CHAPTER 14

CHAPTER 14 ECO-TOURISM DEVELOPMENT PLAN

14.1 Trend and Potential of Eco-tourism

14.1.1 Trend in Eco-tourism

Tourism is one of the leading industries in Latvia as well as Europe in terms of production and employment. The Strategy for Tourism Growth beyond 2000, which intends to develop the Latgale region including LWC as the second tourism cluster in Latvia following Riga, was proposed by the Latgale Regional Development Agency (LRDA) considering its unique and outstanding natural environment and cultural assets. It also recommended that the **Lakeland** concept could be excellent as type of tourism reflecting what the region can offer, such as recreation, camping, fishing, and hunting. In this context, LRDA decided to promote rural tourism through discussion of the regional development strategy in line with the Pilot Regional Development Plan for the Latgale Region financed by the EU Phare in 2000. LRDA is now preparing the Rural Tourism Development Target Program especially focusing on the eco-tourism in the region. Thus, environmentally friendly products of eco-tourism are essential in the region, and LWC could be a model by wisely using its abundant resources.

Meanwhile, the Latvia's Tourism Development Concept clearly mentions that natural and cultural/ historical heritage must be maintained and protected, and that the maintenance, protection and development biological diversity must be promoted. Some Baltic Sea countries have an evaluation system for sustainable development. The Finnish Tourism Board launched a project applying the eco-audit, in which tourism enterprises are to decrease negative environmental impacts caused by their operations. In Denmark, the concept "Green Tourist Destinations" is under consideration. To be granted the status of a green destination, an area must achieve sustainability. A trend is heading for more emphasis on environmental protection. The eco-tourism in LWC should take into consideration the establishment of green records which enable tourists and environmental management authorities to evaluate the performances of eco-tourism developers and operators. Sustainability is a key word for the evaluation.

14.1.2 Development Potential

(1) Natural and historical resources

LWC is rich in natural and historical resources. From 1974 to 1999, 224 bird species (among them 185 species are breeding), 23 mammal species, and 21 fish species were found in LWC. Among the bird species, Spotted Eagle, Corncrake, White-tailed Eagle, and Great Snipe are very rare. In addition, LWC is famous for duck hunting, though its population has been decreasing since 1985. Hunting wild boar, roe deer, elk, red deer, wolf and lynx is popular in LWC. Beavers dams along the Idena canal and the Pededze river are

quite an ecological attraction for Europeans who have missed them in their home countries. Angling bream, pike, roach, and pikeperch is very popular in and around Lake Lubana.

As for rare vegetation, it is possible to use a part of the Teirumnieku, Berzpils, and Idena bogs for educational and scientific purposes. Particularly, as the Teirumnieku bog is located along the road connecting Idena and Nagli, the bog is ideal for eco-tourism. Broad-leaved forests along the Pededze river have potential for eco-tourism due to an easy access to them. Inundated grasslands are approachable near the Aiviekste sluice.

In the Neolithic period (B.C. 4500-1500), the most populated was LWC in Latvia. More than 20 settlements inhabited from the Mesolithic period (B.C. 7700-4500) until the Bronze period (B.C. 1500-500) have been found in LWC. Among all, the Zvidze settlement (Mesolithic) and the Abora settlement (Neolithic) are famous. Neolithic differs from Mesolithic in the life style which was transformed from collecting to producing. Clay dishes and stone tools started to be produced in Neolithic. Amber produce was also famous in LWC. The Abora settlement located in Indrani had 10 ancient houses. Historical resources can be promoted for educational purposes.

(2) Infrastructure and transportation

Access roads are essential for eco-tourism, and safety should be prioritized. Possible eco-tourism activities can be conducted in consideration of infrastructure including electricity, water supply, communications lines, wastewater and solid waste management. The Kvapani and Orenisi fishponds alike are ideal for bird-watching since the two have abandoned facilities with electricity that can easily be reconstructed for eco-tourism. Roads within LWC paved with gravel not asphalt are well prepared for eco-tourism. Alteration of habitats for wildlife should be minimized. Electricity lines are furnished where necessary for eco-tourism. Provision of drinking water is an issue for some proposed eco-tourism facilities. Pumped well construction is essential.

A possible access point from Riga is ideally Lubana town since transportation from Riga to Lubana town is provided by twice-a-day bus services. From Rezekne city, Nagli and Gaigalava are the candidates for the access point to LWC. Roads from Riga to the access points of LWC are well paved by asphalt. However, access roads close to LWC should be more paved in Rezekne district. As the rail service from Madona to Lubana town recently ceased operation, the Madona, Gulbene, and Rezekne stations are the closest to LWC. Railroad transportation seems rather unfavorable.

(3) Human resources

Though economic stagnation in LWC is obvious, dozens of people are really interested in eco-tourism development, not as bystanders but as responsible identities. Gaigalava, Nagli, Indrani, and Lubana townships have shown their interest in eco-tourism development. The Teici Nature Reserve, Latvian Fund for Nature, and Institute of Biology at Latvian University can provide help in nature protection. The Laboratory of Limnology at Daugavpils Pedagogical University (DPU) can afford information technologies. The

Madona Tourism Information Center and the Latgale Tourism Association have shown their support in the tourism development in LWC. Some private landowners and companies have started building eco-tourism facilities in the Kvapani fishpond, along the Idena canal, and the Aiviekste river.

Clear statements by the municipalities in LWC on promotion of eco- and rural- tourism, and support systems such as the EU Special Action Program for Agriculture and Rural Development in Latvia (SAPARD) would exploit new entrepreneurs among the local people who will provide tourism products and accommodations. Although many youths move out to such bigger cities as Riga in LWC, attractive sustainable development is essential to help the local youngsters remain proud of their locality.

(4) Marketing possibilities

Marketing possibilities depend on political, geographical, and social atmosphere. Politically, Latvia seeks EU membership, that means quality of eco-tourism is essential. Geographically, Latvia is located in the center of the Baltic Sea Region (from Denmark to St. Petersburg), which provide the country with an advantage. Socially, tourism is not well developed in Latvia.

The number of foreign tourists in Latvia increased from 1.76 million in 1996 to 1.80 million in 1998, whilst that of Estonia grew overwhelmingly from 1.6 million in 1993 to 2.9 million in 1998. The Estonian advantage position is partly due to efforts of the tourism sector there. Eco-tourism in Estonia is more developed than in Latvia. The Estonian Ecotourism Association collects and provides information on eco-tourism, promotes the idea of eco-tourism, develops due strategies for eco-tourism, participates in domestic and international networking, organizes training programs, and initiates nature conservation activities. One can check homepages related to the Estonian eco-tourism very easily.

According to the Central Statistical Bureau of Latvia, 128,000 Finnish, 86,000 Swedish, 71,000 Germans, 24,000 Americans, and 16,000 Danish visited Latvia in 1998. Average stays are 9.4 nights (Americans), 5.0 nights (Danish), 3.7 nights (Swedish), and 3.2 nights (German). If due efforts are made in Latvia, eco-tourism can be more developed. Foreign potential are Finland, Germany, Sweden, USA, and Denmark. Finnish do not stay long (0.8 night). Locally, anglers can be seen frequently in LWC all year round. The local hunters are active during the season. The local people enjoy swimming in mid summer. Making efforts to access to these potential markets are essential.

(5) Social background

Eco-tourism will never be successful without due cultural concerns. According to the questionnaire survey conducted by the JICA study team, 56% of the local people answered yes to tourism development in LWC. What's more, more than 85% responded positively to tourism development in Nagli and Lubana townships. And, about 65% of the local people expressed their willingness to cooperate with tourism development. The local

original eco-tourism ideas are fully included in this eco-tourism development plan, so that the eco-tourism development plan will be acceptable for the local people.

According to the survey, the positive impacts derived from tourism development were job creation, upgraded infrastructure, nature protection for the local people (33%, 28%, and 37%, respectively). Traditionally, the local people understand the necessity of nature protection and feel the nature as a part of their lives. And, the negative impacts expected included problems caused by outsiders, nature destruction, landscape desolation, increase of car accidents (48%, 21%, 10%, and 8%, respectively). The local people are generally hospitable and tender. LWC is a quiet area with little disturbance from outside.

14.1.3 Possible Scale of Eco-tourism Development

Possible scale of eco-tourism in LWC is figured out by the estimation of the number of eco-tourists who will probably visit LWC. Since there is quite limited available information and data regarding the number of visitors to LWC, this estimation is only a rough idea.

The estimation of the future number of tourists to LWC are made on the bases of two assumptions. One is the current number of tourists to LWC, and the second is the annual increase rate of the tourists. According to the tourism statistics in Latvia tourists who stayed in hotels, guest houses and motels in 1998 are tabulated as in the next table.

Number of tourists stayed in hotels, guest houses and motels (1998)

	No. of visitors		%		of which foreigners		%	
Total	394,389		100		219,258		100	
Riga City	253,749		64		180,549		87	
Rezekne District	8,697	15,412	2.2	3.9	1,883	2,340	0.85	1.0
Balvi District	1,696		0.4		167		0.08	
Gulbene District	2,676		0.7		223		0.1	
Madona District	2,343		0.6		67		0.03	

Source: Statistical bulletin, Tourism in Latvia

In 1998 the total number of foreign tourists in Latvia is 1,801 thousand, among which 220 thousand stayed in hotels, guest houses, and motels. And 2,340 (0.13%) tourists came to stay in the districts of the study area. There are other kinds of accommodations, e.g. sanatorium, besides hotels, guest houses and motels in LWC area, but no foreign tourist stayed there according to the statistics. The number of foreign tourists in Latvia increased from 1,713 thousand in 1996 to 1,801 thousand in 1998, which is approximately 2.5% increase per year. In the whole world the number of international tourists increased from 457,647 thousand in 1990 to 612,835 thousand in 1997, which is approximately 4.3% increase per year according to the WTO's data. In Estonia the number of foreign tourists increased from 1.6 millions in 1993 to 2.9 millions in 1998, which is about 12.7% per year increase according to the data of Estonian Tourist Board. In Lithuania it increased from 3.4 millions in 1996 to 4.3 millions in1998, which is about 11% per year increase according to the data of Lithuania State Department of Tourism.

Considering 2.5% increase p.a. in Latvia during the last 2 years, the future increase may not go up so high as 11% of Lithuania or 12.7% of Estonia in a short period of time, but it would be possible to go up not less than the world average, considering Latvia is rather new in the world tourism market. So it is assumed here that the increase rate of foreign tourists in Latvia will be 4.5% to 10% per year for future projection. The number of eco-tourists visited LWC are recently said to be around 20 mainly from Sweden. It is not quite meaningful to estimate the future number of eco-tourists based on this figure, since this figure is rather accidental, and 20 persons is too small to be a base figure of the future projection. There is no exact statistics about the rate of eco-tourists among general tourists. However, the rate of eco-tourists among general tourists is said to be somewhere between 3% ~ 7% in the U.S.A. Applying this rate for the assumption of number of eco-tourists, within 2,340 foreign tourists who came to the four districts of the study area, there will be 117 potential foreign eco-tourists by assuming 5% of foreign eco-tourist rate. And there will be 308 potential domestic eco-tourists among 15,412 tourists who came to stay to the same area by assuming 2% of domestic eco-tourist rate. Lower rate for the domestic eco-tourist rate is based on the assumption that Latvians are used to their environment and will show less enthusiasm to LWC eco-tourism resources.

Based on this assumption, the potential eco-tourists to LWC will be around 425 persons. And it will increase to around 700 to 1,000 persons in 10 years time provided that LWC is well improved in terms of information, advertisement, access to the site, tourism facility, and tourism management.

14.2 Concept and Strategy of Eco-tourism Development

14.2.1 Concept

The eco-tourism is generally defined that “the promotion of environmentally sensitive tourism and the provision of facilities and environmental education so that tourist will visit, understand, appreciate and enjoy natural and cultural areas without causing unacceptable impacts or damage to their ecosystem or to local culture”. Thus, the concept of eco-tourism development can be set as follows reflecting the specific situations in and around LWC.

(1) Conservation of natural and historical heritages

Eco-tourism involves ecology, culture, and business. However, conservation of natural and historical heritage should be the first priority since eco-tourism is impossible without the precious nature. Excessive eco-tourism activities are to be banned and proper regulations and restrictions should be carefully arranged. Essential are visitor and habitat management, and wastewater and solid water management.

(2) Education and research

Education for both visitors and residents in creating awareness and appreciation of the nature and culture is essential for eco-tourism. Highly educated eco-tourists visiting LWC might be able to help the local efforts to conserve habitats for birds and wildlife based on their own experience and knowledge. Informal education through mutual exchange of experience and knowledge between the local and foreign people is achieved by eco-tourism.

Successful eco-tourism needs systematic training and education for guides whose academic backgrounds are favorably graduate or undergraduate degrees in the natural and social sciences. Through eco-tourism activities, students in environmental management and scientists can accumulate their experience in fieldwork, sometimes voluntarily. Research investments to elaborate the ecosystem of LWC can be done by the help of the eco-tourism sector.

(3) Social and cultural enhancement

Through eco-tourism, the local people can maintain traditional practices by integrating the local cultural activities into eco-tourism development efforts. Usually, eco-tourists do not require luxury, but want to experience the local-style accommodations, culture, and food. Learning natural and cultural history gives the local people the chance to reevaluate their own precious culture. The eco-tourism development necessitates collaboration between the public and private sectors, and between developers. This makes it possible for the local people to share efforts and problems to be faced, promoting the local social integrity.

(4) Activation of regional economy

Diversification of the regional economy is quite essential in terms of economic sustainability. LWC has lost their future potential since it has been mainly dependent on agriculture and fishery. Economic diversification is essential for the reconstruction of the rural economy in the Latgale region including LWC. Normally, tourism development has close link with other industries such as agriculture, forestry, and fishery, and results in positive impacts on regional economy. Therefore, it is expected that the eco-tourism development can provide one way of survival with creative ideas to protect nature and activate economy at the same time.

(5) Economic sustainability and job creation

Ensuring sufficient returns on investments and an equitable distribution of costs and benefits is a key factor to the success of eco-tourism. Developers and eco-tourists should pay proper fees to the authoritative body of environmental management. Eco-tourism can provide a viable means of job creation for the private sector, while preserving the local environment and culture. Carefully arranged eco-tourism businesses can provide job opportunities for the unemployed local labor and mitigate the emigration of educated young generations to big cities. The local people should be well educated and informed

that if nature is destroyed by careless and overburdened eco-tourism, they will lose their profitable jobs forever. Nature once demolished cannot be restored without tremendous human efforts.

14.2.2 Strategy

(1) Sustainable natural resources management

Natural resources are sensitive to human activities. Without natural resources any eco-tourism activity is impossible, and too strict nature protection leads to the impairment of the local economy. Sustainability is balanced only through careful management of the environment. Therefore, the activities of eco-tourism are limited in AMZ and DZ. Visitor management, public awareness promotion, and environmental education are also the tools to ensure sustainability.

(2) Local community driven development process

Tourism development in LWC has been gradually matured. Finding key persons and parties in eco-tourism is essential for local community driven development. The Kvapani fishpond rich in bird watching resources is privately owned by an eco-tourism developer. One private wood-processing company built a house for hunters and anglers along the Idena canal. Local landowners, community leaders, private industry, educators, and ecologists' societies should be involved in eco-tourism development planning activities. Local residents should own and manage businesses, invent new ideas, host visitors/tourists, earn money, share their culture, create more jobs, and envisage their future.

(3) Entrepreneurship promotion

Promotion of entrepreneurship is essential for management, marketing, and planing of eco-tourism development. Management issues include financial sustainability, collaboration and networking of eco-tourism associations, staff training, information management, evaluation system and green credentials, management of accommodations/facilities and services, and wastewater and solid waste management. Marketing issues include information technologies (IT), advertisement, transportation improvements, and green credentials. Planning methodologies facilitate a systematic and consistent eco-tourism development. Evaluation and feedback are emphasized in the planning process to improve eco-tourism activities and services in future.

(4) Full support by local government and public institutions

The mayors of Gaigalava, Nagli, Indrani, and Lubana have expressed their high interests in eco-tourism development in LWC. The Latvian Fund for Nature, which conducted the research to demarcate the nature protection territories in LWC, has its own homepage describing the preciousness of the Kvapani, Idena, Nagli fishponds, and Gomelis for bird

watching. The Teici Nature Reserve and the Daugavpils Pedagogical University expressed their interests and cooperation in eco-tourism development in LWC.

(5) Collaboration between public and private sectors

Collaboration between the public and private sectors is essential. Governments generally take the responsibility to protect the nature since environmental management is a public goods, while the private sector is interested in making profits. Collaboration between the public and private sectors is easily achieved by the establishment of a single administrative organization such as the proposed Environmental Management Center (EMC) and by the initiative taken by the new organization to promote public awareness on sustainable development and environmental protection. The non-profit organization Latgale Tourism Association is quite cooperative to the eco-tourism development in LWC.

(6) Long-term benefits

Long-standing high quality of eco-tourism activities and reasonable prices can be offered by proper management and marketing. Excessive development and overburdened eco-tourism activities should be avoided by the help of experienced biologists. Market prediction should be carefully conducted. Too few eco-tourists will result in wasted investments, and too many will defeat the objectives of sustainable development.

(7) Small scale eco-tourism

All the existing eco-tourism businesses found in Nagli, Gaigalava, and Indrani are small scale. To prevent nature destruction by tourists and to sustain tourism resources, eco-tourism businesses should be small scale. Meanwhile, small-scale businesses should be united as an eco-tourism association to make a collective effort to collect information, improve transportation, manage sanitation, and gain financial supports. Small-scale eco-tourism will increase business opportunities to promote entrepreneurship of the local societies and people.

(8) Supply-oriented management

Eco-tourism potential has not yet fully developed in LWC. Supplying local-style accommodation facilities, eco-tours, cultural and recreational activities will widen the potential of eco-tourism in LWC, and encourage both local and foreign people to visit there. Eco-tourism developers and operators need to coordinate marketing and promotion efforts so that a clear image can be presented to potential consumers in foreign countries that have direct flights to the Latvian capital Riga and whose economies and tourism sectors are well developed.

In 1994, the “Green Key” certification system was founded to reduce environmental threats posed by the tourism sector in Denmark. A Danish evaluation system to grant the status of a “Green Destination” to a tourism business or site which ensures sustainability should be kept in mind to supply accommodations and facilities. The Finish “Eco Audit”

procedure proved to be a good tool for environmental management by the eco-tourism sector and can be applied to the eco-tourism development in LWC. Eco-tourism developers and operators should take into account that European customers are getting more concerned about sustainable eco-tourism.

(9) Differentiation and diversification of eco-tourism

An advantage comes from differentiation and diversification of the eco-tourism activities in LWC. LWC contains very rare and unique broad-leaved forests and raised bogs, rich biodiversity of bird species, vast inundation area in spring, and beavers' rivers. Every piece of rare natural resources in LWC should be highlighted by the eco-tourism development plan. Table 7.4.1 shows the unique characters of LWC compared with Teici and Krustkalnu Nature Reserves. To package the eco-tourism activities in LWC with those in Lake Razna or Teici Nature Reserve is also a sort of differentiation and diversification.

(10) Focusing on the most potential areas

Eco-tourism development should be focused on the most potential areas in LWC to optimize limited financial resources. Gaigalava and Indrani townships have already started their eco-tourism development, while Nagli township and Lubana town are willing to cooperate with their neighboring municipalities. The use of existing infrastructure, accommodation and facilities makes it easy to implement eco-tourism development plans. Gaigalava has private-owned facilities for accommodations for bird-watchers and hunters in the Kvapani fishpond, whilst Nagli has ideal pathways for horse trekking. Indrani has constructed and used a number of saunas and accommodations along the Aiviekste river. Consequently, one project is possible in Gaigalava and Nagli, another is potential in Indrani and Lubana town. Some eco-tourism activities are potential across LWC, too.

14.3 Eco-tourism Development Plan

The eco-tourism development plan consists of the following 11 subcomponents. Since these are closely linked each other, its success fully depends on a well-managed responsible organization for eco-tourism development in LWC. Achievements and experiences in LWC should be a model to guide overall rural tourism development in the Latgale region. The framework of EDP is presented in Figure 14.3.1, and described below.

1) Role of government and Environmental Management Center (EMC)

2) Specification of eco-tourism resources

3) Facilities and sanitation plans for eco-tourism

4) Visitor management

5) Inventories making and monitoring

6) Use of Information Technologies (IT)

7) Evaluation system and green records

8) Management and marketing

9) Planning and implementation by eco-tourism operators

10) Networking of eco-tourism sector

11) Capacity-building and training

14.3.1 Proposed Eco-tourism Resources

Considering the viewpoints of wilderness and naturalness, uniqueness, beauty, applicability, availability, sustainability, accessibility, and safety of potential eco-tourism resources in LWC, the following 20 eco-tourism resources and activities are proposed so far to enhance eco-tourism in LWC. Key points of the proposed eco-tourism resources are summarized below, and those typical figures are shown in Figure 14.3.2.

Eco-tourism Resources and Proposed Activities

No.	Resources/Activities	No.	Resources/Activities
1	Boating and Angling along the Aiviekste	11	Bird Watching Tower
2	Taking Sauna and Cottage	12	Bird Watching in Kvapani
3	Beautiful Inundation	13	Campfire and Sports Activities
4	Watching Rare Broad-leaved Forests	14	Beach along Lake Lubana
5	Canoeing along the Pededze	15	Angling
6	Archeological Experience	16	Experience in Habitat Management
7	Walking around Teirumniku Bog	17	Animal Watching
8	Canoeing and Boating in Idena Canal	18	Agriculture Experience
9	Camping along the Idena Canal	19	Stork Watching
10	Lodge in Orenisi	20	Museum of Nature

Wilderness and Naturalness: Wild nature attracts eco-tourists. The canoeing route along the Pededze river renders a wild picture remained with a lot of beaver dams partly hindering canoes from going through, but allowing eco-tourists to manage by themselves. The Teirumniku bog remains its naturalness with the water body, which creates the beautiful scenery around it.

Uniqueness: Unique landscapes entice eco-tourists. Inundation which is only available during the spring flood season gives the pure example of wetlands. Wetlands play quite an important role in retarding flood water in order to protect the downstream areas. A motor boat is allowed only for inundation watching.

Beauty: Beautiful landscapes seduce eco-tourists. The Orenisu fishpond furnishes beautiful scenery with water bodies and birds. In the east of the pond, an old building stands lonely with its beams and pillars undamaged. A youth hostel can be reconstructed on the land under privatization. Nagli township is recommended to buy a part of the Orenisu fishpond for eco-tourism. The middle of the fishpond is the private land related to the Institute of Biology, which has researched the ecology of the pond for years. The private landowner already assented to construct a bird-watching tower.

Applicability of Reasonable Prices: To compete with other European countries, the eco-tourism in LWC has to have an advantage since transportation is an obvious handicap. Servicing with reasonable prices for customers is possible in LWC where the monthly

household incomes mostly range from 50 to 200 LVL according to the questionnaire survey conducted by the JICA study team. Labor costs are very low compared with other European countries in LWC. Taking this into account, eco-tourism activities from bird-watching to horse trekking can be provided at low prices.

Availability of Human Resources: Necessary are high-educated guides and developers. The Teici Nature Reserve and the Institute of Biology can contribute technical supports and information on habitats of flora and fauna, while marketing using the Internet services can be provided by the Institute of Limnology in DPU. Township mayors have a clear intention of developing eco-tourism resources. Some local people have already started their eco-tourism businesses in LWC, and they can provide accommodations and facilities required easily. One archeological expert has been engaged in the excavation of the Abora and Zvizde settlements for years and willing to provide the information and experiences of participating an archeological excavation on the archeological sites. Horse trekking is unfamiliar to the local people, except the horse farm in the suburb of Rezekne city (Untomi).

Sustainability: Sustainable development can be achieved with well-organized visitor management and education. Preserved should be the broad-leaved forests and beaver dams along the Pededze, the Teirumniku bog, and the landscape in the Orenisu fishpond. Animal and bird populations should be controlled, and water quality be kept clean enough to swim in the Idena canal and Lake Lubana.

Accessibility: The canoeing routes along the Pededze river and the Idena canal have some access points. The Teirumniku bog has one access point. As broad-leaved forests are hidden from the local roads, eco-tourists need guides to follow.

Safety: Eco-tourism requires wilderness as well as safety. The two canoeing routes are located along the local roads, which makes rescue possible. Camping sites should be located along the Idena canal to increase safety in case of emergency. Balloon stations should be located in the vast lands of more than 1 ha with higher elevations than the surroundings. For ballooning, wind speeds should not exceed 2-3 m/s. Medicine and a network in case of emergency should be prepared in advance.

For reference more detailed description of eco-tourism sites in LWC and species of birds which can be observed in the area of the sites are listed in Table 14.3.1 and depicted in Figure 14.3.3.

14.3.2 Eco-tourism Development Projects

Taking the locations and characteristics of eco-tourism resources into account, the following two eco-tourism development projects are proposed as shown in Figure 14.3.4.

- Indrani and Lubana Eco-tourism Development Project, and
- Nagli and Gaigalaba Eco-tourism Development Project

Possible eco-tourism resources and activities are shown in Figure 14.3.5.

(1) Facility and sanitation plan

Building facilities should take a consistent strategy to differentiate the eco-tourism in LWC from others. Local-style, small, and nature-contained facilities should be obtained in LWC. Considering impacts on the ecosystem of LWC and the scale of local economy, the facilities for eco-tourism should not be too grand nor too costly, but should be simple and effective. However, environmental protection measures should be installed. Although they may appeared to be a little more costly.

Accommodations should be local-style, and combination with saunas is quite attractive. The local materials including wood are cheap and sometimes free. Building a sauna with local wood and labor costs from 1,000 to 5,000 LVL. Saunas can be used as party places if they have furnaces, but should not be concentrated in one area to avoid forests destruction due to excessive wood use for saunas. Parking spaces should not be asphalted but paved with gravel. Small-scale parking spaces from 5 to 20 cars are recommended in order not to disturb the nature. The present conditions and future plan of electricity and water supplies and telephone lines should be checked carefully prior to make a detailed plan of a facility.

The location of proposed facilities are grouped in two areas. One is in Lubana and Indrani township area. Another is in Nagli and Gaigalaba township area. The main facility for eco-tourism is accommodated in EMC building together with other facilities like a wild life management.

The following are proposed facilities plan. In these facilities water is planned to be supplied from own deep wells. Cooking fuel is by propane gas. Septic tanks are of combined type for toilet and miscellaneous waste water. Electricity is available for most of the places, but some extensions of power cables are necessary.

Lubana and Indrani township area

1) Tourist information center

Most visitors from Vidzeme region approach Lubana and Indrani to get guidance and information on the eco-tourism in LWC. A reception room in the information center provides pamphlets, brochures and guide maps introducing eco-tourism resources in LWC. There must be a room to exhibit stuffed birds, mammals, flora, archeological features found in LWC. The exhibitions should be explained in both Latvian and English. Flush toilet is preferred. Visitors can rent a bicycle. A storage room is equipped to store bicycles and canoes during the off season. Transportation vehicles and a car park are provided, too.

2) Accommodation lodge

Visitors can stay overnight and observe birds and mammals. This includes bedrooms with a shower room, flush toilets, and a simple kitchen. Meals are not served here. This lodge has a reception desk, a small shop, a car park and a sauna which is also available for outsiders.

3) Canoe terminal and canoe station

Rental canoes are available in the canoe house located at the canoe terminal. Visitors are transported to and from a canoe station. The canoe house has a reception desk, a room for staff, a canoe shed during the season, a changing room with shower and flush toilet. Canoe stations are simply marked by signposts. These are temporary structures during the season only, since the area will be flooded in spring. Car parks and transportation vehicles are equipped here. Simple wooden piers for canoeing and boating are also prepared at these stations.

4) Camping site

Two (2) camping sites are proposed in this area. One in Lubana town and the other at the end of the Pededze canal. Visitors should register before camping in the tourist information center. Camping fees are collected there. A camping tent, camping car, fuel and food should be brought by visitors, but simple materials are available in a small shop in the center. The camping site is provided with parking, drainage, cooking, dishwashing and laundering facilities, and toilets.

5) Information board and sign post

An information board is placed in front of the tourist information center and along the boundary road of LWC. This bears a guide map of LWC, information and instructions on eco-tours in LWC. Signposts are installed to indicate what tourists see or characteristics of the area or direction of eco-tours, telephone numbers, the e-mail and Web site address of the LWC administration. In the flood areas, signposts are removed during the off season.

Nagli and Gaigalava area:

1) EMC

Environmental Management Center (EMC) is proposed in Idena, Nagli. EMC is the center for the environmental management in LWC as a whole, which includes eco-tourism/rural tourism activities among other wild life management activities. Here is the central information office for eco-tourism. Visitors can get information, guidance and lectures about eco-tourism in LWC and watch slides and videos shown by trained guides and experts. Visitors are told what can be expected to see and to experience, what they should do, and what they should not in LWC. For instance, board walkers should pay attention to bogs in order not to give irrevocable damages to precious high bogs. Visitors can see an exhibition of stuffed birds, mammals, flora which can be seen in LWC. These should bear the Latvian and English explanations.

Visitors can rent canoes, boats and bicycles here. They should register for camping and angling here as well, and get an instruction for safe canoeing and other activities before going to the site. For canoeing and boating, visitors are transported to the starting points from here. They will be picked up at a terminal where visitors can change clothes and take a shower. Canoes, boats and bicycles are stored here during the off season. There are accommodations for overnight stay in order to observe birds and mammals in the evening,

at night, and early in the morning. The arrangement for staying in a country house will be done here upon request. Bird watchers are transported to a starting point. They may be picked up upon request at their destinations, and also rent bicycles for bird watching. Guides for eco-tourism will be trained here partly from the wildlife researchers who engage in LWC wildlife conservation.

In order to have these activities, such facilities are planned in EMC as a reception room with a information counter, an office room for tourism, EMC office, a classroom and training room, a room for slide and video show, an exhibition hall, canteen, a small shop, bed rooms with shower and toilet, sauna, a reception room for canoeing, boating, cycling and angling, a changing room with shower and toilet, storage for canoes, boats and bicycle, flush toilet for visitors and staff.

2) Facilities

In location of Kvapani fishpond area tourists facilities are planned, partially utilizing two old abandoned buildings. One is renovated to a tourist house. This tourist house has a dining room, kitchen, a small hall for gathering, bed rooms with shower and flush toilet, self cooking places and a garage. In this place new summerhouses are planned to be constructed. A camping site, an observation hut, a boat pier, and an information board are planned. In another place an old pump house will be converted to an bird observation house with a carpark. Visitors can stay here and enjoy watching many birds.

On Orenisi island of the Nagli fishponds is a little elevated, calm and beautiful place. An accommodation lodge is planned for bird watchers or tourists simply to spend a nice quiet days in a wonderful atmosphere. An observation tower and a car park are planned.

Observation hut and towers where visitors can watch birds or mammals from a little higher level covered with roof. Since LWC is flat area in general, towers are useful for watching birds and mammals. Huts can be used for shelters for visitors. These are of wooden constructions. Spotting scopes are available at the information office.

Board walk is a device to give an opportunity for eco-tourists to walk through bog area, and yet to protect environmentally sensitive bog from human steps. Boards are made from natural wood (red pine). Concrete is not used to prevent from an negative effect of an alkali constituent of boards. These boards are removable for off-seasons. About 1 km board walk is planned in Teirumniek.

Renting a canoe or a boat should be managed at a tourism office in EMC. Visitors can be transported to a canoe station or a boat pier where they start canoeing or paddling a boat. Canoes are brought here EMC, but boats are moored here during the season. Two canoe stations together with boat piers are located along the Idena canal. Visitors can enjoy canoeing watching and listening to birds twittering along the Idena canal or they can canoe in near by Lake Lubana. Canoe and boat piers are simple ones of wood.

3) Camping sites

There are three camping sites. Two of them are located close to two canoe stations along Idenas canal. Another one is in Kvapani fishpond little north of EMC. A registration to use a camping site should be done at a tourism office in EMC. A camping tent or camping car should be brought by themselves. Simple camping materials are available at a small shop in EMC, but visitors are advised to bring fuels and food with them. The camping sites are provided with parking, drainage, cooking, dishwashing and laundering facilities, and toilets.

4) Information boards

Information boards are placed in front of EMC building and at Kvapani tourist house area along boundary road of LWC (refer to Figure 14.3.6). The board is similar to the one in Lubana, informing visitors how to arrange the camping and parking places. It also bears a simple guide map of LWC, information and instructions on eco-tour in LWC. This shows a guide map of LWC eco-tourism. Sign posts are installed in specific points to indicate what visitors see or characteristic of an area or direction of eco-tour. These are written both in Latvian and English. In the flood areas these sign posts are temporary ones which are removed during the off-season.

5) Sanitation

Besides above facilities for eco-tourism in Nagli and Gaigalava area, other facilities are conceivable like a horse track. But this sort of facility which requires a considerable amount of investment will be sought after in a later stage.

Flush toilets are necessary for tourists. The use of septic tanks (combined treatment type), which treat both sewage and domestic miscellaneous wastewater, are highly recommended for these facilities. Domestic miscellaneous wastewater is a heavier pollution source than sewage. (BOD of domestic miscellaneous wastewater is 27g/p.day, while BOD of sewage is 13g/p.day.) A septic tank may be a little costly, but it should be worth spending the money for sustainable eco-tourism.

A wastewater treatment plant which is generally used for a city or a town is not only too large and costly but also technically inappropriate in case of these small facilities. Unfortunately the use of industrially manufactured compact septic tanks are not common in Latvia, yet. It is quite a useful device to treat small scale wastewater. It may be an idea to subsidize the cost of a septic tank installation for a household, which is the case in Japan.

Solid waste management is a longer term issue which local governments have to plan for developing tourism. The amount of solid wastes from tourism activities are not small, when many tourists begin to flow in LWC. There are many well known tourist destinations which are seriously suffering from solid waste discarded from tourism activities. The damage is becoming so serious that a former tourists town is finding it hard to attract tourists anymore. This was due to a lack of solid waste management plan of a municipality. The collection of solid waste should be done regularly during a season. Recycling of usable goods promotes the value of eco-tourism in LWC.

(2) Cost Estimation

The necessary facilities and indicative costs for the two proposed projects are tabulated in Table 14.3.2 and Table 14.3.3. The total cost for the eco-tourism project in Gaigalava and Nagli is about 242,000 LVL, while that for Indrani and Lubana is 279,000 LVL.

The cost estimation was made just to give a rough idea of the magnitude of the proposed projects based on generally available local cost. Materials for constructing buildings and facilities like observation huts and towers are made by using locally available materials as much as possible. Cost of the land acquisition is not included because the project sites are provided by either municipalities or local people who are willing to develop their sites for eco-tourism activities.

The cost of wastewater treatment facilities for environmental protection may be comparatively large in proportion with other parts of building costs. An industrially manufactured septic tank is costly here. But the performance of treating wastewater is much better than a local device. In this project those septic tanks are used for most of the buildings and facilities where it is appropriate. In order to economize the cost and to utilize available resources as much as possible, a tourist house and an observation house in the Kvapani fishponds are renovations of old buildings which have been left in dilapidated conditions.

Financial resources are scarce for the rural businesses. Eco-tourism development can not be developed to its full potential without a possible financial resource. As LWC remains rich in eco-tourism resources, financial supports become crucial. A more than 15% interest rate hinders promotion of small- and middle-sized businesses nationwide. The local governments also lack sufficient financial resources. Inexpensive financial resources for small scale projects are much needed for the development of eco-tourism projects.

(3) Evaluation from technical and financial viewpoints

The above proposed two projects consist of several small components such as a tourist information building, lodges, observation towers, and huts. The construction of those facilities does not require specially high foreign technology. Instead, these facilities are planned to use local methods of constructions and local materials as much as possible. For instance, locally available wood will be used for bird watching towers, huts, and most of the houses. Local people have their own traditional know-how of constructing log houses. Local people know how to maintain them. Besides by doing this, local people have good chances of being involved in the projects. The use of a factory-made compact septic tank may not be too familiar in this area yet. However, there are several manufacturers in Riga. The use of a combined type septic tank is considered to be necessary for this kind of environmentally conscious projects, though it cost more than a local traditional device of treating wastewater.

Financial matters are quite crucial for the implementation of the project. Several families who are already preparing to go into tourism business by their own efforts have been

found during the study. It was a big discussion among local people if it is worth spending money to renovate their houses to accept tourists. They worry that there will be enough tourists to come to recover their investments.

Regarding the government roles in financing for the tourism sector, the Latvian government is advised to put more budget in the tourism sector. At present the budget for the tourism sector is too small in Latvia in comparison with neighboring counties, if they are to recognize the importance of the tourism industry in their future.

14.3.3 Implementation Schedule

(1) Project preparation

The implementation of the tourism projects should be coordinated with other projects proposed by the study. For instance, the tourist information building is a part of EMC. Therefore, it should be planned and constructed at the same time with good coordination with the EMC construction schedule. Bird watching towers, huts and a boardwalk facility will be used for wetland conservation program as well as eco-tourism.

The phasing plan of implementation is an important part of the project preparation, namely deciding projects sites, designing facilities, construction of facilities, procurement of equipment. In parallel with these activities capacity building should be done. The maintenance should not be forgotten. This phasing plan should be well coordinated with other projects of EMP.

(2) International cooperation

In tourism, international cooperation is an important source of exports, foreign currency gains, and tax revenues. The EU gives priority to tourism as a creator of jobs of numerous qualification requirements and as a driving force of regional development. Cross border cooperation is an important element for tourism development both at the regional and local levels. It is quite useful for the development of tourism in Latvia to have international cooperation with surrounding countries. So far LWC has only one example of international cooperation in eco-tourism. It is between the Ecological Society of Latvia and its Swedish counterpart.

Looking at the tourism situation in general, in Latvia the number of foreign tourists increased from 1,760,000 in 1996 to 1,801,309 in 998. The increase rate was 2.3% in 2 years. On the other hand, in the neighboring country of Estonia the number of foreign tourists has increased during the last five years by 75% from 1.6 million in 1993 to 2.9 million in 1998 or in average 12.7% increase per year. Among those tourists, Latvians are the second largest (325,000) after Finland (1,813,380). There are even 5,900 Japanese tourists in 1998. (source: Estonian Tourist Board). The demand for guesthouses, campsites, holiday homes and holiday villages has increased significantly. Their scenario of tourism development projected that foreign tourists in Estonia will increase up to 3.7 million in year 2003.

In Lithuania the number of foreign tourists arriving has increased by 22.6% during the last two years from 3,497,000 in 1996 to 4,287,000 in 1998. Here too, Latvians are the second largest group of tourists at 1,089,234 only after CIS (2,357,390). In 1998, expenditures of foreigners in Lithuania accounts for 9.9% of total Lithuanian export of goods and other services. (source: Lithuania tourist statistics)

Looking at these situations, tourism seems to be a fast growing industry in neighboring countries. Although at present Latvian tourism is not doing so well, Latvia will have a good possibility of increasing the number of foreign tourists. This means that Latvia should take a sound step to develop international tourism in cooperation with neighboring countries.

The first step of this international cooperation is to exchange information on eco-tourism. This involves creating a network on eco-tourism basic data and other information like attractive image of the region. Brochures and pamphlets will be distributed internationally. Then it is an important strategy to form packaged tours with destinations of neighboring countries for the further development of Latvian tourism and especially for eco-tourism. The benefits of the cooperation with other destinations to LWC are firstly a broader opportunity to attract tourists, and secondly broader publicity through media of cooperating countries.

Regarding eco-tourism, Estonia is seemingly more developed and better known among eco-tourism societies. The cooperation with Estonia's counterpart could be a breakthrough and one of the first example for Latvian eco-tourism for the international cooperation. Swedish tourism agency says that more and more travelers are searching for new outdoor experiences in an open, unspoiled and well protected natural environment, which LWC is fortunate with. Because the Ecological Society of Latvia has a connection with Sweden counterpart, Swedish ecological tourists have come to visit LWC. This can be extended to other Scandinavian countries.

In terms of financial arrangement for the implementation of the projects, the international donors are valuable. The OECD/DAC policy emphasizes on assistance for environmental sector as well as the past donors' technical and financial cooperation to Latvia. Considering eco-tourism as a part of rural tourism in broader sense, EU Phare fund are available for renovating a farm house for a tourist lodge. Japanese government may be able to assist for providing soft loan to the projects provided with a proper executing body.

(3) Financial feasibility

At this stage of the study it is rather difficult to state about financial feasibility of the Project, because presently estimated number of tourists to visit LWC are small. But since available data and information are quite limited, there is no other appropriate way of projection at this stage. However, when considering financial feasibility, the following facts should be taken into considerations:

- facilities like a tourist house and an observation house in Kuvanani pond have already been in a state of partially constructed,

- some family in Lubana and Indrani are already in a process of renovating their property for tourism purposes,
- sign posts and information boards are basic things which are necessary without considering the cost recovery,
- most facilities in the project are very basic for eco-tourism, and
- only few viable industries to promote in LWC for sustaining precious ecological resources.

14.4 Management Actions for Eco-tourism Development

14.4.1 Visitor Management

Based on the concept "carrying capacity", visitor management deals with regulations and zoning to protect the nature, licensing for hunters and anglers, warden patrols by EMC, and access controls of approachable locations, seasons, activity types, number of visitors.

(1) Carrying capacity

Carrying capacity is categorized into three: physical, biological, and social. Physical carrying capacity is related to the acceptable numbers of eco-tourists in terms of facilities' and accommodations' capacities often determined by water and electricity supplies and limited spaces. Biological carrying capacity deals with the numbers of game birds and animals, and fish to be hunted or caught and the allowable level of access to rare vegetation. Lastly, social carrying capacity means the local people's capacity to accept visitors especially from foreign countries. Eco-tourism has to keep in mind all these capacities in dealing with visitor management.

(2) Regulations

The eco-tourism development should be subject to the environmental zoning and its regulatory plan. No eco-tourism activities are allowing in NPZ, and the proposed eco-tourism activities are limited in AMZ and DZ. For example, the angling in Lake Lubana, the Aiviekste and Rezekne rivers are prohibited from March 15 to May 30 according to the Angling Regulation, No. 223 to avoid breeding season. Angling in the designated fish wintering are in Lake Lubana and the Rezekne river is allowed only from May 30 to September 1. Every eco-tourism developers and operators should comply the current and proposed regulations.

(3) Licensing

Angling and hunting need specific licenses to be allowed in Latvia. A specific angling card system is proposed for angling in the used-to-be fishponds of LWC. The private owners own some fishponds and they plan to develop recreational areas there. Licensing is a tool

to restrict angling and hunting activities, and then can controls animal and fish populations.

(4) Warden patrols and access control

EMC or the Madona and Rezekne REBs should provide the services to patrol NPZ and AMZ and to watch hunting and angling activities in LWC. Showing patrols by wardens provides a warning effect to illegal hunters and anglers as one of visitor management activities. Limiting access to a sensitive area is essential to preserve the nature. An access point to the Teirumniku bog can be established from the major road connecting Idena and Nagli. Other access points might cause much damage to the educationally important bog. The Lodani bog should not be disturbed by boating and camping activities along the Idena canal. Camping places should be strictly limited in several points which have signboards and fences. Along the Pededze river, eco-tourism activities should be limited only in the river. Beaver dams and broad-leaved forests can be an attraction but should not be disturbed. Landing stations should be limited only in several spots along the Pededze river.

14.4.2 Inventory Preparation and Monitoring

Information collection often forms an obstacle to eco-tourism developers. The Environmental Information Management System (EIMS) of EMP provides technical supports to easily collect the necessary information on eco-tourism resources, social conditions, facilities, water quality and sanitation, and customers.

Eco-tourism Resources: Besides the major eco-tourism resources, the local people hold a big festivals on Midsummer Celebration every June staying up all night to enjoy friendship and family love. LWC attracts the local people to celebrate the national festivals.

Social Conditions: Necessary social conditions are land use and tenure, economic conditions, financial resources, and tax incentives. The two Nagli fishponds, which have eco-tourism resources as bird watching sites and beautiful landscapes are owned by the state but under privatization. The privatization should be carefully managed in order not to lose eco-tourism resources. Unemployed workers need to be engaged in the construction of eco-tourism facilities in LWC. Possible financial resources of low interest rates should be emphasized. Tax incentives might help eco-tourism developers take the first step of eco-tourism businesses.

Facilities: The locations of present accommodations and facilities, services, transportation and infrastructure provide necessary information on possibility of eco-tourism. Developers should prepare as good facilities and services as the present ones to survive.

Water Quality and Sanitation: Surface and groundwater quality should be monitored regularly. Particularly, surface water in the Idena canal, the northeast of Lake Lubana, the Pededze and Aiviekste rivers, the Kvapani and Orenisu fishponds.

Customers: EIMS also provides the customers' inventory origins and popular activities to help eco-tourism developers select possible activities. A system to select honorary guests

of LWC is an idea to promote the eco-tourism in LWC. Honorary guests who have visited LWC, showed their eagerness to conserve the nature in LWC giving high scores in information sheet recording, etc.

14.4.3 Use of Information Technologies (IT)

The Internet has changed the information system worldwide. Connecting to the Internet provides customers with a 24-hour open window to any information. The number of Internet users has been increasing in Latvia, and IT has become a necessity in the Western Europe. Efforts should be concentrated on management and marketing using IT. The functions include inventories making, introduction of regulations, provision of hunting and angling information, introduction of honorary guests, dissemination of evaluation results and green records, condition of facilities, training programs, promotion of advertisement and education.

For eco-tourism promotion, information dissemination on the regulations is the key to keep the eco-tourism values of LWC. The regulations on nature protection should be open to the public. Hunting rules and regulations are somewhat complicated, so it is convenient to obtain seasons, places, prices, and availability for foreigners from the Internet.

With great efforts to protect the nature, green records should be open to the public to promote green credentials and to add a value to eco-tourism. Particularly, eco-tourism developers and operators, guides, and hosts who get highly-evaluated green records should be introduced on the Internet. Competition should be maintained and supported by EIMS.

Advertisement using IT is one of the most important for eco-tourism development. Pictures of the nature, voices of birds, descriptions and prices of eco-tourism activities, possible accommodations and public transportation should be contained in the ads. Booking should be arranged on the Internet. Credit card payment is preferable. Booking sheet is useful. Moreover, customers and eco-tourists who have visited LWC for many times should be honored properly on the Internet. Their motivations, affiliations, and interesting places in LWC should be detailed on the homepage of EMC.

14.4.4 Evaluation System and Green Records

(1) Objectives and scheme

The objectives of the evaluation of eco-tourism activities are nature and culture protection, promotion of green credentials, eco-tourism needs finding, and education.

The concept of green credentials is famous in Estonia. The more nature values, the higher eco-tourism is evaluated. Performances highly rated in evaluation then feeds back to the promotion of eco-tourism resources of LWC for well-educated and concerned eco-tourists. Promotion of green credentials helps the local communities with eco-tourism development by putting emphasis on nature protection efforts. Developers understand their protection efforts might cause profits.

To avoid environmental destruction by eco-tourism activities, mostly developers and guides should be checked up over their eco-tourism plans and activities by eco-tourists and environmental management organizations including EMC and the Rezekne and Madona REBs. Generally, eco-tourists are getting keen on if eco-tourism activities are really suitable for nature protection or not. Eco-tourists' needs should be promptly caught by developers. Otherwise, LWC will lose its value as an eco-tourism site. Wilderness and uniqueness of the nature, reasonable fees for activities, and quality of services are the matter of strenuous efforts.

(2) Evaluation items

In Table 14.4.1, the evaluation items and the relevant criteria are shown. The criteria of evaluation are 1) wilderness and naturalness, 2) uniqueness of eco-tourism activities, 3) reasonable fees for the activities, 4) quality of services, 5) knowledge level, 6) appropriateness of management, and 7) sustainability.

Eco-tourists prefer wilderness and naturalness of the nature and scenery to just following guides' explanations. An eco-tourism activity using information sheet, which makes visitors close to environmental management in LWC, would be quite unique. Every activity is evaluated in terms of rationality of fee levels and quality of services.

Eco-tourism activities in LWC anyway should be much cheaper than those in European countries, especially Estonia. Price comparisons with Estonian similar eco-tourism products should be a monitoring item to take advantage of low labor costs in Latgale. Evaluated services are hospitality, food, drinks, communications, language skills, songs and dances, quality of guides, and transportation.

Knowledge levels of EMC and REBs are evaluated in biological carrying capacity and conservation measures, while those of eco-tourism associations, the local governments, developers, guides and hosts are assessed in their knowledge on sustainable development, green credentials, natural and cultural history in LWC. Appropriateness and sustainability of conservation management, regulations, and sanitation management are to be judged by eco-tourists, EMC, and REBs.

14.4.5 Management and Marketing

(1) Management

Essential for management of eco-tourism are 1) accommodations and facilities, 2) services, 3) green records, 4) networking, 5) finance, and 6) planning.

Management of accommodations and facilities should be based on the sense of beauty. Eco-tourism facilities should be small-scale and local-style. Eco-tourists enjoy environmentally friendly buildings with little disturbance on the nature. Designing of architecture should take into account that buildings made of wood provide the smell of the locality of LWC, following the local regulations. Trees and water bodies along the

accommodations provide a beautiful scenery from inside. Buildings should be carefully painted so they blend in with the surrounding nature.

Management of services includes food, hospitality, languages, safety, and knowledge on natural and cultural history. Though the local soups and deserts have a variety of choices, the local main dishes are rather monotonous. The traditional Latvian food should be provided more. Hospitality is a treasure for most Latgalians. English should be learned more because most Europeans speak English and many other potential markets are English-spoken countries. Safety issues must be a priority for eco-tourism and any activity should take into consideration possible measures in case of emergency. Tourists enjoy the local people's knowledge on natural and cultural history in their accommodations having dinner or lunch. Eco-tourism developers, guides, and hosts are to keep an eye on the information on the local nature and culture.

Green credentials are given to well-managed eco-tourism. Increasing demand for more environmentally friendly tourism is a trend worldwide. Developers should not miss any chance to advertise their eco-tourism products to well-educated and well-experienced customers. As quality of eco-tourism can be only maintained by the efforts of developers, they should know what items are evaluated, who evaluate, what criteria are imposed, and for what reasons evaluation is necessary.

Networking is also a big management issue. Benefits arisen from networking are transportation improvement, financial advantages, and collective marketing. Collaboration with eco-tourism associations helps developers collect information and prepare lump-sum money available. Collateral and credit of associations might be evaluated more than those of small-sized businesses.

Calculation of profits and costs is crucial. As tourism usually depends on foreign tourists and weather, expectations are relatively unstable. Excessive investments should be avoided. Collaboration caused from networking provides experienced know-how avoids miscalculation.

Entrepreneurship is developed through the planning scheme. Planning fosters the use of IT and communications with EMC, eco-tourism associations, and the local governments, and then expands their capacity gradually. Self-sustaining education is the goal.

(2) Marketing

Marketing issues include 1) packaging, 2) IT , 3) advertisement, 4) booking system, and 5) transportation. Packaging of the eco-tourism either in or outside of LWC is crucial. One example schedule of a summer vacation by a family with 2 adults and 1 child from abroad:

> *On the first day, move from Riga to Lubana (4 hours, 10 LVL), take a canoeing lessen in the Aiviekste (2 hours, 6 LVL), have traditional dinner (2 hours, 10 LVL), take a sauna (included in overnight), stay overnight at the cottage (40 LVL).*

On the 2nd day, take a canoe for 3 to the Pededze (3 hours, 15 LVL, transportation included), have lunch at a camping place (1 hour, 3 LVL), take a tour to an archeological experience (3 hours, 6 LVL), have dinner (2 hours, 10 LVL), take a sauna again and stay (40 LVL).

On the third day, bird watching and take lunch (3 hours, one guide 5 LVL, lunch 3 LVL), take a boat and angling (4 hours, 6 LVL), have fish for dinner (3 hours, 8 LVL), take a sauna and stay overnight at a cottage (40 LVL).

On the fourth day, cycling (2 hours, 4 LVL), see the Teirumniku bog (2 hour, 4 LVL, transportation included), shop local crafts, pottery and other souvenirs(25 LVL), arrive at Idena, stay overnight at a cottage in Idena (40 LVL).

On the last day, take a bus to Riga (4 hours, 10 LVL). In total, 285 LVL for 4 nights excluding air plane tickets.

Packaging with such eco-tourism sites as Lake Engre and Lake Razna should be also promoted to make more attractive and interesting eco-tourism products. Transportation, accommodations, schedules, and guides availability are to be carefully arranged.

IT including the Internet has good potential due to its low cost of information updating. Online reservations and payment by credit cards should be developed with the help of academic institutions such as DPU. Low cost advertisement on the homepages of transportation companies could be possible if negotiations are done well.

Advertisement should show reliable and precise product description, the faces of the local people, small-scale products, wilderness and uniqueness of the nature, transportation possibilities, reasonable prices and comparisons, the homepage addresses, contents and schedules of eco-tourism activities, and booking methods. Media include TV, radio, newspaper, LCTA, Tourism Information Centers, and the Internet.

Booking is essential for tourism. Developers should find as many booking systems as possible, from the Internet to telephone booking. The number of possible booking locations decides that of tourists to come. For the purpose of booking, developers should contact the tourism organizations such as Tourism Information Centers as often as possible.

The public transportation available from Riga to Lubana town is twice-a-day bus services. Collective action to improve frequency of buses and quality of seats is necessary according to the real needs, and non-stop services should be provided if appropriate.

14.4.6 Planning and Implementation

The procedure of eco-tourism planning and implementation is shown in Figure 14.4.1. The purposes of planning are 1) entrepreneurship promotion, 2) improvement of eco-tourism activities and services, and 3) consistent monitoring of eco-tourism.

Eco-tourism activities and services should be regularly improved by the systematic evaluation and feedback system to attract more visitors and prevent inappropriate activities for nature protection. As an administrative organization, EMC needs to monitor eco-

tourism activities if they meet the regulations. The eco-tourism developers and operators need to take the following steps.

(1) To recognize zoning and regulations/restrictions

First, eco-tourism developers and operators recognize the environmental zoning. Each zone has regulation describing prohibited and restricted activities. Every eco-tourism developer or operator is required to know if and how hunting, fishing, educational activities are prohibited or allowed in a target area. The meaning of active management should be clearly understood, too.

(2) To identify natural and cultural resources and land tenure for eco-tourism

Inventories related to eco-tourism resources and activities, cultural and historical attractions, water quality monitoring data, and land tenure are provided by the information system of EMC. Eco-tourism developers find what activities are possible and where.

(3) To take into account the local cultural values and concerns

The local people are basically cooperative with eco-tourism. Forerunners of eco-tourism development have to be concerned about the possibility of the eco-tourism activities preferred by the local people.

(4) To identify similar eco-tourism activities

Eco-tourism is very popular in some European countries including Estonia which can provide the useful information on eco-tourism. Eco-tourism activities chosen are compared to the similar activities operated somewhere to understand an available season, reasonable prices, possible customers, safety issues, transportation, and sanitation management.

(5) To acknowledge responsibilities as eco-tourism operators

Developers acknowledge legal and institutional responsibilities to develop eco-tourism. Crucial are hunting, fishing, nature protection regulations. Developers also are greatly recommended to join the local eco-tourism associations to network the eco-tourism sector and promote more attractive activities.

(6) To make facilities plan

Eco-tourism facilities include accommodations, parking spaces, cottages, saunas, an archeological amusement park, balloon landing places, piers for canoeing and boating, resting houses in beaches, and houses for hunters and anglers. Where to build facilities, how to decide the sizes, how much are the reasonable prices, and how to provide water and electricity supplies are the issues to be answered prior to sanitation, marketing,

management, and financial planning. Pumped wells provide a feasible option for water supply in LWC.

(7) To make sanitation plan

Wastewater management includes types of toilets, treatment methods, and municipal and private services. Septic tanks provide a feasible option to collect wastewater from facilities. Solid waste management is connected to the 500- project. A possible new landfill site in Ludza will collect waste from Nagli and Gaigalava. Sanitation planning should be conducted with the advice from the local governments.

(8) To make marketing plan

Strong collaboration with EMC and eco-tourism associations is necessary for developers to get accurate information on the needs in eco-tourism, get possible finances, and improve transportation. To be addressed are when marketing activities should start, to whom the eco-tourism products should be informed, what points should be emphasized especially, and who will be arranging advertisements. Seasonal or annual marketing goals should be set, too.

(9) To understand management requirements

Management of eco-tourism is almost identical to understanding needs in eco-tourism. Necessity of accommodations, facilities, services should be carefully listed up. Managing information using personal computers is crucial since information plays a big role in marketing. Financial sustainability can be achieved by eco-tourism developers' creative ideas and long-standing hospitality.

(10) To make financial plan

Checking available loans from the local governments or national government, eco-tourism developers find investment possibilities. The information on tax incentives should be provided by the local governments.

(11) To make training programs for staff

To achieve the marketing goals set by developers, training for the local staff of eco-tourism businesses should be arranged. EMC and eco-tourism associations are to provide training courses to promote eco-tourism. Developers check the list of the training and decide which courses are necessary.

(12) To implement the eco-tourism plan

Facilities and sanitation plans should be implemented at the same time. Marketing and financial plan should be realized before the implementation of training programs.

(13) To evaluate the eco-tourism activities

Using green records, developers can evaluate such necessary items as preservation of the nature, properness of wastewater and solid waste management, collaboration in visitor management, customers' satisfaction with services provided by eco-tourism operators.

(14) To feedback

Each developer is recommended to report evaluation results to eco-tourism associations, EMC and the local governments to improve eco-tourism activities, to sustain the local economies, and to preserve the substantial eco-tourism resources.

14.4.7 Networking of Eco-tourism Sector

(1) Objectives

Due to excruciating experiences in the Soviet times, the local people are generally reluctant to form cooperatives. However, the Indrani township mayor succeeded in founding the business association. It means that a networking of eco-tourism sector is feasible if the local people are persuaded of the importance of associations. Indrani has its own unique natural resources, whilst Nagli and Gaigalava have their peculiarity in their territories. Combined and packaged eco-tourism activities of uniqueness and wilderness will surely attract many tourists. The Latgale Tourism Association is very active in making tourism products.

Financial problems soften due to networking. Small-scale entrepreneurs often face difficulty in obtaining funds through formal banking institutions. Banks reduce risk by lending to well-established operations with proven track records. Through networking of small-scale eco-tourism businesses, comprehensive business plans, suitable guarantees, and commercial viability become feasible.

(2) Networking steps

Expanding the association takes the following steps:

1) Choosing facilitators and finding key organizations and persons

Facilitators should take the initiative to network voluntarily. Otherwise, forced formation of associations will fail with no exception. Candidates can be the local leaders in Indrani, Lubana, Gaigalava, and Nagli townships. The business association in Indrani, the Latgale Development Agency, townships, the Madona and Rezekne Tourism Information Centers, the Teici Nature Reserve, the Daugavpils Pedagogical University are key organizations. The owners of the Kvapani fishpond, the Orenisu fishpond, wood-processing companies can be the key parties.

2) Expanding communications between key parties

Communications between key parties are almost dead except between Indrani and Lubana town, and between Gaigalava and Nagli. EIMS will hopefully help expand the communications by providing the information sharing opportunities between the concerned parities.

3) Sharing information

The more information is shared, the more cooperation is available. Collaboration happens when necessary information is obtained. Information sharing is the key to the success of the formation of eco-tourism associations. Without the consistent philosophy, nothing can be combined. The basic idea of sustainability should be shared constantly by the help of the facilitators. Competition should be an issue with Estonians and other Latvians, not with developers in LWC.

4) Marketing and training by groups

Marketing can be done by collective action. To obtain information from the homepages on the Internet by one requires much more energy and time than by groups. To advertise eco-tourism activities is possible with a bunch of money collected by associations. Benefits also come up from training arrangements by associations. Each developer can provide his/her expertise and know-how. Sharing information is possible through training activities.

5) Collective action to governments and the financial sector

Financial credibility increases when borrowers can show high financial sustainability and business feasibility. Eco-tourism is financially sustainable only with increased and shared creativity provided by associations.

6) Evaluating benefits of networking

Through formal or informal discussions, benefits from networking are fully evaluated in terms of increased information, understanding on sustainable development, successful marketing and advertisement, organization of training programs, increased financial possibilities, transportation improvements. Enlargement of associations is only a result of the previous steps.

14.4.8 Capacity-building and Training

(1) Objectives

The most crucial fact to hinder economic development in Latgale is that the old people seem to be tamed by the Soviet system in which everything was provided for free and efficiency and creativity were abandoned. Mentally, most of them are not ready to take action to improve their living standard. Self-independence combined with optimism is a fundamental issue to be solved to promote entrepreneurship. Meanwhile, the capacity-building and training strategy is not meant to exclude the local people's potential. In addition, the eco-tourism development plan should be focused on the local key persons and parties. Eco-tourism training and education programs should be based on both the key

people's efforts and new ideas from outside.

(2) Training and education programs for eco-tourism

Training programs are classified into 1) basics, 2) eco-tourism activities, 3) management, 4) services, 5) marketing methodologies, 6) finance, and 7) nature protection as depicted in Table 14.4.2.

The training initiatives should be taken by forerunning eco-tourism developers who deals with eco-tourism in the Kvapani fishpond and township mayors who have found the business association for eco-tourism for Indrani and Lubana town. The essence of the basics equals to how to empower the local people endogenously with a stress on sustainable development.

(3) Implication with EIMS and EE&T

Capacity-building and training for eco-tourism is a part of Environmental Management Information System (EIMS) and Environmental Education and Training programs (EE&T). It should be considered as an integral part of training programs. EIMS and EE&T are described in previous chapters in detail. Eco-tourism resources in LWC can be at the same time good resources for education materials and opportunities for children's environmental education which makes eco-tourism development in LWC sustainable.

14.5 Organization and Institution

14.5.1 Role of Government and Environmental Management Center (EMC)

A number of obstacles need to be overcome by the help of the national and local governments. Bureaucratic system, insufficient educational opportunities, and unreasonable fiscal policies could hinder a healthy development of eco-tourism. Governments should facilitate economically viable entrepreneurship providing financial, technical, regulatory, institutional, and physical supports for the private sector. Although the small scale is one of the strategies, some initial investment is required for the eco-tourism development. Thus, the public sector investment is indispensable in the first phase and then, its operation and management should be gradually handed over to the private sector.

(1) Financial supports

In Latvia, financial supports are usually difficult to obtain for small-sized businesses located in the rural communities. Interest rates are not less than 15%, which makes borrowing money quite infeasible not only for entrepreneurs but also for small business owners and operators. Considering getting financially less burdened loans such as soft loans, which provides low interest rates for the Latvian government, might be helpful to the Latvian government if its fiscal policies are permitting.

The role of local governments has become more important under the decentralization policies, because they are expected to incubate and nurse private sector in each region. Incentives must be more focused on than restrictive controls by governments. Financial supports from the international society and national government should be positively provided to environmentally friendly municipalities where green credentials are well kept and open to the public through information disclosure efforts. The national government should encourage and assist financial institutions to ensure their recognition of sustainable development as a criterion for financing.

(2) Technical supports

Technical supports include eco-tourism development planning, management and marketing, environmental education, training programs, inventories and monitoring. Planning methods enables systematic and consistent planning, evaluation, and feedback. Information technologies (IT) using the Internet should be provided as a result of the EMP implementation to make marketing easy for the private sector. Environmental education is essential to promote public awareness on nature protection which is the basis for eco-tourism businesses. The guideline on training programs is prepared in EDP which is used for development of detailed training programs for eco-tourism. Inventories of eco-tourism and financial resources and monitoring of water quality and sanitation should be furnished in the course of the implementation of EMP.

(3) Regulatory and institutional supports

Environmental regulations and monitoring are essential for eco-tourism. Due consideration of the importance of nature preservation, EDP should not be exploited in NPZ, but AMZ and DZ. Not all eco-tourism activities are allowed even in AMZ, and some conservation measures will be required to reduce negative impacts caused by them. The proposed actual regulations on prohibited and allowable activities with environmental zoning are described in the Environmental Zoning. In addition, detailed regulations especially on hunting and angling should be clearly understood by the local eco-tourism operators and guides. Both Madona and Rezekne REBs should take the initiative to deal with the institutional formation in collaboration with the local eco-tourism associations. For effective and efficient management, the basic information on environmental monitoring on water quality, game bird and mammal species, typical fish species, archeological sites, allowable raised bogs, beautiful landscapes, and bird-watching sites should be provided by the Environmental Information Management System (EIMS).

To avoid overlapping, conflicting, and contradictory measures for natural resources management, the Environmental Management Center (EMC) is necessary to be established as an actual administrative and operative body under the Implementation Committee (IC) of EMP. For education and training of eco-tourism, EMC is proposed to prepare and arrange a variety of training programs in cooperation with the local eco-tourism associations. Under the supervision by IC, EMC should be a bridge of the administrative gaps among the townships concerned with eco-tourism development in

LWC. For the success of attractive packaged eco-tourism activities, equal and arduous cooperation among the townships and businessmen should be formed by coordination efforts provided by EMC.

(4) Physical supports

Transportation, infrastructure provision, water and electricity supplies, wastewater and solid waste management form the main physical supports from the local governments. Presently, foreign eco-tourists fly to Riga. Buses and cars are the only transportation options from Riga to the access points to LWC since the railroad from Madona to Lubana town ceased a few years ago. Transportation options should be widened from more frequent buses to trains, and preferably airplanes. The Rezekne airport might be possible in future depending on the local economic development.

Bird-watching towers, piers for canoeing and boating, public rest houses and parking spaces for swimmers in Lake Lubana, and facilities in boat and canoe stations need to be constructed from the public funds to provide the basic infrastructure for a variety of eco-tourism activities. Although eco-tourism developers are basically to make the best use of existing wells and electricity supply networks, physical infrastructure should be well prepared by the local governments. Along the proposed horse trekking routes in Nagli, one dumping site degrades the beautiful scenery. In line with the 500- project to reduce the number of small and scattering dumping sites across Latvia, Nagli township should close the dumping site and transfer its solid waste to a bigger and more well treated landfill in Ludza in the near future.

14.5.2 Proposed Organization for Eco-tourism Development

For the purpose of materializing eco-tourism development projects of a) Gaigalava and Nagli and b) Lubana and Indrani, it is proposed to form the LWC Eco-tourism Association (LETA). This LETA consists of interested local governments, interested local people groups supported by academic institutes. Possible local governments which are active in promoting these projects are Gaigalava, Nagli, Lubana, Indrani and other interested townships. Possible academic institutes which will support the eco-tourism projects are DPU, the Teici State Nature Reserve Office and other interested institutions which are willing to support LWC eco-tourism from the academic capability. Such cross-sector cooperation can be depicted as the next picture. This LETA will be placed under the Eco-tourism House which is one of the functions in EMC.

Table 14.3.2 Eco-tourism Project for Nagli and Gaigalava

Facilities		Location	Specifications	Costs (LVL)	Type
1. Kuvapani complex (A)	Tourist house, summer house, camping site, carpark observation hut	Kuvapani ponds	Renovation of old structure, local timber house drainage toilet facilities	77,000	B, C
2. Kuvapani complex (B)	Observation house	Kuvapani ponds	Renovation of existing structure	7,000	B
3. Orenisi island complex	Lodge,observation tower carpark Camping site	Orenisi island in Nagli fish pond	Local wooden structure	37,700	B, C
4.Observation tower	Observation tower	refer to Fig. 14.3.4	Wood frame structure (10m)	8,000	B
5. Observation hut	Observation hut	Nagli	Wood frame structure raised floor	2,500	B
6. Camping site	Camping site	refer to Fig. 14.3.4	Drainage, toilet facilities	20,000	C
7. Board walk	Board walk	Teirumnik	Wood board, 1 km	5,000	B
8. Canoe station	Simple pier	Idena canal	Simple wooden structure	600	B
9. Information board	Indicating guide route map, instruction	Refer to Fig. 14.3.5	wooden board with posts written in Latvian & English	4,800	B
10. Sign post	Indicating site characteristics	Refer to Fig. 14.3.5	Metal board with wooden post, written in Latvian & English	700	B
11. Equipment	(1) Vehicle	EMC Eco-tourism office	a) 4WD (5 passengers)	40,000	E
			b) Pick-up (1 ton)	10,000	E
	(2) Canoe & canoe trailer		w/paddles, life jackets	7,000	E
	(4) Boat & boat trailer		Row boat w/paddles	4,600	E
	(6) Bicycle		Cycling bicycle	1,200	E
	(7) Camera & projector		w/ exchange lens	3,000	E
	(8) Video, monitor		8 mm video & monitor	3,000	E
	(9) Spotting scope		w/ lens	9,000	E
	(10) Personal computer		Server & monitor	1,500	E
	Subtotal			79,300	-
Total				242,600	-

Note : B=building, C=civil works, E=equipment

Table 14.3.3 Eco-tourism Project for Lubana & Indrani

Facilities		Location	Specifications	Cost (LVL)	Type
1. Tourist Information Building	Reception and Information, office room, exhibition room & carpark	Lubana town	Renovation of old building, Wooden structure w/ heating & septic tank	108,800	B, C
2. Lodge	Accommodation lodge, Sauna & carpark	Lubana town	Local wooden structure, heating & flush toilet	54,800	B, C
3. Canoe house	Canoe house w/ carpark & pier	Lubana town	Wooden structure w/shower & flush toilet	11,500	B, C
4. Canoe station	Signpost and simple pier	Jaunpededze canal	Wooden simple structure,	600	B
5. Camping site	Camping site (2 sites)	Lubana town,and Jaunpededze canal	Drainage, toilet	40,000	C
6. Information board	Indicating guide route map, instruction,	refer to Fig.14.3.5	wooden board with posts written in Latvian & English	2,800	B
7. Sign post	Indicating site characteristic	refer to Fig.14.3.5	Metal board with wooden post, written in Latvian & English	600	B
8. Equipment	(1) Vehicle	Tourist information building in Lubana	a) 4WD (5 passengers)	20,000	E
			b) Pick-up (1 ton)	10,000	E
	(2) Canoe & canoe trailer		w/paddle, life jacket	7,000	E
	(4) Boat & boat trailer		Row boat w/paddle	4,600	E
	(6) Bicycle		Cycling bicycle	1,800	E
	(7) Camera,		w/ slide projector	3,000	E
	(8) Video camera		8 mm video w/ monitor	3,000	E
	(9) Dummy		Full size dummy for exhibition	6,000	E
	(10) Archeological equipment		Shovel, scoop, covering sheet, hoist	3,000	E
	(10) Personal computer		Server & monitor	1,500	E
	Subtotal			59,900	-
Total				279,000	-

Note : B=building, C=civil works, E=equipment

Table 14.3.1 (1) Detail Description of Eco-tourism Sites

Site No.	Obsevation Objects		Observation Season			Remarks
	Habitats	Species	Spring	Summer	Autumn	
1	Dry grasslands, Wetland vegetation	Cormorant	+	+	+	Collony of ca. 150 pairs as well as feeding individs could be observed
		Bittern		+		singing
		Grey Heron	+	+	+	Collony of ca. 200 pairs as well as feeding individs
		Bean Goose	+		+	Lubana Lake at the evening, sleeping in Lubana Lake
		White-fronted Goose	+		+	Lubana Lake at the evening, sleeping in Lubana Lake
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding birds
		Buzzard	+	+	+	Feeding birds
		Osprey	+	+	+	Feeding birds
		Crane			+	Feeding birds
		Fox	+	+	+	Feeding individs
		Roe Deer	+	+	+	Feeding individs
2	Inundated grasslands, Wetland vegetation	Bittern		+		singing
		Grey Heron	+	+	+	Feeding birds, simultaneously several tens of individs could be observed
		Mute Swan	+	+		Migratory (up to several hundreds) and breeding birds
		Bewick's Swan	+			Migratory birds (some individs or small groups)
		Whooper Swan	+	+		Migratory (up to ca. 2000 individs) and breeding birds (1 pair)
		Bean Goose	+		+	Migratory birds (several hundreds, especially in spring)
		White-fronted Goose	+		+	Migratory birds (several hundreds, especially in spring)
		Greylag Goose	+			Some Pairs breeding
		Ducks	+	+	+	species' individs could be observed
		Smew	+			Some individs during migration period
		Goosander	+			Some individs during migration period
		White-tailed Eagle	+	+	+	Feeding birds
		Mardsh Harrier	+	+	+	Feeding and breeding birds
		Montagu's Harrier		+	+	Feeding birds
		Osprey	+	+	+	Feeding birds
		Coot	+	+	+	Feeding and breeding birds
		Little Gull		+		Breeding birds, up to several hundred pairs
		Black-headed Gull		+		Breeding birds, some pairs
		Black Tern		+		Breeding birds, up to few hundred pairs
		White-winged Black Tern		+		Breeding birds, up to few tens pairs
3	Fish ponds	All Species of Grebes	+	+		Breeding birds
		Cormorant	+	+	+	Feeding birds, simultaneously few tens of individs
		Bittern		+		singing
		Grey Heron	+	+	+	Feeding birds, simultaneously few tens of individs
		Black Stork	+	+		Feeding birds, simultaneously few tens of individs
		Mute Swan	+	+		Migratory (up to few hundreds) and breeding birds
		Bewick's Swan	+			Migratory birds (up to several hundred individs)
		Whooper Swan	+	+		Migratory (up to few hundreds) and breeding birds
		Bean Goose	+		+	Migratory birds (several hundreds, especially in spring)
		White-fronted Goose	+		+	Migratory birds (several hundreds, especially in spring)
		Ducks	+	+	+	Migratory and breeding birds, several hundreds of one species' individs during migration
		Smew	+			Some individs during migration period
		Goosander	+			Some individs during migration period
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding and breeding birds
		Osprey	+	+	+	Feeding birds
		Coot	+	+	+	Feeding and breeding birds
		Lapwing	+	+		Breeding birds
		Redshank	+	+		Breeding birds
		Little Gull		+		Breeding birds, up to few hundred pairs
		Black-headed Gull		+		Breeding birds, up to few hundred pairs
		Whiskered Tern		+		Breeding birds, some pairs
		Black Tern		+		Breeding birds, few tens pairs
		White-winged Black Tern		+		Breeding birds, few tens pairs

Table 14.3.1 (2) Detail Description of Eco-tourism Sites

Site No.	Obsevation Objects		Observation Season			Remarks
	Habitats	Species	Spring	Summer	Autumn	
4	Fish ponds, dry grasslands	All Species of Grebes	+	+		Breeding birds
		Cormorant	+	+	+	Feeding birds, simultaneously several tens individs
		Bittern		+		singing
		Grey Heron	+	+	+	Feeding birds, simultaneously several tens individs
		Black Stork	+	+		Feeding birds, simultaneously several tens individs
		White Stork	+	+		Breeding birds (1 pair)
		Mute Swan	+	+		Migratory (up to several hundreds) and breeding birds
		Bewick's Swan	+			Migratory birds (up to several hundred individs)
		Whooper Swan	+	+		Migratory (up to several hundreds) and breeding birds
		Bean Goose	+		+	Migratory birds (several hundreds, especially in spring)
		White-fronted Goose	+		+	Migratory birds (several hundreds, especially in spring)
		Ducks	+	+	+	Migratory and breeding birds, several hundreds of one species' individs during migration period
		Smew	+			Some individs during migration period
		Goosander	+			Some individs during migration period
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding and breeding birds
		Osprey	+	+	+	Feeding birds
		Lesser Spotted Eagle	+	+		Feeding birds
		Coot	+	+	+	Feeding and breeding birds
		Lapwing	+	+		Breeding birds
		Other Lapwing's Species	+	+	+	Mainly during Autumn migration as feeding birds, several tens individs of each species
		Redshank	+	+	+	Breeding birds, in Autumn migration as feeding birds
		Marsh Sandpiper	+	+	+	Breeding birds, in Autumn migration as feeding birds
		Terek Sandpiper	+	+	+	Breeding birds, in Autumn migration as feeding birds
		Other Sandpiper's species	+	+	+	Breeding birds, in autumn migration mainly as feeding birds
		Little Gull		+		Breeding birds, up to few ten pairs
		Black-headed Gull		+		Breeding birds, up to few hundred pairs
		Common Gull	+	+		Breeding birds, several pairs
		Herring Gull	+	+		Breeding birds, several pairs
		Common Tern		+		Breeding birds, several pairs
		Black Tern		+		Breeding birds, few ten pairs
5	Fish ponds, dry grasslands	All Species of Grebes	+	+		Breeding birds
		Cormorant	+	+	+	Feeding birds, simultaneously several ten individs
		Bittern		+		singing
		Grey Heron	+	+	+	Feeding birds, simultaneously several ten individs
		Black Stork	+	+		Feeding birds, simultaneously several ten individs
		White Stork	+	+		Breeding birds (1 pair)
		Mute Swan	+	+		Migratory (up to several hundred) and breeding birds
		Bewick's Swan	+			Migratory birds (up to several hundred individs)
		Whooper Swan	+	+		Migratory (up to several hundred) and breeding birds
		Ducks	+	+	+	Migratory and breeding birds, several hundred of one species' individs during migration period
		Smew	+			Some individs during migration period
		Goosander	+			Some individs during migration period
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding and breeding birds
		Osprey	+	+	+	Feeding birds
		Coot	+	+	+	Feeding and breeding birds
		Lapwing	+	+		Breeding birds
		Other Lapwing's Species	+	+	+	Mainly in autumn migration as feeding birds, several ten individs of each species
		Redshank	+	+	+	Breeding birds, in autumn migration as feeding birds
		Marsh Sandpiper	+	+	+	Breeding birds, in autumn migration as feeding birds
		Terek Sandpiper	+	+	+	Breeding birds, in autumn migration as feeding birds
		Other Sandpiper's species	+	+	+	Breeding birds, in autumn migration mainly as feeding birds
		Black-headed Gull		+		Breeding birds, up to few hundred pairs
		Common Gull	+	+		Breeding birds, some pairs
		Herring Gull	+	+		Breeding birds, some pairs
		Common Tern		+		Breeding birds, some pairs
		Black Tern		+		Breeding birds, few ten pairs

Table 14.3.1 (3) Detail Description of Eco-tourism Sites

Site No.	Obsevation Objects		Observation Season			Remarks
	Habitats	Species	Spring	Summer	Autumn	
6	Raised/ Transitional bog	Honey Buzzard	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding birds
		Buzzard	+	+	+	Feeding birds
		Hobby		+	+	Feeding birds
		Black Grouse	+			Mating song
		Crane	+	+		Breeding birds
		Golden Plover	+	+		Breeding birds
		Whimbler	+	+		Breeding birds
		Green Sandpiper	+	+		Breeding birds
		Nightjar		+		Mating song in the Night
		Skylark	+	+		Breeding birds
		Tree Pipit	+	+		Breeding birds
		Meadow Pipit	+	+		Breeding birds
		Yellow Wagtail	+	+		Breeding birds
		Whinchat	+	+		Breeding birds
		Red-backed Shirke	+	+		Breeding birds
		Great Grey Shirke	+	+		Breeding birds
		Raven	+	+		Breeding birds
		Reed Bunting	+	+		Breeding birds
7	Raised/Transitional bog, Lake in the					poor bird fauna, mainly bog vegetation and vegetation of forest adjacent to the bog could be observed, high landscape value
8	Fish ponds, Lake	All Species of Grebes	+	+		Breeding birds
		Cormorant	+	+	+	Feeding birds, simultaneously several tens individs
		Bittern		+		singing
		Grey Heron	+	+	+	Feeding birds, simultaneously several tens individs
		Mute Swan	+	+		Migratory (up to several hundred) and breeding birds
		Bewick's Swan	+			Migratory birds (up to several hundred individs)
		Whooper Swan	+	+		Migratory (up to several hundred) and breeding birds
		Bean Goose	+		+	Migratory birds (several hundreds, especially in spring)
		White-fronted Goose	+		+	Migratory birds (several hundreds, especially in spring)
		Ducks	+	+	+	Migratory and breeding birds, several hundreds of one species' individs could be observed during migration
		Smew	+			Some individs during migration period
		Goosander	+			Some individs during migration period
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding and breeding birds
		Osprey	+	+	+	Feeding birds
		Coot	+	+	+	Feeding and breeding birds
		Little Gull		+		Breeding birds, up to few hundred pairs
		Black-headed Gull		+		Breeding birds, up to few hundred pairs
		Black Tern		+		Breeding birds, up to few tens pairs
		White-winged Black Tern		+		Breeding birds, up to few tens pairs
9	Inundated grasslands	Grey Heron	+	+	+	Feeding birds
		Black Stork	+	+		Feeding birds
		Marsh Harrier	+	+	+	Feeding birds
		Montagu's Harrier	+	+	+	Feeding birds
		Buzzard	+	+	+	Feeding birds
		Corncrake		+		singing
		Common Snipe	+	+		Breeding birds Mating Flight
		Woodcock	+	+		Breeding birds Mating Flight
		Common Sandpiper	+	+	+	Breeding birds
		Larks, Pipits and wagtails, Warblers	+	+		Breeding birds
10	Broad - leaved forests and deciduous/wet deciduous forests	Black Stork	+	+		Feeding birds
		Honey Buzzard		+	+	Feeding birds
		Buzzard	+	+	+	Feeding birds
		Lesser Spotted Eagle	+	+	+	Feeding birds
		Woodcock	+	+		Breeding birds Mating Flight
		Green Sandpiper	+	+		Breeding birds
		Woopeckers, Thrushes, Flycatchers, Tits	+	+		Breeding birds
11	River, Forests	Common Sandpiper	+	+	+	Breeding birds
		Warblers	+	+		Breeding birds

Table 14.3.1 (4) Detail Description of Eco-tourism Sites

Site No.	Obsevation Objects		Observation Season			Remarks
	Habitats	Species	Spring	Summer	Autumn	
12	Broad - leaved forests and deciduous/wet deciduous forests	Black Stork	+	+		Feeding birds
		Honey Buzzard		+	+	Feeding birds
		Buzzard	+	+	+	Feeding birds
		Lesser Spotted Eagle	+	+	+	Feeding birds
		Woodcock	+	+		Breeding birds Mating Flight
		Green Sandpiper	+	+		Breeding birds
		Woopeckers, Thrushes, Flycatchers, Tits	+	+		Breeding birds
13	Inundated grasslands	Grey Heron	+	+	+	Feeding birds
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding birds
		Osprey	+	+	+	Feeding birds
		Wagtails, Warblers	+	+		Breeding birds
14	Fish ponds	Cormorant	+	+	+	Feeding birds, simultaneously several tens individs
		Bittern		+		singing
		Grey Heron	+	+	+	Feeding birds, simultaneously several tens individs
		Mute Swan	+	+		Migratory (up to several hundred) and breeding birds
		Bewick's Swan	+			Migratory birds (up to several hundred individs)
		Whooper Swan	+	+		Migratory (up to several hundred) and breeding birds
		Bean Goose	+		+	Migratory birds (several hundred, especially in spring)
		White-fronted Goose	+		+	Migratory birds (several hundred, especially in spring)
		Ducks	+	+	+	Migratory and breeding birds, several hundreds of one species' individs during migration period
		Smew	+			Some individs during migration period
		Goosander	+			Some individs during migration period
		White-tailed Eagle	+	+	+	Feeding birds
		Marsh Harrier	+	+	+	Feeding and breeding birds
		Osprey	+	+	+	Feeding birds
		Coot	+	+	+	Feeding and breeding birds
		Little Gull		+		Breeding birds, up to few hundred pairs
		Black-headed Gull		+		Breeding birds, up to few hundred pairs
		Black Tern		+		Breeding birds, few ten pairs
		White-winged Black Tern		+		Breeding birds, few ten pairs
15	All biotops found in LWC	All bird species found in LWC	+	+	+	

Table 14.4.1 Evaluation of Eco-tourism and Green Record

Types	No.	Evaluation Items	Seasons				Places							Criteria							Objectives						Evaluators			Evaluation Targets						Note
			spring	summer	autumn	winter	Gaigalava	Nagli	Berzpils	Lubana Town	Indrani	Daukstu	in and around LWC	wildemess and naturalness	uniqueness	reasonable fee	services	knowledge level	appropriateness	sustainability	environmental protection	culture preservation	green credentials	eco-tourism needs finding	education	tourists	EMC or REBs	eco-tourism association	EMC/REBs	eco-tourism association	townships	developers/ operators	guides	hosts	
Eco-tourism Activities	1	boating and anglisng along the Aiviekste		x	x					x	x					x	x							x			x				x	x		piers construction are necessary
	2	taking saunas and cottages	x	x	x	x				x	x					x	x							x			x				x		x	accomodation improvements
	3	beautiful inundation	x								x			x	x	x	x							x			x				x	x		only during inundation period
	4	watching rare broad-leaved forests										x		x		x	x							x			x				x	x		bogs, broad-leaved forests, inundated grasslands
	5	canoeing along the Pededze	x	x	x						x	x		x	x	x	x				x			x			x	x				x	x		in the Pededze and the Aiviekste
	6	archeological experience	x	x	x	x					x				x	x	x					x		x	x	x					x		x		unique experience with the staff of EMC
	7	horse trekking	x	x	x			x								x	x							x			x				x	x		potential in Gaigalava
	8	walking around Teirumniku bog	x	x	x	x		x							x	x	x				x			x	x	x	x				x	x		educational resource
	9	boating along the Idena canal		x	x			x						x		x	x							x			x				x	x		in Lake Lubana
	10	camping		x	x			x								x	x							x			x				x	x		along the Idena canal
	11	youth hostel	x	x	x	x		x							x	x	x							x	x	x					x			x	provides beautiful scenery
	12	bird-watching in Orenisi	x			x		x						x	x	x	x				x			x	x	x					x	x		bird-watching from tower
	13	bird-watching in Kvapani and Gomelis	x			x	x							x	x	x	x				x			x	x	x	x				x	x		mainly in Gomelis, Kvapani, Idena, Nagli
	14	campfire and sports activities	x	x	x		x									x	x							x		x					x		x	affiliated attraction
	15	swimming in Lake Lubana		x			x									x	x							x		x					x		x	water quality monitoring necessary in Lake Lubana
	16	angling in the fishponds		x	x	x	x	x								x	x							x		x					x			angling licenses necessary
	17	habitat management	x	x	x	x	x	x							x	x	x				x			x	x	x		x							unique experience with the staff of EMC
	18	animal-watching		x	x		x	x						x	x	x	x							x	x	x	x				x	x		courtship of experienced guides necessary
	19	hunting			x	x							x	x		x	x							x	x	x	x				x	x		hunting licenses necessary
	20	balloon adventure	x	x	x	x							x		x	x	x							x		x					x			scenery over LWC is wonderful
	21	agriculture experience		x	x								x			x	x							x		x					x			cranberry, strowberry
	22	stork watching	x	x									x			x	x							x		x					x	x		whilte storks are rich
	23	visiting nature museum	x	x	x	x							x			x	x							x	x	x	x					x	x	voluntarily operated in Vilani
Knowledge	24	sustainable development																x					x		x				x	x	x	x	x	priority issue in green credentials
	25	eco-tourism resources																x					x		x				x	x	x	x	x	necessity to protect the nature
	26	green records																x					x		x				x	x	x	x	x	role of green records
	27	safety issues																x					x		x				x	x	x	x	x	increase safety knowledge
	28	natural history of LWC																x					x		x				x	x	x	x	x	wetland formation and habitat
	29	cultural history of LWC																x				x	x		x				x	x	x	x	x	archeology and inundation control
	30	financial sustainability																x							x				x	x	x		x	management issue
Habitat Management	31	biological carrying capacity improvements																x	x	x	x		x			x			x						to increase eco-tourism resources
	32	conservation measures																x	x	x	x		x			x			x						both for fauna and flora
	33	grass-cutting and burning																x	x	x	x		x			x			x						to increase habitats for birds
	34	artificial islands																x	x	x	x		x			x			x						to increase habitats for birds
	35	water level management																x	x	x	x		x			x			x						to increase habitats for birds
	36	predator control																x	x	x	x		x			x			x						to increase habitats for birds
Visitor Management	37	nature protection territories and zoning																x	x	x	x		x			x			x						main nature protection activities
	38	regulations and prohibited/restricted activities																x	x	x	x		x			x			x						appropriateness of regulations is a hot issue
	39	improvement of physical carrying capacity																x	x	x	x		x				x			x	x				number of accomodations, facilities
	40	social/cultural carrying capacity improvements																x	x	x	x	x	x				x			x	x				local capacity to accept tourists
	41	wastewater management																x	x	x	x		x				x					x		x	to avoid pollution
	42	solid waste management (recycling)																x	x	x	x		x				x					x		x	to avoid pollution

Note) relevant item is marked with "x".

Table 14.4.2 Eco-tourism Training / Education Programs

Classification	No.	Eco-tourism Training/Education Programs	Target					Qualification	Program Duration					Responsible Organizations					Fee Range (per participant)				Note
			developers /operators	guides	hosts	technical staff (IT)	accountants	program required to be taken in advance	a few hours	one day	a few days	one week	more than 1 week	EMC	Eco-tourism associations	Town/Townships	District Councils	Madona and Rezekne REBs	free	0-1 LVL	1-5 LVL	5-10 LVL	
Basics	1	sustainable development	x	x	x	x	x		x					x					x				key theme of eco-tourism development
	2	confidence, self-independence, and optimism	x	x	x	x	x		x						x				x				to change negative way of thinking
	3	entrepreneurship	x		x				x						x				x				basis for management and marketing
	4	collaboration and association	x	x	x	x	x		x						x				x				basis for networking
	5	necessity of evaluation and green credentials	x	x	x	x	x		x					x					x				basis for green records
	6	ethical principles	x	x	x	x	x		x					x					x				
Eco-tourism Activities	7	eco-tourism resources and activities	x	x	x				x					x					x				overall picture of LWC
	8	hunting in LWC	x	x	x			7	x					x							x		seasons, places, game animals and birds, licenses
	9	fishing in LWC	x	x	x			7	x					x							x		seasons, places, typical fish species
	10	bird- and animal- watching	x	x	x			7	x					x					x				seasons, places, bird species
	11	rare vegetation in LWC	x	x	x			7	x					x					x				Teirumniku, Berzpils bogs, broad-leaved forests
	12	canoeing and horse trekking	x	x	x			7	x					x					x				the Abora, Zvidze settlements
Management	13	management of eco-tourism	x					3		x				x	x				x				general guidance
	14	necessary facilities and planning	x					7		x					x					x			using GIS
	15	green records	x	x	x	x	x	5		x				x					x				using IT
	16	networking of eco-tourism businesses	x		x	x		4		x					x				x				using IT
	17	eco-tourism planning scheme	x								x			x							x		refer to Figure
Services	18	services and hospitality	x	x	x						x				x				x				food, accommodations, transportation
	19	communication skills		x	x							x			x						x		kindness and openness to tourists
	20	language skills (English, German)		x	x	x		19					x		x							x	prerequisite to attract foreign tourists
	21	safety issues		x	x				x						x				x				medicine, hunting, boating, hiking
	22	natural and cultural history of LWC		x	x					x				x					x				
	23	folk songs and dances		x	x							x			x						x		folk songs and dances
marketing	24	marketing methodologies	x			x		3		x				x	x					x			overall guidance on marketing
	25	information technologies for eco-tourism (computer skills)				x		16			x			x							x		IT usage
	26	advertisement and booking				x		16			x			x							x		IT usage
	27	eco-tourism in Estonia	x			x			x						x				x				useful reference of Estonian examples
	28	transportation improvements	x					4	x							x	x		x				necessity of collaboration and association
Finance	29	book-keeping					x					x			x						x		focused on tax incentives
	30	loan management	x				x					x			x	x	x				x		available loans, procedures, interest rates
	31	financial sustainability	x				x		x					x					x				how to get financial sustainability
Nature Protection	32	physical carrying capacity	x	x				1	x					x					x				number of tourists, facilities, activities
	33	biological carrying capacity	x	x				1	x					x					x				to avoid over hunting and fishing
	34	social/cultural carrying capacity	x	x				1	x					x					x				local capacity to accept tourists
	35	conservation measures	x	x				1	x					x				x	x				two types of conservation
	36	habitat management	x	x				1	x					x				x	x				to increase biological carrying capacity
	37	visitor management	x	x				1	x					x				x	x				to increase social/cultural carrying capacity
	38	zoning and regulations/restrictions	x	x				1		x				x				x	x				prohibited activities
	39	wastewater management	x		x			5		x								x	x				appropriate treatment of wastewater
	40	solid waste management	x		x			5		x								x	x				recycling, waste collection
	41	honorary guests of LWC	x		x				x					x		x			x				collaboration with townships

Note) relevant item is marked with "x".

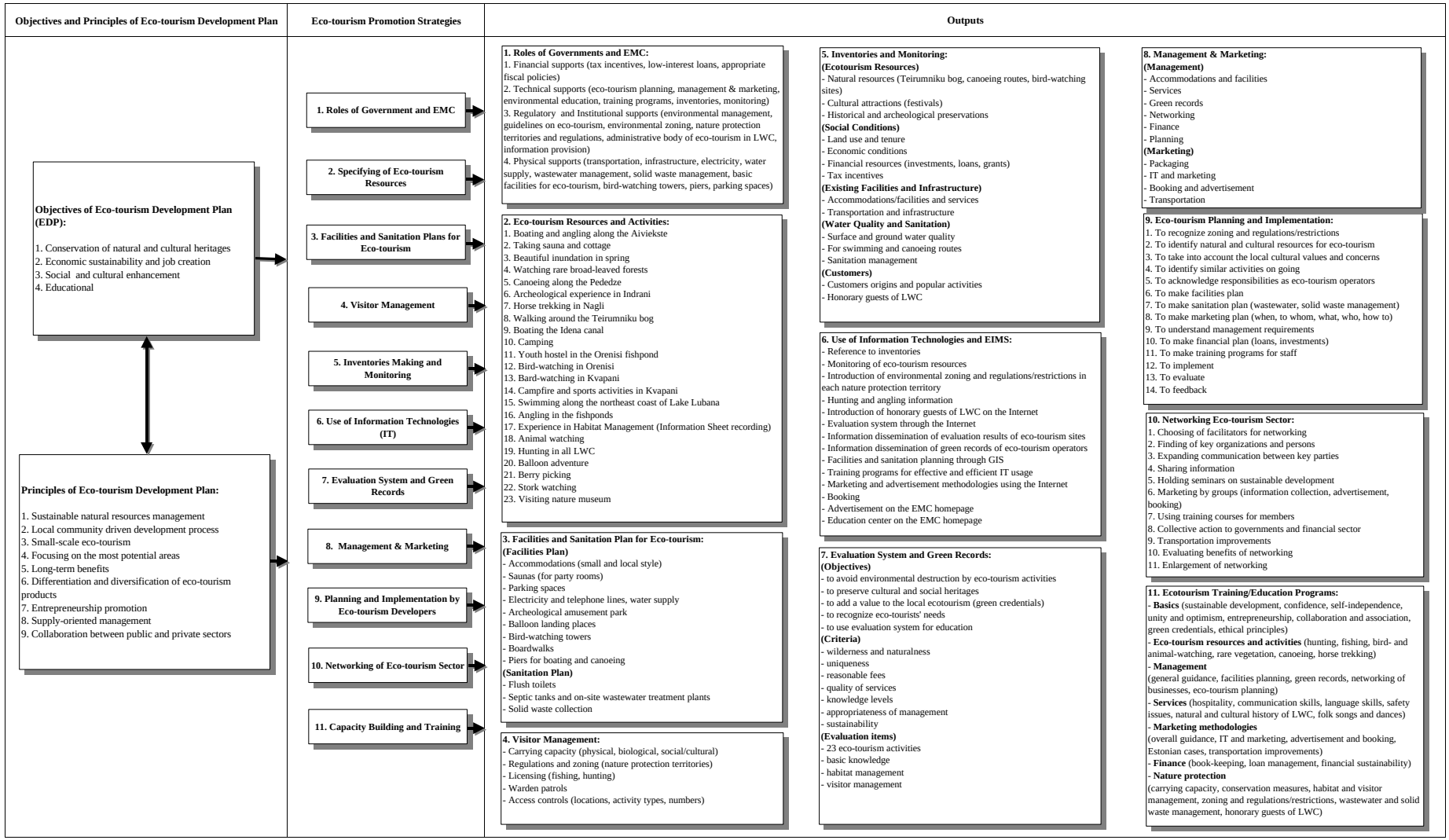


Figure 14.3.1 Framework of Eco-tourism Development Plan

1. Bird Watching in Kvapani

- Eco-tourists can enjoy bird watching at the top of the building located in the Kvapani fishpond (left).
- The best season is from March to the beginning of May (right).
- Accommodation can be provided.

2. Bird Watching

- In the middle of the Orenisi fishpond, a bird watching tower can be constructed (left).
- Building cottage and sauna is possible if the private landowner agrees.

3. Stork-watching

- Storks which make their nests close to human houses are quite popular in Latvia (left and right).
- LWC is rich in white stork and scarce in black stork.

4. Animal-watching

- Beavers are watched at night in Nagli.
- Otters' habitats are rich in LWC.
- Roe deer, red deer, elk, wolf, lynx, fox, wild boar can be seen (left and right).
- Coordination with hunters is necessary.
- Hunting seasons should be avoided.

5. Watching Rare Broad-leaved Forests

- English oak, black alder, birch can be seen near Upesmala (left).
- Big trees can be seen along the Pededze river (right).

Figure 14.3.2 (1) Eco-tourism Resources and Activities

6. Walking around Teirumniku Bog

- Floating bog is unique enough to be an educational resource (left).
- Boardwalks should be carefully arranged to prevent visitors from damaging bogs (right).
- Nature School can be located near this Bog.

7. Beautiful Inundation

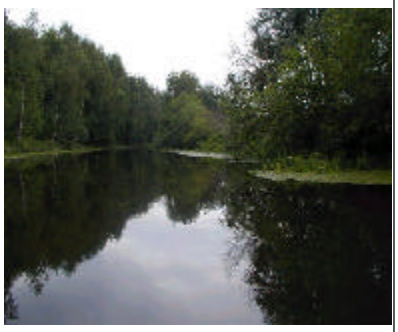
- The inundated area in LWC is quite unique and provide a potential eco-tourism resource in spring.
- Indrani has an access point to see the only vast inundation area in Latvia.
- Motor boats are allowed with permission.

8. Canoeing along the Pededze

- Wild scenery is found along the Pededze river (left).
- Beaver dams can be seen along the Pededze river (right).
- No motor engine may be used in order not to disturb the nature.

9. Canoeing and Boating

- A Canoe/boat station can be located at the beginning of the Idena canal (left).
- Eco-tourists can enjoy wilderness and hear birds singing along the canal (right).
- A house for hunters and anglers is located at the end of the canoeing route.



10. Boating and Angling along the Aiviekste

- Piers construction is necessary along the Aiviekste.
- Boats can be used as transportation for sauna and cottage (left).
- Angling is popular along the Aiviekste.

Figure 14.3.2 (2) Eco-tourism Resource and Activities

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11. Camping along the Idena canal

- Camping places can be found along the Idena canal (left).
- Combined with boating and canoeing, summer camp is suitable.
- The water quality of the Idena canal should be improved.

12. Camping and Sports Activities

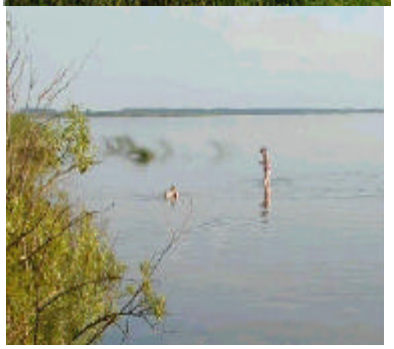
- Next to the Kvapani fishpond, the place for campfire is provided (left).
- Several sports activities including volleyball, badminton are popular.
- Staying in a cottage for hunters/bird-watchers is an exotic experience (right).

13. Lodge in Orenisi

- The orenisi fishpond provides one of the most beautiful sceneries in LWC (left).
- Construction of a lodge is recommended.

14. Swiming in Lake Lubana

- A beach full of white granular sand is located in the northeast coast of Lake Lubana (left).
- Water quality should be regularly monitored during the summer season.
- Parking space (for 20 cars) can be placed near the beach.



15. Angling

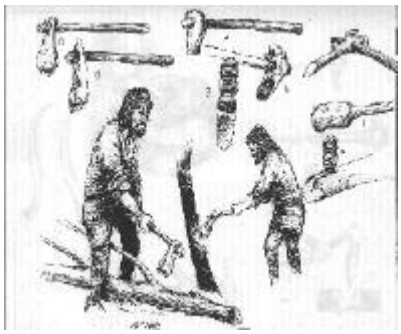
- Pike and pikeperch are available in and around Lake Lubana (left).
- Winter fishing is very popular in Lake Lubana (right).
- Accommodation and proper fish resource management are necessary.

Figure 14.3.2 (3) Eco-tourism Resource and Activities

16. Taking Sauna and Cottage

-Along the Aiviekste, there are several saunas (left).

- Unique cottages can be tourists' attraction in Indrani (right).
- Holiday and summer houses can be operated by the local people.



17. Archeological Experience

- Mesolithic (B.C. 7700-4500) period in the Zvidze settlement (left).
- The Abora settlement is famous for Neolithic (B.C. 4500-1500).
- Making poultry can be an attraction for eco-tourists in reconstructed ancient buildings (right).

18. Museum of Nature

- Animals living in and around LWC are exhibited in a private museum in Varaklani (left and right).
- The museum has an educational value for schoolchildren.
- The exhibition makes bird-watching more interesting.

19. Agriculture Experience

- Cranberry picking is popular in wetlands (left).
- Dairy can provide wonderful experience for children (right).
- Organic agriculture is an attraction for urban dwellers.

20. Experience in Habitat Management

- Burning grasslands is one way of habitat management to increase the number of rare birds (left).
- Visiting EMC and discussions with its staff expands visitors' knowledge.
- Information Sheet of Ramsar provides knowledge enlargement chance (right).

Figure 14.3.2 (4) Eco-tourism Resource and Activities

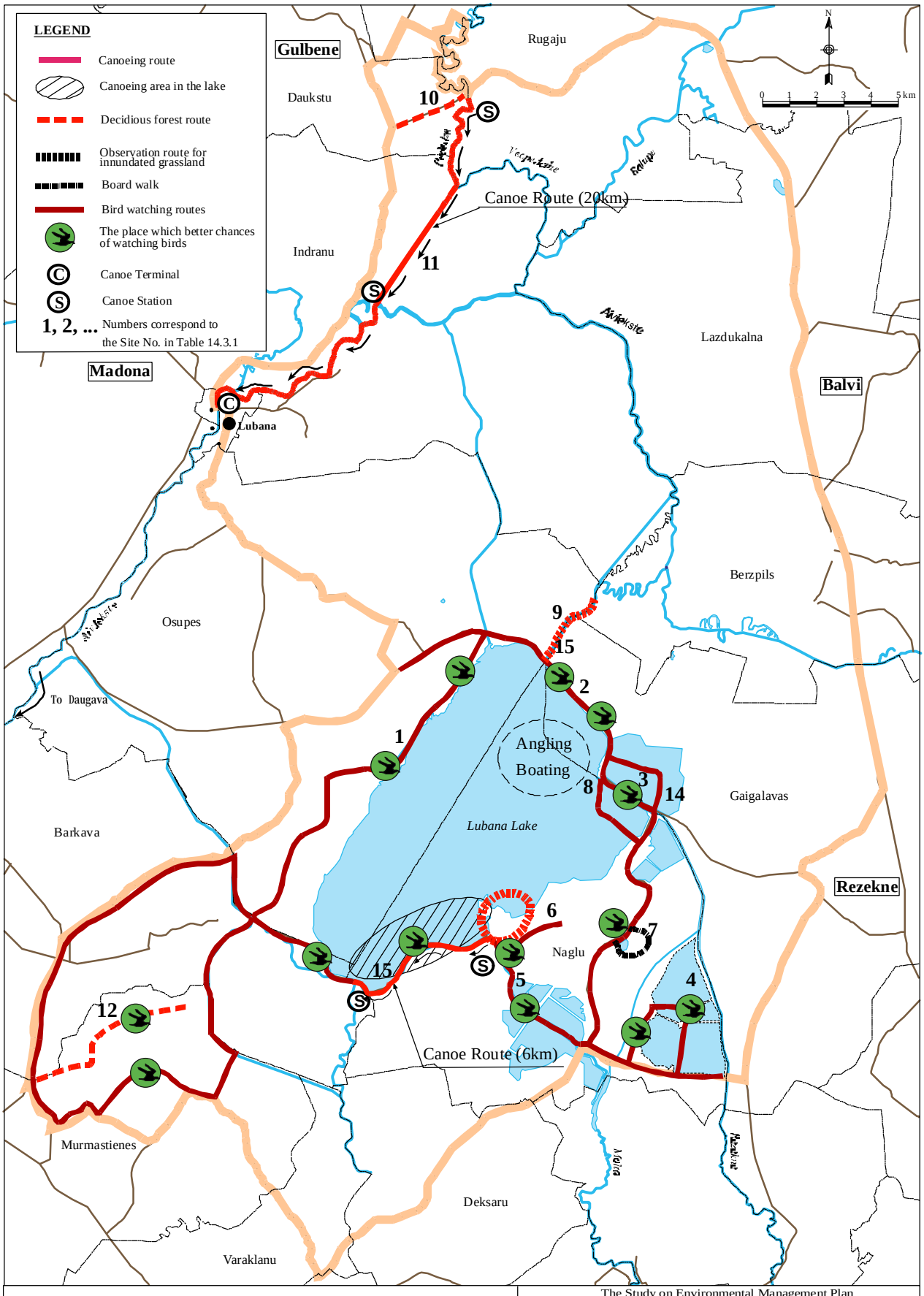


Figure 14.3.3 Proposed Eco-Tourism Activities

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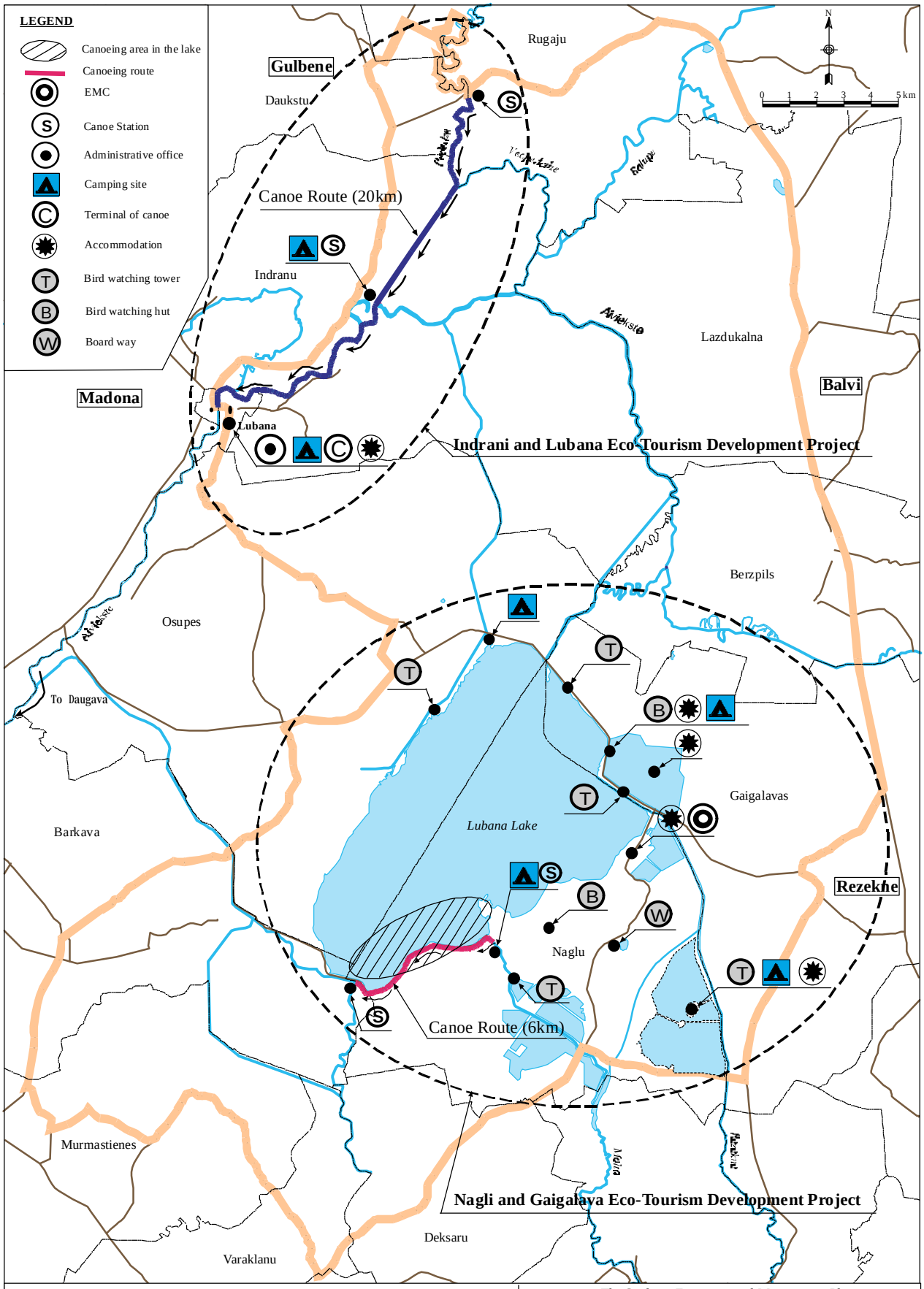

Figure 14.3.4 Proposed Eco-Tourism Development Project

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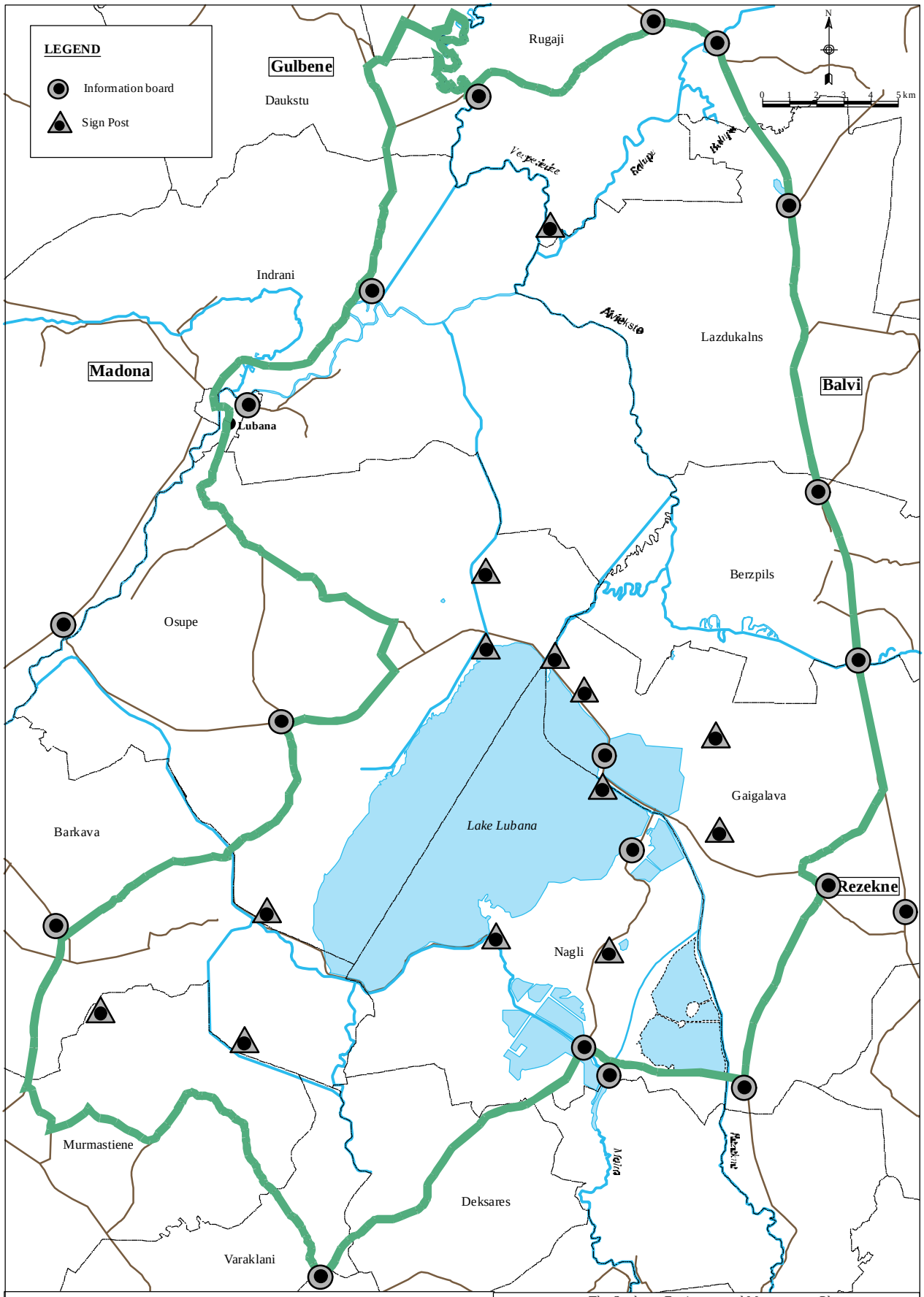

Figure 14.3.5 Location of Information Board & Sign Post

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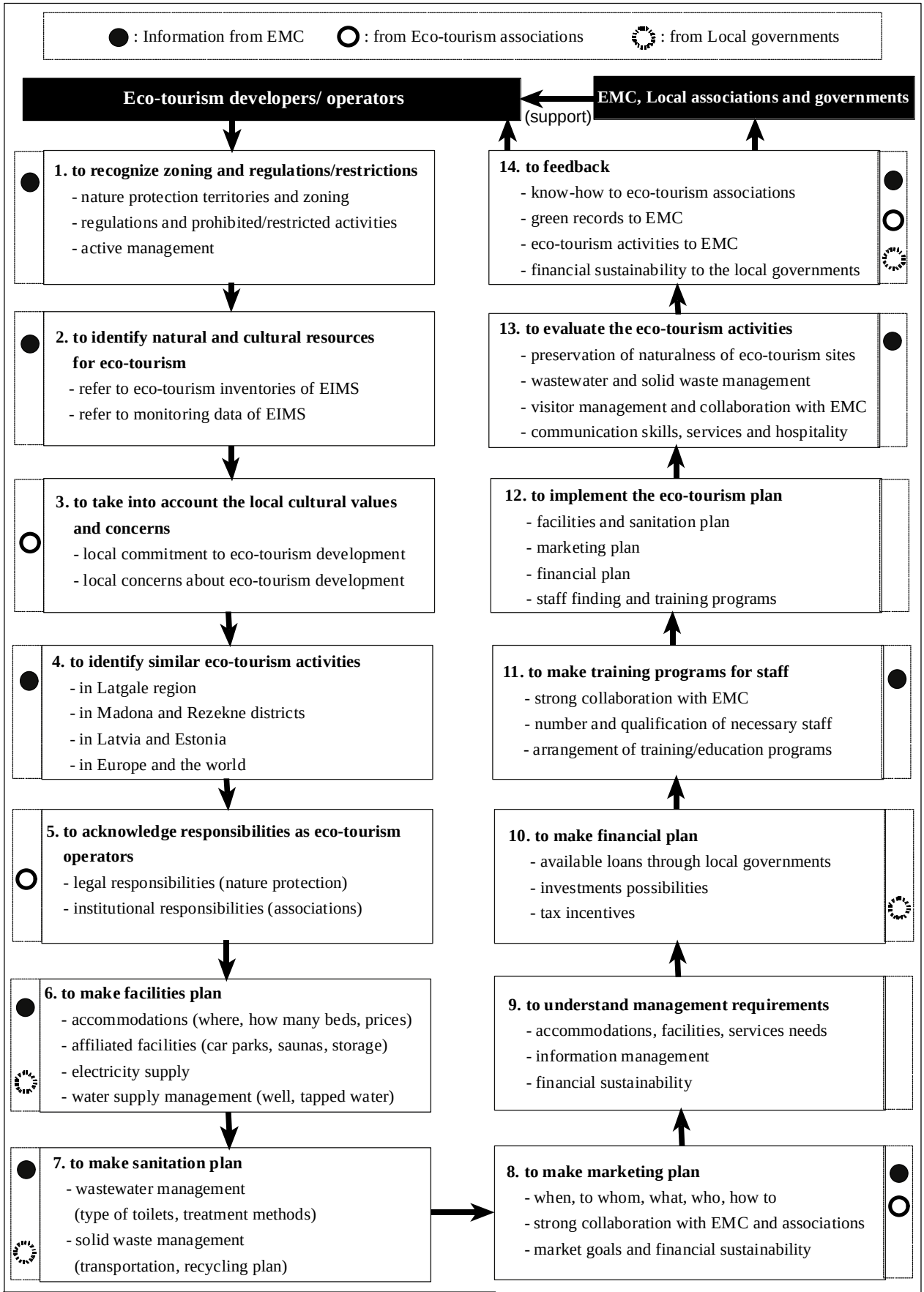

Figure 14.4.1 Eco-tourism Planning and Implementation Scheme

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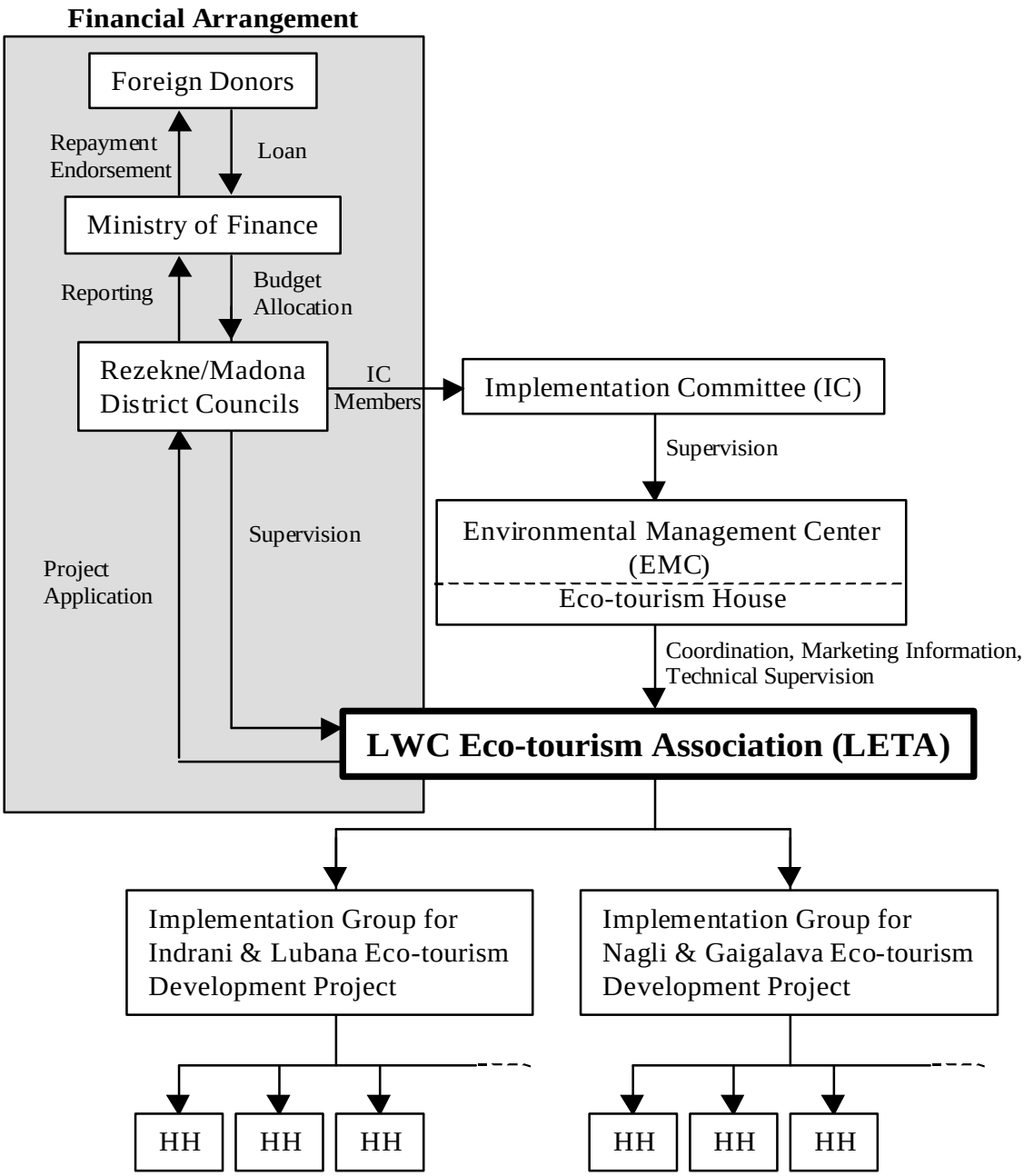

Note: HH - Local Household such as farmers, foresters, and fishermen

Figure 14.5.1 Organizational Structure and Financial Procedure for Eco-tourism Development in LWC

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CHAPTER 15

CHAPTER 15 WATER LEVEL MANAGEMENT PLAN

15.1 Hydrology and Water Level Control

15.1.1 Hydrological Data and Monitoring Conditions

Required hydrological data for water level management are discharge, water depth records of rivers, meteorological data such as snow depth, precipitation and air temperature in the river basins. A reliable hydrological analysis by a mathematical technique requires 30-year or longer observation periods. The State Hydro-Meteorological Agency has been responsible for hydrological and meteorological data. The agency collects the data at five meteorological stations, four hydrological stations and one station for evaporation data in the river basins related to the study area. The data are available from the 1940s or 1950s at the stations. For the hydrological analysis, 30-year data from 1968 to 1997 are collected and analyzed. The location map of the stations is shown in Figure 15.1.1.

Meteorological and Hydrological Stations around LWC

Meteorological Station	Location	Hydrological Station
1) Aluksne	N. 57° 26' E. 27° 02'	1) Aiviekste-Lubana 2) Pededze-Litene 3) Rezekne-Griskani 4) Lake Razna
2) Gulbene	N. 57° 08' E. 26° 44'	
3) Rezekne	N. 56° 31' E. 27° 21'	
4) Dagda	N. 56° 06' E. 27° 33'	Water Level Gauge 1) Aiviekste Sluice 2) Kalnagala Sluice
5) Zilani	N. 56° 31' E. 25° 55'	
6) Zoseni (Evaporation Data)	N. 57° 08' E. 25° 54'	

15.1.2 Hydrological Analysis

(1) Procedure for hydrological analysis

Hydrological analysis deals with a series of studies from examinations of rainfall and snowfall characters to a conversion of precipitation into river discharge in a river basin. And the analysis is executed to each river basin because of its different character. The procedure is 1) to divide area related to LWC into 7 river basins according to watersheds, 2) to estimate average rainfall in each river basin, 3) to analyze precipitation pattern and amount for each river basin, and 4) to convert precipitation amount to river discharge.

(2) River basin

There are nine major river basin in Latvia, and the study area belongs to the Daugava river system with the largest river basin. The Pededze, Balupe, Liede,

Piestina, and Ica are major rivers that flow into LWC from the northern part. Two rivers, namely the Malta and the Rezekne, flow into Lake Lubana directly and the Aiviekste originates from Lake Lubana. The Teici, Liesina, and other small rivers from southern part flow into the Aiviekste river at the outside area of LWC through the Meirani canal. The hydrology analysis considers the small river basins in the southern part with limited observation records as one river basin. The river system in LWC is shown in Figure 15.1.1.

(3) Rainfall analysis

The data recorded at the meteorological station in a river basin cannot be applied to the whole basin as it is. In case a meteorological station is far from a region in a basin, it is suitable to use the data recorded at a near station located in an outside basin for estimate of rainfall amount in a region. Therefore, a rainfall amount in a basin is calculated as an average rainfall corresponding to the commanding areas' ratio between two or more stations.

The Thiessen polygon method as a common method is applied for the estimate of average rainfall. The determined Thiessen polygon and each ratio (weight factor) to calculate the average rainfall are illustrated in Figure 15.1.2.

(4) Relation between rainfall and river discharge

The correlation between rainfall and the river discharge is low especially in summer and autumn seasons. The following table shows the correlation coefficients between average rainfall and the river discharge of each river basin. The observed data shows that a single storm rainfall event with rather big amount of around 40 mm/day does not always cause a rise of a river water level. As one of the causes, it is considered that the flat topographic condition and a lot of lakes with various sizes mitigate a runoff by a storm rainfall.

(5) Selection of a runoff analysis technique

Various kinds of runoff analysis techniques have been developed. A suitable technique for the runoff analysis, which uses the daily records, is a series tank model method. In the study area, available records for the runoff analysis are rainfall, air temperature, evaporation, river discharge and water level, which are observed on a daily basis. The series tank model prepares the hydrograph to each river and forecasts the size of spring flood caused by snowmelt.

The series tank model for each river basin in snowmelt period is developed to show the runoff characteristic. The influential factors in determining the size of the spring floods are the precipitation during winter season, the air temperature in spring, and rainfall in the snowmelt period. Among these factors, the most

influential factor is the air temperature in the snowmelt period, which affects the volume of snowmelt.

(6) Series Tank Model

In general, the river discharge consists of an amount of direct runoff from the ground surface, an amount of outflow from underground delaying a few days after a precipitation and an amount of long-term outflow from underground. The tank model method expresses an underground structure with several tanks having some holes, and simulates the mechanism of direct runoff and delay outflow.

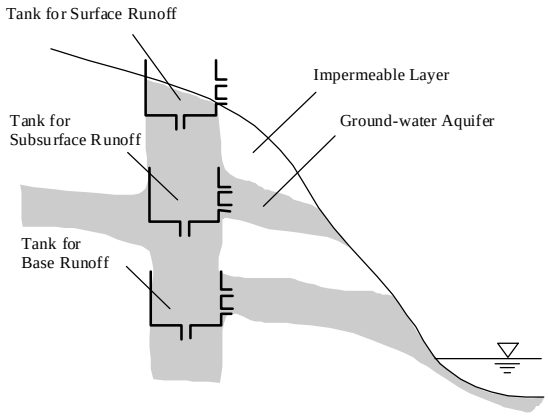


Image of Series Tank Model

As an initial model, calculation starts with two series of tanks. The observed data shows the runoff starts in three days after rainfall or snow-melting. It seems that a lot of ponds and marshes, which exist in flat geographical features, cause the time lag of the runoff. Few numbers of storage type tanks are assumed in the river channel part in order to simulate this runoff characteristic by the model. The initial model for the study area is as shown below.

Since the runoff characteristic is different in each river basin, the own model of each river basin is required basically. However, the model can be made only in the river where the gauging records for a certain period are available. In the study area, only two rivers such as the Pededze and Rezekne rivers have gauging records. Therefore, the tank model of a similar river basin is applied to the remaining river basins in consideration of similarity of the geographic condition.

(7) Snowmelt

Estimation of snowmelt is crucial for prediction of discharge in the spring flood season. In this study, an empirical equation shown below is adopted considering the meteorological elements such as average temperatures and precipitation.

$$V = m^* Ti + Ti * Pi / 80$$

Where V : daily snowmelt in depth (mm)
m : constant
Ti : average daily temperature(℃)
Pi : daily precipitation (mm)

(Reference: Technical Standard of Investigation for River Improvement and Erosion Control, Japan River Association/Ministry of Construction of Japan, 1986)

Constant ‘m’ is decided on a trial basis to match the date of actual snow disappearance to the date of that in the calculation. The constant "m" takes the value ranging from 3 to 6, which is affected by the meteorological condition (Ti) of each year. Average constant ‘m’ in each meteorological station is summarized in the following table.

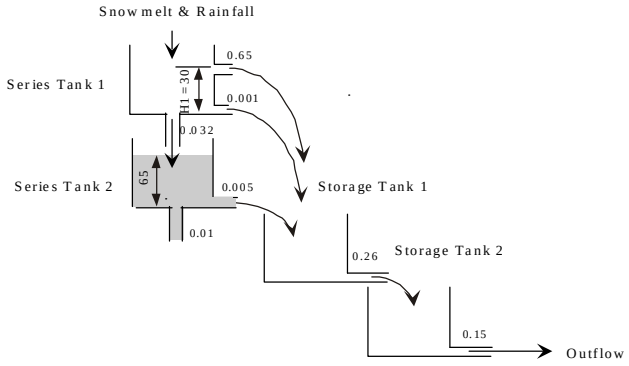
Average Constant “m”

Meteorological Stataion	Estimated Average constant ' m '
Aluksne	4.5
Gulbene	4
Rezekne	4.5
Dagda	5
Zilani	5

(8) Serial tank model for the northern wetland

The discharge data is available in the Pededze river in the northern wetland. The tank model of the Pededze river is applied to all the rivers in the northern wetland.

The rivers in this region show different runoff characteristics every year with a fluctuation of runoff volume, in addition to a seasonal fluctuation of runoff ratio. That is, the year with a lot of river discharge has a tendency of a high runoff ratio and the year with little river discharge has a tendency of a low runoff ratio. Since the analysis of flood water level is important in this study, the model is formed by using meteorological and hydrologic data of three years from 1985 to 1987, which shows relatively high runoff ratio. The coefficients of the model are decided by the trial and error method with repeated calculation as shown below.

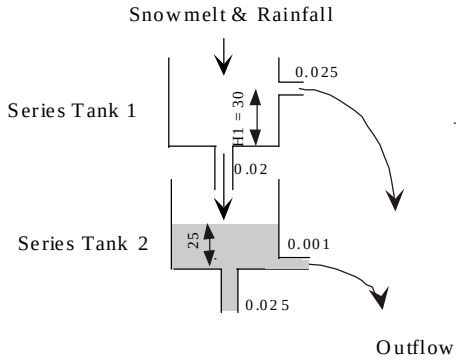


Tank Model for Northern Wetland

(9) Serial tank model for Lake Lubana and southern wetland

The gauging records are not available from the rivers in the southern wetland except the Rezekne river. Therefore, the southern model is simulated by using the data of the Rezekne river of the same observation period of three years from 1985 to 1987 as the northern model. This model is applied to the runoff forecasting of the Teici and the Malta rivers. However, applying the model to the rivers without a lake may result in an inaccurate forecasting of the runoff.

Since Lake Razna is located in the upper reaches of the Rezekne river, the runoff of the river is delayed by the discharge adjustment function of the lake. Applying the model of the Rezekne river to the Teici and Malta rivers basins without a lake may result in an inaccurate forecasting of the runoff in spring season. The coefficients of the southern model are as shown below.



Tank Model for Lake Lubana and Southern Wetland

15.1.3 Groundwater Level

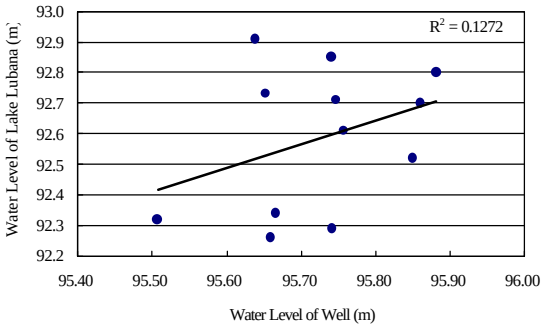
There is no station for groundwater level monitoring in and around the study area. A few farmers had observed the groundwater level privately near the lake before constructing the dyke system in the northern part of Lake Lubana, but the records were lost. Therefore, a groundwater level was measured using a measuring device of electronic self-recording type from November 11, 1999 to May 24, 2000, in order to examine the influence of water level change in Lake Lubana on the surrounding areas.

One existing well in a farmland near the western lakefront was selected for the measurement. The well had advantages of easy installation of the measuring device without digging a new measuring hole, of existence of a person who can watch for the device, and no direct influence by spring flood. It was expected that water level in the lake in spring flood season influences ground water level because of the adjacent location to the lake, and the spring flood, which disturbs the measurement, does not flow into the area. Figure 15.1.3 shows the location of the well.

The influence of the water level change is examined by making a comparison between the water level records of groundwater and the lake. The following table shows the 10-day average of groundwater and the lake water levels, and the following figure presents the correlation between two water levels.

Water Level Record of Every 10 Days' Average

	Well	Lake
Jan.1	95.66	92.26
Jan.2	95.74	92.29
Jan.3	95.51	92.32
Feb.1	95.67	92.34
Feb.2	95.85	92.52
Feb.3	95.76	92.61
Mar.1	95.65	92.73
Mar.2	95.88	92.80
Mar.3	95.86	92.70
Apr.1	95.75	92.71
Apr.2	95.74	92.85
Apr.3	95.64	92.91



Correlation between Water Levels of Well and Lake Lubana

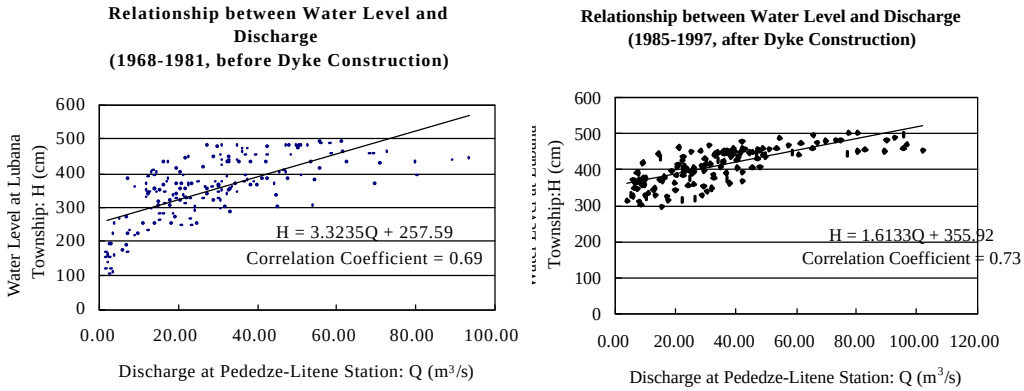
As shown in this figure, it is concluded that there is no relation between the lake water level and the groundwater level. A possible reason of no relation is that the drainage canal, which lies between the lake and farmland, collects infiltration water from the lake and consequently the lake water level does not influence the groundwater level. However, maximum water level of the lake in spring of year 2000 is low of 92.7m of which level is equivalent to probability of once 10 year. So it cannot be denied that this low water level bring the result of no relation.

15.1.4 Effectiveness Verification of Dyke System against Flooding

Before the flood analysis with the selected flooding scales, effectiveness of the existing dyke system surrounding Lake Lubana, especially for the northern dyke system, is examined herewith considering relationship between the water level at Aiviekste-Lubana (Lubana town) and the inflow volume to the northern wetland. The flood water level at Lubana town after the dyke construction has been assumed to be decreased because the dyke is effective on the flood mitigation. For the verification of the assumption, the next data are studied:

- Flood discharge data : Pededze-Litene station
- Water level data : Aiviekste-Lubana

Data in the period of 1982-1983 is excluded to avoid the influence by the dyke construction works. The time lag until the water at Pededze-Litene influences the water level at Aiviekste-Lubana is considered. The correlation between discharge and water level is examined and illustrated in the following figures. The correlation coefficient between two data in each case is about 0.7.



The following table calculates the water level corresponding to each discharge with certain probability by using the above-mentioned equations. As shown in the table, water level that corresponds to a certain discharge decreased by 4 to 158 cm after the dyke construction. Figures 15.1.4 and 15.1.5 are the simulation results in flood scale of once per 100-year with and without the northern dyke, respectively. They show that Lubana town and some agricultural lands are severely damaged by flooding without the northern dyke. The northern dyke system surely contributes to the flood mitigation. The proposed Water Level Management Plan therefore regards the existing dyke system as an essential condition.

Water level to Each Discharge with Statistical Probability under Before and After Dyke Construction Conditions

Item	Equation	Probable Discharge : Pededze-Litene				
		Once2-year	Once 5-year	Once 10-year	Once 50-year	Once 100-year
		60 m^3/s	86 m^3/s	103 m^3/s	140 m^3/s	150 m^3/se
Before Construction	H =3.3xQ +257.6	456 cm	541 cm	598 cm	720 cm	756 cm
After Construction	H=1.6xQ +355.9	452 cm	493 cm	521 cm	580 cm	598 cm
Effect on flood mitigation by dyke		4 cm	48 cm	77 cm	140 cm	158 cm

15.1.5 Flood Analysis and Flood Damages

(1) Spring flood

A spring flood event usually starts in April and continues for several weeks unlike a flood by a storm. For the environmental conservation in LWC, the hydrological study for a prediction of the duration and the inundated water depth caused by a spring flood is more important than the peak flood analysis. The flood situation is greatly mitigated in LWC after construction of the flood prevention facilities done from the 1950s to the beginning of the 1980s. Therefore, it is necessary to analyze flood scale in LWC based on the river discharge and water level records collected around LWC after 1983.

The flood scale in Lake Lubana is examined based on the discharge records observed at the station in the Rezekne river from 1983 to 1995, and it can be

decided based on the maximum discharge of the inflow rivers, the maximum water level of Lake Lubana, and the total river discharge during flood rising period. However, these values are not necessarily corresponding with each other, because a flood continues for several weeks, and the water levels in the lake can be managed during the flood period.

Inflow from the upstream rivers affects the flood situation in the northern LWC. Although drainage water from Lake Lubana flows into the LWC, the discharge does not affect the flood situation. Since the gates in Lake Lubana are closed to prevent reverse flow from the northern LWC, in case the water level in the northern LWC is higher than the lake water level. The scale can be estimated from the discharge records at the station in Lubana town located at the exit point of flood and the water level records at the Aiviekste source.

(2) Floods in Summer and Autumn

It is said that the flood damages sometimes occur in summer or autumn. In 1998, the flood damage was also reported in the summer. However, there are no recorded flood damage data such as inundated area. As long as the river discharge data showed, the high water levels like the spring flood did not occur. There is a possibility that summer and autumn floods occur by different mechanism from spring floods. On the other hand, the 5-day rainfall event in the summer of 1998 was an occurrence level of once per 10-year. The inundated area by the flood is limited to lowlands in agricultural lands.

There was a possibility that rain caused a regional water logging problem. Consequently, summer-autumn flood is a problem of poor drainage facilities rather than a flood problem.

Statistical Analysis of 5-day Rainfall Events

Probability	Rezekne (1998=69.8mm)	
	Log Piason III	Gumbel
1/50	82.9mm	87.4mm
1/25	77.1mm	78.2mm
1/20	75.2mm	75.3mm
1/10	69.1mm	71.1mm
1/5	22.9mm	63.7mm
1/2	52.5mm	52.6mm

Source: Rainfall data from 1968 to 1998, State Meteo-Hydrological Agency

15.1.6 Historical Review of Water Level Control Methods and Facilities

Many efforts against flood problems in LWC started in the 19th century. However, it was necessary to wait for the comprehensive flood control measures until the 1950s. Figure 15.1.6 shows the estimated inundation area to the maximum extent before the construction of the hydraulic facilities. In the middle of the 1950s, a comprehensive flood protection plan was formulated in order to protect the lands from inundation and to reduce the inundation periods by setting

up the following four principles. In line with these principles, the construction works started in the middle of the 1950s.

a) Flood flows should be dispersed and diverted directly to the Aiviekste river not to concentrate into Lake Lubana,

b) Flood protection plan divides into two areas, the area which should be completely protected from floods, and the area where inundated period be shortened,

c) Construction works should be executed by stage wise , and

d) Immediately after completion of the construction work, land reclamation works should be commenced.

1) First Stage in the 1950s:

The 25 km-length Meirani canal with dykes and sluices was constructed. After the construction of the canal, flood flows from the small rivers in the southern area were diverted directly into the Aiviekste river through the Meirani canal.

2) Second Stage in the 1960s:

During this stage, the 15 km-length Zvidzinenas canal with dykes was constructed in the western part of Lake Lubana to protect agricultural lands of 9,800 ha.

3) Third Stage from 1965 to 1967:

In this stage, the 21 km-length Idenu canal with sluices, the southeastern protection dyke system, the Malta-Rezekne canal, and the riverbanks along the Rezekne and the Malta rivers were constructed. These systems were designed to protect the area of 8,100 ha.

4) Fourth Stage in the 1980s:

In the 1980s, the dyke system on the northern edge of Lake Lubana and the sluice way were constructed to control water levels in the Lake. In addition, dredging of the Pededze lower reaches of 9.7 km in length was executed. After construction of the dyke system, the inundation duration in the northern part of the wetland decreased. Main features of these facilities and Lake Lubana are tabulated in Table 15.1.1. and the locations are shown in Figure 15.1.7.

15.1.7 Current Water Level Control and Constraints

(1) Water level control of Lake Lubana

The Aiviekste Land Reclamation System Administration (ALRSA) is responsible for operation and maintenance of water level control facilities in the study area except a sluice way near Nagli village. The Nagli state fish firm operates the Nagli sluice. ALRSA with 63 staffs maintains the drainage facilities in Madona

district including LWC. The commanding area reaches 86,000 ha in total. ALRSA operates the two sluice ways in the dykes of Lake Lubana according to the gate operation rules. The organization chart of the gate operation is illustrated in Figure 15.1.8.

(2) Operation rules for Lake Lubana

The first operation rule was prepared and officially approved in 1983. In 1989, the Institute of Biology evaluated influence of the reclamation activities on the ecology system in the Lubana wetland. As a result of the evaluation, need to revise the first operation rule was recognized.

In 1992, ALRSA started review work and concluded with the "Lake Lubana Hydro-technical Building Operation Rule, Revised". In the course of the revision work, ALRSA found that operation of sluices could not solve all the management problems in Lubana wetland. ALRSA also pointed out the necessities of an administrative unit and of environmental protection and management programs for the Lubana wetland complex. The revised operation rule was approved and the operation activities based on this rule have been continued since August 1993.

Existing Operation Rules

Season	Target of operation	Operation rules
Aug.20–Oct.19	Reduction of water level of the Lake to 91.75m, for the purpose of making storage capacity for spring flood	Aiviekste Sluice: Open until water level becomes 91.75m Kalnagala Sluice: Open in case water level exceeds 92.00m
Oct.20 – Beginning of Spring Flood	Keeping of water level of 91.75m in normal condition or 91.2m in case of extreme flood condition	Aiviekste Sluice: Open until water level becomes 91.75m or 91.2m Kalnagala Sluice: Open in case water level exceeds 91.75m or 91.2m
Spring flood	Evacuation of a flood in the northern part	Aiviekste Sluice: Close Kalnagala Sluice: Close
Extreme flood	Prevention of dyke breaking	Aiviekste Sluice: Open Kalnagala Sluice: Open In case of outside water level is lower than that of the Lake.
End of Spring flood	Keeping water level not to exceed the level of 93.0m	Aiviekste Sluice: Open Kalnagala Sluice: Close, in case of 92.0m (Lake Level)
May – August	Keeping constant water level	Aiviekste Sluice: Open to preserve water level in the Aiviekste river Kalnagala Sluice: Close in case of lower than 91.20m (Aiviekste river)

According to the rule, water level at the beginning of the spring flood is to be kept at the level of 91.20m when the extreme flood with total volume of 2×10^8 m^3 or more is forecasted. For this operation, the hydro-meteorological agency is scheduled to warn ALRSA about the possible flood with the forecasting period from February 1 to the end of spring floods.

In addition, there is a regulation about special discharge for the northern wetland in the low water period. When the water level in the northern wetland becomes

less than 91.20m, the clause 3.3.2 of the rule guarantees the water amount of 1.5m^3/s for conservation of eco-system in the wetland.

(3) Operation rule of intake structure on the Malta river

The intake structure on the Malta river at Nagli was constructed in 1963, and the current operation rule titled "Exploitation rule of water-reservoir on the Malta river" has been applied since 1989. The intake structure consists of a weir with two water level controlling gates, intake gates, dykes on the Malta riversides, and a cross drain structure under the riverbed of the Malta river which was constructed for the drainage of the Rezekne river. The Reservoir exploitation service is the responsible organization of which the staffs are the technical staffs of the Nagli fish farm. The rule stipulates the operations for both normal and emergency cases.

Operation rules under normal condition are:

- to fill fishponds with water volume of 12m^3/s in the spring from April to May,
- to supply supplemental water to fishponds with volume of 1.55m^3/s in summer from June to August,
- to supply maintenance water to fishponds with volume of 0.55m^3/s in winter from September to March,
- to keep water level at 95.5m or more at the upstream reservoir of the weir for water supply to fishponds,
- to keep water level at 97.0m by closing gates in the low water period when river discharge is less than 5.0 m^3/s,
- to keep water level at less than 97.2m by opening gates,
- to open gates to discharge excessive water when the river discharge exceeds more than 50 m^3/s, and
- to discharge water volume of 1.1 m^3/s for controlling water quality at the minimum water level period.

Operation rules under emergency condition are:

- to open gates fully in case the river discharge exceeds more than 100 m^3/s, and
- to take necessary action which includes destruction of the gates in case main gates are out of order.

(4) Actual management in Lake Lubana

The water levels of Lake Lubana and the opening heights at both sites of both the Aiviekste and Kalnagala gates have been recorded since 1983. According to the records, ALRSA operates the gates according to the operation rule revised in 1993.

However, the water levels in winter season have been kept rather higher levels ranging from 91.7m to 92.2m as shown in Figure 15.1.9. These higher water

levels than the rules' levels have been kept to reply to strong demands from fishermen in the lake. Although the high water levels have never created flood problem since 1983, it can be a risky operation from the viewpoint of safe dyke management. Figure 15.1.10 shows a relation between the storage volume and the water levels. The free storage volume of the lake at the water level of 91.7m is 84,700,000 m^3, and that of 92.2m is 123,300,000 m^3. The difference between two volumes is 38,600,000 m^3. Since it takes 3 days for flood to reach at the lake on an average after forecasting of extreme spring flood it takes, around 10 days to drain out the above-mentioned volume of 38,600,000 m^3 through the Aiviekste sluice gate in the spring flood season. Therefore, the following conditions are essential for the timely and proper operation.

a) Warning of big scale flood should be informed to ALRSA as early as possible before the flood reaches the lake.

b) Necessary volume for discharge from the lake is approximately 148m^3/s, and it should be drain out to receive an extreme scale of flood. Since the discharge volume through gates depends on the openings of gates and the difference of water levels between the lake and the downstream channel, it is necessary to open gates fully and at the sane time, it requires an enough difference of water levels between the lake and outside channels.

c) Operation requires a smooth working gate system for quick response to the big scale flood forecasting not to waste time for making storage volume of flood.

(5) Actual operation of the gate on the Malta river

The actual operation can not be clarified because the exploitation service of the Nagli fish farm has not recorded the water levels. According to the inquiry survey to the responsible person of the farm, the service properly operates the gates based on the operation rule.

(6) Constraints on water level control

1) Deterioration and breakdown of water level control facilities

The Aiviekste sluice is constructed in 1981 in order to control outflow from Lake Lubana. This sluice structure with three fixed wheel type gates needs frequent repair because of its inadequate structural design, insufficient quality of guide frame materials, irregular bottom elevation of a culvert portion, and scouring of the downstream apron.

The Meirani sluice has a hinged type gate installed in the 1950s. Although the gate can still work, the gate leaf changes its shapes and the concrete structures such as an operation deck, side walls and transition walls are seriously deteriorated.

2) High water level in the Aiviekste river in spring

The water level of the Aiviekste river rises above the water level of the lake for a certain period. Therefore, drain from the Lake is obstructed, which invites the rise of the water level of the Lake.

3) Requests from fishery sector

Although the operation rules stipulate the water level in winter season, the operation records show that the water levels were not decreased below 91.75 m to meet the request from fishermen. Such a high water level of more than 92.00 m may cause dyke breakdown by an expected extreme flood.

4) Poor data information system for water level control

To predict a spring flood scale, meteorological data is needed. However, the required data cannot be collected appropriately, because of a delay in preparation of digitized data and poor communication between the organizations concerned.

15.2 Water Level Simulation Model

15.2.1 Structure of the Model

(1) River and drainage system for water level simulation

The river and drainage system in LWC is divided into three subsystems from the viewpoint of water level simulation, namely the northern wetland system, the Lake Lubana system and the southwestern wetland system (see Figure 15.2.1).

1) Northern Wetland System:

The Pededze, Balupe, Ica, Liede and Piestina rivers flow into the Aiviekste river in the north part of the study area. In spring, a flood event occurs by rapidly increasing snowmelt flows from northern and eastern highland areas, and this north part wetland is inundated because of the insufficient flow capacity of the Aiviekste rive to excessive flood flows. For a certain period in spring, the inundated water level exceeds the upstream water level in Lake Lubana. This reverse water level creates a problem of gate operation at the Aiviekste sluice.

2) Lake Lubana System:

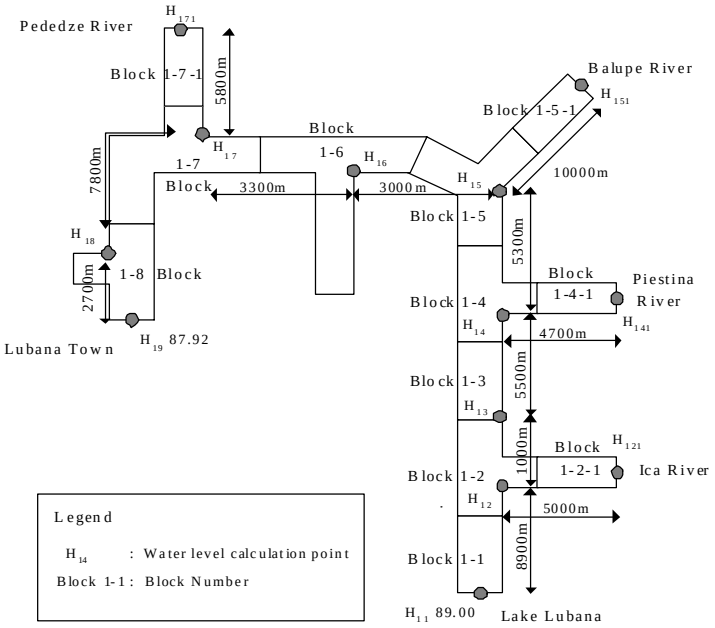
The Rezekne and Malta rivers flow into Lake Lubana. Dykes except the eastern part of two water level control facilities surround the Lake. The eastern part of the Lake with natural high bank plays a role of spillway. Taking these actual conditions into account, it can be said that the Lake acts as an artificial shallow reservoir.

3) Southwest Wetland System:

Before constructing the dyke in the southern part, the Lisina, Teici, Malmuta, and Sulka rivers flowed into Lake Lubana. After construction of the Meirani diversion canal as a flood protection facility, flows from these small rivers are diverted directly to the Aiviekste river through the diversion canal.

(2) Northern wetland system model

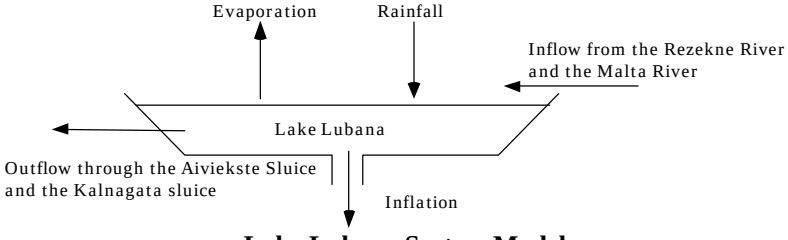
The model for the inundation analysis is made for the section from the Aiviekste river source to Lubana town on the Aiviekste riverbank. In this model, the study area is divided into 12 blocks. The water level for a certain discharge in one block is calculated using the uniform flow or non-uniform flow formulas in order to correspond to the water levels in upstream and downstream blocks. The schematic drawing which shows the relations among blocks is as shown below.



Schematic Diagram of Blocks in the Northern Wetland

(3) Lake Lubana system model

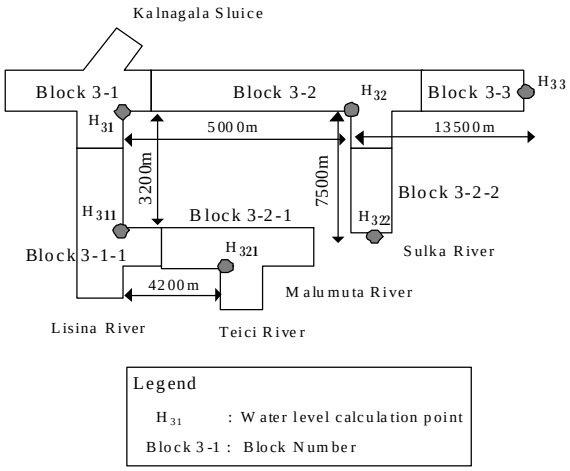
The water level of Lake Lubana is obtained through the daily water balance calculation among the inflow from the Rezekne and the Malta rivers, rainfall on the lake, outflows from two sluice structures, amount of evaporation from the lake surface, and infiltration from the bottom of the lake.



Lake Lubana System Model

(4) Southern wetland system model

The basic model of the southern wetland is the same model as the northern wetland. The Meirani canal, which is the major stream in this wetland, is divided into 6 blocks setting up mathematical equations in each block.



Schematic Diagram of Blocks in the Southern Wetland

15.2.2 Methodology and Verification

(1) Northern and southern wetland system model

The following mathematical model is made to analyze the phenomenon of inundation in each block and to express the reverse flow between the upstream and downstream blocks. Basic formulas for the model are as shown below.

The difference of discharges in the "i" block and the next "j" block is equal to the storage volume change in the "j" block.

$$\frac{dV_j}{dt} = Q_i - Q_j \qquad \text{..... (1)}$$

Where dV_j : change of storage volume in the block “j”
dt : unit time
Q_i, Q_j : discharge from the blocks “i” and “j”

Or, the storage volume change in a block “j” from a certain time “n” to a certain time “n+1” is shown by the following expression.

$$\frac{W_j^{n+1} + W_j^{n}}{2} \times \frac{H_j^{n+1} - H_j^{n}}{\Delta t} = \frac{(Q_i^{n+1} + Q_i^{n}) - (Q_j^{n+1} + Q_j^{n})}{2} \qquad \text{..... (2) or,}$$

$$Q_j^{n+1} = -\frac{W_j^{n+1} + W_j^{n}}{\Delta t} H_j^{n+1} + \frac{W_j^{n+1} + W_j^{n}}{\Delta t} H_j^{n} + (Q_i^{n} - Q_j^{n}) + Q_i^{n+1} \qquad \text{..... (3)}$$

Where W_j : water area of the block “j”
H_j : depth of water in the block “j”
Q_i, Q_j : discharge from the blocks “i” and “j”
Δt : unit time
n, n+1 : unit time number

On the other hand, the discharge from "j" block to the next block can be calculated by the following equation, which are based on "Flood Analysis by the Lowland Tank Model Method" (Hayashi & Kadoya, Vol.49, Journal of the Japanese Society of Irrigation, Drainage & Reclamation Engineering, 1981).

In case of non-uniform flow condition;

$$Q_j = \frac{A_j R_j^{2/3}}{N_j \sqrt{X_j}} \times \frac{H_j - H_k}{\sqrt{|H_j - H_k|}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (4)$$

$$= G_j \frac{F_j}{\sqrt{|F_j|}} \ , \quad G_j = \frac{A_j R_j^{2/3}}{N_j}, F_j = \frac{H_j - H_k}{X_j} \quad \cdots\cdots\cdots\cdots\cdots \quad (5)$$

where Aj : flow area of block "j"
Rj : hydraulic mean depth of block "j"
Nj : Manning's roughness coefficient of block "j"
Xj : distance between block "j" and next block "k"
Hj : water level of block "j"
Hk : water level of block "k"
Gj : function "Gj" of flow area "Aj" or water depth "hj"
Fj : hydraulic gradient

In case of uniform flow condition;

$$Q_j = \frac{A_j R_j^{2/3}}{N_j \sqrt{X_j}} \sqrt{s_j} = G_j \sqrt{s_j} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (6)$$

where Aj : flow area of block "j"
Rj : hydraulic mean depth of block "j"
Nj : Manning's roughness coefficient of block "j"
sj : river bed slope of block "j"

The uniform flow equation is applied when *sj* is more than *Fj*, while the non-uniform flow equation is used when *Fj* equals *sj* or more.

The hydrological materials to be used for the modeling are the water level records observed at the source of the Aiviekste river since 1983 and the water level and discharge recorded at Lubana town for the last 30 years. The calculation results of series tank models are used as flood discharge from each river, which flows into the Aiviekste river in spring. When a flood water level exceeds the river bank elevation, a storage section is considered in addition to flow area section.

(2) Lake Lubana model

The water level of Lake Lubana is obtained through the daily water balance calculation using the following basic equation.

$$V = I + P - (Q_1 + Q_2) - E - F \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (7)$$

where V : storage volume (m^3)

I	:	inflow (m³/s)
P	:	precipitation (mm/day)
Q	:	outflow (m³/s) $Q = Q_1 + Q_2$
E	:	evaporation (mm/day)
F	:	infiltration (mm/day)

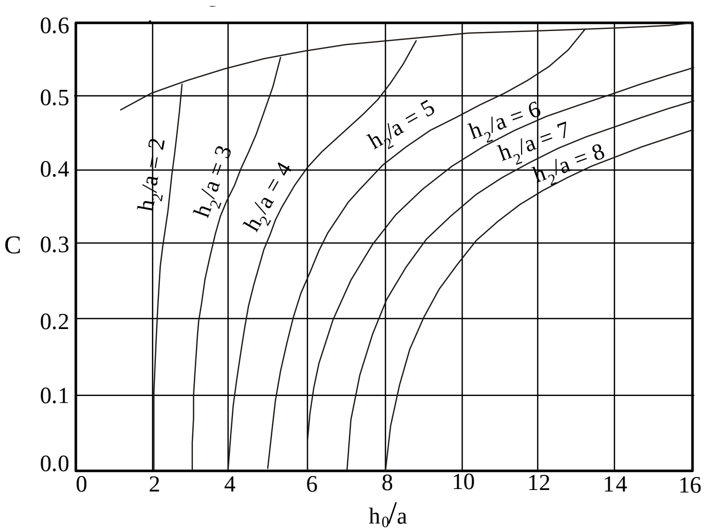
The inflow is a total amount of the daily discharge from the Rezekne and the Malta rivers. The outflow from the Aiviekste sluice is calculated by the following equation which utilize the operation record of the gate, the water level of the lake, and the water level of the drainage river.

$$Q_1 = C * B * h\sqrt{2gH} \quad \ldots\ldots\ldots\ldots\ldots \quad (8)$$

where

Q_1	:	outflow (m^3/s)
C	:	flow coefficient
B	:	width of gate (m)
h	:	opening height of gate (m)
g	:	gravity acceleration (9.8)
H	:	upstream water depth (m)

The flow coefficient "C" of the Aiviekste gate depends on the unfixed upstream and downstream water levels of the gate. The following figure shows the different coefficient "C" under the free or submerged outflow conditions.

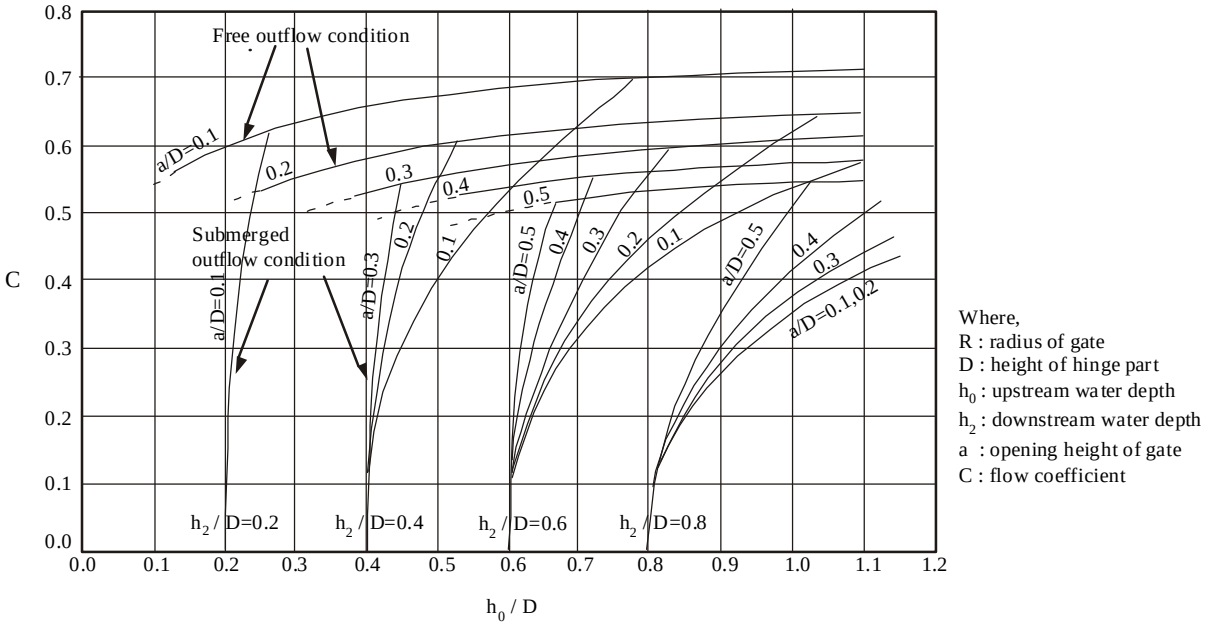


where,
h_0 : Upstream water depth
h_2 : downstream water depth
a : opening height of gate
C : flow coefficient

Source H.R. Henry, Discussion of "Diffusion of Submerged Jets", Trans. ASCE, Vol. 115, 1950

Flow Coefficient of Sluice Gate

The outflow from the Kalnagala sluice is calculated by the similar equation. Although the coefficient "C" shown below is not perfectly match to the Kalnagala gate, the flow coefficient of the gate is assumed to be 0.5 referring to this figure.



Source: D.E. Metzler, A Model Study of Tainter Gate Operations, M.S. Thesis, State Univ. of Iowa, 1948

Flow Coefficient of Hinge TypeGate (R/D=1.5)

The amount of the rainfall is that of the Rezekne station. When the existing data is not suitable for applying to the calculation, the daily rainfall pattern and amount is estimated based on the rainfall data in 1968, which correspond to the maximum rainfall year in last 10 years.

The amount of evaporation from the lake surface is the mean value of the daily evaporation recorded at the Zoseni meteorological station for the last 30 years. The following table shows the mean value of the evaporation.

Mean Value of the Evaporation

(Unit: mm)

	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.
Fine Day	1.5	2.3	2.7	2.5	2.1	1.3	0.7	0.2
Rainy Day	0.7	1.2	1.3	1.2	1.0	0.6	0.3	0.1

This water balance study considers no evaporation during winter period from the middle of November to the middle of March. If a day receives rainfall of 5mm or more, the amount of evaporation will be deducted to 50% of daily amount. The amount of the infiltration is obtained through the daily water balance calculation.

Infiltration rate is estimated at 1.5mm/day on an average by the following equation on a daily basis.

$$F=V-(I+P-(Q_1+Q_2)-E)$$

(3) Verification

The accuracy of the model is examined by the comparison of difference between the observed and calculated discharges or water levels. The correlation coefficient

"J_0" is suitable for evaluation of relative correlation between the observed and estimated discharges. The "J_1" value of the relative standard and the "J_2" value of the χ^2 standard are evaluated to examine the agreement between observed and calculated discharges. The "J_0" ,"J_1" and "J_2" values are obtained from the following equations.

$$J_0 = \frac{N\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{\left\{N\sum x_i^2 - \left(\sum x_i\right)^2\right\} - \left\{N\sum y_i^2 - \left(\sum y_i\right)^2\right\}}} \quad \cdots\cdots\cdots\cdots\cdots (9)$$

$$J_1 = \frac{1}{N}\sum_{i=1}^{N}\frac{\left|Q_{0i} - Q_{ci}\right|}{Q_{0i}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (10)$$

$$J_2 = \frac{1}{N}\sum_{i=1}^{N}\frac{(Q_{0i} - Q_{ci})^2}{Q_{0i}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (11)$$

It is commonly known that the "J_1" value is rather suitable for evaluation of the similarity of peak discharge and the "J_2" value is suitable for evaluation of the similarity of entire hydrograph. As a result of the verification of the models, it can be said that there are enough accuracy since the "J" values of the models prepared in this study exceeds the value of the standard.

Standard Value of "J"

	$J_0 = 0.7$	$J_1 <= 0.25$	J_2
Tank Model			
Northern Wetland Model	0.8 - 0.9	0.12 - 0.26	0.12 - 3.0
Lubana and Southern Wetland Model	0.8 - 0.9	0.13 - 0.26	0.12 - 1.5
Water Level Simulation Models			
Northern Wetland Model	0.8 - 0.9	0.25	1.5
Lake Lubana Model	0.8 - 0.9	0.15	1.0
Southern Wetland Model	0.8 - 0.9	0.25	1.5

15.2.3 Flood Scale and Water Level in Each Block

(1) Flood scale and inundated area

The competitive water level problems between flood water level and Biotope are examined through comparison studies between each Biotope category and inundation situations with flood scale of 1/2, 1/5 and 1/10.

Scales of spring flood fluctuate every year, and their peak flows usually occur in April, but they occur earlier than usual in February in some year. Flood scale and its occurrence time are different between northern and southern wetlands. Hydrographs, which show the change in water levels according to the passage of time, are also different in each year. It is difficult to estimate a hydrograph with a certain probability. Then, the flood water levels in each probability are

determined by selecting reference years, which have almost the same peak discharge as the calculated one through the probability process, for the northern and southern wetlands from existing hydrological data. The reference year is a year, which has almost the same peak discharge as the calculated one through the probability process. The following table summarizes the selected reference years.

Reference Years for Study

Probability	Northern Wetland	Southern Wetland and Lake Lubana
Once per 2years	1987	1987
Once per 5years	1983	1986
Once per 10years	1994	1994

Inundated areas are illustrated on the maps for each flood scale based on the data of the reference year as shown in Figure 15.2.2 to 15.2.4.

(2) Study block for the water level analysis

The study area is divided into 21 blocks (including Lake Lubana as a block) with the same geographical and hydraulic character to evaluate the influence of the flood water level on the ecosystem and the production sectors. The water level at each block is calculated using the water level simulation model. Figure 15.1.9 illustrates the location map of study blocks.

(3) Water Level in each block

The flood water level in each block is estimated by the flood scale of once in two years, once in ten years, and the maximum flood scale by which flood damage is not caused in the study area. The flood scale of once in two years corresponds to the normal flood scale, and that of once in ten years corresponds to the scale which is commonly used for the agricultural development plan. The study period of the northern and southern blocks is three months from March to the end of May when the flood usually occurs. In Lake Lubana block, the water level is calculated for nine months from March to November, when the simulation of the water level is needed for the fishery sector. The maximum water level of each flood scale in each block is tabulated as follows.

Estimated Flood Water Level

(Unit: m)

Block		Probability		
		50%	10%	Max
Northern Wetland				
Block	1-1	93.3	93.8	94.9
	1-2	93.1	93.6	94.8
	1-2-1	93.2	93.7	94.8
	1-3	93.0	93.6	94.7
	1-4	92.9	93.5	94.6
	1-4-1	93.0	93.5	94.6
	1-5	92.8	93.3	94.4
	1-5-1	93.0	93.5	94.5
	1-6	92.7	93.3	94.4
	1-7	92.7	93.2	94.3
	1-7-1	92.7	93.2	94.3
	1-8	92.5	93.0	94.1
Lubana Lake				
Block	Lake	93.7	94.7	95.5
	2-1	93.7	94.7	95.5
	2-2	93.7	94.7	95.5
Southern Wetland				
Block	3-1	92.7	93.1	93.4
	3-1-1	93.0	93.4	93.7
	3-2	92.7	93.1	93.4
	3-2-1	93.0	93.4	93.7
	3-2-2	93.0	93.4	93.7
	3-3	92.7	93.1	93.4

15.2.4 Effectiveness of Current Water Level Control Facilities

Current water level control facilities are only two sluices in Lake Lubana. In the northern part and southern part wetlands, there is no water level control facility. The water level control facilities lower the water level of the lake by the operation rule. The amount of the decrease of the water level a day is limited to 2cm or less from the viewpoint of the safety management of the dyke system according to the operation rule. It corresponds to 1,670,000m^3 (or 19.3m^3/s in the maximum) when the water level is converted into the amount of storage volume of the lake. Even existing sluice facilities have enough capacity of more than 30 m^3/s to drain excessive amount of storage volume. However, it is necessary to rehabilitate or replace the facilities because of their deterioration.

15.2.5 Display of Calculation Result

The calculation result using the hydrological model and water level simulation model will be used in various fields such as the flood protection and the conservation of ecosystem. Therefore, the result should be presented in such a way that all the people with various technological backgrounds could understand them easily. For easy understanding, this study proposes a visual display system of the calculation result. The display system prepares the homepage with the contents of 2 dimensional (2D) maps and a 3 dimensional (3D) movie. User can access various information from the homepage. The content of information is composed of the inundation area map of 2D and the flood water depth map of 2D and the inundation area movie of 3D. These contents which correspond to the model calculation result are linked with the homepage. And these contents are

selected and displayed from among corresponding maps and movies to each flood scale prepared beforehand.

Homepage

It is necessary to prepare the homepage for the future use in the Internet. The sample homepage is prepared for the use of the Internet. All users can accesses various information from this page.

Inundation Area Map of 2D

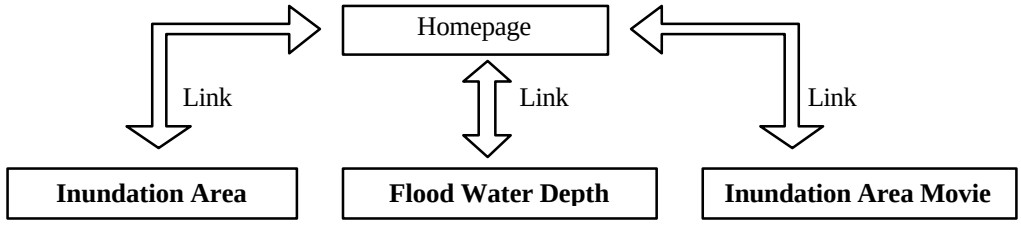
This is an image map in which the inundation area is drawn on the satellite image.

Flood Water Depth Map of 2D

This is a map with 200m x 200m meshes that display the inundated water depth at intervals of 50cm.

Inundation Area Movie of 3D

This movie displays the image which sees "the inundation area map of 2D" from the airplane. The user on an airplane starts the flight toward the northeast from the southeast edge of the Lubana wetland complex study area. The airplane turns the direction from the northeast to west when the airplane reaches the north end. After turning the direction at the north end, the airplane again changes the direction to the south on the edge of the west, and continues the flight toward the south edge of Lake Lubana.



The above-mentioned example of display is as shown in Figure 15.2.6.

15.3 Water Level Management Plan

15.3.1 Approach and Strategy

The principal purposes of the water level management plan are to sustain the current ecosystem, to maintain suitable water level for the activities of agriculture, fishery, and forestry, and to protect towns and villages against floods.

It is preferable not to change an existing water level for the existing ecosystem. Especially, the influence on the fish and birds should be avoided in and around Lake Lubana. However, the water level management for existing industries such as agriculture, fishery, and forestry is vital to activate the production activities. In

addition, the altitude of the Lubana town of around 94.5m is so low that control of flood water level is necessary to prevent any flood damage.

First of all, it is necessary to identify the problem between the water levels in competitive relation. For the identification of the problem, comparative study of water levels in each block is conducted. As the second, a competitive water level problem will be examined as to whether it is possible to solve or not. If it can be solved, the basic project components such as the cost, the effect and the influence on the environmental condition are studied to make a necessary project.

It is important to formulate the water level management plan from the viewpoint of the easiness and low cost for construction, operation, and maintenance activity, and the conservation of natural environment, when taking the natural environmental characteristics and serious local finance situation into consideration. So the strategy is to formulate a water level management plan which can minimize not only the initial investment cost but also the operation and maintenance cost, and which brings minimum influence on the natural environment in the surrounding.

15.3.2 Required Water Level

(1) Biotope conservation

Required water levels for biotope conservation are summarized as follows.

Required Water Level for Biotope Conservation

Biotope category	Relation to the spring flood	Notes
1) Bog	Any flood (1/2, 1/5, 1/10 flood scale) is not acceptable.	Precipitation : only one source Surface water : not acceptable
2) Fen	Annual flood is required, but not necessary every year.	Precipitation : major source Surface water : keeping water level longer time Groundwater : keeping high level
3) Inundated grassland	Annual flood (1/2 flood scale) is required in early spring.	Surface water : major source Groundwater : keeping high level to prevent propagation of tree species
4) Forest	Annual flood (1/2, 1/5, 1/10 flood scale) is acceptable.	Surface water : shorter inundation period is desirable. Groundwater : necessary to keep low level (about 1m from ground).
5) Dry grassland and agricultural land	Annual flood (1/10 flood scale) is not acceptable..	Surface water : flood protection of 1/2 and 1/5 flood scale.

(2) Fishery and fish conservation

The focal point on fishery and fish conservation is to maintain desirable water level for fish in Lake Lubana within its required flood protection capacity. Thus, the following water level management in Lake Lubana for fish conservation and fishery development should be considered.

- to keep water depth of 2.5m or more to ensure fish wintering places,

- to make water level of 91.7m in Lake Lubana at least in autumn and winter seasons for spring flood protection,
- to keep water level same or increasing levels from March to June to provide favorable spawning and living conditions for fish, and
- to discharge the lake water continuously from the Kalnagala sluice for improvement of water quality in the southern part of the lake during spring season.

(3) Agriculture and forestry

An agriculture development plan is usually prepared taking the flood probability of 1/5 into account. So, the existing and proposed agricultural lands will require a lower water level of 1/5 flood scale. This means that control measures are required to the areas which would be inundated by the 1/2 and 1/5 flood scales. Although the forestry does not require a specific water level, the shorter inundation period is desirable for forestry.

(4) Flood protection and maintenance flow

It is necessary to consider required seasonal water levels from the viewpoint of flood mitigation, fishery development, and Biotope conservation in Lake Lubana. Serious floods which damaged Lubana township and areas along the Aiviekste river in the 1920s and 1950s, have not occurred since the construction of the northern dyke system. The problem of the flood will not occur as long as the dyke system in Lake Lubana with a capacity for the flood scale of once per 100 years' probability exists. So, the water level of the lake is required low level of 91.75 or 91.20m in winter to protect the spring floods, though fishes require deep-water depth of 2.5m for wintering.

While, the water level of 94.5m starts to affect the bog area in the west-south lakefront. This will require to keep the lake water level below 94.5m or to implement protection measures. The existing operation rules guarantee minimum discharge of 1.5m^3/s in case the water level of the Aiviekste river becomes at 91.2m or less.

(5) Water level for fishponds

The Kvapani and Idena fishponds, which once functioned using pumped-up water from the Rezekne river in the Soviet era, are leased to a private sector at present and there is no specific restriction for their use. These fishponds will be used as ponds for angling because various building works for the anglers are being advanced in Kvapani. The ponds can receive water in spring when the water levels of outside rivers and drainage channels are higher than that of ponds. So, there is no specific problem on water level management at present.

As for the Nagli fishpond, there would be no problems on water level management because of existence of water level control facilities. If there is a problem, it is a deterioration problem of facilities, since they were constructed in the 1950s. The lowering water level is easier in the Nagli fishpond through operations of drain sluices. On the other hand, the operation for high water level is limited to 97.0m or less because of the operation rule of the upstream reservoir water level in the Malta river.

(6) Water level of the southern wetland

The Idenu canal which runs along the southern edge of Lake Lubana from Idena township to the junction point of the Meirane canal, has an important role of a drainage canal in the southern wetland and of a canal for an emergency spillway of Lake Lubana. There is a slide gate at the end of the canal which controls water level of the canal and its inundated area. The gate opens when the water level of the canal is higher than that of the Meraine canal as an outlet canal. However, the water level is usually lower than the Meraine canal, so the gate is under closed condition. Some water remains in canal and downstream lowland possibly forms the inundated grassland. It seems that this water level condition will not change in future without frequent operation of the control gate.

Four major rivers flow into the wetlands from the outside of the study boundary. The Licina and Meirane canals, which were constructed and improved in the 1950s, make an enough drainage condition in the southern wetland. The riverbanks of these canals protect the riverside farmlands from flooding, and the inundation problems of the other two rivers are not serious at present. The agriculture, forestry, fishery, and ecosystem conservation sectors do not require specific water levels in this wetland.

15.3.3 Competitive Analysis

(1) Competitive water level problem in the northern wetland

Inundated dry grassland

The dry grassland area, which is located along the right bank of the Pokratena river of one tributary of the Balupe river in the northeast part of the area, has a possibility for inundation by spring floods. The area, which is located between Ergala village and Lubana township along the Aiviekste river, has also a possibility for inundation. If positive use of this dry grassland is proposed, some measures are necessary.

Dryness problem in the bog, inundated grassland and fen areas

The ditches accelerate the expansion of making a dryness problem in the inundated grassland and fen after annual floods. The dryness problem also threatens the existence of bog area with drainage ditches and canals, which are dug in and around the area. These bog, fen and inundated grassland areas with ecological importance characterize the wetland in LWC, and necessary measures should be taken for preventing the wetland from dryness. The Wetland Conservation Plan describes the detailed conservation measures of this problem.

Fish habitat conservation of the old Pededze river

Serious dryness problem also happens along the old Pededze river. The Pededze river flows into the new river section, which was excavated as one of the flood protection project to divert spring flood, and the old river section was completely closed by embankment of the new river section.

(2) Competitive water level problem in Lake Lubana

Fishery development and fish conservation

Fishery development and fish conservation require seasonal water level management. In autumn and winter, they require the water levels of 91.7m or more, and from March to June, they require the same or rather increasing water levels. The existing operation rules and actual operation fulfill these required water levels. However, it is necessary to consider counter measures for the requirements of continuous discharge from the Kalnagala sluice for water, and of keeping the water depth of 2.5m or more for fishes wintering place.

The location map of the competitive problem is shown in Figure 15.3.1.

15.3.4 Countermeasures and Cost Estimation

(1) Fish habitat conservation of the old Pededze river

Measures

Construction of a gate structure in the embankment of the Pededze river left bank at the junction point of the old Pededze river will be the fundamental solution. In addition to the gate structure, one small dam on the old Pededze river near Mierini village to keep water level high in the river section will be necessary. The amount to be diverted from the Pededze river should be estimated in consideration of water volume needed for the eco-tourism plan.

Cost

The gate structure of slide type with 1m width and 1m height is proposed. The cost is estimated at 45,000 LVL indicatively. The small dam made of massive

concrete with length of 25m will cost about 20,000 LVL. Proposed dimensions are as below:

Pededze River Gate Structure

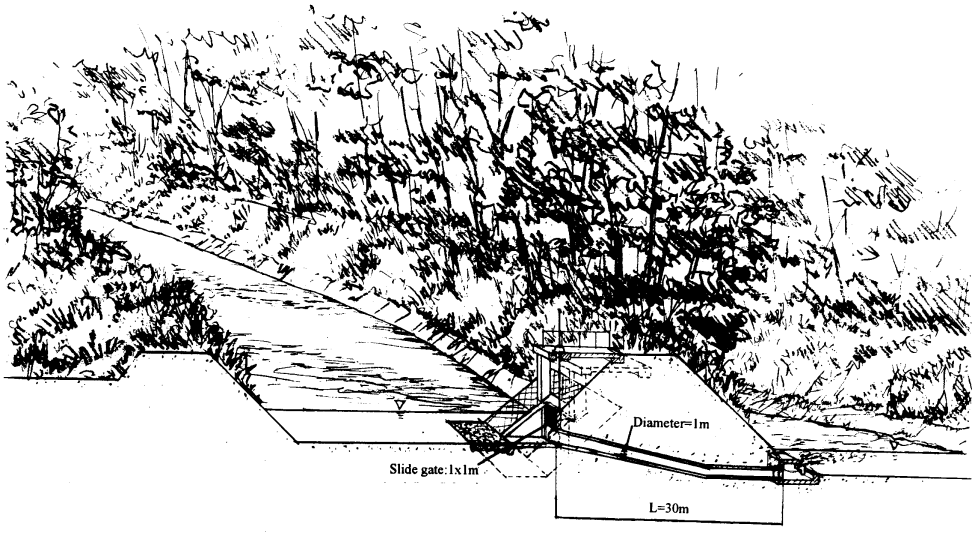
Gate type: Slide gate 1m x 1m x 1 nos. with manual operation

Conduit: Precast concrete pipe with concrete protection, Diameter=1m, Length=30m

Weir Structure

Type: Concrete fixed type

Dimension: Length = 30m, Height = 0.5m (above the river bed)



Cross Section Image of Gate Structure

The discharge through the gate is determined by the difference between the upstream water level on the Pededze river and the downstream water level on the old Pededze river. The following table shows the estimated discharge at each water level condition.

Estimated Discharge Table

Difference of water levels between upstream and downstream sides (m)	Estimated Discharge (m^3/s)
0.1	0.7
0.5	1.6
0.8	2.0
1.0	2.3

As shown in this table, it is possible to discharge the water volume of about 1.5-2.0 (m^3/s) through the gate. This accounts for about 50% of the discharge of the Pededze river in summer without a weir as shown in the table below. Therefore, one gate with 1 m size is suitable for intake water.

Monthly Average Discharge: Pededze-Litene

(m^3/s)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	9.1	7.1	10.0	20.6	9.1	6.0	4.2	5.2	4.8	6.3	8.3	8.1
50%	4.5	3.6	5.0	10.3	4.5	3.0	2.1	2.6	2.4	3.2	4.2	4.0

(2) Preparation of wintering place for fish

Measures

Water depth of 2.5m or more is required in the lake in order to ensure the wintering of fish. The estimated average water depth in the lake in winter season is 1.75m in normal condition, and 1.2 m in extreme condition. The possible countermeasures keeping deep water level management could be 4 alternatives, namely 1) heightening of dyke bank, 2) excavation of lakebed for wintering place, 3) excavation of lakebed for making fish channel, and 4) excavation of canal system in the lake.

1) Heightening of dyke bank

This is an alternative measure to add dyke height of 1.3 m to keep water depth of 2.5m in winter season. The problem of this alternative is whether enough water for filling of the lake can be secured. So, the following equation for the water balance is considered:

Possible total Storage (Qmax) = Annual total inflow (Qin) – Annual total minimum discharge (Qout) – Annual evaporation and infiltration amount (Qloss)

It is concluded that annual flow, which has the scale of once per 2 years probability, can not fill the lake at the water level of 96.6m through the water balance calculation. The estimated excavation volume is about 9,250,000 m^3. So, its total cost is about 31.5 million LVL.

Calculation of Possible Storage Volume

Item	Volume (m^3)	Remarks
1) Qv	84,700,000	Initial storage volume at 91.7m
2) Qin	392,000,000	Estimated total discharge from the Rezekne and Malta rivers in 1987.
3) Qout	0	
4) Qloss	185,000,000	Loss of water depth
Possible storage volume	122,300,000	1)+ 2) – 3)-4)
Capacity of the lake at 96.6m	495,000,000	
Balance	-372,700,000	Can not fill.

2) Excavation of lakebed

This alternative proposes excavation of the lakebed with total area of 80ha near river mouth of the Rezekne river. Preliminary survey of the lake bottom level was carried out by the JICA study team using an echo sounder, because the available

topographical map for calculation was prepared in the 1970s and it seems that the lake bottom level changed after constructing the northern dyke system in the 1980s.

The location map of the survey is shown in Figure 15.3.2 and the cross sections of the lake bottom are illustrated in Figure 15.3.3. The work volume is estimated at 508,000 m^3 based on this survey result, and its indicative cost could be about 2.0 million LVL.

3) Excavation of fish channel

In the course of the survey, the data shows existence of deep areas with total area of approximately 40 ha. In addition, the data shows the existence of high bank areas along the old Rezekne river in the lake. This survey result leads to the following assumptions.

a) There are enough wintering places in the lake.

b) Fish can not find the wintering places because of high banks along the old Rezekne river.

c) If there are some deep channels which cross the old Rezekne river banks, fishes can move to the wintering place.

This alternative proposes two fish channels. Considering a thickness of ice cover in the lake of 1m, the bottom level should be at least 90.0m. The width will need to be around 100m and the length will be 500-700m as shown in Figure 15.3.4. The work volume is estimated at 96,000 m^3 based on this survey result, and its indicative cost could be about 0.4 million LVL.

4) Excavation of canal system

This is an idea described in the "General plan for using Lake Lubana and the northern wetland", Ministry of Meteorology and Water, in 1967. In this idea, canals connect depressions in the lake and fish can move through these canals to wintering places. This alternative may be a most dependable measure for fish wintering. Outline of the idea described in the report is as follows.

a)Main canal system	total length	= 16 km
Main canal 1	width	= 28 – 16 m
Main canal 2	width	= 22m
	Average depth	= 1.2m
b) Branch canal system	total length	= 45 km
c) Total excavation volume		= 1,523,230 m^3

Its indicative cost could be about 6.1 million LVL.

Results

As a result of study for these alternatives, alternative 3) is the best solution for this problem from the viewpoint of the cost and the Eco-system conservation. The following table shows estimated costs for each alternative.

Estimated Cost for Each Alternative

Alternative Measures	Estimated Cost (1,000 LVL)	Remarks
1) Heightening of dyke	31,450	Total length =50km, bank top width=6m
2) Excavation of Lake bed	2,032	80 ha, bottom level = 88.7m
3) Excavation of fish channel	384	Width=100m, Length=500-700m, bottom level = 90.0m
4) Excavation of canal system	6,100	Latvian plan

(3) Improvement of water quality in the southern part of the lake

Measures

Continuous outflow from the Kalnagala sluice is considered one of the effective solutions to improve water circulation. The other possibility is to use the old Malta river to supply water to the southern part. The water level of the old Malta river is lower than that of the lake. Therefore, it is necessary to use pumping power to supply water, and it will cost more than the alternative of using the Kalnagala sluice. Thus, the only possible solution is to use the Kalnagala sluice.

The volume of water to be discharged is estimated in Table 15.3.1 taking account of following conditions.

a) Outflow amount through the northern sluice during the flood recession period, the outflow amount should be the average amount of the Rezekne and Malta rivers for these 30 years.

b) Discharges at the Rezekne and Malta river mouths are estimated based on the discharge record of Rezekne - Griškani..

c) Decreasing rate of the water level is 2 cm per day.

d) Amount of evaporation is 0.2~2.7mm/day and the amount of infiltration is 1.5mm/day.

e) Discharge from the sluice should be the same amount as the inflow from two rivers as much as possible.

Results

Total volume of the possible amount for outflow from the Kalnagala sluice is summarized in Table 15.3.1. It revealed that at least 3.0 m^3/s of water can be discharged from the Kalnagala sluice in spring and summer. If the discharge from the sluice is limited to 1.5 m^3/s of river maintenance flow at the Aiviekste sluice, possible amount will reach to 6.5 to 16.5 m^3/s. It is possible to control these

discharges by revising the existing operation rule of the lake. Therefore, it is no need to estimate special cost except rehabilitation cost of sluice gate structures.

15.3.5 Current and Proposed Operation Manual

(1) Lake Lubana

The existing operation manual for Lake Lubana was prepared for flood mitigation and fishery conservation, and the agency concerned has operated control facilities according to the manual. No special problem to the operation manual has occurred until now. However, the water level management based on the existing manual will not be effective against the water quality deterioration problem which might be serious in the future especially in the southern part of the lake. Utilization of the Kalnagala sluice in the southern part will be crucial to prevent the water quality from deterioration. In this context, partly change of the existing manual is proposed to use the Kalnagala sluice for prevention of water quality deterioration.

Moreover, for conservation of the ecosystem in the northern wetlands, it is also necessary to supply the same amount of river water as before constructing the northern dyke system as much as possible by using the existing water level management facilities during the flood recession period. But, it is necessary to follow the existing manual for safety in the region during the flood rising period.

For the revision of the existing manual, important points to be considered are the influence of desiccation to the northern wetland by the volume change of outflow through the Aiviekste sluice and the influence to fish conservation. Therefore, proposed manual is prepared taking note of the following points. Proposed distribution plan for discharge water from Lake Lubana is summarized in Table 15.3.1.

1) Utilize the Kalnagala sluice as much as possible to improve water quality.
2) Basically, the proposed operation rule is based on the existing one.
3) Discharge from the sluice should be the same amount as the inflow from two rivers as much as possible.
4) Water level should keep at the level of 91.75 m or more for the fish conservation.

Proposed Operation Rules

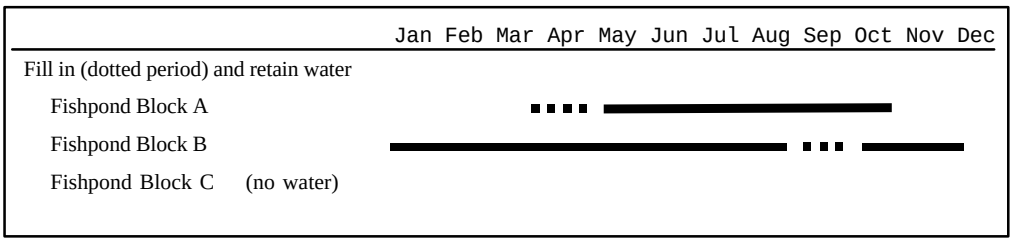
Season	Target of operation	Operation rules
Aug.20–Oct.19	Reduction of water level of the Lake to 91.75m, for the purpose of making storage capacity for spring flood	Aiviekste Sluice: Open until water level becomes 91.75m Kalnagala Sluice: Open until water level becomes 91.75m
Oct.20–Beginning of Spring Flood	Keeping of water level of 91.75m in normal condition or 91.2m in case of extreme flood condition	Aiviekste Sluice: Open until water level becomes 91.75m or 91.2m Kalnagala Sluice: Open in case water level exceeds 91.75m or 91.2m
Spring flood	Evacuation of a flood in the northern part	Aiviekste Sluice: Close Kalnagala Sluice: Close
Extreme flood	Prevention of dyke breaking	Aiviekste Sluice: Open Kalnagala Sluice: Open In case of outside water level is lower than that of the Lake.
End of Spring flood	Keeping water level not to exceed the level of 93.0m	Aiviekste Sluice: Open Kalnagala Sluice: Close, in case of 91.75m
May-August	Keeping constant water level	Aiviekste Sluice: Open to preserve water level in the Aiviekste river. Kalnagala Sluice: Open to discharge for improvement of water quality. Close, in case of 91.75m (Lake Lubana) or close in case of 91.20m (Aiviekste river)

Note: “Extreme floods” means floods in 1/10 or larger scale.

(2) Proposed operation rule for the Intake structure on the Malta river

Fishponds play an important role in providing various and suitable habitat conditions for waterfowls. The following figure proposed in Wetland Conservation Plan shows the favorable water level control of fishponds for waterfowls. The fishponds blocks should have three different types of water level schemes in the rotation use. Aiming at the realization of the rotation use, additional operation rule related to the distribution of intake water through the structure on the Malta river is necessary.

Water Level Control of Fishponds Favorable for Waterfowl



The Idenas canal, which acts as a drainage canal for fishponds, cannot be used as a resource for the eco-tourism projects proposed in the Eco-tourism Development Plan (EDP), because of unsuitable water quality in the canal. Therefore, it is necessary to improve the water quality in the canal for encouragement of the eco-tourism. For the improvement of water quality in the canal, utilization of surplus water produced by the rotation use is proposed.

The distribution plan of the water to the fishponds is proposed as tabulated below in order to improve the water quality of the Idena canal and to meet the request of the Wetland Conservation Plan.

Proposed Water Distribution Plan for Nagli Fishpond

(Unit: m^3/s)

Distribution Place	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Fishpond Block A	-	-	-	7.5	7.5	0.5	0.5	0.5	0.275	0.275	-	-
Fishpond Block B	-	-	-	0.5	0.5	0.5	0.5	0.5	0.275	0.275	-	-
Fishpond Block C	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
Idena Canal	-	-	-	4.0	4.0	0.5	0.5	0.5	0.0	0.0	-	-
Total	-	-	-	12.0	12.0	1.5	1.5	1.5	0.55	0.55	-	-
Existing Rule	0.55	0.55	0.55	12.0	12.0	1.55	1.55	1.55	0.55	0.55	0.55	0.55

Note: "-" means that water is not supplied because of freezing. This rule is for permitted intake volume from the Malta river.

The rotation use of water is based on the followings basic ideas:

1) In the rotation use, the fishpond blocks are divided into three categories within the same fishponds.
2) Fishpond blocks are categorized into A, B and C from the viewpoint of water level control.
   - Fishpond blocks in category "A" should be filled with water from April to December.
   - Fishpond blocks in category "B" should be filled with water from January to September and should be drained on October.
   - Fishpond blocks in category "C" should be dried up throughout year.
3) The fishpond "A" in the 1st year should be categorized as "B" in the 2nd year, and "C" in the 3rd year.
4) The location of A, B, and C can be selected freely at an initial stage of rotational use.

The water distribution rule is proposed based on the next considerations,

1) Because water is not used in one block (C) of three blocks in the rotation use, the surplus water (at least 1/3 of intake water from the Malta river) can be supplied for the water quality improvement of the Idena canal in spring and summer.
2) In winter period from September to March, surplus of the intake water from the Malta river will be supplied to the Idena canal if necessary.
3) Basically, the proposed operation rule follows the existing rule having a long year experience.

Calculations of water volume to be supplied to each categorized fishpond block:

Fishpond Block “A” (from Jan. to Mar.): Because the blocks were categorized in “C” in the previous year, the blocks have been dried up. There is no necessity of supplying water during frozen season.

Intake water volume (Qa) = no necessity

Fishpond Block “A” (Apr. and May): The blocks should be filled with water as early as possible for fish cultivation and for conservation of waterfowls. Water volume to be supplied to the Idena canal is limited to one-third of the total intake water volume to fill water to the blocks quickly.

Qa = QR – Qb –Qc – Qi
= 12.0 – 0.50 – 0.0 – 12.0/3
= 7.5 (m3/s)

QR: total intake water volume of 12.0 (m3/s) stipulated in the existing rule
Qb: intake water volume to be supplied to the blocks in category “B”
Qb = 0.5 (m3/s) (Refer to the explanation for the blocks “B”, April)
Qc: intake water volume to be supplied to the blocks in category “C” without water
Qc = 0.0 (m3/s)
Qi: intake water volume to be supplied to the Idena canal
Qi = (surplus water not used in blocks “C”)
= (total intake water volume in spring) x 1/3

Fishpond Block “A” (form Jun. to Aug.): The blocks are filled, and management water for fish culture is supplied. Because category "A" areas occupy one-third of whole fishpond areas, the management water volume for category "A" is enough in one-third of the total one.

Qa = Qmn / 3 = 1.55 / 3 = 0.517 = 0.5 (m3/s)

Qmn: total management water volume of 1.55 (m3/s) stipulated in the existing rule

Fishpond Block “A” (Sep. and Oct.): The blocks require maintenance water. Maintenance water volume for category "A" is enough in one-third of the total intake water. However, the water is drained to the Idena canal from blocks for fish harvesting in autumn. Therefore there is no necessity to supply water to the Idena canal, and intake water should be supplied only to the two categories “A” and “B” areas that require maintenance water.

Qa = Qm / 2 = 0.55 / 2 = 0.275 (m3/s)

Qm: total maintenance water volume of 0.55 (m3/s) stipulated in the existing rule

Fishpond Block “A” (Nov. and Dec.): For the conservation of waterfowls in early spring, the water should be kept during winter season. However, it is not necessary to supply water during frozen season.

Qa = no necessity

Fishpond Block “B” (from Jan. to Mar.): The category "A" blocks in December of the previous year become the category "B" blocks in January of the next year. Water is kept in these ponds. However, it is not necessary to supply water during frozen season.

Qb = no necessity

Fishpond Block “B” (from Apr. to Aug.): The blocks have been filled since last year, and only the management water is required. The management water volume is same as that of category “A” blocks in summer.

Qb = Qmn / 3 = 1.55 / 3 = 0.517 = 0.5 (m3/s)

Qmn: total management water volume of 1.55 (m3/s) stipulated in the existing rule

Fishpond Block “B” (Sep. and Oct.): The blocks require maintenance water. The required water volume is same as that of category “A”.

Qb = Qm / 2 = 0.55 / 2 = 0.275 (m3/s)

Fishpond Block “B” (Nov. and Dec.): The blocks will not use after fish harvesting, and will be used as those in category “C” in the next year. There is no necessity of supplying water in the frozen season.

Qb = no necessity

Fishpond Block “C” (from Jan. to Dec.): The category "B" blocks in December of the previous year become the category "C" fishponds in January of the next year. The blocks in category “C” are scheduled to be empty throughout year for conservation of waterfowls.

Qc = 0.0 (m3/s)

Idena Canal (from Jan. to Mar.): Supplying water during the frozen season makes no sense for improvement of water quality.

Qi = no necessity

Idena Canal (from Apr. to May.): The water volume that can be supplied at maximum is calculated by the following equation.

Qi = QR – Qa – Qb – Qc = 12.0 – 7.5 - 0.5 – 0.0 = 4.0 (m3/s)

Idena Canal (from Jun. to Aug.): The water volume that can be supplied at maximum is calculated by the following equation.

$$Qi = Qmn – Qa – Qb – Qc = 1.55 – 0.517 - 0.517 – 0.0 = 0.517 = 0.5 \text{ (m3/s)}$$

Idena Canal (from Sep. to Oct.): The water volume that can be supplied at maximum is calculated by the following equation.

$$Qi = Qm – Qa – Qb – Qc = 0.55 – 0.275 - 0.275– 0.0 = 0.0 \text{ (m3/s)}$$

Idena Canal (from Nov. to Dec.): Supplying water during the frozen season makes no sense for improvement of water quality.

Qi = no necessity

15.3.6 Organization and Institution

(1) Proposed organization

It is proposed that the future organization for the water level management should be set up in the existing ALRSA as one section. ALRSA will receive requirements and provide information related to water level management and operation through the Implementation Committee (IC). ALRSA, which has long experience in water management in LWC, will be requested to cooperate for conservation and development of LWC through the water level management services shown below.

- to collect and analyze hydrological and meteorological data ,
- to forecast a flood on a temporal basis,
- to collect warnings and information about spring flood from the Meteo-hydro Agency in MEPRD,
- to evaluate requirements on water level management from EMC,
- to give a technical advice and information to EMC about flood and water level,
- to prepare an annual water management schedule based on the operation manual, current water level situation and the requirement from EMP,
- to decide necessary operation in case of emergency like extreme flood, and
- to operate gates and other facilities related to water level management.

(2) Transmission of data and information

According to the operation rule, ALRSA is schedule to receive flood information from Meteo-hydro agency during spring flood season from February 1 to the end of flood. However, ALRSA usually receives it after the spring flood season. The received information is not useful for flood control due to a transmission delay. Simultaneous transmission and sharing of flood information or warnings between the organizations concerned is indispensable especially in case of the extreme flood. In this connection, it is necessary to improve the existing system

of transmission to more speedy and easy one to access to necessary data. The proposed organization chart is shown in Figure 15.3.5.

(3) Measures for capacity building on water level management

Although some of these services have been already done by ALRSA, it is necessary to reestablish the system for collecting data and to improve the facilities for water level management.

1) Data collection

ALRSA observes water levels at two sluices points. However, there is no hydrological station in the river, which flows into the northern LWC and the lake except the Pededze, and Rezekne rivers.

At least four hydrological stations are necessary to estimate the flood water volume in the Balupe and Ica rivers for northern wetland and in the Malta and Rezekne rivers for the lake as shown in Figure 15.3.6. The automatic data-collection system on an electronic basis is recommendable. In addition, one thermometer is necessary to estimate roughly the starting date of snow melting.

Four hydrological stations and one mother station should be established for collection of necessary data related to water level management. The hydrological station is equipped with an automatic water level gauge, water-conveyance pipes and a storage box for a device. The mother station collects data observed at the hydrological stations through periodical observation. One note book type computer for collecting data and one computer with electric data processing program is necessary at the mother station. The indicative cost for establishment of the hydrological stations is about 10,000 LVL.

2) Improvement of water level management facilities

The major water level management facilities are the Aiviekste and the Kalnagala sluices. The Aiviekste sluice was constructed in 1981 and the Kalnagala sluice with a hinged type gate installed in the 1950s. Especially the Aiviekste sluice as the essential facility for water level management requires frequent repair works because of its deterioration. The most deteriorated portions are the gate leaves, their guide frames and the culvert portions under the dyke.

Malfunctioning of gate leaf portion will be an obstacle for smooth operation especially in an emergency. Irregular bottom elevation of culvert portions under the dyke will cause water leakage. The leakage water flows out with the dyke materials and consequently the dyke breaking might occur.

The service life of the Kalnagala sluice has finished already, and the rehabilitation is indispensable for utilization of this gate to improve water quality in the lake. The proposed improvement works are as follows.

Aiviekste sluice

Replacement of the whole structure is necessary including gate leaves, gate frames, culverts, inlet and outlet structures. One gate type structure is recommendable for smooth operation and simplified discharge control. The cost of the gate leaf is 18,000 LVL and those for earth and structure works are 120,000 LVL. The total cost of rehabilitation of the Aiviekste sluice is about 138,000 LVL indicatively.

Kalnagala Sluice

The rehabilitation works of this gate structure consist of rehabilitation and strengthening of existing concrete structures and replacement of gate leaf. The cost of the gate leaf is estimated at 35,000 LVL and those for earth and structure works are 110,000 LVL . The total cost of rehabilitation of the Aiviekste sluice is about 145,000 LVL indicatively.

Table 15.1.1 Main Features of Hydraulic System

Lubana Lake	Storage			
	Gross capacity	million m^3	400.0	at water level of 95.30 m
	Average storage	- ditto -	135.8	at normal water level of 92.50 m
	Flood control storage	- ditto -	335.0	capacity from 91.20 m to 95.30 m
	Area of Water Body			
		ha	9,553	at surcharge water level of 95.30 m
		- ditto -	8,210	at normal water level of 92.50 m
		- ditto -	6,696	at minimum water level of 91.20 m
	Water Level			
	Normal water level	m	92.50	
	Flood water level	- ditto -	95.30	
	Surcharge water level	- ditto -	95.60	
	Minimum water level	- ditto -	91.20	
	Depth at Normal Water Level of 92.50 m			
	Max. depth	m	2.5	
	Average depth	m	1.6	
	Length and Width			
	Length	km	14.2	
	Width	km	7.9	maximum width
		km	5.8	average width
	Dyke System			
	Dyke	km	36.1	
	Natural embankment		6.3	
	Catchment Area			
	Aiviekste River Basin	km^2	2,160	
	Spring Flood Discharge from the Catchment Area			
	$Q_{1\%}$ probability	m^3/s	424	
	$Q_{10\%}$ probability	m^3/s	258	
	$Q_{25\%}$ probability	m^3/s	187	
	$Q_{50\%}$ probability	m^3/s	129	
	Summer Low Flow Discharge			
	$Q_{75\%}$ probability	m^3/s	1.60	
	$Q_{95\%}$ probability	m^3/s	0.78	
	Sluiceway			
	Aiviekste Sluice			
	Kalnagala Sluice			
Dyke System	Zvidzienes dyke	km	14.8	
	DA dyke	km	12.5	
	Ziemelu dyke	km	11.0	
	Naglu fish farm protection dyke	km	8.4	
	Rezekne River Bank Embankment	km	14.2	
	Malta River Bank Embankment	km	2 x 6	
	Pededze Diversion Canal Embankment	km	9.7	
	Kreslite Polder Dyke	km	8.7	
	Top Elevation of Dyke	m	96.00 - 96.50	
Canal System	Meiranu	km	25.0	
	Zvidziena	km	17.0	
	Idenu	km	20.5	
	Malta Diversion	km	6.2	
	Pededze Diversion	km	6.0	

Table 15.3.1 Inflow and Outflow Calculation for Lake Lubana

(Unit: m^3/s)

Location/ Station	Rezekne Rezekne - Griškani	Rezekne River mouth	Malta River mouth	Total Inflow to Lake Lubana	Allowable Max. Outflow	Proposed Max. Outflow	Proposed Min. Outflow
Catchment Area	(545 km^2)	(957 km^2)	(787 km^2)	per day	through Aiviekste	through Aiviekste	through Kalnagala
Jan.	2.82	4.95	4.07	9.0	16.3	9.0	0.0
Feb.	2.84	4.98	4.10	9.1	16.9	9.0	0.0
Mar.	4.95	8.70	7.15	15.8	17.1	15.0	0.0
Apr.	8.03	14.09	11.59	25.7	16.5	15.0	0.0
May	4.37	7.68	6.31	14.0	15.8	15.0	3.0
Jun.	2.76	4.85	3.99	8.8	15.1	9.0	3.0
Jul.	1.85	3.25	2.67	5.9	14.7	5.0	3.0
Aug.	1.66	2.91	2.40	5.3	14.7	5.0	3.0
Sep.	1.85	3.24	2.67	5.9	14.9	5.0	3.0
Oct.	2.27	3.99	3.28	7.3	15.4	7.0	0.0
Nov.	2.45	4.31	3.54	7.8	15.7	7.0	0.0
Dec.	2.51	4.40	3.62	8.0	16.1	7.0	0.0
Annual Total (x 10^6 m^3)	101	177	145	322	497	284	38

Note: Discharges at the Rezekne and Malta river mouths are estimated based on the discharge record of Rezekne - Griškani.
Total inflow is a total value of the Rezekne and the Malta river discharges.
Daily allowable maximum outflow is estimated taking account of evaporation loss, infiltration loss, and the allowable daily water level fluctuation.

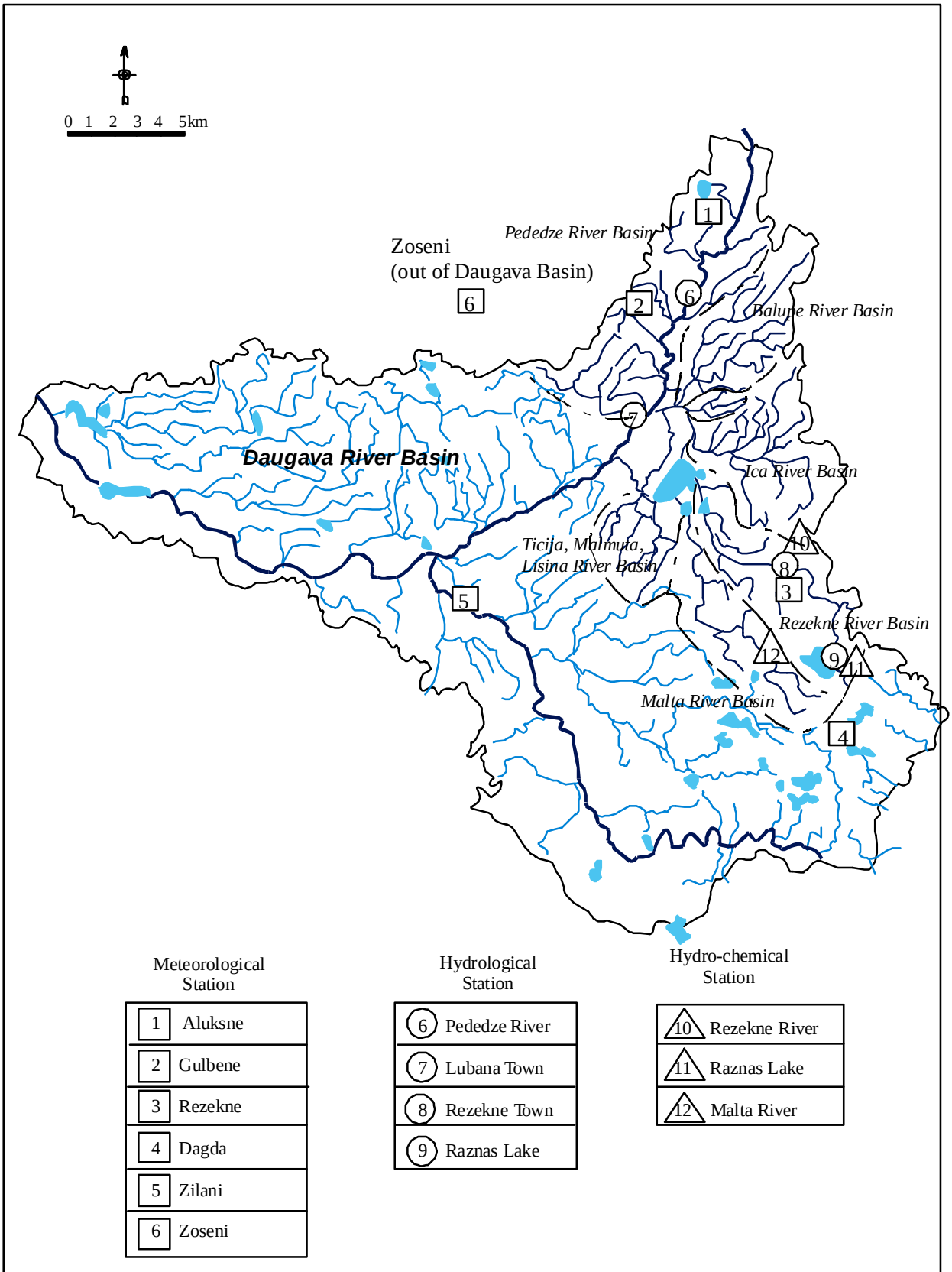


Figure 15.1.1 Meteorological and Hydrological Stations

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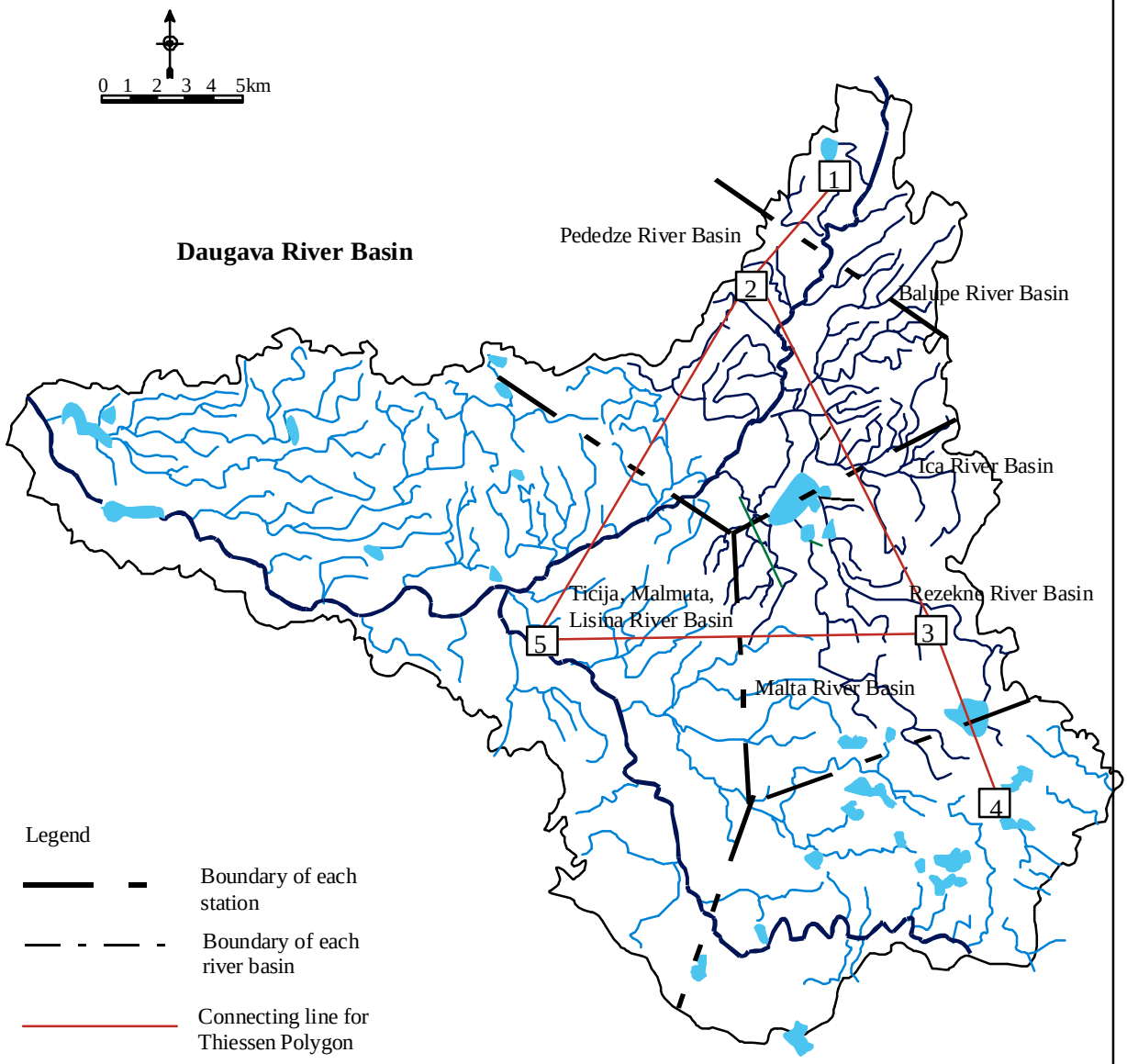

1	Aluksne
2	Gulbene
3	Rezekne
4	Dagda
5	Zilani

Meteorological Station

Weight in proportion to the area

River Basin	Aluksne	Gulbene	Rezekne	Dagda	Zilani
Rezekne	–	–	0.94	0.06	–
Malta	–	–	0.69	0.31	–
Teicija,Malmuta, Lisina	–	0.06	0.57	–	0.37
Ica	–	0.14	0.86	–	–
Balupe	0.33	0.67	–	–	–
Pededze	0.65	0.35	–	–	–

Figure 15.1.2 Thiessen Polygon

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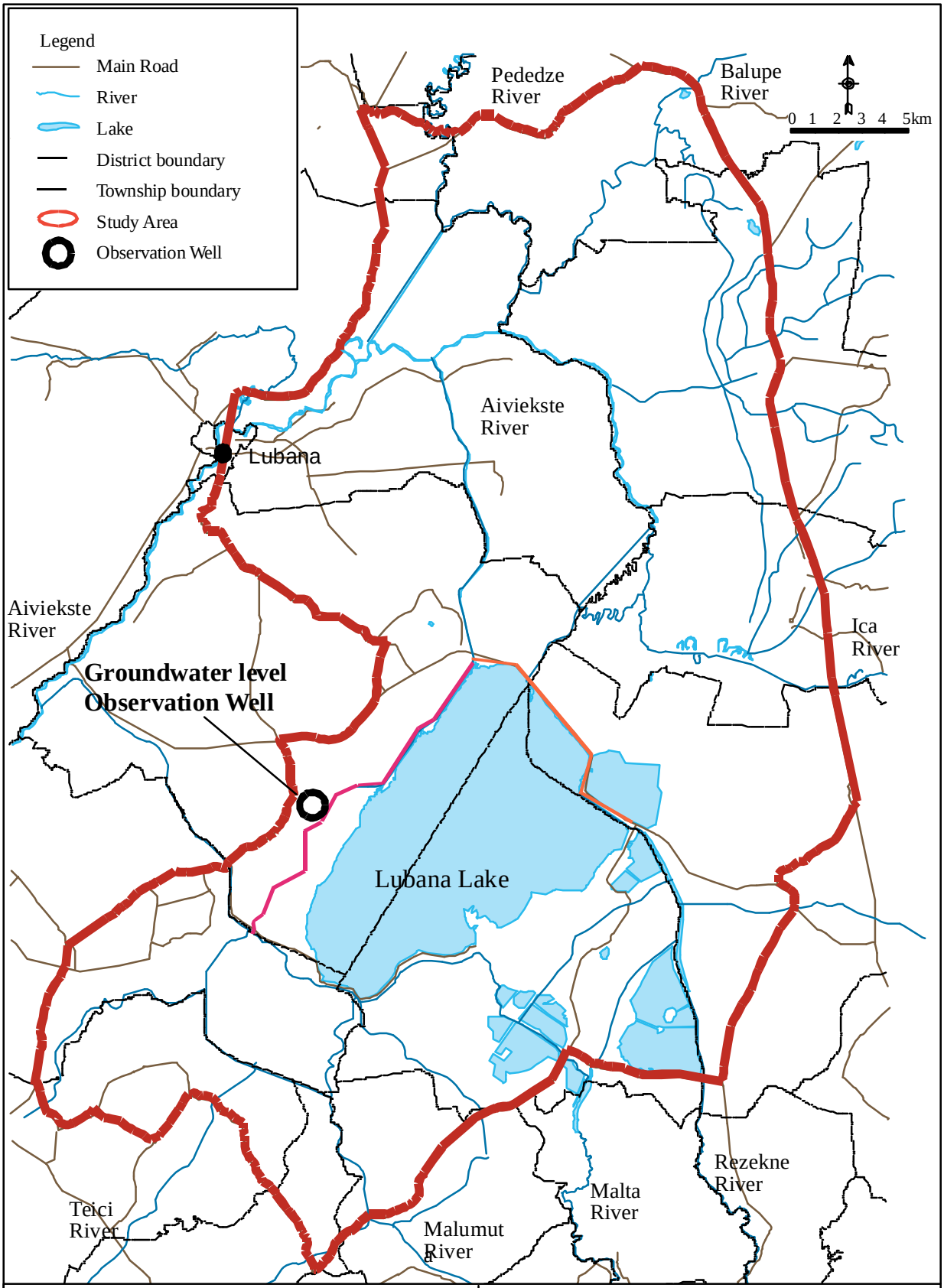

Figure 15.1.3 **Location Map of Groundwater Observation Well**

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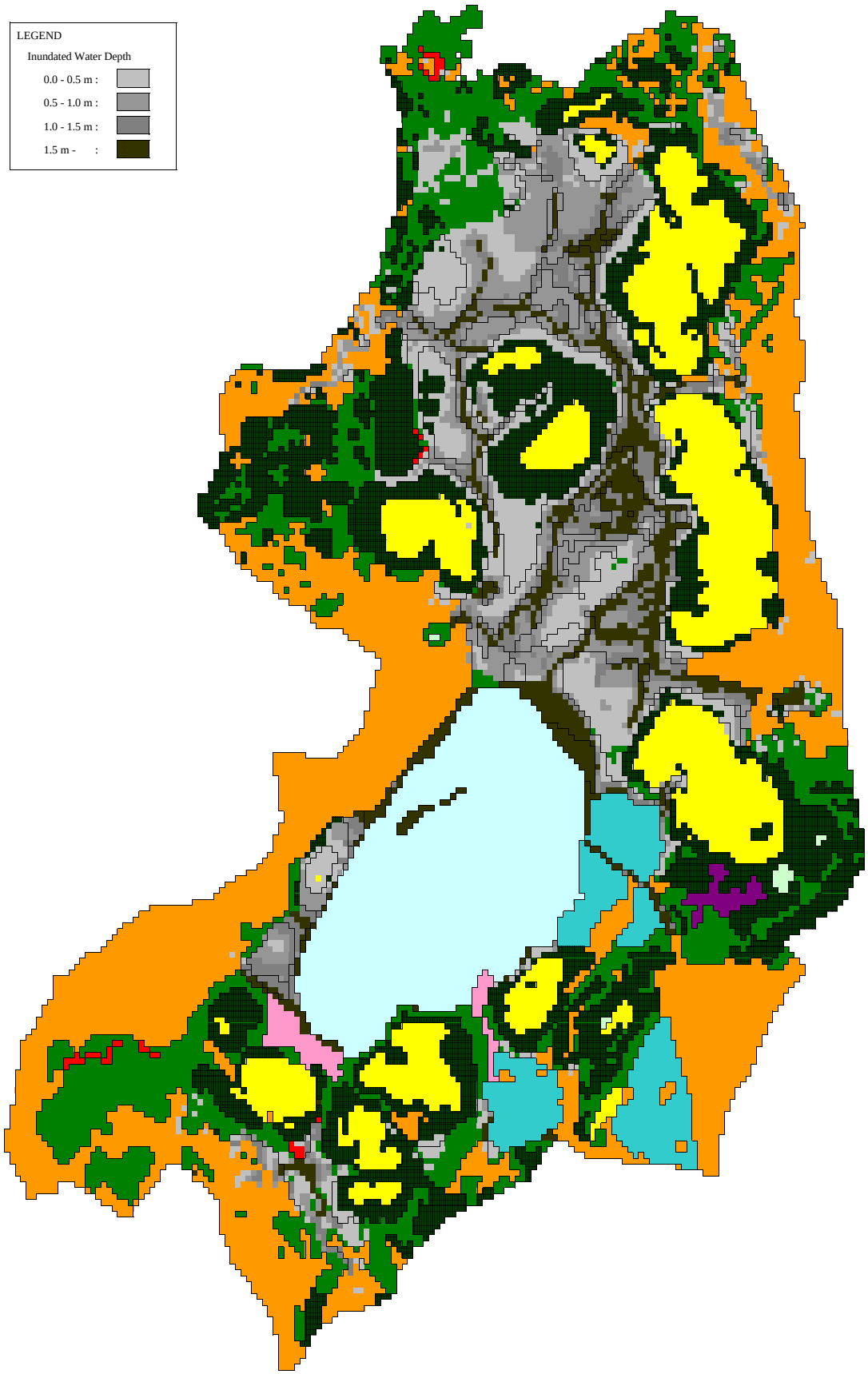

Figure 15.1.4 Flood Situation with Northern Dyke System

(Flood scale of once per 100-year)

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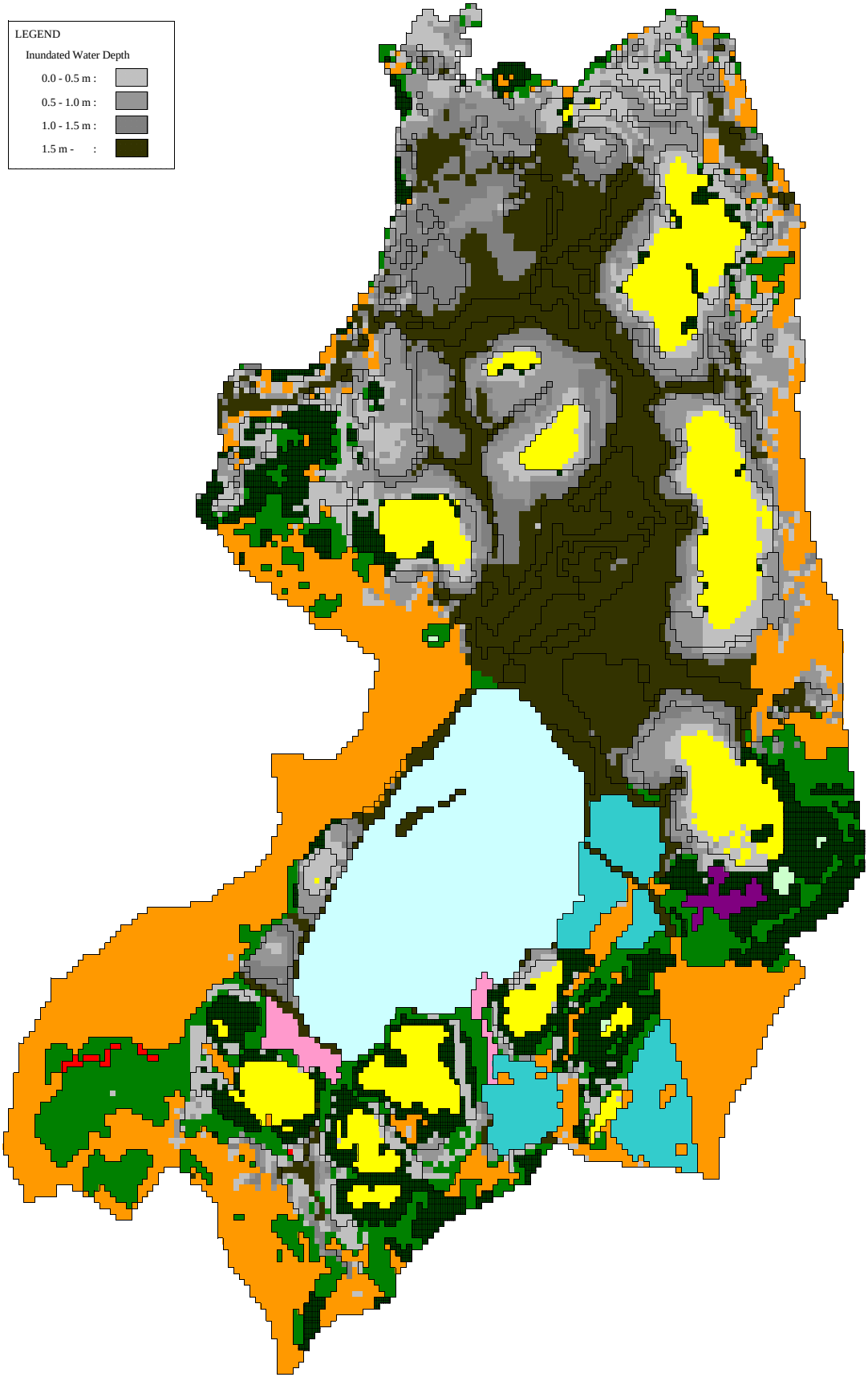

Figure 15.1.5 Flood Situation without Northern Dyke System

(Flood scale of once per 100-year)

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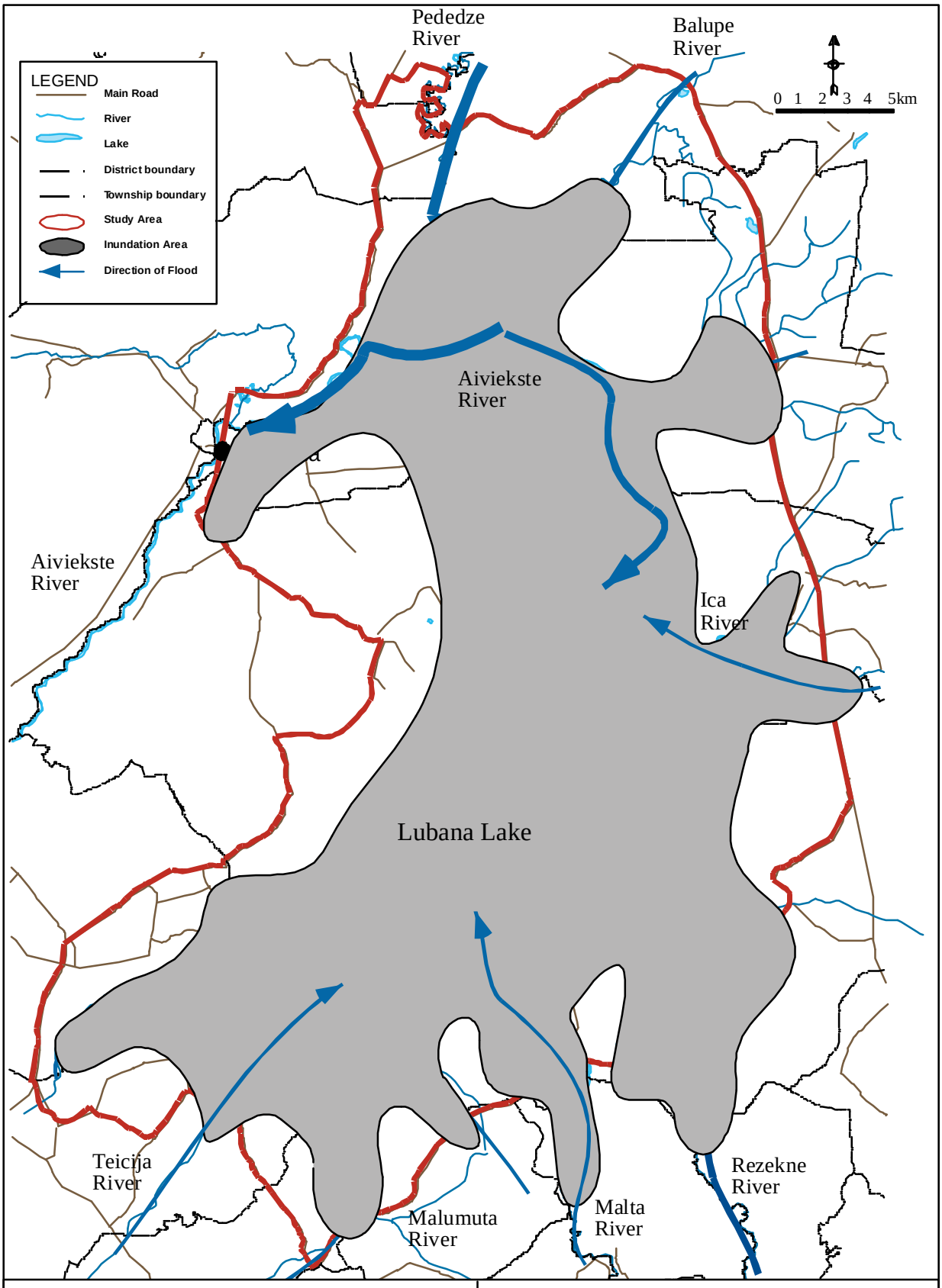

Figure 15.1.6 **Maximum Flood Area before Constructing Dyke System**

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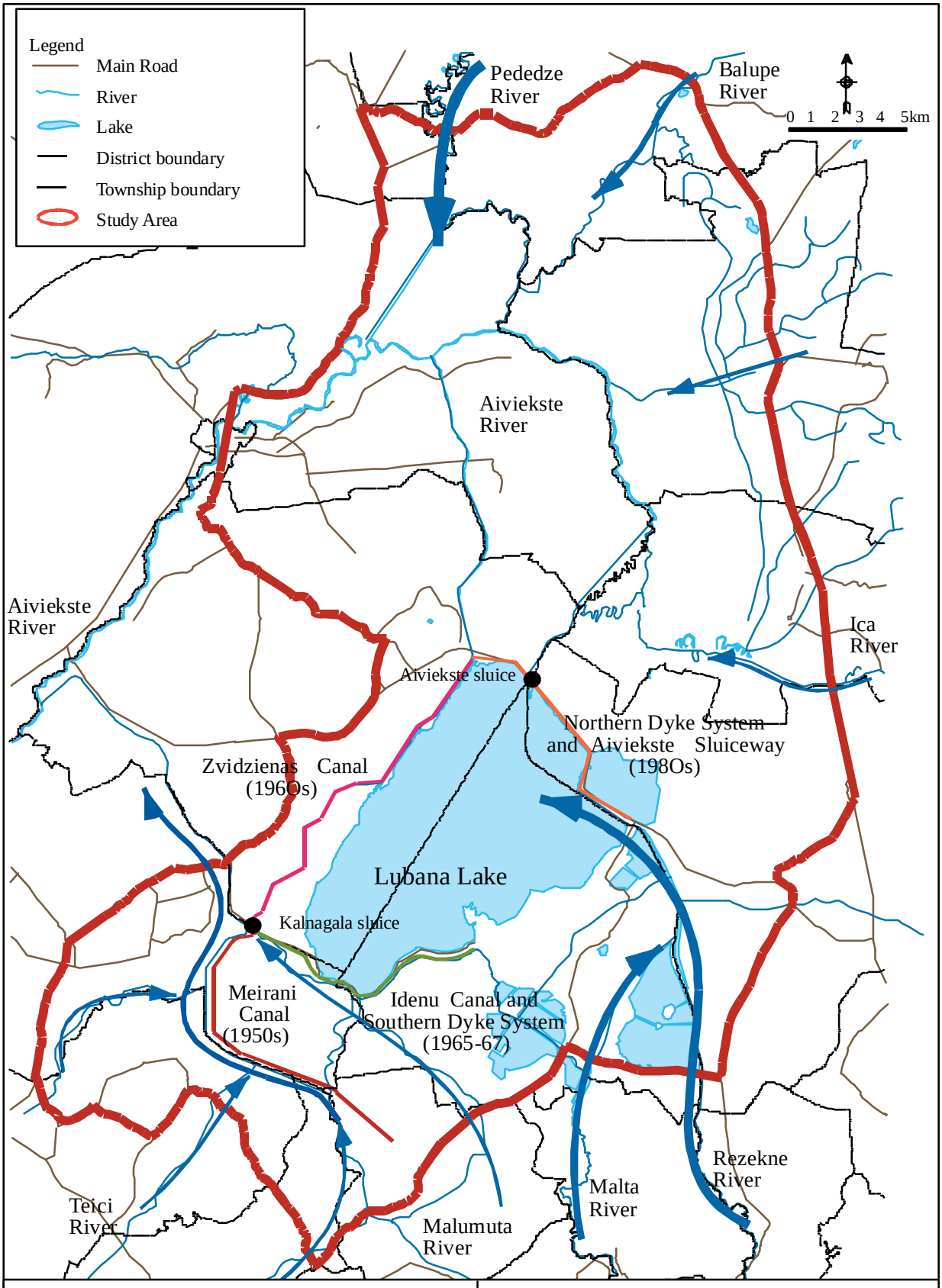

Figure 15.1.7 **Existing Flood Mitigation Facilities**

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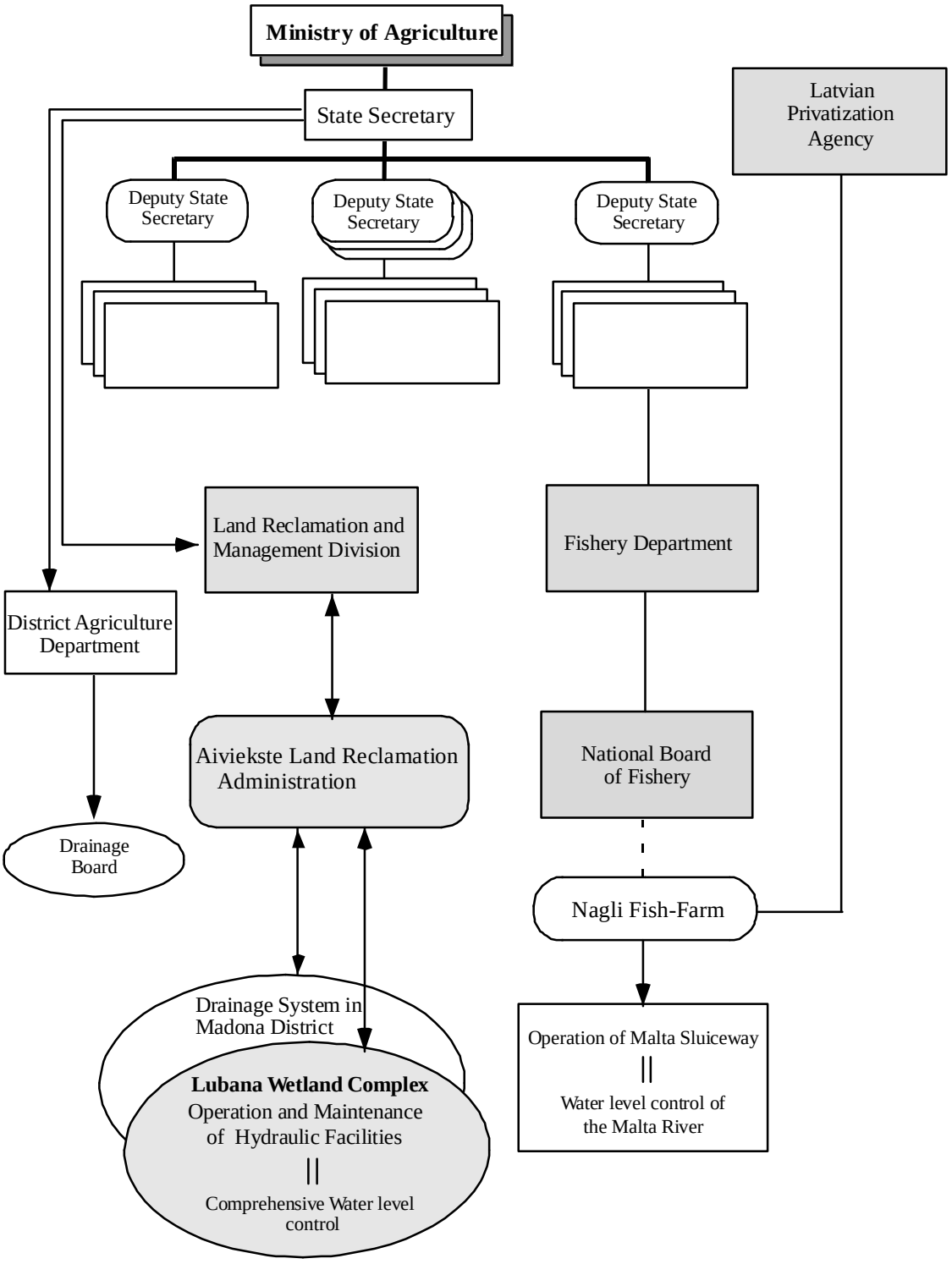

Figure 15.1.8 **Existing Organization for Water Level Control**

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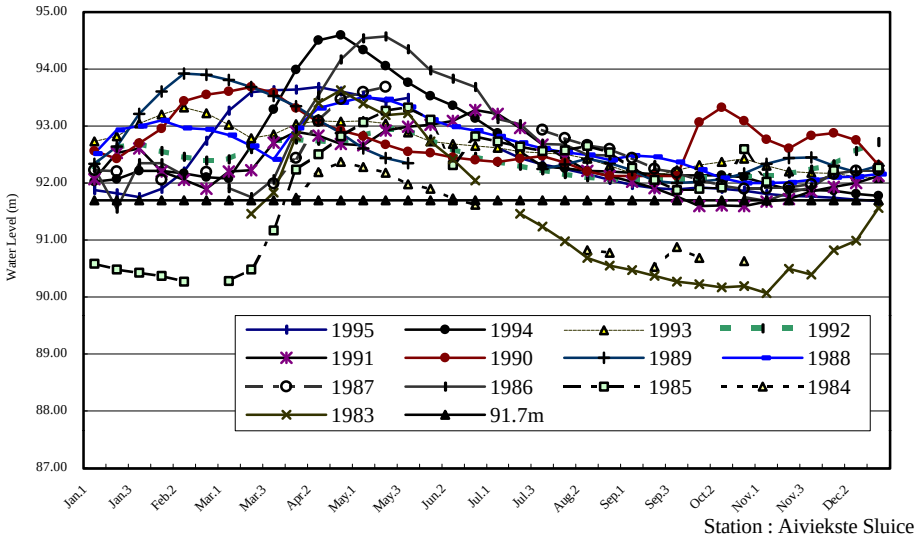

Figure 15.1.9 Water Level Record of Lake Lubana

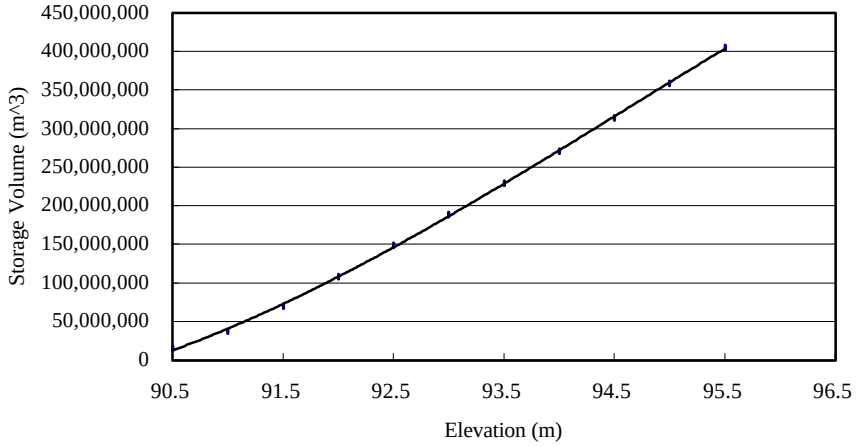

Figure 15.1.10 Storage Volume of Lake Lubana

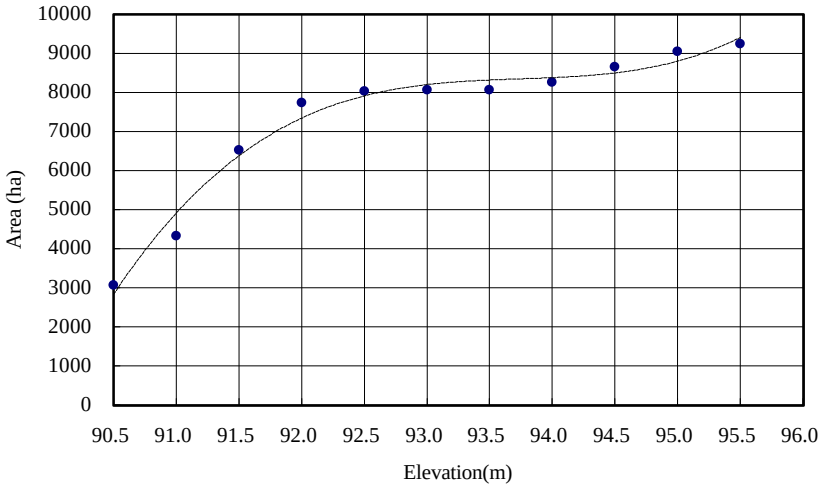

Figure 15.1.11 Surface Area of Lake Lubana (ha)

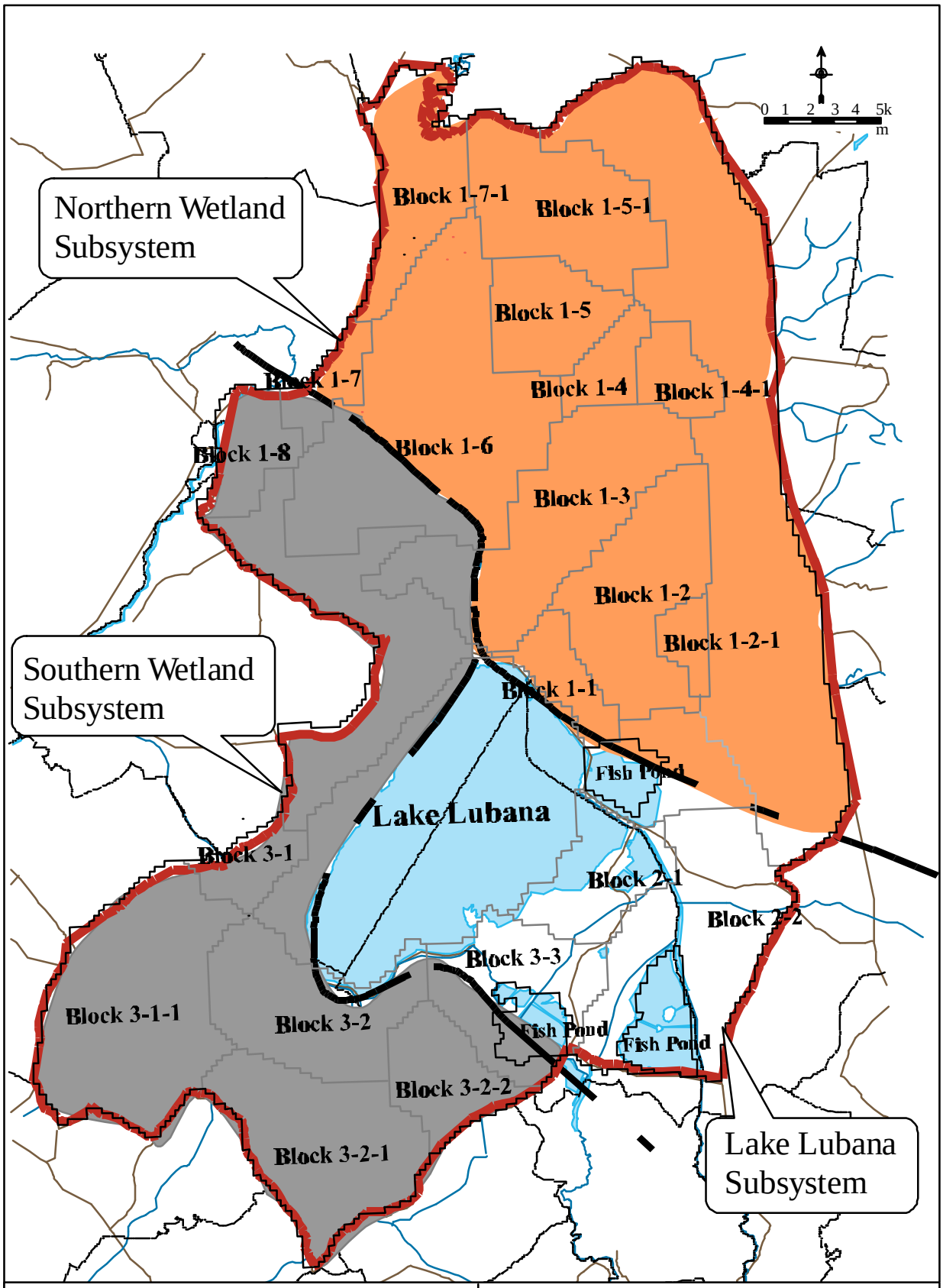

Figure 15.2.1 **Location Map of Subsystems and Blocks**

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