ANNEX B.9

IRRIGATION AND DRAINAGE

B.9 IRRIGATION AND DRAINAGE

B.9.1 IRRIGATION

B.9.1.1 DEVELOPMENT AREA OF IRRIGATION SYSTEM

(1) Outline of Land Use

The whole of the Study area is 61,124 ha, and the outline of land use consists of the farmland of 40,247 ha, the forests of 11,038 ha and the urban area of 5,752 ha. Moreover, from a viewpoint of land use, the land can be roughly divided into three large zones; 1) The river land along the Morava River (herein after Morava), 2) The nature Protection area which is sandwiched between Morava and Malolevarsky-Zohorsky Canal (Protection area, where organic agriculture can be conducted), and 3) Positive Agricultural Production Area (including the forests).

Land Use of the Study Area

Item		River land	Protection area	General activity	Total
		(km^2)	(km^2)	(km^2)	(km^2)
Inundation area		40.87			40.87
Farmland	-Non irrigation area		85.84	154.4	240.24
	-Irrigation area		6.12	156.12	162.24
	Sub-total		91.96	310.51	402.47
Forest			33.63	76.75	110.38
Others (village, reservoir)			4.16	53.36	57.52
Total		40.87	129.75	440.62	611.24

(source: Evaluation from 1/50,000 topographic map)

(2) Development Area of Irrigation System

The arable land of Slovakia extends over an area of 1,461,000 ha, of which the irrigated area is 314,000 ha. Many of the irrigation facilities in this area were built during the period from 1970 through 1990. In Zahorska Lowland, irrigation for crop growing started in the early 1970s, and the present irrigation facilities were completed by 1985.

Since the development act there are 8,584 ha of restricted farmland, which is in the Protection Area, within the total farmland of 40,247 ha, it is engaged in agricultural production without any improvement of natural conditions, except for the existing irrigated land districts in two areas (612 ha). Therefore, 15,612 ha within the Positive Agricultural Production Zone's, out of 31,051 ha, are endowed with irrigation systems. From the total of 40,247 ha of agricultural land, the irrigation area of 16,224 ha became a rate of 40%, and from a viewpoint of the Slovakia's average, the irrigation facility level is high.

Agriculture Land and Irrigation area

Irrigation area (ha)	Slovakia		Study area	
	308,214		16,224	
Land use (ha)	Agriculture land	Arable Land	Agriculture land	Arable land
Area (ha)	2,446,000	1,479,000	40,248	31,051
Rate (%)	12.6	20.8	40.3	52.2

The developed irrigation area and location of irrigation system are shown in Table B.9.1.1, Figure B.9.1.1. The irrigation was designed to increase the productivity of the land. Sixty percent of the irrigation crop is grain such as wheat and barley, with the balance shared by sunflower, maize, potato, and vegetable.

(3) Areas devoid of Irrigation Facilities, and Farming in such Areas

Major areas where no irrigation facilities are provided are Zohor of about 1,000 ha, Plavecky podhradia of 1,500 ha between Zohoznic and Plavecky, and Barsky Svarty Jur of 700 ha. Another approximately 8,000 ha area is present in the Protected Landscape Area. The reasons are that the development of surface water sources was more severely restricted than in other areas. Agriculture, however, is run in an extensive way mainly to produce grain, and there is not a lot of land unused because of the lack of irrigation facilities. Also, the Protected Landscape Area carries on its farming under the policy of no irrigation and no development of irrigation facilities in the cause of nature conservation. Hence, extensive farming of grain and sunflower is done in this district.

B.9.1.2 WATER RESOURCE FOR THE IRRIGATION SYSTEM

The water resource for the 21 irrigation systems is taken respectively from tributaries of the Morava (Malina, Rudava), the Malolevarsky Canal (herein after Malolevarsky) and 7 reservoirs. The benefitting areas of each one of the 21 irrigation systems are shown in Table B. 9.1.3.

(1) Morava

From the Morava, two pump stations carry out direct water intake. One of them is the Stupava CS 01 pump station located to the Southern part of the Study area, and this pump station only supplies water to three irrigation systems. Another one is Zpv.Levare Malacky at the intake located in Gajary. This pump station is supplying water to two irrigation systems.

(2) Malolevarsky

From the Malolevarsky (artificial canal with intakes from Morava and which also functions as a drainage canal), two intakes are installed. This canal is supplying water to three irrigation systems (Sekule Male Levare CSV3, and CSV4, CSV5).

(3) Malina

From the Malina River (herein after Malina), two pump stations (Stupava IIC4 and Jakubov) carry water from direct intake and Stupava IIC4 is supplying water to Stupava IIC4a.

(4) Intakes from reservoirs

Several dams are built in the upper region of Malina and Rudava River (herein after Rudava), and the storage of water is also used for the irrigation systems. Four reservoirs are being built at Malina basin system and three reservoirs are constructed at Rudava basin system. The seven reservoirs are used by seven irrigation systems in the Study area. (Refer to Table B.9.1.3).

(5) Others

Other intakes are using an intake located at a small stream (Jablonove), and there is a creek with two more water intakes from a pond. The location of each water resource and intake structure is shown in Figure B.9.1.2.

B.9.1.3 FUNCTION AND MAINTENANCE OF IRRIGATION FACILITIES

(1) Intake Facilities

1) Structure and Function

a. Intake from Morava

Two intake sites are situated in Stupava and Gajary, and their structures are not based on the weirs. The Gajary take water from the Morava by gravity. Therefore, the amount of water taken by the structures is influenced by the Morava water level. The gate where intakes are located, aimed at controlling the water level of the Morava is not installed so far. These pump stations, using their sluice gates conduct water to the pumps by means of the pipelines. Although the conducting pipeline of Stupava CS 01 was as long as 800m and it was an open canal at the beginning of construction, circumstances have changed, and it has been reported that the planned amount of water has not been flowing from the intake to the pump station.

b. Intake from Malolevarsky

The Malolevarsky takes water from the Morava near Holic, goes across Myjava by siphon, and conducts water to the Study area. From the canal, two pump stations (Sekule-Male Levare CSV3, CV4) receive water. A water-intake-type structure also takes water from the Malolevarsky, and this structure is designed to stabilise water level at the intake sites. CV5 is pumping out water at an intake from Laksarsky by a weir, but water resource is received from CV3. However, as irrigation water is used the remaining water goes to Laksarsky.

c. Intake from Malina

Two pump stations take their water from Malina and both of them are gravity Intakes. Therefore, the amount of water taken by these pump stations is influenced by the water level of Malina. One of them, the Jakubov site is not being used now. Intake facilities are damaged and another, at Stupava IICVs4 is presently useless. Moreover, it is about 500m away from the intake gate to the pump station, and is presently also buried with sediment. In the meantime, it cannot be used, although water is conducted by pipeline.

d. Reservoir

In this Study area, six irrigation systems use the sources from seven reservoirs. An earth-type dam is also built there. Intake facilities are a tower structure made in concrete, and it is presently supplying water via a pipeline to the pump stations adjacent to the dam. The lower stream of the river. Lozorno Lintavy is not used now because its intake control gate is damaged. Although the area over which irrigation is planned at the sources of the reservoir is about 3,320 ha, the area actually used is 715 ha. (Refer to Table B.9.1.3). The dam also regulates field floods, and the management of this is good. Moreover, the surroundings of the reservoir constitute a recreation zone.

e. Other water sources for intakes

Jablonove Pump Station using the Jablonovsky stream stabilizes the water level by means of a wooden weir, and it also serves as an intake.The pump station is not used now but the intake facility is used for other purposes. In addition, there are two pump stations, which are using the water of a pond. One of them, Vysoka pri Morava is conducting water directly from the pond. However, it has been damaged and intake and pump facilities are not being used presently. Irrigation is not carried out, although the Zahorska ves and the Vysoka pri Morava are the same intake types as are in satisfactory condition.

2) Maintenance

Operation of facilities, such as weirs, intakes, gates, intake tower of reservoirs, etc., is in the hands of Manpower. Although there is what is regarded as a wooden gate needing to be exchanged, since gates and screens are made in Slovakia, repair can be done domestically. Maintenance management of intake facilities is performed together with the pump stations. Repairs based on a new plan are required and Stupava I CV0 and Stupava II C4 have a structural problem in their conducting pipeline.

(2) Pump Facilities

1) Structure and Functions

Pumps are installed in sets ranging from 2-10 according to the area of each irrigation system, and, diameter 125-300mm according to the amount of pumping. The pump caliber planned is in the range of 30-210 kw, with 1,640-24,000 l/min. motor capacity. The water volume for irrigation is controlled by the number of operating pumps. Management of "ON, OFF" switching of the pump is controlled by a pressure tank. The models of 23 pump stations, standards, pump head (left: m), and output (kw) are shown in Table B.9.1.2.

2) Maintenance

The management situation is complicated by the need for repairs. The 23 pump stations are classified into the following four operation management conditions.

Category of Functional Condition

Category	Contents	Number of station	Irrigation Area (ha)
Category I	Pump stations operated for irrigation in 2001.	8	9,980
Category II	Pump stations that have not operated in recent 2-3years because of some parts of the equipment in spite of the full facilities.	3	2,380
Category III	Pump stations that have not operated 5 years or more because of damage of the pressure tank , switchboard and etc.	4	1,179
Category IV	Pump stations that are not operable because of loss of principle part of equipment.	6	2,685

Evaluation year of Facilities in 2001 by JICA

As seen in the above table, in Category IV, since many pumps and motors are either damaged or have been lost by theft, almost the whole machine and equipment must be newly provided or repaired. The pump stations in Category III, though operated only for a short period of time, have been abandoned and not operated for more than 10 years now. They are judged that it is not fit to resume operation unless extensively reconditioned beyond the replenishment of parts and the replacement of motor components. In this particular case, the control panels, transformers and pressure tanks are assumed to be unusable. Category II is judged to be operable after repairing damaged parts and providing necessary parts. Category I pumps were operated in 2001. Since some of these pumps were operated by replacing their parts with the counterparts from the other pumps, the same action should be taken as that of Category II.

These pumps were manufactured in Czechoslovakia from the 1960s to the 1980s, and parts required for management are imported from Czech. For the financial phase of maintenance, a system is used by which the Maintenance Company is obliged to submit a parts procurement program and its budget to SWME-PD and bill the cost after the purchase. Under SWME-PD's procurement budget, the Maintenance Company is trying hard to reduce the purchase of new parts to the minimum and is doing its best to use parts now in stock or by replacing inoperable pumps with similar pumps. Some pumps were renewed in Malacky II CS Gajary in 1998 and in Sekule-Male Levare CSV4 in 1999. Also, Rohoznik had its pumps, motors and control panels entirely renewed.

(3) Pipeline Facilities

1) Function and Structure

The pipeline network consists of a reticulate pipeline system. The control valves are arranged in water supply divisions of 200-400 ha/unit of farmland. The water administrator (SWME-ID and Management Companies) is supplying water by opening the valve of a water supply division according to a user's request. A user receives water from the water tap (hydrant) established in the farmland, and is irrigating by sprinkler etc. The amount of water supplied by hydrant is 20-30 l/sec, and serves as an irrigation system suitable for a large scale irrigation site. The asbestos pipe and the steel pipe beyond it have a diameter from 125 to 400 mm. For management, related pipeline facilities such as drain valves are installed in the end of the pipeline, and at the high part of the pipeline, for air valve and water supply control.

2) Maintenance

The irrigation area of this Study area decreased by 10-20% in 1994 and afterwards, and there is an area that has not been irrigated for ten years or longer. The functioning of pipeline that has not been used for a long period of time cannot be checked visually, since it is underground. The water administrator has not conducted a proper functional check to the water supply system of the pipeline by checking the position of the valve from the ground, existence of hydrants, etc. Therefore, a prior water supply test is required for the area, which has not been operating for several years.

The pipelines were built from 1960 to the 1970s and a pipe of 400mm or less is an asbestos pipe. However, the asbestos pipe, under manufacture prohibition on health grounds, is not used and/or made in Slovakia. Broken pipes are changed into polyethylene pipes etc., but it depends on foreign nations to supply connecting equipment (The Netherlands).

Breakage accidents of hydrants have all been caused by agricultural work with large scale farm machinery. On the other hand, it is reported that the breakage of pipeline is due to many causes, such as building construction and construction work of gas pipelines. Measures to reduce these accidents are required from now on. About the pipeline management the management company making repairs of these breakage pipeline, and large scale repairs such as valve exchange, is reported to SWME-PD, and the repair plan is prepared after approval of it.

3) Functional Evaluation of Pipelines Related to Water Flow Test

The water flow test was performed in order to evaluate the function of control facilities, such as a water supply function of pipelines that have not been used for five to ten years or more, and hydrants, and their respective valve ends, etc. Sekule-Male-Levare CS V5 was selected as a flow test area, although the present pump was functioning, the irrigation system had been least used. Although this irrigation area consists of 759 ha, it has not been irrigated since 1994 except for 20-50 ha. The 6 main pipelines that are not used last 5 to 10 years were selected for water flow test, which supplied water along about 16km of the total length.

The number and particulars of facilities subjected to the function test are as follows:

Contents of Water Flow Test

Facilities	Pipeline (125-500 diameter) km	Hydrants	Air valve	Water control valve
Contents of test	Water-flow test over 15.3 km distance	Water discharge test at 12 points	Function check at 3 points	Open/close test at 6 points

a. Pipe Capability for Water Conduction

Water was fed to the water supply test from the end of hydrants of 6 main pipelines (total length; 16km), and it was checked that water could be supplied at a predetermined pressure (8kg/cm^2). Therefore, it can be judged whether this section has had accidents, such as breaking of pipes, and other breakage. In the whole area, breakage occurred in three sites and it has become an obstacle in the pipeline now. Therefore, one can assume that one case of damage has arisen in an average of 200 to 300 ha.

b. The Function of Hydrants

A pinhole needs to be on the opening-and-closing valve of a Hydrant and one in 12 Hydrantsneed to be exchanged. The fault is generated by degradation of valve steel materials, and this deterioration is considered to be progressing. In farmland where cultivation and harvest is done by large scale machines, breakage (three sites) of Hydrants and protection facilities, earth-and-sand burying (one site), etc. have arisen, there is much damage done by the farming, and management is poor.

c. Air Valve

In the upper part of geographical features the exhaust function is operating. The air valve is set in the upper parts, such as a water pipe bridge, which crosses a river, and there is little damage by farming.

d. Control Valve

The opening-and-closing operation is taking place in most of the valves for the first time in several years, and although there is no part which cannot be opened and closed, the operation has been conducted by a third person. Operation of valve ends of 200 mm diameter pipeline is difficult. Rust is attached to the pipes. Moreover, if it is buried with earth and sand, and the position had not been checked damage by agricultural work is likely. It is expected that the above results of the study will be used as a guideline for exploration and evaluation of other irrigation systems , and for management of maintenance of an irrigation system.

(4) Farmland Irrigation Facilities

Provision of irrigation facilities after the hydrant, such as, reel hose sprinkler, drip irrigation, and other equipments, depends on the farmer. Therefore, the farmer who wishes to fulfill his irrigation needs has to arrange irrigation equipment by himself. Irrigation in the Study area is conducted by 12 farmers and one cooperative. Many farms are managed by a company and now, there is no private management. In 1994 and afterwards, the irrigation area was in the range of 2,000-3,000 ha, and, incidentally was 2,978 ha in 2001.

The reason for reduction of irrigation use in 1994 and afterwards was:

1) Almost no irrigation for winter wheat.
2) Farmers cannot buy irrigation equipment, nor improve or maintain deteriorating facilities creating difficulty in operation.
3) Water does not come to farmland due to failure of main infrastructure, etc.

These are the main causes. Moreover, the subsidy to irrigation equipment is 70%. A subsidy is applied for from the government after purchase.

According to the study made by RIMLE in 2000 on the provision of irrigation facilities, of the farmland having irrigation facilities, farmers who have their own water spreading facilities accounted for 57% over the whole country of Slovakia and 45% in Zahorska Lowland. The study found that more than 60% of the irrigation equipment owned by farmers was older than its serviceable life of 12 years or a little longer. The share of equipment 8 to 12 years old was estimated at 20%. Five years from now, it is forecast that the operating rate of irrigation equipment may further go down, as more than 80% of the currently operating equipment will exceed its serviceable life.

For irrigation equipment, the proportion of reel-hose sprinklers stands at 95%. This type of sprinkler is suitable for spreading water to grain. In recent years, as drip irrigation and hose irrigation have been introduced and their use is now spreading into potato and vegetable irrigation, the introduction of an irrigation system capable of controlling water volume is indispensable.

Condition of field irrigation facilities

Item	No. of facility	No. of function	%	Use period (year)							
				Less than 4		4 - 8		8 - 12		More than 12	
				No.	%	No.	%	No.	%	No.	%
Slovak(196,643ha)											
Line irrigation (ks)	6,678	3,918	58.7	444.0	6.6	318.0	4.8	1,439.0	21.5	4,477.0	67.0
Rotation irrigation(ks)	436	243	55.7	3.0	0.7	3.0	0.7	96.0	22.0	334.0	76.6
Other (ha)	4,599	3,531	76.8	1,070.0	23.3	395.0	8.6	471.0	10.2	2,663.0	57.9
Zahorska Lowland(9,266ha)											
Line irrigation (ks)	439	300	68.3	25.0	5.7	0.0	0.0	136.0	31.0	278.0	63.3
Rotation irrigation (ks)	9	7	77.8	0.0	0.0	0.0	0.0	0.0	0.0	9.0	100.0
Other(ha)	29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.0	100.0

Source; Analza technologickeho stavu zavlahoveho detailu na slovensku (2000)

B.9.1.4 WATER SUPPLY SYSTEM AND IRRIGATION TECHNIQUES

(1) Water Supply System

The privatization processing was in progress after 1989. Land use and the old farming methods have been changing, thus the state farm has been replaced by a farming company or by an individual farmer. As for irrigation, water costs and irrigation crops have been selected for those with the highest irrigation effect. Therefore, the localization of irrigation and area are now on a small-scale and there is also an area that cannot use the services of the existing pipeline network. In such an area, the pipeline system has changed into one where application is conducted directly by the user.

(2) Irrigation Techniques

The most common irrigation technique in the Study area is by pressure. Pressurized water goes through a pipe network from the pump stations, and then it is conducted to the farmlands. Hydrants (water tap) are arranged at a rate of one for each 2 to 4 ha farm, and it has become the system that can send water by pressure to the farm units. The farmer, in time of irrigation, irrigates by using equipment, such as reel hoses, sprinklers, and drip hoses from hydrants. Moreover, although it is at a small-scale within the Study area, groundwater irrigation is also performed at the zone of Male Levare (90 ha).

B.9.1.5 MAINTENANCE AND MANAGEMENT ORGANIZATION

(1) Maintenance and Management

All intake facilities of the irrigation systems, as well as the pump stations, and pipelines are under the supervision of SWME-PD, and their property is controlled by the State. There are some areas where maintenance management of such facilities is conducted by SWME-PD directly, on an individual irrigation system basis, and there are areas under the management of a Maintenance Company. Out of the twenty-three pump stations located within the Study area, 8 are maintained by SWME-PD, and the other 13 sites are managed by a private company(11) and PD(4). The administrator in charge of maintenance management for each pump station is shown in Table 9.1.1. On the other hand, hydrants for farms and related devices such as sprinklers, etc. are set and managed by the farmers. Maintenance and operation as to which Maintenance Company is commissioned is as follow;

1) Operation and maintenance management of a pump for water supply by request from users
2) Management of the pipeline for water supply (opening and closing of valves, pipe management in winter)
3) Minor repair of intakes, pumps, and pipelines, and exchange of parts
4) The maintenance management plan for each year (the creation of the budget document for repair is included)

Maintenance of important facilities, repair, etc. is separately planned after discussing with SWME-PD.

(2) Water Management

1) Condition of Water Use Volume for Irrigation

The irrigated surface of the Danube area including Malacky is 141, 760 ha. Among those 19,097 ha are managed by the SVP. Malacky Office, the Study area is 15,915 ha. The amount of water for irrigation of these areas is as follows. Malaky area and the Study area is using an amount of unit irrigation water (m^3/ha) that is 27% of Danube area, this means a low level.

Water Use Volume (1)

Area / Item	Unit	Area		
		Donau	Malacky	Study area
Water amount	m3	41,760,109	1,724,888	1,555,623
Irrigation area	ha	141,760	21,795	16,224
Water amount per ha	m3/ha	295	79	96

Source; SWME-PD (Amount of irrigation water in 2001)

Farmers decide which shall be the irrigation day and connect irrigation to a facility managed by the company or SWME-PD (Pump station of the SVP. Malacky Office or Maintenance Company) in advance, then decide the irrigation time based upon the state of moisture of the field, and then decide the irrigation amount per ha for every year. This irrigation amount of water is 72.5 mm/year at an average (725 m^3/year).

Water Use Volume (2)

Irrigation District (Company farm)	Malacky I,II						Sekule V3	Kutty	Total
	Jakos	Agra.	Agreal	Asparagus	Agro.	Chmela	Agroplamt	Mipros	
Water volume (m^3)/2001	234,000	415,800	44,990	181,552	23,050	800	6,200	140,331	1,046,723
Irrigation area (ha)	535	990	30	100	85	10	18	150	1,918
Unit water volume (m^3/ha/year)	437	420	1,500	1,816	271	80	344	936	725
Crops	Sunflower, maize	Sunflower, maize	Vegetable, potato	Asparagus	-	-	vegetable	Asparagus, Potato	

Source ; Inservice, HMU: Water management company

From the above table, the annual amount of the irrigation water can be estimated with average 770m^3/year. The annual consumption of water by Asparagus is 1,816 m^3/year which is the largest consumption for crops. The irrigation has been done in intervals of 5-7 days, except drip irrigation. The amount of irrigation during a day (one time) is a standard 30mm.

2) Operation for Water Use

Those persons using irrigation water only pay the water bill and do not participate in management and maintenance. A user uses the water, which comes from the water tap (Hydrant) of its farm. The Maintenance Company sends water at the time requested by the users. The water supply time zone serves as AM11:00 to PM17:00 when an electricity bill becomes relatively cheap.

3) Users Organization

There is no irrigation system which has a user's organization in the Area. Even if two or more users in one irrigation system use water, there is no organization like a water supply association that coodinates users. A user connects use of water with SWME-PD or Maintenance Company, and is in the relationshipof one who pays the water bill, and does not participate in maintenance or management of facilities, water distribution, etc. Now, since water demand is very low in the planned irrigation area, problems, such as users' water distribution, and have not appeared. On the other hand, request for access to a user's facility is weak, and since demand for an improvement of irrigation facilities, irrigation facilities restoration prospect, etc. are not in sight, decline of investment in irrigation agriculture is seen ahead.

B.9.1.6 WATER CHARGE

(1) Direct Water Cost

When using irrigation water, users contact SWME-PD or a Maintenance Company in advance, and request water supply. The payee of the water bill and the system of the subsidy are as follows.
Water supply expense which a farmer pays;
- Basic price……..... 1.8 SKK/m^3 (state)
- Maintenance cost…… 0.3-1.0 SKK/m^3 (State or Maintenance Company)
- Electricity bill..... 0.3-0.7 SKK/m^3 (State or Maintenance Company)

Subsidy to water supply cost is 70% of the basic price and the electricity bill. A subsidy is charged and paid by the state after the irrigation term. Thereby, a farmer's average water supply expense is from 1.63 to 75SKK/m^3.

Moreover, the government pays the following costs as facility maintenance administrative expenses and operation administrative expenses to the Maintenance Company.

- As for managed total irrigation area.....…..…..... 190 SKK/ha /year
- As for pump operation management 0.35/SKK/m3

(2) Irrigation Cost

The irrigation cost consists of the labor expense for irrigation with the depreciation cost of the irrigation equipment and tools besides above mentioned direct water cost. The irrigation cost which consists of these total costs is estimated as 2,523 SKK per ha in the case of consumptive water volume 600m3/year (refer to Table B.9.1.14). In the wheat production, an economical effect of irrigation cannot be expected. Therefore, irrigation to wheat is not done by farmers. The irrigation cost by reel hose is shown as follows (Refer to Table B.9.1.14).

Irrigation Cost

Item	Man power Cost (SKK)	Transportation cost (SKK)	Irrigation cost (SKK)	Total of year expenditure (SKK)	Water cost (600m^3/ha/year) (SKK)	Total cost(100ha) (SKK)	Cost per ha (SKK)
Cost	34,793.7	5,000.0	33,333.3	74,250.0	105,000.0	252,377.0	2,523.8

The irrigation cost in the above table is an amount of money on the farmers side by which the subsidy is received.

B.9.1.7 USE CONDITION OF IRRIGATION FACILITIES

(1) Function Area of Irrigation Facilities

The irrigation system of the Study area consists of 23 pump stations, and 21 irrigation systems, and an irrigation area of 16,224 ha is fixed. However, the area under irrigation is falling since 1994. Incidentally, the irrigation area in 2001 is 18.4 % of irrigation maintenance area, at a low level of 2,978 ha, and, as for operation of Pump stations, ten sites and eight irrigation systems are used. (Refer to Table 9.1.3, Figure1.2.3). The average irrigation area is about 1,740ha with the utilization ratio standing at 10.7%.

Average Irrigation Area

No. of irrigation system	Area of irrigation (ha)	Item	1994	1995	1996	1997	1998	1999	2000	2001
21	16,224	Water Amount (m3)	2,486,000	1,620,344	556.675	411,943	828,892	372,598	2,031,207	1,555,623
21	16.224	Irrigation Area (ha)	3,290	2,695	924	685	1,376	620	1,376	2,978

Source; SWME-PD

The main reason is a shift in the social system to market economy, in which agriculture has changed from state farms to private farms run by corporate farmers and independent farmers. Under the pressure of economical farming, farmers have reduced grain irrigation.

(2) Irrigation for Winter Wheat

Winter wheat is on the economic borderline to allow farming without irrigation, and its irrigation is limited to drought years only. Moreover, difference in yields from farming "with irrigation" and "without irrigation" is evaluated to be within a range of around 10% (according to RIMLE test farm data and farmer inquiry survey). If so, the merits of irrigation in terms of farm management are too small to allow irrigation farming in a year of average rainfall.

Ratio of Irrigation Costs and Sales Price

Wheat cultivation	Unit	Without irrigation			With irrigation (Increase 10.0 %)			With irrigation (Increase 20.0 %)		
Yield	t/ha	2.0	3.0	4.0	2.2	3.3	4.4	2.4	3.6	4.8
Unit sales price	SKK/t	4,000.0								
i) Total sale praise	SKK/t	8,000.0	12,000.0	16,000.0	8,800.0	13,200.0	17,600.0	9,600.0	14,400.0	19,200.0
ii) Irrigation cost	SKK/t	0.0	0.0	0.0	2,523.8	2,523.8	2,523.8	2,523.8	2,523.8	2,523.8
i)-ii) Revenue and expenditure	SKK/t	8,000.0	12,000.0	16,000.0	6,276.2	10,676.2	15,076.2	7,076.2	11,876.2	16,676.2
Amount of surplus/deficit	SKK/t	0.0	0.0	0.0	-1,723.8	-1,323.8	-923.8	-923.8	-123.8	676.2
Ratio of irrigation costs to Sales price	%	0	0	0	29	19	14	26	18	13

From the above table, it will be seen that irrigation expenses may be difficult to recuperate unless irrigation increases the yield by more than 20%. Therefore, without some external impacts such as a boost in the market price of wheat or new protective policies taken by the state, the expansion of irrigation water for winter wheat use seems impracticable. At present, irrigation is applied only to such crops as asparagus, potato, sunflower, vegetable and alfalfa that can greatly benefit from irrigation. The effect of the production increase of the irrigation of these crops is 30-50% or more on the average （Refer to Table B.9.1.16）. In particular, irrigation is indispensable for asparagus, potato and vegetable because these products cannot attain commercial quality without the help of irrigation.

B.9.1.8 WATER REQUIREMENT FOR IRRIGATION SYSTEM

Because of meteorological conditions (mainly rainfall) and evapotranspiration, crop growing in Slovakia requires an irrigation water supply to yield products of commercial quality. The relationship between rainfall and evapotranspiration is analyzed as follows:

Monthly Average Value of Temperature (T), Precipitation (Z), Potential Evapotranspiration (ETO) and actual Evapotranspration (ET) in Hurbanovo) for the 1951 to 1980 Period

Month	Unit	Jua.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature	℃	-1.5	0.7	5	10.5	15.2	18.8	20.1	19.4	15.3	10	5	0.8
Precipitation	mm	33	34	29	41	52	69	61	52	41	38	54	42
Potential Evapotranspiration	mm	2	14	41	71	106	123	131	110	68	36	13	5
Actual Evapotranspiration	mm	2	9	28	53	88	84	69	52	33	21	9	3

Source: Scientific Papers (The Research Institute of Irrigation Bratislava)

The actual water volume of irrigation in the Study area is shown in the following table. (Refer to Table B.9.1.13)

Unit Water Requirement from Actual Irrigation

District	Cultivated area(ha)	unit	Irrigation period							
			Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Total
The study area (2001)	1,750	m^3	18,000	203,900	407,500	446,000	348,600	163,000		1,569,000
	1	ha:m^3	10	117	233	255	199	93		897
The study area (2000)	1,376	ha:m^3	13,746	244,590	638,480	296,460	91,850	60,700	650,000	1,982,080
	1	m^3/ha	10	178	464	215	67	44	472.38	1,440
Average water requirement		m^3/ha	10	147	348	235	133	69	236.19	1,169
Average water requirement		mm/mon	1.01	14.71	34.84	23.52	13.30	6.86	23.62	117
Water requirement (6hr;22days)		l/sec/ha	0.02	0.3	0.7	0.5	0.3	0.1	0.5	-

Note: Irrigation time 22 days, 6 hour

The peak amount of irrigation water is 348 m3 in June and the consumptive use is set to 34.8 millimeters. From the result of data analysis, water requirement of each irrigation system in the Study area is estimated as shown in the table below.

Water Requirement for Irrigation Systems

No.	Name of pump station	Planning area of irrigation	Unit Water require - ment	Farming Area			Water requirement		
				Operating area in 2001	43 % of whole area	60 % of whole	Operating area in 2001	43 % of whole	60 % of whole
		(ha)	l/sec/ha	(ha)	(ha)	(ha)	(ha)	I/sec	I/sec
P.1	ZD DNV-STUPAVA I. CS 01(P2+P3+P4)	-	0.7	242	0	0	169.4	0	0
P.2	ZD DNV-STUPAVA I. CS 1	939	0.7	243	404	563	170.1	122	237
P.3	ZD DNV-STUPAVA I. CS 2	855	0.7	244	368	513	170.8	111	215
P.4	ZD DNV-STUPAVA I. CS 3	648	0.7	245	279	389	171.5	84	163
P.5	ZD DNV-STUPAVA II. CS 4	559	0.7	246	240	335	172.2	72	141
P.6	ZD DNV-STUPAVA II. CS 4A	110	0.7	247	47	66	172.9	14	28
P.7	ZP Zahorska Ves	313	0.7	248	135	188	173.6	41	79
P.8	ZH Lozorno – Lintavy	120	0.7	249	52	72	174.3	16	30
P.9	ZH Jablonove	54	0.7	250	23	32	175.0	7	14
P.10	ZK Jakubov	100	0.7	251	43	60	175.7	13	25
P.11	Malacky I. CS Gajary(P12+P13)	-	0.7	252	0	0	176.4	0	0
P.12	ZP V. Levare- Malacky I. CS Dolecky	2,066	0.7	253	888	1,240	177.1	267	521
P.13	ZP V. Levare- Malacky II CS Kostoliste.	4,407	0.7	254	1,895	2,644	177.8	570	1,111
P.14	ZP z VN Lozorno I. CS1(+P15)	440	0.7	255	189	264	178.5	57	111
P.15	ZP z VN Lozorno I. CS2	935	0.7	256	402	561	179.2	121	236
P.16	ZP z VN Kuchyna	490	0.7	257	211	294	179.9	63	123
P.17	ZP Plavecky Sv. Peter	600	0.7	258	258	360	180.6	78	151
P.18	ZP Rohoznik	200	0.7	259	86	120	181.3	26	50
P.19	ZP Sekule-Male Levare I. CS V3 Sekule	653	0.7	260	281	392	182.0	85	165
P.20	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	0.7	261	487	679	182.7	147	285
P.21	ZP Sekule-Male Levare I. CS V5 Male Levare	759	0.7	262	326	455	183.4	98	191
P.22	ZP Husky CS Tomky	535	0.7	263	230	321	184.1	69	135
P.23	Vysoka pri Morava	309	0.7	264	133	185	184.8	40	78
Total		16,224		5,555	6,843	9,549	3,889	2,060	4,011

Note: Irrigation time : 22days/month, 6hour/day

Forty-three per cent and sixty per cent (43% and 60%) respectively, are the real actual irrigation area ratios to the total irrigation facility-endowed area. The supply potential and the water rights of this source of peak water for irrigation are in the range that can be currently utilized.

SWME-ID estimates the amount of water for irrigation with consideration to soil and weather conditions. Calculation of the amount of water for irrigation is required to build the Biological Curve Method.

Water Requirement by Biological Curve Method

(Malacky)

Crops	Water requirement [mm] 1998 - 2001				Water requirement (m3/ha)
	Sandy soil	Loamy soil	Clay	Average	
Peas	52.50	20.00	30.00	34.17	342
Spring barley	67.50	40.00	60.00	55.83	558
Lucerne	225.00	106.67	195.00	175.56	1,756
Early potatoes	81.34	70.00	75.00	75.45	754
Late apple	142.50	100.00	105.00	115.83	1,158
Sugar beet	194.46	140.00	165.00	166.49	1,665
Grain maize	159.86	98.69	133.73	130.76	1,308
Winter wheat	90.00	70.00	75.00	78.33	783
Spring rape	66.10	40.00	60.00	55.37	554
Sunflower	125.36	80.00	105.00	103.45	1,035
Average	120.46	76.54	100.37	110.14	1,101

Source: Monitorovanie dynamiky meteorologickych prvkov apotreby zavlazovania na uzemi Slovenskej Republiky v roku 1999

Table B. 9.1.1 Irrigation System in the Study Area

No.	Register number of WE	Control number	Name of pump station	Irrigation plan area (ha)	Electric station number	Water source	Region	Administration agency (Property)	Operation & maintenance agency	Construction year
P1	M1	5104 177 004	ZP DNV-STUPAVA I. CS 01 (distribution)	-	810 740	Morava	BA	WME (State)	WME (State)	1971
P2	M2	5104 177 012	ZP DNV-STUPAVA I. CS 1	939	810 757	Morava	BA	WME(State)	WME (Malacky)	1972
P3	M3	5104 177 017	ZP DNV-STUPAVA I. CS 2	855	810 858	Morava	BA	WME(State)	WME (Malacky)	1973
P4	M4	5104 177 023	ZP DNV-STUPAVA I. CS 3	648	810 865	Morava	BA	WME(State)	WME (Malacky)	1974
P5	M5	5201 178 004	ZP DNV-STUPAVA II. CS 4	559	810 935	Malina	BA	WME(State)	WME (Malacky)	1975
P6	M6	5201 178 009	ZP DNV-STUPAVA II. CS 4A	110	811 178	Malina	BA	WME(State)	WME (Malacky)	1971
P7	M7	5201 186 001	ZP Zahorska Ves	313	814 432	Lopaty pond	BA	WME(State)	Private Co. (HMU)	1971
P8	M8	5201 196 004	ZH Lozorno – Lintavy	120	812 986	VN Lozorno - Lantavy reservoir	BA	WME(State)	PD Lozorno	1974
P9	M9	5201 204 003	ZH Jablonove	54	-	Jablonovsky stream	BA	WME(State)	Agropartner, Plavecke Podhradie	1971
P10	M10	5201 205 001	ZH Jakubov	100	-	Malina	BA	WME(State)	JAKOS, Kostoliste	1971
P11	M11	5201 346 009	ZP V. Levare- Malacky I. CS Gajary – (Disribution)	-	811 154	Morava	BA	WME(State)	Private Co. (Inservice)	1871
P12	M12	5201 346 019	ZP V. Levare- Malacky I. CS Dolecky	2,066	811 161	Morava	BA	WME(State)	Private Co. (Inservice)	1984
P13	M13	5201 347 011	ZP V. Levare- Malacky II CS Kostoliste.	4,407	811 781	Morava	BA	WME(State)	Private Co. (Inservice)	1985
P14	M14	5201 352 003	ZP z VN Lozorno I. CS1	440	813 383	VN Lozorno II reservoir	BA	WME(State)	PD Lozorno	1985
P15	M15	5201 352 015	ZP z VN Lozorno I. CS2	935	811 868	VN Lozorno II reservoir	BA	WME(State)	PD Lozorno	1986
P16	M16	5201 353 002	ZP z VN Kuchyna	490	811 820	VN Kuchyna reservir	BA	WME(State)	PD Kuchyna	1984
P17	M20	5208 228 003	ZP Plavecky Sv. Peter	600	602 102 502	Hanspil stream (Bukova Re.)	SE	WME(State)	WME (Malacky)	1970
P18	M21	5208 229 004	ZP Rohoznik	200	832 511	VN Vyvrat Rohoznik	SE	WME(State)	Agropartner, Plavecke Podhradie	1970
P19	M25	5208 253 021	ZP Sekule-Male Levare I. CS V3 Sekule	653	830 490	Morava	SE	WME(State)	Private Co. (HMU)	1975
P20	M26	5208 253 032	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	830 445	Morava	SE	WME(State)	Private Co. (HMU)	1975
P21	M27	5208 253 044	ZP Sekule-Male Levare I. CS V5 Male Levare	759	830 452	Morava	SE	WME(State)	Private Co. (HMU)	1975
P22	M30	5208 268 001	ZP Husky CS Tomky	535	830 870	VN Tomky I.,II.reservoir	SE	WME(State)	WME (Malacky)	1980
	Sub-Total			15,915						
P23	Ad.1		Vysoka pri Morava	309		Pond	BA	Private Co.	Private Co.	-
	Total			16,224						

Source : Slovensky urad geodezie a kariografie 1998

Legend:
CS - Pumping station
VN - Reservoir
BA - BRATISLAVA
ZP – Field irrigation
ZH - Fertilizer/manure irrigation
SE - SENICA

Table B.9.1.2 Pump Equipment

No.	Name of pump station	Irrigation plan area	Pump size	Number of pump	Unite discharge	Discharge		Left	Electric Power		Maintenance Office	Water resource
		(ha)	mm		l/min.	l/min.	l/sec	m	kw	Total kw		
P.1	ZD DNV-STUPAVA I. CS 01 -Distributing Station	-	300	5	18,000	90,000	1,500	40	210	1050	WME (State)	Morava
P.2	ZD DNV-STUPAVA I. CS 1	939	250	4	7,500	30,000	500	60	130	520	WME (Malacky)	Morava
P.3	ZD DNV-STUPAVA I. CS 2	855	250	4	6,000	24,000	400	81	130	520	WME (Malacky)	Morava
P.4	ZD DNV-STUPAVA I. CS 3	648	250	3	6,000	18,000	300	81	130	390	WME (Malacky)	Morava
P.5	ZD DNV-STUPAVA II. CS 4	559	250	4	4,500	18,000	300	76	100	400	WME (Malacky)	Malina
P.6	ZD DNV-STUPAVA II. CS 4A	110	150	3	4,000	12,000	200	23	30	90	WME (Malacky)	Malina
P.7	ZP Zahorska Ves	313	200	3	3,600	10,800	180	87	110	330	Private Co. (HMU)	strkovisko Lopaty (stream)
P.8	ZH Lozorno – Lintavy	120	125	2	2,750	5,500	92	80	55	110	PD Lozorno	VN Lozorno - Lintavy
P.9	ZH Jablonove	54	125-400	2	800-3000	3,800	63	65	55-75	130	Agropartner, Plavecke Podhradie	Jablonovsky (stream)
P.10	ZK Jakubov	100	150	1	2,500	2,500	42	82	55	55	JAKOS, Kostoliste	Malina
P.11	ZP V. Levare- Malacky I. CS Gajary – distributing station	-	260	6	24,000	144,000	2,400	35	200	1200	Private Co. (Inservice)	Morava
P.12	ZP V. Levare- Malacky I. CS Dolecky	2,066	125-250	10	1,800-6,000	43,200	720	80	55-160	1180	Private Co. (Inservice)	Morava
P.13	ZP V. Levare- Malacky II CS Kostoliste.	4,407	150-250	7	3,900-6,900	39,300	655	80	100-200	1100	Private Co. (Inservice)	Morava
P.14	ZP z VN Lozorno I. CS1	440	125-250	9	2,040-6,960	42,960	716	72.5-75	55-200	1220	PD Lozorno	VN Lozorno II(reservoir)
P.15	ZP z VN Lozorno I. CS2	935	125-250	8	1860-6240	32,400	540	30.5-39	30-132	648	PD Lozorno	VN Lozorno II(reservoir)
P.16	ZP z VN Kuchyna	490	100-150	6	1200-3,900	15,300	255	65-66	30-75	420	PD Kuchyna	VN Kuchyna (reservoir)
P.17	ZP Plavecky Sv. Peter	600	150-300	4	2,650-6,300	14,250	238	75-80	55-130	295	WME (Malacky)	Bukova (reservoir)
P.18	ZP Rohoznik	200	100	3	1,620	4,860	81	62	37	111	Agropartner, Plavecke Podhradie	VN Vyvrat (reservoir)
P.19	ZP Sekule-Male Levare I. CS V3 Sekule	653	300	3	5,900	17,700	295	81	130	390	Private Co. (HMU)	Morava (Malolevarsky)
P.20	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	350-300	6	6,800-13,000	53,200	887	5.3-82	22-160	684	Private Co. (HMU)	Morava (Malolevarsky)
P.21	ZP Sekule-Male Levare I. CS V5 Male Levare	759	300	3	7,000	21,000	350	72	130	390	Private Co. (HMU)	Morava (Malolevarsky)
P.22	ZP Husky CS Tomky	535	150	3	4,500	13,500	225	89	132	396	WME (Malacky)	VN Tomky I, II (reservoir)
Sub-total		15,915		99		656,270	10,938			11,629		
P.23	Vysoka pri Morava	309	-	-	-	-	-	-	-	-	Private Co.	Malina
Total		16,224		99		656,270	10,938			11,629		

Source: Technologicka karta cerpacej stanice; SVP s.p. OZ PD Bratislava

Table B.9.1.3 Condition of Water Resources

No.	Name of pump station	Irrigation plan area	Irrigation area of water resource in each pump station (ha)				Irrigated area in 2001	Irrigation area of water resource in each pump station (ha)				Water resource
		(ha)	Morava	Malina	Small steam & Pond	Reservoir	(ha)	Morava	Malina	Small steam & Pond	Reservoir	
P.1	ZD DNV-STUPAVA I. CS 01 (Distributing Station)	-	-				0	-				Morava
P.2	ZD DNV-STUPAVA I. CS 1	939	939				0	-				Morava
P.3	ZD DNV-STUPAVA I. CS 2	855	855				247	247				Morava
P.4	ZD DNV-STUPAVA I. CS 3	648	648				0	-				Morava
P.5	ZD DNV-STUPAVA II. CS 4	559		559			0		-			Malina
P.6	ZD DNV-STUPAVA II. CS 4A	110		110			0		-			Malina
P.7	ZP Zahorska Ves	313			313		0			-		strkovisko Lopaty (stream)
P.8	ZH Lozorno – Lintavy	120				120	0				-	VN Lozorno - Lintavy
P.9	ZH Jablonove	54			54		0			-		Jablonovsky (stream)
P.10	ZK Jakubov	100		100			0			-		Malina
P.11	ZP V. Levare-Malacky I. CS Gajary – distributing station	-	-				0					Morava
P.12	ZP V. Levare-Malacky I. CS Dolecky	2,066	2,066				535	535				Morava
P.13	ZP V. Levare-Malacky II CS Kostoliste.	4,407	4,407				1,215	1,215				Morava
P.14	ZP z VN Lozorno I. CS1	440				440	146				146	VN Lozorno II(reservoir)
P.15	ZP z VN Lozorno I. CS2	935				935	0				-	VN Lozorno II(reservoir)
P.16	ZP z VN Kuchyna	490				490	0				-	VN Kuchyna (reservoir)
P.17	ZP Plavecky Sv. Peter	600				600	369				369	Bukova (reservoir)
P.18	ZP Rohoznik	200				200	200				200	VN Vyvrat (reservoir)
P.19	ZP Sekule-Male Levare I. CS V3 Sekule	653	653				216	216				Morava (Malolevarsky)
P.20	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	1,132				0	0				Morava (Malolevarsky)
P.21	ZP Sekule-Male Levare I. CS V5 Male Levare	759	759				50	50				Morava (Malolevarsky)
P.22	ZP Husky CS Tomky	535				535	0	0				VN Tomky I, II (reservoir)
Sub-total		15,915	11,459	769	367	3,320	2,978	2,263			715	
P.23	Vysoka pri Morava	309			309		0			-		Malina
Total		16,224	11,459	769	676	3,320	2,978	2,263			715	
Area rate of water resource		100	71	5	4	20	100	76	-	-	24	

Source SVP s.p. ;OZ PD Bratislava

Table B.9.1.4 Assessment of Function of Pump Station & Irrigated Area in 2001

No.	Name of pump station	Irrigation plan area	Irrigated area in 2001	Ratio of Irrigated area	Condition of pump station		Assessed of Irrigable area				Maintenance Office	Water resource
		(ha)	(ha)	(ha)	Degree of Damage	Presence of operation in 2001	I	II	III	IV		
P.1	ZD DNV-STUPAVA I. CS 01 -Distributing Station	-	0	-		operating	-				WME (State)	Morava
P.2	ZD DNV-STUPAVA I. CS 1	939	0	0.0	almost broken	non operating				939	WME (Malacky)	Morava
P.3	ZD DNV-STUPAVA I. CS 2	855	247	28.9		operating	855				WME (Malacky)	Morava
P.4	ZD DNV-STUPAVA I. CS 3	648	0	0.0	almost broken	non operating				648	WME (Malacky)	Morava
P.5	ZD DNV-STUPAVA II. CS 4	559	0	0.0	almost broken	non operating				559	WME (Malacky)	Malina
P.6	ZD DNV-STUPAVA II. CS 4A	110	0	0.0	almost broken	non operating				110	WME (Malacky)	Malina
P.7	ZP Zahorska Ves	313	0	0.0		non operating		313			Private Co. (HMU)	strkovisko Lopaty (stream)
P.8	ZH Lozorno – Lintavy	120	0	0.0	partly broken	non operating				120	PD Lozorno	VN Lozorno - Lintavy
P.9	ZH Jablonove	54	0	0.0	partly broken	non operating			54		Agropartner, Plavecke Podhradie	Jablonovsky (stream)
P.10	ZK Jakubov	100	0	0.0	partly broken	non operating			100		JAKOS, Kostoliste	Malina
P.11	ZP V. Levare-Malacky I. CS Gajary –	-	0		-	operating	-				Private Co. (Inservice)	Morava
P.12	ZP V. Levare-Malacky I. CS Dolecky	2,066	535	25.9		operating	2,066				Private Co. (Inservice)	Morava
P.13	ZP V. Levare-Malacky II CS Kostoliste.	4,407	1,215	27.6		operating	4,407				Private Co. (Inservice)	Morava
P.14	ZP z VN Lozorno I. CS1	440	146	33.2		operating	440				PD Lozorno	VN Lozorno II(reservoir)
P.15	ZP z VN Lozorno I. CS2	935	0	0.0		non operating		935			PD Lozorno	VN Lozorno II(reservoir)
P.16	ZP z VN Kuchyna	490	0	0.0	partly broken	non operating			490		PD Kuchyna	VN Kuchyna (reservoir)
P.17	ZP Plavecky Sv. Peter	600	369	61.5		operating	600				WME (Malacky)	Bukova (reservoir)
P.18	ZP Rohoznik	200	200	100.0		operating	200				Agropartner, Plavecke Podhradie	VN Vyvrat (reservoir)
P.19	ZP Sekule-Male Levare I. CS V3 Sekule	653	216	33.1		operating	653				Private Co. (HMU)	Morava (Malolevarsky)
P.20	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	0	0.0	partly broken	non operating		1,132			Private Co. (HMU)	Morava (Malolevarsky)
P.21	ZP Sekule-Male Levare I. CS V5 Male Levare	759	50	6.6		operating	759				Private Co. (HMU)	Morava (Malolevarsky)
P.22	ZP Husky CS Tomky	535	0	0.0	partly broken	non operating			535		WME (Malacky)	VN Tomky I, II (reservoir)
Sub-total		15,915	2,978	18.7			9,980	2,380	1,179	2,376		
P.23	Vysoka pri Morava	309	0	0.0	almost broken	non operating				309	Private Co.	Malina
Total		16,224	2,978	18.4			9,980	2,380	1,179	2,685		

Note: Category **I**： Pump station where irrigation is executed in 2001
Category **II**： Pump Station which has not been driven for these several years
Category **III**： Pump Station which pump, damages pressure tank and switchboard, etc. , and has not been driven for ten years or more
Category **IV**： Pump place where drive cannot be restarted by disappearance.

Table B.9.1.5 Assessment of Pump Station

No.	Name of pump station	Irrigation plan area	Pump equipments					Operation and management	Location of pump station
		(ha)	Pump & motor	Other Equipment	Electric control	Transformer	Pomp house		
P.1	ZD DNV-STUPAVA I. CS 01	-	A+B	A+B	A+B	A+B	A	WME (State)	Stupava
P.2	ZD DNV-STUPAVA I. CS 1	939	C+D	C+D	C+D	B+C	B	WME (Malacky)	Stupava
P.3	ZD DNV-STUPAVA I. CS 2	855	A+B	A+B	A+B	A+B	A	WME (Malacky)	Stupava
P.4	ZD DNV-STUPAVA I. CS 3	648	C+D	C+D	C+D	B+C	B	WME (Malacky)	Stupava
P.5	ZD DNV-STUPAVA II. CS 4	559	D	C+D	D	D	B	WME (Malacky)	Stupava
P.6	ZD DNV-STUPAVA II. CS 4A	110	D	C+D	D	D	B	WME (Malacky)	Stupava
P.7	ZP Zahorska Ves	313	B	B	B	B	A	Private Co. (HMU)	Zahor.Ves
P.8	ZH Lozorno – Lintavy	120	C	C	C	D	C	PD Lozorno	Lozorno
P.9	ZH Jablonove	54	C	C	C	C	D	Agropartner , Plavecke Podhradie	Jablonove
P.10	ZK Jakubov	100	C	C	C	C	C	JAKOS, Kostoliste	Jakubov
P.11	ZP V. Levare- Malacky I. CS Gajary	-	A+B	A+B	A+B	A	A	Private Co. (Inservice)	Gajary
P.12	ZP V. Levare- Malacky I. CS Dolecky	2,066	A+B	A+B	A	A	A	Private Co. (Inservice)	Dolecky
P.13	ZP V. Levare- Malacky II CS Kostoliste.	4,407	A+B	A+B	A+B	A	A	Private Co. (Inservice)	Kostoliste
P.14	ZP z VN Lozorno I. CS1	440	A+B	A+B	A	A	A	PD Lozorno	Lozorno
P.15	ZP z VN Lozorno I. CS2	935	A+B	A+B	B	B	A+B	PD Lozorno	Lozorno
P.16	ZP z VN Kuchyna	490	B+C	B+C	B+C	B+C	B	PD Kuchyna	Kuchyna
P.17	ZP Plavecky Sv. Peter	600	A+B	A+B	A	A	A	WME (Malacky)	Plevecky
P.18	ZP Rohoznik	200	A	A	A	A	A	Agropartner , Plavecke Podhradie	Rohoznik
P.19	ZP Sekule-Male Levare I. CS V3 Sekule	653	A+B	A+B	A	A	A	Private Co. (HMU)	Sekule
P.20	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	A+B	A+B	A+B	D	A	Private Co. (HMU)	Zavod
P.21	ZP Sekule-Male Levare I. CS V5 Male Levare	759	A	A+B	A	A	A	Private Co. (HMU)	Male Levare
P.22	ZP Husky CS Tomky	535	B	B+C	B+C	B+C	A	WME (Malacky)	Tomky
Sub-total		15,915	-	-	-	-	-		
P.23	Vysoka pri Morava	309	D	D	D	D	D	Private Co.	Vysoka
Total		16,224	-	-	-	-	-		

A：Funkcne/ Function C：Pokazene (nahrada nutna) / Broken (Replacement necessity)
B：Nefunkcne (Oprava mozna)/ No function (repairable possi D：Chybajuce / Disappeared

Table B. 9.1.6 Assessment of Intake Facility and Pipe Network

No.	Name of pump station	Irrigation plan area	Intake facility					Pipe network		Operation and management office	Water resource
			Weir		Intake Facility						
		(ha)	Intake without diversion	Diversion weir	Intake gate	Screen	Conducting Pipe (canal)	Maintenance	Non maintenance		
P.1	ZD DNV-STUPAVA I. CS 01	-	A	-	A	A	A+B	-	-	WME (State)	Morava
P.2	ZD DNV-STUPAVA I. CS 1	939	-	-	-	-	C+D		939	WME (Malacky)	Morava
P.3	ZD DNV-STUPAVA I. CS 2	855	-	-	-	-	A	300	555	WME (Malacky)	Morava
P.4	ZD DNV-STUPAVA I. CS 3	648	-	-	-	-	C+D		648	WME (Malacky)	Morava
P.5	ZD DNV-STUPAVA II. CS 4	559	D	-	D	C	B+C		559	WME (Malacky)	Malina
P.6	ZD DNV-STUPAVA II. CS 4A	110	-	-	-	-	C		110	WME (Malacky)	Malina
P.7	ZP Zahorska Ves	313	-	-	-	B	C	313		Private Co. (HMU)	Strkovisko Lopaty (stream)
P.8	ZH Lozorno – Lintavy	120	-	-	C	B	C		120	PD Lozorno	VN Lozorno - Lintavy
P.9	ZH Jablonove	54	B	A	-	B	B		54	Agropartner, Plavecke Podhradie	Jablonovsky (stream)
P.10	ZK Jakubov	100	C	-	C	B	C		100	JAKOS, Kostoliste	Malina
P.11	ZP V. Levare- Malacky I. CS Gajary	-	A	-	-	A	A	-	-	Private Co. (Inservice)	Morava
P.12	ZP V. Levare- Malacky I. CS Dolecky	2,066	-	-	-	-	A	2,066		Private Co. (Inservice)	Morava
P.13	ZP V. Levare- Malacky II CS Kostoliste.	4,407	-	-	-	-	A	4,407		Private Co. (Inservice)	Morava
P.14	ZP z VN Lozorno I. CS1	440	-	-	-	-	A	440		PD Lozorno	VN Lozorno II(reservoir)
P.15	ZP z VN Lozorno I. CS2	935	-	-	-	-	A		935	PD Lozorno	VN Lozorno II(reservoir)
P.16	ZP z VN Kuchyna	490	-	-	A	A	A		490	PD Kuchyna	VN Kuchyna (reservoir)
P.17	ZP Plavecky Sv. Peter	600	-	-	A+B	A+B	-	600		WME (Malacky)	Bukova (reservoir)
P.18	ZP Rohoznik	200	-	-	A	A	A	200		Agropartner, Plavecke Podhradie	VN Vyvrat (reservoir)
P.19	ZP Sekule-Male Levare I. CS V3 Sekule	653	-	A+B	A+B	A+B	A+B	653		Private Co. (HMU)	Morava (Malolevarsky)
P.20	ZP Sekule-Male Levare I. CS V4N2 Zavod	1,132	-	A+B	A+B	A+B	A+B	1,132		Private Co. (HMU)	Morava (Malolevarsky)
P.21	ZP Sekule-Male Levare I. CS V5 Male Levare	759	-	A+B	A+B	A+B	A	759		Private Co. (HMU)	Morava (Malolevarsky)
P.22	ZP Husky CS Tomky	535	-	-	A+B	A	A+B		535	WME (Malacky)	VN Tomky I, II (reservoir)
Sub-total		15,915						10,870	5,045		
P.23	Vysoka pri Morava	309	-	-	D	D	D		309	Private Co.	Pond
Total		16,224						10,870	5,354		

A : Funkcne/ Function C : Pokazene (nahrada nutna) / Broken (Necessary replace)
B : Nefunkcne (Oprava mozna)/ No function (repair possit D : Chybajuce (odcudzene) / Disappeared

Table B.9.1.7 Outline of Reservoir (1)

No.	Register No.	Name of Reservoir	Storage Capacity	Surface Area	Type of Dam	Construction Year	Using Amount of Agriculture	Irrigation system	Irrigation Area	Irrigation Area in 2001	Adminis-tration Agency	Operation and Maintenance
			10^3Xm^3	(ha)			(m^3)		(ha)	(ha)		
1	5201 196	VN Lozorno-Lintavy I	24	1	Earth dam	1967		ZH a VN Lozorno-Lintavy	120	0	W.M.E	PD Lozormo
2	5201 349	VN Lozorno II	2,067	37	Earth dam	1985	447,438/Month	ZP z Lozorno I	440	146	W.M.E	PD Lozormo
							2,237,500/year	ZP z Lozorno II	935	0	W.M.E	
3	5201 348	Kuchyna	485	12	Earth	1985		ZP z Vnkuchyha	490	0	W.M.E	PD Kuchyna
4	5208 241	Vyvrat Rohoznik	344	11	Earth	1067		ZP Rohoznik	200	200	W.M.E	Agropartner
5	5201 320	Strskovisko Jakubov	1,361	27	Earth dam	1980	-	-	-	-	W.M.E	JAKOS
6	5208 240	VN Tomky I	160	16	Earth	1963		Husky	335	0	W.M.E	Private
7	5209 240	VN Tomky II	430	27	Earth	1963		Tomky	200	0	W.M.E	Private
8	-	Bukova	1,181	40	Earth dam	1963	250 l/sec per 8 hours	Pleveky peter	600	369	W.M.E	Private
Total			6,052	171					3,320	715		

Source: Zoznam zavlahovych systemou v sprave Povodia Dunaja, s.p.

Table B.9.1.8 Outline of Reservoir (2)

No.	Register No.	Reservoir	Catchments Area	Storage Capacity	Surface Area	Type of Dam	Flood discharge	Crest length	Dam height	Crest width	Construc tion Year	Adminis-tration Agency	Operation and Maintenance	Condition of Dam Maintenance
			$X10^3km^2$	$X10^3m^3$	(ha)		m^3/sec	m	m	m				
1	5201 196	VN Lozorno-Lintavy I	6.25	24	1	Earth dam		80	5.0	3.5	1967	W.M.E	PD Lozormo	Non problem
2	5201 349	VN Lozorno II	19.64*	2,067	37	Earth dam		250		5.0	1985	W.M.E	PD Lozormo	Non problem
3	5201 348	Kuchyna	14.95	485	12	Earth		280		5.0	1985	W.M.E	PD Kuchyna	Non problem
4	5208 241	Vyvrat	10.98	344	11	Earth		350		5.0	1067	W.M.E	Agropartner	Non problem
5	5201 320	Strskovisko Jakubov	-	1,361	27	Earth dam		-		5.0	1980	W.M.E	JAKOS	Non problem
6	5208 240	VN Tomky I	31.85	160	16	Earth		270		5.0	1963	W.M.E	Private	Non problem
7	5209 240	VN Tomky II	5.45	430	27	Earth		310		5.0	1963	W.M.E	Private	Non problem
8	-	Bukova	10.85	1,181	40	Earth dam	26.00	296	12.5	5.0	1963	Pprivate	Private	Non problem
Total			80.33	6,052	171									

Source: Zoznam zavlahovych systemou v sprave Povodia Dunaja, s.p.

Table 9.1.9 Outline of Reservoir (3)

No.	Register No.	Reservoir	Average discharge	Average precipitation	Minimum outflow	Conservation river outflow	River bed level	Full reservoir level	Water level of design flood	Dam crest level	Crest Length of spillway	Design flood discharge	Slope (Upstream)	Slope (Downstream)
			I/s	mm	I/s	m^3/sec	EL(m)	EL(m)	EL(m)	EL(m)	m	m^3/sec	1:n	1:n
1	5201 196	VN Lozorno I-Lipniky	_	708	_	_	_	304.40	_	305.20	11	_	_	_
2	5201 349	VN Lozorno II	110	708	13	_	_	218.60	219.00	220.50	14 (2x7)	2.4, 2.25	1:3.4, 1:2.5	1:2.5, 1:10
3	5201 348	Kuchyna	160	705	14	_	252.60	261.60	262.00	263.40	27	5.14	1:3	1:2, 2.2
4	5208 241	Vyvrat Rohoznik	70	_	8	_	229.80	237.95	238.35	239.00	17	2.42	1:3	1:2.5
5	5201 320	Strskovisko Jakubov	_	_	_	_	_	_	_	_	_	_	_	_
6	5208 240	VN Tomky I	80	580	6	_	_	165.77	165.97	166.85	_	_	1:3	1:2.25
7	5209 240	VN Tomky II	74	580	6	_	_	171.90	172.10	173.00	_	_	1:3	1:2.25
8	-	Bukova	75	810	5	0.09	_	289.29	289.79	290.29	30 (2x15)	12.5	1:2, 1:2.5	1:2.2,1:3

*Dam Site of Bukova is outside of the Study area. Source: Nadrze Povodia Dunaja, s.p., - Zakladne vodohospodarske udaje

Table B.9.1.10 Outline of Reservoir (4)

No.	Register No.	Reservoir	M - daily discharge (l/sec)					N - annual discharge (m^3/sec)					water recourse
			30	90	180	270	355	1	5	10.0	50	100	
1	5201 196	VN Lozorno I-Lipniky	_	_	_	_	_	_	_	_	_	_	Suchy p
2	5201 349	VN Lozorno II	230	130	75	40	13	1.0	2.5	3.5	6.5	8.0	Suchy p + Zahorsky p
3	5201 348	Kuchyna	360	195	115	62	25	1.0	2.7	3.5	6.0	7.3	Kuchynska / Maalina
4	5208 241	Vyvrat Rohoznik	150	85	45	25	8	0.58	1.5	2.0	4.5	6.0	Vyvrat
5	5201 320	Strskovisko Jakubov	_	_	_	_	_	_	_	_	_	_	_
6	5208 240	VN Tomky I	195	100	45	22	6	0.7	2.1	3.2	6.4	8.5	Studena voda
7	5209 240	VN Tomky II	180	90	40	20	6	0.6	2.0	3.0	6.0	8.0	Studena voda
8	_	Bukova	_	_	_	142	-	3.0	7.0	10.0	16.0	20.0	Hrudky

*Dam Site of Bukova is outside of the Study area. Source: Nadrze Povodia Dunaja, s.p., - Zakladne vodohospodarske udaje

Table B.9.1.11 Condition Of The Irrigation Facilities (Zahorska ; 2000)

1. Agricultural region: Zahorska lowland
Number of accounting companies: 12

2. Agricultural soil extend of the accounting companies (ha): 22,191
Irrigation extend built by accounted companies (ha): 9,266
from that functional (ha): 6,145

3.Irrigation classification according to the type:

Cultivation Crop	ha	From that functional (ha)
Field crops	8,943	5,822
Orchards		
Vineyard	10	10
Vegetable	313	313
Meadow		

4. Structure of the irrigation facilities

Type of the facility	Number of Equipment	Function of Equipment	Age structure			
			to 4 years	4 to 8 years	8 to 12 years	12 and more years
	pcs	pcs	pcs	pcs	pcs	pcs
1. Line irrigation						
Hose to 67 mm	169	98	18	0	69	82
Hose 75 mm	266	200	5	0	67	194
from 75 to 100 mm	4	2	2	0	0	2
more than 100 mm	0	0	0	0	0	0
Total:	439	300	25	0	136	278
2. Rotating irrigation	Number	functional				
	pcs	pcs				
SIGMATIC	9	7				9
FREGAT						
Other						
Total:						9
3. Other type of irrigation	Total (ha)	functional (ha)				
Drip irrigation	29	0				29
Stable irrigation						
Mobile irrigation						
Classic detail						

5.Purchase interest in new irrigation facilities

Line irrigation	61
Large scale irrigation	
Drip irrigation (ha)	20 ha

6.Interest in irrigation facilities revitalization

Line irrigation	60 ks
SIGMATIC	
FREGAT	20 ks

Source: Analyza technologickeho stavu zavlahoveho detailu na Slovensku

Table B.9.1.12 Condition Of The Irrigation Facilities (Bratislava; 2000)

1. Agricultural region: Blatislava (BA-1, Senec, Malacky, Pezinok)
Number of accounting companies: 56

2. Agricultural soil extend of the accounting companies (ha): 51,289
Irrigation extend built by accounted companies (ha): 28,146
from that functional (ha): 21,468

3.Irrigation classification according to the type:

Cultivation Crop	ha	From that functional (ha)
Field crops	27,059	20,516
Orchards	108	108
Vineyard	425	310
Vegetable	553	534
Meadow		

4. Structure of the irrigation facilities

Type of the facility	Number of Equipment	Function of Equipment	Age structure			
			to 4 years	4 to 8 years	8 to 12 years	12 and more years
	pcs	pcs	pcs	pcs	pcs	pcs
1. Line irrigation						
Hose to 67 mm	222	122	9	0	79	134
Hose 75 mm	684	455	40	4	116	524
from 75 to 100 mm	137	81	14	2	32	89
more than 100 mm	24	24	24	0	0	0
Total:	1067	682	87	6	227	747
2. Rotating irrigation	Number	functional				
	pcs	pcs				
SIGMATIC	17	4			14	3
FREGAT	38	19			3	35
Other	2	2				
Total:	57	25			17	38
3. Other type of irrigation	Total (ha)	functional (ha)				
Drip irrigation						
Stable irrigation	252	225	15			237
Mobile irrigation	220	220			220	
Classic detail						

5.Purchase interest in new irrigation facilities

Line irrigation	163
Large scale irrigation	2
Drip irrigation (ha)	50 ha

6.Interest in irrigation facilities revitalization

Line irrigation	194 Sk
SIGMATIC	1 sk
FREGAT	8 sk

Source: Analyza technologickeho stavu zavlahoveho detailu na Slovensku

Table B.9.1.13 Condition of The Irrigation Facilities of the Slovak Republic (2000)

Irrigation classification according to the type:			
Cultivation Crop	ha	From that functional (ha)	From that functional (%)
Field crops	186,642	140,935	75.5
Orchards	2,742	2,524	92.0
Vineyard	1,381	1,070	77.5
Vegetable	5,618	5,487	97.7
Meadow	261	154	59.0

Structure of the irrigation facilities:

Type of the facility	Number of Equipment	Function of Equipment		Age structure							
				to 4 years		4 to 8 years		8 to 12 years		12 and more years	
	pcs	pcs	%	pcs	%	pcs	%	pcs	%	pcs	%
1. Line irrigation											
Hose to 67 mm	1,162	583	50.2	19	1.6	2	0.2	318	27.4	823	70.8
Hose 75 mm	4,175	2,421	58.0	128	3.0	272	6.5	740	17.7	3,035	72.8
from 75 to 100 mm	1,166	740	63.6	129	11.1	39	3.4	379	32.7	619	52.8
more than 100 mm	175	170	97.3	168	91.8	5	2.7	2	1.1	-	-
Total:	6,678	3,914	58.7	444	6.6	318	4.8	1439	21.6	4,477	67.0
2. Rotating irrigation	Number	functional									
	pcs	pcs	%								
SIGMATIC	103	52	50.5	-	-	3	2.9	55	53.4	45	43.7
FREGAT	327	185	56.6	-	-	-	-	40	12.2	287	87.8
Other	6	6	100	3	50.5	-	-	1	16.0	2	34.0
Total:	436	243	55.7	3	0.7	3	0.7	96	22	334	76.6
3. Other type of irrigation	Total (ha)	functional (ha)									
Drip irrigation	1608	1316	81.8	655	40.7	279	17.4	201	12.5	473	29
Stable irrigation	1978	1241	62.7	15	0.8	100	5.1	-	-	1,863	94
Mobile irrigation	1004	965	96.1	400	39.8	16	1.6	270	26.9	318	32
Classic detail	9	9	100	-	-	-	-	-	-	9	100

4. Purchase interest in new irrigation facilities:

		Seasonal effectivity (ha)
Line irrigation	825 pcs	20,625
Large scale irrigation	6 pcs	240
Drip irrigation (ha)	490 ha	490

5. Interest in irrigation facilities revitalization:

		Seasonal effectivity (ha)
Line irrigation	1479 pcs	29,580
SIGMATIC	58 pcs	2320
FREGAT	57 pcs	2280

Total: new and revitalization (ha)	55,535

Source: Analyza technologickeho stavu zavlahoveho detailu na Slovensku

Table B.9.1.14 Estimation of Unit Water Requirement based on the Actual Irrigation

Item	Cultivated area (ha)	unit	Irrigation period							
			Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Total
Malacky I (2001)	430	m3		62,160	66,180	70,700	51,600	1,100	600	252,340
	1	ha/m3		145	154	164	120	3	1	587
Malacky II (2001)	1,120	m3		18,150	149,940	219,000	103,392	4,500		494,982
	1	ha/m3		16	134	196	92	4		442
Average water requirement		m3/ha		80	144	180	106	3	1	514
Average water requirement		mm/mon		8.04	14.39	18.00	10.62	0.33	0.07	51
Water requirement (6hr;22days)		l/sec/ha		0.2	0.3	0.4	0.2	0.007	0.001	
The study area (2001)	1,750	m3	18,000	203,900	407,500	446,000	348,600	163,000		1,569,000
	1	ha/m3	10	117	233	255	199	93		897
The study area (2000)	1,376	m3	13,746	244,590	638,480	296,460	91,850	60,700	650	1,332,730
	1	ha/m3	10	178	464	215	67	44	0.5	969
Average water requirement		m3/ha	10	147	348	235	133	69	0	933
Average water requirement		mm/mon	1.01	14.71	34.84	23.52	13.30	6.86	0.02	93
Water requirement (6hr;22days)		l/sec/ha	0.02	0.3	0.7	0.5	0.3	0.1	0.0005	
Asparagus										
Cultivation in 2000	125	m3		60,450	79,027	68,720	59,535	10,584		278,316
	1	ha/m3		484	632	550	476	85		2,227
Cultivation in 2001	125	m3		7,200	15,000	20,830	25,000			68,030
	1	ha/m3		58	120	167	200	0		544
Average water requirement		m3/ha		271	376	358	338	42		1,385
Average water requirement		mm/mon		27.06	37.61	35.82	33.81	4.23		139
Water requirement (6hr;22days)		l/sec/ha		0.6	0.8	0.8	0.7	0.1		
Potato										
Cultivation in 2000	60	m3		12,121	31,330	63,176	8,520			115,147
	1	ha/m3		202	522	1,053	142			1,919
Cultivation in 2001	60	m3		18,890	15,000	23,079	7,000			63,969
	1	ha/m3		315	250	385	117			1,066
Cultivation in 2001	5	m3		5,200	6,800	5,647				17,647
	1	ha/m3		1,040	1,360	1,129				3,529
Average water requirement		m3/ha		519	711	856	129			2,215
Average water requirement		mm/mon		51.90	71.07	85.57	12.93			221
Water requirement (6hr;22days)		l/sec/ha		1.1	1.5	1.8	0.3			
Black current										
Cultivation in 2000	20	m3		22,320	59,274	20,646	11,340			113,580
	1	ha/m3		1,116	2,964	1,032	567			5,679
Cultivation in 2001	20	m3		58,600	32,000	21,231	16,500			128,331
	1	ha/m3		2,930	1,600	1,062	825			6,417
Average water requirement		m3/ha		2,023	2,282	1,047	696			6,048
Average water requirement		mm/mon		202.30	228.19	104.69	69.60			605
Water requirement (6hr;22days)		l/sec/ha		4.3	4.8	2.2	1.5			
Irrigation water volume in the Slovak Republic										
Average water requirement		m3/ha	35	123	152	198	147	95	25	740
Average water requirement		mm/mon	3.50	12.30	15.20	19.80	14.70	9.50	2.50	74
Water requirement (6hr;22days)		l/sec/ha	0.1	0.3	0.3	0.4	0.3	0.2	0.05	

Note: Irrigation time	22 days,	6 hour

Table B.9.1.15 Irrigation Cost

Table B.9.1.15 (1) Irrigation area of hydrant

	Description	l/sec	m3/hr	m3/day(6hr)	mm/ha/day	ha/30mm/day
1)	Water Amount of Hydrant and irrigation area/day	25.0	90.0	540.0	54.0	1.8

Table B.9.1.14 (2) Number of sprinkler equipment

No.	Description	Unit	Farming Scale				
1)	Irrigation scale	ha	10.0	50.0	100.0	200.0	300.0
2)	Using day10day*) 18 ha/day/1unit	ha	18.0	18.0	18.0	18.0	18.0
3)	Number of sprinkler	unite	0.6	2.8	5.6	11.1	16.7
4)	necessity number of sprinkler	unite	1.0	3.0	6.0	11.0	17.0

Table B.9.1.15 (3) Comparison of Irrigation effect (wheat)

No.	Description		unit	Irrigation Cost				
1)	Irrigation scale		ha	10.0	50.0	100.0	200.0	300.0
2)	Number of Sprinkler		unit	1.0	3.0	6.0	11.0	17.0
3)	Man power							
		Transportation and setting	day	1.0	2.0	4.0	7.3	11.3
		Irrigation (1labor/1.8 day)	day	8.3	41.7	83.3	166.7	250.0
		Clear away	day	1.0	2.0	4.0	7.3	11.3
		Total	day	10.3	45.7	91.3	181.3	272.7
	i)Man power Cost	381.0	SKK/day	3,936.5	17,396.8	34,793.7	69,079.4	103,873.0
4)	Drive administrative expenses							
	Transportation work	Track and trailer	day	1.0	2.0	4.0	7.3	11.3
	ii)Transportation cost	1,250.0	SKK/day	1,250.0	2,500.0	5,000.0	9,166.7	14,166.7
	Irrigation work	Tractor	day	8.3	41.7	83.3	166.7	250.0
	iii)Irrigation cost	400.0	SKK/day	3,333.3	16,666.7	33,333.3	66,666.7	100,000.0
5)	Expenditure of Sprinkler							
	Sprinkler cost(Oneunit)	450,000.0	SKK					
	After subsidy price(.30%)	135,000.0	SKK	135,000.0	405,000.0	810,000.0	1,485,000.0	2,295,000.0
	Annual depreciation expense	Redemption for ten years(1/12)	SKK	11,250.0	33,750.0	67,500.0	123,750.0	191,250.0
	Maintenance expense	10% of repair cost	SKK	1,125.0	3,375.0	6,750.0	12,375.0	19,125.0
	iv)Total of year expenditure		SKK	12,375.0	37,125.0	74,250.0	136,125.0	210,375.0
6)	Water cost							
	Amount Irrigation water	990.0	m3/ha/yea	9,900.0	49,500.0	99,000.0	198,000.0	297,000.0
	v)Water cost	1.75	SKK	17,325.0	86,625.0	173,250.0	346,500.0	519,750.0
7)	Total(i)+ii)+iii)+iv)+v))		SKK	38,219.8	160,313.5	320,627.0	627,537.7	948,164.7
	1ha cost		SKK	3,822.0	3,206.3	3,206.3	3,137.7	3,160.5

Table B.9.1.16 Annual Water Requirement According to Soil Type and Crops

(Malacky)

Crops	Water requirement [mm]			Water requirement [mm]		
	Sandy soil	Sandy soil	Sandy soil	Sandy soil	total	Average
	1998	1999	2000	2001		
Peas	60.00	30.00	90.00	30.00	210.00	52.50
Spring barley	90.00	30.00	90.00	60.00	270.00	67.50
Lucerne	240.00	150.00	360.00	150.00	900.00	225.00
Early potatoes	90.00	58.73	118.34	58.27	325.34	81.34
Late apple	180.00	60.00	240.00	90.00	570.00	142.50
Sugar beet	210.00	90.00	297.84	180.00	777.84	194.46
Grain maize	176.44	90.00	255.34	117.65	639.43	159.86
Winter wheat	90.00	60.00	120.00	90.00	360.00	90.00
Spring rape	60.00	60.00	114.38	30.00	264.38	66.10
Sunflower	149.55	60.00	201.87	90.00	501.42	125.36
Crops	Water requirement [mm]			Water requirement [mm]		
	Loamy soil	Loamy soil	Loamy soil	Loamy soil	total	Average
	1998	1999	2000	2001		
Peas	0.00	0.00	80.00	0.00	80.00	20.00
Spring barley	40.00	0.00	80.00	40.00	160.00	40.00
Lucerne	160.00	40.00	-	120.00	320.00	106.67
Early potatoes	80.00	40.00	120.00	40.00	280.00	70.00
Late apple	120.00	0.00	200.00	80.00	400.00	100.00
Sugar beet	160.00	40.00	240.00	120.00	560.00	140.00
Grain maize	120.00	0.00	194.76	80.00	394.76	98.69
Winter wheat	80.00	40.00	120.00	40.00	280.00	70.00
Spring rape	40.00	0.00	120.00	0.00	160.00	40.00
Sunflower	80.00	0.00	160.00	80.00	320.00	80.00
Crops	Water requirement [mm]			Water requirement [mm]		
	Clay	Clay	Clay	Clay	total	Average
	1998	1999	2000	2001		
Peas	30.00	0.00	60.00	30.00	120.00	30.00
Spring barley	60.00	30.00	90.00	60.00	240.00	60.00
Lucerne	210.00	90.00	330.00	150.00	780.00	195.00
Early potatoes	90.00	30.00	120.00	60.00	300.00	75.00
Late apple	120.00	0.00	210.00	90.00	420.00	105.00
Sugar beet	180.00	30.00	300.00	150.00	660.00	165.00
Grain maize	180.00	30.00	204.92	120.00	534.92	133.73
Winter wheat	90.00	30.00	120.00	60.00	300.00	75.00
Spring rape	60.00	30.00	120.00	30.00	240.00	60.00
Sunflower	120.00	30.00	180.00	90.00	420.00	105.00

Source: Monitorovanie dynamiky meteorologickych prvkov a potreby zavlazovania na uzemi Slovenskej Republiky v roku 1999

Table B.9.1.17 Crop Yields of Without Irrigation and With Irrigation

Item		Yield in ton/ha						Average
Year		1975	1981	1984	1989	1993	1997	ton/ha
Winter wheat	Without irrigation	5.02	4.64	6.88	8.13	4.89	7.14	6.12
	With irrigation	5.22	4.86	7.93	9.21	6.15	7.55	6.82
	Difference (%)	3.98	4.74	15.3	13.3	25.8	5.7	11.4
Spring barley	Without irrigation	4.44	4	7.01	3.52	-	-	4.74
	With irrigation	4.86	3.96	6.91	2.87	-	-	4.65
	Difference (%)	9.5	-1	-1.4	-18.5	-	-	-1.9

Item		Yield in ton/ha						Average
Year		1973	1979	1990	1995	1997	1998	ton/ha
Grain Maize	Without irrigation	4.22	7.81	1.56	8.75	-	8.02	6.07
	With irrigation	7.28	10.29	8.69	9.46	-	11.21	9.39
	Difference (%)	72.5	31.8	456.8	8.2	-	39.8	54.7

Item		Yield in ton/ha						Average
Year		1974	1978	1980	1991	1995	1998	ton/ha
Silage Maize	Without irrigation	41.85	8.32	43.68	52.8	-	-	36.67
	With irrigation	53.48	59.63	50.18	73.88	-	-	59.3
	Difference (%)	27.8	616.7	14.9	39.9	-	-	61.7

Item	Yield in ton/ha				Average	
Year	1976		1982		ton/ha	
Sugar beet	Root	Raffinose	Root	Raffinose	Root	Raffinose
Without irrigation	26.17	3.14	63.55	8.42	44.86	5.78
With irrigation	50.3	5.32	6.68	9.21	64.56	7.27
Difference (%)	92.2	69.4	3.3	9.4	43.9	25.8

Item		Yield in ton/ha						Average
Year		1985	1986	1987	1988	1991	1995	ton/ha
Alfalfa	Without irrigation	6.79	7.9	14.43	11.25	-	-	10.5
	With irrigation	9.5	16.55	15.15	13.04	-	-	13.56
	Difference (%)	39.9	109.5	5	15.9	-	-	29.1

Source: Vedecke prace Vyskumneho ustavu zavlahoveho hospodarstva v Bratislave

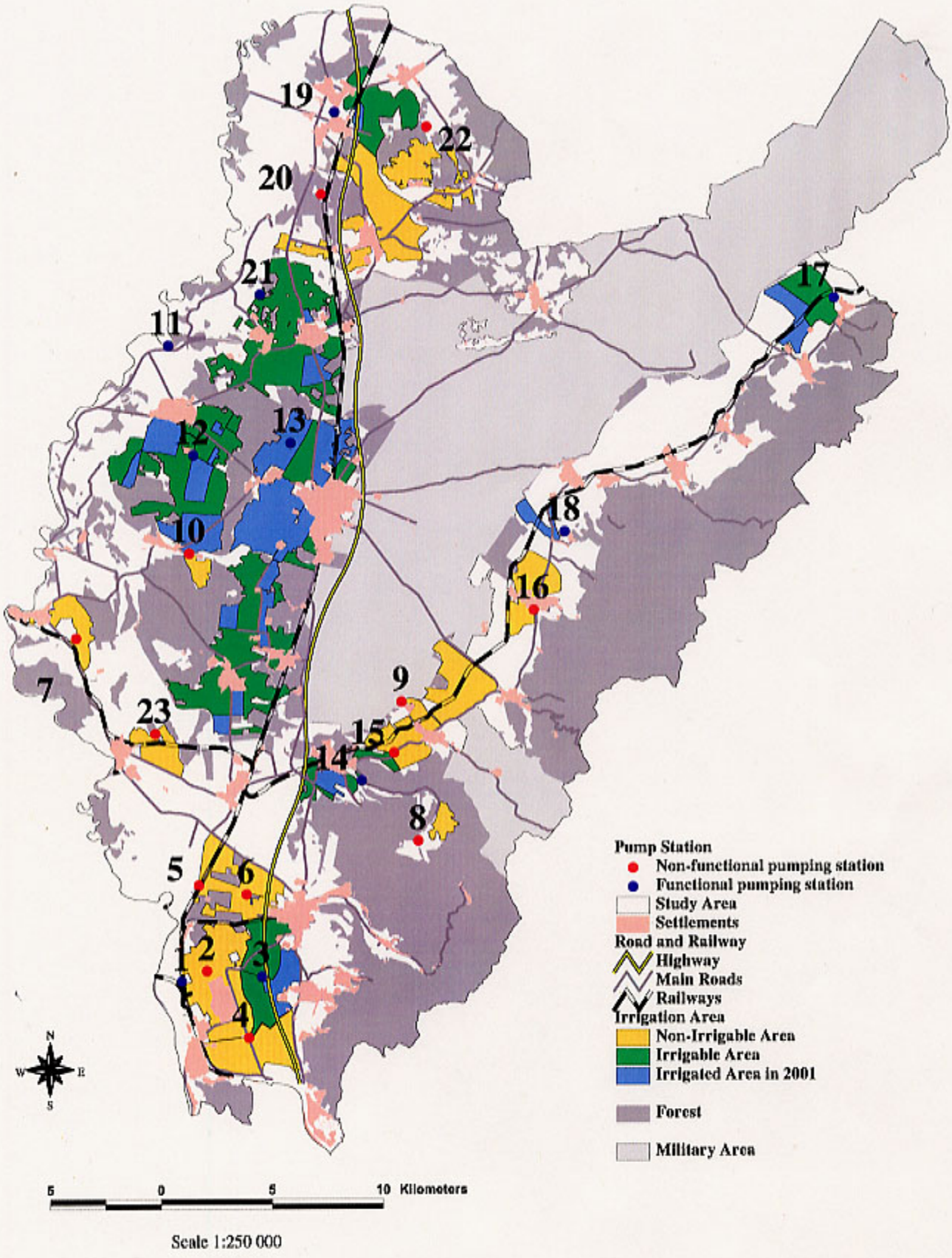


Figure B.9.1.1 Location and State of the Irrigation System

Source: Study Team in Cooperation with SWME-ID

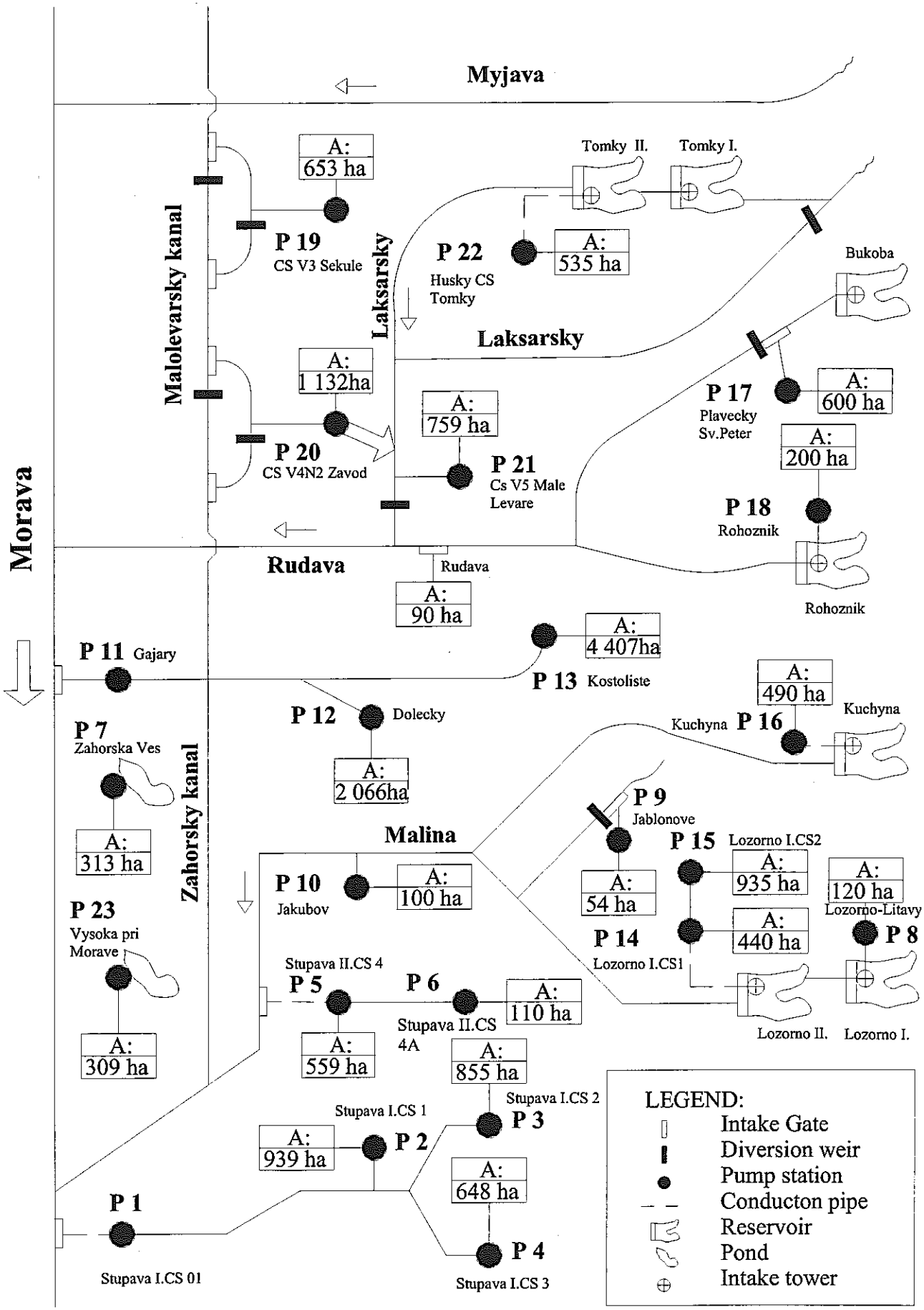


Figure B.9.1.2 Irrigation Area and Water Resources

B.9.2 DRAINAGE

B.9.2.1 PRESENT CONDITIONS OF DRAINAGE IMPROVEMENT

The history of the improvement of drainage facilities of Zahorska Lowland is long, and it can be said that it started in 1920s. There is a report, for the support of every activity referring to the (amelioration of soil), (Na podporu kazdej cinnosti vztahujucej sa na [melioraciu pody]) on drainage facilities built between 1920 and 1930, and according to this report, the drainage facilities (under drainage) improved by 1930 served as many as 650 ha in the Malacky area out of the total of 14,400 ha in the Slovakian country. Since then, drainage improvement has continued until 1990 and the area served is now about 10,500 ha for the Study Area of Zahorska Lowland and the 430,000 ha for the whole Slovak country.

As for construction of these facilities, the country (state) was responsible for 70% of total assistance and farmers were burdened with the remaining 30%, by the 1940s. All maintenance construction was carried out by the government (state) during the socialist days in the 1950s and afterwards. However, the improvement of new drainage canals and facilities was not done after 1989 when the socialist system ceased to function. The drainage improvement area of farmland is equivalent to 20% of the whole Slovakian territory, and the Study Area is 26%.

Drainage Improvement Area

Item	Slovakia		Study area	
Drainage area (ha)	430,000		10,500	
Land use	Agriculture land	Arable Land	Agriculture land	Arable land
Area (ha)	2,446,000	1,479,000	40,248	31,051
Rate (%)	17.5	29.1	26.0	33.8

Source: JICA Study team 2001

B.9.2.2 DRAINAGE SYSTEM OF THE STUDY AREA

The drainage system in the present study area is classified into the following three mechanisms based on the configuration of rivers and topography. Their drainage characteristics are as follows:

(1) The Morava River Land and Flood Basin

The area of the Morava River basin and its flood basin in this zone are 4,087 ha. Farmland and woodland are seen on the higher level of the basin. Though the basin of the higher level and the flood basin are inundated during snow melting in the springtime and during flooding in the summertime, there are few occasions on which these areas are inundated in other seasons. Because of this water environment, agriculture, which is risky in the basin at the higher level (the flood basin of the river), is carried out, but the artificial improvement of drainage is not carried out.

(2) Pump Drainage Zone

The pump drainage zone is sandwiched between the banks of the Morava River, the Myjava, the Rudava and the Malina, covering an area of 17,560 ha. The surface water in this area is drained by the Malolevarsky Canal and the Zohorsky running from north to south. These drainage canals are artificial, and the Malolevarsky is also used as irrigation canals.

The water level of these canals, however, becomes lower than that of the Morava River, making gravitational drainage impossible. Consequently, the topography and hydraulics of this zone requires that water must be drained by pump operation in the period between late February and late April and during flooding in summer. Pump stations are maintained at two sites. On the other hand, this zone includes the nature conservation district of about 5,200 ha. Consideration is given to the pump stations so that this district is not over-drained.

(3) Natural Drainage Zone

Water in the left side area of the Rudava and the Malina River and in the Mlaka river basin is drained to the Morava River by gravity. The upstream areas of the Malina, Rudava and Mlaka are mountainous districts of Male Karpaty, and these rivers contain an outflow volume in areas beyond the present study area.

Since the downstream areas of these rivers are affected by high water levels of the Morava River, they are equipped with banks, and a gate to control the back flow of water was built at one site each on the Malina and Rudava. There is a small depression zone and areas where gravitational drainage is impossible. In these places, water is made to cross the Malina, Rudava and Laksarsky through siphons, and is drained to the canals at a lower level (the Malolevarsky and the Zohorsky).

B.9.2.3 COMPOSITION OF DRAINAGE WORKS

The main facilities of the drainage project are drainage pump stations, ditch drains and underdrains.

(1) Drainage of Surface Water

Surface water is collected through ditch drains and drained to the Rudava, Malina and Mlaka, which are natural drains, and to the Malolevarsky-Zahorsky Canal, which is artificial. Although these rivers are affected by the high water level of the Morava River, because they are equipped with banks, natural drainage is possible. For field drainage, repair of the natural canals (138 km) and construction of ditch drains (398 km) was carried out. The canals are protected by precast concrete lining, concrete on the canal bottom or stone pitching.

(2) Pump Drainage

Surface water in low flatland of 17.56 km^2 located to the south of the Myjava River is collected by the Malolevarsky and the Zohorsky, and drained into the Morava River. During snow melting in the springtime and during flooding in the summertime, however, the water level of the Morava River becomes lower than that of the Malolevarsky and Zohorsky, thus requiring pump drainage.

Consequently, pump stations were built at two sites to drain flood water in this area. One pump station is located in Male Levare in the northern part of the area, and the other is in Zohor in the central part of the area. Both of these stations were constructed in 1941 and suffered great damage from the flooding of the Morava River in 1997. As a result, the Male Levare Pump Station (3.0 m^3/sec) and the Zohor Pump Station (10.0 m^3/sec) were renewed, in 1998 and 2001 (December), respectively. Drainage capacity of the pumps and the relationship with the water level are as shown in the following table.

Drainage Capacity of the Pump

Pump station	Discharge (m^3/sec)	Pump head (m)	Number of pump	Power (kw)	Cleaning Machine (Unit)	Inside water level (m)	Outer Water level (m)
Male Levare	1.536 0.75	3.1 2.9	φ1000: 1 unit φ 600: 2 unit	75 37	1:unit	145.12	146.95
Zohor	2.54 1.25	7.5 7.5	φ1000: 3 unit φ 600: 2 unit	132 75	I: unit	137.90	143.27

Source: SWME-PD

(3) Removal of Underground Water (Underdrainage)

In the areas where the underground water level is high and drainage is bad, improvements of drainage are carried out by constructing underdrains and ditch canals in the field, and by repairing the existing natural canals. In the present study area, the area of drainage improved by means of underdrains is about 10,572 ha, which covers 34% of farmland (10,572/31,051). The percentage of areas where irrigation facilities have also been constructed is about 70%. As to structure of underdrains, unglazed tile had been used until 1980, and the polyethylene type has been employed since then.

B.9.2.4 CONDITION OF POOR DRAINAGE AREA

(1) Poor Drainage Area

In low flatland where water gathers due to topographical characteristics or location/density of drainage canal and in its surrounding areas, the equipment of drainage facilities and their functions were investigated. In the following five areas, drainage was improved by construction or repair of ditch drains, underdrains and/or siphons by the 1990s.

1) Zohor southern part

This area is low flatland spreading on the right bank of the Malina. The drainage of surface water is improved by repairing natural canals and constructing drainages. For underground water in the field, underdrains are used. The main drainages include Stupavsky potok, Zohorsky potok and Rakytov. All of these drainages have a structure in which concrete lining (precast) is employed. Regarding the state of maintenance, bushes grow thickly on the side of canals except for part of Zohorsky potok, and cleaning is necessary. Zohorsky potok is equipped with back-flow prevention gates and flap gates to prevent inundation from the Malina, but they are damaged and do not work.

2) Lab-Plavecky Stvrtok

Forestland lies in the east and west of this area and surrounds spreading farmland. Several drainages have been dug south to north to drain surface water in this area. For the removal of underground water, underdrains have been constructed. Water is drained from the draining outlet of the arterial drainage canal (Mociarka) in this area to the Malina by gravitational drainage. In order to drain underground water by gravitational drainage at the position 1.0 km downstream from the junction of Mociarka, water is made to cross the Malina through a siphon and is led to the Zohorsky. Although there are no breaks in the canals, it is necessary to clean them.

3) Malacky southern part

This area is a point where brooks such as Tancibocky p., Balazov p. and Jezovka join the Malina, and the place expected to flood or be inundated is used for fishponds. In this area, both surface and underground water is drained to the Malina by gravitational drainage. Although there are no breaks in the canals, it is necessary to clean them.

4) Male Levare-Velke Levare Southern Part

This area is a place troubled with drainage problems that forms low flatland by tributaries of the Rudava. The Rudava and Laksarsky are equipped with banks to avoid the influence of the high water level of the Morava . On the other hand, as there are lowlands where natural drainage is difficult; one back-flow prevention gate is planned at the exit point to the Rudava. In addition, a siphon crossing the Rudava was built at one site, and siphons crossing the Laksarsky were constructed at two sites.

These siphons are linked to the Malolevarsky to drain water by gravity. As to the state of management, the siphon crossing the Rudava was repaired in 2000 and the main drainage canals were cleaned. Though the siphons of the Laksarsky are old, they play an important role for drainage canals in the lowland area, and it is considered that these siphons are important facilities for management.

In this area, there is a 90 ha underground irrigation system where underdrains are used. In this system, water is taken from branches of the Rudava, and water for irrigation flows to underdrains through pipes of 200 to 400 m in length. When the underground water level is too high, the water supply is stopped and the system is used as a culvert exclusively for draining.

5) Borsky Svaty Jur

The Borsky Svaty Jur northern area has a gentle incline from south to north, and low flat land is formed around the Myjava. Both surface and underground water are drained to the Myjava. This area is affected by the high water level of the Myjava, which makes gravitational drainage of surface water possible. Drainage of underground water is, however, poor. In a complicated way, part of the surface water is drained through ponds in the lowland to the Malolevarsky on the western side. Due to such conditions, poor drainage of underground water is likely to occur in this area. The SWME-PD cleans drainage canals with priority given to this area.

Poor Drainage Areas in the Study Area

District	Area (ha)	Improvement facility for poor drainage	Maintenance Condition of canal
Zohor Southern Part	800	Drainage canal, Flood gate, underdrain pipe	Broken Flood gate Necessary cleaning
Plavecky Stvrtok	1,500	Drainage canal, underdrain pipe and siphon, drop structure	Necessary cleaning
Malacky Southern Part (Vinohradok)	800	Drainage canal and underdrain pipe	Necessary cleaning
Mare Levare & Velke Levare	1,200	Drainage canal, underdrain pipe and siphon	Necessary cleaning
Borsky Svaty Jur(500ha)	500	Drainage canal and underdrain pipe	Necessary cleaning

(2) Siphon Facilities of the Myjava and the Rudava

1) Myjava Siphon

The Malolevarsky serves as both a drainage canal and an irrigation canal. The source of water for irrigation is near Holic up the Morava River. As water is sent to the irrigation zone inside the present study area, the Malolevarsky crosses the Myjava through a siphon. The siphon has no damage, and operation and maintenance are good.

Dimension of Myjava Siphon

Siphon	Flow Volume (m3)	Length (m)	Size of Culvert (m)	Inlet (m)	Outlet (m)	Gate (m)	Drainage Pipeφ800 (m)	Level of Siphon bet (m)	HWL (m)
Myjava	8.0	117.5	1.40X1.40 2:unit	17.5	10.0	φ600; 2 φ800;1	12.0	147.63	151.85

Source: SWME-PD

2) Rudava Siphon

In order to send part of the flooding volume of the Malolevarsky to the Zohorsky, the Rudava siphon crosses the Rudava. Of the Malolevarsky flooding volume of 6.0 m^3/sec, 3.0 m^3/sec is drained at the Mare Levare Pump Station and the remaining 3.0 m^3/sec is sent to the Zohorsky (herein after Zohorsky). The siphon has no damage, and operation and maintenance are good. Equipment of the siphon facilities is as shown in the following table.

Dimension of Rudava Siphon

Siphon	Flow Volume (m3)	Length (m)	Size of Culvert (m)	Inlet (m)	Outlet (m)	Gate (m)	Water Intake Pipeφ400 (m)	Water intake Valve (unit)	HWL (m)
Myjava	6.0	115.2	1.55X1.55 2:unit	21.1	10	1.55X1.55 2:unit	33.7	3	146.8

Source: SWME-PD

B 9.2.5 MAINTENANCE AND MANAGEMENT OF DRAINAGE SYSTEM

Operation and maintenance of drainage facilities are largely divided into the following two categories. Those of drainage stations, Drainage Rivers and small natural waterways are carried out by the SWME-PD (Malacky office). In the present management system at the field level, ditch canals are managed by the SWME-PD (state) while underdrains laid in the field are managed by farmers because the underdrains belong to the land owners (underdrains are facilities owned by farmers). Although there is a system where subsidies are given for underdrain repair work done by farmers, no underground repair work is carried out by farmers in this area.

(1) Management of the Rivers in the Study Area

Three rivers, the Rudava, the Malina and the Mlaka, undertake drainage of surface water in the district covering 72.6 % of the study area (444.4 km^2/611.2 km^2). These rivers are equipped with banks up to the level influenced by the high water level of the Morava. At the junction points of brooks or drainage canals, protection work is provided. Control and management of these rivers are carried out by the SWME-PD, and the condition of management is good.

(2) Pump Stations

In the present system, the operation of each pump station is started when the water level of the Malolevarsky and the Zohorsky reaches the water level to activate a pump. This condition is maintained all year round. Pumps are operated for a long time in the period of snow melting between late February and late April and during flooding in the summertime. In these periods, since the water level of the Morava River becomes higher than that of Malolevarsky and Zohorsky, drainage by operation of pumps is required. Although a manager of pump operation is permanently stationed there, operation is automatically controlled according to the water level. Auto-screens are used for disposal of waste, which becomes an obstruction to operation.

(3) Management of Drainage Canals and Underdrains

Drainage canals from the outlet of an underdrain to a pump station are managed by the SWME-PD. The main management works for drainage canals are grass cutting on the side and dredging of earth and sand accumulated on the bottom. Due to the severe difficulties in obtaining sufficient budget in recent years, adequate management has become difficult. Underdrains must be managed by farmers, but there is practically no management at all. The SWME-PD estimates that 40% of underdrainage facilities have functional disorders, increasing by 4% to 5% per year.

Contents of Drainage Canals and Underdrains

Construction period	Material of underdrain	Area with underdrain (ha)	Ditch canal (km)	Modified natural canal (km)
1930-1960	Earthenware pipe	101	21.0	22.6
1960-1970	Earthenware pipe	5,214	232.5	111.0
1970-1980	Earthenware & Vinyl chloride pipe	4,930	139.0	3.6
1980-1990	Vinyl chloride pipe	327	5.6	1.1
Total		10,572	398.1	138.3

Source: SWME-PD

Under these conditions, it is said that almost no maintenance and management is executed by farmers. Many underdrains were built on large-scale farms of the state system. In the present situation where division of land proceeds, there are two or more farmers in one drainage system, and maintenance and management cannot be carried out without cooperation.

B.9.3 EVALUATION OF IRRIGATION AND DRAINAGE FACILITIES

Regarding the main irrigation facilities, that is, water intake facilities (including dams), pump facilities, pipelines, field irrigation and drainage facilities, their functions and conditions of operation, maintenance and management are described in Items 1 to 3 above. These results are classified into evaluation categories of the respective facilities, and the following is obtained.

Evaluation of Irrigation and Drainage Facilities and Maintenance

Facilities	Category of evaluation	Amount / Evaluation	Note
Water-intake facilities	Functions.	6 places	Table B.9.1. 3
	Functions by partially repairing.	2 places	
	A complete repair is needed.	1 place	
	Examines from the plan and the repair is needed.	2 Place	
Pump facilities	Functions.	8 Station	Table B.9.1.4
	Functions by partially repairing.	3 Station	
	Needs a complete repair excluding Pump.	4 Station	
	Examines from the plan and the repair is needed.	6 Station	
Pipeline	Managed district	10,870 ha	Table B..9.1.5
	District which has not been managed for a long term	5,354 ha	
Field irrigation facilities(machine and tool)	District in irrigation facilities (machine and tool) (12 company) ・Functions ・Non Function	8,943 ha 5,822 ha 3,121 ha	Table B.9.1.11
	District which irrigation facilities (machine and tool) do not have	7,281 ha	
Drainage system	Drainage pumping station(two places)	Functions.	
	Backwash gate (two places)	It is necessary to repair one place.	
	Drain Siphon: A large scale ; two places(Myjava、Rudava) :Small scale; five places	Large scale siphons are managed and functions. Needs cleaning small-scale Siphon.	
	・Natural Drainage river（Rudava、Malina、Mlaka） ・Repaired nature drainage canal （１38 km）	These rivers are managed and functions. Cleaning is necessary for 80% canal.	
	・Ditch drain（398 km）	Cleaning is necessary for 80% canal.	
	・Under drainage（10,572ha） ・Poor drainage area	There is a functional disorder in 40%. 600ha	

Table B.9.2.1 Underdrainage Area and Drainage canal Length (1)

Number	Registration number	Name of drainage system	Drained area (ha)	Modified flows (m)	Drainage canals (m) Odvodnovacie kanaly (m)						Constructed in:
Porad. cislo	Evidencne cislo	Nazov odvodnenia	odvodn. plocha (ha)	Upravene toky (m)	open otvorene	covered kryte	drainage s odv.uc.	total spolu	material material	condition stav	Rok zaradenia
1	5208 093	OP Solosnica	9	-	13,326	-	-	13,326		B	1925
2	5201 005	OP Lamac I. A UT Velka Luka	20	1,500	280	-	-	280		B	1959
3	5104 006	OP Lamac - Antosov kanal	70	-	1,549	-	-	1,549		B	1960
4	5201 025	OP Gajary - Kare-Junkov	-	-	1,598	-	-	1,598		B	1960
5	5201 031		2	-	-	-	4,244	4,244		B	1960
		Subtotal	101	1,500	16,753	0	4,244	20,997			
6	5104 017	OP Devinska Nova Ves	-	-	1,003	-	1,027	2,030		B	1961
7	5201 036	OP a UT Kostoliste II..	-	1,392	-	-	1,400	1,400		B	1961
8	5201 057	OP Mast - hlavny kanal	-	-	820	-	-	820		B	1961
9	5208 008	OP Borsky Jur	-	-	3,520	-	-	3,520		B	1961
10	5208 053	OP Male Levare	-	-	4,836	-	-	4,836		B	1961
11	5201 058	OP Stupava III - UT Potok VIII	208	2,214	1,890	-	-	1,890		B	1962
12	5201 018	OP Z. Bystrica-Medzichotarny	-	-	1,594	-	-	1,594		B	1962
13	5201 046	OP Malacky	-	-	-	-	2,165	2,165		B	1962
14	5201 055	OP Plavecky Stvrtok II.	-	-	4,060	-	-	4,060		B	1962
15	5208 231	OP Borsky Jur	-	-	17,909	-	-	17,909		B	1962
16	5211 061	OP Bukova	25	-	6,670	-	-	6,670		B	1962
17	5201 027	OP Gajary - Cigansky kanal	-	-	-	-	9,697	9,697		B	1963
18	5201 032	OP Jakubov II. a UT Lucky	-	3,750	580	-	-	580		B	1963
19	5201 060	OP JRD Mast	401	-	1,393	-	-	1,393		B	1963
20	5201 069	OP Zohor III.	-	-	-	-	11,628	11,628		B	1963
21	5208 109	OP Velke Levare	235	-	9,986	-	-	9,986		B	1963
22	5208 114	OP Zavod	152	-	11,520	-	-	11,520		B	1963
23	5201 024	OP Gajary II.	15	-	-	-	1,105	1,105		B	1964
24	5201 037	OP Malacky - Kostoliste I.	250	-	1,888	-	-	1,888		B	1964
25	5201 043	OP Lab I.	57	-	-	-	10,600	10,600		B	1964
26	5201 059	OP SM Stupava IV.	55	-	870	-	-	870		B	1964
27	5201 129	OP Lozorno - Jablonove	285	-	190	-	-	190		B	1964
28	5208 081	OP Rohoznik	168	-	1,805	-	-	1,805		B	1964
29	5208 095	OP Solosnica	336	-	14,076	-	-	14,076		B	1964
30	5201 033	OP Jakubov II. - Cigansky k.	-	-	-	-	5,850	5,850		B	1965
31	5201 038	OP Kostoliste III.	37	-	-	-	1,200	1,200		B	1965
32	5201 047	OP SM Malacky III.	115	-	1,812	-	-	1,812		B	1965
33	5201 048	OP VLM Malacky - Novina	48	-	-	-	3,100	3,100		B	1965
34	5201 064	OP Vysoka - Spice	-	-	1,100	-	-	1,100		B	1965
35	5208 010	OP Borsky Jur	354	-	5,439	-	-	5,439		B	1965
36	5208 064	OP Plavecky Peter	229	-	3,060	-	-	3,060		B	1965
37	5201 029	OP Jablonove- Mlynsky nahon	-	-	300	-	-	300		B	1966
38	5201 041	OP Kuchyna II.	200	-	2,080	-	-	2,080		B	1966
39	5201 042	OP a UT Kuchyna III.	163	2,676	1,277	-	-	1,277		B	1966
40	5201 049	OP Malacky - Tancibok	214	-	3,673	-	-	3,673		B	1966
41	5201 061	OP SM Stupava	-	-	2,670	-	-	2,670		B	1966
42	5201 062	OP Mast II.	47	-	600	-	-	600		B	1966
43	5201 065	OP Vysoka - Sviniarska jama	-	-	551	-	-	551		B	1966
44	5201 070	OP Zohor - Blatna Struha	-	-	1,568	-	-	1,568		B	1966
45	5208 084	OP Sekule	78	-	1,710	-	-	1,710		B	1966
46	5201 019	OP Zahorska Bystrica	-	-	780	-	-	780		B	1967
47	5201 026	OP Gajary - Kruzkovy kanal	-	-	-	-	1,686	1,686		B	1967
48	5201 028	OP Jablonove, ovocny sad	11	-	2,500	-	-	2,500		B	1967
49	5201 039	OP a UT Malacky - Kostoliste II.	277	3,479	3,641	-	-	3,641		B	1967
50	5201 066	OP Vysoka - Kanal U zeleznice	-	-	730	-	-	730		B	1967
51	5201 067	OP Vysoka- Kanal Z obce	-	-	250	-	-	250		B	1967
52	5201 068	OP Vysoka - Kanal Zbrodky	-	-	1,910	-	-	1,910		B	1967
53	5201 071	OP Zohor IV.	305	-	5,000	-	-	5,000		B	1967
54	5208 110	OP Velke Levare	75	-	4,300	-	-	4,300		B	1967
55	5104 022	OP Zahorska Bystrica	8	-	800	-	-	800		B	1968
56	5201 040	OP Kostoliste IV.	100	-	1,235	-	-	1,235		B	1968
57	5201 044	OP Lab II.	-	-	3,639	-	-	3,639		B	1969
58	5201 063	OP Mast III.	-	-	3,571	-	-	3,571		B	1969
59	5208 099	OP a UT Kuty-Kuklov-Cary	491	17,635	24,764	-	-	24,764		B	1969
60	5201 030	OP a UT JRD Jablonove II.	68	3,532	3,463	-	-	3,463		B	1970
61	5201 045	OP Lozorno II.	140	-	2,901	-	-	2,901		B	1970
62	5201 076	OP Zahorska Ves	-	-	1,225	-	-	1,225		B	1970
63	5208 120	OP Male Levare	207	-	6,819	-	-	6,819		B	1970
64	5208 121	OP Velke Levare	68	-	5,067	-	-	5,067		B	1970
		Subtotal	5,214	34,678	183,045	0	49,458	232,503			

70% concrete

Necessary repair 30%

Note (poznamka): Material (material): A: Earth canal (zemny kanal)
B: Concrete canal (betonovy kanal)

Maintenance condition (stav): A: Good (dobry)
B: Cleaning Necessary (potreba vycistit)
C: Concrete lining Necessary (oprava beton. oblozenia)

Source: The list of drainage under administration of Povodie Dunaja, s.p., Bratislava

Table B.9.2.1 Underdrainage Area and Drainage canal Length (2)

Number	Registration number	Name of drainage system	Drained area (ha)	Modified flows (m)	Drainage canals (m) Odvodnovacie kanaly (m)						Constructed in:
Porad. cislo	Evidencne cislo	Nazov odvodnenia	odvodn. plocha (ha)	Upravene toky (m)	open otvorene	covered kryte	drainage s odv.uc.	total spolu	material material	condition stav	Rok zaradenia
65	5201 072	OP JRD Zohor V.	98	-	4,021	-	-	4,021		B	1971
66	5201 073	OP a UT JRD Pernek	31	388	1,380	-	-	1,380		B	1971
67	5201 132	OP JRD Lab II.	106	-	-	-	8,717	8,717		B	1971
68	5201 133	OP SM Malacky - Kostoliste IV.	-	-	3,938	-	-	3,938		B	1971
69	5201 134	OP JRD Kuchyna IV.	-	-	815	-	-	815		B	1971
70	5201 137	OP SM Plavecky Stvrtok IV.	-	-	1,548	-	-	1,548		B	1971
71	5208 129	OP a UT Laksar - Porec	1,492	6,665	23,834	-	-	23,834		B	1971
72	5201 143	OP Lab - Pasienky	20	-	2,570	-	-	2,570		B	1972
73	5201 144	OP Lozorno 3.st.	14	-	2,510	-	1,411	3,921		B	1972
74	5201 147	OP JRD Zohor VI.	19	-	2,254	-	-	2,254		B	1972
75	5201 149	OP a UT Malina - Niva Moravy	389	1,925	8 453	-	-	8 453		B	1972
76	5208 128	OP a UT Rudava - Podhorie	1,239	15,653	45,482	-	-	45,482		B	1972
77	5201 154	OP Pasienky - Lab	84	-	1,980	-	-	1,980		B	1973
78	5201 164	OP a UT Malina - Podhorie	544	19,404	15,549	-	-	15,549		B	1973
79	5201 165	OP Stupava - Borinka III.	35	-	2,241	-	-	2,241		B	1974
80	5201 166	OP Zohor - Graba I.	71	-	3,507	-	-	3,507		B	1974
81	5201 167	OP JRD Pernek - Pri krizi	40	-	-	358	792	1,150		B	1974
82	5104 168	OP SM Stupava, h, D.N. Ves	-	-	646	-	-	646		B	1975
83	5201 173	OP SM Stupava, h. D.N. Ves	26	-	1,007	-	-	1,007		B	1975
84	5201 284	OP JRD Stupava- Podgajarska	26	-	600	-	-	600		B	1976
85	5201 287	OP JRD Zahoran - Jakubov	101	-	-	-	3,064	3,064		B	1976
86	5201 288	OP JRD Zohor - Graba II.	191	-	-	-	5,499	5,499		B	1977
87	5201 296	OP SM Stupava - Sorkav	42	-	-	-	1,229	1,229		B	1977
88	5201 298	OP Podhorie	73	-	-	-	2,400	2,400		B	1977
89	5201 311	OP Gajary - Bahna	147	-	-	600	-	600		B	1979
90	5208 265	OP a UT Plavecke Podhradie	142	1,230	1,066	-	-	1,066		B	1979
		Subtotal	4,930	45,265	114,948	958	23,112	139,018			
91	5201 331	OP JRD Podhorie - Pernek	30	-	277	83	-	360		B	1982
92	5208 291	OP Borsky Jur I.	208	-	3,780	-	-	3,780		B	1986
93	5208 294	OP a UT Rohoznik	30	553	-	-	-	-		B	1986
94	5208 296	OP Borsky Jur I.	30	-	315	-	-	315		B	1987
95	5208 306	OP SM Velke Levare, sady I.	29	-	1,190	-	-	1,190		B	1989
		Subtotal	327	553	5,562	83	0	5,645			
		Total	10,572	81,996	320,308	1,041	76,814	398,163			

70% concrete

Necessary repair 20%

Note (poznamka): Material (material): A: Earth canal (zemny kanal)
B: Concrete canal (betonovy kanal)

Maintenance condition (stav): A: Good (dobry)
B: Cleaning Necessary (potreba vycistit)
C: Concrete lining Necessary (oprava beton. oblozenia)

Source: The list of drainage under administration of Povodie Dunaja, s.p., Bratislava

Table B.9.2.2 Modified Canal Length

Number Porad. cislo	Registration number Evidence cislo	Name of UT construction Nazov stavby UT	Modified flows (m) Upravene toky (m)	Constructed in: Rok zaradenia	Materials Material	Maintenance Condition Stav	
1	5201 208	UT Jablonovsky - Jablonove I.	890	1942	70%concrete	Necessary repair 20- 30%	B
2	5201 211	UT Mastecky - Stupava	4,470	1952			B
3	5104 258	UT Vapenicky - Zahorska Bystrica	2,893	1954			B
4	5104 259	UT Bystricky - Zahorska Bystrica	1,450	1954			B
5	5201 230	UT Bahnokanal - Kostoliste	4,840	1958			B
6	5201 238	UT Stav. Oliva - Plavecky Stvrtok	1,200	1958			B
7	5201 212	UT Stav. Oliva - Lab	4,228	1959			B
8	5201 223	UT Dubravsky - Lamac	2,633	1960			B
	Subtotal		22,604				B
9	5104 213	UT Lamackeho toku - Lamac	4,300	1961			B
10	5201 231	UT Bahnokanal - Kostoliste	1,460	1961			B
11	5208 201	UT Solosnicky	3,200	1961			B
12	5201 214	UT Balazov jarok - Malacky	3,269	1962			B
13	5201 215	UT Tancibok - Malacky	1,823	1962			B
14	5201 216	UT Kanal II. Zohor	3,306	1962			B
15	5201 218	UT Kanal 2.- Zohor	2,406	1962			B
16	5201 219	UT Vampil - Plavecky Stvrtok	2,064	1962			B
17	5201 220	UT Kruzky - Plavecky Stvrtok	789	1962			B
18	5201 252	UT Podgajsky - Mast	1,365	1962			B
19	5208 197	UT Zpod Vysokej- Zavod	600	1962			B
20	5208 203	UT Vajarek s prit. - Solosnica	3,853	1962			B
21	5208 204	UT Hranicny - Solosnica	3,409	1962			B
22	5208 206	UT Hranicny - Plavecky Peter	5,770	1962			B
23	5201 221	UT Cabadov - Kuchyna	4,200	1963			B
24	5201 222	UT 05 Nivky - Kuchyna	1,750	1963			B
25	5201 224	UT Dubravsky - Lamac	130	1963			B
26	5208 208	UT Planava - Moravsky Jan	1,299	1963			B
27	5201 225	UT Ondriasovsky tok - Lozorno	3,600	1964			B
28	5201 226	UT Javorinka - Kuchyna	2,333	1964			B
29	5201 227	UT Congersky tok - Gajary	4,760	1964			B
30	5201 228	UT Zahumenicky - Gajary	4,976	1964			B
31	5201 232	UT Bahnokanal - Kostoliste	2,393	1964			B
32	5201 239	UT Stupava IV.	2,615	1964			B
33	5208 184	UT Rohoznicky	121	1964			B
34	5208 195	UT Laksarsky	14,126	1964			B
35	5208 202	UT Vyvrat - Rohoznik	1,385	1964			B
36	5208 205	UT Fenes - Plavecky Mikulas	3,332	1964			B
37	5201 229	UT Borinsky tok - Jakubov	3,400	1965			B
38	5201 233	UT Pavlinka - Stupava	930	1966			B
39	5201 234	UT Pernecka Malina - Kuchyna	3,810	1966			B
40	5201 235	UT Z kamenolomu - Kuchyna	905	1966			B
41	5201 236	UT Zachytny kanal - Vysoka	5,884	1966			B
42	5201 209	UT Jablonovsky - Jablonove II.	210	1967			B
43	5208 196	UT Porec - Zavod	6,854	1967			B
44	5208 209	UT Sekule - Sekule	1,774	1967			B
45	5104 237	UT Vapenicky - Zahorska Bystrica	800	1968			B
46	5201 210	UT Jablonovsky - Jablonove III.	403	1968			B
47	5201 217	UT Kanal 2. - Lozorno	420	1969			B
48	5104 240	UT Dievci tok - Zahorska Bystrica	988	1970			B
	Subtotal		111,012				B
49	5104 256	UT Dievci tok - Zahorska Bystrica	541	1971			B
50	5201 262	UT Stumpach - Lab	2,414	1973			B
51	5201 263	UT Sucheho - Lozorno	673	1975			B
	Subtotal		3,628				B
52	5208 279	UT Vyvrat	240	1982			B
53	5201 348	VN Kuchyna	887	1985			B
	Subtotal		1,127				B
	Total		**138,371**				B

Note (poznamka):

Material (material): A: Earth canal (zemny kanal)
B: Concrete canal (betonovy kanal)

Maintenance condition (stav): A: Good (dobry)
B: Cleaning Necessary (potreba vycistit)
C: Concrete lining Necessary (oprava beton. oblozenia)

Source: Zoznam upravenych tokov

Table B.9.2.3 Yield Ratio corresponding to flooding duration

Flooding duration (days)	Yield Ratio Corresponding to flooding duration							
	Winter wheat		Sugar beet		Alfalfa		Meadow cover	
	Flood season							
	spring	summer	spring	summer	spring	summer	spring	summer
0	100	100	100	100	100	100	100	100
1	95	96	87	89	94	96	97	99
3	91	92	65	70	82	85	90	97
5	79	81	19	53	72	78	84	93
10	62	64	18	25	50	59	68	75
20	45	41	17	5	18	24	47	19
30	39	27	16	0	0	0	37	0

Source: ODVODNOVANIE PRIRODA: 1987

Table B.9.2.4 Drainage Discharge of Catchments Area(1)

Number of Block	River basin	Catchments area(km^2)	Unit discharge ($m^3/sec/km^2$)			Discharge of catchments area (m^3/sec)		
	Probable year		1/2	1/5	1/10	1/2	1/5	1/10
1	Malolevarsky	135.5	0.033	0.047	0.057	4.47	6.37	7.72
2	Zohorsky	65.37	0.033	0.047	0.057	2.16	3.07	3.73
3	Mlaka	99.59	0.033	0.047	0.062	3.29	4.68	6.17
4	Malina	398.68	0.030	0.046	0.057	11.96	18.34	22.72
5	Rudava	417.72	0.030	0.046	0.057	12.53	19.22	23.81
6	Myjava	19.79	0.070	0.2	0.3	1.39	3.96	5.94
total								

(Refer to Figure B.9.2.2 Drainage Carchment Area(1))

Table B.9.2.4 Drainage Discharge of Catchments Area(2)

Number of Block	River basin	Catchments area(km^2)	Unit discharge (m3/sec/km^2)			Discharge of catchments area (m^3/sec)		
	Probable year		1/2	1/5	1/10	1/2	1/5	1/10
1	Malolevarsky	135.50	0.033	0.047	0.057	4.47	6.37	7.72
2	zohorsky	65.37	0.033	0.047	0.057	2.16	3.07	3.73
3	Mlaka	63.81	0.028	0.046	0.06	1.79	2.94	3.83
4	Mlaka	35.78	0.028	0.046	0.06	1.00	1.65	2.15
5	Malina	6.42	0.028	0.046	0.058	0.18	0.30	0.37
6	Malina	52.49	0.028	0.046	0.06	1.47	2.41	3.15
7	Malina	33.70	0.028	0.046	0.059	0.94	1.55	1.99
8	Malina	42.65	0.028	0.046	0.06	1.19	1.96	2.56
9	Malina	70.24	0.029	0.047	0.061	2.04	3.30	4.28
10	Malina	24.49	0.028	0.046	0.059	0.69	1.13	1.44
11	Malina	9.98	0.028	0.046	0.058	0.28	0.46	0.58
12	Malina	103.58	0.029	0.047	0.061	3.00	4.87	6.32
13	Malina	55.13	0.028	0.046	0.06	1.54	2.54	3.31
14	Rudaba	303.85	0.032	0.05	0.062	1.76	2.76	3.42
15	Rudaba	40.10	0.028	0.046	0.06	3.79	6.23	8.13
16	Rudaba	73.77	0.029	0.047	0.061	3.93	6.37	8.27
17	Myjava	19.79	0.028	0.046	0.058	3.79	6.23	7.86
Total		1136.65						

(Refer to Figure B.9.2.3 Drainage Carchment Area(1))

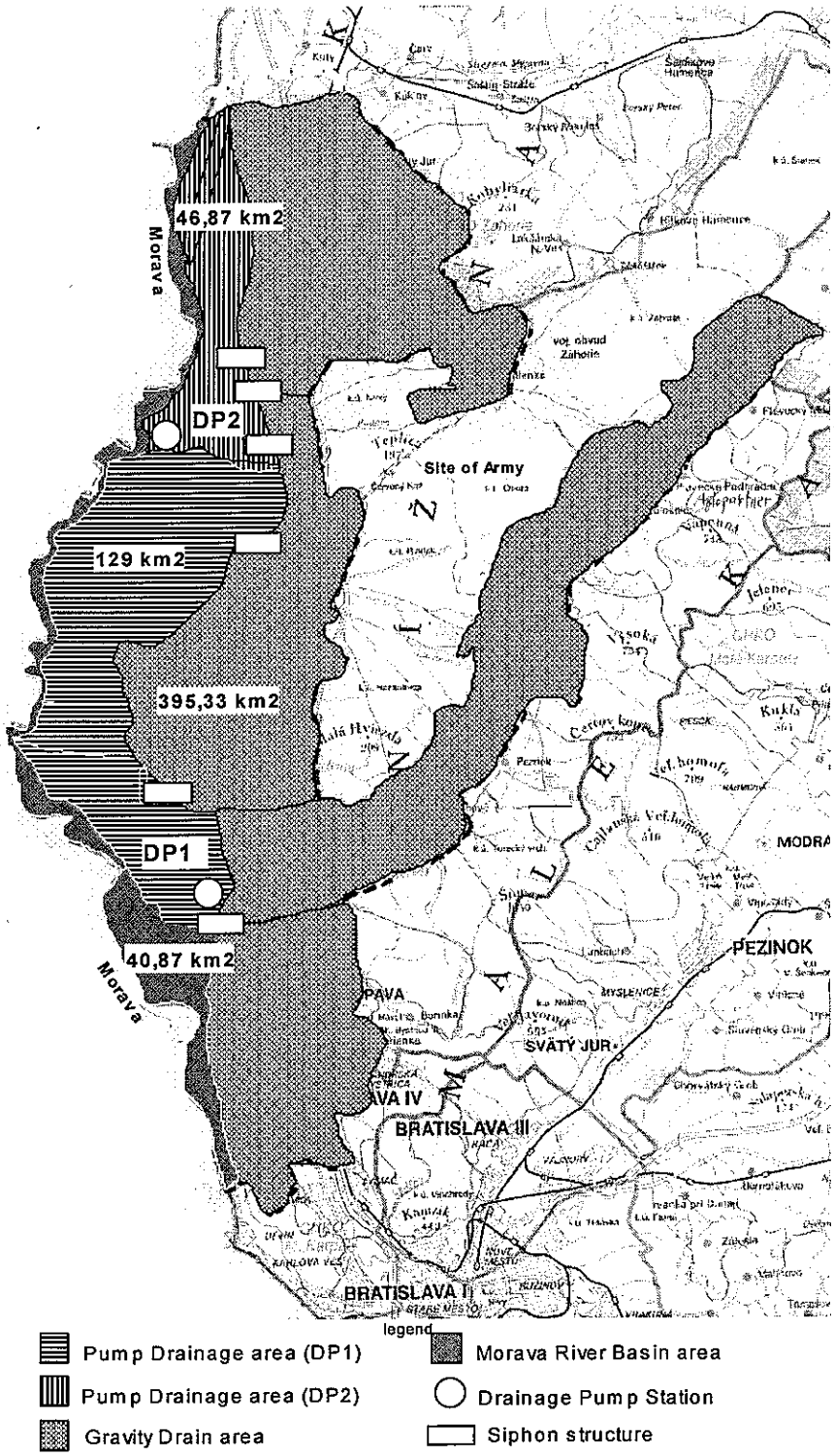
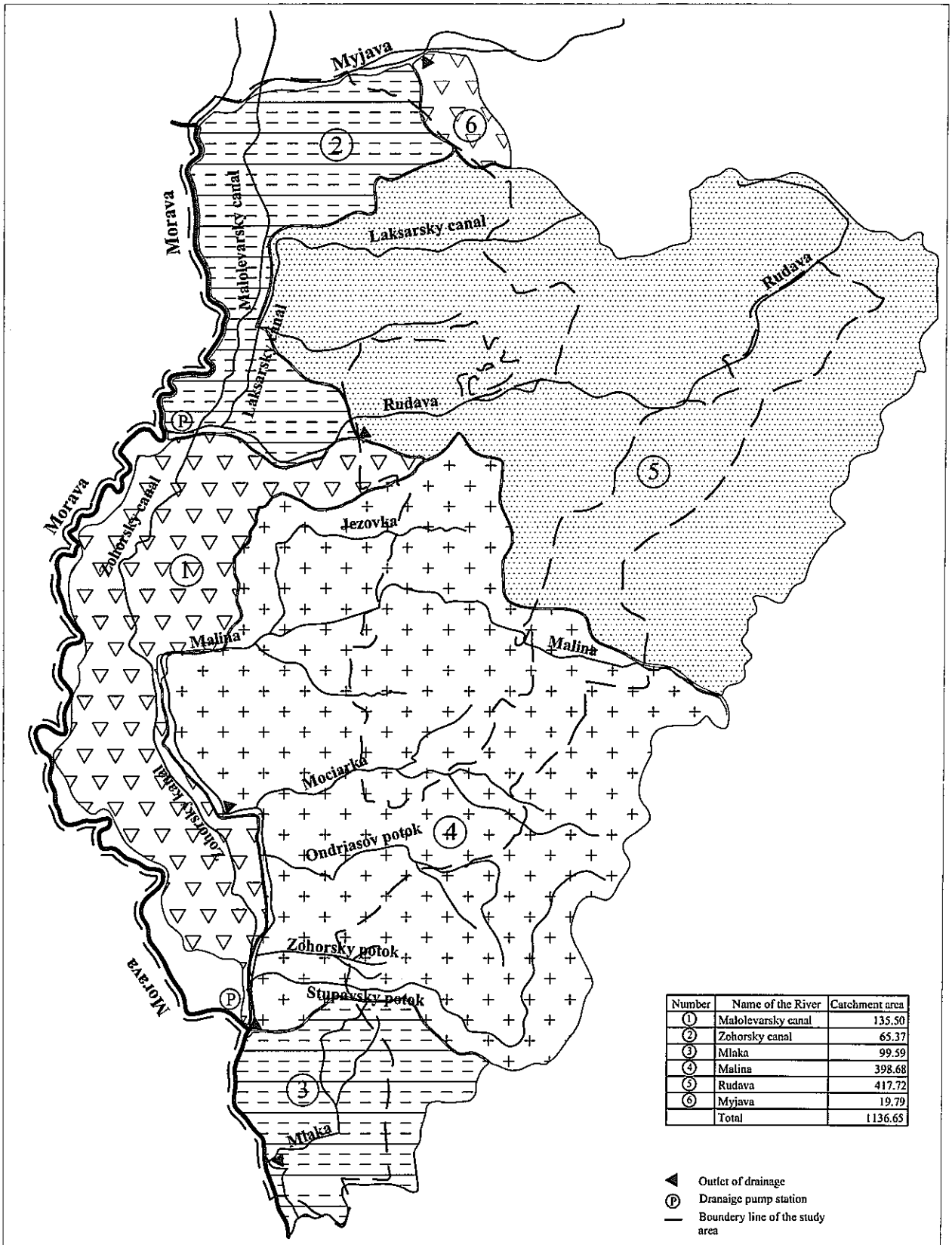


Figure B. 9.2.1 Drainage System in The Study Area



Number	Name of the River	Catchment area
①	Malolevarsky canal	135.50
②	Zohorsky canal	65.37
③	Mlaka	99.59
④	Malina	398.68
⑤	Rudava	417.72
⑥	Myjava	19.79
	Total	1136.65

◀ Outlet of drainage
Ⓟ Dranaige pump station
— Boundery line of the study area

Figure B.9.2.2 Drainage Catchment Area (1)

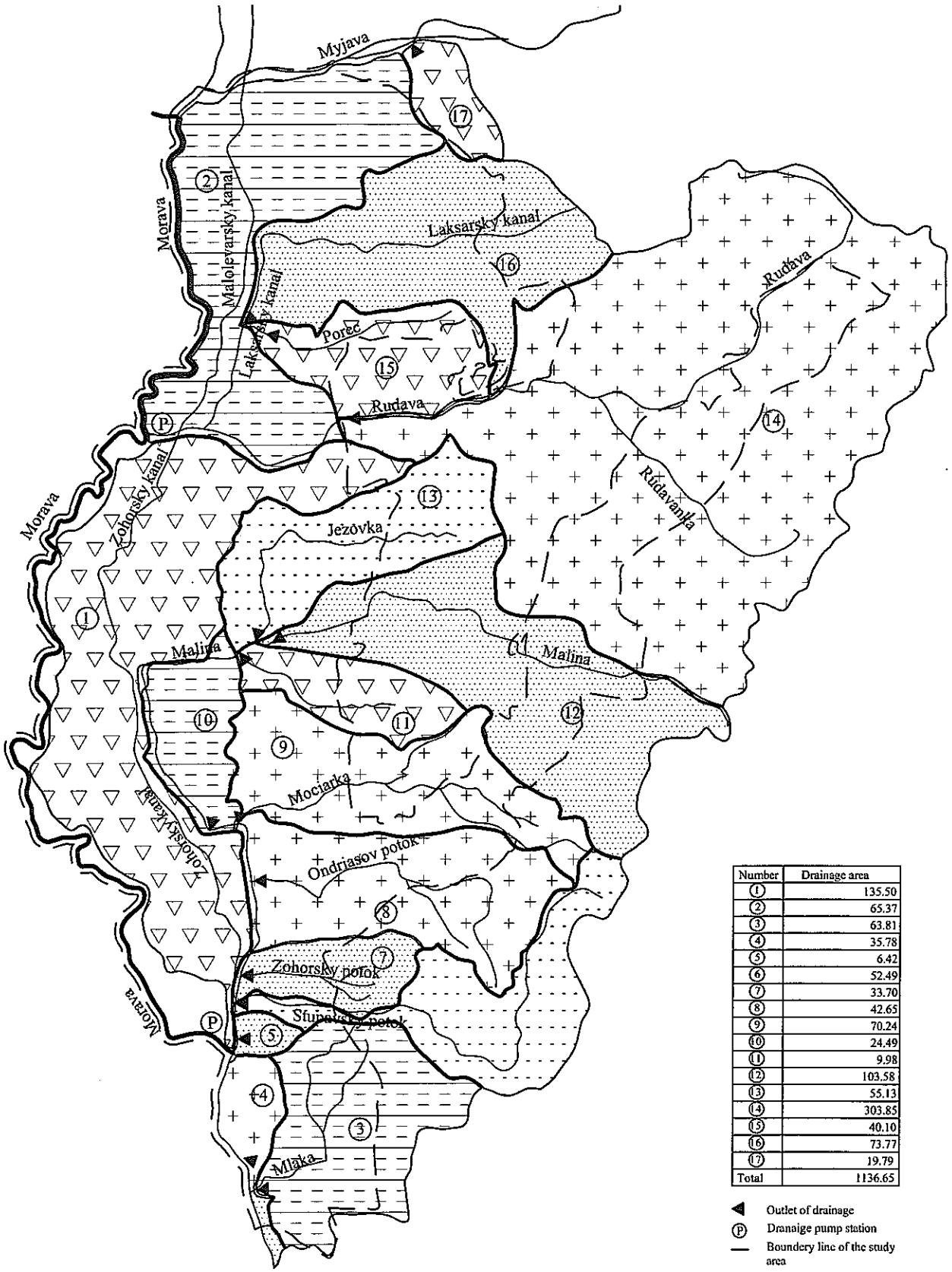


Figure B.9.2.3 Drainage Catchment Area (2)

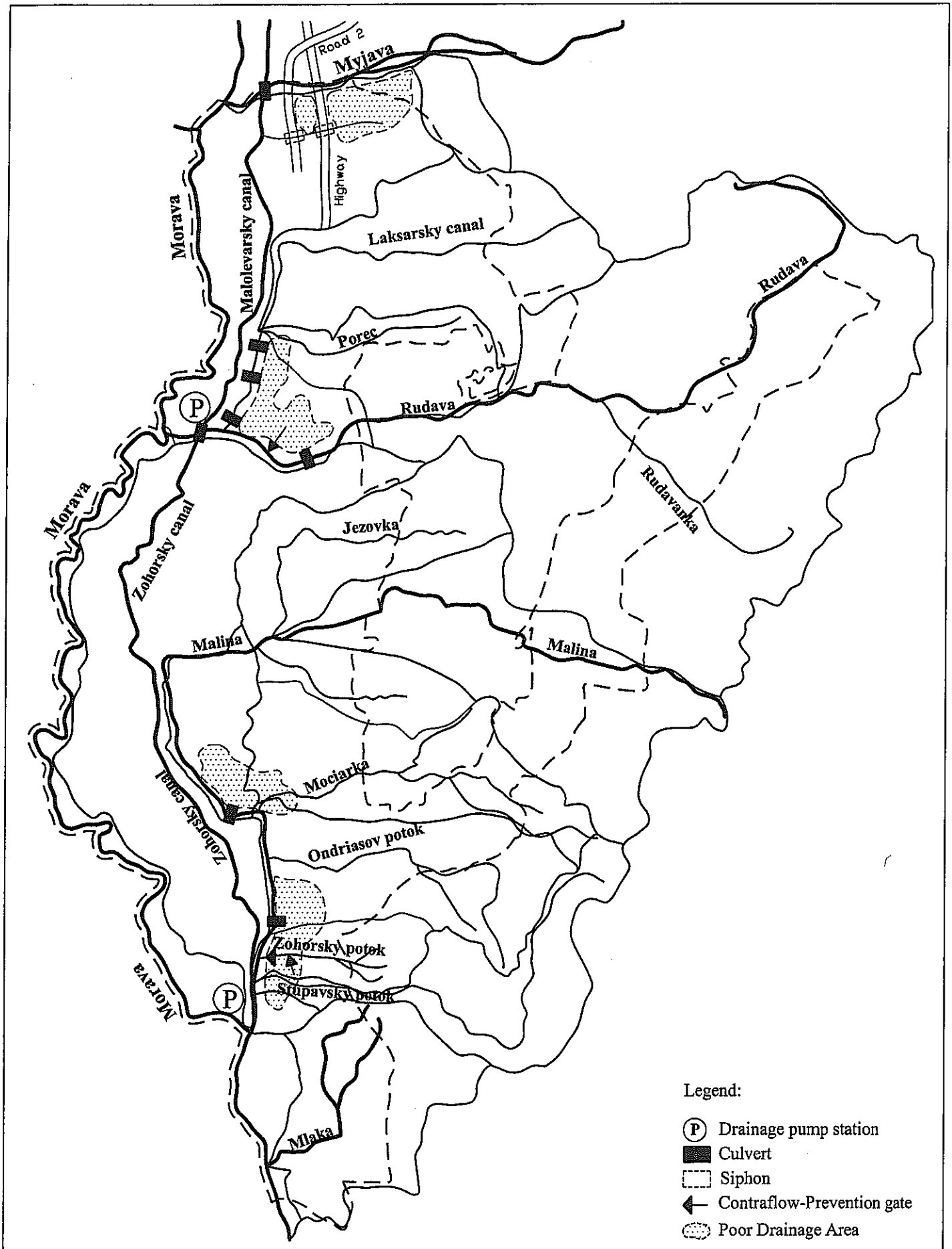
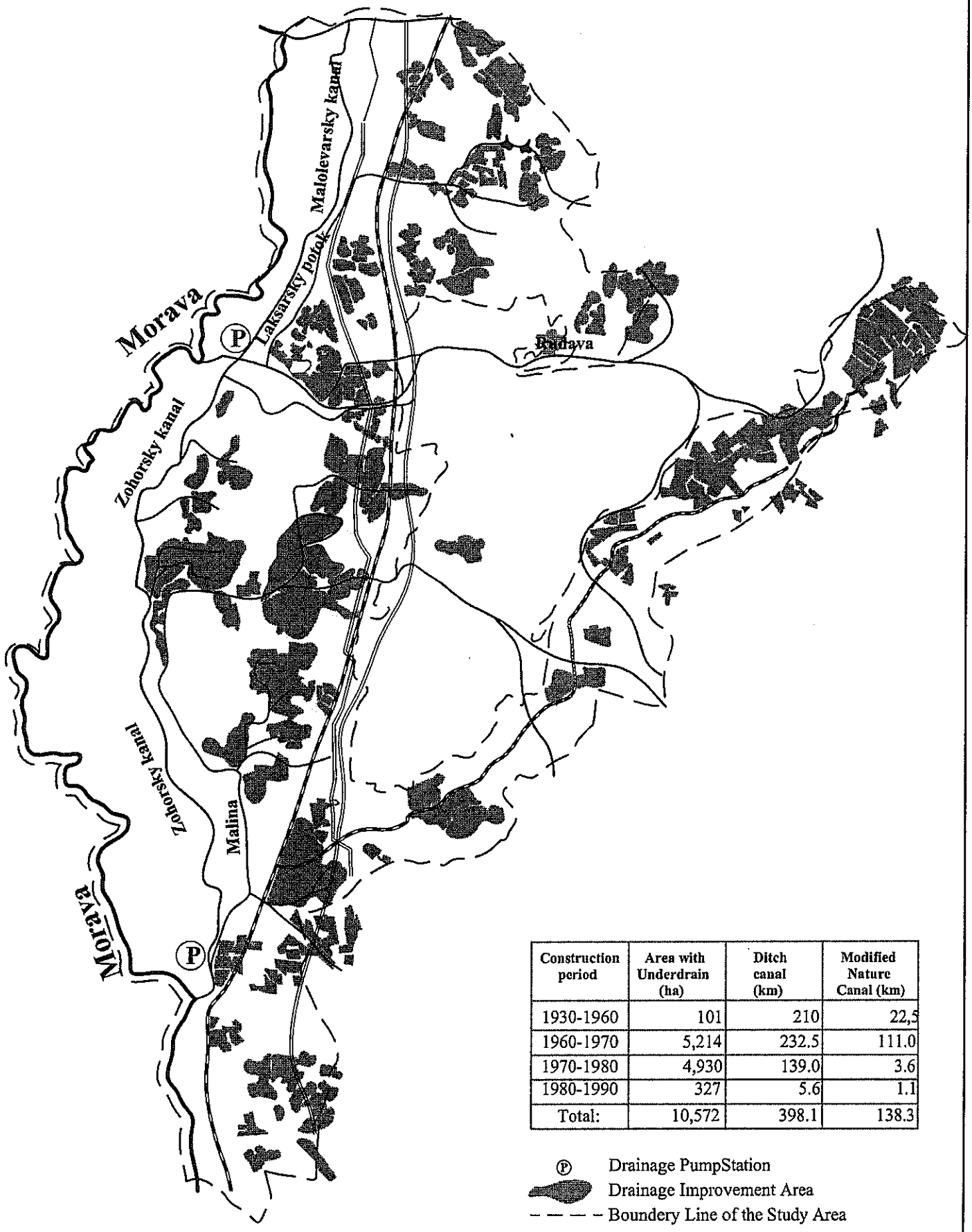


Figure B.9.2.4 Location of Drainage Facilities



Construction period	Area with Underdrain (ha)	Ditch canal (km)	Modified Nature Canal (km)
1930-1960	101	210	22,5
1960-1970	5,214	232.5	111.0
1970-1980	4,930	139.0	3.6
1980-1990	327	5.6	1.1
Total:	10,572	398.1	138.3

Ⓟ Drainage PumpStation
Drainage Improvement Area
– – – – Boundery Line of the Study Area

Figure B. 9.2.5 Location of Drainage Improvement Area

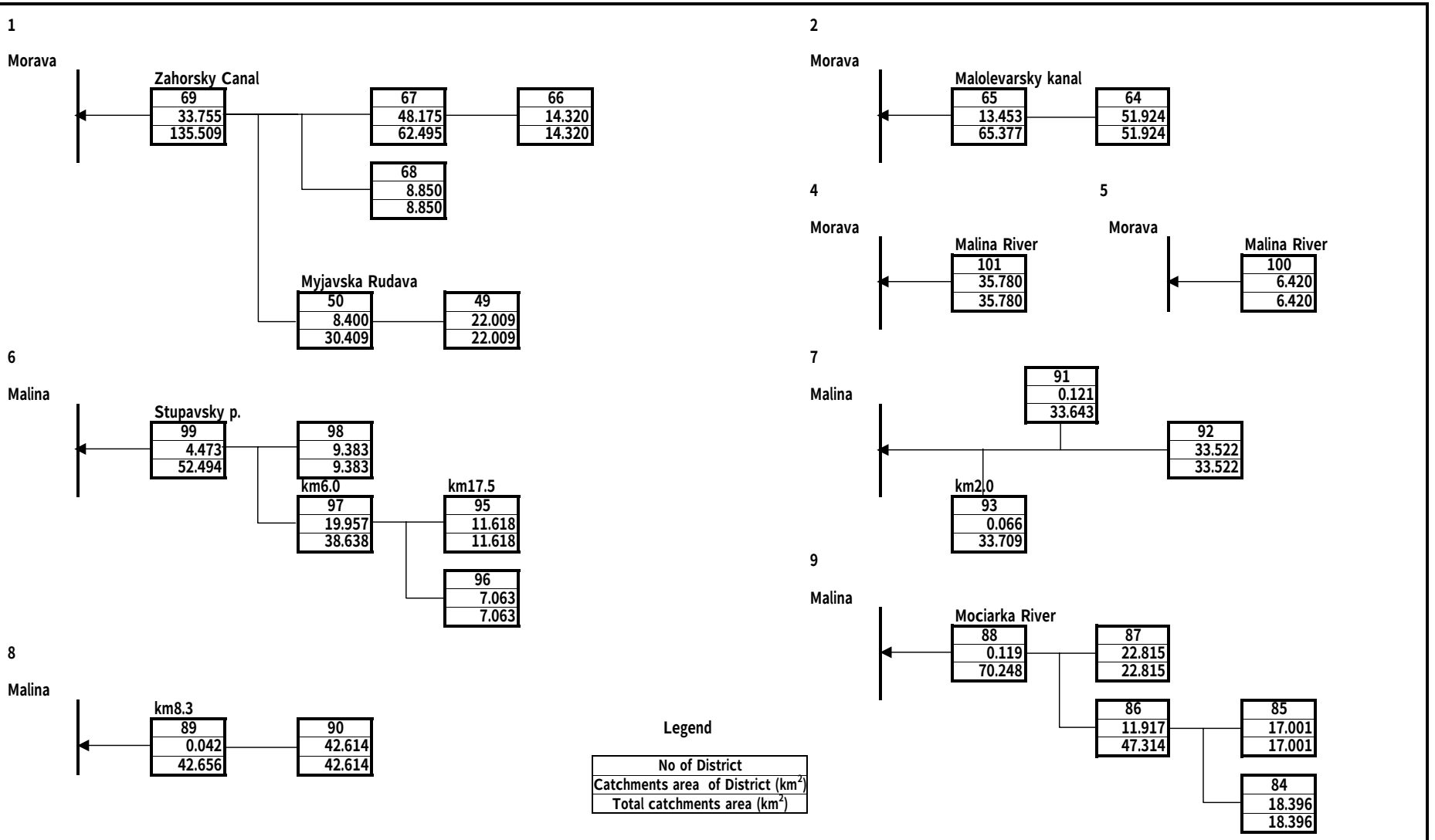


Figure B.9.2.6-1 Drainage System Network

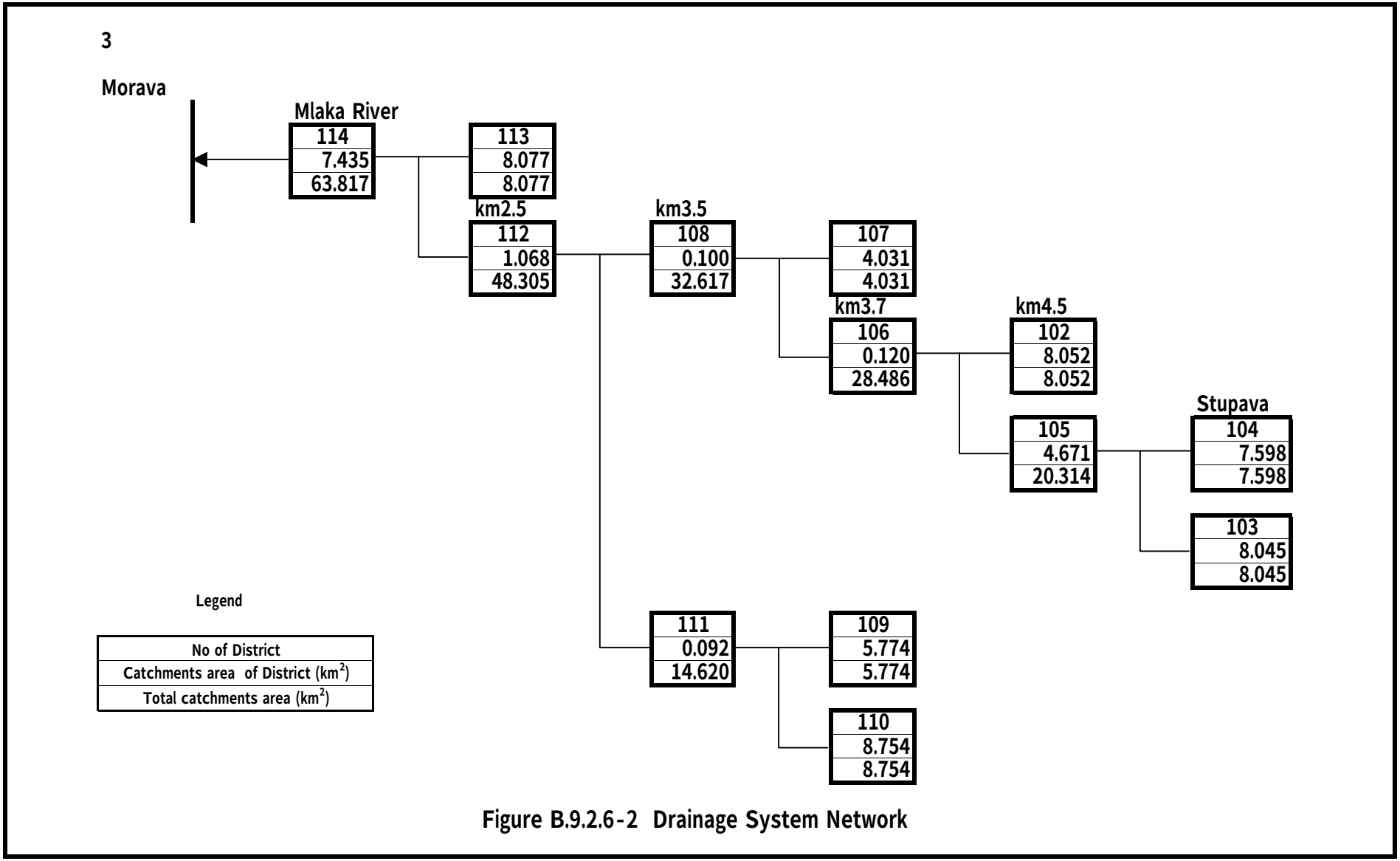


Figure B.9.2.6-2 Drainage System Network

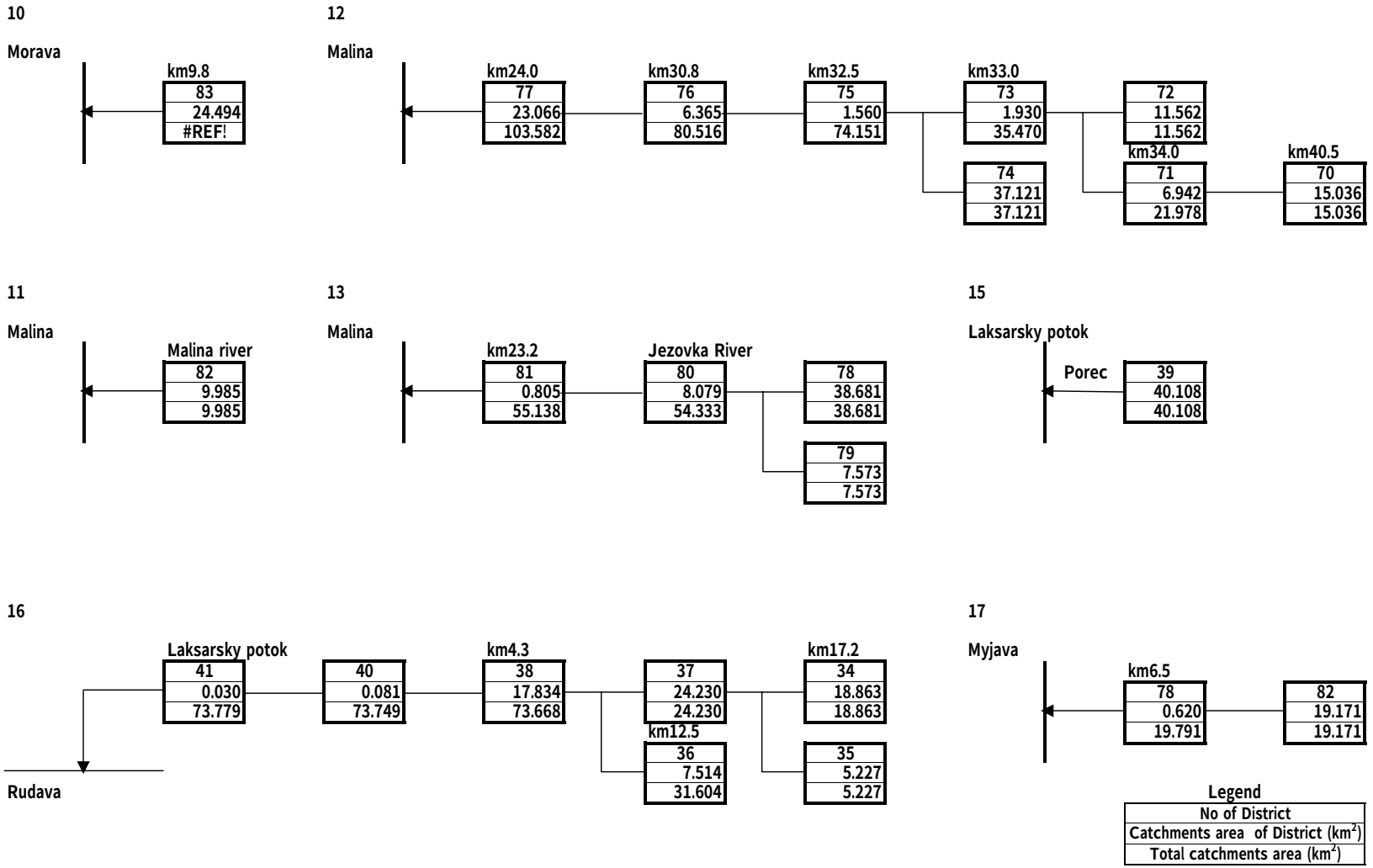


Figure B.9.2.6- 3 Drainage System Network

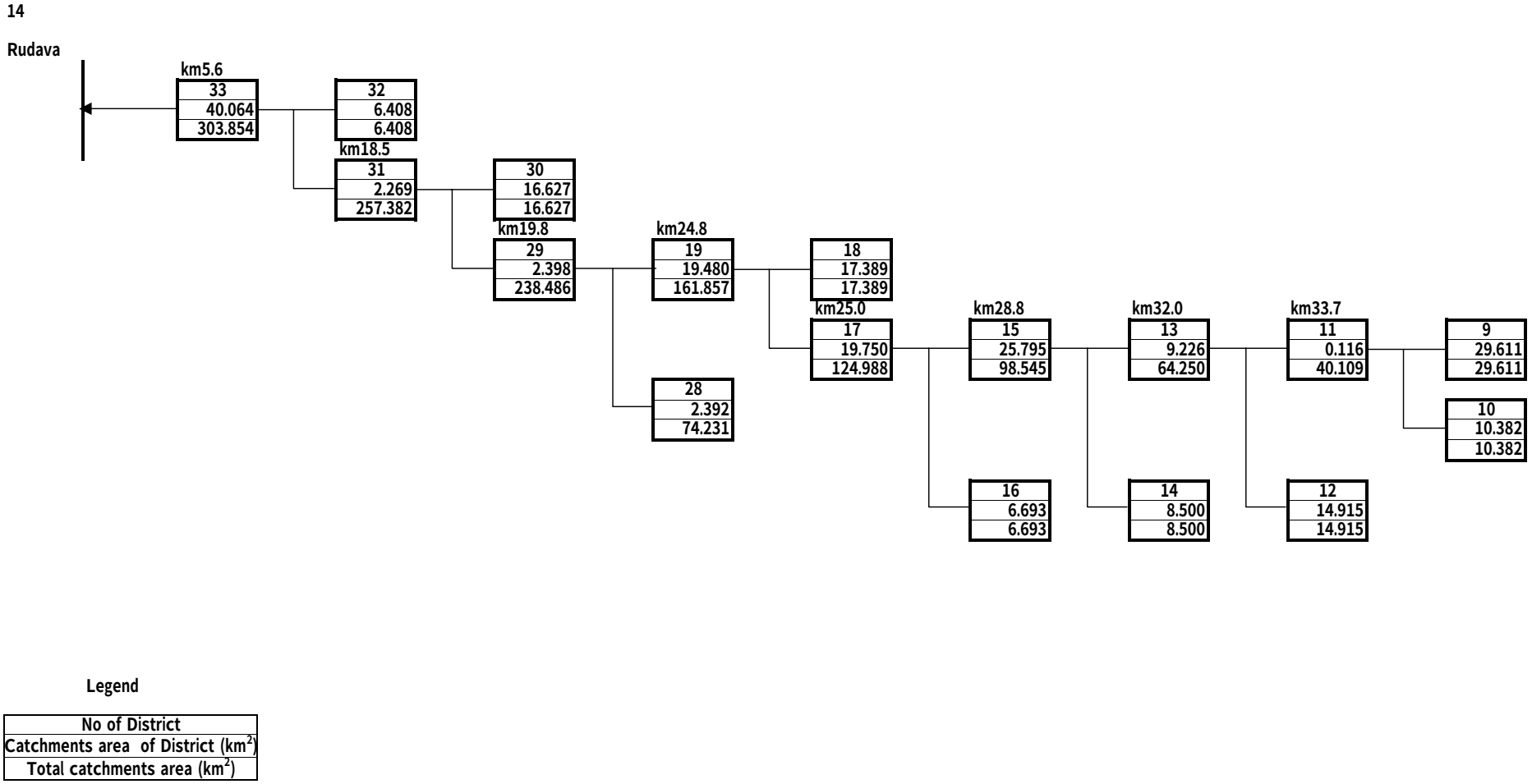


Figure B.9.2.6- 4 Drainage System Network