, and so on.

Considering these background and needs in the region, the following development direction was established:

- 1) Firstly, to develop water resources with installation of water supply network to deal with seasonal/all the year water shortage for municipal and industrial use in the municipalities like Shtip, Kochani, etc. along the Bregalnica River
- 2) Secondly, to develop water resources with irrigation system for a purpose of securing agricultural water to the Bregalnica irrigation system
- 3) Thirdly, to develop rural water supply facilities for a purpose of contribution to BHN satisfaction, improvement of living conditions, activation of rural communities and promotion of returning to home villages
- 4) Fourthly, in parallel with 3), to protect rivers and wells from water pollution due to wastewater from households, factories, fertilized irrigation area and livestock farm
- 5) Fifthly, though it is rather an accompaniment, to construct a small-size

and environmental-friendly hydroelectric power station in the facility of multipurpose projects to be developed from now on for a purpose of well utilization of the facility as well as reduction of waste of fossil fuel consumed in thermal power plants

To meet the development directions above, development projects were identified and selected for the project evaluation. As a result, the strategy of development in the region was formulated as follows by water use purpose and phasing:

- 1) To secure municipal water, development of a project which was started partly with expectation of high contribution to the local society after implementation and with documentation though some review will be needed in PHASE I. Projects, which are small size and mostly ready to be implemented, are included in PHASE II. Projects, which are ranked low in the project evaluation, are included in PHASE III.
- 2) Regarding agricultural water, no project is proposed in PHASE I to be implemented with so good results. It is proposed, through the water resources management plan, to improve the existing irrigation system for a purpose of increase of the irrigation efficiency. Projects, which form a part of the multipurpose plans of documentation and are ranked around the middle in the project evaluation, are included in PHASE II. Other projects than above with low ranking in the project evaluation are included in PHASE III.
- 3) To secure industrial water, same strategy as municipal water is applied.
- 4) Some projects included in the development plan are small hydroelectric plans. They are rather accompaniment with low priority in the energy sector, and hence will be developed in PHASE III.

(2) Development of Projects

From the above, the following six projects are proposed to be developed as the development plan in the region (See Figure 8.1).

Proposed Projects in Vardar River Middle Reach

PHASE	Project Name (No.)	Purpose/ Supply of
I	1) Zletovica Multipurpose Dam Development Project (5)	1) M&I
II	1) Razlovci Dam Project (14) 2) Rechani Multipurpose Dam Development Project (15) 3) Construction of Irrigation of Sub-system "Shtipsko Pole", left side (16) 4) Beregalnica River Basin Rural Water Supply Project (39)	1) M&I,A 2) M&I,P 3) A 4) RS
III	1) Blatec Dam Project (25)	1) M&I,A

(M : Municipal Water, I : Industrial Water, A : Agricultural Water, RI : Improvement/Rehabilitation of Existing Irrigation System, P : Hydroelectric Power Generation Water, RS : Rural Water Supply)

Prevention from water pollution is included in the water quality conservation plan in the water resources management plan (See Subsection 8.4.1).

One project proposed in PHASE I is featured as follows:

- 1) **The Zletovica multipurpose dam development project (5)** is sited in the upper reach of the Zletovska river - a right bank tributary of the Bregalnica river - a left bank tributary of the Vardar River about 80 km east of Skopje. This project targets (1) to supply municipal and industrial water to Kratovo, Probishtip, Shtip and Sveti Nikole for population of approximately 100,000 from an intake dam to be constructed on the river at around an altitude of 1,000 m a.s.l, (2) to supply water to newly developed irrigation system of 3,100 ha, and (3) power generation of 56.4×10^6 kWh per annum. In the region, Shtip and Probishtip are suffering from water shortage through the year, with water pollution resulting in occurrence of waterborne diseases. After the implementation of the project, water shortage problem will be solved with such expectation as improvement of health conditions of people, enjoying of civilized living, activation of the region, increase of agricultural production, supply of clean energy and reduction of utilization of fossil fuel consumption, and so on.

8.3.3 Water Resources Development Plan in Vardar River Lower Reach

(1) Strategy for Development

The region of Vardar River lower consists of river basins of the Vardar main stream and a tributary on the right bank side-the Crna River. The catchment area occupies 28% of the whole land and 16% of the population live in the region. Along the Vardar main stream and in/around Pelagonija located at the upper reach of the Crna River, there are factories of light industry like food and beverage, and tobacco, and heavy industry of metal, which use approximately 17% of the industrial water in the country.

On the other hand, water is demanded for production of self-efficiency crops such as wheat, maize, vegetable, etc. as well as fruit and grape in the Tikvesh irrigation system (20,000 ha) situated on the right bank side of the Vardar River lower reach and the Crna River lower reach. Further, irrigation water is demanded for production of self-efficiency crops such as wheat, maize, vegetable, etc. as well as export product like fresh vegetable and grape in the irrigation system situated around the most lower reach of the Vardar River in the Macedonia territory and near the border with Greece where small and middle size systems are scattered with an area of 9,000 ha in total. In Pelagonia the water is demanded for production of self-efficiency crops such as wheat, maize, vegetable, etc. as well as tobacco in the Prilep irrigation system (6,000 ha) and the Strezevo irrigation

system (20,000 ha).

The Vardar River lower reach is located in the central southwest/east of the country with small rainfall.

The region has experienced droughts of which intensity exceeded more or less those in the past almost every year from the end of 1980s to the present, suffering from seasonal/all the year water shortage due to limited rainfall in the dry season in summer.

Such water shortage, in addition to wastewater discharged from households and factories, polluted water in the rivers and wells, which causes social concerns to the safe drinking water and environmental impact. Recently, depopulation in villages in the rural area progresses and it is required for the rural area to improve the level of satisfying BHN and living conditions, to make rural communities active, and to promote returning to home villages. Further, it is needed to secure water for agricultural use in the Buchin irrigation system (27,000 ha) planned to be newly developed for production increase around 2025.

Considering these background and needs in the region, the following development direction was established:

- 1) Firstly, to increase irrigation efficiency through improvement of the existing irrigation system to deal with seasonal water shortage in the irrigation system situated along the lower reach of the Vardar main stream
- 2) Secondly, to develop rural water supply facilities for a purpose of contribution to BHN satisfaction, improvement of living conditions, activation of rural communities and promotion of returning to home villages sited in rural area around Pelagonija
- 3) Thirdly, to develop water resources with installation of water supply network to deal with water shortage for municipal and industrial use in the urban/rural area situated on both banks of the lower reach of the Vardar main stream
- 4) Fourthly, to develop water resources with irrigation system for a purpose of securing water to the Buchin irrigation system planned to be developed newly for production increase around 2025

Further,

- 5) In parallel with 3) to prevent rivers and wells from water pollution due to wastewater from households and factories

To meet the development directions above, development projects were identified and selected for the project evaluation. As a result, the strategy of development in the region was formulated as follows by water use purpose and phasing:

- 1) To secure municipal water, development of a rural water supply project urgently will be needed in PHASE I. Projects, which are small size and expected to have high contribution to the local society after implementation, will be developed in PHASE II including a rural water supply project. Projects, which need further investigation and study, are included in PHASE III
- 2) To secure agricultural water, improvement of the existing small size irrigation system will be required for a purpose of increase of irrigation efficiency in PHASE I. Projects, which form a part of the multipurpose plans of documentation, are included in PHASE II. Projects, which need further investigation and study, are included in PHASE III.
- 3) To secure industrial water, same strategy as municipal water is applied.
- 4) No project is proposed for power generation.

(2) Development of Projects

From the above, the following 13 projects are proposed to be developed as the development plan in the region (See Figure 8.1).

Proposed Projects in Vardar River Lower Reach

PHASE	Project Name (No.)	Purpose/ Supply of
I	1) Valandovo Area Irrigation System Rehabilitation Project (6)	1) RI
	2) Pelagonija Rural Water Supply Project (37)	2) RS
II	1) Studencica Supplemental Water Supply Project (17)	1) M&I
	2) Kovansko Dam Project (18)	2) A
	3) Konsko Dam Project (19)	3) M&I,A
	4) Vardar River Lower Reach/Strumica River Basin Rural Water Supply Project (40)	4) RS
III	1) Krapa Dam Project (26)	1) M&I,A
	2) Zhan Dam Project (27)	2) A
	3) Obedenic Dam Project (28)	3) A
	4) Kochishte Dam Project (29)	4) A
	5) Zhurche Dam Project (30)	5) A
	6) Konjarka Dam Project (31)	6) A
	7) Petrushka Dam Project (32)	7) A

(M : Municipal Water, I : Industrial Water, A : Agricultural Water, RI : Improvement/Rehabilitation of Existing Irrigation System, RS : Rural Water Supply)

Prevention from water pollution is included in the water quality conservation plan in the water resources management plan (See Subsection 8.4.1).

Two projects proposed in PHASE I are featured as follows:

- 1) **The Valandovo Area Irrigation Rehabilitation Project (6)** is sited In the lower reach of the Vardar River. This project targets to rehabilitate the existing irrigation system with an area of 3,600 ha. As described

above, it is reported that irrigation area supplied with water covers approximately 40% of the existing irrigation area in the whole country, which is presumed to be applied to the project area through site inspection, etc. After the rehabilitation, the irrigation area supplied with water will be increased, resulting in increase of cash crop such as fruits, vegetable, etc., which will bring about increase of income, improvement of living conditions of people, activation of the activities in the region, and so on.

- 2) **The Pelagonija Rural Water Supply Project (37)** targets to supply drinking water to rural areas scattered in the hilly/mountainous suburbs on the Pelagonijan field including Medzitlija area where some parts suffer from water shortage. The beneficiary is estimated approximately at 23,600 people in 142 villages in 1997. After the project, it is expected keeping of access to safe water, improvement of health condition of inhabitants, protection of the area from the devastation as well as watershed conservation in the mountainous area, activation of the activities in the region, and so on.

8.3.4 Water Resources Development Plan in Crn Drim River Basin

(1) Strategy for Development

The region of Crn Drim River basin consists of river basins of the Crn Drim main stream flowing out from Lake Ohrid and the basin of Lake Prespa. The catchment area occupies 10% of the whole land and 8% of the population live in the region. Around Ohrid situated at the lakefront and Resen facing to Lake Prespa, there are factories of only light industry like food and beverage and textile.

On the other hand, water is demanded for production of self-efficiency crops such as vegetable, etc. in small size irrigation system situated along the Crn Drim River basin where small and middle size systems are scattered with an area of a few thousand ha in total, and in Asamati/Sirhan irrigation system (5,000 ha) situated on the north of Lake Prespa for production of self-efficiency crops such as wheat, maize, vegetable, etc. as well as export product like apple.

The Crn Drim River basin is located in the central-southwest of the country with relatively high rainfall.

Water-related problems in the basin are water shortage and water pollution in both lakes due to increase of tourists in the summer vacation season in particular and water contamination in the Lake Ohrid due to muddy flow during torrent. The facilities in the Asamati/Sirhan irrigation system constructed about 40 years ago have been badly deteriorated, resulting in difficulty to increase the typical production of apple quantitatively and qualitatively. Urgent countermeasures to

solve this situation are keenly required. To promote export of apples to foreign countries under a market-oriented economy, improvement of post-harvest system is also required. Further it is needed for the rural area to improve the level of satisfying BHN and living conditions, to make rural communities active, and to promote returning to home villages.

Considering these background and needs in the region, the following development direction was established:

- 1) Firstly, to increase irrigation efficiency through improvement of the existing irrigation system to deal with seasonal water shortage in the irrigation system situated at the north of Lake Prespa (and also to support coping with the market-oriented economy)
- 2) Secondly, to develop rural water supply facilities for a purpose of contribution to BHN satisfaction, improvement of living conditions, activation of rural communities and promotion of returning to home villages sited in rural area between Lakes Ohrid and Prespa and at the Crn Drim River basin downstream of Lake Ohrid.

Further,

- 3) In parallel with 1) and 2), to prevent Lakes Ohrid and Prespa from water pollution/contamination due to wastewater from sightseeing zones and muddy flow during torrent.

To meet the development directions above, development projects were identified and selected for project evaluation. As a result, the strategy of development in the Crn Drim River basin was formulated as follows by water use purpose and phasing:

- 1) Regarding municipal water, no project is proposed in PHASE I. It is proposed to take necessary steps for water shortage due to increase of tourist in summer season, which is not included in development plan. A rural water supply project, which is small size and ranked in the middle in the project evaluation, is included in PHASE II.
- 2) To secure agricultural water, improvement of the existing small size irrigation system for a purpose of increase of irrigation efficiency together with support to coping with the market-oriented economy will be required in PHASE I. One rehabilitation project, which is ranked in the middle in the project evaluation, is included in PHASE II.
- 3) No project is proposed for industrial water, power generation, etc.

(2) Development of Projects

From the above, the following three projects are proposed to be developed as the

development plan in the region (See Figure 8.1).

Proposed Projects in Crn Drim River Basin

PHASE	Project Name (No.)	Purpose/ Supply of
I	1) Irrigation System Betterment Project in Resen (7)	1) RI
II	1) Ohrid Area Irrigation Rehabilitation Project (20)	1) RI
	2) Southwest Mountainous Area Rural Water Supply Project (41)	2) RS

(RI: Improvement/Rehabilitation of Existing Irrigation System, RS: Rural Water Supply)

Prevention from water pollution is included in the water quality conservation plan in the water resources management plan (See Subsection 8.4.1).

One project proposed in PHASE I is featured as follows:

- 1) **The Irrigation System Betterment Project in Resen (7)** is located in the southwestern part of the country, facing Lake Prespa on the north. With its privileged natural conditions for fruit production, the area of about 5,200 ha has a long history as a center of fruit production in Macedonia. However, in the last decade, the area has been unable to increase its production quantitatively and qualitatively mainly due to badly deteriorated irrigation facilities, which were installed about 40 years ago. It is reported that irrigation water supplied area covers approximately 60% higher than the reported 40% of the existing irrigation area in the whole country, however the volume of water has not been sufficiently provided for a cash crop. After the rehabilitation, the irrigation area supplied with water will be increased, resulting in increase of cash crop such as agricultural produce and processed food for export, which will bring about obtaining of foreign currencies from export, improvement of living conditions of farmers, settlement in the area, activation of the activities in the region, and so on.

8.3.5 Water Resources Development Plan in Strumica River Basin

(1) Strategy for Development

The region of the Strumica River basin consists of river basins of the Strumica main stream and its tributaries. The catchment area occupies 6% of the whole land and 7% of the population live in the region. In the region, there are factories of light industry like food and beverage, textile and tobacco and heavy industry of metallurgy and metal.

On the other hand, water is demanded for production of self-efficiency crops such as wheat, maize, vegetable, etc. as well as fruit and grape in the Mantovo irrigation system (6,000 ha), Turija irrigation system (6,000 ha) and Vodocha irrigation system (4,000 ha). Further, water is demanded for livestock.

The Strumica River basin is located in the southeast of the country and has small rainfall.

The Strumica River basin has experienced droughts of which intensity exceeded more or less those in the past almost every year from the end of 1980s to the present, suffering from seasonal/all the year water shortage due to limited rainfall in the dry season in summer. Besides the water shortage problem, wastewater discharged from households, factories, fertilized irrigation area and livestock farm, pollute water in the rivers and wells. Further, it is needed for the rural area to improve the level of satisfying BHN and living conditions, to make rural communities active and to promote returning to home villages.

Considering these background and needs in the region, the following development direction was established:

- 1) Firstly, to develop water resources with installation of water supply network to deal with water shortage for municipal and industrial use in Radovish, Strumica, etc. and also to protect the Strumica River from water pollution due to wastewater from households, factories, fertilized irrigation area and livestock farm with discharge of additional water
- 2) Secondly, to improve the existing irrigation system to deal with seasonal shortage of agricultural water through increase of irrigation efficiency
- 3) Thirdly, to develop water resources with for a purpose of securing water demand for municipal and agricultural use forecasted to increase in the near future
- 4) Fourthly, to develop rural water supply facilities for a purpose of contribution to BHN satisfaction, improvement of living conditions, activation of rural communities and promotion of returning to home villages sited in rural area of the basin

To meet the development directions above, development projects were identified and selected for the project evaluation. As a result, the strategy of development in the Strumica River basin was formulated as follows by water use purpose and phasing.

- 1) To secure municipal water, a rural water supply project is proposed in PHASE I, which is combined with that in the Vardar River lower reach. No project is included in PHASE II. A project, which is ranked low in the project evaluation and with high investment cost, will be included in PHASE III.
- 2) To secure agricultural water, no project is included in PHASE I. The existing irrigation system is included in PHASE II. One project, which is ranked low in the project evaluation and with high investment cost,

will be included in PHASE III.

- 3) No project is proposed for industrial water in PHASES I and II. A project is included in PHASE III, which will be developed with municipal and irrigation water.
- 4) To deal with water pollution in the Strumica River, one project, which is also for municipal water supply is proposed in PHASE I.
- 6) No project is proposed for power generation, etc.

(2) Development of Projects

From the above, the following four projects are proposed to be developed as the development plan in the region (See Figure 8.1).

Proposed Projects in Strumica River Basin

PHASE	Project Name (No.)	Purpose/ Supply of
I	1) Oraovica Dam Project (8)	1) M,E
II	1) Mantovo Area Irrigation Rehabilitation Project (21) 2) Strumica Area Irrigation Rehabilitation Project (22)	1) RI 2) RI
III	1) Podares Dam Project (33)	1) M&I,A

(M : Municipal Water, I : Industrial Water, A : Agricultural Water, RI : Improvement/Rehabilitation of Existing Irrigation System, RS : Rural Water, E : Environmental Water)

Prevention from water pollution is included in the water quality conservation plan in the water resources management plan (See Subsection 8.4.1).

One projects proposed in PHASE I is featured as follows:

- 1) **The Oraovica Dam Project (8)** is located In the Oraoviska river-a left bank tributary of the Strumica River, about 2 km east from Radovish. The project targets to supply drinking water, from an intake dam to be constructed with a height of 50 to 60 m, for an area which is suffering from seasonal water shortage, as well as to discharge supplementarily the biological minimum to protect the Strumica river from water pollution classified into IV (equivalent BOD is nearly 20 at present). After the project, the water shortage problem will be mostly settled with rather stable supply of water. Accordingly, it is expected improvement of the water quality in the Strumica River, improvement of health conditions of people, activation of the activities in the region, and so on.

One rural water supply project is proposed by combination with that listed up in PHASE II and the Vardar River lower reach.

8.3.6 Nationwide Rural Water Supply Extension/Improvement Project

It is proposed to complete the rural water supply projects in the whole country by 2015.

For 10 years since 2016 until 2025 in PHASE III, one package project (Project No. 42) is proposed for all the country to extend the facilities to deal with increase of population in the rural area and to rehabilitate facilities which will be deteriorated.

8.4 Water Resources Management Plan

8.4.1 Water Quality Conservation Plan

For smooth promotion of the development projects and improvement of living conditions and social welfare of Macedonian people, it is indispensable to prevent water from pollution which is an environmental issue identified in each river basin through the Study (See Figure 8.2). Thus, reduction of the pollutant load due to increasing water utilization after completion of the projects should be proceeded. Tables 8.1(1/4) to (4/4) tabulate the water quality conservation plan as the counter-plans required based on results of identification of the water utilization and water quality conditions at the present and environmental states in the future forecasted with the results of the pollutant load analysis and water quality monitoring. Following the table, it is proposed to provide wastewater treatment facilities by region to deal with the present water pollution and in line with the progress of the development of the projects as the water quality conservation plan.

It is required, in promoting the plan, to conform it with projects such as those of EU-PHARE Wastewater Improvement and Monitoring Project, World Bank Water Supply and Sewerage Project, and so on.

(1) Water Quality Conservation Plan in Vardar River Upper Reach

In the region of the Vardar River upper reach, water is polluted with wastewater discharged untreated from irrigation system around Gostivar and that from households and factories of light and heavy industries in/around Tetovo and Skopje. The river water quality of the Vardar in this stretches is classified into Class III (or converted into BOD value of 5 to 7 mg/l, presented as "BOD = 5 to 7" hereinafter). In the Pchinja River-the main left bank tributary of the Vardar River and the Kumanovska River-a right bank tributary of the Pchinja River, where wastewater from households, industries, and irrigation system as well as livestock in/around the second largest city of Kumanovo next to Skopje is discharged untreated. Water pollution is seriously increased and classified into Class IV or more (BOD=20 or more), which is a social concern. Treatment of wastewater from mining is required around Kriva Palanka sited on the most upper reach of the Kriva River-the main left bank tributary of the Pchinja River. In the

Treska River-the main right bank tributary of the Vardar River, where wastewater from households in/around Kichevo and Makedonski Brod is discharged untreated, water is rather clean with Class II (BOD less than 3) due to relatively much water volume and small settlement.

To deal with present water pollution in the region, it is proposed to provide wastewater treatment facilities at Gostivar, Tetovo, Skopje and Kumanovo in the early stage.

In the region, it is proposed to develop projects for municipal and industrial water and agricultural water (Water Supply Project for Tetovo – River Pena Intake and Slupchanka Dam Project) in PHASE I, which require Environmental Impact Study (EIS) prior to the development for assessment of the environmental impact forecasted as well as planning for countermeasures for not only construction stage but also operation and maintenance period when necessary.

For the development projects included in PHASES II and III, it is also proposed to conduct EIS prior to the development for assessment of the environmental impacts forecasted as well as planning for countermeasures for not only construction stage but also operation and maintenance period when necessary.

(2) Water Quality Conservation Plan in Vardar River Middle Reach

In/around Veles in the region of the Vardar River middle reach, water is polluted with wastewater discharged untreated from copper and zinc smelters and leather factories, which classifies the water in the Vardar River into Class III (BOD = 6 or more). In the Bregalnica River-the main left bank tributary of the Vardar, where water quality is deteriorated to BOD = 4 with wastewater discharged untreated from the irrigation system near Delchevo, downstream of which water is classified into BOD = 5 with wastewater untreated and discharged from the mining at M.Kamenica sited on the upper reach of the Bregalnica. Such polluted water flows into the Kalimanci reservoir, which supplies water to the Bregalnica irrigation system of 32,000 ha. On the middle and lower reaches of the Bregalnica River, water is deteriorated to BOD = 7 to 9 with wastewater untreated and discharged from households, industry, irrigation system and livestock in/around Kochani, Shtip and Sveti Nikole on the irrigation system.

To deal with water pollution at present In the region, it is proposed to provide wastewater treatment facilities at Veles on the middle reach of the Vardar River as well as Kochani, Shtip and Sveti Nikole on the irrigation system in the early stage.

In the region, it is proposed to develop one project for municipal and industrial water (Zletovica Multipurpose Dam Project, Phase 1) in PHASE I, which has started partly. According to the Initial Environmental Examination (IEE) and other surveys, there is no adverse impact by the development. However, it may require EIS prior to the development for assessment of the environmental impact

forecasted as well as planning for countermeasures for not only construction stage but also operation and maintenance period when necessary.

For the development projects included in PHASEs II and III, it is also proposed to conduct EIS prior to the development for assessment of the environmental impacts forecasted as well as planning for countermeasures for not only construction stage but also operation and maintenance period when necessary.

(3) Water Quality Conservation Plan in Vardar River Lower Reach

In/around Negotino, Valandovo, Kavadarci and Gevgelija in the region of the Vardar River lower reach, water is polluted with wastewater untreated and discharged from wine and beverage factories in addition to one from households, which classifies the water in the Vardar River as Class III (BOD = 5 or more) including wells around there. On the Crna River-the main right bank tributary of the Vardar River, where water quality is deteriorated to BOD = 9 to 12 up to the reach of the Tikvesh reservoir with wastewater untreated and discharged from the beverage and tobacco factories in addition to one from households.

To deal with water pollution at the present in the region, it is proposed to provide wastewater treatment facilities at Negonino, Valandovo, Kavadarci and Gevgelija on the lower reach of the Vardar River as well as Bitola and Prilep on the upper reach of the Crna river-the main right bank tributary of the Vardar River in the early stage (A World Bank project for sewerage treatment plant in Bitola and Prilep was commenced in 1998. Coordination is required with the project).

In the region, it is proposed to develop one project for irrigation rehabilitation (Valandovo Area Irrigation Rehabilitation Project) in PHASE I. No adverse impact by the development is forecasted.

For the development projects included in PHASEs II and III, it is also proposed to conduct EIS prior to the development for assessment of the environmental impacts forecasted as well as planning for countermeasures for not only construction stage but also operation and maintenance period when necessary (See Table 8.1).

In Lake Dojran located at the southeast of the country, the eastern part of which belongs to Greek territory, water pollution due to lowering of water level becomes a social concern. One 6,000 population equivalent wastewater treatment plant is on operation at the lakeside town of Nov Dojran. It is proposed to take necessary steps as soon as possible to reduce the water pollution based on basic studies on relationship between water level lowering and water pollution, on size and capacity of the plant and so on.

(4) Water Quality Conservation Plan in Crn Drim River Basin

In the basin (the region) of the Crn Drim River, which flows out from Lake Ohrid,

water is classified into Class I to II (BOD = 1 to 2) with rather good quality. At Vraniste facing to Lake Ohrid and Resen to Lake Prespa, there have operated wastewater treatment plants with 34,000 and 12,000 population equivalent since 1988, respectively. Little problem relating to water pollution is found on both lakes, except for the summer season when water pollution is reported due to increase of tourists. It is proposed to take necessary steps as soon as possible to deal with the situation coordinating with a World Bank project to expand the capacity of the wastewater treatment plant at Vraniste.

In the region, it is proposed one project for irrigation rehabilitation (Irrigation System Betterment Project in Resen) in PHASE I. No adverse impact by the development is forecasted.

The projects included in PHASES II and III are an irrigation rehabilitation project and a rural water supply project. No adverse impact by these projects is forecasted.

Prevention of Lake Ohrid from water pollution due to muddy flow during torrent and sedimentation due to erosion in the basins of Lakes Ohrid and Prespa is included in the Watershed Conservation Plan (See Subsection 8.4.2).

(5) Water Quality Conservation Plan in Strumica River Basin

The Strumica River Basin (the region) is located in a dry area in the country. In the Strumica River, water is polluted severely with wastewater untreated and discharged from mining activity located north of Radovish in addition to discharge from households in/around Radovish, and with wastewater untreated and discharged from households, industry, irrigation system and livestock in/around Strumica, which classifies the water in the Strumica River into Class IV (BOD = 20 more or less) including wells around there. The Strumica River is an international river with a rather short length of 70 km in the Macedonian territory than that of 300 km of the Vardar River and flows down through Bulgaria.

To deal with present water pollution in the region, it is proposed to provide wastewater treatment facilities in the early time at Radovish and Strumica to reduce water pollution due to wastewater untreated and discharged from households, industry, and irrigation system in addition to one development project (Oraovica Dam Project) for municipal water and environmental water in PHASE I (See Table 8.1).

In PHASE II, it is proposed to conduct two projects for irrigation rehabilitation (Mantovo Area Irrigation Rehabilitation Project and Strumica Area Irrigation Rehabilitation Project). No adverse impact from the development is forecasted.

In Phase III, it is proposed to conduct one project for municipal water, industrial water and irrigation water. EIS will be required prior to the development for

assessment of the environmental impacts forecasted as well as planning for countermeasures for not only construction stage but also operation and maintenance period when necessary.

8.4.2 Watershed Conservation Plan

In order to proceed with sustainable water resources development in the watersheds, it is necessary to undertake initially countermeasures for conservation of natural conditions relevant to topography, geology, hydrology etc. and livelihood in the watershed and social environment. In the aspect of conservation of potential water resources and maintenance of the water-related structures, the watershed conservation plan is proposed by river basin as follows. Location of the plan is shown in Figure 8.3.

(1) Watershed Conservation Plan in Vardar River Upper Reach

Considering erosion condition in the watershed, the following five projects are proposed to be implemented together with the water resources development projects which have been prepared for the metropolitan area of Skopje and Tetovo in the aspect of the time frame and regional development needs.

Watershed Conservation Plan In Vardar River Upper Reach

Project Name (Project No.)	River Basin	Purpose
Pena River Erosion Control Project (1)	Pena and Mazradracha Rivers	Debris Flow Control
Dzhepishte River Erosion Control Project (2)	Dzhepishte River	Debris Flow Control
Markova and Kadina River Basins Erosion Control Projects (3)	Markova and Kadina Rivers	Protection against Surface Erosion
Shara Mountains Erosion Control Projects (4)	Shara Mountains	Protection against Surface Erosion
Skopsko Crna Gora Mountains Erosion Control Project (5)	Skopje and its Suburban Area	Protection against Surface Erosion

(2) Watershed Conservation Plan in Vardar River Middle Reach

In order to maintain the function of the existing reservoirs (Ratevska, Kalimanci and Mantovo, etc.), which are suffering from significant sedimentation, and Bregalnica irrigation system, the following six countermeasures for the watershed conservation are proposed in this basin. Especially, the countermeasure against sedimentation in the Kalimanci reservoir is essential to sustain the proper function of the Bregalnica irrigation system and to support the on-going irrigation rehabilitation and restructuring projects. Therefore, it is proposed to implement erosion control for the Kalimanci reservoir in the earlier stage with high priority.

Watershed Conservation Plan in Vardar River Middle Reach

Project Name (Project No.)	River Basin	Purpose
Kalimanci Reservoir Erosion Control Project (6)	Bregaluica River	Restriction of Sediment Yield
Ratevska Reservoir Erosion Control Project (7)	Ratevska River	Restriction of Sediment Yield
Kamenicika River Erosion Control Project (8)	Kamenicika River	Protection against Surface Erosion
Bregalnica Middle Reach River Improvement Project (9)	Bragalinica River	Protection of River Bank Erosion
Vinicika River Erosion Control Project (10)	Vinicika River	Protection against Surface Erosion
Mantovo Reservoir Debris Flow Control Project (11)	Kriva Lakavica River	Debris Flow Control

(3) Watershed Conservation Plan in Vardar River Lower Reach

The most urgent problem in this basin is drainage improvement in the Pelagonija Field lying over the Crna River Upper reach for betterment of irrigation efficiency. Additionally, it is proposed that the drainage improvement of the existing drainage canal is to be prioritized to be conducted because new large-scale irrigation development (27,000 ha) is planned in this area in future. In the Vardar River lower reach, protection against surface erosion in the Kavadarci area and river bank protection where encroaching along the mainstream is remarkable are required. According to the basic direction, the following five projects are proposed.

Watershed Conservation Plan in Vardar River Lower Reach

Project Name (Project No.)	River Basin	Purpose
Pelagonija Field Drainage Improvement Project (12)	Crna River	Improvement of Drainage Canal
Vardar River Lower Reach Improvement Project (13)	Vardar River	Protection against River Bed and Bank Erosion
Konsko River Improvement Project (14)	Konsko River	Protection against Bank Erosion
Selechka Mountain Erosion Control Project (15)	Tributary from Left Bank of Crna River	Protection against Surface Erosion
Kavadarci Area Erosion Control Project (16)	Tributary from Right Bank of Vardar River	Protection against Surface Erosion

(4) Watershed Conservation Plan in Crn Drim River Basin

In this river basin, environmental conservation is the most serious problem to be solved. Conservation plan in the Sateska River basin is proposed where surface erosion in the upstream area and mud flow into Lake Ohrid become serious problem recently. The following three projects are proposed, which include the protection works to prevent erosion in small creeks from flowing into Lake Debar (reservoir of Sphilje dam) and to control of surface erosion in the mountain ranges of Galichica/Pelister that is separating Lakes Ohrid and Prespa.

Watershed Conservation Plan in Crn Drim River Basin

Project Name (Project No.)	River Basin	Purpose
Sateska River Basin Conservation Project (17)	Sateska River	Protection against Surface Erosion and Flood Control
Debar Reservoir Erosion Control Project (18)	Crn Drim River	Restriction of Sediment Yield
Galichica and Pelister Mountains Erosion Control Project (19)	Creeks in Galichica and Pelister Mountains	Protection against Surface Erosion

In the Strumica river basin, one development project to control debris flow in the Illova River basin (tributary joining from left side of the Strumica River) is underway. Since few area and/or river stretches needing urgent countermeasure is identified through the Study, no project is formulated in this river basin.

8.4.3 Surface Water and Groundwater Monitoring System Improvement Plan

Operation and maintenance of the existing monitoring network for climate, surface water and groundwater over the country, is carried out by HMI. Regarding the climatology monitoring network, principal stations (35 nos.) and rain gauge stations (295 nos.) sufficiently cover the national territory. The operation and maintenance conditions are moderately good. On the other hand, regarding water level gauging stations (110 nos.), the stations properly maintained are around only 50 % and the existing facilities/organizations are also insufficient level. Further, monitoring stations of groundwater working properly are under 50 % in total, which causes a bottleneck of safe water supply.

Considering the current conditions, an improvement plan of the existing surface water and groundwater monitoring is proposed as follows to achieve efficient and effective water utilization and management. The component of the plan is tabulated in Table 8.2 and location is shown in Figure 8.4.

However, this plan requires further review taking account of the progress of implementation of the on-going projects undertaken by other donors such as PHARE and Swiss Government, etc. As for strengthening water management, selection of appropriate facilities and locations to be installed are prerequisite. In this point of view, coordination among each plan above will be inevitably essential.

Surface Water and Groundwater Monitoring System Improvement Plan

<p>(a) Water Level Monitoring Network Improvement and Expansion Plan</p> <p>Number of locations: 4 nos. existing and 8 nos. newly installed</p> <p>Purpose: Improvement of existing facilities for water level gauging stations and installation of new automatic water level gauges (limnigraph) (mainly in the river basins where the water resources development projects are proposed in PHASE I and II) and improvement/expansion of hydrological data- base system (including institutional strengthening for monitoring works)</p>
<p>(b) Flood Forecasting and Warning System Enhancement Plan</p>

<p>Number of locations: 28 nos.</p> <p>Purpose: Gathering of the real time data and analysis and modernization/strengthening of the existing flood forecasting and warning system aiming at prediction of flood discharge (by introducing telemetering system including development of software for prediction of flood discharge)</p>
<p>(c) Surface Water Quality Monitoring Network Enhancement Plan</p> <p>Number of locations: 50 nos.</p> <p>Purpose: Enhancement of water quality monitoring network for rivers and lakes</p>
<p>(d) Groundwater Monitoring Network Enhancement Plan</p> <p>Number of locations: Improvement of existing groundwater monitoring stations (61 nos.) Installation of land subsidence monitoring stations (10 nos.) Installation of groundwater quality monitoring stations (150 nos.)</p> <p>Purpose: Continuous measurement/prediction system of groundwater and land subsidence in parallel with formation of groundwater monitoring system</p>

In addition, it is proposed that these plans shall be implemented under HMI, that is supervising operation of the system up to present.

8.4.4 Water-related Facilities Operation and Maintenance Improvement Plan

Preparation of operation and maintenance manual for the water-related facilities such as dam, tapping/ transporting/ purifying/ distributing facilities and irrigation facilities, etc. is inevitable to strengthen water resources management.

In the nationwide level, the existing facilities can not play the designed function due to poor maintenance and repair of instruments and structures caused by lack of operation and maintenance manual. To meet this situation, the following three improvement plans of water-related facilities operation and maintenance improvement are proposed to be prepared as soon as possible.

Water-related Facilities Operation and Maintenance Improvement Plan

<p>(a) Operation and Maintenance Manual of Water Supply Facilities</p> <p>Contents: Preparation of O & M Manual of facilities</p> <p>Implementing agency: MUCP</p> <p>Purpose: Technical enhancement on operation and maintenance, strengthening of distributed water control, promotion of water restriction for end-user</p> <p>Target facilities: Purification plant, service reservoir, distribution pipeline and pumping station, etc.</p>
<p>(b) Operation and Maintenance Manual of Dam and Appurtenant Structures</p> <p>Contents: Preparation of basic data for operation Preparation of operation and maintenance guideline</p> <ul style="list-style-type: none"> - Embankment (leakage, deformation, condition on surface of slopes, pore pressure, etc.) - Abutment (leakage, crack, falling, sliding, etc.) - Intake and river outlet facilities (operation rules of valves and gates for discharge measurement/control - reservoir (sedimentation, surface sliding, etc.) <p>Implementing agency: MAFWE</p> <p>Purpose: Preparation of technical guideline for operation and maintenance rules of dam and reservoir</p> <p>Target facilities: Existing major dams (20 locations in total), reservoirs and appurtenant facilities</p>

(c) Operation and Maintenance Manual for Irrigation Facilities	
Contents:	Preparation of manual for measurement of intake volume Preparation of technical guideline of gate operation
Implementing agency:	MAFWE
Purpose:	Strengthening of water supply control and operation/maintenance of facilities
Target facilities:	Intake facilities, canals and distribution facilities, etc.

Formulating the water-related facilities operation and maintenance improvement plans, the basic data of water-related facilities is fundamental. At the earlier stage of the plan, the inventory of principal feature for the existing intake, distribution, storage, and purification facilities is to be made. It is proposed that MAFWE is to be responsible as the main agency and MUPC (divided from the former MUPCE in December 1998) is to be participated if required for the implementing agency.

8.4.5 Institutions and Legal System Strengthening Plan

In order to ensure smooth, efficient, and effective realization of the water resources development plan and the management plan, it is essential to promote the capacity building in the related institutions and in the legal system especially focusing on the following points:

- (1) Institutional Strengthening in Decision-making Level: Establishment of Coordination Committee of Water Resources Development and Management

In the sector of water resources development and management in Macedonia, three major executing ministries are involved: MAFWE, MUPC, and MOE. MOD coordinates these water-related ministries and agencies in planning of development projects. However, the coordination system does not function practically yet. Each ministry and agency has made a development plan and implemented a project separately, although harmonization among them is essential for effective and efficient development and management of limited water resources in Macedonia.

As the first step to improve the coordination among the concerned ministries and agencies, the Coordination Committee for Water Resources Development and Management needs to be established, comprised of policy-making level representatives from the water-related ministries and agencies.

The Committee should be set up and operated based on the consensus of all the related ministries and agencies in order to utilize the domestic/foreign human and financial resources. The Committee should provide practical and influential decisions and services for the smooth progress of the Master Plan.

It is desirable that the secretariat office of the Committee is to be established in MAFWE, and MAFWE provides coordination activities for the Committee based on the provision in the Water Law specifying that MAFWE is the responsible

agency of water resources development and management.

The candidate members and the major activities of the Committee are proposed as follows:

**Proposed Organization Structure of the Coordination Committee of the Water Resources
Development and Management**

<u>Organization Structure and Member Institutions:</u>	
[Directorial Agency]	MAFWE
[Regular Members]	Leading members
	MOD, MUPC, MOE, MOH, and MOEn
	Ordinary members
	PWME HQ, MAKKOM, HMI, WDI, and RIHP
	Geohydroproject
	Agency for Economically Underdeveloped Areas
[Associate Members]	MOF, MOFA, ACU, and Municipal Governments

The major activities of the Committee are summarized as follows:

- Promotion of the Master Plan and coordination between the Master Plan and the related development plans;
 - Coordination with the on-going water resources development and management projects;
 - Management of the information about policies, action plans, budget plan, etc. of the concerned ministries and agencies;
 - Formulation and management of a database system about development projects, which are being planned, constructed, and operated in the country, including investment, implementation schedule, project purpose, outline of activities, etc.;
 - Conducting monitoring and evaluation of on-going projects, including budgeting, construction progress, operation situations, attainment, impact, etc.;
 - Development of a Map for Water Resources Development and Management showing the existing water-related facilities, institutions, existing problems, etc.;
 - Consulting and information services for formulating development projects and financial plans;
 - Formulation and management of list of the data related to water resources owned by all of the concerned agencies and promotion of developing a common database of the water-related data.
- (2) Institutional Strengthening at Executing Agencies Level: Early establishment of PWME management system

Since the establishment of the PWME headquarter (HQ) in Skopje in May 1998, the establishment of a new nationwide water resources development and management system has been still in a transition period; how the current decentralized WMO system should be converted into the new PWME centralized system. In order to realize the most appropriate system, the following issues need to be resolved.

- 1) Concrete and specific action plan of PWME needs to be made as soon as possible, describing the objective, roles, activities, budget system, etc. of HQ and the branches.
- 2) For the preparation of the action plan, detailed evaluation about the existing WMOs should be conducted. Based on the evaluation results, optimum organization, personnel, financial and activity plans as the regional branches of PWME are to be formulated. WMOs have a long history of working with independent financial system as well as localized experience and expertise, which should be utilized to make the new PWME system more functional.
- 3) On converting WMOs into the local branches of PWME, some of the authorities of WMOs should be kept by the branches in order to allow them to provide more flexible and localized services, without making every business centralized. The branches are responsible for providing good service to local water users and operating and maintaining of facilities. To do this more successfully, the profit-making activities currently conducted by WMOs, which do not have direct relationship with the water-related services, should be separated and privatized.
- 4) PWME HQ is to supervise financial issues, information management, monitoring and evaluation of maintenance conditions of water-related facilities, technical support, and human resources development for all of the branches. The management and reporting system between HQ and the branches needs to be improved.
- 5) Guidelines and manuals for operation and maintenance of facilities, regulations of dam operation, manuals for inventory control of equipment and materials for facility maintenance should be developed. A prototype of these guidelines and manuals is to be prepared first by PWME HQ. Each branch will develop its own manuals based on the prototype and promote its operation and maintenance system under the guidance and supervision of HQ.
- 6) A database about PWME HQ and the branches needs to be developed. This will include all the information about organization, personnel, budget, activities, facilities and equipment, etc. as well as the current

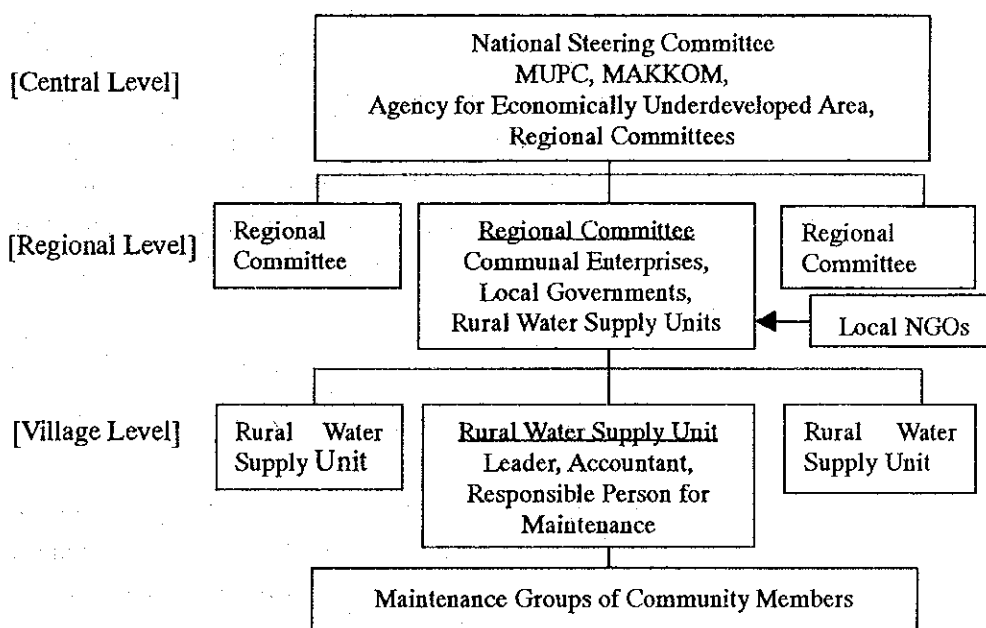
facility operation and maintenance conditions. The database can be utilized as the PWME's internal operation and maintenance network.

(3) Institutional Strengthening for Promoting Rural Water Supply Projects:
Establishment of Rural Water Supply Unit

For the implementation of the rural water supply projects proposed by the Master Plan, a National Steering Committee of the Rural Water Supply Project is to be established at the central level, a Regional Committee of the Rural Water Supply Project at the local (municipal) level, and a Rural Water Supply Unit at the village level. The Rural Water Supply Unit will be the actual executing organization in each village for project planning, implementation, operation, and maintenance. They are outlined as follows:

- 1) "The National Steering Committee of the Rural Water Supply Project" is to be established at the central level for coordinating and supervising the nationwide promotion of the rural water supply projects. The directorial agency will be the MUPC and the member agencies will include MOD's Agency for Economically Underdeveloped Area, MAKKOM, and "the Regional Committee of the Rural Water Supply Project". The activities of the National Steering Committee are mentioned below:
 - Formulation of a guideline and manuals for preparation of detailed implementation plan and financial plan of facility construction, institutional strengthening, operation, maintenance, and training;
 - Information management about all of the water supply projects in the country;
 - Conducting regular monitoring and evaluation;
 - Providing technical services about project planning and implementation. It is necessary to coordinate with the NGOs such as MCIC and so on, because their support might be effective.
- 2) Under the National Steering Committee, "a Regional Committee of the Rural Water Supply Project" will be set up in the Communal Enterprises (CEs) as the coordination body at the regional level. Each CE presides the Regional Committee with the members representing the municipal government, village leaders, and "the Rural Water Supply Unit". The main activities of the Regional Committee are as follows:
 - Technical support for establishing Rural Water Supply Units, financial management, and facility maintenance;
 - Regular monitoring and information services about maintenance after the completion of the facilities;
 - Technical services for solving troubles in the facilities and equipment,

- which can not be handled by the Rural Water Supply Unit;
- Management of maintenance equipment and stock control of spare parts;
 - Collecting the membership fee from the Rural Water Supply Unit(s) according to the size of population covered by services.
- 3) The Rural Water Supply Unit will be established at the village level. The Unit will be composed of a leader who will be appointed by the community members, an accountant, and a responsible person for facility maintenance. The major activities of the Unit are as follows:
- Daily operation and maintenance of the water supply facilities (the responsible person of the facility maintenance supervises the daily maintenance conducted by the community member groups);
 - Temporary measures for facility troubles;
 - Water charge collection;
 - Budget management;
 - Basically the Unit will be operated through the water charges collected from the users. However, until the attainment of the stable operation, subsidies need to be provided by the local governments or the central agencies.



Implementation Institution of Rural Water Supply Projects

- (4) Institutional Strengthening at Users Level: Promotion of Community Participation

Institutional strengthening among the users to promote community participation is desirable, especially targeting the following three issues.

- 1) Establishment of Water Users' Association for operation and

maintenance of irrigation facilities

Operation and maintenance of irrigation facilities, especially for secondary and tertiary channels, requires active participation of users. An operation and maintenance system of these channels through Water Users' Associations increases the effectiveness and efficiency of the operation and maintenance activities as well as of the facility functions.

In the World Bank's on-going project of rehabilitating irrigation facilities, pilot projects have been promoted in order to establish a Water Users' Association. It is desirable that PWME promotes establishment of Water Users' Association through conducting other pilot projects by themselves based on the experience in the World Bank project.

The successful results in the pilot projects are to be extended to other irrigation areas all over the country. Guidelines and handbooks to educate and train farmers need to be developed with the specific description about objective of association, organization, functions, activities, etc., which can be practically utilized on the irrigation site.

2) Community cooperation in water quality and environment conservation

It is essential to obtain understanding and cooperation from inhabitants to promote water quality and environment conservation. Negative impact of untreated wastewater discharge and solid waste dumping should be widely demonstrated through the mass media. It is effective to conduct a clean-up campaign of river environment in collaboration with community groups. It is also important to teach children about waste disposal, importance of water quality and environment conservation, etc. in the classes of the primary education.

3) Community understanding and cooperation in water charge payment

Water charges are the most important means of financing the operation and maintenance of irrigation facilities and drinking water supply systems properly and for securing stable and safe water supply. Therefore, in order to make the inhabitants understand this and cooperate in paying the charges, it is necessary to make an appeal to them through mass media, campaigns, and school education.

(5) Institutional Strengthening in the Legal System

The following items should be established in order to implement the water quality conservation plan effectively.

- 1) It is necessary to establish the system to enforce the "polluters pay" rule. The early establishment of the operational regulations of the Water Fund,

which has been prepared by MAFWE, is essential.

- 2) An effective monitoring network of pollution levels should be developed in PWME, through the integration of the cooperative environment-related projects, which have been conducted individually by each agency and/or donor.
- 3) To establish the legal system for prevention of water from pollution is required in conformity with the EU standards and the "Law for Water Supply, Drainage, Wastewater Treatment and Atmospheric Water Collection and Treatment", which is being proposed by MUPC. Further, to establish a routine water quality monitoring system of wastewater at major outlets of domestic, agricultural, and industrial wastewater (important points influential to conservation of river environment), legal institution regulating water quality standards, monitoring method, location/frequency of observation, etc. shall be specifically stipulated in the Law.
- 4) To establish a strict control system with appropriate penalties is needed for the wastewater producers who violate the laws and regulations mentioned above.

8.4.6 Human Resources Development Plan

The development of human resources is very important for successful implementation of the Master Plan. Currently, education and training programs for engineers and managers in the water resources development and management have not been well established. Only on-the-job training has been provided at the working places.

Education and training on the following items in the proposed Human Resources Development Plan should be formally provided for the concerned people engaging in various stages of development projects and/or in the entire part of the water resources development and management.

**Human Resources Development Plan
for the Water Resources Development and Management**

<p>(1) Decision-making Level</p> <p>Target Group: Responsible persons at the decision-making level</p> <p>Training Type and Responsible Organization: OJT training and technology transfer in the foreign institutes and/or in the related development projects in Macedonia</p> <p>Training Items:</p> <ul style="list-style-type: none"> - Formulation of long-term and comprehensive development plans - Formulation of sector development strategy - Project management (planning, implementation, operation, monitoring/evaluation) - Formulation of fund raising and operation plans - General and basic information about the Master Plan
<p>(2) Executing Agency Level</p> <p>Target Group: Responsible persons at the executing agency levels including PWME, Communal Enterprises, etc.</p> <p>Training Type and Responsible Organization: Seminars by the Coordination Committee of the Water Resources Development and Management (technical transfer will be done by the Macedonian or foreign experts)</p> <p>Training Items:</p> <ul style="list-style-type: none"> - Collection, analysis, and management of the technical data - Development and management of the database and information network - Information management at the branch and monitoring station level - Monitoring and evaluation of development projects - Operation and maintenance of facilities and management of maintenance equipment - Improvement of services for communities and public relations activities - General and basic information about the Master Plan
<p>(3) For Promotion of the Rural Water Supply Projects</p> <p>Target Group: Responsible persons and leaders of communities for implementing water supply projects at the central, regional and village levels</p> <p>Training Type and Responsible Organization: Seminars by the National Steering Committee (technical transfer will be provided by Macedonian or foreign experts)</p> <p>Training Items:</p> <ul style="list-style-type: none"> - Planning, implementation, operation, monitoring and evaluation of the projects - Institutional strengthening of facility management and maintenance system - Countermeasures and procedures for trouble-shooting - Collecting water charge and budget management - Leadership training - How to improve the awareness of the community members
<p>(4) At the Water Users' Level</p> <p>Target Group: All of the water users (municipal, agricultural, industrial water, etc.)</p> <p>Training Type and Responsible Organization: the Coordination Committee will make nationwide plan. At the community level, training of the population will be done by PWME, Communal Enterprises, the Rural Water Supply Units, etc.</p> <p>Training Items:</p> <p>For the Municipal and Industrial Water Users</p> <ul style="list-style-type: none"> - Importance of water management/environment conservation/wastewater treatment - Promotion of economized water use - Importance of paying water charges - Improvement of living environment of the communities <p>For the Municipal and Industrial Water Users</p> <ul style="list-style-type: none"> - Institutional strengthening of water users' association - Irrigation facility management

Table 8.1 Water Resources Development Plan and Water Resources Management Plan (Water Quality Conservation Plan) (1/4)

River Basin	River Course	Results of Survey on Current Water Quality and Future Forecast			Water Resources Development Plan			Water Resources Management Plan		
		Current and Pollution Conditions	BOD (mg/l)	Future Forecast	BOD (mg/l)	PHASE I	PHASE II	PHASE III	BOD (mg/l)	Basic Guideline
1. Vardar River Upper Reach: Vardar Main Stream	Most upstream ~ confluence with the Pehinja (L: 150km)	<p>Around Gostivar and its suburbs, water pollution in the Vardar River due to wastewater from agricultural area</p> <p>Tetovo is supplied water from 4 springs on the Popova Shapka mountainous region. In the Vardar River near Tetovo, water is polluted by wastewater from households and factories.</p> <p>Skopje metropolitan is supplied water from the Rashete spring (Q=3.0 m³/s). In the Vardar River near Skopje, water is polluted by wastewater from households and factories</p>	4~5	Gostivar~Skopje: water quality is forecasted to be Class III by 2025	6~7	<p>-Water Supply Project for Tetovo - River Pehinja (1)</p> <p>- Studena Voda Groundwater Development Project (9)</p>	<p>-Construction of By-pass Channel Raven - Rechica (23)</p>	2~4	<p>-To provide wastewater treatment facilities so as to control the current water pollution reducing pollutant load within the water quality standard.</p> <p>-Improvement and modernization of deteriorated wastewater treatment facilities owned/operated by only a part of factories.</p> <p>-To implement EIS for development project and formation of countermeasure if required.</p>	<p>1. Provision of wastewater treatment facilities: (1) Skopje (M,I) (2) Tetovo (M,I) (3) Kumanovo (M,I,A) (4) Gostivar (M,A) (5) Kriva Palanka (M,I) (6) Makedonski Brod (M) (7) Krasovo (M,I) (8) Kichevo (M)</p> <p>(M: for reduction of pollutant load from households, I: for reduction of pollutant load from factories, A: for reduction of pollutant load from agricultural activities including livestock water, prioritization will be based on its urgency, etc.)</p>
Treska River (right bank tributary)	All the Course (L: 110km)	This river course is in a canyon, where pollutant load is small resulting in good water quality.	2~4	Kichevo~Confluence with the Pehinja river: It is forecasted water pollution around 2025 between quite ~Makedonski.	2~4	<p>-Kichevsko Pole Area Irrigation Rehabilitation Project (2)</p> <p>-Treska River Upper Reach Rural Water Supply Project (34)</p>		2~4	<p>2. Improvement and modernization of deteriorated wastewater treatment facilities owned by only some factories)</p>	
Pehinja River (left bank tributary)	All the Course (L: 120km)	In the Kriva River near Kriva Palanka and Kratovo, water is polluted by wastewater from households and mining.	4~7	Kumanovo~Confluence with the Vardar River: In the Kumanovska river, water will be polluted due to wastewater from households in Kumanovo and from livestock farm around Kumanovo.	8~9	<p>-Slupchaka Dam Project (4)</p> <p>-Kriva Palanka/Kumanovo Circle Rural Water Supply Project (36)</p>	<p>-Kisefitshka Dam Project (12)</p> <p>-Lipkovo - Glaznja Area Irrigation Rehabilitation Project (11)</p> <p>-Vakuf Multipurpose Dam Project (13)</p>	<p>-Pelince Dam Project (24)</p>	2~4	<p>3. Implementation of Environmental Impact Study (EIS) and formation of countermeasures for the project proposed in PHASE I. EIS will be carried out for projects proposed in PHASE II and III depending on the necessity.</p>

Note: Class I= BOD 2.0 mg/l under, Class II= BOD 2.0~4.0 mg/l, Class III= BOD4.0~7.0 mg/l, Class IV= BOD 7.0~20.0 mg/l

Table 8.1 Water Resources Development Plan and Water Resources Management Plan (Water Quality Conservation Plan) (2/4)

River Basin	River Course	Results of Survey on Current Water Quality and Future Forecast				Water Resources Development Plan			Water Resources Management Plan		
		Current and Pollution Conditions	BOD (mg/l)	Future Forecast	BOD (mg/l)	PHASE I	PHASE II	PHASE III	BOD (mg/l)	Basic Guideline	Water Quality Conservation Plan
2. Vardar River Middle Reach: Vardar Main Stream	Confluence with the Pehinja River~ Confluence with the Crna River (L.:50km)	In Veles, water is polluted due to wastewater from household and factories. Big pollutant sources are smelters of zinc and lead, and leather processing factories.	6~8	Confluence with the Pehinja River~Confluence with the Begalnica River: Water is polluted around Veles and downstream reach of Veles.	7~10				4~7	To provide wastewater treatment facilities so as to control the current water pollution reducing pollutant load within the water quality standard. -Improvement and modernization of deteriorated wastewater treatment facilities owned/operated by only a part of factories. -To implement EIS for development project and formation of countermeasure if required.	1. Provision of wastewater treatment facilities: (1) Veles (M,I) (2) Ship (M,I) (3) Sveti Nikola (M,I) (4) Proship (I) (5) Kochani (M,I) (6) Vinica (M) (7) Delchevo (M) (8) Berovo (M) (M: for reduction of pollutant load from households, I: for reduction of pollutant load from factories, A: for reduction of pollutant load from agricultural activities-including wastewater from livestock field, prioritization will be based on its urgency, etc.)
		All the Course (L.:180km)	4~5	Dochevo~Kalinanci Reservoir: Water pollution due to wastewater from irrigation water and factories progresses.	5~6	-Zletovica Multipurpose Dam Project (5) -Razloveci Dam Project (14) -Bleto Dam Project (25)			2~4		
Begalnica River (left bank tributary)	All the Course (L.:180km)	At Kochani, where drinking water is supplied through wells, water is polluted due to wastewater from irrigation area.	8~10	Kochani~Confluence with the Vardar: Water pollution progresses.	10~15		-Rechani Multipurpose Dam Project (15)		4~7		2. Implementation of Environmental Impact Study (EIS) and formation of countermeasures for the project proposed in PHASE I. EIS will be carried out for projects proposed in PHASE II and III depending on the necessity.
		At Ship, drinking water supplied through wells is polluted. At Sveti Nikola, water is polluted due to wastewater from livestock farms.	8~10		10~15		-Construction of Irrigation of Sub-system "Shtipsko Pole", left side (16) -Begalnica River Basin Rural Water Supply Project (39)		4~7		

Note: Class I= BOD 2.0 mg/l under, Class II= BOD 2.0~4.0 mg/l, Class III= BOD 4.0~7.0 mg/l, Class IV= BOD 7.0~30.0 mg/l

Table 8.1 Water Resources Development Plan and Water Resources Management Plan (Water Quality Conservation Plan) (3/4)

River Basin	River Course	Results of Survey on Current Water Quality and Future Forecast			Water Resources Development Plan			Water Resources Management Plan				
		Current and Pollution Conditions	BOD (mg/l)	Future Forecast	BOD (mg/l)	PHASE I	PHASE II	PHASE III	BOD (mg/l)	Basic Guideline	Water Quality Conservation Plan	
3. Vardar River Lower Reach: Vardar Main Stream	Confluence with the Crna River~Border with Greece (L.:95km)	At Negotino, water is polluted due to wastewater from wineries	5~6	Confluence with the Crna River~Border with Greece: Dilution after joining of the Crna River is expected, but there is much pollutant load due to wastewater from winery, food processing factories and wastewater from irrigation area, from newly developed area in particular.	6~7		•Konso Dam Project (19) •Kovanska Dam Project (18)			2~4	•To provide wastewater treatment facilities so as to control the current water pollution reducing pollutant load within the water quality standard. •To implement EIS for development project and formation of countermeasure if required.	1. Provision of wastewater treatment facilities (1) Bitola (M,I) (2) Prilep (M) (3) Kavadarci (M,I) (4) Gevgelija (M) (5) Kreshevo (M) (6) Demir Hisar (M) (7) Negotino (M,I) (8) Valandovo (M) (M: for reduction of pollutant load from households, I: for reduction of pollutant load from factories, A: for reduction of pollutant load from agricultural activities-including wastewater from livestock field, prioritization will be based on its urgency, etc.)
		At Gevgelija, water is polluted due to wastewater from wineries and food processing factories.	5~6		6~7	•Valandovo Area Irrigation Rehabilitation Project (6)	•Vardar River Lower Reach/Strumica River Basin (40)			2~4		
Crna River	All the Course (L.:220km)	At Krashevo, where drinking water is supplied through the Studenica system, water is polluted due to wastewater from households discharged to sub-tributaries of the Crna river.	9~12	Demir Hisar~Bitola: Water pollution will progress due to increase of wastewater from households and irrigation in the agricultural development on the Pelagonija field.	10~15	•Pelagonija Circle Rural Water Supply Project (37)	•Studenica Supplemental Water Supply Project (17)	•Krapa Dam Project (26) •Zhvani Dam Project (27) •Obednik Dam Project (28) •Kochiste Dam Project (29) •Zhurche Dam Project (30) •Konjarka Dam Project (31)		2~4		2. Implementation of Environmental Impact Study (EIS) and formation of countermeasures for the project proposed in PHASE I. EIS will be carried out for projects proposed in PHASE II and III depending on the necessity.
		At Demir Hisar, where drinking water is supplied through springs, water is polluted due to wastewater from households discharged to the Crna river. Bitola is located on the south of Pelagonia field (area: 56,000ha) with population of 86,000 and the third largest city next to Kumanovo. Water in the Crna river is polluted due to wastewater from households and irrigation area.		Water pollution due to lowering of water level								
	Dojran Lake	Water pollution due to lowering of water level		Water pollution due to lowering of water level								

Note: Class I= BOD 2.0 mg/l under, Class II= BOD 2.0~4.0 mg/l, Class III= BOD 4.0~7.0 mg/l, Class IV= BOD 7.0~20.0 mg/l

Table 8.1 Water Resources Development Plan and Water Resources Management Plan (Water Quality Conservation Plan) (4/4)

River Basin	River Course	Results of Survey on Current Water Quality and Future Forecast		Water Resources Development Plan			Water Resources Management Plan				
		Current and Pollution Conditions	BOD (mg/l)	Future Forecast	BOD (mg/l)	PHASE I	PHASE II	PHASE III	BOD (mg/l)	Basic Guideline	Water Quality Conservation Plan
4. Crn Drim River Basin	Ohrid lake~Shpijje Dam~Border with Albania (L:40km)	In this river basin, pollutant load is relatively low and water quality is good condition. In the Ohrid and Prespa lakes, water is polluted in summer season when tourists increase.	2~4	Ohrid Lake~Shpijje Dam: In this river basin, pollutant load is relatively low and water quality is good condition. In the Ohrid and Prespa lakes, water is polluted in summer season when tourists increase.	2~4	• Irrigation System Betterment Project in Resen (7)	• Ohrid Area Irrigation Rehabilitation Project (20) • Southwest Mountains Area Rural Water Supply Project (41)			• To provide wastewater treatment facilities so as to control the current water pollution reducing pollutant load within the water quality standard. • To implement EIS for development project and formation of countermeasure if required.	1. Provision of wastewater treatment facilities (1) Resen (M) (2) Ohrid (M) (3) Struga (M) (4) Debar (M)
5. Strumica River	Most upstream~Border with Bulgaria (L: 70km)	At Radovish where drinking water is supplied through groundwater. Water is polluted in summer season due to wastewater from mining.	15~18	Strumica~Border with Bulgaria: At present, water in the Strumica River is seriously polluted with Class IV corresponding to BOD more than 20 in the course of downstream from Radovish up to the border with Bulgaria. From now on, further pollution will progress with adverse effects in the river. Suitable countermeasures will be required.	20~25	• Oraovica Dam Project (8)	• Mantovo Area Irrigation Rehabilitation Project (21)	• Podares Dam Project (33)	4~7	• To provide wastewater treatment facilities so as to control the current water pollution reducing pollutant load within the water quality standard. • To implement EIS for development project and formation of countermeasure if required.	1. Provision of wastewater treatment facilities (1) Radovish (M,I) (2) Strumica (M,I)
		At Strumica, water is polluted due to wastewater from household, factories, irrigation area and livestock farms.	15~20	Strumica~Border with Bulgaria: At present, water in the Strumica River is seriously polluted with Class IV corresponding to BOD more than 20 in the course of downstream from Radovish up to the border with Bulgaria. From now on, further pollution will progress with adverse effects in the river. Suitable countermeasures will be required.	25~30		• Strumica Area Irrigation Rehabilitation Project (22)		4~7		2. Implementation of Environmental Impact Study (EIS) and formation of countermeasures for the project proposed in PHASE I. EIS will be carried out for projects proposed in PHASE II and III depending on the necessity.

Note: Class I= BOD 2.0 mg/l under, Class II= BOD 2.0~4.0 mg/l, Class III= BOD 4.0~7.0 mg/l, Class IV= BOD 7.0~20.0 mg/l

Table 8.2 Surface Water and Groundwater Monitoring System Improvement Plan

(a) Water Level Monitoring Network Improvement and Expansion Plan

- Renewal of instruments and new installation of limnigraph

No.	Name of Gauging Station	River Name	Related Water Resources Development Projects
1	Balin Dol (existing)	Vardar River mainstream	Projects located in Vardar Upper Reach
2	Pena	Pena River	Water Supply Pipeline for Tetovo - River Pena Intake
3	Paligrad	Kadina River	Paligrad Multipurpose Dam Project
4	Kiselichka	Kriva River	Kiselichka dsam Project
5	Vakuf	Kriva River	Vakuf Multipurpose Dam Project
6	Slupchanka	Slupchanska River	Slupchanka Dam Project
7	Berovo (existing)	Bregalnica River	Razlovci Dam Priject
8	Bolotino (existing)	Bolotinska River (Crna River)	Development Projects in Pelagonija field (northern part)
9	Bucin (existing)	Crna River	Development Projects in Pelagonija field (western part)
10	Konsko	Konska River	Konsko Dam Project
11	Oraovica	Oraovica River	Oraovica Dam Project
12	Smolarski Most	Strumica River	Development Projects in Strumica River

(b) Flood Forecasting and Warning System Enhancement Plan

- Introducing telemetering system including development of software for prediction of flood discharge

No.	Name of Gauging Station	River Name	Existing or New
1	Balin Dol	Vardar River mainstream	Existing
2	Radusha	Vardar River mainstream	Existing
3	Skopje	Vardar River mainstream	Existing
4	Veles	Vardar River mainstream	Existing
5	Demir Kapija	Vardar River mainstream	Existing
6	Gevgelija	Vardar River mainstream	Existing
7	Vliv	Lepenec River	Existing
8	Nov Dojran	Lake Dojran	Existing
9	Makedonski Brod	Treska River	Existing
10	Modrishte	Treska River	New
11	Sveta Bogorodica	Treska River	New
12	Pelince	Pchinja River	New
13	Katlanovska Banja	Pchinja River	Existing
14	Kriva Palanka	Pchinja River	Existing
15	Berovo	Bregalnica River	Existing
16	Ochi Pale	Bregalnica River	Existing
17	Shtip	Bregalnica River	Existing
18	Dolenci	Crna River	New
19	Buchin	Crna River	Existing
20	Skochivir	Crna River	Existing
21	Vozarci	Crna River	New
22	Borotino	Borotinska River	Existing
23	Sushevo	Strumica River	Existing
24	Novo Selo	Strumica River	Existing
25	Stenje	Lake Prespa	Existing
26	Ohrid	Lake Ohrid	Existing
27	Boshkov Most	Radika River	Existing
28	Shpilje	Crn Drim River	Existing

(c) Surface Water Quality Monitoring Network Enhancement Plan

- Support of regular monitoring works of water quality at existing/planned monitoring stations (by EU-PHARE and Swiss Government) and technology transfer of water quality sampling/analysis and procurement of monitoring instruments

(d) Groundwater Monitoring Network Enhancement Plan

• Improvement of existing groundwater monitoring stations	61 nos. (See Appendix B of Supporting Report 1)
• Installation of land subsidence monitoring stations	10 nos. (Polog (2), Skopje (2), Kochani (2) Pelagonija (2), Vardar lower reach (Gevgelija) (1), Strumica (1))
• Installation of groundwater quality monitoring stations	150 nos. (See Appendix B of Supporting Report 1)

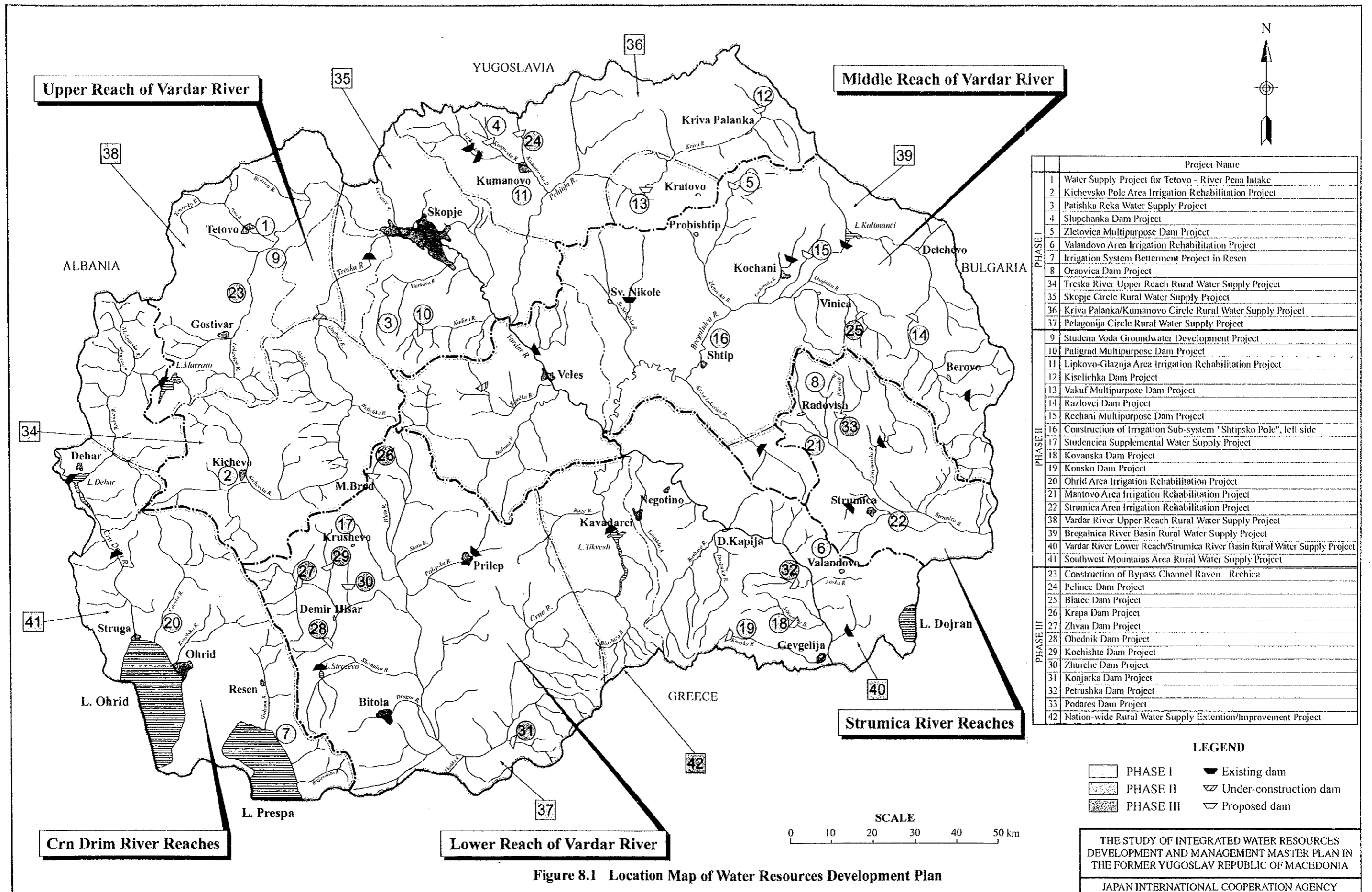


Figure 8.1 Location Map of Water Resources Development Plan

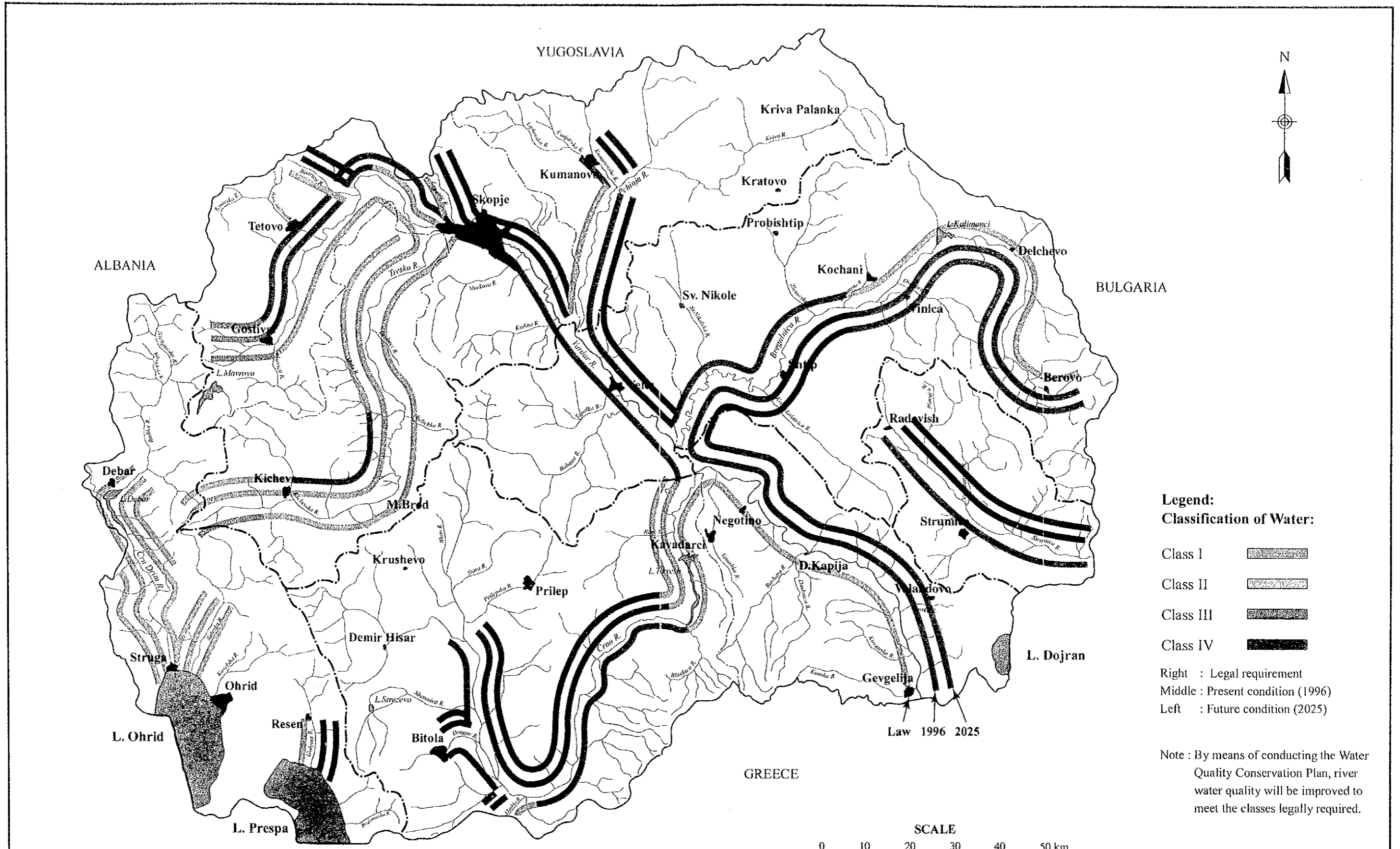
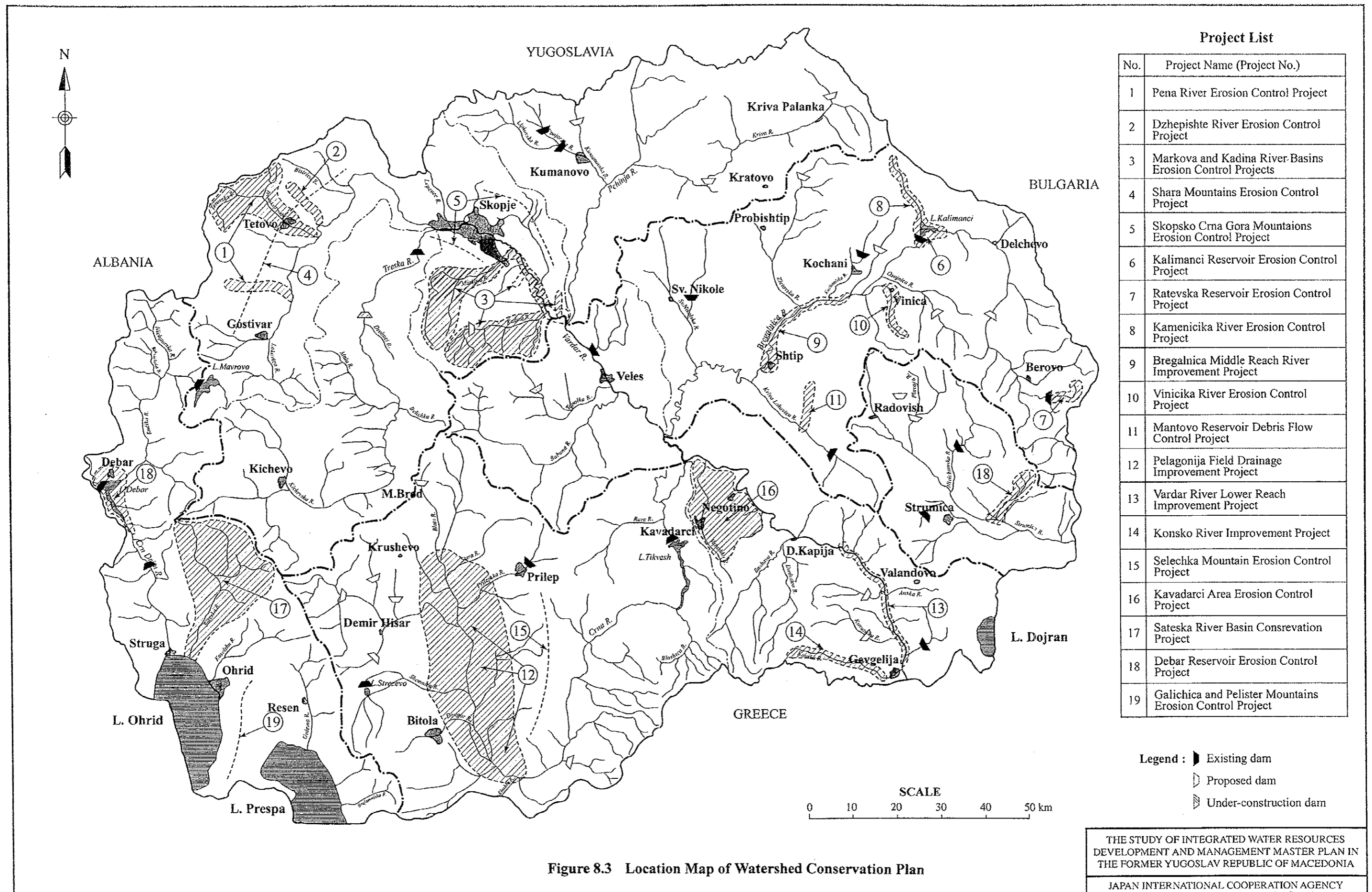


Figure 8.2 Water Quality Legally Required and Estimated Water Quality 1996 and 2025

THE STUDY OF INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT MASTER PLAN IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA
 JAPAN INTERNATIONAL COOPERATION AGENCY



Project List	
No.	Project Name (Project No.)
1	Pena River Erosion Control Project
2	Dzhepishte River Erosion Control Project
3	Markova and Kadina River Basins Erosion Control Projects
4	Shara Mountains Erosion Control Project
5	Skopsko Crna Gora Mountains Erosion Control Project
6	Kalimanci Reservoir Erosion Control Project
7	Ratevska Reservoir Erosion Control Project
8	Kamenicika River Erosion Control Project
9	Bregalnica Middle Reach River Improvement Project
10	Vinicika River Erosion Control Project
11	Mantovo Reservoir Debris Flow Control Project
12	Pelagonija Field Drainage Improvement Project
13	Vardar River Lower Reach Improvement Project
14	Konsko River Improvement Project
15	Selechka Mountain Erosion Control Project
16	Kavadarci Area Erosion Control Project
17	Sateska River Basin Conservation Project
18	Debar Reservoir Erosion Control Project
19	Galichica and Pelister Mountains Erosion Control Project

Legend : Existing dam
 Proposed dam
 Under-construction dam

SCALE
 0 10 20 30 40 50 km

Figure 8.3 Location Map of Watershed Conservation Plan

THE STUDY OF INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT MASTER PLAN IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA
 JAPAN INTERNATIONAL COOPERATION AGENCY

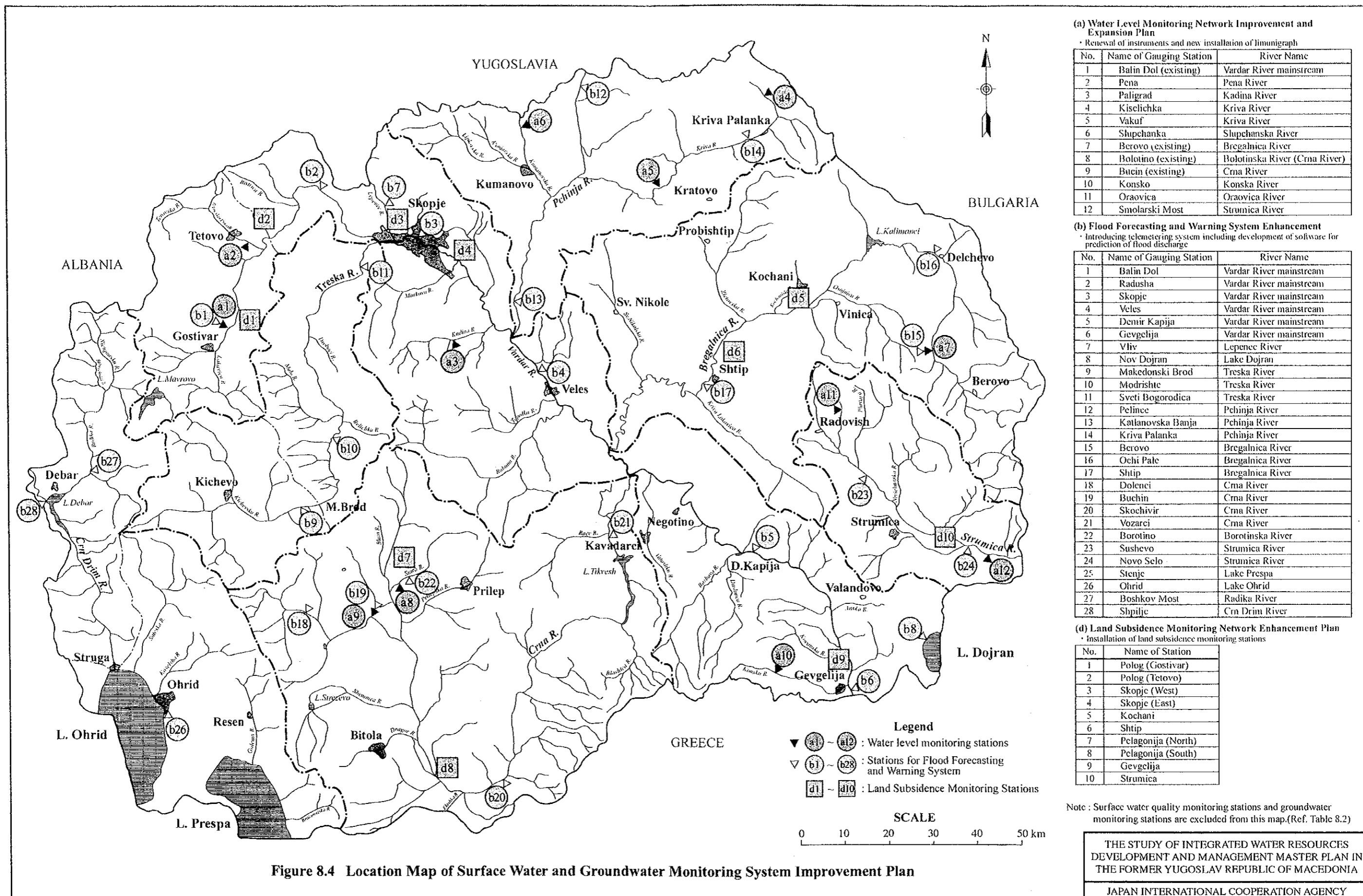


Figure 8.4 Location Map of Surface Water and Groundwater Monitoring System Improvement Plan

THE STUDY OF INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT MASTER PLAN IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA
 JAPAN INTERNATIONAL COOPERATION AGENCY

